Standard Bidding Document

T-3027-FA-REQ-1025-1-00166- SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ (Goods)

National

Single Stage-One Envelope

September 09, 2026

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REQUEST FOR BIDS

PROCUREMENT OF GOODS

1. The **Pakistan Security Printing Corporation (Pvt) Ltd (Procurement)** has reserved Funds for the procurement planned for FY **2026-27**. The **Pakistan Security Printing Corporation (Pvt) Ltd (Procurement)** intends to apply part of the proceeds of this Fund to cover eligible payments under the contract for the "**T-3027-FA-REQ-1025-1-00166- SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ**" with the reference of **"P97735"**

2. The **Pakistan Security Printing Corporation (Pvt) Ltd (Procurement)** invites sealed Bids from eligible Bidders for procurement of goods described in the bidding documents on **EPADS v2.0**.

3. **Single Stage-One Envelope** will be used by adopting **Least Cost Based Selection (LCBS)** Technique for the subject procurement, in line with the Public Procurement Rules, 2004 and any Regulations, Regulatory Guides, Procurement Guidelines or Instructions issued by the Authority from time to time.

4. All Bids must be accompanied by a Bid Security amounting described in Bid Security Section in Bidding Document in the form of **Pay Order, Bank Guarantee** or all bids must be accompanied by bid securing declaration in the format specified in the Bidding documents

5. E-Bidding documents, containing detailed terms & conditions, specifications and requirements etc. are available on **e-Pak Acquisition and Disposal System (EPADS)** at **https://epads.gov.pk/opportunities/federal/procurements/97735** for all the interested bidders registered on **EPADS v2.0**. Bidders are required to get themselves registered on **EPADS v2.0** to participate in Bidding process.

6. The e-bids, prepared in accordance with the instructions in the e-Bidding Documents, must be submitted through **EPADS v2.0** on or before **Tuesday,**

October 6, 2026 11:00 AM. E-bids will be opened using **EPADS v2.0** on the same day at **Tuesday, October 6, 2026 11:30 AM**. Manual submission of Bids shall not be entertained. Those vendors who have not yet registered on the new version of **EPADS v2.0,** may register themselves on **https://vendors.epads.gov.pk/**. A tutorial to explain the registration process is available at **https://www.youtube.com/watch?v=MNW6T38v7tc**

In terms of Rule 48 of Public Procurement Rules, 2004 Grievance Redressal Committee (GRC) is notified for the subject procurement and notification copy is available on the procuring agency's website and on Authority's website at (**www.ppra.org.pk**).

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Instructions to Bidders

A. Introduction

1.Scope of Bids

1.1 The Procuring Agency (PA), as indicated in the **Bids Data Sheet (BDS)** invites Bids **through EPADS v2.0** for the provision of Goods for as specified in the BDS and **in Section V – Evaluation Criteria, Specifications & Schedule of Requirements**. The name, identification, and number of items/deliverables are provided in the **BDS**. The successful Bidders will be expected to provide the goods within the specified period and timeline(s) as stated in the **BDS**.

2. Source of Funds

2.1 Source of funds is referred in Clause-1 of Invitation for Bids.

3. Eligible Bidders

3.1 A Bidder may be natural person, company or firm or public or semi-public agency of Pakistan or any foreign country**,** or any combination of them with a formal existing agreement (on Judicial Papers) in the form of a joint venture, consortium, or association. In the case of a joint venture, consortium, or association, all members shall be jointly and severally liable for the execution of the Contract in accordance with the terms and conditions of the Contract. The joint venture, consortium, or association shall nominate a Lead Member as nominated in the BDS, who shall have the authority to conduct all business for and on behalf of any and all the members of the joint venture, consortium, or association during the Bidding process, and in case of award of contract, during the execution of the contract.

3.2 Verifiable copy of the agreement that forms a joint venture, consortium or association shall be required to be submitted as part of the Bid.

3.3 The appointment of Lead Member in the joint venture, consortium, or association shall be confirmed by submission of a valid Power of Attorney to the Procuring Agency.

3.4 Any bid submitted by the joint venture, consortium or association shall indicate the part of proposed contract to be performed by each party and each party shall be evaluated (or post qualified if required) with respect to its contribution only, and the responsibilities of each party shall not be substantially altered without prior written approval of the Procuring Agency and in line with

any instructions issued by the Authority.

(The limit on the number of members of JV or Consortium or Association may be prescribed in BDS, in accordance with the guidelines issued by the PPRA).

3.5 The invitation for Bids is open to all prospective suppliers, manufacturers, or authorized agents / dealers subject to any provisions of incorporation or licensing by the respective national incorporating agency or statutory body established for that particular trade or business. Procuring agencies shall specify the registration/licensing requirements for the foreign bidders keeping in view the requirement of that business.

3.6 A Bidder shall not have a conflict of interest. All Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to have a conflict of interest with one or more parties in this Bidding process, if they:

1. are associated or have been associated in the past, directly or indirectly with a firm or any of its affiliates which have been engaged by the Procuring Agency to provide consulting services for the preparation of the design, specifications and other documents to be used for the procurement of the Goods to be purchased under this Invitation for Bids.

2. have controlling shareholders in common; or

3. receive or have received any direct or indirect subsidy from any of them; or

4. have the same legal representative for purposes of this Bid; or

5. have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bids of another Bidder, or influence the decisions of the Procuring Agency regarding this Bidding process; or

6. Submit more than one Bid in this Bidding process.

3.7 A Bidder may be ineligible if –

1. he is declared bankrupt or, in the case of company or firm, insolvent;

2. payments in favor of the Bidder is suspended in accordance with the judgment of a court of law other than a judgment declaring bankruptcy and resulting (in accordance with the national laws) in the total or partial loss of the right to administer and dispose of its property;

3. the Bidder is convicted, by a final judgment, of any offence involving professional conduct;

4. the Bidder is blacklisted locally or by international organizations and hence debarred due to involvement in corrupt and fraudulent practices, or performance failure or due to breach of Bid securing declaration.

3.8 As and when required, bidders shall provide to the Procuring Agency evidence of their eligibility, proof of compliance with the necessary legal requirements to carry out the contract effectively.

3.9 Bidders shall submit Bids relating to the nature, conditions and modalities of sub-contracting wherever the sub-contracting of any elements of the contract amounting to more than ten (10) percent of the Bid price is envisaged.

4. Eligible Goods and Related Services

4.1 All goods and related services to be supplied under the contract shall have their origin in eligible source countries, and all expenditures made under the contract will be limited to such goods and services. For purpose of this Bid, ineligible countries are the countries declared ineligible by the Federal Government.

5. One Bid per Bidder

5.1 A bidder shall submit only one Bid, in the same bidding process, either individually as a Bidder or as a member in a joint venture or any similar arrangement.

5.2 The Bidder shall not engage a subcontractor for any portion of the contract if the value of such subcontracting exceeds thirty percent (30%) of the total contract amount.

6. Cost of Bidding

6.1 Any cost incurred by the bidder relating to the preparation and submission of its Bid shall be borne by the bidder, and the Procuring Agency shall in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

B. Bidding Documents

7. Contents of Bidding Document

7.1 The Goods required, Bidding procedures, and terms and conditions of the contract are prescribed in the Bidding Documents. In addition to the Invitation for Bids, the Bidding documents which should be read in conjunction with any addenda issued in accordance with **ITB 9.1** include:

Section I -Invitation to Bids

Section II Instructions to Bidders (ITB)

Section III Bid Data Sheet (BDS)

Section IV Evaluation Criteria, Specifications, Schedule of Requirements

Section V Bid Forms

Section VI General Conditions of Contract (GCC)

Section VII Special Conditions of Contract (SCC)

Section VIII Contract Forms

7.2 The Bidder is expected to examine all instructions, forms, terms and specifications in the Bidding documents. Failure to furnish all the information required in the Bidding documents through **EPADS v2.0** will be at the Bidder’s risk and may result in the rejection of his Bids.

8. Clarification of Bidding documents

8.1 A prospective Bidder requiring any clarification of the Bidding documents may notify the Procuring Agency through **EPADS v2.0.**

8.2 The Procuring Agency will within three (3) working days after receiving the request for clarification, respond to any request for clarification through **EPADS v2.0** provided that such request is received not later than three (03) days prior to the deadline for the submission of Bids as prescribed in **ITB 22**

8.3 Copies of the Procuring Agency's response will be forwarded to all identified Prospective Bidders through **EPADS v2.0**, including a description of the inquiry, but without identifying its source.

8.4 Should the Procuring Agency deem it necessary to amend the Bidding document as a result of a clarification, it shall do so following the procedure under **ITB 9.**

8.5 If indicated **in the BDS**, the Bidder's designated representative is invited at the Bidder's cost to attend a pre-Bid meeting at the place, date and time mentioned **in the BDS**. During this pre-Bid meeting, prospective Bidders may request clarification of the schedule of requirement, the Evaluation Criteria or any other aspects of the Bidding document.

8.6 Minutes of the pre-Bid meeting, if applicable, including the text of the questions asked by Bidders, including those during the meeting (without identifying the source) and the responses given, together with any responses prepared after the meeting will be uploaded on **EPADS v2.0**. Any modification to the Bidding documents that may become necessary as a result of the pre-Bid meeting shall be made by the Procuring Agency exclusively through the use of an Addendum pursuant to **ITB 9**. Non-attendance at the pre-Bid meeting will not be a cause for disqualification of a Bidder.

9. Amendment of Bidding documents

9.1 Before the deadline for submission of Bids, the Procuring Agency for any reason, whether at its own initiative or in response to a clarification requested by a prospective Bidder or Pre-Bid meeting may modify the Bidding documents by issuing addenda through **EPADS v2.0**.

9.2 The Procuring Agency shall promptly publish the addendum through **EPADS v2.0**.

9.3 Any addendum issued including the notice of any extension of the deadline shall also be communicated through EPADS v2.0 to all the bidders who have already submitted their bids. Such bidders shall have the right to withdraw their already submitted bid and re-submit the revised bid prior to the original or extended bid submission deadline.

9.4 To give prospective Bidders reasonable time in which to take an addendum/corrigendum into account in preparing their Bids, the Procuring Agency may, at its discretion, extend the deadline for the submission of Bids through **EPADS v2.0**:

Provided that the Procuring Agency shall extend the deadline for submission of Bids, if such an addendum is issued within last three (03) days of the Bids submission deadline.

C. Preparation of Bids

10. Language of Bid

10.1 The Bid prepared by the bidder, as well as all correspondence and documents relating to the Bids exchanged by the Bidder and the Procuring Agency shall be written in the English language unless otherwise specified in the BDS**.** Supporting documents and printed literature furnished by the Bidder may be in another language provided they are accompanied by an accurate translation of the relevant pages in the English language unless otherwise specified in the **BDS**, in which case, for purposes of interpretation of the Bidder, the translation shall govern.

11. Documents and samples Constituting the Bid

11.1 The Bid prepared by the Bidder shall constitute thedocuments required in the **BDS**.

Details of sample(s) where applicable and requested in the BDS.

1. Documentary evidence established in accordance with ITB that the Bidder is eligible and/or qualified for the subject bidding process;

2. Documentary evidence establish that the Bidder has been authorized by the manufacturer to deliver the goods into Pakistan, where required and where the supplier is not the manufacturer of those goods;

3. Documentary evidence establish that the goods and related services to be supplied by the Bidder are eligible goods and services, and conform to the Bidding Documents;

4. Bid security or Bid Securing Declaration furnished in accordance with **ITB 18.**

12. Documents Establishing Eligibility of the Goods and Conformity to Bidding documents

12.1 To establish the conformity of the bidder to the Bidding document, the Bidder shall furnish as part of its Bids the documentary evidence that Goods provided conform to the technical specifications and standards.

13. Documents Establishing Eligibility and Qualification of the Bidder

13.1 The Bidder shall furnish, as part of itsBid, all those documents establishing the Bidder's eligibility to participate in the Bidding process and/or its qualification to perform the contract if its Bid is accepted.

14. Form of Bids

14.1 The Bidder shall fill the Form of Bid furnished in the Bidding documents.The Bids Form must be completed without any alterations to its format and no substitute shall be accepted.

15. Bids Prices

15.1 The Bids Prices quoted by the Bidder in the Form of Bid and in the Price Schedules shall conform to the requirements specified below or exclusively mentioned hereafter in the Bidding documents.

15.2 All items in the Schedule of Requirement must be listed and priced separately in the Price Schedule(s). If a Price Schedule shows items listed but not priced and neither explicitly denied, their prices shall be construed to be included in the prices of other items.

15.3 Items not listed in the Price Schedule shall be assumed not to be included in the Bid, and provided that the Bid is still substantially responsive in their absence or due to their nominal nature, the corresponding average price of the respective item(s) of the remaining substantially responsive Bidder(s) shall be construed to be the price of those missing item(s)

15.4 The Bid price to be quoted in the Form of Bid in accordance with **ITB 14.1** shall be the total price of the Bid.

15.5 The Bidder shall indicate on the appropriate Price Schedule, the unit prices (where applicable) and total Bid price of the Goods it proposes to provide under the contract.

15.6 Prices quoted by the Bidder shall be fixed during the Bidder's performance of the contract and not subject to variation on any account. A Bid submitted with an adjustable price will be treated as non-responsive and shall be rejected.

16. Bids Currencies

16.1 Prices shall be quoted in Pakistani Rupees unless otherwise specified in the BDS in accordance with Rule 30 (2) of the Public Procurement Rules, 2004.

17. Bids Validity Period

17.1 Bids shall remain valid for the period specified in the **BDS** after the Bid submission deadline prescribed by the Procuring Agency. A Bid valid for a shorter period shall be rejected by the Procuring Agency as non-responsive**.** The period of Bid validity will be determined from the complementary Bid securing instrument, i.e. the expiry period of Bid Security or Bids Securing Declaration as the case may be.

17.2 The procuring agency shall ordinarily be under an obligation to process and evaluate the bid and to issue letter of award within the stipulated bid validity period.

17.3 Under exceptional circumstances, prior to the expiration of the initial Bid validity period, the Procuring Agency may request the Bidders' consent to an extension of the period of validity of their Bids only once through **EPADS v2.0**, for the period not more than the period of initial bid validity. The Bid Security provided under **ITB 18** shall also be suitably extended. A Bidder may refuse the request without forfeiting its Bid security or causing to be executed its Bid Securing Declaration. A Bidder agreeing to the request will not be required nor permitted to modify its Bid, but will be required to extend the validity of its Bid Security or Bid Securing Declaration for the period of the extension.

18. Bid Security or Bid Securing Declaration

18.1 The Bidder shall furnish as part of its Bid, a Bid Security in accordance with Rule 25 of the Public Procurement Rules, 2004.

18.2 The original Bid Security shall be enclosed within the sealed envelope and to be submitted physically before closing time for submission of bids. Whereas, scanned copy of bid security shall be uploaded electronically through EPADS v2.0 before closing hours for submission of bids.

18.3 The Bidder who failed to submit the original Bids security before the submission deadline shall be disqualified straightaway.

18.4 The Bid Security or Bid Securing Declaration is required to protect the Procuring Agency against the risk of Bidder's conduct which would warrant the security's forfeiture, pursuant to **ITB 18.7.**

18.5 The Bid Security shall be denominated in the local currency, and it shall be a Bank Draft in the name of the Procuring Agency and valid for twenty-eight (28) days beyond the end of the validity of the Bid. This shall also apply if the period

for Bids/Bid Validity is extended. In either case, the form must include the complete name of the Bidder.

18.6 The Bid Security shall be payable promptly upon written demand by the Procuring Agency in case any of the conditions listed in **ITB 18** are invoked.

18.7 Unsuccessful Bidders' Bid Security will be discharged or returned as promptly as possible, however in no case later than thirty (30) days after the expiration of the period of Bids Validity prescribed by the Procuring Agency pursuant to **ITB 17**. The Procuring Agency shall make no claim to the amount of the Bid Security, and shall promptly return the Bid Security document, after whichever of the following that occurs earliest:

a. the expiry of the Bid Security;

b. the entry into force of a procurement contract and the provision of a Performance Guarantee, for the performance of the contract if such a guarantee, is required by the Bid documents;

c. the rejection by the Procuring Agency of all Bids;

d. the withdrawal of the Bids prior to the deadline for the submission of Bids, unless the Bids documents stipulate that no such withdrawal is permitted.

18.8 The successful Bidder's Bids Security will be discharged upon the Bidder signing the contract**,** or furnishing the Performance Guarantee.

18.9 The Bid Security may be forfeited or the Bid Securing Declaration executed:

a. if a Bidder:

b. withdraws its Bid during the period of Bid Validity as specified by the Procuring Agency, and referred by the Bidder on the Form of Bids except as provided for in **ITB 17.2**; or

c. does not accept the correction of errors**;** or

d. in the case of a successful Bidder, if the Bidder fails:

e. to sign the contract; or

f. to furnish Performance Guarantee**.**

19. Withdrawal, Substitution, and Modification of Bid

19.1 Before Bid submission deadline, any Bidder may withdraw, substitute, or modify its Bid after it has been submitted through EPADS v2.0. Bids requested to be withdrawn, shall be returned unopened to the Bidders through **EPADS v2.0**.

20. Format and Signing of Bid

20.1 The Bidder shall prepare and submit Bids with due diligence after carefully reading all the terms and condition **before bid submission deadline** through EPADS v2.0.

D. Submission of Bids

21. Submission of Bids through EPADS v2.0

21.1 The Technical and Financial Bids if required to submitted, shall be submitted on **EPADS v2.0**.

22. Deadline for Submission of Bids

22.1 Bids shall be received by the Procuring Agency through **EPADS v2.0** before bid submission deadline.

22.2 The Procuring Agency may, under exceptional circumstances, extend the deadline for the submission of Bids, after recording reasons in writing and in an equal opportunity manner.

In such case, all rights and obligations of the Procuring Agency and the Bidders that were previously governed by the original deadline shall thereafter be subject to the revised deadline.

E. Opening and Evaluation of Bids

23. Opening of Bids

23.1 The Bid Evaluation Committee of the Procuring Agency shall open all Bids through the EPADS v2.0, on the date and time specified in the Bid Data Sheet (BDS).

23.2 The Bid Evaluation Committee **shall generate minutes through EPADS v2.0 containing brief details of bid opening process.** The record of the Bid opening shall include, as a minimum: the name of the Bidder, the Bid price if applicable, and the presence or absence of a Bid Security or Bid Securing Declaration.

23.3 The procuring agency shall live broadcast the opening of bids on national media or on their website or digital channels, if the volume of procurement exceeds five hundred million rupees in case of goods and services and one thousand million rupees in case of works.

23.4 In case the date of opening of bid has been declared as public holiday or the procuring agency fail to open bid due to any EPADS v2.0 related issues, the submission and opening of bids shall be shifted to the next working day on the same time.

23.5 In case of Single Stage One Envelope Procedure, the Bidders names, the Bid prices, the total amount of each Bid and, the presence or absence of Bid Security, Bid Securing Declaration and such other details as the Procuring Agency may consider appropriate, will be announced by the Bid Evaluation Committee.

24. Clarification of Bids

24.1 To assist in the examination, evaluation and comparison of Bids of the Bidders, the Procuring Agency may, ask any Bidder for a clarification of its Bid including breakdown of prices.

24.2 The request for clarification and the response shall be sought through EPADS v2.0 before **three days prior to the deadline for submission of bids.** No change in the prices or substance of the Bids shall be sought, offered, or permitted.

24.3 The alteration or modification in the BIDS which in any way affect the following parameters will be considered as a change in the substance of a Bids:

1. evaluation & qualification criteria;
2. required scope of work or specifications;
3. all securities requirements;
4. tax requirements;

5. terms and conditions of Bidding documents.

6. change in the ranking of the Bidder

24.4 From the time of Bids opening to the time of Contract award if any Bidder wishes to contact the Procuring Agency on any matter related to the Bids it should do so through **EPADS v2.0**.

25. Preliminary Examination of Bids

25.1 Prior to the detailed evaluation of Bids, the Procuring Agency will determine whether each Bid:

1. meets the eligibility criteria defined in **ITB 3**;

2. has been prepared as per the format and contents defined by the Procuring Agency in the Bidding documents;

3. is accompanied by the required securities; and

4. is substantially responsive to the requirements of the Bidding documents.

25.2 The Procuring Agency's determination of a Bid's responsiveness will be based on the contents of the Bid itself.

25.3 A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the Bidding documents, without material deviation or reservation. A material deviation or reservation is one that: -

1. affects in any substantial way the scope, quality, or performance of the Goods;

2. limits in any substantial way, inconsistent with the Bidding documents, the Procuring Agency's rights or the Bidders obligations under the Contract; or

3. if rectified, would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids.

25.3 If a Bids is not substantially responsive, it will be rejected by the Procuring Agency and may not subsequently be evaluated for complete technical responsiveness.

26. Examination of Terms and Conditions; Technical Evaluation

26.1 The Procuring Agency shall examine the Bids to confirm that all terms and conditions specified in the **GCC** and the **SCC** have been accepted by the Bidder without any material deviation or reservation.

26.2 The Procuring Agency shall evaluate the technical aspects of the Bids submitted, to confirm that all requirements specified in Schedule of Requirements and Technical Specifications of the Bidding documents have been met without material deviation or reservation.

26.3 If after the examination of the terms and conditions and the technical evaluation, the Procuring Agency determines that the Bid is not substantially responsive in accordance with **ITB 25.2,** it shall reject the Bid.

27. Correction of Errors

27.1 Bids determined to be substantially responsive will be checked for any arithmetic errors. Errors will be corrected as follows: -

1. if there is a discrepancy between unit prices and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail, and the total price shall be corrected, unless in the opinion of the Procuring Agency there is an obvious misplacement of the decimal point in the unit price, in which the total price as quoted shall govern and the unit price shall be corrected;

2. if there is an error in a total corresponding to the addition or subtraction of sub-totals, the sub-totals shall prevail and the total shall be corrected; and

3. where there is a discrepancy between the amounts in figures and in words, the amount in words will govern.

4. Where there is discrepancy between grand total of price schedule and amount mentioned on the Form of Bids, the amount referred in Price Schedule shall be treated as correct subject to elimination of other errors.

27.2 The amount stated in the Bid will, be adjusted by the Procuring Agency in accordance with the above procedure for the correction of errors and, with the concurrence of the Bidder, shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount, its Bid will then be rejected, and the Bid Security may be forfeited or the Bids Securing Declaration may be executed.

28. Conversion to Single Currency

28.1 To facilitate evaluation and comparison, the Procuring Agency will convert all Bids prices expressed in the amounts in various currencies in which the Bids prices are payable. For the purposes of comparison of bids quoted in different currencies, the price shall be converted into a single currency specified in the bidding documents. The rate of exchange shall be the selling rate prevailing on the date of opening of financial bids specified in the bidding documents, in accordance with weighted average customer exchange rates list issued by the State Bank of Pakistan on that day.

29. Evaluation of Bids

29.1 The Bids, quotations, or proposals shall be evaluated by the respective evaluation committees as per evaluation criteria described in the Bidding Documents in accordance with Rule 29 and 30 of the Public Procurement Rules, 2004.

1. Least Cost Based Selection (LCBS)

After meeting the requirements of eligibility, qualification and substantial responsiveness, the bid in compliance with all the mandatory (technical) specifications/requirements and/or requisite quality threshold (if any), and having lowest evaluated cost (or financial proposal) shall be considered Successful Bid.

2. Quality and Cost Based Selection (QCBS)

In such combination, there shall be some specific weightage of both the technical features and financial aspects of the proposal. The financial marks shall be awarded on the basis of inverse proportion calculations. The successful bid shall be declared, on the basis of combined evaluation.

3. Quality Based Selection (QBS)

Atter meeting the requirements of eligibility, qualification and substantial responsiveness the bid in compliance with all the mandatory (technical) specifications/requirements and attaining highest marks in the Technical Evaluation considering all other qualitative and/or quantitative parameters (or point rated criteria) for technical proposal(s) such as working methodology, implementation plan, resource allocation, additional functionalities, risk management approach, knowledge transfer techniques, post implementation methodology etc. shall be treated as highest ranked bid. Later on, the financial proposal of highest ranked bidder shall be opened, however, in case of failure to proceed further with such a bidder, the procuring agency may resort to second

highest bidder and so on.

29.2 In case of tie of bids, the bidders shall be provided an opportunity to offer their best and final monetary offer through EPADS v2.0. However, in no case the rates shall be higher than the original financial bids.

30. Domestic Preference

30.1 The procuring agency shall evaluate and compare bids, allow for preference to domestic bidders, while competing with the international bidders in accordance with the policies of Federal Government.

The percentage of preference, to be accorded shall be clearly mentioned in the bidding documents under the bid evaluation criteria.

31. Determination of Successful Bid

31.1 Selection technique will be adopted for determining the Successful Bid in accordance with the criteria referred in the BDS or prescribed in the separate section titled as Evaluation Criteria.

31.2 In case where the Procuring Agency adopts the Cost Based Evaluation Technique and, the Bid with the lowest evaluated price from amongst those which are eligible, compliant and substantially responsive shall be the Successful Bid.

31.3 The Procuring Agency may adopt the Quality & Cost Based Selection Technique due to the following two reasons:

1. Where the Procuring Agency knows about the main features, usage and output of the products; however not clear about the complete features, technical specifications and functionalities of the goods to be procured and requires the bidders to submit their proposals defining those features, specifications and functionalities; or

2. Where the Procuring Agency, in addition to the mandatory requirements and mandatory technical specifications, requires parameters specified in Evaluation Criteria to be evaluated while determining the quality of the goods.

31.4 In such cases, the Procuring Agency may allocate certain weightage to these factors as a part of Evaluation Criteria, and may determine the ranking of the bidders on the basis of combined evaluation in accordance with provisions of Rule 2(1)(h) of the Public Procurement Rules, 2004.

32. Abnormally Low Financial Bids

32.1Where the Bid price is considered to be abnormally low, the Procuring Agency shall perform price analysis either during determination of Successful Bids or as a part of the post-qualification process.

32.2 The Procuring Agency may reject an Abnormally low financial bids.

32.3 In order to identify the Abnormally Low Bids (ALB) following approaches can be considered to minimize the scope of subjectivity:

1. Comparing the Bids price with the cost estimate;

2. Comparing the Bids price with the Bids offered by other Bidders submitting substantially responsive Bids; and

3. Comparing the Bids price with prices paid in similar contracts in the recent past either government- or development partner-funded.

32.4 The Procuring Agency will determine to its satisfaction whether the Bidder that is selected as having submitted the successful bid is qualified to perform the contract satisfactorily.

32.5 The determination will take into account the Bidder's financial, technical, and production capabilities. It will be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, as well as such other information as the Procuring Agency deems necessary and appropriate. Factors not included in these Bidding documents shall not be used in the evaluation of the Bidders' qualifications.

32.6 Procuring Agency may seek "Certificate for Independent Price Determination" from the Bidder and the results of reference checks may be used in determining an award of contract.

Explanation: The Certificate shall be furnished by the Bidder. The Bidder shall certify that the price is determined keeping in view of all the essential aspects such as raw material, its processing, value addition, optimization of resources due to economy of scale, transportation, insurance and margin of profit etc.

32.7 An affirmative determination will be a prerequisite for award of the contract to the Bidder. A negative determination will result in rejection of the Bidder's Bids, in which event the Procuring Agency will proceed to the next ranked Bidder to make a similar determination of that Bidder's capabilities to

perform satisfactorily.

F. Award of Contract

33. Criteria of Award

33.1 The Procuring Agency will award the Contract to the Bidder whose Bids has been determined to be substantially responsive to the Bidding documents and who has been declared as Most Advantageous Bidder.

34. Negotiations

34.1 The procuring agency shall not engage in negotiations with respect to scope and price with the bidder except when the procuring agency conducts a procurement using direct **or negotiated** contracting or a request for proposals with evaluation based on quality alone.

34.2 The procuring agency may negotiate with the most advantageous bid with a view to streamline the work or task execution, at the time of contract finalization on methodology, work plan, staffing, finalizing payment arrangements, delivery arrangements, minor amendments to the special conditions of the contract.

35. Procuring Agency Right to reject all bids

35.1 The Procuring Agency reserves the right to reject all bids or proposals at any time prior to the issuance of the Letter of Award, without incurring any liability, in accordance with Rule 33 of the Public Procurement Rules, 2004.

36. Procuring Agency’s Right to Vary Quantities at the Time of Award

36.1 The Procuring Agency reserves the right at the time of contract award to increase or decrease the **quantity of** Goods originally specified in these Bidding documents provided this does not exceed **by** 15%, without any change in unit price or other terms and conditions of the Bids and Bidding documents.

37. Notification of Award

37.1 Prior to the award of contract, the procuring agency shall announce and publish the result of bid evaluation on **EPADS v2.0** in accordance with Rule 35

of the Public Procurement Rules, 2004.

37.2 The Bidder whose Bids has been accepted will be notified of the award by the Procuring Agency prior to expiration of the Bids/Bid Validity period. The Letter of Award will state the sum that the Procuring Agency will pay the successful Bidder in consideration for the delivery of Goods as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price).

37.3 The Letter of award will constitute the formation of the Contract, subject to the Bidder furnishing the Performance Guarantee and signing of the contract.

38. Signing of Contract

38.1 Promptly after issuance of Letter of award, Procuring Agency shall send the successful Bidder the draft Contract, incorporating all terms and conditions as agreed by the parties to the contract.

38.2 Immediately after the Redressal of grievance by the GRC (if any), mandatory standstill period in accordance with Rule 35 of the Public Procurement Rules, 2004 and **after fulfillment of all condition's precedent** of the Contract Form, the successful Bidder and the Procuring Agency shall sign the Contract.

39. Corrupt & Fraudulent Practices

39.1 Procuring Agencies (including beneficiaries of Government funded projects and procurement) as well as Bidders/Contractors under Government financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts, and will avoid to engage in any corrupt and fraudulent practices.

F. Grievance Redressal & Complaint Review Mechanism

40. Constitution of Grievance Redressal

40.1 The Grievance Redressal Committee shall address the grievance, if any submitted by any party, including the bidder, in accordance with Rule 48 of the Public Procurement Rules, 2004 to be read with Redressal of Grievances Regulations, 2021.

40.2 In case if any party or the bidder is not satisfied with the decision of the GRC or if it fails to decide within ten days, the bidder or the party may file an appeal before the Appellate Committee of the Authority in accordance with Rule 48 of the Public Procurement Rules, 2004 to be read with Redressal of Grievances Regulations, 2021.

G. Mechanism of Blacklisting

41. Mechanism of Blacklisting

41.1 The Procuring Agency shall initiate blacklisting proceedings against any bidder, supplier, or contractor in accordance with the Mechanism for Blacklisting Regulations, 2024, read with Rule 19 of the Public Procurement Rules, 2004.

41.2 The blacklisted/debarred bidder may file the review petition before the Authority in accordance with Rule 19 of the Public Procurement Rules, 2004 to be read with Procedure of filing and disposal of Review Petitions Regulations, 2021.

Bid Data Sheet

Bids Data Sheet (BDS)

The following specific data for the procurement of Goods to be procured shall complement, supplement, or amend the provisions in the Instructions to Bidders (ITB). Whenever there is a conflict, the provisions herein shall prevail over those in ITB.

BDS Clause Number
ITB Number
Amendments of, and Supplements to, Clauses in the Instruction to Bidders

A. Introduction

BDS Clause Number 1
ITB Number 1.1

Name of Procuring Agency: **Pakistan Security Printing Corporation (Pvt) Ltd (Procurement)**

The subject of procurement is: **T-3027-FA-REQ-1025-1-00166- SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ**

Expected commencement date: **Tuesday, December 15, 2026**

BDS Clause Number 2
ITB Number 2.1

Financial year for the operations of the Procuring Agency: **2026-27**

Name and identification number of the Contract: **P97735**

BDS Clause Number 3
ITB Clause Number 3.1

JV/Consortium or Association Allowed: **Yes**
Number of JV/Consortium Members: **03**
see section of eligibility criteria.

B. Bidding Documents

BDS Clause Number 4
ITB Number 8.1

The Bidders may seek clarifications through **EPADS v2.0** : Clarification Date: Friday, October 2, 2026
Pre-Bid Meeting: Tuesday, September 22, 2026 11:00 AM
Venue: RUMI HALL Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi, (For entry approval send your email at furqan.awan@pspc.gov.pk / 021-99248511 (Ext-2218)

C. Preparation of Bids

BDS Clause Number 5
ITB Number 10.1

The Language of all correspondences and documents related to the Bids shall be in: **English**

List of documents required along with the bid:

1. Annexure - A (BOQ / TORS of the Project) (All Parts due to large file size)
2. Annexure - B (Break Down of Financials and Financial Bid)
3. Annexure - C (Scanned Original Affidavit for Bidder’s Blacklisting Status)
4. Annexure - D (Code of Conduct & Undertaking)
5. Annexure - E (Duly Filled Format of Declaration for Ultimate Beneficial Owners Information)
6. Annexure - F (Scanned Joint Venture Documentation)
7. Annexure - G (Non-Disclosure Agreement)
8. Annexure - H (Undertaking for Compliance with HSE)
9. Annexure - I (Contract Forms)
10. Note: All Annexure formats are attached under annexures clause, Bidder is required to be upload duly filled, signed and stamped and submitted at the time of bid opening, preferable on company's letter head. Except Affidivat for Blacklisting, JV Documentation which is required to be submitted on Affidavit. The contract forms will only be submitted by the successful bidder

BDS Clause Number 6
ITB Number 11.1
Items/Lots and threre related documents:
See section items and Lots

BDS Clause Number 7
ITB Number 12.1

Items / Lots Specifications:

see section of items specifications.

BDS Clause Number 8
ITB Number 15.6

The price shall be **Fixed**.

BDS Clause Number 9
ITB Number 16.1

Currency of the Bids shall be : **PKR**

BDS Clause Number 10
ITB Number 17.1

The Bids/Bid Validity period shall be: **120 Days**

BDS Clause Number 11
ITB Number 18.1

The amount of Bid Security shall be as defined in Bid Security Section for items and lots given in **BDS 6**
The Bid Security shall be in the form of: **Pay Order, Bank Guarantee**

D. Submission of Bids

BDS Clause Number 12
ITB Number 20.1

Bid shall be submitted online on EPADS v2.0 whereas hard copy of the bid security should be submitted to the following;

Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi before bid submission deadline.

Bids that are not submitted on EPADS v2.0 shall be disqualified.

The deadline for Bids submission is: **Tuesday, October 6, 2026 11:00 AM**

E. Opening and Evaluation of Bids

BDS Clause Number 13
ITB Number 23.1

The Bids opening shall take place on **EPADS v2.0**.

Day *:* ***Tuesday***

Date: ***Tuesday, October 6, 2026***

Time *:* ***11:30 AM***

BDS Clause Number 14
ITB Number 31.1

Selection technique adopted will be: **Least Cost Based Selection (LCBS)**
see Evaluation Criteria

F. Review of Procurement Decisions

BDS Clause Number 15
ITB Number 41.1

Grievence against this procurement shall be submitted online on EPADS v2.0.

Arbitrator shall be appointed by mutual consent of the both parties.

Eligibility Criteria

Bidder's Type	Required Registration
Partnership Firm	FBR (NTN)
Company (Private Limited)	FBR (GSTN)
Company (Public Limited)	SECP
Company (Holding Company)	PEC
Company (Limited by Guarantee)	
State Owned Enterprise (Private Limited)	
State Owned Enterprise (Public Limited)	

Eligibility Criteria	Document
SRB Registration Certificate	Yes
The Bidder must have a Valid PEC License – Relevant to HVAC / MEP Works i. Category C-2 or higher.[SN-P1.1] OR ii. Category C-3 and /or C-4 (JV and consortium [BRHO(2.1]with same or higher categories is acceptable, maximum 03 JV partners allowed).	Yes
The Bidder must have an average turnover of at least 200M for last 3 years. (Audited Financial Statement must be provided)	Yes

The bidder must have a Minimum of 10 Years of supply, installation and commissioning experience of ducting and MEP works in HVAC sector with at least 2 completed projects (documentary evidence must be provided).	Yes
IEC 62443 compliance third party certification, or OEM-issued cyber-hardening certificate for the proposed BMS platform (Qualitative) (Documentary evidence required)	Yes
The bidder must have completed at least 2 projects within last 5 years in HVAC sector (Job completion certificate together with documentary evidence of the scope of work, from the employing agency must be submitted). (Scope included installation of AHUs at least 30, chillers at least 2 , pumps at least 8 , cooling towers at least 2 , BMS (installation and integration ,) ducting (8000m2 or more), FCUs, Chilled water piping (1000Rm or more), along with dismantling works of old system.	Yes
The bidder must have a Building Management System Execution Experience, BMS authorization from OEM in the name of bidder firm (or at least in the name of one JV partner. (Authorization letter from the OEM)	Yes
The bidding firm must depute dedicated team for Site execution, as per Table 1 - Project Management and Execution Team deputed at site. CVs as well as PEC registration numbers of these personnel must be submitted with the bid. (The documentary proof must be attached along with bid.)	Yes
Project Management and Execution Team To be Deputed at Site: The Project Management and Execution Team deputed at the site shall comprise the following key personnel.	No
The Project Manager shall have a Bachelor’s degree in Mechanical Engineering with at least 10 years of experience, or a DAE with 20 years of MEP/HVAC experience, respectively, and must be deputed permanently on site	Yes
The Automation and Control Engineer (BMS) shall have a Bachelor’s degree in Electrical/Electronic or equivalent Engineering with at least 05 years of BMS experience and BMS certification from the OEM, and must be dedicated to the project site.	Yes

Four (4) Site Supervisors shall be provided, having DAE/Equivalent qualifications in Mechanical, Electrical, Plumbing, and Civil, with at least 10 years of relevant experience, with one supervisor for each relevant field; they must be deputed permanently on site.	Yes
The Health Safety Inspector shall have a Bachelor’s degree in Engineering with 5 years of experience, or a Diploma/Certification in HSE/equivalent with at least 10 years of experience, and must be deputed permanently on site.	Yes
The Bidder must submit the Project Execution Plan on MS Project or Primavera - Level 03 (completion within 8-10 months – marking to be done as per the plan and execution timelines, Late delivery to be charged in case the firm exceeds its submitted planned time).	Yes
The bidder must submit an undertaking to comply with all applicable HSE laws, regulations and industry standards; and with all HSE requirements of PSPC, using the prescribed format provided in the tender document.	Yes

Evaluation Criteria

Eligibile bidder(s) with substantially responsive bid(s) offering **Least Cost Based Selection (LCBS)** shall be consider for the award of contract(s).

Least Cost Based Selection (LCBS)

Weightage

Technical Evaluation %
100

Technical Marks	60
Passing Marks	**25**
Diversity of Experience & Business Maturity	
Diversity of Experience & Business Maturity (Qualitative)(Doc Required) Experience of HVAC projects in different industries (Pharmaceutical /Hospitals/ Textile/ / Printing) Industries, similar to our scope Project(s) = 10 (02 mark for each project in above mentioned industries in last 10 years value minimum 200M. One project from each industry shall be considered for awarding marks. Fifth project shall be considered from Pharma/hospital sector only) Evidence - Job Completion Certificates and Purchase Orders **(10)**	10
Relevant Project Experience	

Relevant Project Experience of Similar Nature Projects: Similar nature means scope included installation of AHUs at least 30, chillers at least 2, pumps at least 8, cooling towers at least 2 , BMS (installation and integration ,) ducting (8000m2 or more), FCUs, Chilled water piping (1000Rm or more), along with dismantling works of old system. Evidence, Completion Certificates and Purchase Orders (Qualitative)(Doc Required) if number of completed projects are more than 5 **(10)** if number of completed projects are 5 **(7)** if number of completed projects are 4 **(3)** if number of completed projects are 3 **(1)**	10
Quality & Safety System, certification Evidence - Valid ISO Certificates for all JV and/ or consortium members (Qualitative)(Doc Required) ISO 9001 & ISO 45001 **(5)** ISO 45001 **(3)** ISO 9001 **(2)**	5
Current Work in Hand	
Current Work in Hand Evidence - Must provide the evidence in form of Purchase Orders (Qualitative)(Doc Required) Currently under execution similar nature project(s) each having value 200M or more **(10)** Currently under execution similar nature project(s) each having value 100m - 200M **(5)**	10
Professional Memberships	

Professional Memberships Evidence - Membership Proof as industry membership/ or individual membership of project site team (Qualitative)(Doc Required) ASME / ASHRAE / Pakistan - HVACR Society / Equivalent = 5 (membership of anyone of them qualifies for 3 marks, however if two memberships are available, then 5 marks) **(5)**	5
International Work Experience	
International Working experience in MEP/HVAC of similar nature projects within in last 10 years Evidence - Completion Certificates/ Purchase Orders from client (Qualitative)(Doc Required)	5
Testing, Adjusting & Balancing (TAB) Capability	
NEBB/AABC-certified TAB technician on team or documented TAB capability with calibrated instrument (Qualitative)(Doc Required)	5
In-House Ducting Fabrication Facility	
Owned sheet-metal fabrication shop with capacity ≥ tender scope = 5; subcontracted fabrication = 0. (Qualitative)(Doc Required)	5
Project completion Timeline	
Project completion timeline Completion Certificates/ Purchase Orders (Qualitative)(Doc Required) Within 8 months **(5)** Within 9 months **(3)** Within 10 months **(1)**	5

Items/Lots

Lot Title : SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ

Bid Security : 10000000 PKR

Item	UNSPSC	Delivery Schedule	Quantity	Manufacturer / Dealer Authorization	Warranty
SUPPLY OF ALL ASSOCIATED EQUIPMENT AND AUXILIARIES FOR COMPLETE AIR SIDE LOCAL WORKS	Heating and cooling and air conditioning HVAC installation and maintenance service	**Address:** Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi **Schedule:** 08 to 10 Months after the award of contract **Quantity:** 1/As per BOQ	1 / As per BOQ	Any	2 Years
HIRING SERVICES FOR INSTALLATION OF COMPLETE DUCTING, INSULATION, FANS, BMS AND ALL RELATED ITEMS OF AIR SIDE AS PER BOQ	Heating and cooling and air conditioning HVAC installation and maintenance service	**Address:** Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi **Schedule:** 8 to 10 Months after the award of contract **Quantity:** 1/As per BOQ	1 / As per BOQ	Any	2 Years

Related Services of Goods:

No

SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ

Item	UNSPSC	Related Services
SUPPLY OF ALL ASSOCIATED EQUIPMENT AND AUXILIARIES FOR COMPLETE AIR SIDE LOCAL WORKS	Heating and cooling and air conditioning HVAC installation and maintenance service	As per BOQ / TORS
HIRING SERVICES FOR INSTALLATION OF COMPLETE DUCTING, INSULATION, FANS, BMS AND ALL RELATED ITEMS OF AIR SIDE AS PER BOQ	Heating and cooling and air conditioning HVAC installation and maintenance service	As per BOQ / TORS

Items/Lot Specification

Lot Title : SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ

Item: SUPPLY OF ALL ASSOCIATED EQUIPMENT AND AUXILIARIES FOR COMPLETE AIR SIDE LOCAL WORKS

UNSPSC: Heating and cooling and air conditioning HVAC installation and maintenance service

Specifications / Requirements:

As per TORS, BOQ, Drawing, datasheets and site conditions attached at Annexure - A (All Parts due to size issue) Bidder is required to read all annexure parts in detail and upload the same after sign and stamp.

Item: HIRING SERVICES FOR INSTALLATION OF COMPLETE DUCTING, INSULATION, FANS, BMS AND ALL RELATED ITEMS OF AIR SIDE AS PER BOQ

UNSPSC: Heating and cooling and air conditioning HVAC installation and maintenance service

Specifications / Requirements:

As per TORS, BOQ, Drawing, datasheets and site conditions attached at Annexure - A. Bidder is required to read all annexure parts in detail and upload the same after sign and stamp.

Price Schedule

For Individual Items

#	Item Title	Quantity	Unit Price (PKR)	Total Price (PKR)	Delivery Location	Delivery Period / Year	Country of Origin
1							
2							

For Lots

#	Lot Title	Total Lot Price (PKR)	Country of Origin
1	[Lot 1 Title]		

PUBLIC PROCUREMENT REGULATORY AUTHORITY
(PPRA)
EPADS

General Conditions of Contract

A. General

1. Definitions

1.1 Unless the context otherwise requires, the following terms whenever used in this Contract shall have the same meaning and shall be interpreted as indicated

a. “Applicable Law” means the laws and any other instruments having the force of law in the Government’s Country, or in such other country as may be specified in the Special Conditions of the Contract (SC), as they may be issued and in force from time to time;

b. “Procuring Agency” means:-

a. any Ministry, Division, Department or any Office of the Government;

b. any authority, corporation, body or organization established by or under a Law or which is owned or controlled by the Government;.

c. “The Contract” means an agreement enforceable by law;

d. “The Contract Price” means the price payable to the Bidder under the Contract for the full and proper performance of its contractual obligations;

e. “Ancillary Services” means those services ancillary to the provision of Goods, such as transportation and insurance, and any other incidental services, such as installation, commissioning, provision of technical assistance, training, and other such obligations of the Bidder covered under the Contract;

f. “GCC” means the General Conditions of Contract contained in this section;

g. “SCC” means the Special Conditions of Contract by which the GCC may be amended or supplemented;

h. **“**Day” means calendar day unless indicated otherwise.

i. “Effective Date” means the date on which this Contract comes into force and effect.

j. The Bidder” means the individual or corporate body whose Bids to provide the Goods has been accepted by the Procuring Agency;

k. “The Project Site,” where applicable, means the place or places named in Bids Data Sheet and technical Specifications;

l. “Government” means the Government of Pakistan;

m. “Subcontractor” means any entity to which the Bidder subcontracts any part of the Goods.

n. "Service" means any object of procurement other than goods or works;

o. “Party” means the Procuring Agency or the Bidder, as the case may be, and “Parties” means both of them;

p. “Foreign Currency” means any currency other than the currency of the country of the Procuring Agency;

q. “Completion Date” means the date of completion of the contract by the Bidder as certified by the Procuring Agency;

r. “In Writing” means communicated in written form with proof of receipt;

s. “Local Currency” means the currency of Pakistan;

2. Application and Interpretation

2.1 These General Conditions shall apply to the extent that they are not superseded by provisions of other parts of the Contract.

2.2 In interpreting these Conditions of Contract headings and marginal notes are used for convenience only and shall not affect their interpretations unless specifically stated; references to singular include the plural and vice versa; and masculine include the feminine. Words have their ordinary meaning under the language of the Contract unless specifically defined.

3. Applicable Law

3.1 The contract shall be governed and interpreted in accordance with the laws of Pakistan, unless otherwise specified in SCC.

4. Governing Language

4.1 The Contract as well as all correspondence and documents relating to the Contract exchanged between the Bidder and the Procuring Agency, shall be written in the **English language** unless otherwise stated in the **SCC**. Supporting documents and printed literature that are part of the Contract may be in another language provided these are accompanied by an accurate translation of the relevant passages in English, in which case, for purposes of interpretation of the Contract, this translation shall govern.

5. Notices

5.1 Any notice, request, or consent made pursuant to this Contract shall be in writing and shall be deemed to have been made when delivered in person to an authorized representative of the Party to whom the communication is addressed, or when sent by registered mail, telex, telegram, or facsimile to such Party at the address specified in the **SCC**.

6. Delivery/Location

6.1 The Goods shall be delivered to such locations as the Procuring Agency may approve and as specified in SCC.

7. Authorized Representatives / Authority of Member in charge

7.1 Any action required or permitted to be taken, and any document required or permitted to be executed, under this Contract by the Procuring Agency or the Bidder may be taken or executed by the officials specified in the **SCC**.

B. Commencement, Completion, Modification, and Termination of Contract

8. Effectiveness of Contract

8.1 This Contract shall come into effect on the date the Contract is signed by both parties and such other later date as may be stated in the SCC.

9. Commencement of Services

9.1 The Bidder shall confirm availability of Key Experts and begin carrying out the Services not later than the number of days after the Effective Date specified in the SCC.

10. Program

10.1 Before commencement of the Services, the Bidder shall submit to the Procuring Agency for approval a Program showing the general methods, arrangements, order and timing for all activities. The Services shall be carried out in accordance with the approved Program as updated.

11. Starting Date/Expiration Date

11.1 The Bidder shall start carrying out the Services Five (05) days after the date the Contract becomes effective, or at such other date as may be specified in the **SCC.**

11.2 Unless terminated earlier pursuant to Clause **GCC 15** hereof, this Contract shall expire at the end of such time period after the Effective Date as specified in the SCC.

12. Entire Agreement

12.1 This Contract contains all covenants, stipulations and provisions agreed by the Parties. No agent or representative of either Party has authority to make, and the Parties shall not be bound by or be liable for, any statement, representation, promise or agreement not set forth herein.

13. Modification

13.1 Any modification or variation of the terms and conditions of this Contract, including any modification or variation of the scope of the Services, may only be made by written agreement between the Parties. However, each Party shall give due consideration to any Bids for modification or variation made by the other Party.

13.2 In cases of any modifications or variations, the prior written consent of the Procuring Agency is required.

14. Force Majeure

14.1 Definition

For the purposes of this Contract, "Force Majeure" means an event which is beyond the reasonable control of a Party and which makes a Party's performance of its obligations under the Contract impossible or so impractical as to be considered impossible under the circumstances.

14.2 No Breach of Contract

The failure of a Party to fulfill any of its obligations under the contract shall not be considered to be a breach of, or default under, this Contract in so far as such inability arises from an event of Force Majeure, provided that the Party affected by such an event (a) has taken all reasonable precautions, due care and reasonable alternative measures in order to carry out the terms and conditions of this Contract, and (b) has informed the other Party as soon as possible about the occurrence of such an event.

14.3 Extension of Time

Any period within which a Party shall, pursuant to this Contract, complete any action or task, shall be extended for a period equal to the time during which such Party was unable to perform such action as a result

of Force Majeure.

14.4 Payments

During the period of their inability to perform the Services as a result of an event of Force Majeure, the Bidder shall be entitled to continue to be paid under the terms of this Contract, as well as to be reimbursed for additional costs reasonably and necessarily incurred by them during such period for the purposes of the Services and in reactivating the Service after the end of such period.

15. Termination

15.1 By the Procuring Agency

The Procuring Agency may terminate this Contract in case of the occurrence of any of the events specified in paragraphs (a) through (e) of this Clause. In such an occurrence the Procuring Agency shall give at least thirty (30) calendar days' written notice of termination to the Bidder in case of the events referred to in (a) through (d); at least sixty (60) calendar days' written notice in case of the event referred to in (e);

a. If the Bidder fails to remedy a failure in the performance of its obligations hereunder, as specified in a notice of suspension;

b. If the Bidder becomes (or, if the Bidder consists of more than one entity, if any of its members becomes) insolvent or bankrupt or enter into any agreements with their creditors for relief of debt or take advantage of any law for the benefit of debtors or go into liquidation or receivership whether compulsory or voluntary;

c. If the Bidder fails to comply with any final decision reached as a result of arbitration proceedings;

d. If, as the result of Force Majeure, the Bidder is unable to perform a material portion of the Services for a period of not less than sixty (60) calendar days;

e. If the Procuring Agency, in its sole discretion and for any reason whatsoever, decides to terminate this Contract;

15.2 By the Bidder

The Bidder may terminate this Contract, by not less than thirty (30) calendar days' written notice to the Procuring Agency, in case of the occurrence of any of the events specified in paragraphs (a) through (d) of this Clause.

a. If the Procuring Agency fails to pay any money due to the Bidder pursuant to this Contract and not subject to dispute within forty-five (45) calendar days after receiving written notice from the Bidder that such payment is overdue.

b. If, as the result of Force Majeure, the Bidder is unable to perform a material portion of the Services for a period of not less than sixty (60) calendar days.

c. If the Procuring Agency fails to comply with any final decision reached as a result of arbitration.

d. If the Procuring Agency is in material breach of its obligations pursuant to this Contract and has not remedied the same within forty-five (45) days (or such longer period as the Bidder may have subsequently approved in writing) following the receipt by the Procuring Agency of the Bidder's notice specifying such breach.

C. Obligations of the Bidder

16. General

16.1 Standard of Performance

1. The Bidder shall deliver the product and carry out the Services with all due diligence, efficiency and economy, in accordance with generally accepted professional standards and practices, and shall observe sound management practices, and employ appropriate technology and safe and effective equipment, machinery, materials and methods. The Bidder shall always act, in respect of any matter relating to this Contract or to the Services, as a faithful adviser to the Procuring Agency, and shall at all times support and safeguard the Procuring Agency's legitimate interests in any dealings with the third parties.

16.2 Law Applicable to Goods

The Bidder shall deliver the goods in accordance with the Contract and in accordance with the Law of Pakistan and shall take all practicable steps to ensure that any of its Experts and Sub-Bidders, comply with the Applicable Law.

17. Conflict of Interests

17.1 Bidder Not to Benefit from Commissions and Discounts.

The remuneration of the Bidder shall constitute the Bidder's sole remuneration in connection with this Contract or the Services, and the Bidder shall not accept for their own benefit any trade commission, discount, or similar payment in connection with activities pursuant to this Contract or to the Services or in the discharge of their obligations under the Contract, and the Bidder shall use their best efforts to ensure that the Personnel, any Subcontractors, and agents of either of them similarly shall not receive any such additional remuneration.

17.2 Bidder and Affiliates Not to be Otherwise Interested in Project

The Bidder agree that, during the term of this Contract and after its termination, the Bidder and its affiliates, as well as any Subcontractor and any of its affiliates, shall be disqualified from providing Goods for any project resulting from or closely related to the Services.

17.3 Prohibition of Conflicting Activities

Neither the Bidder nor its Subcontractors nor the Personnel shall engage, either directly or indirectly, in any of the following activities:

a. during the term of this Contract, any business or professional activities in the Government's country which would conflict with the activities assigned to them under this Contract;

b. during the term of this Contract, neither the Bidder nor their Subcontractors shall hire public employees in active duty or on any type of leave, to perform any activity under this Contract;

18. Confidentiality

18.1 Except with the prior written consent of the Procuring Agency, the Bidder and the Experts shall not at any time communicate to any person or entity any confidential information acquired in the course of the contract.

19. Insurance to be Taken Out by the Bidder

19.1 The Bidder(a) shall take out and maintain, and shall cause any Subcontractors to take out and maintain, at its (or the Subcontractors', as the case may be) own cost but on terms and conditions approved by the Procuring Agency, insurance against the risks, loss or damage, and for the coverage, as shall be specified in the SCC; and (b) at the Procuring Agency's request, shall provide evidence to the Procuring Agency showing that such insurance has been taken out and maintained and that the current premiums have been paid.

20. Bidder's Actions Requiring Procuring Agency's Prior Approval

20.1 The Bidder shall obtain the Procuring Agency's prior approval in writing before taking any of the following actions:

(a) appointing such members of the Personnel not provided by the Bidder;

(b) changing the Program of activities; and

(c) any other action that may be specified in the SCC.

21. Reporting Obligations

21.1 The Bidder shall submit to the Procuring Agency the reports and documents in the numbers, and within the periods as prescribed by the Procuring Agency.

22. Liquidated Damages

22.1 If the Supplier fails to deliver any or all of the Goods or to perform the Services within the period(s) specified in the Contract, the Procuring Agency shall, without prejudice to its other remedies under the Contract, deduct from the Contract Price, as liquidated damages, a sum equivalent to the percentage specified in **SCC** of the delivered price of the delayed Goods or unperformed Services for each week or part thereof of delay until actual delivery or performance, up to a maximum deduction of the performance security (or guarantee) specified in **SCC**. Once the said maximum is reached, the Procuring Agency may consider termination of the Contract pursuant to **GCC Clause 15.**

22.2 Correction for Over-payment

If the Intended Completion Date is extended after liquidated damages have been paid, the Procuring Agency shall correct any overpayment of liquidated damages by the Bidder by adjusting the next payment certificate. The Bidder shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in SCC.

22.3 Lack of performance penalty

If the Bidder has not corrected a Defect within the time specified in the Procuring Agency's notice, a penalty for Lack of performance will be paid by the Bidder. The amount to be paid will be calculated as a percentage of the cost of having the Defect corrected, assessed as specified in the SCC.

23. Performance Guarantee

23.1 Within Seven (07) days from the issuance of acceptance letter from the Procuring Agency, the successful Bidder shall furnish the Performance Guarantee in shape of ------- at the discretion of the PA in the amount **specified in SCC.** In case the amount of Bids security is equal or greater than

23.2 The proceeds of the Performance Guarantee shall be payable to the Procuring agency as compensation for any loss resulting from the Supplier's failure to complete its obligations under the Contract.

23.3 The Performance Guarantee shall be denominated in the currency of the Contract, or in a freely convertible currency acceptable to the Procuring agency and shall be in the acceptable form as specified in SCC.

23.4 The Performance Guarantee will be discharged by the Procuring agency and returned to the Supplier not later than thirty (30) days following the date of completion of the Supplier's performance obligations under the Contract, including any warranty obligations, unless otherwise **specified in SCC.**

24. Fraud and Corruption

24.1 The Procuring Agency requires the Supplier to disclose any commissions or fees that may have been paid or are to be paid to agents or any other party with respect to the Bidding process or execution of the Contract. The information disclosed must include at least the name and address of the agent or other party, the amount and currency, and the purpose of the commission, gratuity or fee.

25. Sustainable Procurement

25.1 The Bidder shall conform to the sustainable procurement contractual provisions, if and as specified in the SCC.

D. Bidder's Personnel

26. Description of Personnel

26.1 The titles, agreed job descriptions, minimum qualifications, and estimated periods of engagement in the carrying out of the Services of the Bidder's Key Personnel. The Key Personnel listed by title as well as by name are hereby approved by the Procuring Agency.

27. Removal and/or Replacement of Personnel

27.1 Except as the Procuring Agency may otherwise agree, no changes shall be made in the Key Personnel. If, for any reason beyond the reasonable control of the Bidder, it becomes necessary to replace any of the Key Personnel, the Bidder shall provide as a replacement a person of equivalent or better qualifications.

27.2 If the Procuring Agency finds that any of the Personnel have (i) committed serious misconduct or have been charged with having committed a criminal action, or (ii) have reasonable cause to be dissatisfied with the performance of any of the Personnel, then the Bidder shall, at the Procuring Agency's written request specifying the grounds thereof, provide as a replacement a person with qualifications and experience acceptable to the Procuring Agency.

27.3 The Bidder shall have no claim for additional costs arising out of or incidental to any removal and/or replacement of Personnel.

E. Obligations of the Procuring Agency

28. Assistance and Exemptions

28.1 The Procuring Agency shall use its best efforts to ensure that the Government shall provide the Bidder such assistance and exemptions as specified in the SCC.

29. Change in the Applicable Law

29.1 If, after the date of this Contract, there is any change in the Applicable Law with respect to taxes and duties which increases or decreases the cost of the related Services rendered by the Bidder, then the remuneration and reimbursable expenses otherwise payable to the Bidder under this Contract shall be increased or decreased accordingly by agreement between the Parties, and corresponding adjustments shall be made to the amounts referred in the SCC.

30. Services and Facilities

30.1 The Procuring Agency shall make available to the Bidder and the Experts, for the purposes of the Services and free of any charge, the services, facilities and property described , at the times and in the manner specified in the SCC or terms of reference.

30.2 In case that such services, facilities and property shall not be made available to the Bidder, the Parties shall agree on (i) any time extension that it may be appropriate to grant to the Bidder for the performance of the Services, (ii) the manner in which the Bidder shall procure any such services, facilities and property from other sources, and (iii) the additional payments, if any, to be made to the Bidder as a result thereof.

F. Payments to the Bidder

31. Contract Price

31.1 The price payable shall be in Pakistani Rupees unless otherwise specified in the SCC. Prices charged by the Supplier for Goods delivered under the Contract shall not vary from the prices quoted by the Supplier in its Bid.

32. Terms and Conditions of Payment

32.1 Payments will be made to the Bidder according to the payment schedule stated in the SCC and as per actual invoice submitted by the Bidder.

32.2 Unless otherwise stated in the SCC, the advance payment shall be made against the provision by the Bidder of a bank guarantee for the same amount, and shall be valid for the period stated in the SCC. Any other payment shall be made after the conditions listed in the SCC for such payment have been met, and the Bidder have submitted an invoice to the Procuring Agency specifying the amount due.

33. Currency of Payment

33.1 Any payment under this Contract shall be made in the currency(ies) specified in the SCC.

G. Quality Control

34. Identifying Defects

34.1 The principle and modalities of Inspection of the Goods by the Procuring Agency shall be as indicated in the SCC. The Procuring Agency shall check the Bidder’s performance and notify him of any Defects that are found. Such checking shall not affect the Bidder’s responsibilities. The Procuring Agency may instruct the Bidder to search for a Defect and to uncover and test any service that the Procuring Agency considers may have a Defect. Defect Liability Period is as defined in the SCC.

35. Correction of Defects,and

Lack of Performance Penalty

35.1 The Procuring Agency shall give notice to the Bidder of any Defects before the end of the Contract. The Defects liability period shall be extended for as long as Defects remain to be corrected.

35.2 Every time notice a Defect is given, the Bidder shall correct the notified Defect within the length of time specified by the Procuring Agency's notice.

35.3 If the Bidder has not corrected a Defect within the time specified in the Procuring Agency's notice, the Procuring Agency will assess the cost of having the Defect corrected, the Bidder will pay this amount, and a Penalty for Lack of Performance.

36. Taxes and Duties

36.1 A Supplier shall be entirely responsible for all taxes, duties, fees, etc., incurred until delivery of the contracted Goods to the Procuring Agency.

H. Settlement of Disputes

37. Alternate Dispute Resolution

37.1 The disputes between the parties to the contract may be settled in accordance with Public Procurement Rules, 2004.

37.2 The procuring agency shall refer the matter to the Chief Justice Islamabad High Court or Managing Director PPRA or the Secretary Ministry of Law & Justice for appointment of Arbitrator.

37.3 The fee for the Arbitrator shall be specified in Pak Rupees as determined by the appointing authority which shall be borne and shared equally by the contracting parties.

Special Conditions of Contract

SECTION VIII. SPECIAL CONDITIONS OF CONTRACT

The following Special Conditions of Contract shall supplement the General Conditions of Contract. Whenever there is a conflict, the provisions herein shall prevail over those in the Conditions of Contract. The corresponding clause number of the GCC is indicated in parentheses.

Number of GC Clause

Amendments of, and Supplements to, Clauses in the General Conditions of Contract

Number of GC Clause 1

Definitions

The Procuring Agency is: Pakistan Security Printing Corporation (Pvt) Ltd (Procurement), Dy. General Manager - Procurement Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi

The Supplier is:

The title of the subject procurement is: T-3027-FA-REQ-1025-1-00166- SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ

Number of GC Clause 3

Applicable/Governing Law:

The Contract shall be interpreted in accordance with the laws of Islamic Republic of Pakistan

Number of GC Clause 4

Language:

The language of the Contract, all correspondence and communications to be given, and all other documentation to be prepared and supplied under the Contract shall be in **English.**

Number of GC Clause 5

Notices:

The addresses for the notices are:

Procuring Agency:

Pakistan Security Printing Corporation (Pvt) Ltd (Procurement), Dy. General Manager - Procurement
Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi
+92-333-687-0000
furqan.awan@pspc.gov.pk

Contractor/ Bidder:

[Name, address and telephone number].

The Contractor/ Bidder's Representative(s)

[Name, address, telephone number and e-mail address]

Number of GC Clause 7.1

The Authorized Representatives are:

For the Procuring Agency:

Pakistan Security Printing Corporation (Pvt) Ltd (Procurement), Dy. General Manager - Procurement
Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi
+92-333-687-0000
furqan.awan@pspc.gov.pk

For the Bidder:

Name: ……

Designation: ……..

Address: ……..

Number of GC Clause 8

Effectiveness of the contract

Number of GC Clause 9

Commencement of Contract:

Number of GC Clause 11.2

Expiration of Contract:

Number of GC Clause 15

Termination

In the event of termination of the contract due to any reason as already defined in the General Conditions of Contract, the Bidder shall be responsible for providing to the Authority the Goods till the time of alternate arrangements.

Number of GC Clause 17

Conflict of Interest:

The Procuring Agency reserves the right to determine on a case-by-case basis whether the Bidder should be disqualified from providing goods or services due to a conflict of a nature described in Clause GCC 17**.**

Number of GC Clause 22

Liquidated Damages

If the Bidder fails to provide services as required under the contract or in case of any data loss/data breach or any incident compromising the data security or other such failures related to any services, the Bidder shall

pay to the Procuring Agency as Liquidated Damages at a rate of **0.06%** to **2.00%** of the Contract value, in accordance with the extent of performance failure & the cost of investigating such incidents as judged by the Authority.

Number of GC Clause 23

Performance Guarantee:

The amount of performance guarantee shall be **5.00%** of the contract price in acceptable form of **Pay Order, Bank Guarantee**

Number of GC Clause 32

Payment terms:

Payment will be made to the Bidder against the procured Goods and services according to the actual invoice or running bills submitted by the Bidder against the services provided within the time given in the conditions of the contract.

Number of GC Clause 33

Currency of Payment:

All the payment to be released to the contractor/Bidder shall be in Pakistani Rupees.

Number of GC Clause 34

Identifying Defects:

The Authority reserves the right at any time to inspect the premises of the provider to inspect the goods and monitor the goods being provided.

Number of GC Clause 37

Following is the guidance for Dispute Resolution

i. If any dispute of any kind whatsoever shall arise between the Authority and the Bidder in connection with or arising out of the Contract, including without prejudice to the generality of foregoing, any question regarding its existence, validity, termination and the execution of the Contract – whether during developing phase or after their completion and whether before or after the termination, abandonment or breach of the Contract – the parties shall seek to resolve any such dispute or difference by mutual diligent negotiations in good faith within 14 (fourteen) days following a notice sent by one Party to the other Party in this regard**.**

ii. At future of negotiation the dispute shall be resolved through mediation and mediator shall be appointed with the mutual consent of the both parties**.**

iii. At the event of failure of mediation to resolve the dispute relating to this contract such dispute shall finally be resolved through binding Arbitration by sole arbitrator in accordance with Arbitration Act 1940. The arbitrator shall be appointed by mutual consent of the both parties**.** The Arbitration shall take place in Islamabad, Pakistan and proceedings will be conducted in English language.

iv. The cost of the mediation and arbitration shall be shared by the parties in equal proportion however the both parties shall bear their own costs and lawyer's fees regarding their own participation in the mediation and arbitration. However, the Arbitrator may make an award of costs upon the conclusion of the arbitration making any party to the dispute liable to pay the costs of another party to the dispute**.**

v. Arbitration proceedings as mentioned in the above clause regarding resolution of disputes may be commenced prior to, during or after completion of the contract.

Notwithstanding any reference to the arbitration herein, the parties shall continue to perform their respective obligations under the Contract unless they otherwise agree that the Authority shall pay the Bidder any monies due to the Bidder.

Rules of procedure for arbitration proceedings:

Any dispute between the Authority and a Bidder who is a national of the Islamic Republic of Pakistan arising in connection with the present Contract shall be referred to adjudication or arbitration in accordance with the laws of the Islamic Republic of Pakistan including Arbitration Act 1940, however above provision shall prevail in referring the case to the Arbitrator.

Place of Arbitration and Award:

The arbitration shall be conducted in English language and place of arbitration shall be at Islamabad. The award of the arbitrator shall be final and shall be binding on the parties.

Bid Securing Declaration

Form 9: Bid Securing Declaration

Date: *[insert date (as day, month and year)]*

Bid No.:***P97735***

To: **Pakistan Security Printing Corporation (Pvt) Ltd (Procurement), Dy. General Manager - Procurement Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi**

We, the undersigned, declare that:

We understand that, according to your conditions, Bids must be supported by a Bid Securing Declaration.

We accept that we will be blacklisted and henceforth cross debarred for participating in respective category of public procurement proceedings for a period of (not more than) six months, if fail to abide with a bid securing declaration, however without indulging in corrupt and fraudulent practices, if we are in breach of our obligation(s) under the Bid conditions, because we:

1. have withdrawn or modified our Bid during the period of Bid Validity specified in the Form of Bid;

2. Disagreement to arithmetical correction made to the Bid price; or

3. having been notified of the acceptance of our Bid by the Procuring Agency during the period of Bid Validity, (i) failure to sign the contract if required by Procuring Agency to do so or (ii) fail or refuse to furnish the Performance Security or to comply with any other condition precedent to signing the contract specified in the Bidding Documents.

We understand this Bid Securing Declaration shall expire if we are not the successful

Bidder, upon the earlier of (i) our receipt of your notification to us of the name of the successful Bidder; or (ii) twenty-eight (28) days after the expiration of our Bid.

Contract Form

SECTION IX: CONTRACT FORMS

THIS AGREEMENT made the _____ day of _____ 20_____ between **Pakistan Security Printing Corporation (Pvt) Ltd (Procurement), Dy. General Manager - Procurement Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi**

(hereinafter called "the Procuring Agency") of the one part and *[name of Bidder]* of *[city and country of Bidder]* (hereinafter called "the Bidder") of the other part:

WHEREAS the Procuring Agency invited Bids for provision of goods, viz., **T-3027-FA-REQ-1025-1-00166- SUPPLY AND HIRING SERVICES FOR COMPLETE AIR-SIDE LOCAL WORKS, INCLUDING ALL ASSOCIATED EQUIPMENT, AUXILIARIES, DUCTING, INSULATION, FANS, BMS, INSTALLATION, AND RELATED ITEMS AS PER BOQ (*P97735*)** and has accepted a Bids by the Bidder for the provision of Goods in the sum of *[contract price in words and figures]* (hereinafter called "the Contract Price").

NOW THIS CONTRACT WITNESSETH AS FOLLOWS:

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

2. The following documents shall be deemed to form and be read and construed as part of this Contract, In the event of any ambiguity or conflict between the Contract Documents listed below, the order of precedence shall be the order in which the Contract Documents are listed below:-

1. This form of Contract;
2. the Form of Bids and the Price Schedule submitted by the Bidder;
3. the Schedule of Requirements;
4. the Technical Specifications;
5. the Special Conditions of Contract;
6. the General Conditions of the Contract;
7. the Procuring Agency's Letter of Acceptance; and
8. [*add here: any other documents*]

3. In consideration of the payments to be made by the Procuring Agency to the Bidder as hereinafter mentioned, the Bidder hereby covenants with the Procuring Agency to provide the Goods related services and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Procuring Agency hereby covenants to pay the Bidder in consideration of the provision of Goods and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the contract at the times and in the manner prescribed by the contract.

IN WITNESS whereof the parties hereto have caused this Contract to be executed in accordance with their respective laws the day and year first above written.

Signed, sealed, delivered by _____the _____ (for the Procuring Agency)

Witness to the signatures of the Procuring Agency:

……

Signed, sealed, delivered by _____the _____ (for the Procuring Agency)

Witness to the signatures of the Bidder: ……

Integrity Pact

Integrity Pact

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC. PAYABLE BYTHE SUPPLIERS OF GOODS, SERVICES & WORKS IN CONTRACTS WORTH RS.10.00 MILLION OR MORE

Contract Number: Contract Value: Contract Title:

Dated:

[Name of Supplier] hereby declares that it has not obtained or induced the procurement of any contract, right, interest, privilege or other obligation or benefit from Government of Pakistan or any administrative subdivision or agency thereof or any other entity owned or controlled by it (GoP) through any corrupt business practice.

Without limiting the generality of the foregoing [Name of Supplier] represents and warrants that it has fully declared the brokerage, commission, fee etc. paid or payable to anyone and not given or agreed to give and shall not give or agree to give to anyone within or outside Pakistan either directly or indirectly through any natural or juridical person, including its affiliate, agent, associate, broker, consultant, director, promoter, shareholder, sponsor or subsidiary, any commission, gratification, bribe, finder's fee or kickback, whether described as consultations fee or otherwise, with the object of obtaining or inducing the procurement of a contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP, except that which has been expressly declared pursuant hereto.

[Name of Supplier] certifies that it has made and will make full disclosure of all agreements and arrangements with all persons in respect of or related to the transaction with GoP and has not taken any action or will not take any action to circumvent the above declaration, representative or warranty.

[Name of Supplier] accepts full responsibility and strict liability for making and false declaration, not making full disclosure, misrepresenting fact or taking any action likely to defeat the purpose of this declaration, representation and warranty. It agrees that any contract, right interest, privilege or other obligation or benefit obtained or procured as aforesaid shall, without prejudice to any other right and remedies available to GoP under any law, contract or other instrument, be voidable at the option of GoP.

Notwithstanding any rights and remedies exercised by GoP in this regard, [Name of Supplier] agrees to indemnify GoP for any loss or damage incurred by it on account of its corrupt business practices and further pay compensation to GoP in an amount equivalent to ten time the sum of any commission, gratification, bribe, finder's fee or kickback given by [Name of Supplier] as aforesaid for the purpose of obtaining or inducing the procurement of any contract, right, interest, privilege or other obligation or benefit in whatsoever form from GoP.

Performance Guarantee Form

Performance Guarantee Form

To: **Pakistan Security Printing Corporation (Pvt) Ltd (Procurement), Dy. General Manager - Procurement Pakistan Security Printing Corporation (Pvt) Ltd, Jinnah Avenue Malir Halt, Karachi**

WHEREAS *[name of Bidder]* (hereinafter called "the Bidder") has undertaken, in pursuance of Contract No. *[reference number of the contract]* dated *[insert date]* for provision of Goods*(*hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Bidder shall furnish you with a Bank Guarantee by a reputable bank for the sum specified therein as security for compliance with the Bidder's performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the Bidders guarantee:

THEREFORE, WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Bidder, up to a total of *[amount of the guarantee in words and figures],* and we undertake to pay you, upon your first written demand declaring the Bidder to be in default under the Contract and without cavil or argument, any sum or sums within the limits of *[amount of guarantee]* as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the: *[insert date]*

Signature and seal of the Guarantors

_____

[name of bank or financial institution]

_____

[address]

_____

[date}

Annexure

Annexure - A Part 1 - BOQ / TORS of Project File 1 data sheets and drawings

Signed and stamp each page and upload

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - A Part 1 - BOQ / TORS of Project File 1 data sheets and drawings** (page number: 73)

Annexure - A Part 2 - BOQ / TORS of Project File 1 data sheets and drawings

SINGNED AND STAMP EACH PAGE AND UPLOAD

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - A Part 2 - BOQ / TORS of Project File 1 data sheets and drawings** (page number: 174)

Annexure - A Part 3 - BOQ / TORS of Project File 1 data sheets and drawings

SIGNED & STAMP EACH PAGE AND UPLOAD

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - A Part 3 - BOQ / TORS of Project File 1 data sheets and drawings** (page number: 180)

Annexure - A Part 4 - BOQ / TORS of Project File 1 data sheets and drawings

SIGNED AND STAMP EACH PAGE AND UPLOAD

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - A Part 4 - BOQ / TORS of Project File 1 data sheets and drawings** (page number: 181)

Annexure - A Part 5 - BOQ / TORS of Project File 1 data sheets and drawings

SIGNED AND STAMP EACH PAGE AND UPLOAD

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - A Part 5 - BOQ / TORS of Project File 1 data sheets and drawings** (page number: 182)

Annexure - A Part 6 - BOQ / TORS of Project File 1 data sheets and drawings

SIGNED AND STAMP EACH PAGE AND UPLOAD

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - A Part 6 - BOQ / TORS of Project File 1 data sheets and drawings** (page number: 185)

Annexure - B (Breakdown of Financials and Financial Bid)

Financial Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - B (Breakdown of Financials and Financial Bid)** (page number: 297)

Annexure C - Affidavit for Bidder’s Blacklisting Status

To be Submitted on scanned affidivat

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure C - Affidavit for Bidder's Blacklisting Status** (page number: 309)

Annexure D - Code of Conduct & Undertaking

Signed and stamp on all pages and upload

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure D - Code of Conduct & Undertaking** (page number: 310)

Annexure - E Declaration for Ultimate Beneficial Owners Information

filled the format and upload after signed and stamp

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - E Declaration for Ultimate Beneficial Owners Information** (page number: 316)

Annexure - F (Proof of Joint Venture Documentation to be attached)

upload the JV documentation

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - F (Proof of Joint Venture Documentation to be attached)** (page number: 318)

Annexure - G (Non Disclosure Agreement)

NDA signed and stamped to be uploaded here on the letterhead of bidder

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - G (Non Disclosure Agreement)** (page number: 319)

Annexure - H (Undertaking for Compliance with HSE)

submit undertaking as per attached format

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Annexure - H (Undertaking for Compliance with HSE)** (page number: 323)

Annexure - I (Draft Contract for information only)

Information (Read-Only)

See Form Under Additional Forms and Documents: **Annexure - I (Draft Contract for information only)** (page number: 324)

Payment Terms & Conditions

sign and stamp and upload

Technical Submission (Vendor)

Document Required

See Form Under Additional Forms and Documents: **Payment Terms & Conditions** (page number: 328)

Procurement Forms

Contractor's Key Personnel Representative and Their Schedules

See Form Under Additional Forms and Documents: **Contractor's Key Personnel Representative and Their Schedules** (page number: 332)

Financial Resources

See Form Under Additional Forms and Documents: **Financial Resources** (page number: 336)

Past Experience and Completed Contracts

See Form Under Additional Forms and Documents: **Past Experience and Completed Contracts** (page number: 337)

Historical Contract Non-Performance, and Pending Litigation and Litigation History

See Form Under Additional Forms and Documents: **Historical Contract Non-Performance, and Pending Litigation and Litigation History** (page number: 338)

Current Contracts and Their Progress

See Form Under Additional Forms and Documents: **Current Contracts and Their Progress** (page number: 340)

Average Annual Turnover

See Form Under Additional Forms and Documents: **Average Annual Turnover** (page number: 341)

PUBLIC PROCUREMENT REGULATORY AUTHORITY
(PPRA)
EPADS

Additional Forms and Documents

FORM No. QAF - 23 73 10	QUALITY ASSESSMENT FORM AIR HANDLING UNITS	FAHIM, NANJI & DESOUZA (PVT.) LTD. CONSULTING ENGINEERS

THIS FORM IS TO BE FILLED AND SUBMITTED BY THE MANUFACTURER/SUPPLIER

PROJECT _____ PROJECT NO. _____

SUPPLIER'S NAME _____

MANUFACTURER _____

MAKE & MODEL _____ COUNTRY OF ORIGIN _____

S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
1.0	**GENERAL**	
1.1	Name of the equipment manufacturer.	
1.2	Country of Origin.	
1.3	For how long are these units being manufactured.	
1.4	Is ISO 9000 certification available.	
1.5	No. of projects where equipment is installed in Pakistan.	
1.6	Representative in Pakistan.	
1.7	After sales service arrangements.	
1.8	Conformance to any other standard.	
1.9	Certification by any other body.	
2.0	**TECHNICAL**	
2.1	Type of Air Handling Units	
2.2	Type of external panels	
2.3	Thickness of panel material	
2.4	Finish of panels	
2.5	Insulation	
2.6	Type of structural system/material	
2.7	Is base plate provided	
2.8	Type of jointing system between sections	
2.9	Are hinged access doors provided	
2.10	Are acess door provided with universal mounting and do not require any tool for opening the door	
2.11	Source of fans	
2.12	Do fans have certified operating curve	
2.13	What certification do the fans have	
2.14	Source of motor (manufacturer)	
2.15	Is the cooling coil selection based on computer software	
2.16	Do the cooling coil have any certification	
2.17	What is the coil pressure drop at specified conditions (Mention separately for each AHU)	
2.18	What is the coil pressure drop on water side at specified conditions (Mention separately for each AHU)	

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S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
2.19	What is total internal pressure drop of Air Handling Unit (Mention separately for each AHU)	
2.20	Is the fan and motor mounted on a separate base plate and installed isolated in the fan section	
2.21	Is the motor mounting adjustable in two directions	
2.22	Is there a thermal barrier provided to prevent condensation at structural members	
2.23	Are the cavities in the structural members insulated	
2.24	What kind of gaskets are used and what material on the panels	
2.25	What kind of gasket are used and what material between the sections	
2.26	To what positive pressure are the units air tight	
2.27	To what negative pressure are the units air tight	
2.28	What type of insulation is used, Thickness, thermal conductivity	
2.29	Is the fan discharge isolated from the fan casing	
2.30	What arrangement is there to mount Panel filter? What is the leakage rate	
2.31	What arrangement is there to mount Bag filter? What is the leakage rate	
2.32	What kind of Dampers are installed in the AHU? What is there leakage rate	
2.33	What is the material for the drain tray	
2.34	How much is the insulation on the drain tray	
2.35	Is Ultra Violet & Germicidal Irradiation (UVGI) Lamp provided for all AHUs at the downstream of cooling coil?	
2.36	Does the drain tray conform to current indoor air quality standard	
We hereby certifying that the above information is correct and we shall be held responsible for any deviation from the above data.		
SIGNATURE OF MANUFACTURER/SUPPLIER		**CONSULTANT'S REMARKS**

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FORM NO. CSF-23 73 10	SPECIFICATION CONFORMANCE STATEMENT AIR HANDLING UNITS	FAHIM, NANJI & DESOUZA (PVT.) LTD CONSULTING ENGINEERS

THIS FORM IS TO BE FILLED AND SUBMITTED BY THE MANUFACTURER/SUPPLIER

Following points to be noted when filling this Form.

1) The information provided shall apply to all Air Handling Units conforming to the Specifications given under 'Air Handling Units', Section 23 73 10.

2) In the case, one or more units have conformation statement different from the other units, seperate sheet shall be submitted by the Manufacturer/Supplier and the information shall be clearly indicated.

3) Seperate sheet(s) may be used by the Manufacturer/Supplier to clearly mention the statements if needed.

PROJECT _____ PROJECT NO. _____

SUPPLIER'S NAME _____

MANUFACTURER _____

MAKE & MODEL _____ COUNTRY OF ORIGIN _____

S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
1.0	**GENERAL**	
1.1	Confirm that the capacity requirements for Central Station Air Handling Unit given under EQUIPMENT DATA SHEET are fullfilled.	
1.2	Confirm that the Units have Eurovent or Equivalent Certification as specified or approved by the Consultant.	
1.3	Confirm that the Units are labelled to identify the components and their specifications (eg. Filtergrade, heat transfer rate (Kw), electrical rating (Kw), Flow rate, pressure drop etc.)	
1.4	Confirm that the unit includes: Waterproof drain pan Cooling Coils Heating Coils Empty Secions & Mixing Sections Heat Recovery Sections where specified Necessary Piping Fans Motors Adjustable V-belt drives & belt guards Filters Dampers Removable panels Hinged access doors Combination filter mixing Box Neoprene rubber–in-shoe vibration isolators Spring vibration isolators if indicated in EQUIPMENT DATA SHEET.	
1.5	Confirm that dimensions of AHU's are suitable for installation in the space allocated.	
1.6	Confirm that unit is factory tested.	
2.0	**DOUBLE SKINNED CONSTRUCTION**	
2.1	Confirm that the casing of frame construction is provided for pressure upto 8" of wc.	
2.2	Confirm that the frame sections & corner connections are made of extruded aluminum.	
2.3	Confirm that the walls, doors & covers are of air-tight double-skinned design and the metal shall have minimum thickness of 0.7mm for inner skin and 1 mm for outer skin.	
2.4	Confirm that synthetic insulation is provided and thickness of insulation is: 40mm (minimum) for internal installation. 50mm (minimum) for exposed installation or as necessary to prevent condensation.	
2.5	Confirm that U-factor for walls is less than 0.15 Btu/ur sq ft ^{o}F (0.85 w/sq.m K).	

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S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
2.6	Confirm that sound insulation for walls is not less than Frequency (Hz) 63 125 250 500 1000 2000 4000 8000 Insertion loss(dB) 11 11 15 25 26 27 27 27	
2.7	Confirm that the sheeting is provided with: Galvanising to a minimum thickness of 20 microns Synthetic epoxy based coating to a thicknes of 50 microns	
2.8	Confirm that the doors & inspection covers are made of non-aging rubberised material.	
2.9	Confirm that the Bolts for doors & inspection covers are removable & of galvanized steel.	
2.10	Confirm that thermal barrier at frame corners are provided.	
2.11	Guarantee that no condensation shall occur externally when AHU is exposed to 95^{o}F & 16 gr/lbs atmosphere.	
2.12	Confirm that all sections are mounted on a galvanised structural base extending to the full length of the air handling unit.	
2.13	Confirm that the jointing between sections is either by galvanised steel bolts or by galvanised steel cleats.	
2.14	Confirm that non-aging rubberised gasket is provided between sections.	
2.15	Confirm that atmospherically exposed AHU's are provided with weather canopy, rain hood & other construction features required for proper operation in open atmosphere.	
2.16	Confirm that access doors shall have 400 mm (min) width, hinged & removable type.	
3.0	**VOLUME CONTROL DAMPERS**	
3.1	Confirm that Control Dampers shall be of extruded aluminium	
3.2	Confirm that Dampers shall be of opposed blade and multi leaf type and shall have open-close indication sign.	
3.3	Confirm that necessary brackets & linkages shall be available for motorized operation.	
3.4	Confirm that Dampers shall have necessary seals to ensure leakage rate doesnot exceed 1% of nominal flow at 250 Pa negative pressures.	
4.0	**FANS & MOTOR**	
4.1	Confirm that Fans shall either be DWDI Centrifugal fans as specified in Section 23 34 16 or Plug Fans as specified in Section 23 34 17, as indicated in EQUIPMENT DATA SHEET.	
4.2	Confirm that Motors shall comply with Specificationsgiven in Section 23 05 13.	
4.3	Confirm that Fans and Motors shall be mounted on mounting base, isolated from casing with spring mounted vibration isolators.	
4.4	Confirm that the fan is capable of discharging the required volume of air against the duct work system resistance plus the resistance through the unit itself.	
4.5	Confirm that the Impellers shall be of mild steel or aluminium and shall be capable of running continuously at ten percent in excess of normal speed.	
4.6	Confirm that the impeller wheels are accurately balanced and free from objectionable noise or vibrations.	
4.7	Confim that the fan blades are provided as indicated in the Specifications.	
4.8	Confim that Belt Driven Fans shall be fitted with pulleys suitable for V-Belts.	
4.9	Confirm that bearings are self-aligning ball type with accessible grease fittings and are selected for at least 100,000 hours of operation.	
4.10	Confirm that fan shaft is of accurately finished steel.	
4.11	Confirm that the drive is selected for minimum 1.2 times BHP.	

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S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
4.12	Confirm that units upto & including 50HP have variable pulleys and suitable for adjustment within +10% of specified RPM.	
4.13	Confirm that motor mounting allow quick adjustment using jack screw.	
4.14	Confirm that if free flow plug fans are used then blades are either back-ward inclined or air foil design.	
4.15	Confirm that for variable Air Volume AHU's with plug fan, inlet of fan is provided with air-flow measuring device as detailed in the specificaitons.	
5.0	**COIL SECTION**	
5.1	Confirm that selected coil is suitable for required heat transfer capacity.	
5.2	Confirm that the coil is removable from the unit without dismantling the entire unit.	
5.3	Confirm that eliminators are provided at the coil outlet for preventing carryover of droplets.	
5.4	Confirm that the coil is of: Extended surface, Staggered tube, Flat plate fin type.	
5.5	Confirm that coil arrangement is counter flow & multipass.	
5.6	Confirm that air face velocity on the coil not exceed 550 fpm (2.8 m/s).	
5.7	Confirm that no turbulator is provided inside the coil.	
5.8	Confirm that each coil is leak tested before shipment at 250 psi & 220 F.	
5.9	Confirm about casing: Construction is of galvanized steel Have adequate diameter bolts holes for mounting. Have reinforced flange type coil side plate.	
5.10	Confirm about tubes: Round seamless copper tubes 3/8" or 5/8" outer diameter All joints are brazed with positive bonding of copper tube & aluminium fin collar.	
5.11	Confirm about Fins: Flat aluminium plate with full drawn collars. Tubes are mechanically expanded into the fins. Maximum fin spacing is 10 fpi	
5.12	Confirm about Headers: Are of extra heavy seamless copper tubing Intruded tube holes Heavy gauge, die formed copper header end caps. Air vent on top of each Header is provided. Cooling coils are circuited for drainability and for service without removing individual pluges from each tube.	
5.13	Confirm about Drain Pan: Double skinned Fabricated of stainless steel Have 1“ minimum insulation of polyurethane or closed cell foam Threaded drain outlet from drain pan sealed to the casing with neoprene gasket	
6.0	**FILTERS**	
6.1	Confirm that Filters shall be provided in accordance with Section 23 41 10- Air Filters.	
6.2	Confirm that the air-handling unit filter is mounted in an air-tight flat or angular filter box of galvanised steel or aluminium sheet so that they can be removed from either end for replacement and cleaning.	
6.3	Confirm that in air handling unit the filter section is a standard module from the AHU manufacturer.	

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S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
6.4	Confirm that manufacturer's performance guarantee certificate and technical bulletins are available from the Air Filter manufacturer and can be shown by the AHU manufacturer when ever required.	
6.5	Confirm that a multi-blade damper in the plenums of air handling unit having high efficiency filters is installed to balance the air system when the filtering media is new with low initial resistance.	
6.6	Type F-1: Viscous Impingement Filters:	
6.6.1	Confirm for Viscous Impingement Filter (Type-F1)	
	* are min. 2 inch (50mm) thick,	
	* are permanent viscous impingement and washable.	
	* Are all metal type	
	* Are panel type.	
	* Media is corrugated strips of aluminium screen enclosed in an 18 gauge aluminium frame with flush mitred corners.	
	* The corrugation is tappered to form a series of pyramid shaped pockets to prevent dust laden air from drifting through the filters.	
	* Expanded metal is placed on both sides of the filtering media to add strength and for mechanical protection.	
	* Resistance to air flow of a clean filter do not exceed 0.1inch WG. final pressure drops do not exceed 0.5 inch of WG.	
	* The filters is selected for face velocities not exceeding 500 fpm (2.5 m/s).	
	* filter adhesive is provided in suitable containers in sufficient quantity for one year's requirement, based on operating the system for 10 months on 24 hour basis.	
	* a filter washing tank suitable for washing of the particular size of filter is provided.	
6.7	Type F-2: Replaceable Panel Filter:	
6.7.1	Confirm for replaceable Panel Filter:	
	* This filter consist of 2 inch thick glass fibre mat coated with dust binding adhesive (Viscosine) as the filtering media.	
	* The filtering media is fixed into a U-shaped metal frame and a metal grid is provided for additional support.	
	* Filter media is of thick resilient spun fibre structure of variable density and provide synthetic dust arrestance of 80-90% based on (Eurovent 3) ASHRAE 52-76 Test Method.	
	* The filter is supplied with a 50mm deep galvanised steel cell (holding) frame with quick release clamps or hinge type spring clips for positive airtight clamping of the filter.	
	* The filter have a rated face velocity of 500 FPM (2.5 m/s)	
	* Maximum initial resistance is of 0.24 inch of WG (60 Pa) final pressure drop do not exceed 0.72 inch of WG (180 Pa)	
6.8	Type F-3: PERMANENT WASHABLE PANEL FILTER	
6.8.1	Confirm for permanent washable Panel Filter:	
	* Synthetic Filters is permanent washable high velocity using a media composed of high bulk polyester fibers, bonded together with a fire retardant resin to form a high loft blanket of resilient fibers.	
	* The media is soft, light, easy to handle, extremely resilient able to with stand temperature ranges from 40°F to 120°F (4.4°C to 49°C) without deterioration or media failure.	
	* Filter is provide dust arrestance of 80-90% based on Eurovent rating EU-3.	
	* washable media is cleanable with only pure water without need of adding detergents.	
	* The filter is selected for face velocities not exceeding 550 FPM (3.0m/s).	
	* The initial resistance is less than 0.1 inch WG (25 Pa).	
6.9	Type F-4: Medium Efficiency Bag Filters (60-65% efficient):	
6.9.1	Confirm for medium efficiency Bag Filters that:	

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S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
	* The filter type is extended surface air filters, pocket type having a minimum of 8 pockets;	
	* Filter is with either a retainer device designed to give full top, bottom and side support to each pleat, or	
	* pleats are so designed as not to require a supporting retainer.	
	* Retainer device, if used, is of galvanised wire with PVC coating.	
	* Filter media is ultra-fine fibre-glass specifically manufactured for filtration.	
	* Filters are provided with holding frames lined with sealing gasket with quick-release clamps, for side access application, designed to ensure a positive seal against leakage of unfiltered air.	
	* The filters have a rated filter face velocity of 500 FPM (2.5 m/s),	
	* maximum Initial Resistance is 0.24 inch of WG. (60 Pa) or 60-65% efficient filters.	
	* final resistance is maximum 1 inch WG. (250 Pa) for 60-65% efficient filters.	
	* Filter depth is 22 inches (560mm).	
	* Filter provides Atmospheric Dust Spot Efficiency as indicated in the EQUIPMENT DATA SHEET.	
	Confirm that:	
	* Maximum initial resistance is 0.3 inch of WC (75 Pa), for 65-80% efficient of items.	
	* Final resistance is 1 inch WG (250 Pa), for 65-80% efficient filters.	
6.10	Type F-8: Activated Carbon Filters:	
6.10.1	Confirm for activated Carbon Filters that:	
	* These filters consist of activated carbon filter cells for removal of odour and harmful vapours by adsorption process.	
	* Filter housing is constructed of 16 gauge galvanised steel sheet with internal stiffner bars.	
	* Top and bottom slide track inserts is one-piece molded corrosion resistant plastic.	
	* Filter cell frame consist of moisture resistant chip board with neoprene seals.	
	* The activated carbon cells is of wedge formation securely fixed to the frames.	
	* The activated carbon used have cylindrical shaped granules.	
	* Filter is minimum 1 inch (25mm) thick.	
	* Carbon trays is rechargable and manufactured of high impact plastic with internal separators to prevent settling of the carbon beds.	
	* Two beads of caulking, one on either side of the mounting holes and around the frame work are provided to allow the filters to seal against each other is provided.	
	* The filters have a rated filter velocity of 500 fpm (2.5m/s).	
	* maximum initial resistance is 0.5 inch of WG (125 Pa).	
	* Minimum service life is one year.	
7.0	**MIXING BOX**	
7.1	Confirm that Mixing Box is furnished for all AHU's where scheduled or shown on drawings.	
7.2	Confirm that Damper arrangement at top & side or bottom & side is of parallel type and set for merging of air streams inside the box.	
7.3	Confirm that Damper blade rods rotate on rust-proof bushing and are air tight.	
7.4	Confirm that each box is equipped with duct connection flanges & necessary fastener holes.	
7.5	Confirm that mixing box is manufacturer's standard product.	

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S. NO.	DESCRIPTION	SUPPLIER / MANUFACTURER CONFIRMATION
7.6	Confirm that all spares are provided as indicated in EQUIPMENT DATA SHEET.	
8.0	**ACCESSORIES**	
8.1	Confirm that Flexible Connections are provided between fan discharge and AHU casing outlet in compliance with fire regulations.	
8.2	Confirm that Magnehelic Pressure Gage across each filter set is provided to measure pressure drop across each filter.	
8.3	Confirm that Port Holes are provided in all sections.	
8.4	Confirm that Ultra Violet & Germicidal Irradiation (UVGI) Lamp is provided for all AHUs in the downstream of Cooling Coil.	
8.5	Confirm that bulk head mounted lights are provided in all sections of the AHU.	
8.6	Confirm that Terminal Box is provided on outside of the AHU.	
We hereby certifying that the above information is correct and we shall be held responsible for any deviation from the above data.		
SIGNATURE OF MANUFACTURER/SUPPLIER		**CONSULTANT'S REMARKS**

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FND	**EQUIPMENT DATA SHEET**	**REV** 0	**1902-23 07 13 - 1 / 1**
		PROJECT TITLE :	**CGMP PLANT UPGRADATION WORKS PHASE - II AT MARTIN DOW LIMITED**
	DUCT INSULATION SCHEDULE	**PROJECT NO. :**	**FND/1902**
		LOCATION :	**KARACHI**

DATA

IDENTIFICATION SYMBOL

SPECIFICATIONS REFERENCE **23 07 13**

FND CALC. REF. NO.:

	ID NO.	APPLICATION	INSULATION					
			MATERIAL	THICKNESS (mm)	THERMAL CONDUCTIVITY (BTU/hr ft² °F)	DENSITY (lb./Ft.³)	VAPOUR BARRIER	COATING / JACKET / CLADDING
		DUCT INSULATION						
1	I/D1	Supply Air Duct / Treated Fresh Air Duct - Air Conditioned Space / Air Conditioned Ceiling Cavity	XLPE (Polyolefin Thermal Insulation Foam) Cross Linked Closed Cell (With Self Adhesive coating) Class 'O' and FM Global Approved	20	0.02 @75°F	1.6-2.0	Foil Reinforced Kraft (FRK)	-
2	I/D2	Return Air Duct - Air Conditioned Space / Air Conditioned Ceiling Cavity	XLPE (Polyolefin Thermal Insulation Foam) Cross Linked Closed Cell (With Self Adhesive Coating) Class 'O' and FM Global Approved	12	0.02 @75°F	1.6-2.0	Foil Reinforced Kraft (FRK)	-
3	I/D3	Supply Air Duct / Treated Fresh Air Duct - Non Air Conditioned Space	XLPE (Polyolefin Thermal Insulation Foam) Cross Linked Closed Cell (With Self Adhesive Coating) Class 'O' and FM Global Approved	20	0.02 @75°F	1.6-2.0	Foil Reinforced Kraft (FRK)	-
4	I/D4	Return Air Duct- Non Air Conditioned Space	XLPE (Polyolefin Thermal Insulation Foam) Cross Linked Closed Cell (With Self Adhesive Coating) Class 'O' and FM Global Approved	12	0.02 @75°F	1.6-2.0	Foil Reinforced Kraft (FRK)	-
5	I/D5	Supply Air Duct / Treated Fresh Air Duct - Exposed to Atmosphere	XLPE (Polyolefin Thermal Insulation Foam) Cross Linked Closed Cell (With Self Adhesive Coating) Class 'O' and FM Global Approved	20	0.02 @75°F	1.6-2.0	Foil Reinforced Kraft (FRK)	Cladding G.I. 26 Gauge
6	I/D6	Fresh / Exhaust / Return Air Duct Exposed to Atmosphere	XLPE (Polyolefin Thermal Insulation Foam) Cross Linked Closed Cell (With Self Adhesive Coating) Class 'O' and FM Global Approved	12	0.02 @75°F	1.6-2.0	Foil Reinforced Kraft (FRK)	Cladding G.I. 26 Gauge

REVISION	**0**	
STATUS	**ISSUED FOR TENDER**	
DATE	**18/09/2025**	
CHECKED / SIGN.	**UMAR QURESHI**	

FND	EQUIPMENT DATA SHEET	SHEET 1 OF 1		DATA SHEET NO.
		REV 1		1606-23 07 19 - 1 / 1
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	PIPING INSULATION	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DATA								REV
1	IDENTIFICATION SYMBOL								
2	SPECIFICATIONS REFERENCE	**23 07 19**							
3	FND CALC. REF. NO.:								
4	**ID NO.**	**APPLICATION**	**INSULATION**						
			MATERIAL	**THICKNESS (mm)**	**THERMAL CONDUCTIVITY (BTU/hr. ft² °F)**	**DENSITY (lb./Ft.³)**	**VAPOUR BARRIER**	**COATING / JACKET / CLADDING**	
5		**CHILLED & HOT WATER PIPE INSULATION**							
6	I/P1	Piping in Protected Space & Ceiling Cavities	Closed Cell Foam-Class 0 (EPDM) (Fire Retardant)	19mm thk. (Upto ø4") 25mm thk. (Upto 10") 32mm thk. (> ø10")	0.26 @75°F	4.1 to 4.4	–	26 Guage G.I Sheet Cladding	
7	I/P2	Piping in Mechanical Room & Plant Room	Closed Cell Foam-Class 0 (EPDM) (Fire Retardant)	25mm thk. (Upto 10") 32mm thk. (>10")	0.26 @75°F	4.1 to 4.4	-	26 Guage G.I Sheet Cladding	
8	I/P3	Piping Exposed to Atmosphere / In Trench / Burried	Closed Cell Foam-Class 0 (EPDM) (Fire Retardant)	32mm thk. (Upto ø12")	0.26 @75°F	4.1 to 4.4	–	26 Guage G.I Sheet Cladding	
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	REVISION	0	1	
	STATUS	**ISSUED FOR TENDER**	**ISSUED FOR TENDER**	
	DATE	**19/05/2025**	**12/09/2025**	
	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

THE INFORMATION ON THIS DATA SHEET IS CONFIDENTIAL TO FAHIM, NANJI & DESOUZA (PVT.) LTD.
AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

DWG. NO. 01	HVAC CONTROLS LIST OF DRAWING

DWG. NO.	DESCRIPTION
01	HVAC CONTROLS LIST OF DRAWING
02	HVAC CONTROLS LEGENDS & SYMBOLS
03	CONTROL SCHEMATIC FOR CENTRIFUGAL CHILLERS
04	CONTROL SCHEMATIC FOR DIRECT FIRED ABSORPTION CHILLER
05	CONTROL SCHEMATIC FOR COOLING TOWER FANS
06	CONTROL SCHEMATIC FOR PRIMARY CHILLED WATER & CONDENSER WATER PUMPS
07	CONTROL SCHEMATIC FOR VARIABLE SPEED PUMPS (SECONDARY CHILLED WATER PUMPS)
08	CONTROL SCHEMATIC FOR CHILLED WATER CIRCUIT
09	CONTROL SCHEMATIC FOR CONDENSER WATER CIRCUIT
10	CONTROL SCHEMATIC FOR CHILLED WATER ENERGY METERING
11	CONTROL SCHEMATIC FOR AIR HANDLING UNIT FOR CONSTANT AIR VOLUME (CAV)
12	CONTROL SCHEMATIC FOR AIR HANDLING UNIT FOR CONSTANT AIR VOLUME (CAV)
13	CONTROL SCHEMATIC FOR AIR HANDLING UNIT FOR CONSTANT AIR VOLUME (CAV)
14	DATA FOR FCU/AHU COILS
15	CONTROL SCHEMATIC FOR DUCTED FAN COIL UNIT (TYPICAL)
16	CONTROL SCHEMATIC FOR CONSTANT SPEED FAN FOR PLANT ROOM (WITH FILTERS)
17	CONTROL SCHEMATIC FOR CONSTANT SPEED FAN (WITH FILTERS)
18	CONTROL SCHEMATIC FOR CONSTANT SPEED FAN (WITHOUT FILTERS)

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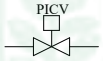
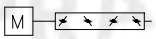
DWG. NO. 02	HVAC CONTROLS LEGENDS & SYMBOLS

SYMBOL	LEGEND	SYMBOL	LEGEND
T	TEMPERATURE SENSOR		FAN/PUMP
H	RELATIVE HUMIDITY SENSOR	FST	FIRE STAT
P	PRESSURE TRANSMITTER SENSOR	DP	DIFFERENTIAL PRESSURE SWITCH
FT	FLOW TRANSMITTER		MOTORIZED BUTTERFLY VALVE
FM	FLOW METER		PRESSURE INDEPENDENT CONTROL VALVE
START/STOP	START/STOP OF EQUIPMENT	VFD	VARIABLE FREQUENCY DRIVE
CO_2	CARBON DIOXIDE SENSOR	PRS	PRESSURE SWITCH
CON	CONTROLLER	NC	NORMALLY CLOSED
EM	ENERGY METER	NO	NORMALLY OPEN
FS	FLOW SWITCH	NIC	NOT IN CONTRACT
H	HIGH LEVEL		MOTORIZED DAMPER
HH	HIGH HIGH LEVEL	US	ULTRASONIC LEVEL SENSOR
L	LOW LEVEL	S	SOLENOID VALVE
LL	LOW LOW LEVEL		

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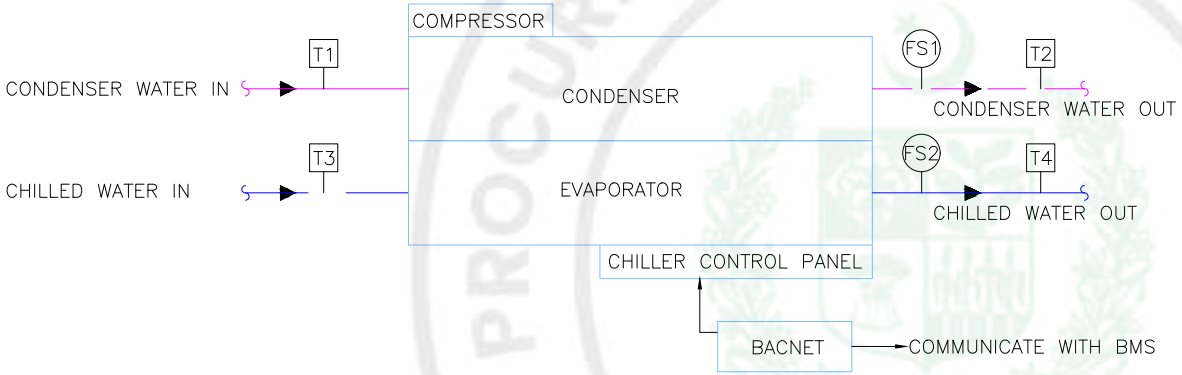
DWG. NO. 03	CONTROL SCHEMATIC FOR CENTRIFUGAL CHILLERS



NOTES:

1. OUT SIDE AIR T H MONITORED AT A SINGLE LOCATION FOR THE ENTIRE BUILDING & TRANSMITTED TO ALL CONTROLLERS VIA BMS.

QUANTITY = 04 NOS. (01 FUTURE)

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
START/STOP	CHILLER CONTROL PANEL	PLANT ROOM				04	CHILLER SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE, CHILLER SHALL START AUTOMATICALLY. BMS SHALL COMMUNICATE WITH CHILLER MICRO PROCESSOR ON BACNET.
FS1	FLOW SWITCH	COND.WATER OUT		04			INDICATES FLOW ESTABLISHED. ALARMS, IF PUMPS ARE OPERATING AND FLOW IS NOT ESTABLISHED.
FS2	FLOW SWITCH	CHW OUT		04			INDICATES FLOW ESTABLISHED. ALARMS, IF PUMPS ARE OPERATING AND FLOW IS NOT ESTABLISHED.
T1	TEMPERATURE SENSOR	COND.WATER IN	04				FOR MONITORING PURPOSE
T2	TEMPERATURE SENSOR	COND.WATER OUT	04				FOR MONITORING PURPOSE
T3	TEMPERATURE SENSOR	CHW IN	04				FOR MONITORING PURPOSE
T4	TEMPERATURE SENSOR	CHW OUT	04				FOR MONITORING PURPOSE

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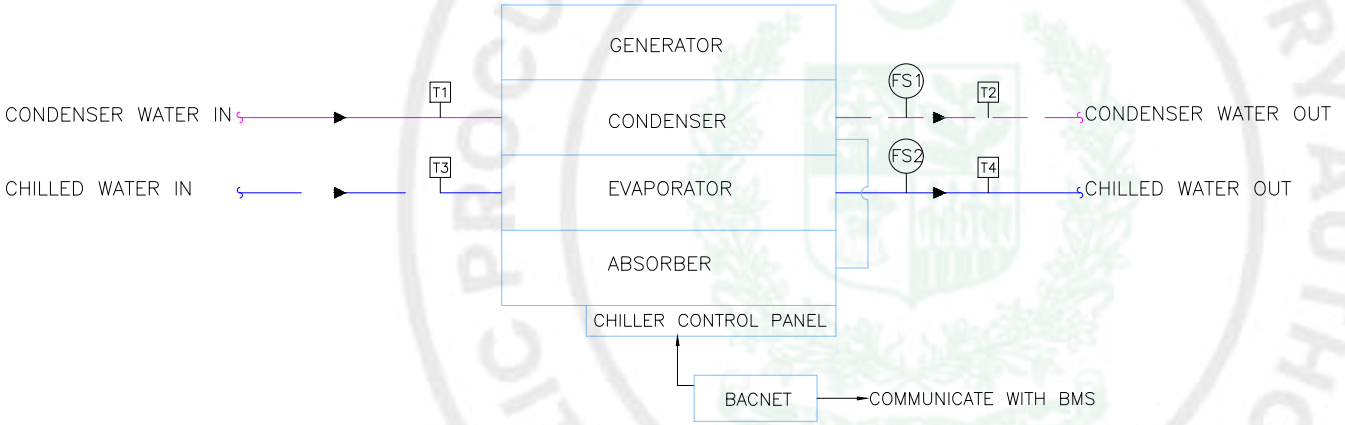
DWG. NO. 04	CONTROL SCHEMATIC FOR DIRECT FIRED ABSORPTION CHILLER



QUANTITY = 01 NO.

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
START/STOP	START/STOP OF CHILLER	PLANT ROOM				01	CHILLER SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE CHILLER SHALL START AUTOMATICALLY. BMS SHALL COMMUNICATE WITH CHILLER MICRO PROCESSOR ON BACNET.
FS1	FLOW SWITCH	COND.WATER OUT		01			INDICATES FLOW ESTABLISHED. ALARMS, IF PUMPS ARE OPERATING AND FLOW IS NOT ESTABLISHED.
FS2	FLOW SWITCH	CHW OUT		01			INDICATES FLOW ESTABLISHED. ALARMS, IF PUMPS ARE OPERATING AND FLOW IS NOT ESTABLISHED.
T1	TEMPERATURE SENSOR	COND.WATER IN	01				FOR MONITORING PURPOSE
T2	TEMPERATURE SENSOR	COND.WATER OUT	01				FOR MONITORING PURPOSE
T3	TEMPERATURE SENSOR	CHW IN	01				FOR MONITORING PURPOSE
T4	TEMPERATURE SENSOR	CHW OUT	01				FOR MONITORING PURPOSE

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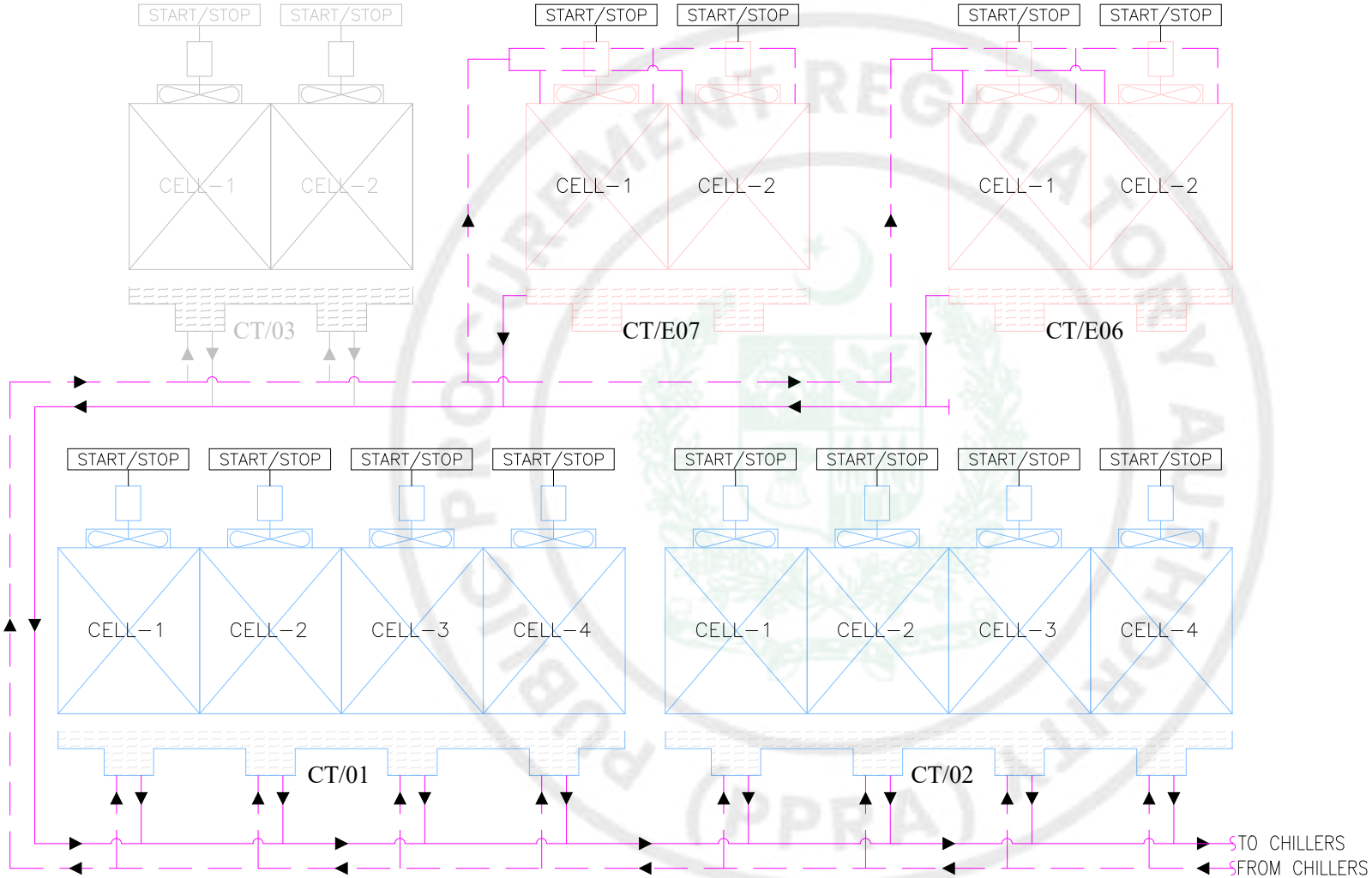
DWG. NO. 05	CONTROL SCHEMATIC FOR COOLING TOWER FANS



NOTES:

1. COOLING TOWER CONTROLS CAN BE COVERED IN PLANT ROOM CONTROLLERS.

QUANTITY = 05 SETS. (CT/03 IS FUTURE)

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
START/STOP	START/STOP COOLING TOWER FAN	PLANT ROOM		12		12	COOLING TOWER SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE, COOLING TOWER SHALL START AUTOMATICALLY. STARTER TO PROVIDE COOLING TOWER FAN ON/OFF STATUS TO BMS

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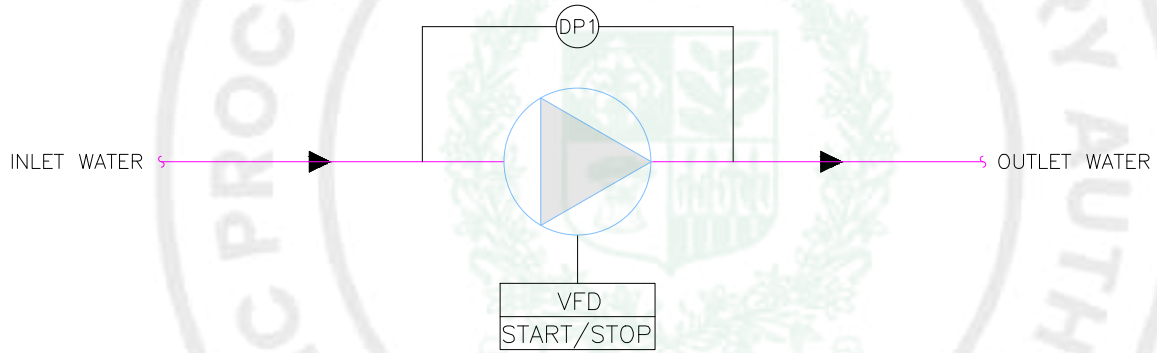
DWG. NO. 06	CONTROL SCHEMATIC FOR PRIMARY CHILLED WATER & CONDENSER WATER PUMPS



QUANTITY = 06 NOS. PRIMARY CHILLED WATER PUMPS FOR EOWC CENTRIFUGAL CHILLER (TWO STAND BY & ONE FUTURE)
06 NOS. CONDENSER WATER PUMPS (TWO STAND BY, ONE FUTURE)
02 NOS. PRIMARY CHILLED WATER PUMPS FOR ABSORPTION CHILLERS (ONE STAND BY)
02 NOS. CONDENSER WATER PUMPS FOR ABSORPTION CHILLER (ONE STAND BY)

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
VFD START/STOP	START/STOP OF PUMP	PLANT ROOM		16		16	PUMP SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE PUMP SHALL START AUTOMATICALLY.
DP1	DIFFERENTIAL PRESSURE SWITCH (WATER APPLICATION)	ACROSS PUMP		16			TO STOP THE PUMP AND GIVE ALARM, IF PUMP FAILS TO OPERATE.

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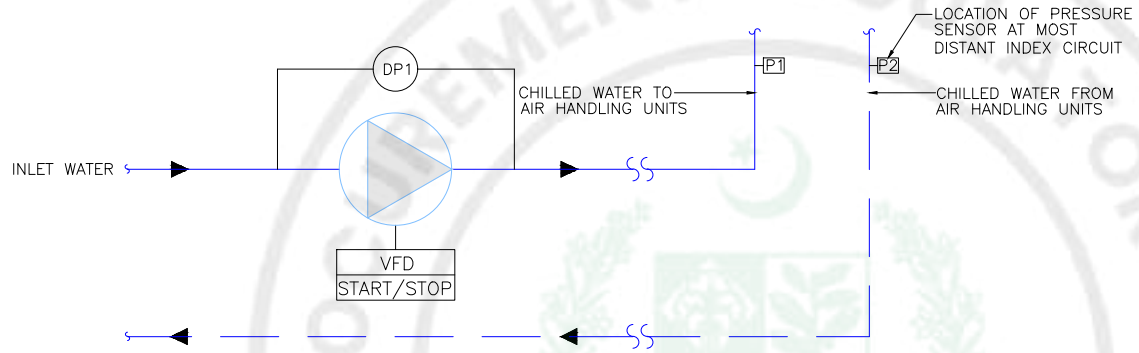
DWG. NO. 07	CONTROL SCHEMATIC FOR VARIABLE SPEED PUMPS (SECONDARY CHILLED WATER PUMPS)



NOTES:

1. SENSOR P1 SHALL BE INSTALLED AT FARTHEST AHU ON LATER STAGE WHEN AIR SIDE EQUIPMENT WILL BE PROCURED
2. A SEPERATE CONTROLLER SHOULD BE CONSIDERED FOR PRESSURE SENSORS

SECONDARY CHILLED WATER PUMPS : QTY = 02 NOS.(ONE STANDBY)

SECONDARY CHILLED WATER PUMPS (FOR FACTORY BLOCK) : QTY = 04 NOS.(ONE STANDBY)

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
VFD START/STOP	START/STOP OF PUMP	PLANT ROOM				06	PUMP SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE, PUMP SHALL START AUTOMATICALLY.
P1 & P2	DIFFERENTIAL PRESSURE SENSOR	ON CHILLED WATER SUPPLY & RETURN LINE AT INDEX CIRCUIT	02				PRESSURE SENSOR TO CALCULATE DIFFERENTIAL PRESSURE SET POINT. SHALL OPERATE VFD TO MAINTAIN A CONSTANT DIFFERENTIAL PRESSURE.
VFD	VARIABLE FREQUENCY DRIVE	PLANT ROOM	06		06		MODULATE PUMP SPEED TO MAINTAIN CONSTANT DIFFERENTIAL PRESSURE IN THE SECONDARY CHILLED WATER LINE.VFD TO COMMUNICATE WITH BMS.
DP1	DIFFERENTIAL PRESSURE SWITCH (WATER APPLICATION)	ACROSS PUMP		06			TO STOP THE PUMP & GIVE ALARM, IF PUMP FAILS TO OPERATE.

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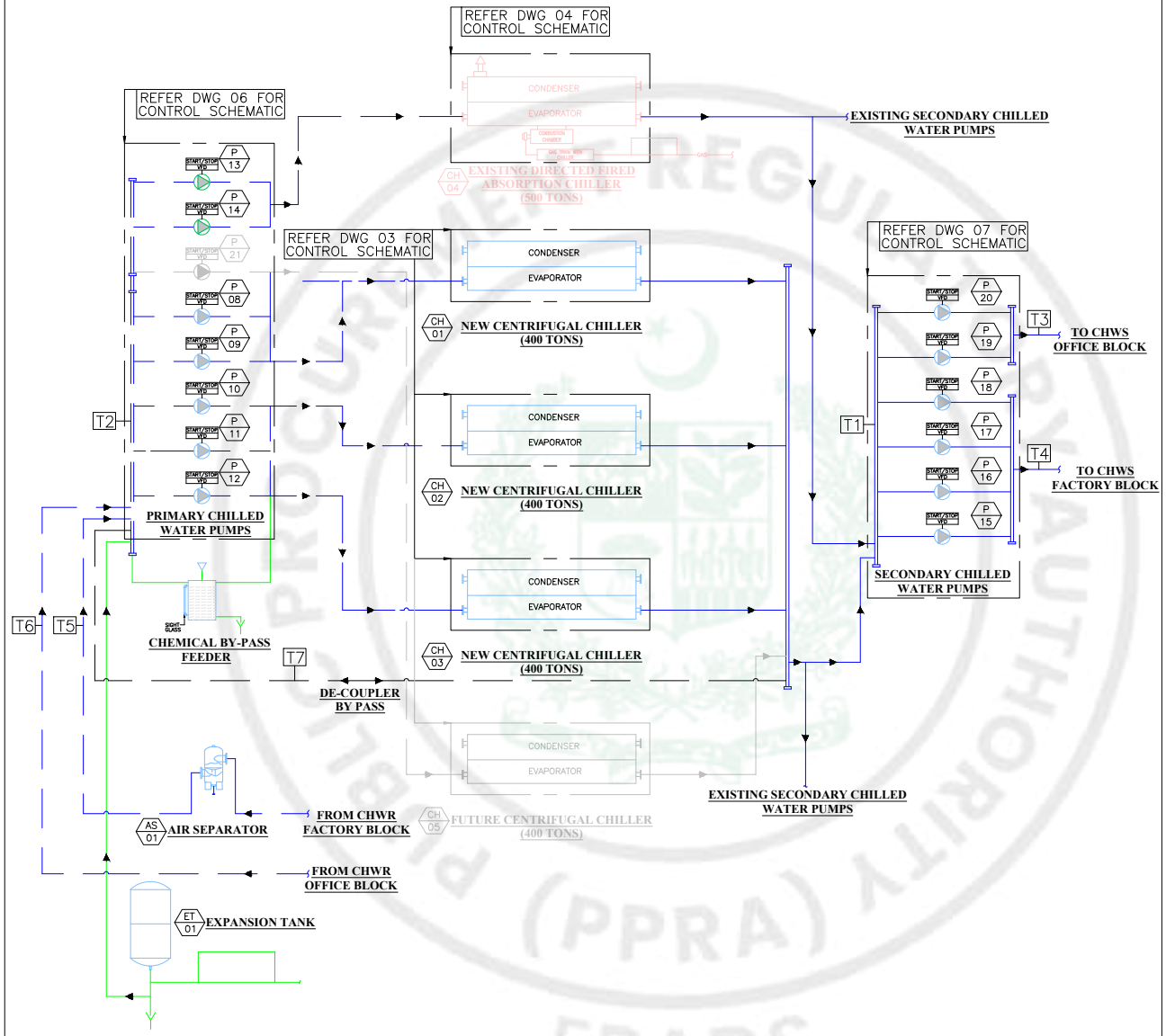
DWG. NO. 08	CONTROL SCHEMATIC FOR CHILLED WATER CIRCUIT



QUANTITY = 1 SET.

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
T1	TEMPERATURE SENSOR	CHILLED WATER SECONDARY HEADER	01				FOR MONITORING PURPOSE
T2	TEMPERATURE SENSOR	CHILLED WATER PRIMARY HEADER	01				FOR MONITORING PURPOSE
T3	TEMPERATURE SENSOR	CHILLED WATER SUPPLY TO OFFICE BLOCK	01				FOR MONITORING PURPOSE
T4	TEMPERATURE SENSOR	CHILLED WATER SUPPLY TO FACTORY BLOCK	01				FOR MONITORING PURPOSE
T5	TEMPERATURE SENSOR	CHILLED WATER RETURN FROM FACTORY BLOCK	01				FOR MONITORING PURPOSE
T6	TEMPERATURE SENSOR	CHILLED WATER RETURN FROM OFFICE BLOCK	01				FOR MONITORING PURPOSE
T7	TEMPERATURE SENSOR	DE-COUPLER BY PASS	01				FOR MONITORING PURPOSE
EA	ENERGY ANALYZER	IN MCC		01			ENERGY ANALYZER WILL PROVIDE ELECTRICAL ENERGY CONSUMPTION OF MECHANICAL EQUIPMENT. ELECTRICITY METER SHALL BE COMPATIABLE TO COMMUNICATE INTO BMS ON BACNET/LON WORKS.

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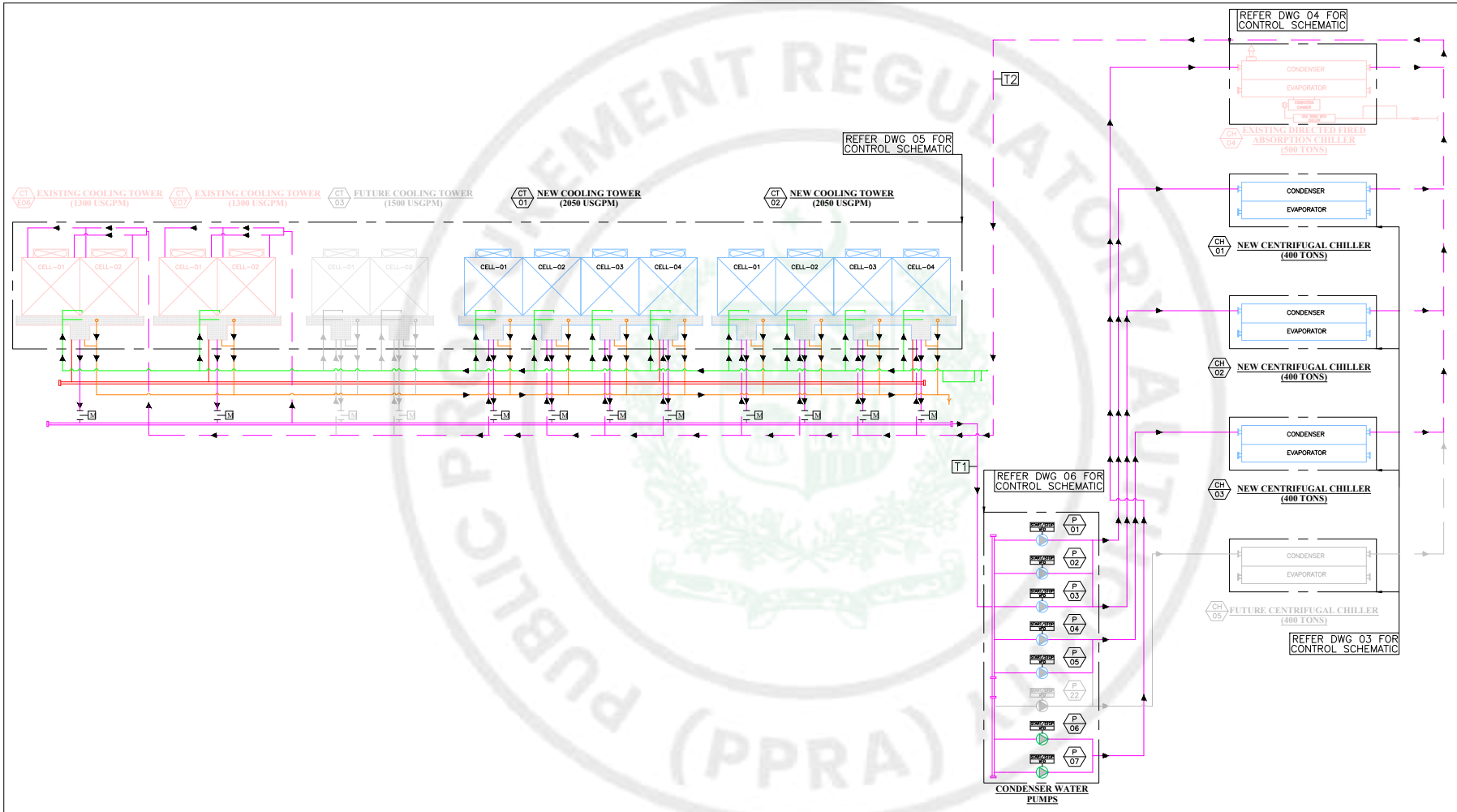
DWG. NO. 09	CONTROL SCHEMATIC FOR CONDENSER WATER CIRCUIT



QUANTITY = 1 SET.

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
T1	TEMPERATURE SENSOR	COOLING TOWER OUT TEMPERATURE	01				FOR MONITORING PURPOSE
T2	TEMPERATURE SENSOR	COOLING TOWER IN TEMPERATURE	01				FOR MONITORING PURPOSE

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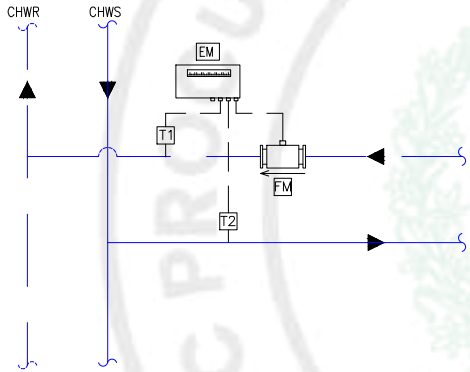
DWG. NO. 10	CONTROL SCHEMATIC FOR CHILLED WATER ENERGY METERING

NOTES:

1. ENERGY METER SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS ON BACNET/LONWORKS /M-BUS WITHOUT ANY NEED OF GATE WAY OR ANY OTHER INTERMEDIATE DEVICE NEEDED FOR COMMUNICATION.



DATA FOR ENERGY METER (EM)

LOCATION	QTY OF EM	CHILLED WATER USGPM	PIPE SIZE (mm)
OFFICE BLOCK	1	240	ø100
FACTORY BLOCK	1	4083	ø450

QUANTITY = 02 SETS.

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
T1	TEMPERATURE SENSOR-MATCHED & ACCURATE	CHW-R	02				TEMPERATURE DATA TO ENERGY METER
T2	TEMPERATURE SENSOR-MATCHED & ACCURATE	CHW-S	02				TEMPERATURE DATA TO ENERGY METER
FM	FLOW METER (WATER)	CHW-R	02				CHILLED WATER FLOW RATE DATA TO ENERGY METER
EM	ENERGY METER	PLANT ROOM			02		METER ENERGY CONSUMPTION AND TRANSFER DATA TO BMS.

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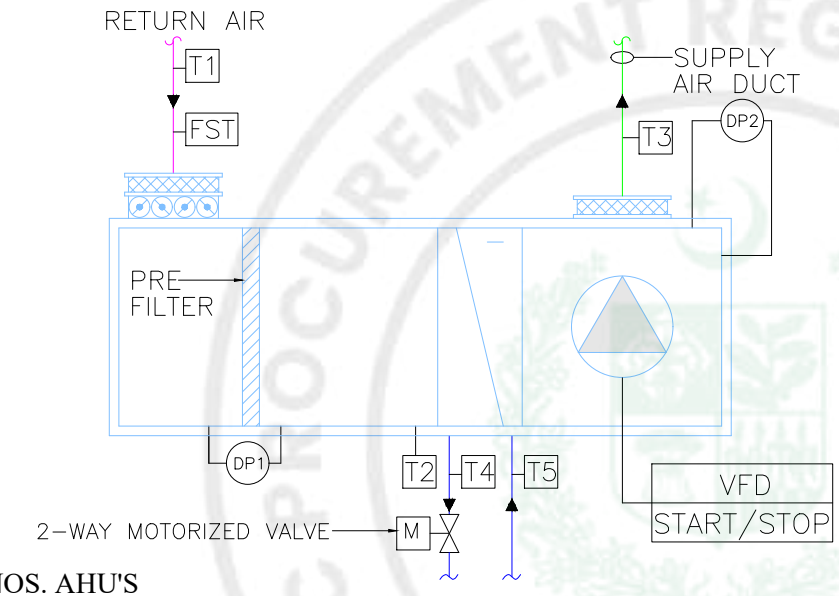
DWG. NO. 11	CONTROL SCHEMATIC FOR AIR HANDLING UNIT FOR CONSTANT AIR VOLUME (CAV)



NOTES:

1. THIS DATA SHEETS COVERS THE FOLLOWING AHUS.

a) AHU/BF-02
b) AHU/GF-07B
c) AHU/GF-09

QUANTITY = 03 NOS. AHU'S

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
VFD/START/STOP	FAN START/STOP	AHU MCC				03	AHU SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE AHU SHALL START AUTOMATICALLY.
T1	TEMPERATURE SENSOR	RETURN AIR DUCT	03				TO OPERATE V1 IN MODULATING MODE. TO CONTROL AIR TEMPERATURE AT T1.
T2	TEMPERATURE SENSOR	COIL INLET (AIR SIDE)	03				FOR MONITORING PURPOSE.
T3	TEMPERATURE SENSOR	SUPPLY AIR DUCT	03				FOR MONITORING PURPOSE.
T4	TEMPERATURE SENSOR	CHW-RETURN PIPE	03				FOR MONITORING PURPOSE.
T5	TEMPERATURE SENSOR	CHW-SUPPLY PIPE	03				FOR MONITORING PURPOSE.
M	2-WAY MOTORIZED CONTROL VALVE	CHW-RETURN PIPE			03		SHALL BE MODULATED TO MAINTAIN CONSTANT SET POINT AT T1
DP1	DIFFERENTIAL PRESSURE SWITCH	ACROSS PRE-FILTER		03			INDICATE DIRTY FILTER-ALARM
DP2	DIFFERENTIAL PRESSURE SWITCH	ACROSS FAN		03			TO STOP THE FAN & GIVE ALARM, IF FAN FAILS TO OPERATE.
FST	FIRE STAT	ON RA DUCT				03	STOP THE AHU FAN IN CASE OF FIRE
–	SMOKE DETECTOR SIGNAL	FIRE ALARM PANEL	03				SWITCH OFF AHU IN CASE OF FIRE.

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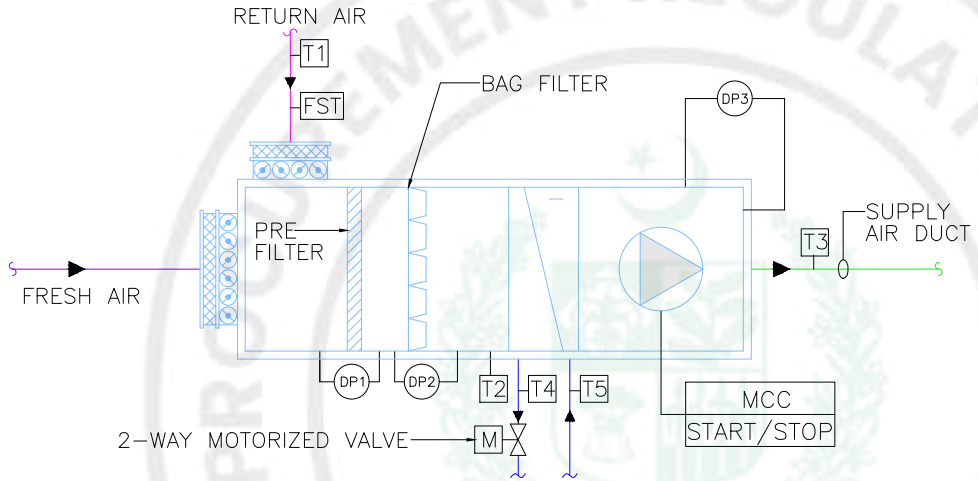
DWG. NO. 12	CONTROL SCHEMATIC FOR AIR HANDLING UNIT FOR CONSTANT AIR VOLUME (CAV)



NOTES:

1. THIS DATA SHEETS COVERS ALL CEILING HUNG AND HORIZONTAL AHU'S

a) AHU/GF-03
b) AHU/GF-08
c) AHU/GF-11
d) AHU/GF-14
e) AHU/BF-03
f) AHU/GF-10
g) AHU/OF-BF-01
h) AHU/OF-GF-01
i) AHU/OF-1F-01
j) AHU/OF-2F-01
k) AHU/OF-3F-01
l) AHU/OF-4F-01

QUANTITY = 12 NOS. HORIZONTAL AHU'S (CAV)

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
MCC/START/STOP	FAN START/STOP	AHU MCC				12	AHU SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE AHU SHALL START AUTOMATICALLY.
T1	TEMPERATURE SENSOR	RETURN AIR DUCT	12				TO OPERATE V1 IN MODULATING MODE.
T2	TEMPERATURE SENSOR	COIL INLET (AIR SIDE)	12				FOR MONITORING PURPOSE.
T3	TEMPERATURE SENSOR	SUPPLY AIR DUCT	12				FOR MONITORING PURPOSE.
T4	TEMPERATURE SENSOR	CHW-RETURN PIPE	12				FOR MONITORING PURPOSE.
T5	TEMPERATURE SENSOR	CHW-SUPPLY PIPE	12				FOR MONITORING PURPOSE.
M	2-WAY MOTORIZED CONTROL VALVE	CHW-RETURN PIPE			12		SHALL BE MODULATED TO MAINTAIN CONSTANT SET POINT AT T1
DP1	DIFFERENTIAL PRESSURE SWITCH	ACROSS PRE-FILTER		12			INDICATE DIRTY FILTER-ALARM
DP2	DIFFERENTIAL PRESSURE SWITCH	ACROSS BAG FILTER		12			INDICATE DIRTY FILTER-ALARM
DP3	DIFFERENTIAL PRESSURE SWITCH	ACROSS FAN		12			TO STOP THE FAN & GIVE ALARM, IF FAN FAILS TO OPERATE.
FST	FIRE STAT	ON RA DUCT				12	STOP THE AHU FAN IN CASE OF FIRE
–	SMOKE DETECTOR SIGNAL	FIRE ALARM PANEL	12				SWITCH OFF AHU IN CASE OF FIRE.

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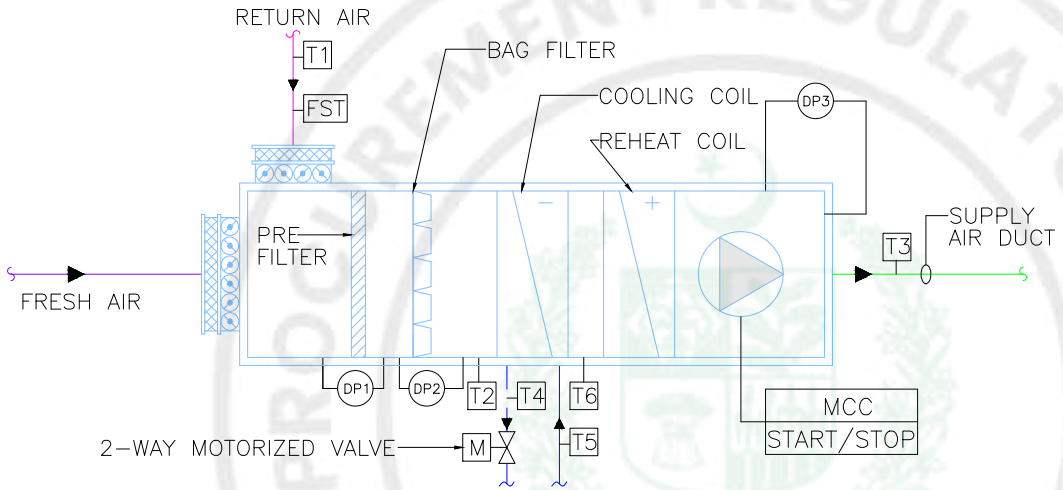
DWG. NO. 13	CONTROL SCHEMATIC FOR AIR HANDLING UNIT FOR CONSTANT AIR VOLUME (CAV)



NOTES:

1. THIS DATA SHEETS COVERS ALL CEILING HUNG AND HORIZONTAL AHU'S

a) AHU/BF-01
b) AHU/GF-01 (2 QTY)
c) AHU/GF-02 (6 QTY)
d) AHU/GF-04
e) AHU/GF-05 (2 QTY)
f) AHU/GF-06 (3 QTY)
g) AHU/GF-07A
h) AHU/GF-07
i) AHU/GF-08A
j) AHU/GF-11A
k) AHU/GF-12
l) AHU/GF-13

QUANTITY = 21 NOS. HORIZONTAL AHU'S (CAV)

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
MCC/START/STOP	FAN START/STOP	AHU MCC				21	AHU SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE AHU SHALL START AUTOMATICALLY.
T1	TEMPERATURE SENSOR	RETURN AIR DUCT	21				TO OPERATE V1 IN MODULATING MODE.
T2	TEMPERATURE SENSOR	COOLING COIL INLET (AIRSIDE)	21				FOR MONITORING PURPOSE.
T3	TEMPERATURE SENSOR	SUPPLY AIR DUCT	21				FOR MONITORING PURPOSE.
T4	TEMPERATURE SENSOR	CHW-RETURN PIPE	21				FOR MONITORING PURPOSE.
T5	TEMPERATURE SENSOR	CHW-SUPPLY PIPE	21				FOR MONITORING PURPOSE.
T6	TEMPERATURE SENSOR	REHEAT COIL INLET (AIRSIDE)	21				FOR MONITORING PURPOSE.
M	2-WAY MOTORIZED CONTROL VALVE	CHW-RETURN PIPE			21		SHALL BE MODULATED TO MAINTAIN CONSTANT SET POINT AT T1
DP1	DIFFERENTIAL PRESSURE SWITCH	ACROSS PRE-FILTER		21			INDICATE DIRTY FILTER-ALARM
DP2	DIFFERENTIAL PRESSURE SWITCH	ACROSS BAG FILTER		21			INDICATE DIRTY FILTER-ALARM
DP3	DIFFERENTIAL PRESSURE SWITCH	ACROSS FAN		21			TO STOP THE FAN & GIVE ALARM, IF FAN FAILS TO OPERATE.
FST	FIRE STAT	ON RA DUCT				21	STOP THE AHU FAN IN CASE OF FIRE
-	SMOKE DETECTOR SIGNAL	FIRE ALARM PANEL	21				SWITCH OFF AHU IN CASE OF FIRE.

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DWG. NO. 14	DATA FOR FCU/AHU COILS

	IDENTIFICATION SYMBOL	DESCRIPTION	QTY	CHILLED WATER FLOW RATE (USGPM)	HOT WATER FLOW RATE (USGPM)	LINE SIZE (Ø) (mm)	MINIMUM DESIGN PRESSURE FOR VALVE(PSIG)
1	**AHU /BF-01**	**BASEMENT**	**01**	**68.0**	**-**	**Ø65**	**150**
2	**AHU / BF-02**	**BASEMENT**	**01**	**94.0**	**-**	**Ø75**	**150**
3	**AHU / BF-03**	**BASEMENT**	**01**	**11.0**	**-**	**Ø32**	**150**
4	**AHU / GF-01**	**GROUND FLOOR**	**02**	**77.0**	**-**	**Ø75**	**150**
5	**AHU / GF-02**	**GROUND FLOOR**	**06**	**104.0**	**-**	**Ø75**	**150**
6	**AHU / GF-03**	**GROUND FLOOR**	**01**	**123.0**	**-**	**Ø75**	**150**
7	**AHU / GF-04**	**GROUND FLOOR**	**01**	**63.0**	**-**	**Ø65**	**150**
8	**AHU / GF-05**	**GROUND FLOOR**	**02**	**83.0**	**-**	**Ø75**	**150**
9	**AHU / GF-06**	**GROUND FLOOR**	**03**	**131.0**	**-**	**Ø75**	**150**
10	**AHU / GF-07A**	**GROUND FLOOR**	**01**	**65.0**	**-**	**Ø65**	**150**
11	**AHU / GF-07B**	**GROUND FLOOR**	**01**	**22.0**	**-**	**Ø40**	**150**
12	**AHU / GF-07**	**GROUND FLOOR**	**01**	**221.0**	**-**	**Ø100**	**150**
13	**AHU / GF-08A**	**GROUND FLOOR**	**01**	**75.0**	**-**	**Ø75**	**150**
14	**AHU / GF-08**	**GROUND FLOOR**	**01**	**60.0**	**-**	**Ø65**	**150**
15	**AHU / GF-09**	**GROUND FLOOR**	**01**	**15.0**	**-**	**Ø32**	**150**
16	**AHU / GF-10**	**GROUND FLOOR**	**01**	**28.0**	**-**	**Ø50**	**150**
17	**AHU / GF-11A**	**GROUND FLOOR**	**01**	**43.0**	**-**	**Ø50**	**150**
18	**AHU / GF-11**	**GROUND FLOOR**	**01**	**48.0**	**-**	**Ø65**	**150**
19	**AHU / GF-12**	**GROUND FLOOR**	**01**	**117.0**	**-**	**Ø75**	**150**
20	**AHU / GF-13**	**GROUND FLOOR**	**01**	**122.0**	**-**	**Ø75**	**150**
21	**AHU / GF-14**	**GROUND FLOOR**	**01**	**281.0**	**-**	**Ø125**	**150**
22	**AHU / OF-BF-01**	**BASEMENT**	**01**	**25.0**	**-**	**Ø50**	**150**
23	**AHU / OF-GF-01**	**GROUND FLOOR**	**01**	**35.0**	**-**	**Ø50**	**150**
24	**AHU / OF-1F-01**	**FIRST FLOOR**	**01**	**35.0**	**-**	**Ø50**	**150**
25	**AHU / OF-2F-01**	**SECOND FLOOR**	**01**	**35.0**	**-**	**Ø50**	**150**
26	**AHU / OF-3F-01**	**THIRD FLOOR**	**01**	**35.0**	**-**	**Ø50**	**150**
27	**AHU / OF-4F-01**	**FOURTH FLOOR**	**01**	**38.0**	**-**	**Ø50**	**150**

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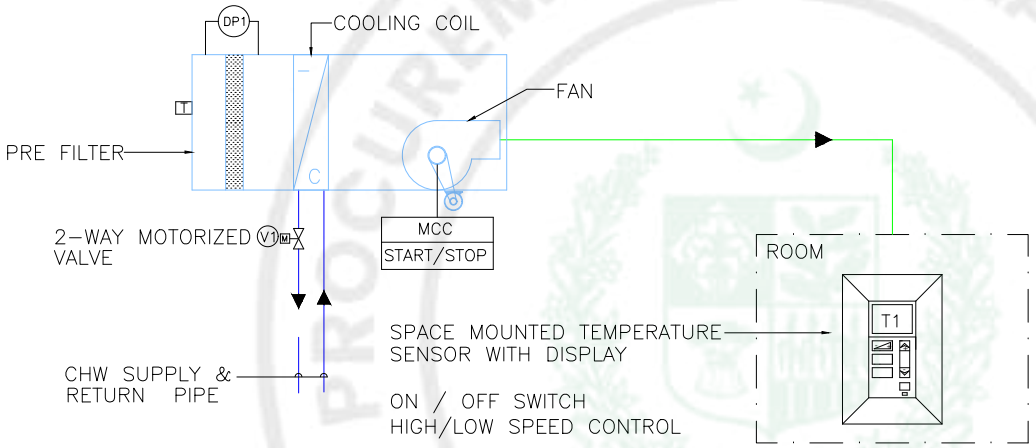
DWG. NO. 15	CONTROL SCHEMATIC FOR DUCTED FAN COIL UNIT (TYPICAL)



NOTES:

1. FOLLOWING FCU'S ARE COVERED IN THIS CONTROL SCHEMATIC.

a) FCU/01-04

QUANTITY = 04 Nos.

ITEM NO.	ITEM DESCRIPTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
START/STOP	OPERATION OF FCU	ROOM THERMOSTAT			04	04	FCU SHALL BE OPERATED AS PER OCCUPANCY COMMAND THROUGH WALL MOUNTED FCU CONTROLLER. ON RESTORATION OF POWER OUTAGE FCU SHALL START AUTOMATICALLY. TEMPERATURE TO BE DISPLAYED FOR MONITORING & CONTROLLING PURPOSES.
T	FCU CONTROLLER	ROOM	04				TEMPERATURE TO BE DISPLAYED FOR MONITORING AND CONTROLLING PURPOSES.
VI	TWO WAY MODULATING MOTORIZED VALVE	CHW RETURN LINE OF EACH FCU	04				SHALL BE MODULATED TO MAINTAIN CONSTANT SET POINT AT T. NO FLOW THRU VI IN CASE OF FCU STOPPAGE.
DP1	DIFFERENTIAL PRESSURE SWITCH	ACROSS FILTER		04			INDICATE DIRTY FILTER

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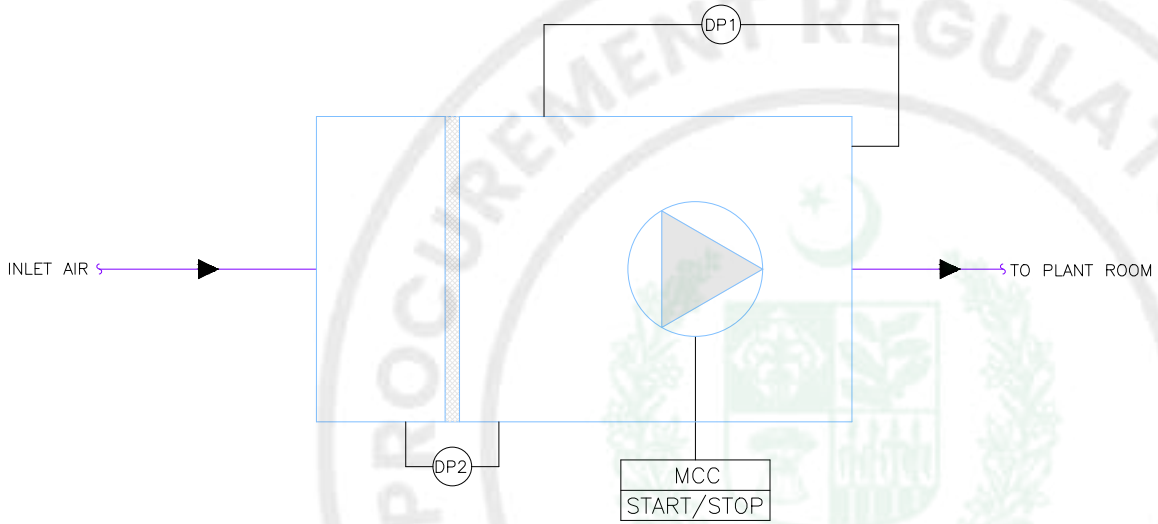
DWG. NO. 16	CONTROL SCHEMATIC FOR CONSTANT SPEED FAN FOR PLANT ROOM (WITH FILTERS)



NOTES

1. FOLLOWING FAN IS COVERED IN THIS CONTROL SCHEMATIC.

a) FN/PR-01

QUANTITY = 01 NO.

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
START/STOP	FAN START/STOP	MCC				01	FAN SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE FAN SHALL START AUTOMATICALLY.
DP1	DIFFERENTIAL PRESSURE SWITCH	ACROSS FAN		01			GIVE ALARM, IF FAN IS NOT OPERATIVE.
DP2	DIFFERENTIAL PRESSURE SWITCH	ACROSS PRE-FILTER		01			INDICATE DIRTY FILTER ALARM

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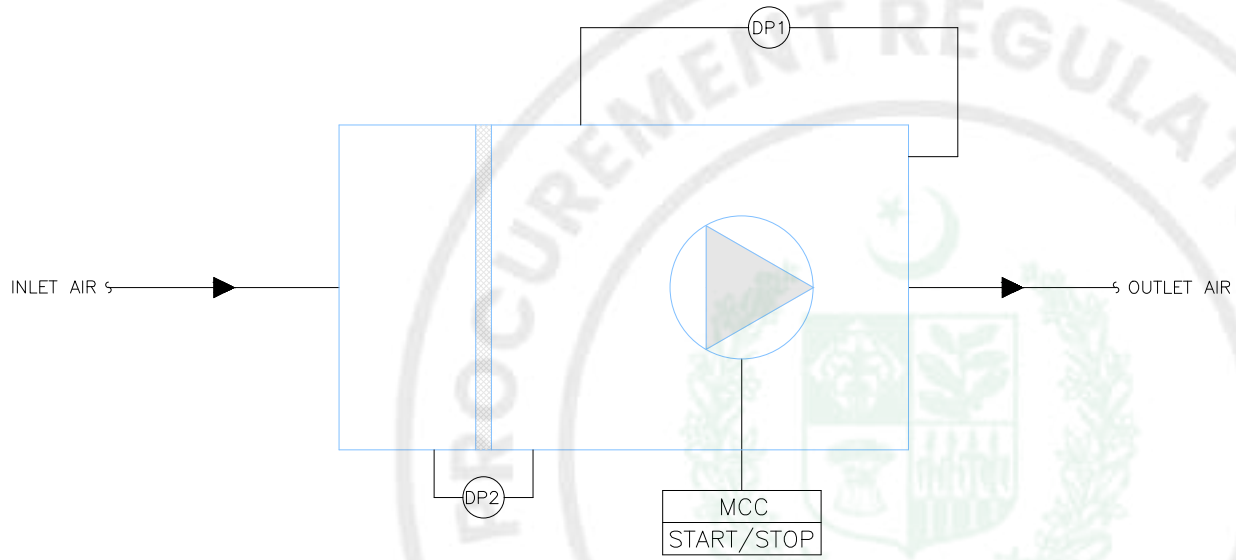
DWG. NO. 17	CONTROL SCHEMATIC FOR CONSTANT SPEED FAN (WITH FILTERS)



NOTES

1. FOLLOWING FAN IS COVERED IN THIS CONTROL SCHEMATIC.

a) FN/FA–01
b) FN/FA–02
c) FN/FA–03

QUANTITY = 03 NOS.

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
START/STOP	FAN START/STOP	MCC				03	FAN SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE FAN SHALL START AUTOMATICALLY.
DP1	DIFFERENTIAL PRESSURE SWITCH	ACROSS FAN		03			GIVE ALARM, IF FAN IS NOT OPERATIVE.
DP2	DIFFERENTIAL PRESSURE SWITCH	ACROSS PRE–FILTER		03			INDICATE DIRTY FILTER ALARM
–	SMOKE DETECTOR SIGNAL (BY OTHER)	FIRE ALARM PANEL	03				SWITCH OFF FAN IN CASE OF FIRE.

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DWG. NO. 18	CONTROL SCHEMATIC FOR CONSTANT SPEED FAN (WITHOUT FILTERS)

NOTES

1. DPS I/O MODULE TO BE COVERED IN NEAREST AHU CONTROLLER

a) FN/EF-01
b) FN/EF-02
c) FN/EF-03
d) FN/EF-04
e) FN/EF-05
f) FN/EF-06
g) FN/EF-07
h) FN/EF-08
i) FN/EF-09
J) FN/EF-11
k) FN/EF-12
l) FN/EF-14
m) FN/EF-15
n) FN/EF-16
o) FN/EF-17
p) FN/EF-18
q) FN/EF-19
r) FN/EF-20
s) FN/EF-21
t) FN/EF-22
u) FN/EF-23
v) FN/RE-BF-01
w) FN/RE-BF-02
x) FN/RE-BF-03
y) FN/RE-GF-01
z) FN/RE-GF-02
aa) FN/RE-GF-04
bb) FN/RE-GF-05
cc) FN/RE-GF-07b
dd) FN/RE-GF-07
ee) FN/RE-GF-08a
ff) FN/RE-GF-09
gg) FN/RE-GF-10
hh) FN/RE-GF-11a
ii) FN/RE-GF-12
jj) FN/RE-GF-13

QUANTITY = 36 NOS.

ITEM NO.	DESCRIPTION OF FIELD DEVICES/FUNCTION	LOCATION	AI	DI	AO	DO	CONTROL LOGIC
START/STOP	FAN START/STOP	MCC				36	FAN SHALL BE OPERATED BY USER DEFINED SCHEDULE ON BMS. ON RESTORATION OF POWER OUTAGE AHU SHALL START AUTOMATICALLY.
DP1	DIFFERENTIAL PRESSURE SWITCH	ACROSS FAN		36			GIVE ALARM, IF FAN IS NOT OPERATIVE.
–	SMOKE DETECTOR SIGNAL (BY OTHER)	FIRE ALARM PANEL	36				SWITCH OFF FAN IN CASE OF FIRE.

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FND	**EQUIPMENT DATA SHEET** **HYDRONIC PIPING & SPECIALITIES**	**SHEET** 1 **OF** 1 **REV** 1	**DATA SHEET NO.** **1606-22 11 16 / 23 21 13 - 1 / 1**
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**
		PROJECT NO. :	**FND/1606**
		LOCATION :	**KARACHI**

	DATA					REV
1	SPECIFICATIONS REFERENCE	**22 11 16 / 23 21 13**				
2	FND CALC. REF. NO.:					
3	**FND ID NO.:**	**APPLICATION**	**PIPING MATERIAL**	**STANDARD**	**REMARKS**	
4	I/P1	Chilled & Hot Water Piping	Seamless Black Steel, Schedule 40	ASTM A53 Grade-B or A120 Grade-B	Section 23 21 13	
5–52						

	REVISION	0	1	
	STATUS	**ISSUED FOR TENDER**	**ISSUED FOR TENDER**	
	DATE	**19/05/2025**	**12/09/2025**	
	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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FND	**EQUIPMENT DATA SHEET**	**SHEET** 1 **OF** 1		**DATA SHEET NO.**
		REV 1		1606-23 34 13 - 1 / 1
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	
	AXIAL FANS	**PROJECT NO. :**	**FND/1606**	
		LOCATION :	**KARACHI**	

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
1	IDENTIFICATION SYMBOL	-	-	**FN / EF-10**		**FN / EF-13**		
2	SPECIFICATIONS REFERENCE	-	-	**23 34 13**		**23 34 13**		
3	FND CALC. REF. NO.	-	-	-		-		
4	QUANTITY	Nos.	Nos.	**1**		**1**		
5	ALTITUDE,ASML	FT	m	**32.8**	**10**	**32.8**	**10**	
6	AIR FLOW RATE	CFM	m^3/hr	**1,529**	**2600**	**401**	**682**	
7	EXTERNAL STATIC PRESSURE	Inch of Wg	Pascal	**0.25**	**50**	**0.25**	**50**	
8	IMPELLER DIA	Inch	mm	**AS SELECTED**		**AS SELECTED**		
9	FAN RPM	RPM	RPM	**1450**		**1450**		
10	POWER ABSORBED	BHP	kW	**-**	**-**	**-**	**-**	
11	MOTOR POWER	HP	kW	**-**	**-**	**-**	**-**	
12	MOTOR SIZE	HP	kW	**0.5**	**0.37**	**0.3**	**0.22**	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	**220/1/50**		**220/1/50**		
14	APPLICATION	-	-	**EXHAUST FROM STORE**		**EXHAUST FROM MRP PACKING STORE**		
15	**CONSTRUCTION**							
16	• TYPE OF FAN	-	-	**AXIAL - WALL MOUNTED WITH GRAVITY DAMPER**		**AXIAL - WALL MOUNTED WITH GRAVITY DAMPER**		
17	• MOUNTING ARRANGEMENT	-	-	**WALL MOUNTED**		**WALL MOUNTED**		
18	• MOTOR COOLING METHOD	-	-	**TEFC**		**TEFC**		
19	• MOTOR INSULATION CLASS (VDE 0530)	-	-	**F**		**F**		
20	• MOTOR VOLTAGE VARIATION	-	-	**10%**		**10%**		
21	CERTIFICATION	-	-	**-**		**-**		
22	BEARING LIFE	Hrs	Hrs	**40,000**		**40,000**		
23	REMARKS	-	-	**EXHAUST AIR**		**EXHAUST AIR**		
24								

	SPARES	**QUANTITY**	**UNITS**	**REMARKS**
25				
26	(a) FAN BEARINGS	-	Set	For each Fan
27	(b) MOTOR BEARINGS	2	Sets	For each Fan
28	(c) FAN BELTS	-	Set	For each Fan

29

30 **NOTE:**

31 1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

32 2) FAN SHOULD BE DIRECT DRIVE.

33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51

	REVISION	0	1	
	STATUS	**ISSUED FOR TENDER**	**ISSUED FOR TENDER**	
	DATE	**19/05/2025**	**12/09/2025**	
	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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FND	EQUIPMENT DATA SHEET	SHEET 1 OF 1 REV 1	DATA SHEET NO. 1606-23 34 16 - 1 / 1	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	CENTRIFUGAL FANS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA						REV
		(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	FN / FA-01		FN / FA-02		FN / FA-03		
2	SPECIFICATIONS REFERENCE	–	–	23 34 16		23 34 16		23 34 16		
3	FND CALC. REF. NO.	–	–	–		–		–		
4	QUANTITY	No.	No.	1		1		1		
5	ALTITUDE,ASML	FT	m	32.8	10	32.8	10	32.8	10	
6	AIR FLOW RATE	CFM	m^3/hr	1,154	1,962	1,800	3,060	8,356	14,205	
7	STATIC PRESSURE (EXTERNAL)	Inch of Wg	Pascal	0.8	200	0.8	200	0.8	200	
8	MAXIMUM TEMPERATURE OF AIR	°F	°C	108	42.2	108	42.2	108	42.2	
9	IMPELLER DIA	Inch	mm	–		–		–		
10	FAN RPM	RPM	RPM	1450		1450		1450		
11	POWER ABSOBERED	BHP	kW	–	–	–	–	–	–	
12	MOTOR POWER	HP	kW	0.5	0.4	0.8	0.6	5.0	3.7	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	220/1/50		400/3/50		400/3/50		
14	APPLICATION	–	–	MAKEUP AIR FOR HEATING CHAMBER		MAKEUP AIR FOR HEATING CHAMBER		MAKEUP AIR FOR HEATING CHAMBER		
15	**CONSTRUCTION:**									
16	• TYPE OF FAN	–	–	DOUBLE SKIN CABINET TYPE CENTRIFUGAL FAN WITH G4 - 2" THICK PLEATED FILTER WITH RAIN PROTECTION GRAVITY LOUVER & WEATHER PROOF CANOPY		DOUBLE SKIN CABINET TYPE CENTRIFUGAL FAN WITH G4 - 2" THICK PLEATED FILTER WITH RAIN PROTECTION GRAVITY LOUVER & WEATHER PROOF CANOPY		DOUBLE SKIN CABINET TYPE CENTRIFUGAL FAN WITH G4 - 2" THICK PLEATED FILTER WITH RAIN PROTECTION GRAVITY LOUVER & WEATHER PROOF CANOPY		
17	• MOUNTING ARRANGEMENT	–	–	–		–		–		
18	• MOTOR COOLING METHOD	–	–	TEFC		TEFC		TEFC		
19	• MOTOR INSULATION CLASS (VDE 053(	–	–	F		F		F		
20	• MOTOR VOLTAGE VARIATION	–	–	10%		10%		10%		
21	CERTIFICATION	–	–	–		–		–		
22	REMARKS	–	–	FRESH AIR		FRESH AIR		FRESH AIR		
23										

	SPARES	QUANTITY	UNITS	REMARKS
24				
25	A) FAN BEARINGS	2	Sets	-
26	B) MOTOR BEARINGS	2	Sets	-
27	C) FAN BELTS	2	Sets	-

28

NOTES:

30 1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

31 2) CABINET SHALL BE DOUBLE SKINNED, 40MM THICK.

32 3) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

33 4) MOTORS SHALL BE HIGH EFFICIENCY MOTORS CLASSIFIED AS IE-3.

34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	19/05/2025	12/09/2025	
	CHECKED / SIGN.	DANIALABDUL AZIZ	DANIALABDUL AZIZ	
	APPROVED	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET	SHEET 1 OF 5 REV 1	DATA SHEET NO. 1606-23 34 16 - 1 / 5	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	CENTRIFUGAL FANS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA						REV
		(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	FN / RE-BF-01		FN / RE-BF-02		FN / RE-BF-03		
2	SPECIFICATIONS REFERENCE	–	–	23 34 16		23 34 16		23 34 16		
3	FND CALC. REF. NO.	–	–	–		–		–		
4	QUANTITY	No.	No.	1		1		1		
5	ALTITUDE,ASML	FT	m	32.8	10	32.8	10	32.8	10	
6	AIR FLOW RATE	CFM	m^3/hr	4,871	8,281	4,404	7,487	696	1,183	
7	STATIC PRESSURE (EXTERNAL)	Inch of Wg	Pascal	0.6	150	0.8	200	0.8	200	
8	MAXIMUM TEMPERATURE OF AIR	°F	°C	108	42.2	108	42.2	108	42.2	
9	IMPELLER DIA	Inch	mm	–		–		–		
10	FAN RPM	RPM	RPM	1450		1450		1450		
11	POWER ABSOBERED	BHP	kW	–	–	–	–	–	–	
12	MOTOR POWER	HP	kW	2.0	1.5	1.5	1.1	0.3	0.2	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		220/1/50		
14	APPLICATION	–	–	RELIEF EXHAUST FOR AHU-BF-01		RELIEF EXHAUST FOR AHU-BF-02		RELIEF EXHAUST FOR AHU-BF-03		
15	**CONSTRUCTION:**									
16	• TYPE OF FAN	–	–	CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		
17	• MOUNTING ARRANGEMENT	–	–	–		–		–		
18	• MOTOR COOLING METHOD	–	–	TEFC		TEFC		TEFC		
19	• MOTOR INSULATION CLASS (VDE 053(	–	–	F		F		F		
20	• MOTOR VOLTAGE VARIATION	–	–	10%		10%		10%		
21	CERTIFICATION	–	–	–		–		–		
22	REMARKS	–	–	EXHAUST AIR		EXHAUST AIR		EXHAUST AIR		
23										

	SPARES	QUANTITY	UNITS	REMARKS
24				
25	A) FAN BEARINGS	2	Sets	-
26	B) MOTOR BEARINGS	2	Sets	-
27	C) FAN BELTS	2	Sets	-

28

29 **NOTES:**

30 1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

31 2) CABINET SHALL BE DOUBLE SKINNED, 40MM THICK.

32 3) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

33 4) MOTORS SHALL BE HIGH EFFICIENCY MOTORS CLASSIFIED AS IE-3.

34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	19/05/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET	SHEET 2 OF 5 REV 1	DATA SHEET NO. 1606-23 34 16 - 2 / 5	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	CENTRIFUGAL FANS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA						REV
		(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	FN / RE-GF-01		FN / RE-GF-02		FN / RE-GF-04		
2	SPECIFICATIONS REFERENCE	–	–	23 34 16		23 34 16		23 34 16		
3	FND CALC. REF. NO.	–	–	–		–		–		
4	QUANTITY	No.	No.	1		1		1		
5	ALTITUDE,ASML	FT	m	32.8	10	32.8	10	32.8	10	
6	AIR FLOW RATE	CFM	m^3/hr	2,488	4,230	2,253	3,830	4,126	7,014	
7	STATIC PRESSURE (EXTERNAL)	Inch of Wg	Pascal	0.6	150	0.6	150	0.6	150	
8	MAXIMUM TEMPERATURE OF AIR	°F	°C	108	42.2	108	42.2	108	42.2	
9	IMPELLER DIA	Inch	mm	–		–		–		
10	FAN RPM	RPM	RPM	1450		1450		1450		
11	POWER ABSOBERED	BHP	kW	–	–	–	–	–	–	
12	MOTOR POWER	HP	kW	0.8	0.6	0.8	0.6	1.5	1.1	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		400/3/50		
14	APPLICATION	–	–	RELIEF EXHAUST FOR AHU-GF-01		RELIEF EXHAUST FOR AHU-GF-02		RELIEF EXHAUST FOR AHU-GF-04		
15	**CONSTRUCTION:**									
16	• TYPE OF FAN	–	–	CABINET TYPE CENTRIFUGAL FAN WITH RAIN PROTECTION GRAVITY LOUVER & WEATHER PROOF CANOPY		CABINET TYPE CENTRIFUGAL FAN WITH RAIN PROTECTION GRAVITY LOUVER & WEATHER PROOF CANOPY		CABINET TYPE CENTRIFUGAL FAN		
17	• MOUNTING ARRANGEMENT	–	–	–		–		–		
18	• MOTOR COOLING METHOD	–	–	TEFC		TEFC		TEFC		
19	• MOTOR INSULATION CLASS (VDE 053(	–	–	F		F		F		
20	• MOTOR VOLTAGE VARIATION	–	–	10%		10%		10%		
21	CERTIFICATION	–	–	–		–		–		
22	REMARKS	–	–	EXHAUST AIR		EXHAUST AIR		EXHAUST AIR		
23										

	SPARES	QUANTITY	UNITS	REMARKS
24				
25	A) FAN BEARINGS	2	Sets	-
26	B) MOTOR BEARINGS	2	Sets	-
27	C) FAN BELTS	2	Sets	-

28

29 **NOTES:**

30 1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

31 2) CABINET SHALL BE DOUBLE SKINNED, 40MM THICK.

32 3) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

33 4) MOTORS SHALL BE HIGH EFFICIENCY MOTORS CLASSIFIED AS IE-3.

34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	19/05/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET	SHEET 3 OF 5	DATA SHEET NO.	
		REV 1	1606-23 34 16 - 3 / 5	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	CENTRIFUGAL FANS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA						REV
		(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	FN / RE-GF-05		FN / RE-GF-07B		FN / RE-GF-07		
2	SPECIFICATIONS REFERENCE	–	–	23 34 16		23 34 16		23 34 16		
3	FND CALC. REF. NO.	–	–	–		–		–		
4	QUANTITY	No.	No.	1		1		1		
5	ALTITUDE,ASML	FT	m	32.8	10	32.8	10	32.8	10	
6	AIR FLOW RATE	CFM	m^3/hr	3,169	5,387	2,760	4,692	2,205	3,749	
7	STATIC PRESSURE (EXTERNAL)	Inch of Wg	Pascal	0.6	150	0.6	150	0.6	150	
8	MAXIMUM TEMPERATURE OF AIR	°F	°C	108	42.2	108	42.2	108	42.2	
9	IMPELLER DIA	Inch	mm	–		–		–		
10	FAN RPM	RPM	RPM	1450		1450		1450		
11	POWER ABSOBERED	BHP	kW	–	–	–	–	–	–	
12	MOTOR POWER	HP	kW	1.5	1.1	1.5	1.1	0.8	0.6	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		400/3/50		
14	APPLICATION	–	–	RELIEF EXHAUST FOR AHU-GF-05		RELIEF EXHAUST FOR AHU-GF-07B		RELIEF EXHAUST FOR AHU-GF-07		
15	**CONSTRUCTION:**									
16	• TYPE OF FAN	–	–	CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		
17	• MOUNTING ARRANGEMENT	–	–	–		–		–		
18	• MOTOR COOLING METHOD	–	–	TEFC		TEFC		TEFC		
19	• MOTOR INSULATION CLASS (VDE 0530	–	–	F		F		F		
20	• MOTOR VOLTAGE VARIATION	–	–	10%		10%		10%		
21	CERTIFICATION	–	–	–		–		–		
22	REMARKS	–	–	EXHAUST AIR		EXHAUST AIR		EXHAUST AIR		
23										

	SPARES	QUANTITY	UNITS	REMARKS
24				
25	A) FAN BEARINGS	2	Sets	-
26	B) MOTOR BEARINGS	2	Sets	-
27	C) FAN BELTS	2	Sets	-
28				

NOTES:

1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

2) CABINET SHALL BE DOUBLE SKINNED, 40MM THICK.

3) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

4) MOTORS SHALL BE HIGH EFFICIENCY MOTORS CLASSIFIED AS IE-3.

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	19/05/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET	SHEET 4 OF 5	DATA SHEET NO.	
		REV 1	1606-23 34 16 - 4 / 5	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	CENTRIFUGAL FANS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA						REV
		(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	FN / RE-GF-08A		FN / RE-GF-09		FN / RE-GF-10		
2	SPECIFICATIONS REFERENCE	–	–	23 34 16		23 34 16		23 34 16		
3	FND CALC. REF. NO.	–	–	–		–		–		
4	QUANTITY	No.	No.	1		1		1		
5	ALTITUDE,ASML	FT	m	32.8	10	32.8	10	32.8	10	
6	AIR FLOW RATE	CFM	m^3/hr	605	1,029	1,515	2,576	2,761	4,694	
7	STATIC PRESSURE (EXTERNAL)	Inch of Wg	Pascal	0.6	150	0.6	150	0.6	150	
8	MAXIMUM TEMPERATURE OF AIR	°F	°C	108	42.2	108	42.2	108	42.2	
9	IMPELLER DIA	Inch	mm	–		–		–		
10	FAN RPM	RPM	RPM	1450		1450		1450		
11	POWER ABSOBERED	BHP	kW	–	–	–	–	–	–	
12	MOTOR POWER	HP	kW	0.3	0.2	0.5	0.4	1.5	1.1	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	220/1/50		220/1/50		400/3/50		
14	APPLICATION	–	–	RELIEF EXHAUST FOR AHU-GF-08A		RELIEF EXHAUST FOR AHU-GF-09		RELIEF EXHAUST FOR AHU-GF-10		
15	**CONSTRUCTION:**									
16	• TYPE OF FAN	–	–	CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		
17	• MOUNTING ARRANGEMENT	–	–	–		–		–		
18	• MOTOR COOLING METHOD	–	–	TEFC		TEFC		TEFC		
19	• MOTOR INSULATION CLASS (VDE 053(	–	–	F		F		F		
20	• MOTOR VOLTAGE VARIATION	–	–	10%		10%		10%		
21	CERTIFICATION	–	–	–		–		–		
22	REMARKS	–	–	EXHAUST AIR		EXHAUST AIR		EXHAUST AIR		
23										

	SPARES	QUANTITY	UNITS	REMARKS
24				
25	A) FAN BEARINGS	2	Sets	-
26	B) MOTOR BEARINGS	2	Sets	-
27	C) FAN BELTS	2	Sets	-
28				

29 **NOTES:**

30 1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

31 2) CABINET SHALL BE DOUBLE SKINNED, 40MM THICK.

32 3) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

33 4) MOTORS SHALL BE HIGH EFFICIENCY MOTORS CLASSIFIED AS IE-3.

34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	19/05/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET	SHEET 5 OF 5	DATA SHEET NO.	
		REV 1	1606-23 34 16 - 5 / 5	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	CENTRIFUGAL FANS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA						REV
		(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	FN / RE-GF-11A		FN / RE-GF-12		FN / RE-GF-13		
2	SPECIFICATIONS REFERENCE	–	–	23 34 16		23 34 16		23 34 16		
3	FND CALC. REF. NO.	–	–	–		–		–		
4	QUANTITY	No.	No.	1		1		1		
5	ALTITUDE,ASML	FT	m	32.8	10	32.8	10	32.8	10	
6	AIR FLOW RATE	CFM	m^3/hr	1,861	3,164	1,542	2,621	6,001	10,202	
7	STATIC PRESSURE (EXTERNAL)	Inch of Wg	Pascal	0.6	150	0.6	150	0.6	150	
8	MAXIMUM TEMPERATURE OF AIR	°F	°C	108	42.2	108	42.2	108	42.2	
9	IMPELLER DIA	Inch	mm	–		–		–		
10	FAN RPM	RPM	RPM	1450		1450		1450		
11	POWER ABSOBERED	BHP	kW	–	–	–	–	–	–	
12	MOTOR POWER	HP	kW	0.8	0.6	0.5	0.4	3.0	2.2	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		220/1/50		400/3/50		
14	APPLICATION	–	–	RELIEF EXHAUST FOR AHU-GF-11A		RELIEF EXHAUST FOR AHU-GF-12		RELIEF EXHAUST FOR AHU-GF-13		
15	**CONSTRUCTION:**									
16	• TYPE OF FAN	–	–	CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		CABINET TYPE CENTRIFUGAL FAN		
17	• MOUNTING ARRANGEMENT	–	–	–		–		–		
18	• MOTOR COOLING METHOD	–	–	TEFC		TEFC		TEFC		
19	• MOTOR INSULATION CLASS (VDE 053(	–	–	F		F		F		
20	• MOTOR VOLTAGE VARIATION	–	–	10%		10%		10%		
21	CERTIFICATION	–	–	–		–		–		
22	REMARKS	–	–	EXHAUST AIR		EXHAUST AIR		EXHAUST AIR		
23										

	SPARES	QUANTITY	UNITS	REMARKS
24				
25	A) FAN BEARINGS	2	Sets	-
26	B) MOTOR BEARINGS	2	Sets	-
27	C) FAN BELTS	2	Sets	-
28				

29 **NOTES:**

30 1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

31 2) CABINET SHALL BE DOUBLE SKINNED, 40MM THICK.

32 3) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

33 4) MOTORS SHALL BE HIGH EFFICIENCY MOTORS CLASSIFIED AS IE-3.

34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	19/05/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET	SHEET 7 OF 7 REV 1	DATA SHEET NO. 1606-23 34 16 - 7 / 7	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	CENTRIFUGAL FANS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA						REV
		(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	(FPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	FN / EF-21		FN / EF-22		FN / EF-23		
2	SPECIFICATIONS REFERENCE	–	–	23 34 16		23 34 16		23 34 16		
3	FND CALC. REF. NO.	–	–	–		–		–		
4	QUANTITY	No.	No.	1		1		1		
5	ALTITUDE,ASML	FT	m	32.8	10	32.8	10	32.8	10	
6	AIR FLOW RATE	CFM	m^3/hr	1,218	2,071	2,263	3,847	2,517	4,279	
7	STATIC PRESSURE (EXTERNAL)	Inch of Wg	Pascal	0.6	150	0.6	150	0.6	150	
8	MAXIMUM TEMPERATURE OF AIR	°F	°C	108	42.2	108	42.2	108	42.2	
9	IMPELLER DIA	Inch	mm	–		–		–		
10	FAN RPM	RPM	RPM	1450		1450		1450		
11	POWER ABSOBERED	BHP	kW	–	–	–	–	–	–	
12	MOTOR POWER	HP	kW	0.5	0.4	0.8	0.6	1.5	1.1	
13	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	220/1/50		400/3/50		400/3/50		
14	APPLICATION	–	–	EXHAUST FROM STRONG ROOM (LITHO)		EXHAUST FROM STORE		EXHAUST FROM MEDICAL CENTER		
15	**CONSTRUCTION:**									
16	• TYPE OF FAN	–	–	DOUBLE SKIN CABINET TYPE CENTRIFUGAL FAN WITH G4 - 2" THICK PLEATED FILTER		DOUBLE SKIN CABINET TYPE CENTRIFUGAL FAN WITH G4 - 2" THICK PLEATED FILTER		DOUBLE SKIN CABINET TYPE CENTRIFUGAL FAN WITH G4 - 2" THICK PLEATED FILTER		
17	• MOUNTING ARRANGEMENT	–	–	–		–		–		
18	• MOTOR COOLING METHOD	–	–	TEFC		TEFC		TEFC		
19	• MOTOR INSULATION CLASS (VDE 053(	–	–	F		F		F		
20	• MOTOR VOLTAGE VARIATION	–	–	10%		10%		10%		
21	CERTIFICATION	–	–	–		–		–		
22	REMARKS	–	–	EXHAUST AIR		EXHAUST AIR		EXHAUST AIR		
23										

	SPARES	QUANTITY	UNITS	REMARKS
25	A) FAN BEARINGS	2	Sets	-
26	B) MOTOR BEARINGS	2	Sets	-
27	C) FAN BELTS	2	Sets	-

NOTES:

1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

2) CABINET SHALL BE DOUBLE SKINNED, 40MM THICK.

3) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

4) MOTORS SHALL BE HIGH EFFICIENCY MOTORS CLASSIFIED AS IE-3.

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	19/05/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET AIR HANDLING UNITS (PROCESS)	SHEET 1 OF 6 REV 1	DATA SHEET NO. 1606-23 73 10 & 23 84 20 - 1 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DATA							REV
	DESCRIPTION	UNIT (IPS)	UNIT (SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	AHU / BF-01		AHU / GF-01		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		
3	QUANTITY	Nos.	Nos.	1		2		
4	FND CALC. REF. NO.:	–	–	-		-		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	
6	APPLICATION	–	–	PAPER STORE		OFFSET PRINTING		
7	**COOLING COIL DATA:**							
8	• TOTAL COOLING COIL LOAD	MBH	kW	512	150	576	169	
9	• SENSIBLE COIL LOAD	MBH	kW	272.4	80	490.7	144	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	6868	11676	24707.5	42003	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	4871	8281	1325	2253	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	4871	8281	2266.5	3853	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	94.2 / 77.9	34.6 / 25.5	74.7 / 63	23.7 / 17.2	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	57.5 / 56.5	14.2 / 13.6	56.0 / 54.9	13.3 / 12.7	
15	• WATER FLOW RATE	USGPM	L / min	68	258	77	290	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	
17	• REFRIGERANT	–	–	CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		
20	• COATED COILS	–	–	NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	-		-		
22	**RE-HEAT COIL DATA (ELECTRIC):**							
23	• CAPACITY	MBH	kW	20	6	77	23	
24	• COIL AIR VOLUME	CFM	m^3/hr	6868	11676	24707.5	42003	
25	• ENTERING AIR, DRY BULB	°F	°C	-		-		
26	• LEAVING AIR, DRY BULB	°F	°C	-		-		
27	• POWER CONSUMPTION	kW		6		23		
28	**FAN DATA:**							
29	• TYPE OF FAN (NOTE - 05)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
30	• TYPE OF FAN BLADE	–	–	AS PER SPECIFICATIONS		AS PER SPECIFICATIONS		
31	• SUPPLY AIR VOLUME	CFM	m^3/hr	6868	11676	24707.5	42003	
32	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.50	375	
33	• MOTOR POWER	kW	kW	5.5		30.0		
34	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		
35	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		
36	• AHU MOTOR VFD COMPATIBLE	–	–	YES		YES		
37	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**							
38	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		
39	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		
40	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		
41	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		
42	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		
43	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		
44	**CONSTRUCTION:**							
45	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
46	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		
47	• MIXING BOX	–	–	YES		YES		
48	• PANEL FILTER SECTION WITH FILTERS	–	–	G-4		G-4		
49	• BAG FILTER SECTION WITH FILTERS	–	–	F-7		F-7		
50	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		
51	• RETURN AIR FAN	–	–	NO		NO		
52	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
53	• BYPASS SECTION	–	–	NO		NO		
54	• ULTRAVIOLET & GERMICIDAL IRRADIATION(UVGI) LAMP	–	–	NO		NO		
55	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		
56	• SOUND ATTENUATOR	–	–	NO		NO		

For Reference Only
Owner Furnished

FND	**EQUIPMENT DATA SHEET**	**SHEET** 1 **OF** 6		**DATA SHEET NO.**
		REV 1		1606-23 73 10 & 23 84 20 - 1 / 6
	AIR HANDLING UNITS (PROCESS)	**PROJECT TITLE :**	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	
		PROJECT NO. :	**FND/1606**	
		LOCATION :	**KARACHI**	

	DATA							REV
	DESCRIPTION	**UNIT**						
		(IPS)	**(SI)**	**(IPS)**	**(SI)**	**(IPS)**	**(SI)**	
57	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mm	**4150 X 1750 X 1300**		**5300 X 2950 X 2200**		
58	• PORT HOLES	–	–	**YES (NOTE-05)**		**YES (NOTE-05)**		
59	• LIGHTS	–	–	**YES (NOTE-06)**		**YES (NOTE-06)**		
60	• MAGNEHELLIC GAUGES	–	–	**YES (NOTE-11)**		**YES (NOTE-11)**		
61	• HEAT EXCHANGER	–	–	**-**		**-**		
62								

63	**SPARES**	**QUANTITY**	**UNITS**	**REMARKS**
64	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
65	(b) FAN BEARINGS	1	Set	For Each Fan
66	(c) FAN BELTS	2	Sets	For Each Fan
67	(d) FILTERS (Each Type)	2	Sets	For Each AHU
68				

69 **NOTES:**

70 1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

71 2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

72 3) AHU PANEL THICKNESS SHALL BE 50MM.

73 4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

74 5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.

75 6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.

76 7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS:
- FILTER SECTIONS - 4 PER SECTIONS
- FAN SECTIONS - 2 PER SECTIONS

77 8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

78 9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.

79 10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.

80 11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.

81 12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.

82 13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS

83 14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)

84 15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.

85 16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL

86 17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.

87 18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501

88 19) VFD SHALL BE PROVIDED WITH DC CHOKE.

89 20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.

90 21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.

92 22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE

93 23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE EXPECTED AMBIENT TEMPERATURE IS 45 TO 48°C.

95 24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)

96 IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.

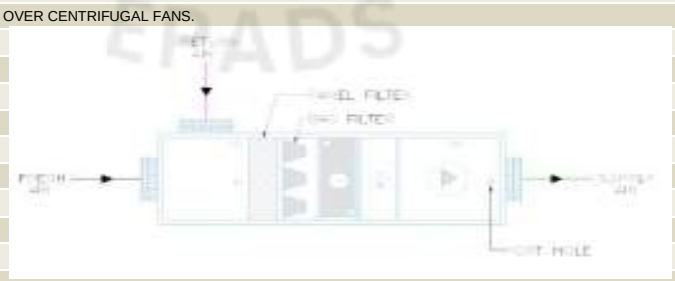
97 25) CABLE GLANDS TO BE PROVIDED IN ALL SECTIONS FOR BMS SENSORS AND WIRES. IN FAN SECTION PROVIDE CABLE GLANDS FOR MOTOR POWER.

98 2) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14

99 27) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 33

100 28) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.

102



103 104 105 106 107 108 109 110 111

	REVISION	0	1	
	STATUS	**ISSUED FOR TENDER**	**ISSUED FOR TENDER**	
	DATE	**28/02/2025**	**12/09/2025**	
	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED BY	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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FND	**EQUIPMENT DATA SHEET**	**SHEET** 2 **OF** 6			**DATA SHEET NO.**
		REV 1			1606-23 73 10 & 23 84 20 - 2 / 6
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**		
	AIR HANDLING UNITS (PROCESS)	**PROJECT NO. :**	**FND/1606**		
		LOCATION :	**KARACHI**		

	DESCRIPTION	UNIT		DATA				REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	AHU / GF-02		AHU / GF-04		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		
3	QUANTITY	Nos.	Nos.	6		1		
4	FND CALC. REF. NO.:	–	–	-		-		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	
6	APPLICATION	–	–	INTAGLIO + LITHO		IPM + RECTIFIER		
7	**COOLING COIL DATA:**							
8	• TOTAL COOLING COIL LOAD	MBH	kW	802.3	235	475.5	139	
9	• SENSIBLE COIL LOAD	MBH	kW	762.7	224	465.1	136	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	39838	67725	24419	41512	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	525	893	0	0	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	363	617	4533	7706	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	72.9 / 61.2	22.7 / 16.2	72.9 / 61.0	22.7 / 16.1	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	55.1 / 54.0	12.8 / 12.2	55.2 / 54.1	12.9 / 12.1	
15	• WATER FLOW RATE	USGPM	L / min	107	404	63	240	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	
17	• REFRIGERANT	–	–	CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		
20	• COATED COILS	–	–	NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	-		-		
22	**RE-HEAT COIL DATA (ELECTRIC):**							
23	• CAPACITY	MBH	kW	328	96	129	38	
24	• COIL AIR VOLUME	CFM	m^3/hr	39838	67725	24419	41512	
25	• ENTERING AIR, DRY BULB	°F	°C	-		-		
26	• LEAVING AIR, DRY BULB	°F	°C	-		-		
27	• POWER CONSUMPTION	kW		96		38		
28	**FAN DATA:**							
29	• TYPE OF FAN (NOTE - 05)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
30	• TYPE OF FAN BLADE	–	–	AS PER SPECIFICATIONS		AS PER SPECIFICATIONS		
31	• SUPPLY AIR VOLUME	CFM	m^3/hr	39838	67725	24419	41512	
32	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.00	250	
33	• MOTOR POWER	kW	kW	30.0		18.5		
34	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		
35	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		
36	• AHU MOTOR VFD COMPATIBLE	–	–	YES		YES		
37	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**							
38	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		
39	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		
40	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		
41	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		
42	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		
43	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		
44	**CONSTRUCTION:**							
45	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
46	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		
47	• MIXING BOX	–	–	YES		YES		
48	• PANEL FILTER SECTION WITH FILTERS	–	–	G-4		G-4		
49	• BAG FILTER SECTION WITH FILTERS	–	–	F-7		F-7		
50	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		
51	• RETURN AIR FAN	–	–	NO		NO		
52	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
53	• BYPASS SECTION	–	–	NO		NO		
54	• ULTRAVIOLET & GERMICIDAL IRRADIATION(UVGI) LAMP	–	–	NO		NO		
55	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		
56	• SOUND ATTENUATOR	–	–	NO		NO		
57	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mm	5600 X 3950 X 2500		5300 X 2950 X 2200		

Owner Furnished

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
58	• PORT HOLES	–	–	YES (NOTE-05)		YES (NOTE-05)		
59	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		
60	• MAGNEHELLIC GAUGES	–	–	YES (NOTE-11)		YES (NOTE-11)		
61	• HEAT EXCHANGER	–	–	-		-		
62								

	SPARES	QUANTITY	UNITS	REMARKS
64	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
65	(b) FAN BEARINGS	1	Set	For Each Fan
66	(c) FAN BELTS	2	Sets	For Each Fan
67	(d) FILTERS (Each Type)	2	Sets	For Each AHU

NOTES:

1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

3) AHU PANEL THICKNESS SHALL BE 50MM.

4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.

6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.

7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS:
- FILTER SECTIONS - 4 PER SECTIONS
- FAN SECTIONS - 2 PER SECTIONS

8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.

10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.

11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.

12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 150MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.

13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS

14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)

15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.

16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL

17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.

18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501

19) VFD SHALL BE PROVIDED WITH DC CHOKE.

20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.

21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.

22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE

23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE EXPECTED AMBIENT TEMPERATURE IS 45 TO 48°C.

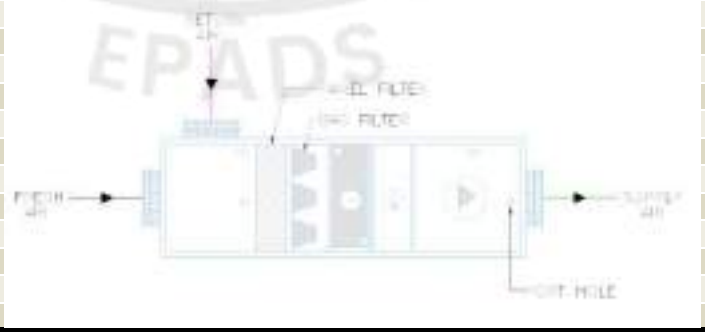
24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION) IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.

25) CABLE GLANDS TO BE PROVIDED IN ALL SECTIONS FOR BMS SENSORS AND WIRES. IN FAN SECTION PROVIDE CABLE GLANDS FOR MOTOR POWER.

26) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14

27) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 33

28) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.



	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	**EQUIPMENT DATA SHEET**	**SHEET** 3 **OF** 6		**DATA SHEET NO.**
		REV 1		1606-23 73 10 & 23 84 20 - 3 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	AIR HANDLING UNITS (PROCESS)	**PROJECT NO. :**	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT		DATA				REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	AHU / GF-05		AHU / GF-07		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		
3	QUANTITY	Nos.	Nos.	2		1		
4	FND CALC. REF. NO.:	–	–	-		-		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	
6	APPLICATION	–	–	COATING DEPARTMENT		CUTPACK		
7	**COOLING COIL DATA:**							
8	• TOTAL COOLING COIL LOAD	MBH	kW	626.05	183	1656.4	485	
9	• SENSIBLE COIL LOAD	MBH	kW	457.1	134	1051.5	308	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	21059.5	35801	39471	67101	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	3298.5	5607	10197	17335	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	1584.5	2694	4403	7485	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	77.4 / 66.0	25.2 / 18.9	81.1 / 68.7	27.3 / 20.4	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	57.3 / 56.2	14.1 / 13.4	56.0 / 55.0	13.3 / 12.8	
15	• WATER FLOW RATE	USGPM	L / min	83	316	221	835	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	
17	• REFRIGERANT	–	–	CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		
20	• COATED COILS	–	–	NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	-	-	-	-	
22	**RE-HEAT COIL DATA (ELECTRIC):**							
23	• CAPACITY	MBH	KW	120	35	39	11	
24	• COIL AIR VOLUME	CFM	m^3/hr	21059.5	35801	39471	67101	
25	• ENTERING AIR, DRY BULB	°F	°C	-		-		
26	• LEAVING AIR, DRY BULB	°F	°C	-		-		
27	• POWER CONSUMPTION	kW		35		11		
28	**FAN DATA:**							
29	• TYPE OF FAN (NOTE - 05)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
30	• TYPE OF FAN BLADE	–	–	AS PER SPECIFICATIONS		AS PER SPECIFICATIONS		
31	• SUPPLY AIR VOLUME	CFM	m^3/hr	21059.5	35801	39471	67101	
32	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.80	450	
33	• MOTOR POWER	kW	kW	15.0		30.0		
34	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		
35	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		
36	• AHU MOTOR VFD COMPATIBLE	–	–	YES		YES		
37	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**							
38	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		
39	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		
40	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		
41	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		
42	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		
43	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		
44	**CONSTRUCTION:**							
45	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
46	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		
47	• MIXING BOX	–	–	YES		YES		
48	• PANEL FILTER SECTION WITH FILTERS	–	–	G-4		G-4		
49	• BAG FILTER SECTION WITH FILTERS	–	–	F-7		F-7		
50	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		
51	• RETURN AIR FAN	–	–	NO		NO		
52	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
53	• BYPASS SECTION	–	–	NO		NO		
54	• ULTRAVIOLET & GERMICIDAL IRRADIATION(UVGI) LAMP	–	–	NO		NO		
55	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		

Owner Furnished

FND	EQUIPMENT DATA SHEET AIR HANDLING UNITS (PROCESS)	SHEET 3 OF 6 REV 1		DATA SHEET NO. 1606-23 73 10 & 23 84 20 - 3 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
		PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
56	• SOUND ATTENUATOR	–	–	NO		NO		
57	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mm	5300 X 2500 X 2200		5660 X 3950 X 2500		
58	• PORT HOLES	–	–	YES (NOTE-05)		YES (NOTE-05)		
59	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		
60	• MAGNEHELLIC GAUGES	–	–	YES (NOTE-11)		YES (NOTE-11)		
61	• HEAT EXCHANGER	–	–	-		-		
62								

	SPARES	QUANTITY	UNITS	REMARKS
64	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
65	(b) FAN BEARINGS	1	Set	For Each Fan
66	(c) FAN BELTS	2	Sets	For Each Fan
67	(d) FILTERS (Each Type)	2	Sets	For Each AHU

68

69 **NOTES:**

70 1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

71 2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

72 3) AHU PANEL THICKNESS SHALL BE 50MM.

73 4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

74 5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.

75 6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.

76 7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS:
- FILTER SECTIONS - 4 PER SECTIONS
- FAN SECTIONS - 2 PER SECTIONS

77 8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

78 9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.

79 10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.

80 11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.

81 12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.

82 13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS

83 14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)

84 15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.

85 16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL

86 17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.

87 18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501

88 19) VFD SHALL BE PROVIDED WITH DC CHOKE.

89 20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.

90 21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.

91 22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE

92 23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE EXPECTED AMBIENT TEMPERATURE IS 45 TO 48°C.

94 24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)

95 IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.

96 25) CABLE GLANDS TO BE PROVIDED IN ALL SECTIONS FOR BMS SENSORS AND WIRES. IN FAN SECTION PROVIDE CABLE GLANDS FOR MOTOR POWER.

97 26) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14

98 27) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 33

99 28) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.

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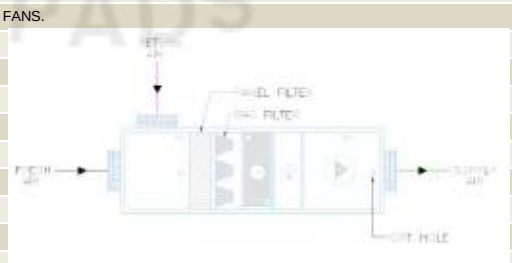

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	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET	SHEET 4 OF 6	DATA SHEET NO.
		REV 1	1606-23 73 10 & 23 84 20 - 4 / 6
	AIR HANDLING UNITS (PROCESS)	PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
1	IDENTIFICATION SYMBOL	–	–	AHU / GF-08A		AHU / GF-11A		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		
3	QUANTITY	No.	No.	1		1		
4	FND CALC. REF. NO.:	–	–	-		-		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	
6	APPLICATION	–	–	MRP DEPARTMENT		PAPER STORE		
7	**COOLING COIL DATA:**							
8	• TOTAL COOLING COIL LOAD	MBH	kW	559.4	164	319.5	94	
9	• SENSIBLE COIL LOAD	MBH	kW	460.4	135	297.4	87	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	22810	38777	14585	24795	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	1253	2130	545	927	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	605	1029	1861	3164	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	74.0 / 62.8	23.3 / 17.1	73.4 / 61.8	23.0 / 16.6	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	55.3 / 54.3	12.9 / 12.4	55.3 / 54.2	12.9 / 12.3	
15	• WATER FLOW RATE	USGPM	L / min	75	282	43	161	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	
17	• REFRIGERANT	–	–	CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		
20	• COATED COILS	–	–	NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	-		-		
22	**RE-HEAT COIL DATA (ELECTRIC):**							
23	• CAPACITY	MBH	kW	138	41	5	1.5	
24	• COIL AIR VOLUME	CFM	m^3/hr	22810	38777	14585	24795	
25	• ENTERING AIR, DRY BULB	°F	°C	-		-		
26	• LEAVING AIR, DRY BULB	°F	°C	-		-		
27	• POWER CONSUMPTION	kW		41		1.5		
28	**FAN DATA:**							
29	• TYPE OF FAN (NOTE - 05)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
30	• TYPE OF FAN BLADE	–	–	AS PER SPECIFICATIONS		AS PER SPECIFICATIONS		
31	• SUPPLY AIR VOLUME	CFM	m^3/hr	22810	38777	14585	24795	
32	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.00	250	
33	• MOTOR POWER	kW	kW	15.0		11.0		
34	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		
35	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		
36	• AHU MOTOR VFD COMPATIBLE	–	–	YES		YES		
37	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**							
38	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		
39	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		
40	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		
41	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		
42	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		
43	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		
44	**CONSTRUCTION:**							
45	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
46	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		
47	• MIXING BOX	–	–	YES		YES		
48	• PANEL FILTER SECTION WITH FILTERS	–	–	G-4		G-4		
49	• BAG FILTER SECTION WITH FILTERS	–	–	F-7		F-7		
50	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		
51	• RETURN AIR FAN	–	–	NO		NO		
52	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
53	• BYPASS SECTION	–	–	NO		NO		
54	• ULTRAVIOLET & GERMICIDAL IRRADIATION(UVGI) LAMP	–	–	NO		NO		
55	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		
56	• SOUND ATTENUATOR	–	–	NO		NO		

Owner Furnished

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
57	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mm	5300 X 2800 X 2200		5000 X 2200 X 1900		
58	• PORT HOLES	–	–	YES (NOTE-05)		YES (NOTE-05)		
59	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		
60	• MAGNEHELLIC GAUGES	–	–	YES (NOTE-11)		YES (NOTE-11)		
61	• HEAT EXCHANGER	–	–	-		-		
62								

	SPARES	QUANTITY	UNITS	REMARKS
64	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
65	(b) FAN BEARINGS	1	Set	For Each Fan
66	(c) FAN BELTS	2	Sets	For Each Fan
67	(d) FILTERS (Each Type)	2	Sets	For Each AHU

NOTES:

1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

3) AHU PANEL THICKNESS SHALL BE 50MM.

4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.

6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.

7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS:
- FILTER SECTIONS - 4 PER SECTIONS
- FAN SECTIONS - 2 PER SECTIONS

8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.

10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.

11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.

12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.

13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS

14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)

15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.

16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL

17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.

18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501

19) VFD SHALL BE PROVIDED WITH DC CHOKE.

20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.

21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.

22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE

23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.

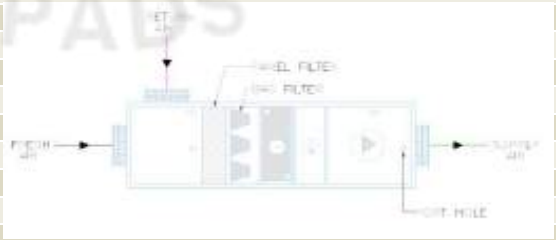
24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION) IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.

25) CABLE GLANDS TO BE PROVIDED IN ALL SECTIONS FOR BMS SENSORS AND WIRES. IN FAN SECTION PROVIDE CABLE GLANDS FOR MOTOR POWER.

26) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14

27) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 33

28) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.



	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	EQUIPMENT DATA SHEET	SHEET 5 OF 6	DATA SHEET NO.
		REV 1	1606-23 73 10 & 23 84 20 - 5 / 6
	AIR HANDLING UNITS (PROCESS)	PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DESCRIPTION	UNIT		DATA				REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	AHU / GF-12		AHU / GF-13		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		
3	QUANTITY	No.	No.	1		1		
4	FND CALC. REF. NO.:	–	–	-		-		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	
6	APPLICATION	–	–	STATIONARY		STRONG ROOM		
7	**COOLING COIL DATA:**							
8	• TOTAL COOLING COIL LOAD	MBH	kW	881	258	915.6	268	
9	• SENSIBLE COIL LOAD	MBH	kW	782.4	229	746	219	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	33794	57450	37180	63206	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	1562	2655	3144	5345	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	1542	2621	6001	10202	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	77.4 / 63.6	25.2 / 17.6	74.7 / 63.5	23.7 / 17.5	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	55.9 / 54.7	13.3 / 12.6	56.1 / 55.1	13.4 / 12.8	
15	• WATER FLOW RATE	USGPM	L / min	117	444	122	461	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	
17	• REFRIGERANT	–	–	CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		
20	• COATED COILS	–	–	NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	-		-		
22	**RE-HEAT COIL DATA (ELECTRIC):**							
23	• CAPACITY	MBH	kW	276	81	5	1.5	
24	• COIL AIR VOLUME	CFM	m^3/hr	33794	57450	37180	63206	
25	• ENTERING AIR, DRY BULB	°F	°C	-		-		
26	• LEAVING AIR, DRY BULB	°F	°C	-		-		
27	• POWER CONSUMPTION	kW		81		1.5		
28	**FAN DATA:**							
29	• TYPE OF FAN (NOTE - 05)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
30	• TYPE OF FAN BLADE	–	–	AS PER SPECIFICATIONS		AS PER SPECIFICATIONS		
31	• SUPPLY AIR VOLUME	CFM	m^3/hr	33794	57450	37180	63206	
32	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.50	375	
33	• MOTOR POWER	kW	kW	22.0		30.0		
34	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		
35	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		
36	• AHU MOTOR VFD COMPATIBLE	–	–	YES		YES		
37	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**							
38	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		
39	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		
40	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		
41	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		
42	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		
43	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		
44	**CONSTRUCTION:**							
45	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
46	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		
47	• MIXING BOX	–	–	YES		YES		
48	• PANEL FILTER SECTION WITH FILTERS	–	–	G-4		G-4		
49	• BAG FILTER SECTION WITH FILTERS	–	–	F-7		F-7		
50	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		
51	• RETURN AIR FAN	–	–	NO		NO		
52	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
53	• BYPASS SECTION	–	–	NO		NO		
54	• ULTRAVIOLET & GERMICIDAL IRRADIATION(UVGI) LAMP	–	–	NO		NO		
55	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		

Archived
Owner Furnished

	DATA							REV
	DESCRIPTION	UNIT						
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
56	• SOUND ATTENUATOR	–	–	NO		NO		
57	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mm	5450 X 3500 X 2350		5600 X 3950 X 2350		
58	• PORT HOLES	–	–	YES (NOTE-05)		YES (NOTE-05)		
59	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		
60	• MAGNEHELLIC GAUGES	–	–	YES (NOTE-11)		YES (NOTE-11)		
61	• HEAT EXCHANGER	–	–	-		-		
62								

	SPARES	QUANTITY	UNITS	REMARKS
64	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
65	(b) FAN BEARINGS	1	Set	For Each Fan
66	(c) FAN BELTS	2	Sets	For Each Fan
67	(d) FILTERS (Each Type)	2	Sets	For Each AHU

68

69 **NOTES:**

70 1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

71 2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

72 3) AHU PANEL THICKNESS SHALL BE 50MM.

73 4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

74 5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.

75 6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.

76 7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS:
- FILTER SECTIONS - 4 PER SECTIONS
- FAN SECTIONS - 2 PER SECTIONS

77 8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

78 9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.

79 10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.

80 11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.

81 12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.

82 13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS

83 14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)

84 15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.

85 16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL

86 17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.

87 18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501

88 19) VFD SHALL BE PROVIDED WITH DC CHOKE.

89 20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.

90 21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.

91 22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE

92 23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.

94 24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION) IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.

96 25) CABLE GLANDS TO BE PROVIDED IN ALL SECTIONS FOR BMS SENSORS AND WIRES. IN FAN SECTION PROVIDE CABLE GLANDS FOR MOTOR POWER.

97 26) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14

98 27) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 33

99 28) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.

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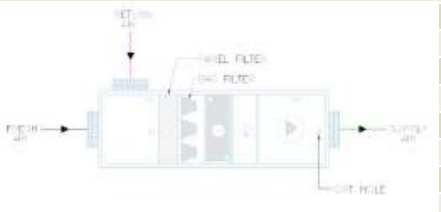

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	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	EQUIPMENT DATA SHEET AIR HANDLING UNITS (PROCESS)	SHEET 6 OF 6 REV 1	DATA SHEET NO. 1606-23 73 10 & 23 84 20 - 6 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
1	IDENTIFICATION SYMBOL	–	–	AHU / GF-06		AHU / GF-07A		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		
3	QUANTITY	Nos.	Nos.	3		1		
4	FND CALC. REF. NO.:	–	–	-		-		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	
6	APPLICATION	–	–	NUMBERING		SHREDDING PLANT		
7	**COOLING COIL DATA:**							
8	• TOTAL COOLING COIL LOAD	MBH	kW	810.9	238	487.3	143	
9	• SENSIBLE COIL LOAD	MBH	kW	750.7	220	472.1	138	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	38751	65877	21205	36049	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	813	1382	200	340	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	0	0	0	0	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	73.0 / 61.4	22.8 / 16.3	74.8 / 61.1	23.8 / 16.2	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	55.1 / 54.0	12.8 / 12.2	54.1 / 52.8	12.3 / 11.6	
15	• WATER FLOW RATE	USGPM	L / min	108	409	65	246	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	
17	• REFRIGERANT	–	–	CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		
20	• COATED COILS	–	–	NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	-		-		
22	**RE-HEAT COIL DATA (ELECTRIC):**							
23	• CAPACITY	MBH	kW	181	53	77	22.5	
24	• COIL AIR VOLUME	CFM	m^3/hr	38751	65877	21205	36049	
25	• ENTERING AIR, DRY BULB	°F	°C	-		-		
26	• LEAVING AIR, DRY BULB	°F	°C	-		-		
27	• POWER CONSUMPTION	kW		53.0		22.5		
28	**FAN DATA:**							
29	• TYPE OF FAN (NOTE - 05)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
30	• TYPE OF FAN BLADE	–	–	AS PER SPECIFICATIONS		AS PER SPECIFICATIONS		
31	• SUPPLY AIR VOLUME	CFM	m^3/hr	38751	65877	21205	36049	
32	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.5	375	1.0	250	
33	• MOTOR POWER	kW	kW	30.0		15.0		
34	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		
35	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		
36	• AHU MOTOR VFD COMPATIBLE	–	–	YES		YES		
37	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**							
38	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		
39	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		
40	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		
41	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		
42	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		
43	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		
44	**CONSTRUCTION:**							
45	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
46	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		
47	• MIXING BOX	–	–	YES		YES		
48	• PANEL FILTER SECTION WITH FILTERS	–	–	G-4		G-4		
49	• BAG FILTER SECTION WITH FILTERS	–	–	F-7		F-7		
50	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		
51	• RETURN AIR FAN	–	–	NO		NO		
52	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
53	• BYPASS SECTION	–	–	NO		NO		
54	• ULTRAVIOLET & GERMICIDAL IRRADIATION(UVGI) LAMP	–	–	NO		NO		
55	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		
56	• SOUND ATTENUATOR	–	–	NO		NO		

Owner Furnished
Owner Furnished

FND	**EQUIPMENT DATA SHEET**	**SHEET** 6 **OF** 6	**DATA SHEET NO.**	
		REV 1	**1606-23 73 10 & 23 84 20 - 6 / 6**	
	AIR HANDLING UNITS (PROCESS)	**PROJECT TITLE :**	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	
		PROJECT NO. :	**FND/1606**	
		LOCATION :	**KARACHI**	

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	REV
57	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mm	**5600 X 3950 X 2500**	**5300 X 2800 X 2200**	
58	• PORT HOLES	–	–	**YES (NOTE-05)**	**YES (NOTE-05)**	
59	• LIGHTS	–	–	**YES (NOTE-06)**	**YES (NOTE-06)**	
60	• MAGNEHELLIC GAUGES	–	–	**YES (NOTE-11)**	**YES (NOTE-11)**	
61	• HEAT EXCHANGER	–	–	**-**	**-**	
62						

	SPARES	QUANTITY	UNITS	REMARKS
64	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
65	(b) FAN BEARINGS	1	Set	For Each Fan
66	(c) FAN BELTS	2	Sets	For Each Fan
67	(d) FILTERS (Each Type)	2	Sets	For Each AHU

NOTES:

1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

3) AHU PANEL THICKNESS SHALL BE 50MM.

4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.

6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.

7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS:
- FILTER SECTIONS - 4 PER SECTIONS
- FAN SECTIONS - 2 PER SECTIONS

8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.

9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.

10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.

11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.

12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 150MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.

13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS

14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)

15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.

16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL

17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.

18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501

19) VFD SHALL BE PROVIDED WITH DC CHOKE.

20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.

21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.

22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE

23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.

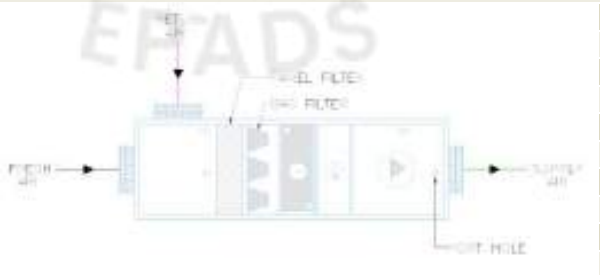
24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION) IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.

24) CABLE GLANDS TO BE PROVIDED IN ALL SECTIONS FOR BMS SENSORS AND WIRES. IN FAN SECTION PROVIDE CABLE GLANDS FOR MOTOR POWER.

26) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14

27) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 33

28) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.



	REVISION	0	1	
	STATUS	**ISSUED FOR TENDER**	**ISSUED FOR TENDER**	
	DATE	**28/02/2025**	**12/09/2025**	
	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED BY	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	**EQUIPMENT DATA SHEET**	**SHEET** 1 **OF** 6		**DATA SHEET NO.**	
		REV 1		1606 -23 73 10 - 1 / 6	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATI		
	AIR HANDLING UNITS	**PROJECT NO. :**	FND/1606		
		LOCATION :	KARACHI		

	DESCRIPTION	UNIT		DATA						REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	AHU / GF-03		AHU / GF-08		AHU / GF-11		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		23 73 10		
3	QUANTITY	No.	No.	1		1		1		
4	FND CALC. REF. NO.:	–	–	–		–		–		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	32.8	10	
6	APPLICATION	–	–	SHEET EXAMINATION HALL		PRODUCTION OFFICE + MEDICAL CENTER		ENGINEERING OFFICE + MRP PACKING / RECEIVING		
7	**COOLING COIL DATA:**									
8	• TOTAL COOLING COIL LOAD	MBH	kW	956	280	389	114	360	106	
9	• SENSIBLE COIL LOAD	MBH	kW	678	199	311	91	309	91	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	29,991	50,955	13,791	23,431	16,576	28,163	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	4218	7,166	1368	2,324	747	1,269	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	-	-	-	-	-	-	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	78.4 / 66.8	25.8 / 19.3	78.4 / 65.6	25.7 / 18.7	74.3 / 63.4	23.5 / 17.4	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	57.4 / 56.4	14.1 / 13.6	57.5 / 56.3	14.2 / 13.5	57 / 56	13.9 / 13.3	
15	• WATER FLOW RATE	USGPM	L / min	127	483	52	196	48	182	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	42/57	5.6/13.9	
17	• COIL TYPE	–	–	CHILLED WATER		CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		12		
20	• COATED COILS	–	–	NO		NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	–		–		–		
22	**FAN DATA: (SUPPLY FAN)**									
23	• TYPE OF FAN (NOTE - 04)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
24	• TYPE OF FAN BLADE	–	–	BACKWARD CURVE		BACKWARD CURVE		BACKWARD CURVE		
25	• SUPPLY AIR VOLUME	CFM	m^3/hr	29,991	50,985	13,791	23,445	16,576	28,179	
26	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.50	375	1.50	375	
27	• MOTOR POWER	kW	kW	22.0		11.0		15.0		
28	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		400/3/50		
29	• FAN MOTOR VOLTAGE VARIATION	–		±10%		±10%		±10%		
30	• AHU MOTOR WITH VFD	–		YES		YES		YES		
31	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**									
32	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		D1		
33	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		L2		
34	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		L2		
35	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		≤1 (F8)		
36	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		T2		
37	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		TB2		
38	**CONSTRUCTION:**									
39	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
40	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		NOT REQUIRED		
41	• MIXING BOX	–	–	YES		YES		YES		
42	• PANEL FILTER	–	–	G4		G4		G4		
43	• BAG FILTER	–	–	F7		F7		F7		
44	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		NO		
45	• RETURN AIR FAN	–	–	NO		NO		NO		
46	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
47	• BYPASS SECTION	–	–	NO		NO		NO		
48	• ULTRAVIOLET & GERMICIDAL IRRADIATION (UVGI) LAMP (AIRBORNE TYPE)	–	–	NO		NO		NO		
49	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		NO		
50	• SOUND ATTENUATOR	–	–	NO		NO		NO		
51	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mmxmmxmm	4650 X 3350 X 2350		4200 X 2200 X 1900		4350 X 2350 X 1900		
52	• VIEW PORT	–	–	YES (NOTE-05)		YES (NOTE-05)		YES (NOTE-05)		
53	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		YES (NOTE-06)		
54	• MAGNEHELLIC GAUGES (0 - 5 Inch of WG)	–	–	YES (NOTE-11)		YES (NOTE-11)		YES (NOTE-11)		
55	• HEAT EXCHANGER	–	–	–		–		–		
56										

	SPARES	QUANTITY	UNITS	REMARKS
57	**SPARES**	**QUANTITY**	**UNITS**	**REMARKS**
58	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
59	(b) FAN BEARINGS	1	Set	For Each Fan
60	(c) FAN BELTS	2	Sets	For Each Fan
61	(d) FILTERS (Each Type)	2	Sets	For Each AHU

NOTES:

1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

3) AHU PANEL THICKNESS SHALL BE 50MM.

4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

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FND	EQUIPMENT DATA SHEET AIR HANDLING UNITS	SHEET 1 OF 6 REV 1	DATA SHEET NO. 1606 -23 73 10 - 1 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATI
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DESCRIPTION	DATA UNIT								REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
67	5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.									
68	6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.									
69	7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS: - FILTER SECTIONS - 4 PER SECTIONS - FAN SECTIONS - 2 PER SECTIONS									
70	8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.									
71	9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.									
72	10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.									
73	11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.									
74	12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.									
75	13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS									
76	14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)									
77	15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.									
78	16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL									
79	17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.									
80	18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501									
81	19) VFD SHALL BE PROVIDED WITH DC CHOKE.									
82	20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.									
83	21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.									
84	22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE									
85	23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE.									
86	EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.									
87	24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)									
88	IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.									
89	25) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14.									
90	26) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 27.									
91	27) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.									
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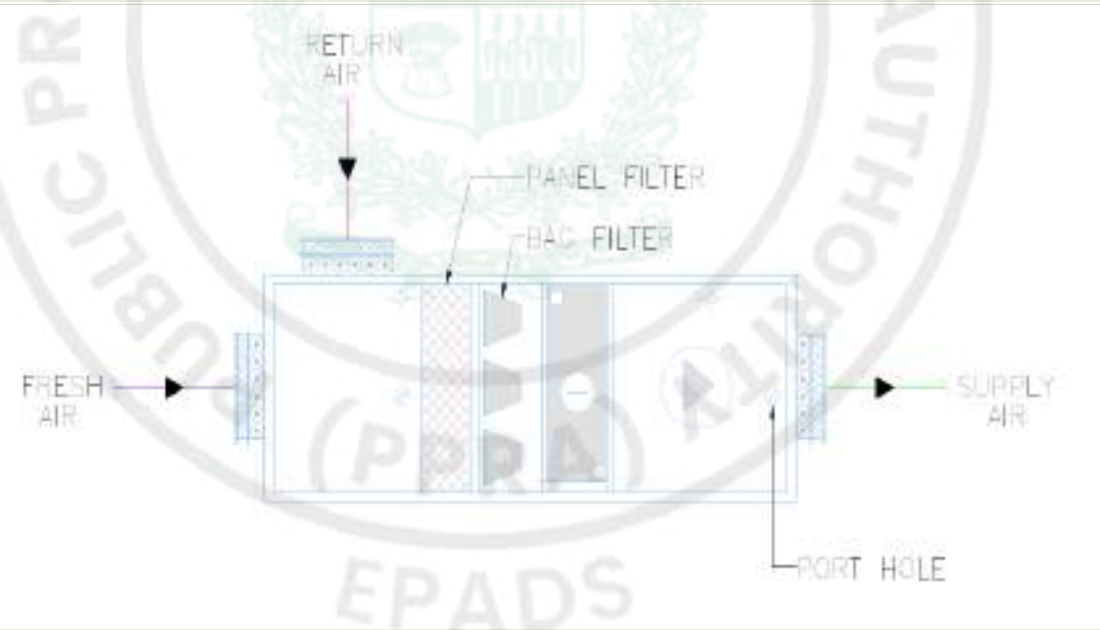

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

THE INFORMATION ON THIS DATA SHEET IS CONFIDENTIAL TO FAHIM, NANJI & DESOUZA (PVT.) LTD
AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	**EQUIPMENT DATA SHEET**	**SHEET** 2 **OF** 6	**DATA SHEET NO.**	
		REV 1	1606 -23 73 10 - 2 / 6	
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	
	AIR HANDLING UNITS	**PROJECT NO. :**	**FND/1606**	
		LOCATION :	**KARACHI**	

	DESCRIPTION	UNIT		DATA						REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	AHU / OF-BF-01		AHU / OF-GF-01		AHU / OF-1F-01		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		23 73 10		
3	QUANTITY	No.	No.	1		1		1		
4	FND CALC. REF. NO.:	–	–	–		–		–		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	32.8	10	
6	APPLICATION	–	–	OFFICE BLOCK (BASEMENT)		OFFICE BLOCK (GROUND FLOOR)		OFFICE BLOCK (1ST FLOOR)		
7	**COOLING COIL DATA:**									
8	• TOTAL COOLING COIL LOAD	MBH	kW	190	56	260	76	261	76	
9	• SENSIBLE COIL LOAD	MBH	kW	126	37	193	57	193	57	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	4,226	7,180	5,838	9,919	5,838	9,919	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	1000	1,699	1000	1,699	1000	1,699	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	-	-	-	-	-	-	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	82.5 / 68.8	28 / 20.4	84.8 / 67.6	29.3 / 19.8	84.8 / 67.6	29.3 / 19.8	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	54.9 / 53.8	12.7 / 12.1	54.1 / 52.7	12.3 / 11.5	54.1 / 52.7	12.3 / 11.5	
15	• WATER FLOW RATE	USGPM	L / min	25	96	35	131	35	132	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	42/57	5.6/13.9	
17	• COIL TYPE	–	–	CHILLED WATER		CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		12		
20	• COATED COILS	–	–	NO		NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	–		–		–		
22	**FAN DATA: (SUPPLY FAN)**									
23	• TYPE OF FAN (NOTE - 04)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
24	• TYPE OF FAN BLADE	–	–	BACKWARD CURVE		BACKWARD CURVE		BACKWARD CURVE		
25	• SUPPLY AIR VOLUME	CFM	m^3/hr	4,226	7,184	5,838	9,925	5,838	9,925	
26	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.00	250	1.00	250	1.00	250	
27	• MOTOR POWER	kW	kW	4.0		5.5		5.5		
28	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		400/3/50		
29	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		±10%		
30	• AHU MOTOR WITH VFD	–	–	YES		YES		YES		
31	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**									
32	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		D1		
33	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		L2		
34	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		L2		
35	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		≤1 (F8)		
36	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T1		T1		T1		
37	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB1		TB1		TB1		
38	**CONSTRUCTION:**									
39	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
40	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		NOT REQUIRED		
41	• MIXING BOX	–	–	YES		YES		YES		
42	• PANEL FILTER	–	–	G4		G4		G4		
43	• BAG FILTER	–	–	F7		F7		F7		
44	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		NO		
45	• RETURN AIR FAN	–	–	NO		NO		NO		
46	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
47	• BYPASS SECTION	–	–	NO		NO		NO		
48	• ULTRAVIOLET &/GERMICIDAL IRRADIATION (UVGI) LAMP (AIRBORNE TYPE)	–	–	NO		NO		NO		
49	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	YES		YES		YES		
50	• SOUND ATTENUATOR	–	–	NO		NO		NO		
51	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mmxmmxmm	3200 X 1600 X 1150		3200 X 1600 X 1150		3200 X 1600 X 1150		
52	• VIEW PORT	–	–	YES (NOTE-05)		YES (NOTE-05)		YES (NOTE-05)		
53	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		YES (NOTE-06)		
54	• MAGNEHELLIC GAUGES (0 - 5 Inch of WG)	–	–	YES (NOTE-11)		YES (NOTE-11)		YES (NOTE-11)		
55	• HEAT EXCHANGER	–	–	–		–		–		
56										

	SPARES	QUANTITY	UNITS	REMARKS
57	**SPARES**	**QUANTITY**	**UNITS**	**REMARKS**
58	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
59	(b) FAN BEARINGS	1	Set	For Each Fan
60	(c) FAN BELTS	2	Sets	For Each Fan
61	(d) FILTERS (Each Type)	2	Sets	For Each AHU

62 **NOTES:**

63 1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

64 2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

65 3) AHU PANEL THICKNESS SHALL BE 50MM.

66 4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

Reviewed

FND	EQUIPMENT DATA SHEET	SHEET 2 OF 6	DATA SHEET NO.	
		REV 1	1606 -23 73 10 - 2 / 6	
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	AIR HANDLING UNITS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	DATA								REV
		UNIT								
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
67	5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.									
68	6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.									
69	7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS: - FILTER SECTIONS - 4 PER SECTIONS - FAN SECTIONS - 2 PER SECTIONS									
70	8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.									
71	9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.									
72	10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.									
73	11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.									
74	12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.									
75	13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS									
76	14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)									
77	15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.									
78	16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL									
79	17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.									
80	18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501									
81	19) VFD SHALL BE PROVIDED WITH DC CHOKE.									
82	20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.									
83	21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.									
84	22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE									
85	23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE.									
86	EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.									
87	24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)									
88	IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.									
89	25) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14.									
90	26) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 27.									
91	27) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.									
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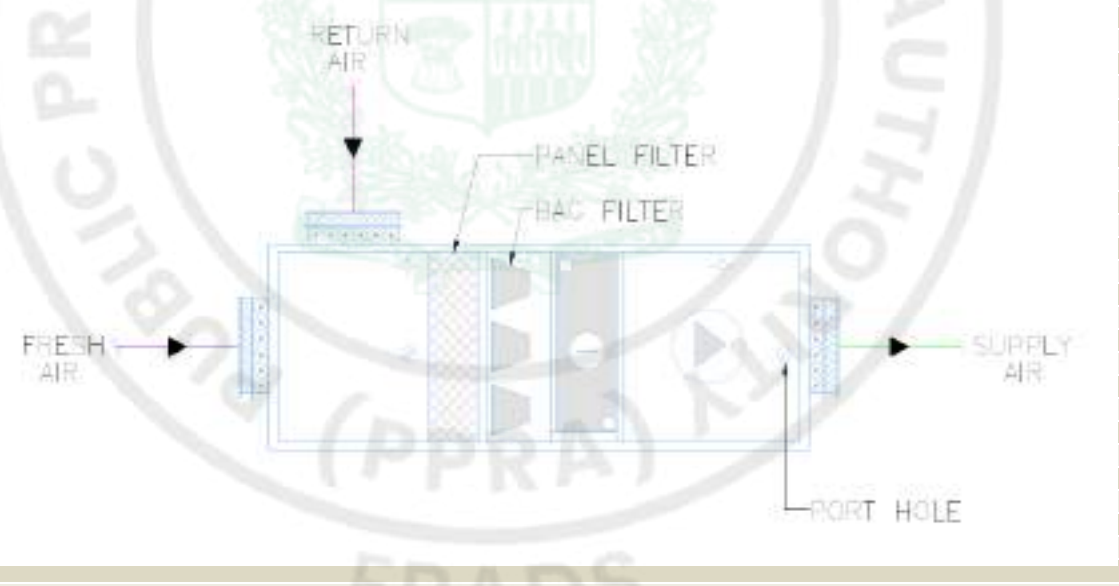

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

THE INFORMATION ON THIS DATA SHEET IS CONFIDENTIAL TO FAHIM, NANJI & DESOUZA (PVT.) LTD
AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	**EQUIPMENT DATA SHEET**	**SHEET** 3 **OF** 6	**DATA SHEET NO.**	
		REV 1	1606 -23 73 10 - 3 / 6	
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	
	AIR HANDLING UNITS	**PROJECT NO. :**	**FND/1606**	
		LOCATION :	**KARACHI**	

	DESCRIPTION	UNIT		DATA						REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	–	–	AHU / OF-2F-01		AHU / OF-3F-01		AHU / OF-4F-01		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		23 73 10		
3	QUANTITY	No.	No.	1		1		1		
4	FND CALC. REF. NO.:	–	–	–		–		–		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	32.8	10	
6	APPLICATION	–	–	OFFICE BLOCK (2ND FLOOR)		OFFICE BLOCK (3RD FLOOR)		OFFICE BLOCK (4TH FLOOR)		
7	**COOLING COIL DATA:**									
8	• TOTAL COOLING COIL LOAD	MBH	kW	261	76	261	76	289	85	
9	• SENSIBLE COIL LOAD	MBH	kW	193	57	193	57	221	65	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	5,838	9,919	5,838	9,919	6,684	11,356	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	1000	1,699	1000	1,699	1000	1,699	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	-	-	-	-	-	-	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	84.8 / 67.6	29.3 / 19.8	84.8 / 67.6	29.3 / 19.8	84.8 / 67.2	29.3 / 19.6	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	54.1 / 52.7	12.3 / 11.5	54.1 / 52.7	12.3 / 11.5	54.1 / 52.6	12.3 / 11.5	
15	• WATER FLOW RATE	USGPM	L / min	35	132	35	132	38	146	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	42/57	5.6/13.9	
17	• COIL TYPE	–	–	CHILLED WATER		CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		12		
20	• COATED COILS	–	–	NO		NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	–		–		–		
22	**FAN DATA: (SUPPLY FAN)**									
23	• TYPE OF FAN (NOTE - 04)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
24	• TYPE OF FAN BLADE	–	–	BACKWARD CURVE		BACKWARD CURVE		BACKWARD CURVE		
25	• SUPPLY AIR VOLUME	CFM	m^3/hr	5,838	9,925	5,838	9,925	6,684	11,363	
26	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.00	250	1.00	250	1.00	250	
27	• MOTOR POWER	kW	kW	5.5		5.5		5.5		
28	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		400/3/50		
29	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		±10%		
30	• AHU MOTOR WITH VFD	–	–	YES		YES		YES		
31	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**									
32	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		D1		
33	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		L2		
34	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		L2		
35	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		≤1 (F8)		
36	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T1		T1		T1		
37	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB1		TB1		TB1		
38	**CONSTRUCTION:**									
39	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
40	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		NOT REQUIRED		
41	• MIXING BOX	–	–	YES		YES		YES		
42	• PANEL FILTER	–	–	G4		G4		G4		
43	• BAG FILTER	–	–	F7		F7		F7		
44	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		NO		
45	• RETURN AIR FAN	–	–	NO		NO		NO		
46	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
47	• BYPASS SECTION	–	–	NO		NO		NO		
48	• ULTRAVIOLET & GERMICIDAL IRRADIATION (UVGI) LAMP (AIRBORNE TYPE)	–	–	NO		NO		NO		
49	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	YES		YES		YES		
50	• SOUND ATTENUATOR	–	–	NO		NO		NO		
51	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mmxmmxmm	3200 X 1600 X 1150		3200 X 1600 X 1150		3200 X 1600 X 1150		
52	• VIEW PORT	–	–	YES (NOTE-05)		YES (NOTE-05)		YES (NOTE-05)		
53	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		YES (NOTE-06)		
54	• MAGNEHELLIC GAUGES (0 - 5 Inch of WG)	–	–	YES (NOTE-11)		YES (NOTE-11)		YES (NOTE-11)		
55	• HEAT EXCHANGER	–	–	–		–		–		
56										

	SPARES	QUANTITY	UNITS	REMARKS
57	**SPARES**	**QUANTITY**	**UNITS**	**REMARKS**
58	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
59	(b) FAN BEARINGS	1	Set	For Each Fan
60	(c) FAN BELTS	2	Sets	For Each Fan
61	(d) FILTERS (Each Type)	2	Sets	For Each AHU

62 **NOTES:**

63 1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

64 2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

65 3) AHU PANEL THICKNESS SHALL BE 50MM.

66 4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

Reviewed for Bidding Purposes Only

FND	EQUIPMENT DATA SHEET	SHEET 3 OF 6		DATA SHEET NO.
		REV 1		1606 -23 73 10 - 3 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
	AIR HANDLING UNITS	PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	DATA								REV
		UNIT								
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
67	5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.									
68	6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.									
69	7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS: - FILTER SECTIONS - 4 PER SECTIONS - FAN SECTIONS - 2 PER SECTIONS									
70	8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.									
71	9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.									
72	10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.									
73	11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.									
74	12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.									
75	13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS									
76	14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)									
77	15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.									
78	16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL									
79	17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.									
80	18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501									
81	19) VFD SHALL BE PROVIDED WITH DC CHOKE.									
82	20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.									
83	21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.									
84	22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE									
85	23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE.									
86	EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.									
87	24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)									
88	IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.									
89	25) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14.									
90	26) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 27.									
91	27) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.									
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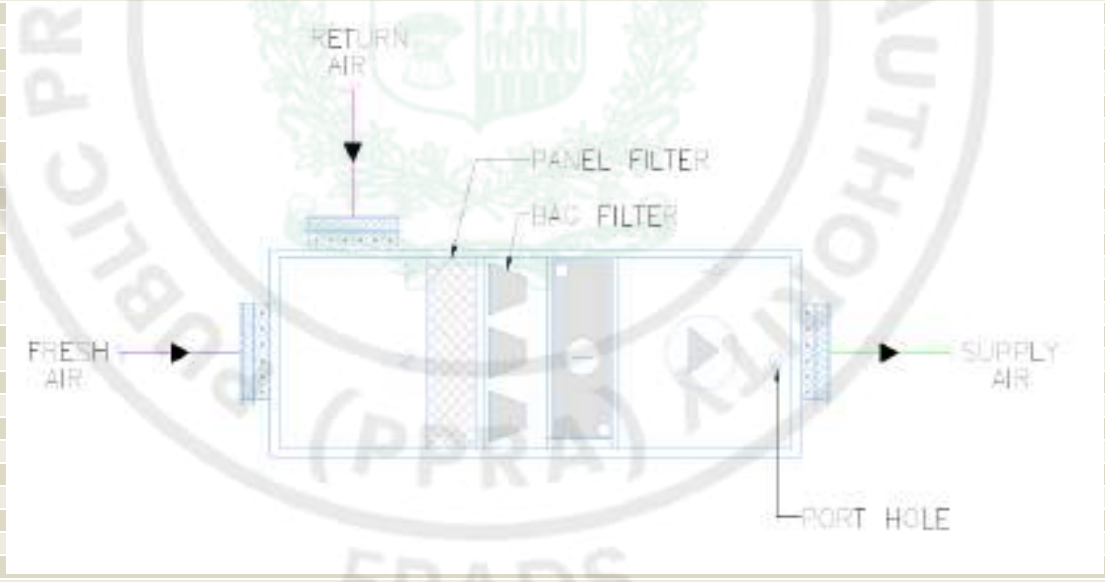
94										
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	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	EQUIPMENT DATA SHEET AIR HANDLING UNITS	SHEET 4 OF 6 REV 1	DATA SHEET NO. 1606 -23 73 10 - 4 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	REV
1	IDENTIFICATION SYMBOL	–	–	AHU / GF-14		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		
3	QUANTITY	No.	No.	1		
4	FND CALC. REF. NO.:	–	–	–		
5	ALTITUDE AMSL	FT	m	32.8	10	
6	APPLICATION	–	–	CORRIDOR		
7	**COOLING COIL DATA:**					
8	• TOTAL COOLING COIL LOAD	MBH	kW	2038	597	
9	• SENSIBLE COIL LOAD	MBH	kW	1119	328	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	28,835	48,991	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	18452	31,350	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	-	-	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	92.4 / 76.3	33.6 / 24.6	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	56.4 / 55.4	13.6 / 13	
15	• WATER FLOW RATE	USGPM	L / min	272	1029	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	
17	• COIL TYPE	–	–	CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		
20	• COATED COILS	–	–	NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	–		
22	**FAN DATA: (SUPPLY FAN)**					
23	• TYPE OF FAN (NOTE - 04)	–	–	PLUG FAN / BELT DRIVEN FAN		
24	• TYPE OF FAN BLADE	–	–	BACKWARD CURVE		
25	• SUPPLY AIR VOLUME	CFM	m^3/hr	28,835	49,020	
26	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.80	450	
27	• MOTOR POWER	kW	kW	22.0		
28	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		
29	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		
30	• AHU MOTOR WITH VFD	–	–	YES		
31	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**					
32	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		
33	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		
34	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		
35	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		
36	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		
37	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		
38	**CONSTRUCTION:**					
39	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW-THROUGH		
40	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		
41	• MIXING BOX	–	–	YES		
42	• PANEL FILTER	–	–	G4		
43	• BAG FILTER	–	–	F7		
44	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		
45	• RETURN AIR FAN	–	–	NO		
46	• EMPTY/ACCESS SECTION	–		AS PER MANUFACTURER RECOMMENDATION		
47	• BYPASS SECTION	–	–	NO		
48	• ULTRAVIOLET & GERMICIDAL IRRADIATION (UVGI) LAMP (AIRBORNE TYPE)	–	–	NO		
49	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		
50	• SOUND ATTENUATOR	–	–	NO		
51	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)		mmxmmxmm	4650 X 3100 X 2350		
52	• VIEW PORT	–	–	YES (NOTE-05)		
53	• LIGHTS	–	–	YES (NOTE-06)		
54	• MAGNEHELLIC GAUGES (0 - 5 Inch of WG)	–	–	YES (NOTE-11)		
55	• HEAT EXCHANGER	–	–	–		
56						

57	SPARES	QUANTITY	UNITS	REMARKS
58	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
59	(b) FAN BEARINGS	1	Set	For Each Fan
60	(c) FAN BELTS	2	Sets	For Each Fan
61	(d) FILTERS (Each Type)	2	Sets	For Each AHU

62 **NOTES:**

63 1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

64 2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

65 3) AHU PANEL THICKNESS SHALL BE 50MM.

66 4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

67 5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.

Owner Furnished

	DESCRIPTION	DATA UNIT (IPS)	(SI)	(IPS)	(SI)	REV
68	6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.					
69	7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS: - FILTER SECTIONS - 4 PER SECTIONS - FAN SECTIONS - 2 PER SECTIONS					
70	8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.					
71	9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.					
72	10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.					
73	11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.					
74	12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.					
75	13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS					
76	14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)					
77	15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.					
78	16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL					
79	17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.					
80	18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501					
81	19) VFD SHALL BE PROVIDED WITH DC CHOKE.					
82	20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.					
83	21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.					
84	22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE					
85	23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE.					
86	EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.					
87	24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)					
88	IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.					
89	25) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14.					
90	26) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 27.					
91	27) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.					
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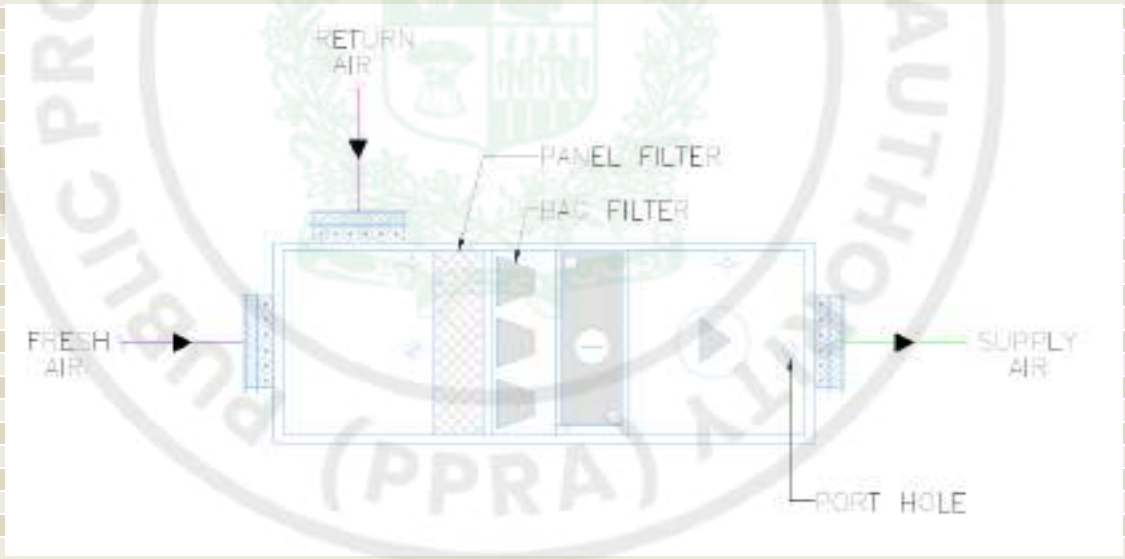

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	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
	CHECKED / SIGN.	DANIAL ABDUL AZIZ	DANIAL ABDUL AZIZ	
	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	EQUIPMENT DATA SHEET AIR HANDLING UNITS	SHEET 5 OF 6 REV 1	DATA SHEET NO. 1606 -23 73 10 - 5 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
1	IDENTIFICATION SYMBOL	–	–	AHU / BF-03		AHU / GF-10		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		
3	QUANTITY	No.	No.	1		1		
4	FND CALC. REF. NO.:	–	–	–		–		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	
6	APPLICATION	–	–	VAULT AREA		WORKSHOP + ENGINEER STORE + OFFICE		
7	**COOLING COIL DATA:**							
8	• TOTAL COOLING COIL LOAD	MBH	kW	85	25	207	61	
9	• SENSIBLE COIL LOAD	MBH	kW	51	15	151	44	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	2,202	3,741	6,254	10,626	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	696	1,183	945	1,606	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	696	1,183	2761	4,691	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	81.7 / 70.9	27.6 / 21.6	78.9 / 66.3	26.1 / 19.1	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	60.1 / 59.2	15.6 / 15.1	56.5 / 55.4	13.6 / 13.0	
15	• WATER FLOW RATE	USGPM	L / min	11	43	28	104	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	
17	• COIL TYPE	–	–	CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		
20	• COATED COILS	–	–	NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	–		–		
22	**FAN DATA: (SUPPLY FAN)**							
23	• TYPE OF FAN (NOTE - 04)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
24	• TYPE OF FAN BLADE		–	BACKWARD CURVE		BACKWARD CURVE		
25	• SUPPLY AIR VOLUME	CFM	m^3/hr	2,202	3,743	6,254	10,632	
26	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.00	250	
27	• MOTOR POWER	kW	kW	2.2		5.5		
28	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		
29	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		
30	• AHU MOTOR WITH VFD	–	–	YES		YES		
31	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**							
32	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		
33	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		
34	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		
35	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		
36	• THERMAL TRANSMITTAMCE (U) OF CASING (EN1886)	–	–	T2		T2		
37	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		
38	**CONSTRUCTION:**							
39	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
40	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		
41	• MIXING BOX	–	–	YES		YES		
42	• PANEL FILTER	–	–	G4		G4		
43	• BAG FILTER	–	–	F7		F7		
44	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		
45	• RETURN AIR FAN	–	–	NO		NO		
46	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
47	• BYPASS SECTION	–	–	NO		NO		
48	• ULTRAVIOLET & GERMICIDAL IRRADIATION (UVGI) LAMP (AIRBORNE TYPE)	–	–	NO		NO		
49	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		
50	• SOUND ATTENUATOR	–	–	NO		NO		
51	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mmxmmxmm	2950 X 1300 X 850		3200 X 1600 X 1300		
52	• VIEW PORT	–	–	YES (NOTE-05)		YES (NOTE-05)		
53	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		
54	• MAGNEHELLIC GAUGES (0 - 5 Inch of WG)	–	–	YES (NOTE-11)		YES (NOTE-11)		
55	• HEAT EXCHANGER	–	–	–		–		
56								

57	SPARES	QUANTITY	UNITS	REMARKS
58	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
59	(b) FAN BEARINGS	1	Set	For Each Fan
60	(c) FAN BELTS	2	Sets	For Each Fan
61	(d) FILTERS (Each Type)	2	Sets	For Each AHU

62 **NOTES:**

63 1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

64 2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

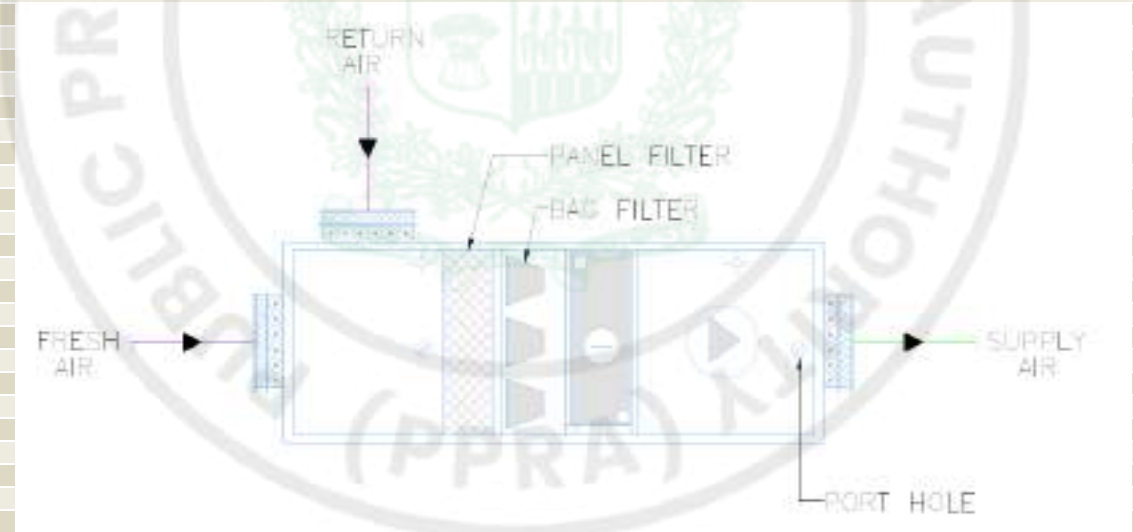
65 3) AHU PANEL THICKNESS SHALL BE 50MM.

66 4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

Owner Furnished

FND	EQUIPMENT DATA SHEET	SHEET 5 OF 6		DATA SHEET NO.
		REV 1		1606 -23 73 10 - 5 / 6
	AIR HANDLING UNITS	PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION	
		PROJECT NO. :	FND/1606	
		LOCATION :	KARACHI	

	DESCRIPTION	DATA UNIT (IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	REV
67	5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.							
68	6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.							
69	7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS: - FILTER SECTIONS - 4 PER SECTIONS - FAN SECTIONS - 2 PER SECTIONS							
70	8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.							
71	9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.							
72	10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.							
73	11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.							
74	12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.							
75	13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS							
76	14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)							
77	15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.							
78	16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL							
79	17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.							
80	18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501							
81	19) VFD SHALL BE PROVIDED WITH DC CHOKE.							
82	20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.							
83	21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.							
84	22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE							
85	23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE.							
86	EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.							
87	24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)							
88	IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.							
89	25) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14.							
90	26) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 27.							
91	27) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.							



	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
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	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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AND SHALL NOT BE DISCLOSED TO A THIRD PARTY WITHOUT PRIOR WRITTEN PERMISSION

FND	EQUIPMENT DATA SHEET AIR HANDLING UNITS	SHEET 6 OF 6 REV 1	DATA SHEET NO. 1606 -23 73 10 - 6 / 6
		PROJECT TITLE :	REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
		PROJECT NO. :	FND/1606
		LOCATION :	KARACHI

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)	REV
1	IDENTIFICATION SYMBOL	–	–	AHU / BF-02		AHU / GF-07B		AHU / GF-09		
2	SPECIFICATIONS REFERENCE	–	–	23 73 10		23 73 10		23 73 10		
3	QUANTITY	No.	No.	1		1		1		
4	FND CALC. REF. NO.:	–	–	–		–		–		
5	ALTITUDE AMSL	FT	m	32.8	10	32.8	10	32.8	10	
6	APPLICATION	–	–	WIPING SOLUTION RECYCLING PLANT		NFC STRONG ROOM		NJ STAMP		
7	**COOLING COIL DATA:**									
8	• TOTAL COOLING COIL LOAD	MBH	kW	707	207	163	48	109	32	
9	• SENSIBLE COIL LOAD	MBH	kW	699	205	163	48	90	26	
10	• SUPPLY AIR VOLUME	CFM	m^3/hr	36,183	61,475	5,863	9,961	3,651	6,203	
11	• MAKEUP AIR VOLUME	CFM	m^3/hr	-	-	-	-	-	-	
12	• RELIEF AIR VOLUME	CFM	m^3/hr	4404	7,482	2760	4,689	1515	2,574	
13	• ENTERING AIR, DRY BULB/WET BULB	°F	°C	72.9 / 60.8	22.7 / 16.0	79.9 / 48.2	26.6 / 9.0	80.2 / 63.8	26.8 / 17.7	
14	• LEAVING AIR, DRY BULB/WET BULB	°F	°C	55.0 / 53.8	12.8 / 12.1	54.1 / 35.0	12.3 / 1.7	54.1 / 52.6	12.3 / 11.4	
15	• WATER FLOW RATE	USGPM	L / min	94	357	22	82	15	55	
16	• ENTERING WATER TEMP./LEAVING WATER TEMP.	°F	°C	42/57	5.6/13.9	42/57	5.6/13.9	42/57	5.6/13.9	
17	• COIL TYPE	–	–	CHILLED WATER		CHILLED WATER		CHILLED WATER		
18	• MINIMUM ROWS	Nos.	Nos.	4		4		4		
19	• MAXIMUM FINS/INCH	Nos/Inch	–	12		12		12		
20	• COATED COILS	–	–	NO		NO		NO		
21	• SATURATED SUCTION TEMPERATURE	°F	°C	–		–		–		
22	**FAN DATA: (SUPPLY FAN)**									
23	• TYPE OF FAN (NOTE - 04)	–	–	PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		PLUG FAN / BELT DRIVEN FAN		
24	• TYPE OF FAN BLADE	–	–	BACKWARD CURVE		BACKWARD CURVE		BACKWARD CURVE		
25	• SUPPLY AIR VOLUME	CFM	m^3/hr	36,183	61,511	5,863	9,967	3,651	6,207	
26	• EXTERNAL STATIC PRESSURE (NOTE-1)	Inch of WG	Pascal	1.50	375	1.50	375	1.50	375	
27	• MOTOR POWER	kW	kW	30.0		5.5		3.0		
28	• POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50		400/3/50		
29	• FAN MOTOR VOLTAGE VARIATION	–	–	±10%		±10%		±10%		
30	• AHU MOTOR WITH VFD	–	–	YES		YES		YES		
31	**MECHANICAL PERFORMANCE OF CASING-EN 1886 (2007):**									
32	• MECHANICAL STRENGTH OF CASING (EN1886)	–	–	D1		D1		D1		
33	• CASING AIR LEAKAGE (at 400 Pa Negative Pressure) (EN1886)	–	–	L2		L2		L2		
34	• CASING AIR LEAKAGE (at 700 Pa Positive Pressure) (EN1886)	–	–	L2		L2		L2		
35	• FILTER BYPASS LEAKAGE (Maximum filter bypass leakage rate as % of nominal flow rate) (EN1886)	–	–	≤1 (F8)		≤1 (F8)		≤1 (F8)		
36	• THERMAL TRANSMITTANCE (U) OF CASING (EN1886)	–	–	T2		T2		T2		
37	• THERMAL BRIDGING OF CASING (Thermal bridging factor k_b) (EN1886)	–	–	TB2		TB2		TB2		
38	**CONSTRUCTION:**									
39	• TYPE	–	–	DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		DOUBLE SKIN, HORIZONTAL, DRAW THROUGH		
40	• HYGENIC MODEL (REFER SPECIFICATION NO. 23 73 10)	–	–	NOT REQUIRED		NOT REQUIRED		NOT REQUIRED		
41	• MIXING BOX	–	–	YES		YES		YES		
42	• PANEL FILTER	–	–	G4		G4		G4		
43	• BAG FILTER	–	–	NO		NO		NO		
44	• HEPA FILTER SECTION WITH FILTERS	–	–	NO		NO		NO		
45	• RETURN AIR FAN	–	–	NO		NO		NO		
46	• EMPTY/ACCESS SECTION	–	–	AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		AS PER MANUFACTURER RECOMMENDATION		
47	• BYPASS SECTION	–	–	NO		NO		NO		
48	• ULTRAVIOLET & GERMICIDAL IRRADIATION (UVGI) LAMP (AIRBORNE TYPE)	–	–	NO		NO		NO		
49	• WEATHERPROOF CONSTRUCTION & CANOPY	–	–	NO		NO		NO		
50	• SOUND ATTENUATOR	–	–	NO		NO		NO		
51	• MAXM. ALLOWABLE UNIT DIM. (L X W X H)	–	mmxmmxmm	4650 X 3650 X 2350		3200 X 1600 X 1300		3050 X 1300 X 1300		
52	• VIEW PORT	–	–	YES (NOTE-05)		YES (NOTE-05)		YES (NOTE-05)		
53	• LIGHTS	–	–	YES (NOTE-06)		YES (NOTE-06)		YES (NOTE-06)		
54	• MAGNEHELLIC GAUGES (0 - 5 Inch of WG)	–	–	YES (NOTE-11)		YES (NOTE-11)		YES (NOTE-11)		
55	• HEAT EXCHANGER	–	–	–		–		–		
56										

	SPARES	QUANTITY	UNITS	REMARKS
57	**SPARES**	**QUANTITY**	**UNITS**	**REMARKS**
58	(a) FAN MOTOR	1	Lot	One for Each kW Rating Among all AHUs
59	(b) FAN BEARINGS	1	Set	For Each Fan
60	(c) FAN BELTS	2	Sets	For Each Fan
61	(d) FILTERS (Each Type)	2	Sets	For Each AHU

NOTES:

1) EXTERNAL STATIC PRESSURE DATA INCLUDES ONLY PRESSURE DROP EXTERNAL TO AHU. PRESSURE DROP ACROSS AHU & COIL ARE NOT INCLUDED.

2) MOISTURE ELIMINATOR TO BE PROVIDED FOR COIL FACE VELOCITIES EXCEEDING 550 FPM.

3) AHU PANEL THICKNESS SHALL BE 50MM.

4) FAN IS TO BE SELECTED AT HIGHEST EFFICIENCY SEGMENT OF FAN CURVE BUT EFFICIENCY SHOULD NOT BE LESS THAN 65%.

e-Pak Acquisition and Disposal System (EPADS) generated document

	DESCRIPTION	DATA								REV
		UNIT								
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
67	5) VIEW PORT TO BE PROVIDED IN FAN SECTIONS & FILTER SECTIONS.									
68	6) LIGHT TO BE PROVIDED IN FAN SECTION & BAG FILTER ACCESS/EMPTY SECTION & SECTIONS HAVING PORT HOLES.									
69	7) PROVIDE AIR TAPS WITH CAPS FOR INSTALLATION OF MANOMETER / PRESSURE SENSORS: - FILTER SECTIONS - 4 PER SECTIONS - FAN SECTIONS - 2 PER SECTIONS									
70	8) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.									
71	9) MOTOR SHALL BE HIGH EFFICIENCY MOTORS - CLASSIFIED AS IE-3.									
72	10) DRAIN CONNECTION SHOULD BE PROVIDED WITH THREADED CONNECTION.									
73	11) MAGNEHELLIC GAUGES SHALL BE PROVIDED FOR ALL FILTERS SECTIONS & FAN SECTION. RANGE OF MAGNEHELLIC GAUGE SHALL BE 0-5 INCH OF WATER COLUMN.									
74	12) ALL AHU SECTIONS SHALL BE MOUNTED ON A GALVANISED STRUCTURAL BASE, MINIMUM 160MM HIGH, EXTENDING TO THE FULL LENGTH OF THE AIR-HANDLING UNIT.									
75	13) FILTER PRESSURE DROP SHALL BE BASED ON MEDIUM PRESSURE DROP OF FILTERS									
76	14) VFDS TO BE PROVIDED BY AHU MANUFACTURER AND SHALL BE UNIT MOUNTED. (DANFOSS/ ABB OR EQUIVALENT)									
77	15) FAN SELECTION SHALL BE CARRIED OUT AT 50 Hz OR BELOW.									
78	16) UGVI LAMP SHALL BE AT DOWNSTREAM OF COOLING COIL									
79	17) AHU SHALL BE PROVIDED WITH ISOLATOR SWITCH FOR MOTOR. WIRING FROM ISOLATOR SWITCH TO MOTOR SHALL BE IN AHU SUPPLIER SCOPE.									
80	18) VFD SHALL BE PROVIDED WITH EMC & RFI FILTERS AS PER EN 5501									
81	19) VFD SHALL BE PROVIDED WITH DC CHOKE.									
82	20) VFD SHALL BE COMPATIBLE TO COMMUNICATE WITH BMS. THE COMMUNICATION PROTOCOL SHALL BE BACNET/MSTP.									
83	21) VFD SHALL BE PROVIDED WITH IP-55 PROTECTION CLASS.									
84	22) WIRING (100% SHEILDED CABLE) FROM VFD TO MOTOR SHALL BE IN AHU SUPPLY SCOPE									
85	23) VFD KW RATING SHOULD BE SELECTED ONE SIZE HIGHER THAN THE RATED MOTOR POWER TO ACCOUNT FOR DERATING OF THE VFDS DUE TO HIGH AMBIENT TEMPERATURE.									
86	EXPECTED AMBIENT TEMPERATURE IS 45 TO 48 °C.									
87	24) VFD TO BE PROVIDED WITH BUILT-IN PROTECTION AS MENTIONED IN THE SPECIFICATIONS. IF ADDITIONAL PROTECTION (AS PER MANUFACTURER RECOMMENDATION)									
88	IS REQUIRED, KINDLY INDICATE AND PROVIDE DETAILS.									
89	25) A VARIATION OF 3% WILL BE ACCEPTABLE AGAINST ITEMS MENTIONED FROM S. NO 10 & 14.									
90	26) A VARIATION OF 10% WILL BE ACCEPTABLE AGAINST ITEM MENTIONED AT S. NO 27.									
91	27) PLUG FAN WILL BE PREFERRED OVER CENTRIFUGAL FANS.									
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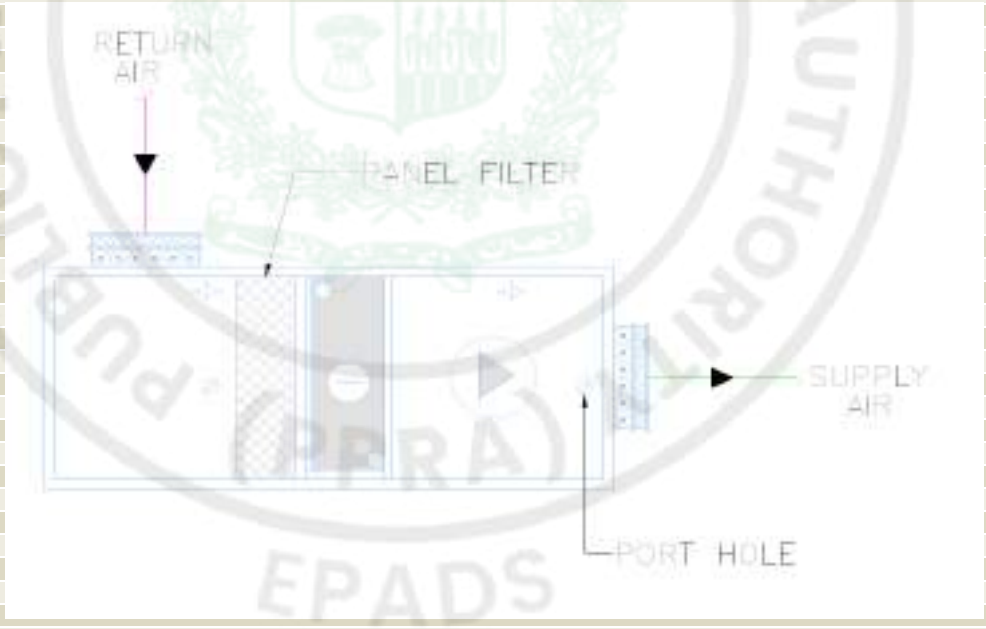

	REVISION	0	1	
	STATUS	ISSUED FOR TENDER	ISSUED FOR TENDER	
	DATE	28/02/2025	12/09/2025	
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	APPROVED BY	FAHAD ABDULLAH	FAHAD ABDULLAH	

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FND	**EQUIPMENT DATA SHEET** **ELECTRIC STEAM HUMIDIFIER, ROOM / SPACE TYPE**	**SHEET** 1 **OF** 6 **REV** 1			**DATA SHEET NO.** **1606-23 84 10 - 1 / 6**
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**		
		PROJECT NO. :	**FND/1606**		
		LOCATION :	**KARACHI**		

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)		REV
1	IDENTIFICATION SYMBOL	-	-	HM / BF-01		HM-GF-01			
2	SPECIFICATIONS REFERENCE	-	-	23 84 10		23 84 10			
3	FND CALC. REF. NO.	-	-	-		-			
4	QUANTITY	Nos.	Nos.	1		1			
5	APPLICATION	-	-	PAPER STORE (BASEMENT)		SIMULATION DEPARTMENT/ OFFSET PRINTING			
6	ALTITUDE, AMSL	FT	m	32.8	10	32.8	10		
7	SUPPLY AIR VOLUME	CFM	m^3/hr	AS PER MANUFACTURER		AS PER MANUFACTURER			
8	STEAM FLOW RATE	Lbs/hr	Kg/hr	167	76	88	40		
9	MAKE-UP WATER	USGPM	l/min	1	3.8	1	3.8		
10	CONTROL TYPE	-	-	ELECTRIC MOTOR ON / OFF CONTROL		ELECTRIC MOTOR ON / OFF CONTROL			
11	ELECTRIC POWER	HP	kW	100	74.8	50	37.4		
12	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50			
13	**CONSTRUCTION**								
14	TYPE	-	-	ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE		ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE			
15	**ACCESSORIES**								
16	• AIR FLOW SWITCH	-	-	NO		NO			
17	• STEAM DISPERSION MANIFOLD	-	-	NO		NO			
18	• STEEL MESH SCREEN INSIDE MANIFOLD	-	-	NO		NO			
19									
20									
21	**NOTES:**								
22	1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.								
23	2) APPROVED MANUFACTURERS:								
24	• CONDAIR, GERMANY								
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	REVISION	0	1	
	STATUS	**ISSUED FOR TENDER**	**ISSUED FOR TENDER**	
	DATE	**19/05/2025**	**12/09/2025**	
	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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FND	**EQUIPMENT DATA SHEET** **ELECTRIC STEAM HUMIDIFIER, ROOM / SPACE TYPE**	**SHEET** 2 **OF** 6 **REV** 1			**DATA SHEET NO.** **1606-23 84 10 - 2 / 6**
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**		
		PROJECT NO. :	**FND/1606**		
		LOCATION :	**KARACHI**		

	DESCRIPTION	UNIT		DATA				REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)	
1	IDENTIFICATION SYMBOL	-	-	**HM / GF-02**		**HM-GF-03**		
2	SPECIFICATIONS REFERENCE	-	-	**23 84 10**		**23 84 10**		
3	FND CALC. REF. NO.	-	-	**-**				
4	QUANTITY	Nos.	Nos.	**1**		**1**		
5	APPLICATION	-	-	**INTAGLIO DEPARTMENT & LITHO**		**IPM & RECTIFIER**		
6	ALTITUDE, AMSL	FT	m	**32.8**	**10**	**32.8**	**10**	
7	SUPPLY AIR VOLUME	CFM	m^3/hr	**AS PER MANUFACTURER**		**AS PER MANUFACTURER**		
8	STEAM FLOW RATE	Lbs/hr	Kg/hr	**108**	**49**	**155**	**70**	
9	MAKE-UP WATER	USGPM	l/min	**1**	**3.8**	**1**	**3.8**	
10	CONTROL TYPE	-	-	**ELECTRIC MOTOR ON / OFF CONTROL**		**ELECTRIC MOTOR ON / OFF CONTROL**		
11	ELECTRIC POWER	HP	kW	**75**	**56.1**	**100**	**74.8**	
12	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	**400/3/50**		**400/3/50**		
13	**CONSTRUCTION**							
14	TYPE	-	-	**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**		**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**		
15	**ACCESSORIES**							
16	• AIR FLOW SWITCH	-	-	**NO**		**NO**		
17	• STEAM DISPERSION MANIFOLD	-	-	**NO**		**NO**		
18	• STEEL MESH SCREEN INSIDE MANIFOLD	-	-	**NO**		**NO**		
19								
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21	**NOTES:**							
22	1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.							
23	2) APPROVED MANUFACTURERS:							
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	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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FND	**EQUIPMENT DATA SHEET** **ELECTRIC STEAM HUMIDIFIER, ROOM / SPACE TYPE**	**SHEET** 3 **OF** 6 **REV** 1		**DATA SHEET NO.** **1606-23 84 10 - 3 / 6**
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	
		PROJECT NO. :	**FND/1606**	
		LOCATION :	**KARACHI**	

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)		REV
1	IDENTIFICATION SYMBOL	-	-	**HM / GF-04**		**HM-GF-05**			
2	SPECIFICATIONS REFERENCE	-	-	**23 84 10**		**23 84 10**			
3	FND CALC. REF. NO.	-	-	**-**					
4	QUANTITY	Nos.	Nos.	**2**		**2**			
5	APPLICATION	-	-	**CTOP & COATING DEPARTMENT**		**NUMBERING DEPARTMENT**			
6	ALTITUDE, AMSL	FT	m	**32.8**	**10**	**32.8**	**10**		
7	SUPPLY AIR VOLUME	CFM	m^3/hr	**AS PER MANUFACTURER**		**AS PER MANUFACTURER**			
8	STEAM FLOW RATE	Lbs/hr	Kg/hr	**113**	**51**	**164**	**75**		
9	MAKE-UP WATER	USGPM	l/min	**1**	**3.8**	**1**	**3.8**		
10	CONTROL TYPE	-	-	**ELECTRIC MOTOR ON / OFF CONTROL**		**ELECTRIC MOTOR ON / OFF CONTROL**			
11	ELECTRIC POWER	HP	kW	**75**	**56.1**	**100**	**74.8**		
12	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	**400/3/50**		**400/3/50**			
13	**CONSTRUCTION**								
14	TYPE	-	-	**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**		**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**			
15	**ACCESSORIES**								
16	• AIR FLOW SWITCH	-	-	**NO**		**NO**			
17	• STEAM DISPERSION MANIFOLD	-	-	**NO**		**NO**			
18	• STEEL MESH SCREEN INSIDE MANIFOLD	-	-	**NO**		**NO**			
19									
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21	**NOTES:**								
22	1) IN CASE OF ANY DISCREPANCY IN THE VALUES NOTED IN IPS AND SI SYSTEM OF UNITS, VALUE NOTED IN IPS UNIT SHALL GOVERN.								
23	2) APPROVED MANUFACTURERS:								
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	DATE	**19/05/2025**	**12/09/2025**	
	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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FND	**EQUIPMENT DATA SHEET** **ELECTRIC STEAM HUMIDIFIER, ROOM / SPACE TYPE**	**SHEET** 4 **OF** 6 **REV** 1			**DATA SHEET NO.** **1606-23 84 10 - 4 / 6**
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**		
		PROJECT NO. :	**FND/1606**		
		LOCATION :	**KARACHI**		

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)		REV
1	IDENTIFICATION SYMBOL	-	-	**HM / GF-06**		**HM-GF-07**			
2	SPECIFICATIONS REFERENCE	-	-	**23 84 10**		**23 84 10**			
3	FND CALC. REF. NO.	-	-	**-**					
4	QUANTITY	Nos.	Nos.	**1**		**2**			
5	APPLICATION	-	-	**SHREDDING PLANT**		**CUTPACK MACHINE AREA**			
6	ALTITUDE, AMSL	FT	m	**32.8**	**10**	**32.8**	**10**		
7	SUPPLY AIR VOLUME	CFM	m^3/hr	**AS PER MANUFACTURER**		**AS PER MANUFACTURER**			
8	STEAM FLOW RATE	Lbs/hr	Kg/hr	**10**	**5**	**175**	**80**		
9	MAKE-UP WATER	USGPM	l/min	**1**	**3.8**	**1**	**3.8**		
10	CONTROL TYPE	-	-	**ELECTRIC MOTOR ON / OFF CONTROL**		**ELECTRIC MOTOR ON / OFF CONTROL**			
11	ELECTRIC POWER	HP	kW	**5**	**3.7**	**100**	**74.8**		
12	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	**220/1/50**		**400/3/50**			
13	**CONSTRUCTION**								
14	TYPE	-	-	**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**		**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**			
15	**ACCESSORIES**								
16	• AIR FLOW SWITCH	-	-	**NO**		**NO**			
17	• STEAM DISPERSION MANIFOLD	-	-	**NO**		**NO**			
18	• STEEL MESH SCREEN INSIDE MANIFOLD	-	-	**NO**		**NO**			
19									
20									
21	**NOTES:**								
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FND	**EQUIPMENT DATA SHEET** **ELECTRIC STEAM HUMIDIFIER, ROOM / SPACE TYPE**	**SHEET** 5 **OF** 6 **REV** 1			**DATA SHEET NO.** **1606-23 84 10 - 5 / 6**
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**		
		PROJECT NO. :	**FND/1606**		
		LOCATION :	**KARACHI**		

	DESCRIPTION	UNIT (IPS)	UNIT (SI)	DATA (IPS)	DATA (SI)	DATA (IPS)	DATA (SI)		REV
1	IDENTIFICATION SYMBOL	-	-	HM / GF-08		HM-GF-09			
2	SPECIFICATIONS REFERENCE	-	-	23 84 10		23 84 10			
3	FND CALC. REF. NO.	-	-	-					
4	QUANTITY	Nos.	Nos.	1		1			
5	APPLICATION	-	-	MRP DEPARTMENT		PAPER STORE (GROUND FLOOR)			
6	ALTITUDE, AMSL	FT	m	32.8	10	32.8	10		
7	SUPPLY AIR VOLUME	CFM	m^3/hr	AS PER MANUFACTURER		AS PER MANUFACTURER			
8	STEAM FLOW RATE	Lbs/hr	Kg/hr	43	20	20	9		
9	MAKE-UP WATER	USGPM	l/min	1	3.8	1	3.8		
10	CONTROL TYPE	-	-	ELECTRIC MOTOR ON / OFF CONTROL		ELECTRIC MOTOR ON / OFF CONTROL			
11	ELECTRIC POWER	HP	kW	75	56.1	15	11.2		
12	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	400/3/50		400/3/50			
13	**CONSTRUCTION**								
14	TYPE	-	-	ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE		ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE			
15	**ACCESSORIES**								
16	• AIR FLOW SWITCH	-	-	NO		NO			
17	• STEAM DISPERSION MANIFOLD	-	-	NO		NO			
18	• STEEL MESH SCREEN INSIDE MANIFOLD	-	-	NO		NO			
19									
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21	**NOTES:**								
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	REVISION	0	1	
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	CHECKED / SIGN.	**DANIAL ABDUL AZIZ**	**DANIAL ABDUL AZIZ**	
	APPROVED	**FAHAD ABDULLAH**	**FAHAD ABDULLAH**	

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FND	**EQUIPMENT DATA SHEET** **ELECTRIC STEAM HUMIDIFIER, ROOM / SPACE TYPE**	**SHEET**	**6**	**OF**	**6**
		REV	**1**		**DATA SHEET NO.** **1606-23 84 10 - 6 / 6**
		PROJECT TITLE :	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**		
		PROJECT NO. :	**FND/1606**		
		LOCATION :	**KARACHI**		

	DESCRIPTION	UNIT		DATA					REV
		(IPS)	(SI)	(IPS)	(SI)	(IPS)	(SI)		
1	IDENTIFICATION SYMBOL	-	-	**HM / GF-10**		**HM-GF-11**			
2	SPECIFICATIONS REFERENCE	-	-	**23 84 10**		**23 84 10**			
3	FND CALC. REF. NO.	-	-	**-**					
4	QUANTITY	Nos.	Nos.	**1**		**1**			
5	APPLICATION	-	-	**STATIONARY**		**STRONG ROOM**			
6	ALTITUDE, AMSL	FT	m	**32.8**	**10**	**32.8**	**10**		
7	SUPPLY AIR VOLUME	CFM	m^3/hr	**AS PER MANUFACTURER**		**AS PER MANUFACTURER**			
8	STEAM FLOW RATE	Lbs/hr	Kg/hr	**540**	**245**	**108**	**49**		
9	MAKE-UP WATER	USGPM	l/min	**1**	**3.8**	**1**	**3.8**		
10	CONTROL TYPE	-	-	**ELECTRIC MOTOR ON / OFF CONTROL**		**ELECTRIC MOTOR ON / OFF CONTROL**			
11	ELECTRIC POWER	HP	kW	**38**	**28.1**	**75**	**56.1**		
12	POWER SUPPLY	V/Ph/Hz	V/Ph/Hz	**400/3/50**		**400/3/50**			
13	**CONSTRUCTION**								
14	TYPE	-	-	**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**		**ELECTRIC STEAM TYPE WITH BLOWER PACK TO BE INSTALLED INSIDE ROOM / SPACE**			
15	**ACCESSORIES**								
16	• AIR FLOW SWITCH	-	-	**NO**		**NO**			
17	• STEAM DISPERSION MANIFOLD	-	-	**NO**		**NO**			
18	• STEEL MESH SCREEN INSIDE MANIFOLD	-	-	**NO**		**NO**			
19									
20									
21	**NOTES:**								
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SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

INSTALLATION GUIDE LINES:

1 Work shall be carried out in accordance with the 16th Edition of the IEE/UK "Regulations for Electrical Installations", and to the requirements of the Electrical Inspector.

2 Ratings and data given are nominal and indicative only. Contractor shall supply cabling and switch gear that is compatible with the supplied. HVAC/mechanical equipment ratings.

3 Power cabling shall be PVC/PVC 600/1000V grade copper conductor cable run in raceway, as follows:

- Medium-duty (1.5mm) hot dipped galvanized after fabrication (HDGAF), perforated (40% free area) cable tray, with HDGAF fixing and suspension accessories.
- 16 SWG enamelled steel conduit, with hospital-type saddles.
- Extra-light quality GI pipe (under-ground or outdoors).
- Flexible plastic-covered ("light-tight") metal conduit (maximum length 600mm) at equipment termination.

4 Control cabling shall be PVC/PVC 600/1000V grade multicore copper conductor, run in separate raceway, as above.

5 Circuit protective conductors (CPC) shall be stranded HDBC (2 Nos.), connected to all motors, raceways, panels and electrical equipment at two points.

6 All conductor terminations, joints, and tap-offs shall be provided with crimped copper lugs and ferrules.

7 Voltage relay (adjustable) for under/over/reverse phase voltages

8 MCC shall be provided with

- Incoming load-break switch (AC-23 duty) with ammeter/CTs/ASS, Voltmeter/VSS, and phase lamps.
- MCCB feeders, as shown.
- Motor-starter feeders, as shown, with MCCB back-up protection (type 2 to IEC 947) motor-protection (AC3-duty) magnetic contactors, 3-pole differential-type thermal overload relay with "hand/auto-reset", "on/off" push buttons, "hand/off/auto" selector SWI.
- Service socket outlets, single-phase and three-phase, as required.

9 Provide local weatherproof isolator/disconnect near each motor that is out of line-of-sight of MCC.

10 Provide all power and control connections and cabling to all package equipment, as required by the manufacturer.

11 Provide all control inter-connections and cabling in accordance with the control logic defined elsewhere/below.

a) Provide "HOA" switches to allow remote start up in 'Auto' position.

b) Unless otherwise specified, Interlock all AHU's in all MCC's with building fire alarm system to switch "OFF" in the event of fire (one ON/OFF fire alarm signal would be provided by others at required location).

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	1/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/02	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	PLANT ROOM	PHASE:	3		
IP CLASS:	42	BUS RTG:	3,200	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	MCC-BF-01	MCC-BF-02	MCC-GF-01	MCC-GF-02	MCC-GF-03	MCC-R-01
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW	1460.0	2.4	105.9	311.6	225.7	145.7	473.7
4	Full Load Current		Amps	2635	4	191	562	407	263	855
5	MCCB/MCB		Amps	3200	15	300	630	630	400	1000
6	Phase		–	3						
7	Ammeter		Amps	✓						
8	Volt meter		Volts	✓						
9	Equipment Provided with Control Panel		–							
10	Starters		DOL							
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²	-	-	-	-	-	-	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By PSPC	As Required	As Required	As Required	As Required	As Required	As Required
18	Conduit		mm		Cable tray	Cable tray	Cable tray	Cable tray	Cable tray	Cable tray
19	CPC-2 Nos.		SWG		As Required	As Required	As Required	As Required	As Required	As Required
20	Remarks		-		Outgoing	Outgoing	Outgoing	Outgoing	Outgoing	Outgoing

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	2/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/02	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	3,200	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				MCC-R-02	MCC-R-03	MCC-R-04	MCC-R-05	MCC-OF-01	SP/01	SP/02
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW	931.4	21.6	63.3	219.8	32.1		
4	Full Load Current		Amps	1681	39	114	397	58		
5	MCCB/MCB		Amps	2000	63	150	630	75	100	75
6	Phase		–						3	3
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL						✓	✓
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²	-	-	-	-	-		
		3½ Core	mm²	-	-	-	-	-		
		4 Core	mm²	As Required	As Required	As Required	As Required	As Required		
18	Conduit		mm	Cable tray	Cable tray	Cable tray	Cable tray	Cable tray		
19	CPC-2 Nos.		SWG	As Required	As Required	As Required	As Required	As Required		
20	Remarks		-	Outgoing	Outgoing	Outgoing	Outgoing	Outgoing	Spare	Spare

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	3/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/02	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	3,200	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				SP/03	Control CKT					
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW							
4	Full Load Current		Amps							
5	MCCB/MCB		Amps	63	10					
6	Phase		–	3	1					
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL	✓						
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²							
		3½ Core	mm²							
		4 Core	mm²							
18	Conduit		mm							
19	CPC-2 Nos.		SWG							
20	Remarks		-	Spare	DDC Controller					

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	4/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	1,000	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / GF-04	AHU / GF-04 (REHEAT COIL)	AHU / GF-06	AHU / GF-06 (REHEAT COIL)	AHU / GF-13	FN / FA-01
1	Feeder		–							
2	Equipment Location		–		BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF
3	Connected Load		kW	473.7	1 x 18.5	1 x 37.8	3 x 30	3 x 53	1 x 7.5	1 x 0.4
4	Full Load Current		Amps	855	1 x 33.4	1 x 68.2	3 x 54.2	3 x 95.7	1 x 13.5	1 x 2.2
5	MCCB/MCB		Amps	1000	1 x 50	1 x 100	3 x 75	3 x 150	1 x 30	1 x 5
6	Phase		–	3	3	3	3	3	3	1
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	×	×	×	✓
			Star/Delta		×	×	×	×	×	×
			VFD		✓	×	✓	×	✓	×
11	Hour-meter		-		✓	×	✓	×	✓	✓
12	Auto-Interlocks		-		✓	×	✓	×	✓	✓
13	Thermistor Relay in Motor		-		✓	×	✓	×	×	×
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	×	✓	×	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	-	-	1 x 4
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 10	1 x 25	3 x 25	3 x 25	1 x 4	-
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		14	8	8	8	14	14
20	Remarks		-		FOR IPM+RECTIFIER		FOR NUMBERING DEPARTMENT		FOR STRONG ROOM	FOR HEATING CHAMBER

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	5/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	1,000	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				FN / EF-03	FN / EF-07	FN / EF-08	FN / EF-09	FN / EF-10	FN / RE-GF-04	FN / RE-GF-13
1	Feeder		–							
2	Equipment Location		–	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	GROUND FLOOR	BUILDING ROOF	BUILDING ROOF
3	Connected Load		kW	1 x 0.2	1 x 0.2	1 x 5.6	1 x 0.6	1 x 0.4	1 x 1.1	1 x 2.2
4	Full Load Current		Amps	1 x 1.1	1 x 1.1	1 x 10.1	1 x 1.1	1 x 2.2	1 x 2	1 x 4
5	MCCB/MCB		Amps	1 x 5	1 x 5	1 x 30	1 x 5	1 x 5	1 x 10	1 x 15
6	Phase		–	1	1	3	3	1	3	3
7	Ammeter		Amps	×	×	×	×	×	×	×
8	Volt meter		Volts	×	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–	×	×	×	×	×	×	×
10	Starters		DOL	✓	✓	✓	✓	✓	✓	✓
			Star/Delta	×	×	×	×	×	×	×
			VFD	×	×	×	×	×	×	×
11	Hour-meter		-	✓	✓	✓	✓	✓	✓	✓
12	Auto-Interlocks		-	✓	✓	✓	✓	✓	✓	✓
13	Thermistor Relay in Motor		-	×	×	×	×	×	×	×
14	Remote Control		-	×	×	×	×	×	×	×
15	Remote Indicator		-	×	×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-	✓	✓	✓	✓	✓	✓	✓
17	Cable	3 Core	mm²	1 x 4	1 x 4	-	-	1 x 4	-	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	-	-	1 x 4	1 x 4	-	1 x 4	1 x 4
18	Conduit		mm	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG	14	14	14	14	14	14	14
20	Remarks		-	FOR SHEET DEPARTMENT OFFICE TOILET	FOR IPM TOILETS	FOR NUMBERING DEPARTMENT	FOR HEATING CHAMBER	FOR STORE	FOR AHU/GF-04	FOR AHU/GF-13

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	6/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	1,000	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				FN / EF-22	HM-GF-05	SP/01	SP/02	SP/03	SP/04	SP/05
1	Feeder		–							
2	Equipment Location		–	BUILDING ROOF	GROUND FLOOR					
3	Connected Load		kW	1 x 0.6	2 x 74.8					
4	Full Load Current		Amps	1 x 1.1	2 x 135					
5	MCCB/MCB		Amps	1 x 5	2 x 200	150	100	75	50	40
6	Phase		–	3	3	3	3	3	3	3
7	Ammeter		Amps	×	×					
8	Volt meter		Volts	×	×					
9	Equipment Provided with Control Panel		–	×	✓					
10	Starters		DOL	✓	×					
			Star/Delta	×	×					
			VFD	×	×					
11	Hour-meter		-	✓	×					
12	Auto-Interlocks		-	✓	×					
13	Thermistor Relay in Motor		-	×	×					
14	Remote Control		-	×	×					
15	Remote Indicator		-	×	×					
16	Remote Isolator Near Equipment (Weather Proof)		-	✓	✓					
17	Cable	3 Core	mm²	-	-					
		3½ Core	mm²	-	-					
		4 Core	mm²	1 x 4	2 x 50					
18	Conduit		mm	Cable Tray	Cable Tray					
19	CPC-2 Nos.		SWG	14	8					
20	Remarks		-	FOR STORE	FOR NUMBERING DEPARTMENT	Spare	Spare	Spare	Spare	Spare

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	7/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	1,000	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				SP/06	SP/07	SP/08	SP/09	SP/10	Control CKT	
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW							
4	Full Load Current		Amps							
5	MCCB/MCB		Amps	30	15	10	5	5	10	
6	Phase		–	3	3	3	3	1	1	
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL							
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²							
		3½ Core	mm²							
		4 Core	mm²							
18	Conduit		mm							
19	CPC-2 Nos.		SWG							
20	Remarks		-	Spare	Spare	Spare	Spare	Spare	DDC Controller	

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	8/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-02	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	2,000	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / GF-01	AHU / GF-01 (REHEAT COIL)	AHU / GF-02	AHU / GF-02 (REHEAT COIL)	FN / FA-02	FN / FA-03
1	Feeder		–							
2	Equipment Location		–		BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF
3	Connected Load		kW	931.4	2 x 30	2 x 23	6 x 30	6 x 96	1 x 0.6	1 x 3.7
4	Full Load Current		Amps	1681	2 x 54.2	2 x 41.5	6 x 54.2	6 x 173.3	1 x 1.1	1 x 6.7
5	MCCB/MCB		Amps	2000	2 x 75	2 x 75	6 x 75	6 x 200	1 x 5	1 x 30
6	Phase		–	3	3	3	3	3	3	3
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	×	×	✓	✓
			Star/Delta		×	×	×	×	×	×
			VFD		✓	×	✓	×	×	×
11	Hour-meter		-		✓	×	✓	×	✓	✓
12	Auto-Interlocks		-		✓	×	✓	×	✓	✓
13	Thermistor Relay in Motor		-		✓	×	✓	×	×	×
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	×	✓	×	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	-	-	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	2 x 25	2 x 25	6 x 25	6 x 95	1 x 4	1 x 4
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		8	8	8	1/0	14	14
20	Remarks		-		FOR OFFSET PRINTING		FOR INTAGLIO+LITHO		FOR HEATING CHAMBER	FOR HEATING CHAMBER

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0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	9/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-02	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	2,000	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				FN / EF-02	FN / EF-04	FN / EF-17	FN / EF-18	FN / RE-GF-01	FN / RE-GF-02	HM-GF-11
1	Feeder		–							
2	Equipment Location		–	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	GROUND FLOOR
3	Connected Load		kW	1 x 0.4	1 x 0.2	1 x 1.1	1 x 5.6	1 x 0.6	1 x 1.1	1 x 56.1
4	Full Load Current		Amps	1 x 2.2	1 x 1.1	1 x 2	1 x 10.1	1 x 1.1	1 x 2	1 x 101.3
5	MCCB/MCB		Amps	1 x 5	1 x 5	1 x 10	1 x 30	1 x 5	1 x 10	1 x 150
6	Phase		–	1	1	3	3	3	3	3
7	Ammeter		Amps	×	×	×	×	×	×	×
8	Volt meter		Volts	×	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–	×	×	×	×	×	×	✓
10	Starters		DOL	✓	✓	✓	✓	✓	✓	×
			Star/Delta	×	×	×	×	×	×	×
			VFD	×	×	×	×	×	×	×
11	Hour-meter		-	✓	✓	✓	✓	✓	✓	×
12	Auto-Interlocks		-	✓	✓	✓	✓	✓	✓	×
13	Thermistor Relay in Motor		-	×	×	×	×	×	×	×
14	Remote Control		-	×	×	×	×	×	×	×
15	Remote Indicator		-	×	×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-	✓	✓	✓	✓	✓	✓	✓
17	Cable	3 Core	mm²	1 x 4	1 x 4	-	-	-	-	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	-	-	1 x 4	1 x 4	1 x 4	1 x 4	1 x 25
18	Conduit		mm	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG	14	14	14	14	14	14	8
20	Remarks		-	FOR SHEET DEPARTMENT TOILET	FOR CTOP+COATING STORE	FOR HEATING CHAMBER	FOR HEATING CHAMBER	FOR AHU / GF-01	FOR AHU / GF-02	FOR CUTPACK DEPARTMENT

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0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	10/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-02	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	2,000	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				SP/01	SP/02	SP/03	SP/04	SP/05	SP/06	Control CKT
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW							
4	Full Load Current		Amps							
5	MCCB/MCB		Amps	200	75	30	10	5	5	10
6	Phase		–	3	3	3	3	3	1	1
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL							
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²							
		3½ Core	mm²							
		4 Core	mm²							
18	Conduit		mm							
19	CPC-2 Nos.		SWG							
20	Remarks		-	Spare	Spare	Spare	Spare	Spare	Spare	DDC Controller

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	11/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-03	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	63	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / GF-09	AHU / GF-10	FN / EF-01	FN / EF-11	FN / RE-GF-09	FN / RE-GF-10
1	Feeder		–							
2	Equipment Location		–		BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF
3	Connected Load		kW	21.6	1 x 3	1 x 5.5	1 x 0.2	1 x 0.2	1 x 0.4	1 x 1.1
4	Full Load Current		Amps	39	1 x 5.4	1 x 9.9	1 x 1.1	1 x 1.1	1 x 2.2	1 x 2
5	MCCB/MCB		Amps	63	1 x 15	1 x 20	1 x 5	1 x 5	1 x 5	1 x 10
6	Phase		–	3	3	3	1	1	1	3
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	✓	✓	✓	✓
			Star/Delta		×	×	×	×	×	×
			VFD		✓	✓	×	×	×	×
11	Hour-meter		-		✓	✓	✓	✓	✓	✓
12	Auto-Interlocks		-		✓	✓	✓	✓	✓	✓
13	Thermistor Relay in Motor		-		×	×	×	×	×	×
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	✓	✓	✓	✓	✓
17	Cable	3 Core	mm²	-	-	-	1 x 4	1 x 4	1 x 4	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 4	1 x 4	-	-	-	1 x 4
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		14	14	14	14	14	14
20	Remarks		-		FOR NJ STAMP	FOR WORKSHOP+ENGINEER STORE+OFFICE	FOR MEZANINE FLOOR TOILETS	FOR MEZANINE FLOOR TOILETS	FOR AHU / GF-09	FOR AHU / GF-10

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	12/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-03	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	63	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				HM-GF-09	SP/01	SP/02	SP/03	SP/04	Control CKT	
1	Feeder		–							
2	Equipment Location		–	GROUND FLOOR						
3	Connected Load		kW	1 x 11.2						
4	Full Load Current		Amps	1 x 20.2						
5	MCCB/MCB		Amps	1 x 40	20	15	10	5	10	
6	Phase		–	3	3	3	3	1	1	
7	Ammeter		Amps	×						
8	Volt meter		Volts	×						
9	Equipment Provided with Control Panel		–	✓						
10	Starters		DOL	×						
			Star/Delta	×						
			VFD	×						
11	Hour-meter		-	×						
12	Auto-Interlocks		-	×						
13	Thermistor Relay in Motor		-	×						
14	Remote Control		-	×						
15	Remote Indicator		-	×						
16	Remote Isolator Near Equipment (Weather Proof)		-	✓						
17	Cable	3 Core	mm²	-						
		3½ Core	mm²	-						
		4 Core	mm²	1 x 6						
18	Conduit		mm	25						
19	CPC-2 Nos.		SWG	14						
20	Remarks		-	FOR PAPER STORE	Spare	Spare	Spare	Spare	DDC Controller	

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	13/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-04	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	150	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / BF-01	AHU / BF-01 (REHEAT COIL)	AHU / GF-11A	AHU / GF-11A (REHEAT COIL)	AHU / GF-11	AHU / GF-14
1	Feeder		–							
2	Equipment Location		–		BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF
3	Connected Load		kW	63.3	1 x 5.5	1 x 6	1 x 11	1 x 1.5	1 x 15	1 x 22
4	Full Load Current		Amps	114	1 x 9.9	1 x 10.8	1 x 19.9	1 x 2.7	1 x 27.1	1 x 39.7
5	MCCB/MCB		Amps	150	1 x 20	1 x 30	1 x 40	1 x 5	1 x 40	1 x 60
6	Phase		–	3	3	3	3	3	3	3
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	×	×	×	×
			Star/Delta		×	×	×	×	×	×
			VFD		✓	×	✓	×	✓	✓
11	Hour-meter		-		✓	×	✓	×	✓	✓
12	Auto-Interlocks		-		✓	×	✓	×	✓	✓
13	Thermistor Relay in Motor		-		×	×	×	×	×	✓
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	×	✓	×	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	-	-	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 4	1 x 4	1 x 6	1 x 4	1 x 6	1 x 16
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		14	14	14	14	14	14
20	Remarks		-		FOR PAPER STORE		FOR PAPER STORE		FOR ENGINEERING OFFICE+MRP PACKING/RECEIVING	FOR CORRIDOR

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	14/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-04	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	150	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				FN / EF-13	FN / RE-BF-01	FN / RE-GF-11A	SP/01	SP/02	SP/03	SP/04
1	Feeder		–							
2	Equipment Location		–	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF				
3	Connected Load		kW	1 x 0.2	1 x 1.5	1 x 0.6				
4	Full Load Current		Amps	1 x 1.1	1 x 2.7	1 x 1.1				
5	MCCB/MCB		Amps	1 x 5	1 x 10	1 x 5	60	40	30	20
6	Phase		–	1	3	3	3	3	3	3
7	Ammeter		Amps	×	×	×				
8	Volt meter		Volts	×	×	×				
9	Equipment Provided with Control Panel		–	×	×	×				
10	Starters		DOL	✓	✓	✓				
			Star/Delta	×	×	×				
			VFD	×	×	×				
11	Hour-meter		-	✓	✓	✓				
12	Auto-Interlocks		-	✓	✓	✓				
13	Thermistor Relay in Motor		-	×	×	×				
14	Remote Control		-	×	×	×				
15	Remote Indicator		-	×	×	×				
16	Remote Isolator Near Equipment (Weather Proof)		-	✓	✓	✓				
17	Cable	3 Core	mm²	1 x 4	-	-				
		3½ Core	mm²	-	-	-				
		4 Core	mm²	-	1 x 4	1 x 4				
18	Conduit		mm	Cable Tray	Cable Tray	Cable Tray				
19	CPC-2 Nos.		SWG	14	14	14				
20	Remarks		-	FOR MRP PACKING STORE	FOR AHU / BF-01	FOR AHU / GF-11A	Spare	Spare	Spare	Spare

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	15/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-04	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	150	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				SP/05	SP/06	Control CKT				
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW							
4	Full Load Current		Amps							
5	MCCB/MCB		Amps	5	5	10				
6	Phase		–	3	1	1				
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL							
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²							
		3½ Core	mm²							
		4 Core	mm²							
18	Conduit		mm							
19	CPC-2 Nos.		SWG							
20	Remarks		-	Spare	Spare	DDC Controller				

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	16/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-05	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / GF-08A	AHU / GF-08A (REHEAT COIL)	AHU / GF-08	FN / EF-13	FN / EF-16	FN / EF-19
1	Feeder		–							
2	Equipment Location		–		BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF
3	Connected Load		kW	219.8	1 x 15	1 x 41	1 x 11	1 x 0.2	1 x 0.4	1 x 0.6
4	Full Load Current		Amps	397	1 x 27.1	1 x 74	1 x 19.9	1 x 1.1	1 x 2.2	1 x 1.1
5	MCCB/MCB		Amps	630	1 x 40	1 x 100	1 x 40	1 x 5	1 x 5	1 x 5
6	Phase		–	3	3	3	3	1	1	3
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	×	✓	✓	✓
			Star/Delta		×	×	×	×	×	×
			VFD		✓	×	✓	×	×	×
11	Hour-meter		-		✓	×	✓	✓	✓	✓
12	Auto-Interlocks		-		✓	×	✓	✓	✓	✓
13	Thermistor Relay in Motor		-		×	×	×	×	×	×
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	×	✓	✓	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	1 x 4	1 x 4	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 6	1 x 25	1 x 6	-	-	1 x 4
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		14	8	14	14	14	14
20	Remarks		-		FOR MRP DEPARTMENT		FOR PRODUCTION OFFICE+MEDICAL CENTER	FOR MRP PACKING STORE	FOR TOILET	FOR MRP DEPARTMENT

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	17/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-05	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				FN / RE-GF-08A	FN/EF-21	FN/EF-23	HM-GF-01	HM-GF-02	HM-GF-08	SP/01
1	Feeder		–							
2	Equipment Location		–	BUILDING ROOF	BUILDING ROOF	BUILDING ROOF	GROUND FLOOR	GROUND FLOOR	GROUND FLOOR	
3	Connected Load		kW	1 x 0.2	1 x 0.4	1 x 1.1	1 x 37.4	1 x 56.1	1 x 56.1	
4	Full Load Current		Amps	1 x 1.1	1 x 2.2	1 x 2	1 x 67.5	1 x 101.3	1 x 101.3	
5	MCCB/MCB		Amps	1 x 5	1 x 5	1 x 10	1 x 100	1 x 150	1 x 150	40
6	Phase		–	1	1	3	3	3	3	3
7	Ammeter		Amps	×	×	×	×	×	×	
8	Volt meter		Volts	×	×	×	×	×	×	
9	Equipment Provided with Control Panel		–	×	×	×	✓	✓	✓	
10	Starters		DOL	✓	✓	✓	×	×	×	
			Star/Delta	×	×	×	×	×	×	
			VFD	×	×	×	×	×	×	
11	Hour-meter		-	✓	✓	✓	×	×	×	
12	Auto-Interlocks		-	✓	✓	✓	×	×	×	
13	Thermistor Relay in Motor		-	×	×	×	×	×	×	
14	Remote Control		-	×	×	×	×	×	×	
15	Remote Indicator		-	×	×	×	×	×	×	
16	Remote Isolator Near Equipment (Weather Proof)		-	✓	✓	✓	✓	✓	✓	
17	Cable	3 Core	mm²	1 x 4	1 x 4	-	-	-	-	
		3½ Core	mm²	-	-	-	-	-	-	
		4 Core	mm²	-	-	1 x 4	1 x 25	1 x 25	1 x 25	
18	Conduit		mm	Cable Tray	Cable Tray	Cable Tray	25	Cable Tray	Cable Tray	
19	CPC-2 Nos.		SWG	14	14	14	8	8	8	
20	Remarks		-	FOR AHU / GF-08A	FOR TOILET	FOR MEDICAL CENTER	FOR SIMULTAN DEPARTMENT/ OFFSET PRINTING	FOR INTAGLIO DEPARTMENT+LITHO	FOR MRP DEPARTMENT	Spare

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	18/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/R-05	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BUILDING ROOF	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				SP/02	SP/03	SP/04	SP/05	Control CKT		
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW							
4	Full Load Current		Amps							
5	MCCB/MCB		Amps	100	5	10	5	10		
6	Phase		–	3	3	3	1	1		
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL							
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²							
		3½ Core	mm²							
		4 Core	mm²							
18	Conduit		mm							
19	CPC-2 Nos.		SWG							
20	Remarks		-	Spare	Spare	Spare	Spare	DDC Controller		

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	19/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / GF-03	AHU / GF-05	AHU / GF-05 (REHEAT COIL)	FN / EF-05	FN / EF-06	FN / RE-GF-05
1	Feeder		–							
2	Equipment Location		–		GROUND FLOOR	GROUND FLOOR	GROUND FLOOR	BUILDING ROOF	BUILDING ROOF	GROUND FLOOR
3	Connected Load		kW	311.6	1 x 22	2 x 15	2 x 35	1 x 0.4	1 x 1.1	1 x 1.1
4	Full Load Current		Amps	562	1 x 39.7	2 x 27.1	2 x 63.2	1 x 2.2	1 x 2	1 x 2
5	MCCB/MCB		Amps	630	1 x 60	2 x 40	2 x 100	1 x 5	1 x 10	1 x 10
6	Phase		–	3	3	3	3	1	3	3
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	×	✓	✓	✓
			Star/Delta		×	×	×	×	×	×
			VFD		✓	✓	×	×	×	×
11	Hour-meter		-		✓	✓	×	✓	✓	✓
12	Auto-Interlocks		-		✓	✓	×	✓	✓	✓
13	Thermistor Relay in Motor		-		✓	✓	×	×	×	×
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	✓	×	✓	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	1 x 4	1 x 4	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 16	2 x 6	2 x 25	-	-	1 x 4
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		14	14	8	14	14	14
20	Remarks		-		FOR SHEET EXAMINATION HALL	FOR COATING DEPARTMENT		FOR CTOP	FOR COATING	FOR AHU / GF-05

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	20/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				HM-GF-03	HM-GF-04	SP/01	SP/02	SP/03	SP/04	SP/05
1	Feeder		–							
2	Equipment Location		–	GROUND FLOOR	GROUND FLOOR					
3	Connected Load		kW	1 x 74.8	2 x 56.1					
4	Full Load Current		Amps	1 x 135	2 x 101.3					
5	MCCB/MCB		Amps	1 x 200	2 x 150	100	60	40	10	5
6	Phase		–	3	3	3	3	3	3	1
7	Ammeter		Amps	×	×					
8	Volt meter		Volts	×	×					
9	Equipment Provided with Control Panel		–	✓	✓					
10	Starters		DOL	×	×					
			Star/Delta	×	×					
			VFD	×	×					
11	Hour-meter		-	×	×					
12	Auto-Interlocks		-	×	×					
13	Thermistor Relay in Motor		-	×	×					
14	Remote Control		-	×	×					
15	Remote Indicator		-	×	×					
16	Remote Isolator Near Equipment (Weather Proof)		-	✓	✓					
17	Cable	3 Core	mm²	-	-					
		3½ Core	mm²	-	-					
		4 Core	mm²	1 x 50	2 x 25					
18	Conduit		mm	Cable Tray	Cable Tray					
19	CPC-2 Nos.		SWG	8	8					
20	Remarks		-	FOR IPM + RECTIFIER	FOR CTOP + COATING DEPARTMENT	Spare	Spare	Spare	Spare	Spare

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	21/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Control CKT						
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW							
4	Full Load Current		Amps							
5	MCCB/MCB		Amps	10						
6	Phase		–	1						
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL							
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²							
		3½ Core	mm²							
		4 Core	mm²							
18	Conduit		mm							
19	CPC-2 Nos.		SWG							
20	Remarks		-	DDC Controller						

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	22/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-02	VOLTAGE:	400	MOUNTING: ☐WALL ☑FLOOR	
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / GF-07A	AHU / GF-07A (REHEAT COIL)	AHU / GF-07B	FN / EF-15	FN / RE-GF-07B	HM-GF-06
1	Feeder		–							
2	Equipment Location		–		GROUND FLOOR	GROUND FLOOR	GROUND FLOOR	BUILDING ROOF	GROUND FLOOR	GROUND FLOOR
3	Connected Load		kW	225.7	1 x 15	1 x 22.5	1 x 5.5	1 x 0.2	1 x 1.1	1 x 3.7
4	Full Load Current		Amps	407	1 x 27.1	1 x 40.6	1 x 9.9	1 x 1.1	1 x 2	1 x 20.1
5	MCCB/MCB		Amps	630	1 x 40	1 x 75	1 x 20	1 x 5	1 x 10	1 x 15
6	Phase		–	3	3	3	3	1	3	1
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	✓
10	Starters		DOL		×	×	×	✓	✓	×
			Star/Delta		×	×	×	×	×	×
			VFD		✓	×	✓	×	×	×
11	Hour-meter		-		✓	×	✓	✓	✓	×
12	Auto-Interlocks		-		✓	×	✓	✓	✓	×
13	Thermistor Relay in Motor		-		×	×	×	×	×	×
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	×	✓	✓	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	1 x 4	-	1 x 4
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 6	1 x 25	1 x 4	-	1 x 4	-
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	25
19	CPC-2 Nos.		SWG		14	8	14	14	14	14
20	Remarks		-		FOR SHREDDING PLANT		FOR NFC STRONG ROOM	FOR TOILET	FOR AHU / GF-07B	FOR SHREDDING PLANT

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	23/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-02	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	630	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				HM-GF-07	HM-GF-10	SP/01	SP/02	SP/03	SP/04	Control CKT
1	Feeder		–							
2	Equipment Location		–	GROUND FLOOR	GROUND FLOOR					
3	Connected Load		kW	2 x 74.8	1 x 28.1					
4	Full Load Current		Amps	2 x 135	1 x 50.7					
5	MCCB/MCB		Amps	2 x 200	1 x 75	75	40	20	5	10
6	Phase		–	3	3	3	3	3	1	1
7	Ammeter		Amps	×	×					
8	Volt meter		Volts	×	×					
9	Equipment Provided with Control Panel		–	✓	✓					
10	Starters		DOL	×	×					
			Star/Delta	×	×					
			VFD	×	×					
11	Hour-meter		-	×	×					
12	Auto-Interlocks		-	×	×					
13	Thermistor Relay in Motor		-	×	×					
14	Remote Control		-	×	×					
15	Remote Indicator		-	×	×					
16	Remote Isolator Near Equipment (Weather Proof)		-	✓	✓					
17	Cable	3 Core	mm²	-	-					
		3½ Core	mm²	-	-					
		4 Core	mm²	2 x 50	1 x 25					
18	Conduit		mm	Cable Tray	Cable Tray					
19	CPC-2 Nos.		SWG	8	8					
20	Remarks		-	FOR CUTPACK MACHINE AREA	FOR STATIONARY	Spare	Spare	Spare	Spare	DDC Controller

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	24/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-03	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	400	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / GF-07	AHU / GF-07 (REHEAT COIL)	AHU / GF-12	AHU / GF-12 (REHEAT COIL)	FN / EF-14	FN / RE-GF-07
1	Feeder		–							
2	Equipment Location		–		GROUND FLOOR	GROUND FLOOR	GROUND FLOOR	GROUND FLOOR	BUILDING ROOF	GROUND FLOOR
3	Connected Load		kW	145.7	1 x 30	1 x 11	1 x 22	1 x 81	1 x 0.2	1 x 1.1
4	Full Load Current		Amps	263	1 x 54.2	1 x 19.9	1 x 39.7	1 x 146.2	1 x 1.1	1 x 2
5	MCCB/MCB		Amps	400	1 x 75	1 x 40	1 x 60	1 x 200	1 x 5	1 x 10
6	Phase		–	3	3	3	3	3	1	3
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	×	×	✓	✓
			Star/Delta		×	×	×	×	×	×
			VFD		✓	×	✓	×	×	×
11	Hour-meter		-		✓	×	✓	×	✓	✓
12	Auto-Interlocks		-		✓	×	✓	×	✓	✓
13	Thermistor Relay in Motor		-		✓	×	✓	×	×	×
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	×	✓	×	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	-	1 x 4	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 25	1 x 6	1 x 16	1 x 70	-	1 x 4
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		8	14	14	7	14	14
20	Remarks		-		FOR CUTPACK		FOR STATIONARY		FOR COMMON TOILETS	FOR AHU / GF-07

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0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	25/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-03	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	400	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				FN / RE-GF-12	SP/01	SP/02	SP/03	SP/04	SP/05	SP/06
1	Feeder		–							
2	Equipment Location		–	GROUND FLOOR						
3	Connected Load		kW	1 x 0.4						
4	Full Load Current		Amps	1 x 2.2						
5	MCCB/MCB		Amps	1 x 5	200	60	75	40	10	5
6	Phase		–	1	3	3	3	3	3	1
7	Ammeter		Amps	×						
8	Volt meter		Volts	×						
9	Equipment Provided with Control Panel		–	×						
10	Starters		DOL	✓						
			Star/Delta	×						
			VFD	×						
11	Hour-meter		-	✓						
12	Auto-Interlocks		-	✓						
13	Thermistor Relay in Motor		-	×						
14	Remote Control		-	×						
15	Remote Indicator		-	×						
16	Remote Isolator Near Equipment (Weather Proof)		-	✓						
17	Cable	3 Core	mm²	1 x 4						
		3½ Core	mm²	-						
		4 Core	mm²	-						
18	Conduit		mm	Cable Tray						
19	CPC-2 Nos.		SWG	14						
20	Remarks		-	FOR AHU / GF-12	Spare	Spare	Spare	Spare	Spare	Spare

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	26/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/GF-03	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	GROUND FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	400	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Control CKT						
1	Feeder		–							
2	Equipment Location		–							
3	Connected Load		kW							
4	Full Load Current		Amps							
5	MCCB/MCB		Amps	10						
6	Phase		–	1						
7	Ammeter		Amps							
8	Volt meter		Volts							
9	Equipment Provided with Control Panel		–							
10	Starters		DOL							
			Star/Delta							
			VFD							
11	Hour-meter		-							
12	Auto-Interlocks		-							
13	Thermistor Relay in Motor		-							
14	Remote Control		-							
15	Remote Indicator		-							
16	Remote Isolator Near Equipment (Weather Proof)		-							
17	Cable	3 Core	mm²							
		3½ Core	mm²							
		4 Core	mm²							
18	Conduit		mm							
19	CPC-2 Nos.		SWG							
20	Remarks		-	DDC Controller						

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	27/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/BF-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BASEMENT FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	15	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / BF-03	FN / RE-BF-03	SP/01	SP/02	Control CKT	
1	Feeder		–							
2	Equipment Location		–		BASEMENT	BASEMENT				
3	Connected Load		kW	2.4	1 x 2.2	1 x 0.2				
4	Full Load Current		Amps	4	1 x 4	1 x 1.1				
5	MCCB/MCB		Amps	15	1 x 10	1 x 5	10	5	10	
6	Phase		–	3	3	1	3	1	1	
7	Ammeter		Amps	✓	×	×				
8	Volt meter		Volts	✓	×	×				
9	Equipment Provided with Control Panel		–		×	×				
10	Starters		DOL		×	✓				
			Star/Delta		×	×				
			VFD		✓	×				
11	Hour-meter		-		✓	✓				
12	Auto-Interlocks		-		✓	✓				
13	Thermistor Relay in Motor		-		×	×				
14	Remote Control		-		×	×				
15	Remote Indicator		-		×	×				
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	✓				
17	Cable	3 Core	mm²	-	-	1 x 4				
		3½ Core	mm²	-	-	-				
		4 Core	mm²	By HVAC Contractor	1 x 4	-				
18	Conduit		mm		Cable Tray	Cable Tray				
19	CPC-2 Nos.		SWG		14	14				
20	Remarks		-		FOR VAULT AREA	FOR AHU / BF-03	Spare	Spare	DDC Controller	

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	28/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/BF-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	BASEMENT FLOOR	PHASE:	3		
IP CLASS:	42	BUS RTG:	300	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / BF-02	FN / RE-BF-02	HM-BF-01	SP/01	SP/02	Control CKT
1	Feeder		–							
2	Equipment Location		–		BASEMENT	BASEMENT	BASEMENT			
3	Connected Load		kW	105.9	1 x 30	1 x 1.1	1 x 74.8			
4	Full Load Current		Amps	191	1 x 54.2	1 x 2	1 x 135			
5	MCCB/MCB		Amps	300	1 x 75	1 x 10	1 x 200	75	10	10
6	Phase		–	3	3	3	3	3	3	1
7	Ammeter		Amps	✓	×	×	×			
8	Volt meter		Volts	✓	×	×	×			
9	Equipment Provided with Control Panel		–		×	×	✓			
10	Starters		DOL		×	✓	×			
			Star/Delta		×	×	×			
			VFD		✓	×	×			
11	Hour-meter		-		✓	✓	×			
12	Auto-Interlocks		-		✓	✓	×			
13	Thermistor Relay in Motor		-		✓	×	×			
14	Remote Control		-		×	×	×			
15	Remote Indicator		-		×	×	×			
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	✓	✓			
17	Cable	3 Core	mm²	-	-	-	-			
		3½ Core	mm²	-	-	-	-			
		4 Core	mm²	By HVAC Contractor	1 x 25	1 x 4	1 x 50			
18	Conduit		mm		Cable Tray	Cable Tray	25			
19	CPC-2 Nos.		SWG		8	14	8			
20	Remarks		-		FOR WIPING SOLUTION RECYCLING PLANT	FOR AHU / BF-02	FOR PAPER STORE (BASEMENT)	Spare	Spare	DDC Controller

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	29/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/OF-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	OFFICE FLOOR	PHASE:	3		
IP CLASS:	65	BUS RTG:	75	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				Incoming	AHU / OF-BF-01	AHU / OF-GF-01	AHU / OF-1F-01	AHU / OF-2F-01	AHU / OF-3F-01	AHU / OF-4F-01
1	Feeder		–							
2	Equipment Location		–		BASEMENT	1ST FLOOR	1ST FLOOR	1ST FLOOR	ROOF	ROOF
3	Connected Load		kW	32.1	1 x 4	1 x 5.5	1 x 5.5	1 x 5.5	1 x 5.5	1 x 5.5
4	Full Load Current		Amps	58	1 x 7.2	1 x 9.9	1 x 9.9	1 x 9.9	1 x 9.9	1 x 9.9
5	MCCB/MCB		Amps	75	1 x 20	1 x 20	1 x 20	1 x 20	1 x 20	1 x 20
6	Phase		–	3	3	3	3	3	3	3
7	Ammeter		Amps	✓	×	×	×	×	×	×
8	Volt meter		Volts	✓	×	×	×	×	×	×
9	Equipment Provided with Control Panel		–		×	×	×	×	×	×
10	Starters		DOL		×	×	×	×	×	×
			Star/Delta		×	×	×	×	×	×
			VFD		✓	✓	✓	✓	✓	✓
11	Hour-meter		-		✓	✓	✓	✓	✓	✓
12	Auto-Interlocks		-		✓	✓	✓	✓	✓	✓
13	Thermistor Relay in Motor		-		✓	✓	✓	✓	✓	✓
14	Remote Control		-		×	×	×	×	×	×
15	Remote Indicator		-		×	×	×	×	×	×
16	Remote Isolator Near Equipment (Weather Proof)		-		✓	✓	✓	✓	✓	✓
17	Cable	3 Core	mm²	-	-	-	-	-	-	-
		3½ Core	mm²	-	-	-	-	-	-	-
		4 Core	mm²	By HVAC Contractor	1 x 4	1 x 4	1 x 4	1 x 4	1 x 4	1 x 4
18	Conduit		mm		Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray	Cable Tray
19	CPC-2 Nos.		SWG		14	14	14	14	14	14
20	Remarks		-		FOR OFFICE BLOCK BASEMENT	FOR OFFICE BLOCK GROUND FLOOR	FOR OFFICE BLOCK FIRST FLOOR	FOR OFFICE BLOCK SECOND FLOOR	FOR OFFICE BLOCK THIRD FLOOR	FOR OFFICE BLOCK FOURTH FLOOR

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	30/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

SELECTION DATA	PROJECT	CONSULTANT
MOTOR CONTROL CENTER	**REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION**	**FAHIM, NANJI & DESOUZA (PVT.) LTD.**

MCC NO.:	MCC/OF-01	VOLTAGE:	400	MOUNTING: ☐WALL	☑FLOOR
LOCATION:	OFFICE FLOOR	PHASE:	3		
IP CLASS:	65	BUS RTG:	75	Icu = to be communicate by PSPC	Ics = 50% of ICU

S.NO	DESCRIPTION		UNITS	IDENTIFICATION NO.						
				FN / EF-20	SP/01	SP/02	Control CKT			
1	Feeder		–							
2	Equipment Location		–	GROUND FLOOR						
3	Connected Load		kW	1 x 0.6						
4	Full Load Current		Amps	1 x 3.3						
5	MCCB/MCB		Amps	1 x 5	20	5	10			
6	Phase		–	1	3	1	1			
7	Ammeter		Amps	×						
8	Volt meter		Volts	×						
9	Equipment Provided with Control Panel		–	×						
10	Starters		DOL	✓						
			Star/Delta	×						
			VFD	×						
11	Hour-meter		-	✓						
12	Auto-Interlocks		-	✓						
13	Thermistor Relay in Motor		-	×						
14	Remote Control		-	×						
15	Remote Indicator		-	×						
16	Remote Isolator Near Equipment (Weather Proof)		-	✓						
17	Cable	3 Core	mm²	1 x 4						
		3½ Core	mm²	-						
		4 Core	mm²	-						
18	Conduit		mm	Cable Tray						
19	CPC-2 Nos.		SWG	14						
20	Remarks		-	OFFICE BLOCK EXHAUST	Spare	Spare	DDC Controller			

NO.	REVISIONS	DATE	CHECKED	APPROVED	FORM NO.:	PAGE NO.:
0	ISSUED FOR TENDER	19/05/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH	DS-23 87 15	31/31
1	ISSUED FOR TENDER	12/09/2025	DANIAL ABDUL AZIZ	FAHAD ABDULLAH		

LIST OF APPROVED MANUFACTURERS (HVAC WORKS)

Equipment & Material shall be supplied only from the approved sources noted below. However in all cases the Contractor shall submit complete technical details of the equipment, material and obtain Consultants approval prior to delivery on site. Where option of "Approved Equivalent" is indicated, it shall be at the discretion of the Consultant to accept the alternate proposal submitted by the Contractor.

CSI No.	Equipment/Material	Approved Manufacturers	Country of Origin
23 05 13	Motors	Siemens	Europe
		ABB	Europe
		Imported	USA/Europe/Japan
23 05 19	Thermometers / Pressure Gauges	Trerice, WGTC, Weksler, Weiss, Brennan	USA/UK
23 05 23	Gate Valves, Globe Valves, Strainers, Check Valves Ball Valves	Kitz	Japan
		Duyar	Turkey
		Scon	Pakistan
		Hattersley	China
	Butterfly Valves	Tomoe	Japan/China
		Duyar	Turkey
		Scon	Pakistan
23 05 29	Supports & Anchors	Hilti	Germany/Imported
		Sikla	Germany
		Index	Imported
		Fischer	Germany
		Walraven	Netherlands
	Concrete Fasteners	Rawal Plug	UK
23 05 50	Paint	Berger	Pakistan
		ICI	Pakistan
23 05 91	Fire Stopping Material	Hilti/STI	China or Germany/USA
23 07 13	Duct Work Insulation (Fiberglass)	Afico	Saudi Arabia
		Kimco	Kuwait
		Knauf	Germany
	Insulation Adhesive	Zahabiya	Pakistan
		Ductmate Inc.	USA
23 07 19	Piping Insulation Closed Cell Foam Insulation	Armaflex (EPDM)	Imported
		Aeroflex (EPDM)	Thailand
23 09 10	Building Management System & Controls	MEP Solutions/Avanceon (Siemens)	Pakistan
		Shan Controls (Johnson Controls)	Pakistan
		CNSE (Schneider)	Pakistan
		Comfort Control (Airtek)	Australia
		Accrescent (Delta/Honeywell)	Canada/USA
23 21 13	Hydronic Piping & Specialities		
	Black Steel, Schedule 40 Pipe (Seamless)	Protek	China
		Approved Equivalent	Imported
		Baoloi (Pacific)	China
		KSPM	China
	Flexible Connectors	Durodyne	USA
		Proflex	USA
		Approved Equivalent	Imported
23 23 15	Refrigerant Piping & Accessories	Muller (Crescent Corporation)	USA
23 31 13	Sheet Metal (For Machine Made Ducting)	International Steel Limite (ISL)	Pakistan
		Aisha Steel	Pakistan
	Volume Control Dampers	Engatech	Pakistan
		Uni-Air	Pakistan
		EAP	Pakistan
		Thermec	Pakistan
		Steel Craft	Pakistan
		Carrier	Pakistan
23 33 46	Flexible Duct	Atco	USA
		DEC International	Netherland
		Approved Equivalent	Imported
23 34 13 23 34 16	Fans - Centrifugal / Axial	Sodeca	Spain
		BVN	Turkey
		Air Engg.	Pakistan
		Dyuar	UAE

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CSI No.	Equipment/Material	Approved Manufacturers	Country of Origin
23 37 13	Air Devices	Thermec	Pakistan
		Steel Craft	Pakistan
		Carrier Engineering	Pakistan
		Uni-Air	Pakistan
		EAP	Pakistan
23 37 20	Louvers	Thermec	Pakistan
		Steel Craft	Pakistan
		Carrier Engineering	Pakistan
		Uni-Air	Pakistan
		EAP	Pakistan
23 41 10	Air Filters	Air Guard	USA
		Trox	Germany
		Camfil	UK
		American Air Filter	USA
		Approved Equivalent	Imported
23 73 10	Air Handling Units	Carrier	Turkey
		Daikin	Malaysia
		Untes	Turkey
		Petra	Jordan
		System Aire	Turkey
		EuroClima	Italy/UAE
		Mekar	UAE
23 86 20	Flow Balancing Valves	Oventrop	Germany
		Scon	Pakistan
		Duyar	Turkey
		Hattersley	UK/China
23 86 35	Air Vents	Hattersley	UK
		Kitz	Japan
		Scon	Pakistan
		Duyar	Turkey
		Approved Equivalent	Imported
23 87 10	Power Cables	Pakistan Cable	Pakistan
		Pioneer Cables	Pakistan
		Indus Cables	Pakistan
		Newage Cables	Pakistan
	Control Cables (LSZH, Fire Resistant Cables)	Belden	Procured from authorized distributors/suppliers: some of them are: Draka Cables, Karachi Office No. 610, 6th Floor, Progressive Centre, 30-A, Block No. 6, P.E.C.H.S. Karachi. Tel: +92 21 4383238-9, Fax: +92 21 4537138 Integrated Engineering Services (Pvt)Ltd. 38A (Commercial)1st Floor, Sector-XX Kahayban-e-Iqbal PhaseIII, DHA, Lahore-54792, Pakistan Tel.:+92-42-35693810/11 or 35693739, Fax:+92-42-35722954 Excel Technological Services 235-S, Street No.11 DHA Lahore, Pakistan, 54796 Phone 92-42-5734740Fax 92-42-5734742 M/s Maxwell Automation, House No A-5, Sector 9, Ahmed Raza Road North Karachi Ph: 042-3586-1522. M/s OBA International, office No. 8, First Floor, Masco Plaza, 64 West, H-Block, Jinnah Avenue, Blue Area, Islamabad-Pakistan Tel: +92-51-2270707, 4305730 M/s. C-XOR Engineering, 199 A4, P.G.E.C.H.S. Near Wapda Town Lahore, Pakistan. Tel: +9242-3612 6722, 3518 0653, Fax: +9242-3518 1114 M/s ELAND CABLES Imran Shah :International Projects Manager Direct: +44 (0)20 7241 8738 | Mobile: +44 (0)7980 712 535 | Office: +44 (0)20 7241 8740 | Fax: +44 (0)20 7241 8700 | Web: http://www.elandcables.com
		FCT	
		Cavicel	
		Prysmian/Draka	
		Nexan	
		Eland Cables	
		2M Kablo	
		Datwyler	

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CSI No.	Equipment/Material	Approved Manufacturers	Country of Origin
	Steel Conduits	Steelex	Pakistan
		IIL	Pakistan
	Circuit Breakers / Contractors	ABB	Europe
		Schneider	Europe
		General Electric	Europe
		Siemens	Europe
	Control Panel (MCC) Manufacturers	JEI	Pakistan
		Hussain & Co.	Pakistan
		Sunbeam Engineers	Pakistan
	Cable Tray	JEI	Pakistan
		Ezzi	Pakistan
		Electroline	Pakistan
	ELECTRIC STEAM HUMIDIFIER	CondAir	Canada/USA
23 89 10	Tools & Instruments	-	Imported

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PAKISTAN SECURITY PRINTING CORPORATION (PVT) LTD

LIST OF APPROVED MANUFACTURERS

CIVIL WORKS		
S. No.	**Description**	**Manufacturer**
1	Aluminum	Lucky
		ALCOP
		Al-AHLI Aluminum Company (Pvt) Ltd.
		Krudson
		Ittehad aluminum
		Alumex- Pakistan Cable
2	Paints	ICI Paints,
		Nippon Paints
		BERGER Paints
3	Wall Coatings	Rock Shied
		Rockwall
		Grit Wall finishes
4	Ceramic Tiles	Master Tiles
		STILE
		Pakistan tile
5	Precast and Prestressed Concrete	Hubcrete (Pvt) Ltd.
		IZHAR
		Banu Mukhtar
6	Cement	Lucky
		Falcon
		Power
7	Reinforcement Grade 60	Amreli
		Agha steel
		Razzaque
8	Waterproofing	Unicorn membranes
		Roof powers
		RessiChem
		Roof Grip
		Hi Grip
9	Floor Hardner	Mitchell construction Pakistan
		Sika Pakistan
		Vertex/Pagel
10	Grout, bonding material, Epoxy sealer	Vertex/Pagel Pakistan
		Sika
		RessiChem
		Mungo
		CHEMSEAL EP (Chemi Tech)
		Aquafin
11	Epoxy Flooring	ChemCoatHB (Chemi Tech)
		Nan Ya Epoxy Resin
12	uPVC Doors and Windows	AluPlast German or equivalent
13	Glass	pakistan safety glass
		Ghani Glass
		Tariq Glass

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MECHANICAL WORKS		
1	Bridge Crane - Chinese	M/S Henan Defang Heavey Machine Co
		Nucleon Global
		M/S Henan Dima Crane Co Ltd
		M/S Weihua Cranes
2	Bridge Crane - Turkish	Kumsan Cranes
		Arnikon Cranes
3	Bridge Crane - European	OMIS Cranes
		Verlinde Cranes
		Street Cranes
		SWF cranes
4	FRP Grating	FCI Pvt.Ltd
		FRP Engineers
		Syed Engineers
5	Ventilation Fans	Greenheck
		Sasa Metals
		System Air
		S.A. Associates
6	uPVC Pipes	Pak arab
		Jeddah Polymer
7	Fire Extinguishers	Ansul
		Naffco
		SRI
		Firex
		Saffico

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ELECTRICAL WORKS		
S. No.	**Description**	**Manufacturer**
L.T. SWITCHGEARS		
1	MDB	Libra Engineering
		Sunbeam Engineering
		Power Engineering
2	SMDB, DB	Libra Engineering
		Sunbeam Engineering
		Power Engineering
3	Current Transformer	Revalco
		Saci
		Lovato
4	Circuit Breaker	Terasaki- Japan
		Schneider Electric (previeously Merlin
		ABB - Italy
		General Electric - USA
5	MCCB	Terasaki- Japan
		Hager - France
		ABB
		Schneider Electric (previeously Merlin
6	Magnetic Contactor, Relays etc	Telemecanique
		Finder
		ABB
7	Voltmeter, Ammeter	Revalco - Italy
		Lovato Electric
		Autonics
8	L.T Cables	Pakistan Cables
		Newage Cables
		Fast Cables
9	KWH Meter	Revalco - Italy
		Legrand - France
		Lovato Electric
ELECTRICAL ACCESSORIES		
1	Receptacles, Switches, Sockets	MK, UK
		Schneider Electric (Clipsal - Australia)
		Orange
2	Isolators	Nokevale
		Socomec
3	Lighting Fixtures.	Philips
		Clipsal
		Britlite
4	Conduits	Civic
		Dadex
		Jeddah Polymer

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CABLE TRAYS		
1	Cable Tray	Al Fazal Engineering
		Electric Power Engineering
		ENGINEERIC Pvt Ltd
TELEPHONE & NETWORKING		
1	Telephone & Lan	Panduit
		KRONE
		3M
2	Conduits	Civic
		Dadex
		Jeddah Polymer
3	Structured cabling & Telephone System	
a	MDF	Krone
		Panduit
		3M
b	TJB	Krone
		3M
		Panduit
c	Patch Panels	Panduit
		Krone
		3M
FIRE ADDRESSABLE SYSTEM		
1	Fire Alarm System	Simplex
		Secutron
		Gent
2	Fire Alarm System Cabling (Fire rated)	Belden
		Prysmian
		Cavicel
3	Gas Dectector	Honeywell
		Genreal Electric
		Emerson Electric
SECURITY (CCTV)		
1	CCTV System Cabling	Panduit
		Krone
		3M
2	Conduits	Civic
		Dadex
		Jeddah Polymer
LIGHTNING PROTECTION AND EARTHING		
1	Components	Raychem RPG
		ABB
		Wallis
		UL
Notes :		
·	All materials shall be of best quality. Its purchasing must be from approved authorized dealers, sole	
·	Make, model & country of origin should be asked from the material supplier	
·	Equivalent material other than listed above should also get approved from consultant before	

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REPLACEMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION

Technical Specifications

HVAC Works

BASIC MECHANICAL REQUIREMENTS

1. Related Documents:

Drawings and general provisions of Contract, including General and Special Conditions apply to this Section.

2. Instructions to Tenderers:

a) The Specifications & Drawings refer to certain Standard Specifications and also to certain manufacturers and equipment model numbers. The object of these references is to ensure that the equipment and materials offered by the Tenderers and supplied by the Bidder are in accordance with the required standard of quality, workmanship and capacities, etc. The object is not to limit the selection of equipment to a particular manufacturer unless specifically mentioned in the tender documents that a particular equipment and/or material is to be supplied.

b) It is clarified that the equipment and the materials complying with various standards and of manufacturers other than mentioned in the tender documents shall be acceptable provided they meet the required capacities as specified and meet the intent of the specifications regarding quality and workmanship.

c) In case there is any deviation between any item or material offered by the Tenderer from the tender specifications and drawings, the Tenderer shall clearly draw attention to all such deviations and no such item or material shall be supplied by the Bidder without prior written approval of the Engineer/Consultant.

d) These Specifications and accompanying Drawings are to be considered as supplementing each other and as such are intended to serve jointly as the basis upon which the Bidder shall establish a Contract Price, and upon which he shall base the performance of the required work.

e) It is the intent of these Specifications and Drawings to call for finished work, tested, complete, and ready for operation.

f) These Drawings and Specifications are presented to the Tenderer with the understanding that he is an expert and is competent in the preparation of Contact Bid Prices on the basis of information such as is contained in these documents, which do not include assurance as to their complete accuracy and validity, in all details, and which may depend, for proper execution, upon interpretation by the Engineer/ Consultant and other Authorities, during the course of construction.

g) For the above reasons, the Tenderer shall understand that his submission of an un-qualified proposal commits him to perform all work expressed and implied in the Drawings and Specifications without additional compensation. He shall further understand that such submission commits him without extra compensation, and within the scope of the Contract, to the following:

i) To provide, if required by the Engineer/Consultant, the items or arrangements of greater quantity, better quality, or higher cost in the event that a disagreement with regard to; such items occurs between the drawings and specifications, or within one.

ii) To provide any small items of work not specifically called for, but required to complete the intended installations.

iii) To co-ordinate his work or adjust the same so that conflicts in space do not occur with other trades involved at the project.

iv) To coordinate his work or adjust the same to suit site or any other existing conditions.

3. Design Life of Equipment:

The design life of all equipment and material shall be a minimum of 25 years. Bidder shall identify all equipment and material that has a lower design life and shall indicate the proposed design life in his bid, and this shall be subject to approval by the Consultant.

4. Standards to be kept on Site:

The Bidder shall maintain at his site office a hard-copy of all standards that are referenced in these specifications. The Bidder shall submit to the Consultant and obtain approval on a list of all standards that he is required to maintain in his site office. The cost of maintain these standards is assumed to be covered in the overall contract price.

5. Interpretation of the Drawings & Specifications:

a) Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instructions to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

b) It shall be understood that the specifications and drawings are complimentary and are to be taken together for a complete interpretation of the work. Exceptions are that notes on the drawings, which refer to an individual element of work, take precedence over the specifications where they conflict with the same.

c) No exclusions from, or limitation, in the language used in the Drawings or Specifications shall be interpreted as meaning that the appurtenances or accessories necessary to complete any required system or item of equipment are omitted.

d) The necessary Drawings utilize symbols and schematic diagrams to indicate various items of work. Neither of these have any dimensional significance nor do they delineate every item required for the intended installations. The work shall be installed in accordance with the diagrammatic intent expressed on the mechanical drawings, and in conformity with the dimensions indicated on final Architectural and Structural Working Drawings and on equipment shop drawings.

e) No interpretation shall be made from the limitations of symbols and diagrams that any elements necessary for complete work are excluded.

f) Certain details appear on the Drawings which are specific with regard to the dimensions and positioning of the work. These details are intended only for the purpose of establishing general feasibility. They do not obviate field co-ordination for the indicated work.

g) Information as to the general construction not evident in this specifications and drawings shall be derived from structural & architectural drawings and specifications.

6. Execution of Works:

6.1 Program of Works

The Bidder shall submit to the Engineer/Consultant a detailed Program of Works within 2 weeks from the acceptance of his tender showing the intended method, stages and order of work execution in coordination with the building construction Program, together with the duration he estimated for each and every stage of the Works. The timeline for execution of the program of works shall be in line with the overall timeline committeed by the bidder in the bid document. The Program shall include at least the following:

a. Dates for submission of shop drawings and technical submittals;

b. Dates for the placement of orders for equipment and materials;

c. Expected completion dates for builder's works, i.e. when work site needs to be ready;

d. Delivery dates of equipment and materials to Site;

e. Dates of commencement and completion of every stage of the Works in line with the building construction Program, i.e. each floor level and/or zone area;

f. Dates of documents/drawings submissions to relevant Government departments to obtain the necessary approvals;

g. Dates of requirement of temporary facilities necessary for testing & commissioning, e.g. electricity supply, water and town gas;

h. Dates of completion, testing and commissioning; and

i. Short term Programs showing the detailed work schedules of coming weeks and months shall also be provided to the Engineer/Consultant. Programs shall be regularly updated to reflect the actual progress and to meet the Bidder's obligations under the Contract.

In addition, detailed submission schedules for installation drawings, equipment and testing and commissioning shall be submitted to the Engineer/Consultant for approval. The formats and information to be included in the schedules shall be as required by the Engineer/Consultant.

6.2 Builder's Work

Bidder's bills.

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6.3 Cooperation with other Bidders

The Bidder shall cooperate at all times with the Building Bidder and all other bidders and sub-bidders in order to achieve efficient workflow on Site.

Any significant problems beyond the Bidder's control shall promptly be reported to the Engineer/Consultant.

6.4 Site Supervision

The Bidder shall keep on the Site a Site Engineer along with a team of competent and technically qualified site supervisors to control, supervise and manage all the Works on Site. The Site Engineer shall be vested with suitable powers to receive instructions from the Consultant.

The team shall be of adequate strength and all personnel deployed on site by the Bidder shall be technically competent and have adequate site experience for the Works. The Bidder shall submit the CV at time of technical bid of all such personnel and obtain approval from the Consultant prior to their deployment on site. The Bidder shall immediately replace any site supervisor whose experience, skill or competency is, in the opinion of the Engineer/Consultant found to be inadequate for the particular work.

All such approvals provided by the Consultant shall not relieve the Bidder from any and all obligations of the Contract. The Bidder shall also refer to the Conditions of Contract for other specific requirements, if any, on site supervision.

7. Codes, Permits & Inspection:

a) All works shall meet or exceed the latest requirements of all authorities exercising jurisdiction over construction work at the project site.

b) All required permits and inspection certificates shall be obtained, paid for, and made available at the time of completion of the Works.

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c) All work shall be carried out in accordance with the following codes:

i) HVAC Works:

- Uniform Mechanical Code
- KBCA Building Rules
- ASHRAE Standard
- SMACNA
- NFPA

ii) Plumbing Works:

- Uniform Plumbing Code
- KBCA Building Rules

iii) Electrical Works:

- IEE Wiring Regulation
- Pakistan Electricity Rules
- Electric Inspectors Regulation & Requirements
- NFPA Standards

8. Drawings by the Bidder:

8.1 Shop Drawings

a) The Contract Drawings are schematic and are intended to enable the Bidder to prepare his estimate and submit a tender. The contract drawings are not intended to be used as shop drawings and will not be used for execution. Bidder shall prepare installation (Shop) drawings for execution of his works.

b) If the Bidder requires any further instructions, details, contract drawings or information drawings to enable him to prepare his working drawing he will apply in writing to the Engineer/Consultan for such information well in advance of application of such information.

c) All shop drawings shall be prepared on computer using current version of AUTOCAD software.

d) Prior to commencement of works on site and at least 3 weeks in advance of the drawings being required for actual execution, the Bidder shall submit hard-copies of shop drawings in triplicate plus soft-copy on AUTOCAD CD (both PDF & DWG format) for approval of the Consultant/Engineer The Consultant/Engineer shall review the drawings & (i) approve the drawing or, (ii) disapprove the drawings with comments or, (iii) disapprove the drawings with comments for rectification/revision. In the event of (iii), the Bidder shall correct/revise the drawing & resubmit 3 hard-copies of the drawings plus soft-copy on AUTOCAD CD to the Consultant/Engineer for Approval. On a drawing being approved, the Bidder shall submit 6 hard-copies plus soft-copy on AUTOCAD CD for formal approval and distribution to relevant offices.

e) All drawings shall show plans and sections with sufficient details to clearly reflect the installation of the plant. All material specifications shall be provided on the drawings. All information required for preparing suitable foundation, for providing suitable access to the plant, for making openings in building structure, for coordination with electrical, plumbing, air-conditioning and other designs etc., shall be clearly provided.

f) The Bidder shall submit to the Consultant/Engineer 3 sets of hard-copy drawings plus soft-copy on AUTOCAD CD showing all major holes, cavities, embedded frames and other parts of the plant to be embedded in the floor, ceiling and walls, channels in the floors, cable trenches, cement pipes or other major conduits, which are needed for the successful and timely completion of the works. The Consultant/Engineer after ascertaining the accuracy of these drawings, shall return 1 (one) set of the drawings to the Bidder, within 14 days of the receipt of these drawings.

g) All shop drawings shall be fully dimensioned and suitably scaled showing construction, sizes, weights, arrangements, operating clearances and performance characteristics.

h) Shop drawings shall only be of standard sizes of A0, A1 size as per ISO 5457:1999, as approved by the Consultant.

i) Installation shall not be allowed to commence unless approved shop drawings are in possession of the Bidder, for which purpose shop drawings shall be submitted by the Bidder to the Consultant/Engineer sufficiently in advance of actual requirements to allow for ample time

to the Consultant in checking and approval and no claim for extension of the Contract time will be considered by reason of the Bidder's failure to submit the drawings on time.

j) Each shop drawing submitted by the Bidder shall include a certificate by the Bidder that all related conditions on site relevant to the particular installation have been checked and that no conflict exists.

k) Any expenses resulting from an error mistake or omission in or delay in delivery of the drawings & information mentioned in sub-clause (b) of this clause shall be borne by the Bidder.

l) Drawings approved shall not be departed from except on the instructions of the Consultant.

m) The approval by the Consultant for any submitted data, working drawings, performance curves, test certificates for any items, arrangements and/or layout shall not relieve the Bidder for any responsibility regarding the performance of the Contract. Such approval shall also not relieve the Bidder from responsibility of any error in the submitted data & workings, brought to light at any time subsequent to any approvals.

8.2 Civil Work Drawings

The Bidder shall submit to the Engineer/Consultant in accordance with the approved "Submission Schedule", 6 copies of drawings showing details of all civil work to be done by this Bidder or other bidders as noted below:

a) Equipment foundation drawings, duly coordinated with the equipment certified dimensions, and indicating the weight and the load on each support of equipment.

b) Plant room drawings, clearly indicating the details and positions of all openings, trenches, ducts and cutting required and construction details needed to complete the Works.

c) Elevations of all masonry and concrete and other walls, clearly indicting the dimensions and locations of all openings required and the type and design of the sleeves to be installed.

8.3 Manufacturer's Shop Drawings

The drawings shall show detailed construction, principal dimensions, weights and clearances for maintenance, etc. Immediately after placing of any order or at any event within 4 weeks unless otherwise approved in writing by the Engineer/ Consultant, the Bidder shall forward to the Engineer/Consultant for comment, 4 copies of manufacturer's shop drawings indicating detailed construction, principal dimensions and weights, clearances for withdrawals and/ or cleaning, etc. No work shall proceed on or off Site unless drawings requiring approval are so approved in writing by the Engineer/Consultant.

8.4 Record Drawings

The Bidder shall maintain an accurate record of changes as work progresses on a set of Record Drawings, which shall be maintained at Site, and the following procedure shall be adopted:

a) Make records in a neat and legibly printed manner with a non-smudging medium.

b) Identify each Record Drawing as the "Project Record Copy", maintain Drawings in good condition, do not use them for construction purposes, and make them readily available to the Engineer/Consultant.

c) Maintain project Record Drawings in a state current to the project. Failure to comply with this requirement may prejudice Progress Payments. The Engineer/ Consultant's visual inspection shall constitute proof that Record Drawings are current.

d) If the Bidder fails to produce either the marked-up drawings during the execution of the works or the record drawings, etc. for the Engineer/Consultant approval, within one month after sectional or practical completion, the Engineer/Consultant will have the right to have these drawings produced by others. The cost of obtaining the necessary information and preparing such drawings etc. will be deducted from the outstanding payments owing to the Bidder.

8.5 As–Built Drawings

a) The Bidder shall submit 3 sets of the first draft prints of As-Built drawings within 28 days of the issuance of the Certification of Completion to the Engineer/ Consultant/Consultant for checking. The Engineer/Consultant after checking the above draft prints shall return one set of the marked up copies of these As-Built drawings to the Bidder within 42 days from the date of submission of the Bidder's draft prints with comments. The Bidder shall within a further 28 days from the date of receiving the Engineer Consultant's comments on the draft As-Built drawings re-submit to the Engineer/ Consultant for his approval another 3 sets of the second draft prints of As-Built drawings with the Engineer Consultant's comments incorporated. This process of submission and approval shall continue until the final approval of the Engineer Consultant on these As-Built drawing is obtained.

b) The Bidder shall ensure all As-Built drawings are accurate representation of the complete Works, before submitting them to the Engineer Consultant.

c) As-built drawings shall only be of standard sizes of A0, A1 size as stipulated in ISO 5457:1999, as approved by the Consultant.

d) The final approved As-Built drawings shall be in 6 sets of hard copy and 3 sets of electronic copies. These shall be submitted within 21 days from the date of final approval. Each electronic copy shall be in the form of CD-ROM (both in PDF & DWG formats), labeled, with cross reference to a printed list of files explaining the contents and purpose of each file and supplied in sturdy plastic containers.

9. Verification of Actual Dimensions on Site:

a) The Bidder shall be solely responsible for verification of actual site dimensions and building layout. Building layouts shown on Consultant's drawings shall not be considered to be final with regard to dimensions and layout but shall be subject to actual verification by the Bidder. All working drawings prepared by the Bidder shall incorporate actual measurements taken on site. The Bidder shall ensure that all equipment can be conveniently fitted into the space allocated for this purpose.

b) If any space allocated for certain equipment or combination of equipments is insufficient or deficient in terms of clearances required for maintenance etc., the Bidder shall forthwith inform the Consultant/Engineer of the discrepancy. He shall provide all reasonable assistance to the Consultant/Engineer for verification of the same and for taking remedial measures. It is understood that all tenderers during tendering shall have checked that the equipment proposed to be supplied by them fits conveniently into the space allocated for this purpose. In case any such space is insufficient, the tenderer shall so indicate the deficiency in his tender documents and specify the space requirements. Failure on the part of the tenderer to point out any discrepancies existing in this regard shall make him liable, if his tender has been accepted, to bear the full consequences developing out of any equipment not fitting into the space allocated for the purpose.

c) If any time during the progress of the Works any error shall appear or arise in the position, levels, dimensions or alignment of any part of the works, the Bidder on being required to do so by the Consultant/Engineer shall at his own expense rectify such error to the satisfaction of the Consultant/Engineer unless such error is based on incorrect data supplied in writing by the Consultant/ Engineer in which case the expense of rectifying the same shall be borne by the Procuring Agency. The checking of any setting out or of any line or level by the Consultant/Engineer shall not in any way relieve the Bidder of his responsibility for correctness thereof and the Bidder shall carefully protect and preserve all benchmarks, site rails, pegs and other things used in setting out the Works.

10. Responsibility for Accuracy of Information:

a) The Bidder shall be fully responsible for accuracy of all information necessary for successful and timely completion of the works.

b) The Bidder shall be responsible for making all measurements and set out all the necessary dimensions for their correctness.

c) The Bidder shall be fully responsible for ascertaining the accuracy of the dimensions and other information given in the tender documents before carrying out the work. The Bidder shall provide the complementary dimensions and communicate the same to the Engineer/ConsultantThe Bidder shall consult the drawings and documents which have been prepared for the Civil and other contracts by other Engineer/Consultants, which can affect his work and which are either kept on site or are available with the other Engineer/ Consultants.

d) It shall be the responsibility of the Bidder to acquire all necessary information and ascertain its accuracy for co-ordination of the works with the works of other Bidders.

11. Approval for Material & Equipment:

a) General: All equipment and material to be used in the Works shall be subject to approval obtained prior to delivery of the same on site. It is to be specifically noted that any approval given by the Engineer/Consultant/ shall not relieve this Bidder of his obligations under this Contract.

b) Approval of Locally Manufactured Equipment: The procedure of approval of locally manufactured equipment shall be the same as stipulated above for imported equipment. Additionally, all locally manufactured equipment shall be inspected at the manufacturer's premises by the Consultant/Engineer, and approval given prior to delivery on site.

c) Approval of Imported Material: All imported material to be used in the works shall be submitted to the Consultant/Engineer and approval obtained. Manufacturer's literature/brochure etc. that provide

complete information on the material specifications, to enable the Consultant/Engineer to check conformance to specification, shall be submitted. Any additional information, test reports etc., required by the Consultant/Engineer shall be supplied by the Bidder.

d) Approval of Locally Procured Material: All locally procured material shall be submitted to the Consultant/Engineer for approval, and approval obtained prior to delivery of the same on site. The procedure for obtaining approval shall generally be the same as given above for imported material, except that where manufacturer's literature is not available, a sample of the material shall be submitted along with type written notes indicating relevant source data and specs on the material. Any other samples, information, test reports etc., required by the Engineer/Consultant's shall be submitted.

12. Storage Arrangements:

a) The Bidder shall make adequate arrangements for the storage of the materials arranged by him or supplied by the Procuring Agency. No payment shall be made to the Bidder for storage arrangements whatsoever. However adequate space for stores shall be provided on site to the Bidder.

b) The location of the store area shall be within the Site premises and/or selected with the consultation and approval of the Engineer/Consultant.

13. Cutting & Patching:

a) Cutting will be done under Specifications of other trades. Perform cutting, fitting and patching of mechanical equipment and materials required to:

i) Set openings and sleeves for ducts & pipes accurately before the structural concrete are poured or set boxes on the forms so as to leave openings in the structure in which the required sleeves can be subsequently located in which case Bidder shall fill in the concrete voids around the sleeves.

ii) Uncover work to provide for installation of ill-timed work.

iii) Remove and replace defective work.

iv) Remove and replace work not conforming to requirements of the Contract Documents.

v) Remove samples of installed work as specified for testing.

vi) Install equipment and materials in existing structures.

vii) Upon written instructions from the Consultant uncover and restore work to provide for observation of concealed work.

b) All patching will be done under Specifications of other trades. Should the Bidder neglect to perform his preliminary work and should cuttings be required in order to install the piping or equipment, then the expense of the cutting and restoring of surface to their original condition shall be borne by the Bidder.

c) Cut, remove and legally dispose of selected mechanical equipment, components and materials as directed by the Consultant, including but not limited to removal of mechanical piping, heating units and trim and other mechanical items made obsolete by new work.

d) Protect structure, furnishings, finishes and adjacent materials not indicated or scheduled to be removed.

e) Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

f) Patch and refinished existing finished surfaces and building components using new materials matching existing materials and experienced installers.

14. Measuring Instruments:

The Bidder shall acquire and maintain on site various required measuring instruments in perfect working condition to enable the representative of the Procuring Agency Consultant/ Engineer to check the quality and standard of all material and performance of equipment.

15. Standards & Typical Design:

The specification either cites or implies IEEE, IEC, ASME, ASHRAE, or BS Standards where the context so refers. Other comparable United States, European or Japanese standards and typical designs are equally acceptable providing that they in no way detract from the quality, safety, operability or durability of the equipment and material furnished. However, when other standards or typical designs than those cited or implied are offered by a tenderer, he shall set forth in his proposal the alternate standards and/or designs he proposes so that a direct comparison can be made by the Engineer/Consultant before the issue of a Letter of Award. Each specific difference from the specifications shall be clearly spelled out by the tenderer. If no alternates are set forth by the Tenderer in his proposal, it will be assumed that the equipment and material will be in accordance with the standards and typical designs as cited or implied in the Specifications.

16. Abbreviations for Standards:

The standards, codes of practice and recommendations of the following societies or institutions have either been used in the specifications and are cited here as a general level of quality for the equipment, materials and workmanship.

a) Abbreviations for International institutions are given below:

- International Electro technical Commission ... IEC

b) Abbreviations for some European societies and standards institutions are as follows:

- Association Francaise de Normalisation ... AFN
- American Society of Heating Refrigeration
  Air-conditioning Engineer/Consultants Inc.....ASHRAE
- British Standard Institution..... BSI
- Chartered Institution of Building Services.....CIBS
- Deutsches Institute fur Normung.....DIN
- Institution of Electrical Engineer/Consultants, London.....IEE

c) Abbreviations for Pakistani Societies and Standard Institutions:

- Pakistan Standards Institution..... PSI
- Water and Power Development Authority.....WAPDA

d) Abbreviations for various United States Societies and Standard Institutions:

- American Standards Association.....ASA
- American Society of Heating, Refrigerating and
  Air-conditioning Engineer/Consultants.....ASHRAE
- American Society of Mechanical Engineer/Consultants.....ASME
- National Electrical Manufacturers Association.....NEMA
- American Society for Testing and Material.....ASTM
- American Refrigeration Institute..... ARI
  Sheet Metal and Air-conditioning Bidders National Association.....SMACNA
- Instrument Society of America.....ISA
- National Bureau of Standards..... NBS
- National Fire Protection Association.....NFPA
- Thermal Insulation Manufacturer's Association..... TIMA

e) Where differences or contradictions appear between any of the laws, standards, codes, specified herein, the decision of the Consultant shall be final and binding on the Bidder and the Bidder shall not claim any additional charges for carrying out the same.

17. Operating & Maintenance Instructions:

a) Framed Instructions: Approved piping, wiring and control diagrams showing the complete layout of the entire system, including equipment, piping, valves and control sequence, framed under glass or in approved laminated plastic, shall be posted; where directed. In addition, condensed operating instructions, explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures of safely starting and stopping the system shall be prepared in typed form, framed as specified above and posted beside the diagrams. Proposed diagrams, instructions and other sheets shall be submitted for approval prior to the posting. The framed instructions shall be posted before acceptance testing of the system.

b) Field Instructions: During the two months of the operation and maintenance period upon completion of the work the services of one or more project engineers shall be provided by the Bidder to instruct the representative of the Procuring Agency in the operation and maintenance of the Works. The field instructions shall cover all the items contained in the bound instructions.

18. Operation & Maintenance (O&M) Manual & User Manual:

18.1 General

The Bidder shall provide two types of manuals to the Engineer/Consultant with all changes made to the installation during the course of the Contract suitably incorporated.

The "O&M Manual" is for use by the maintenance bidder of the completed installation. It shall contain detailed technical information covering both operation and maintenance aspects of the installation.

The "User Manual" seeks to give users of the completed installation an overview of the essential information of the installation. The contents of the manual should be concise and succinct for ease of comprehension by people with a non-technical background.

18.2 Presentation

All manuals shall be written in English, unless otherwise specified. The text of descriptive parts shall be kept concise while at the same time ensure completeness. Diagrammatic materials shall also be supported by comprehensive descriptions.

The manuals shall comprise A4 size loose-leaf, where necessary, A3 size folded loose-leaf. The loose-leaves shall be of good quality paper that is sufficiently opaque to avoid "show-through". Unless otherwise specified in the Contract, the manuals shall be bound in durable loose-leaf four ring binders with hard covers.

The manuals shall have labels or lettering on the front cover and spine. The Engineer/Consultant's approval shall be obtained on this at the draft manual stage. The electronic copy of manuals including the technical literatures shall be in PDF format.

18.3 Checking and Approval

The Bidder shall submit 3 sets of the first draft of O&M Manuals together with a list of recommended spare parts for one year's operation and a list of special tools both complete with prices to the Engineer/Consultant for comment within 28 days of the issuance of the Completion Certificate.

The Bidder shall submit 2 sets of the first draft of the User Manual to the Engineer/Consultant for comment at least 56 calendar days before the date of completion. The Engineer/Consultant will check the drafts and return them to the Bidder within 42 days from the date of submission with comments necessary for a final and approved set of document. The Bidder shall then make all necessary amendments to the documents and resubmit them to the Engineer/ Consultant within 21 days from the date of receipt of comments.

The Bidder shall submit 3 sets of hard copies (one of which shall be the original) and one set of electronic copy of the final approved O&M Manuals in CD-ROM within 21 days from the date of approval by the Engineer/Consultant. The Bidder shall submit 6 sets of hard copies and 3 electronic copy of the final approved User Manuals in CD-ROM within 21 days from the date of approval by the Engineer/Consultant.

18.4 Structure and Content of O&M Manual

The detailed requirements, structure and contents of the O&M Manual shall include the following information under separate sections where appropriate:

(a) Project Information

This shall include: Project title, site address, contract no., contract title, bidder/sub-bidder name, address, contact persons and their telephone/fax nos., contract commencement date, substantial completion date and end date of operation & maintenance period.

(b) System Description

(i) Type(s) of system(s) and equipment installed;

(ii) Design criteria, design data and parameters;

(iii) Locations of the system and major equipment, and what they serve;

(iv) Description of operation and functions of the system and equipment;

(v) General operating conditions, expected performance and energy and resources consumption where applicable.

(c) List of Installed Equipment

Schedule of all items of equipment and plant stating the location, name, model no., manufacturer's serial or reference no., manufacturer's design duties and data.

(d) Spare Parts and Special Tools Lists

(i) List of Spare Parts supplied by the Bidders: Item descriptions, supplied quantities, model nos. manufacturer's serial or reference nos. and storage locations.

(ii) Recommended Spare Parts List and Special Tools List: Manufacturers'/ suppliers' recommendations for spare parts and special tools with item description, unit rate, recommended stock quantities as well as the agents for the spare parts and special tools.

(e) Manufacturers' Certificates/Guarantees

(i) Manufacturers' certificates such as factory test certificates, laboratory test reports and guarantees and any others where required for the equipment and plants, etc.

(ii) Originals of Statutory Inspection Certificate for various installations, including:

[Note: Testing records & commissioning data (other than the types prescribed above), which are required under the Contract are checked and endorsed separately by the Engineer/Consultant and do not form part of the O&M manuals.

(f) Safety Precautions for Operation and Maintenance

State, where applicable, hazard warnings and safety precautions of which the operation and maintenance staff need to be aware:

(i) mandatory requirements relating to safety;

(ii) known hazards against which protection measures shall be taken; and

(iii) known features or operational characteristics of the installed equipment or systems which may cause hazard and the related safety precautions.

(g) Operation Instructions

Instructions for the safe and efficient operation, under both normal and emergency conditions, of the installed system which shall comprise:

(i) an outline of the operating mode;

(ii) control logic and data (sequence, effect, limits of capability, modes and set points);

(iii) procedures and sequences for start-up and shut-down;

(iv) interlocks between equipment/system;

(v) calling on of stand-by equipment;

(vi) precautions necessary to overcome known hazards;

(vii) means by which any potentially hazardous equipment can be made safe;

(viii) estimation of energy consumption and energy costs;

(ix) forms for recording plant running hours, energy consumption and energy costs; and

(x) operating data such as running current, operating pressure, operating flow rates, etc.

(h) Maintenance

(i) Maintenance instructions

Manufacturers' and the Bidder's recommendations and instructions for the maintenance of the installed equipment. Clear distinction should be made between planned tasks (preventive maintenance) and fault-repair tasks (corrective maintenance). Instructions shall be given on each of the following, as appropriate:

(a) nature of deterioration, and the defects to be looked for;

(b) isolation and return to service of plant and equipment;

(c) dismantling and reassembly;

(d) replacement of components and assemblies;

(e) dealing with hazards which may arise during maintenance;

(f) adjustments, calibration and testing; and

(g) special tools, test equipment and ancillary services.

(ii) Maintenance schedules

Proposed maintenance schedules for all the preventive maintenance tasks identified above. The schedules shall be based on both manufacturers' recommendations and other authoritative sources (e.g. statutory or mandatory requirements) and should include:

(a) routine servicing;

(b) inspections;

(c) tests and examinations;

(d) adjustments;

(e) calibration; and

(f) overhaul

The frequency of each task may be expressed as specific time intervals, running hours or number of completed operations as appropriate. Collectively, the schedules will form a complete maintenance cycle, repeated throughout the whole working life of the installation.

(a) Drawing Lists

(b) A complete list of as-built drawings identified with drawing number/ reference;

(c) A complete list of manufacturers' shop drawings with drawing number/reference, where applicable; and

(d) A brief description of CD-ROM for these drawings.

(e) Technical Literatures

A complete set of manufacturers' literatures for all the plant and equipment installed in the system. The contents of these literatures shall cover the following areas where applicable:

(a) description of equipment with model numbers highlighted;

(b) performance -behavioral characteristics of the equipment;

(c) applications -suitability for use;

(d) factory/laboratory test reports, detailed drawings, circuit diagrams;

(e) methods of operation and control;

(f) operation instructions;

(g) cleaning and maintenance requirements;

(h) plants, materials and space required for maintenance;

(i) protective measures and safety precautions for operation and maintenance; and part lists

(j) Contact addresses and telephone numbers of suppliers of major equipment

18.5 Structure and Content of User Manual

The detailed requirements, structure and contents of the User Manual shall include, where applicable, the following information:

(a) Project Information

This shall include: Project title, site address, contract no., contract title, contract commencement date, substantial completion date and end date of Maintenance Period.

(b) System Description

(i) Type(s) of system(s) and equipment installed, and their purposes;

(ii) Locations of major plant spaces and riser ducts;

(iii) Brief description of the operation and functions of the systems and equipment; and

(iv) Listing of set points which can be adjusted by the user to suit their operation needs.

(c) Schedule of Major Plant Spaces and Installed Equipment

(i) Schedule of major plant spaces and riser ducts including their locations; and

(ii) Schedule of major equipment and plants including their locations and serving areas.

(d) Safety Precautions for Operation

Any safety precautions and warnings signals that the users shall be aware of in the daily operation

of the various systems and equipment in the installation including:

(i) mandatory requirements relating to safety;

(ii) features or operational characteristics of the installed systems or equipment which may cause hazard and the related safety precautions;

(iii) protective measures and safety precautions for operation; and

(iv) list of warning signals and the related meanings that the user shall be aware of and the actions to be taken

(e) Operation Instructions

Instructions for the safe and efficient operation, under both normal and emergency conditions, of the installed system which shall comprise:

(i) an outline of the operating mode;

(ii) step by step operation instructions for systems and equipment that are to be operated by the user, including at least procedures for start-up and shut-down;

(iii) means by which any potentially hazardous situation can be made safe;

(iv) cleaning and basic maintenance procedures.

(f) List of Statutory Periodic Inspections and Tests

A schedule of periodic inspections and tests that Procuring Agency and/or user of the installation have to arrange to achieve compliance with the requirements stipulated in the relevant Laws (if any). The frequency of such inspections and tests shall be expressed in specific time intervals.

(g) Drawings

A set of selected as-built drawings which shall be able to illustrate to the user the general layout of the completed installation.

(h) Photographs

A set of photographs with suitable captions to illustrate to the user the appearance and locations of devices which require their setting and operation.

19. Mechanical Installations:

Sequence, coordinate, and integrate the various elements of mechanical systems, materials and equipment. Comply with the following requirements:

a) Coordinate mechanical systems, equipment and materials installation with other building components

b) Verify all dimensions by field measurements.

c) Arrange for chases, slots and openings in other building components during progress of construction, to allow for mechanical installations.

d) Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

e) Sequence, coordinate and integrate installations of mechanical, materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing the building.

f) Install systems, materials and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Consultant/Engineer/Consultant.

g) Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

h) Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

i) Install access panel or doors where units are concealed behind finished surfaces.

j) Install systems, materials and equipment giving right of-way priority to systems required to be installed at a specified slope.

k) Provide fire stopping materials in all annular spaces surrounding piping, conduits, ducts, etc. that penetrate fire-resistive construction.

20. Delivery of Equipment / Material on Site:

a) No plant or Bidder's Equipment shall be shipped or delivered to the Site until intimation in writing has been applied for and obtained by the Bidder from the Engineer/ Consultant that the plant may be
b) delivered. The Bidder shall be responsible for the reception on Site of all plant and Bidder's Equipment delivered for the purpose of the Contract.
c) All materials delivered to Site shall be accurately listed and recorded in the site record books maintained on site by the Bidder and shared with Procuring Agency's Project Manager.
d) Materials and equipment delivered to Site and paid for in interim payment shall be the Procuring Agency's property. Such materials and equipment shall not be removed from Site without the approval of the Engineer/Consultant in writing and appropriate deduction shall be made in the next interim payment in accordance with the Contract.

21. Unloading & Storage at Site:

a) The Bidder shall unload all procuring agency supplied or otherwise equipment & material at the site from delivery vehicles as the case may be. Items for permanent installation shall be properly stored in areas designated by the Engineer/Consultant and shall be protected as required to prevent damage or deterioration of any type. Storage methods shall be such as to cause minimum inconvenience to others and shall be arranged to facilitate inspection.

b) All equipment and material storage shall be subject to the approval of the Engineer/ Consultant.

i) Items stored shall be blocked up at least six (6) inches off the ground.

ii) The ends of all nozzles, pipes, tubes and conduits while in storage at the site shall be covered with a tube cap to save against entrance of rain water, blowing dirt, and other foreign matter. Tubing shall be shipped and stored in neat bundles.

iii) Miscellaneous steel, plate work, pipes, etc. shall be protected by a prime coat of paint and kept painted throughout the storage and erection period to inhibit rusting unless such items are galvanised or have other corrosion proof finish.

c) All packing boxes, shipping containers, planking, covering, etc., shall become the property of the Procuring Agency as soon as the equipment and material which is contained therein arrives at the site. The Procuring Agency, on application from the Bidder, may permit the Bidder to use some of the boxes, containers, etc., without charge for equipment and material storage purposes.

22. Equipment Lifting:

a) The bidder shall be solely responsible for safe lifting of the equipments from place of storage to location of final installation and finally on the foundations.

b) Prior to lifting the equipments the following procedure shall be adopted:

i) Submit comprehensive insurance policy for the full value of the equipment to the Engineer/Consultant/Procuring Agency from approved insurance company.

ii) Submit complete information of specialist firm of lifters/riggers to the Engineer/ Consultant & obtain approval.

iii) Submit complete procedure & equipment to be used for lifting the equipment in place. Identify on plans location of tripods, hoist, etc. that will transfer weight to the equipment, to the structure & obtain approval.

iv) All the above to be completed with one month before the date of lifting of equipment.

23. Qualification of Equipment & Material Manufacturer:

a) All minor equipment and all materials shall be manufactured by companies which have had at least five years previous experience in the design and manufacture of equipment and or material of comparable type, capacity and operating conditions.

b) Where the requirements of this clause make any material non-obtainable the Procuring Agency and/or Engineer/ Consultant reserves the right to waive any portion or portions of it as required to obtain the intent of the Specifications.

c) When manufacturer's product is specified by name or equivalent, it shall be the sole judgement of the Engineer/Consultant to determine the acceptability of any product which is offered as an equal to that specified.

d) Proposals shall be based on the equipment and materials specified, and any request to substitute any time shall be so mentioned in the proposal and the amount to be added or deducted shall be given. Any request for substitution after the date of Letter of award shall likewise be accompanied with the difference in price.

e) If the Bidder in his tender proposal has offered more than one source of equipment or material the selection of the source shall be at the judgement of the Consultant/ Engineer.

24. Safety Program:

a) The Bidder shall strictly follow at his own cost the Safety Program outlined below and such additional measures as the Engineer/Consultant or Engineer/Consultant's Representative may determine to be reasonably necessary.

i) Prior to commencement of work the successful Bidder shall submit safety Program for discussion with the Procuring Agency and the Engineer/Consultant.

ii) The Bidder shall prepare a plan of the Works' Site to assure that storage areas for materials and equipment are located on the project/work site for maximum efficiency. This plan will be subject to the approval of the Engineer/Consultant.

iii) Activities between different operations and different crafts will be co-ordinated.

iv) The Bidder shall layout and provides an efficient access system with information and directional signs posted as necessary.

v) All employees will be instructed on safe work method.

vi) The Bidder shall advise all his supervisory staff of their responsibility for the prevention of injury to persons or damage to property or equipment in their respective areas of supervision.

vii) Safety will be included in all job planning. This will include providing safe construction equipment and vehicles, protective equipment necessary for protection of workmen, and establishing methods for safe operation.

viii) Good housekeeping will be maintained at all times.

ix) Scaffolds, ladders, ramp", runways etc. will be constructed properly and maintained in safe conditions.

x) Ample fire protection will be provided and fire hazards guarded, by the Bidder.

xi) Adequate lighting, ventilation etc. will be provided as necessary, by the Bidder.

xii) Equipment will be properly and regularly inspected and maintained by the Bidder to the satisfaction of the Engineer/Consultant.

xiii) The Bidder will assign to his employees only such duties as are within their physical and mental capabilities.

xiv) The Bidder will hold monthly meetings with his supervisory staff and the man incharge at the lower level will hold safety meetings of 10 to 15 minutes with his crew each week.

xv) First Aid facilities will be provided at job sites, the services of doctors and hospitals made available, and all supervisors instructed in handling of injured employees.

xvi) Adequate toilet facilities will be provided, maintained in a hygienic condition and their use enforced by the Bidder.

b) Accident reports will be furnished to the Engineer/Consultant for onward transmission to the Procuring Agency within 2 hours of the reported accident.

c) Copies of the safety Program will be supplied by the Bidder to the Engineer/ Consultant and will be promptly posted in all offices in use of projects/works under this Contract.

d) At all construction sites the following instructions shall be followed:

i) availability of safety (hard) hats, which should be worn by anyone visiting or working within the designated work area

ii) controlled entry to the designated work area

iii) proper distribution of temporary electric power (use of RCDs/ELCBs, switch gear, cabling, socket outlets)

iv) proper guarding of shafts, stairs and floor edges up, to a height of 42".

v) proper access stairs and ladders with handrails

vi) properly demarcated passageways, which are kept clear of materials, equipment, and rubbish

vii) daily cleaning of debris and rubbish from the site

viii) adequate temporary lighting

ix) proper housekeeping to reduce slipping and tripping hazards.

x) proper protection to pedestrians and adjoining buildings

xi) bidder's all-risk Insurance policy to be in place.

e) To ensure safety of all people on the Site during the construction process, including Bidders' personnel and Procuring Agency's representatives, the following procedures shall be adopted by all Bidders for the use of temporary electricity supply.

i) Work shall generally be carried out in accordance with 16th Edition of UK IEE Wiring Regulations, BS CP 1017 "Distribution of Electricity on Building Sites", and the Pakistan "Electricity Rules, 1937" all legal formalities of the Electric Inspector's office shall be complied with.

ii) Construction of cables used shall be as follows:

a) to fixed distribution boards and fixed equipment, PVC/PVC/SWA/PVC, to BS 6346.

b) to moveable plant, flexible armoured cables, to BS 6116.

c) to welding electrode-holders, flexible cables to BS 638.

d) to portable tools and hand-lamps, flexible cords to BS 6500

iii) Installation of cables shall be as follows:

a) outdoors, directly buried at least 500mm below grade, with tile covers and cable markers (at minimum 10 meter intervals and at bends), and in RCC pipe at road/traffic crossings.

b) indoors, clipped to the surface at least 3000mm above floor/ground level.

c) strain relief shall be provided at termination of all cables at equipment, plugs, etc.

iv) Double earthing, with stranded copper conductors, shall be used to establish a TNS system. No separate earthing electrodes are required at each location.

v) A main distribution board, to BS 4363, of totally enclosed sheet-steel construction (IP 54) shall be provided, with 30mA trip residual current device(s) for the earth-leakage protection of circuits. Short-circuit and overload protection shall be provided by circuit-breakers of the appropriate rupturing capacity.

vi) Plugs, sockets, and accessories of a robust, unbreakable construction, to BS 4343, shall be used for all equipment. Portable tools, to BS 2769, shall preferably be of double-insulated construction and be operated at 110V.

vii) A layout drawing of the proposed temporary installation with schematics, cable sizes and routes, earth conductors, and protection details shall be had approved from the Procuring Agency. After installation, test results (insulation resistance, earth-loop impedance, etc.) shall be submitted; re-testing shall be done every three months.

25. Guarantees / Warrantees for Equipment / Plant:

a) The period of guarantee/warrantee on the equipment/plant shall be the period stated in Conditions of Contract.

b) The Bidder's guarantee does not cover the normal wear & tear.

c) Manufacturer's equipment warranties if they exceed the Maintenance Period as defined in these Documents shall be transferred to the Procuring Agency at the end of the Maintenance Period.

d) The Bidder shall guarantee that the material & workmanship incorporated into the plant/equipment are new and the best of their respective kinds for the service intended and that all items will be free from inherent defect in design, workmanship & materials, and that all equipment in its several parts will operate successfully at all capacities up to and including the maximum specified load without undue noise, heating, straining of parts, wear and vibration and that an ample factor of safety is included in every design.

e) Guarantee/Warrantee, shall be furnished by the Bidder upon forms approved by the Consultant/Engineer and shall be signed by both the Bidder and the Sub-Bidders whose work is involved.

f) If the equipment/plant manufacturer's standard guarantee/warrantee is applicable, the guarantee/warrantee form and conditions must be submitted along with the equipment/plant 'technical submittals'.

g) The Bidder's liability shall be limited to the replacement of defective parts that may develop in the equipment or material of his own work or manufacture or his Sub-Bidders under proper use and arising solely from faulty design, material, or workmanship provided always that such defective parts are not repairable at the Site, and are not essential in the meantime for commercial use of the equipment, are promptly returned to the Bidder's or Sub-Bidder's factory unless otherwise arranged. The equipment so replaced or repaired shall be in conformity with the specifications.

h) For indigenous equipment, all replacements shall be made free of cost at the Site by the Bidder.

i) For imported equipment, all replacement shall be made free of cost ex-Karachi port, and the Procuring Agency shall arrange to have then cleared, pay all duties and hand-over the replaced parts to the Bidder.

j) The return of defective parts to the Bidder's or Sub-Bidder's factory shall be the Bidder's responsibility and shall be made at his expense. The Procuring Agency will, however, render such assistance as necessary to expedite the same. In the case of defective parts not repairable at the site but essential in the meantime for the commercial use of the equipment, the Bidder shall, whenever possible, replace free of cost at the site the said defective parts before the defective parts are removed from the site.

k) If it becomes necessary for the Bidder to replace or renew any defective portions of the Plant under this clause, the provisions of this clause will apply to the portions of the plant so replaced or renewed until the expiration of seven months from the date of such replacement or until the end of the guarantee period, whichever shall be later. If any defects are not remedied within a reasonable time, the Procuring Agency, after due notice to the Bidder, may proceed with the work at the Bidder's risk and expense without prejudice to any other rights which the Procuring Agency may have against the Bidder in respect to such defects.

l) If the replacements or renewals are of such a character as may effect the efficiency of the plant, the Engineer/Consultant/Consultant shall have the right to give to the Bidder within one month of such replacement or renewal, notice in writing that performance tests be made, in which case tests shall be carried out as provided in these Documents. Should such tests show that the guarantees of the Contract are sustained; the cost of the tests shall be borne by the Procuring Agency. Should the guarantees not be sustained, the cost of the test shall be borne by the Bidder.

m) If during the guarantee period the services of the Bidder's personnel are required for the rectification or replacement of any defective part or work due to defective material, design or workmanship, such services shall be made by the Bidder without charge to the Procuring Agency.

26. Tests on Completion:

a) The Bidder shall give to the Consultant in writing 15 days' notice of the date after which he will be ready to make the "Tests on Completion". Unless otherwise agreed the tests shall take place within 10 days after the said date on such day or days as the Consultant/Engineer shall in writing notify the Bidder.

b) If the Consultant fails to appoint a time after having been asked to do or to attend at any time or place duly appointed for making the said tests, the Bidder shall be entitled to proceed in his absence and the said tests shall be deemed to have been made in the presence of the Consultant/Engineer.

c) If in the opinion of the Consultant the tests are being unduly delayed he may, by notice in writing, call upon the Bidder to make such tests within 10 days from the receipt of the said notice, and the Bidder shall make the said tests on such day within the said 10 days as the Bidder may fix and of which he shall give notice to the Consultant/Engineer. If the Bidder fails to make such tests within the time aforesaid, the Consultant/Engineer may himself proceed to make the tests. All tests so made by the Consultant/Engineer shall be at the risk and expense of the Bidder.

d) The Procuring Agency, except where otherwise specified, shall provide free of charge subject to the provisions of Sub-clause (e) of this clause; electricity, fuel and water, as may be reasonably demanded to carry out such tests efficiently.

e) If any portion of the works fail to pass the tests, tests of the said portion shall, if required by the Consultant/Engineer or by the Bidder, be repeated within a reasonable time upon the same terms and conditions, as aforesaid, save that all expenses to which the Procuring Agency may be put by the repetition of the tests shall be deducted from the Contract Price.

27. Inspection of Completed Works:

a) The Bidder is required to give the Procuring Agency/Consultant due notification when he expects the work to be completed, a report in triplicate of the measurements carried out with regard to pressure testing of pipes and leak testing of duct work and other specified tests shall be attached to this application. The final inspection should then be carried out, without unnecessary delay, and if possible within four weeks.

b) At the request of either party, inspection of such Sections of the work as will not be accessible after completion, or will be difficult to alter, which are to be taken into use by the Procuring Agency before the time of the final inspection, may be carried out in advance. (Advance Inspection).

c) An inspection is to be carried out immediately before the expiry of the guarantee period. (Guarantee Inspection).

d) Inspection of corrected faults or omissions noted in connection with advance, final, or guarantee inspection is also to be done (Supplementary Inspection).

e) Inspections are to be carried out by the Consultant/Engineer or any other suitable and competent person appointed by the Procuring Agency.

f) The costs of Advance Inspection, Final Inspection & Guarantee Inspection are to be met by the Procuring Agency, where the inspection has been carried out by a person appointed by him.

g) The costs of supplementary inspections and re-inspections are to be borne by the Bidder.

h) It is the responsibility of the Bidder to provide & pay for, any help or assistance necessary in connection with the inspection work.

i) The inspector's decision as to what faults or omissions may have occurred is binding on both sides.

j) The Bidder is required to carry out, without delay, any improvements, alterations or additions which may be considered necessary as the result of an inspection report.

k) When the final inspection has taken place, the work is to be handed over to the Procuring Agency in so far has been found to be in the state required by the Contract, and can suitably be put into use for this purpose for which it was intended.

l) The Procuring Agency has the right to put into use any Section of the work contracted for and not approved at the time of inspection, provided this can be done without jeopardising the progress of the work, and he may use it without special compensation even before the faults or omissions have been made good.

m) Where special dates are specified under the Contract for the completion of different Sections of the work, the provisions of this Clause are to apply to each part separately.

n) The inspection report required under this Clause is to be delivered in writing, and signed by the inspector, giving the date on which it is to be made available for the parties' inspection. The report should cover the following points:

i) State whether the work has been approved or not.

ii) State the reasons for failing to approve it, if it has not been approved.

iii) State faults or omissions for which the Bidder is to be held responsible, together with the time within which they are to be made good.

iv) Include notes on matters which do-not require immediate action, but ought to be finally settled in connection with the guarantee inspection.

v) The sum to which the Procuring Agency is entitled.

vi) Date on which the insurance taken out by the Bidder lapses.

vii) If the work has been approved at the final inspection, the date from which the guarantee/maintenance period is to run and the day after which it expires.

viii) Distribution of costs connected with the inspection.

28. Acceptance & Interim Operation:

a) After the performance tests, if the equipment supplied by the Bidder is found to meet the guarantee and any other specified requirement, and if all other work called for hereunder has been completed, the Procuring Agency's acceptance will be forth-coming and final payment will become due as provided for under the terms of payment. This acceptance shall, however, not relieve the Bidder of his responsibility for the first inspection.

b) Should the equipment furnished by the Bidder fail to operate as required, or in case of failure to meet any of its guarantees, the Procuring Agency shall have the right to operate the equipment, using the Bidder's supervisory operating personnel, until such defects have been remedied and guarantees met with. In the event that defects necessitate the rejection of the equipment or any part thereof, the Procuring Agency shall have the right to operate the equipment until such time as new equipment is provided to replace the rejected equipment. Such operation shall not be deemed as an acceptance of any equipment.

29. Inspection & Testing During Manufacture:

a) The Consultant/ Procuring Agency shall be entitled at all responsible times during manufacture to inspect, examine and test on the Bidder's premises the materials and workmanship of all plant to be supplied under the Contract, and if part of the said plant is being manufactured on another premises the Bidder shall obtain the Consultant/Engineer/Consultant's permission to inspect, examine & test as if the said plant were being manufactured on the Bidder's premises. Such inspections, examination or testing if made shall not release the Bidder from any obligation under the Contract.

b) The Bidder shall give to the Consultant reasonable notice in writing of the date and place at which the plant will be ready for testing as provided in the Contract, and unless the Engineer/Consultant shall attend at the place so named within ten days of the date which the Bidder has stated in his notice, the Bidder may proceed with the test and also get the inspection and test carried out by an international testing agency of repute in the country of manufacture of the plant and thereafter forward to the Engineer/Consultant duly certified

copies of the test report carried out by him and the international inspecting agency, who on basis thereof give his opinion/decision. Provided that the Engineer/Consultant shall give the Bidder twenty-four hours' notice in writing of his intention to attend the test.

c) Where the Contract provides for tests on the premises of any Sub-Bidder, the Bidder shall provide such assistance, labour, materials, electricity, fuel, stores, apparatus and instruments as may be requisite and as may be reasonably demanded to carry out such tests efficiently.

d) As and when any Plant shall have passed the tests referred to in this Clause the Consultant/Engineer shall furnish to the Bidder a certificate in writing to that effect.

END OF SECTION 23 05 01

BASIC MECHANICAL MATERIALS AND METHODS

PART-1: GENERAL

1.1 Related Documents:

Drawings and general provisions of Contract, including General and Special Conditions apply to this Section.

1.2 Summary:

This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.

a) Piping materials and installation instructions common to most piping systems.

b) Nonshrink grout for equipment installations.

c) Field-fabricated metal and wood equipment supports.

d) Installation requirements common to equipment specification sections.

e) Mechanical demolition

f) Cutting and patching

g) Touch-up painting and finishing

1.3 Definitions:

a) Pipe and pipe fitting materials are specified in piping system Section.

b) Equipment and installation shall be in compliance with ANSI/ASHRAE 15 (latest edition).

c) Pipe, pipe fittings and piping include tube, tube fittings and tubing.

d) Finished spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, spaces above ceiling, crawl spaces and tunnels.

e) Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

f) Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

g) Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

1.4 Submittals:

1.4.1 Tendering Stage Submittals

Tenderer shall submit the following documentation:

a) Equipment catalogue having specifications, selection data; equipment dimensions, etc.

b) Factory computer selection.

c) Equipment Quality Assessment Form supplied by the Consultants, dully filled.

d) Statement of deviation from specifications.

1.4.2 Technical Approval Stage Submittals

Bidder shall submit the following documentation and obtain Consultants approval prior to ordering the equipment:

a) Equipment catalogue;

b) Factory computer selection;

c) Electrical control panel diagram and information

d) Microprocessor control panel information

e) Crating information

f) Shipment information;

g) Utility requirements;

h) Statement of deviation from specifications.

1.4.3 Construction Stage Submittals

Bidder shall submit the following documentation at appropriate times:

a) Certified dimensional drawings of the equipment.

b) Equipment Installation Manual.

c) Field Wiring Diagram.

d) Factory Performance Test Protocol

1.4.4 Close-Out Submittals

Bidder shall submit the following documentation at the closeout of the project:

a) Commissioning Reports, as per manufacturer's standard, duly signed by the commissioning engineer.

b) 03 sets of operation & maintenance manual.

c) 05 sets of spare parts manual.

1.5 Quality Assurance:

1.5.1 Standard & Regulatory Requirements

a) Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code – Steel."

b) Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications."

i) Comply with provisions of ASE B31 Series "Code for Pressure Piping."

ii) Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

c) ASME A13.1 for lettering size. Length of color field, colors and viewing angles of identification devices.

d) Equipment Selection: Equipment of greater or larger power, dimensions, capacities and ratings may be furnished, provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors bases and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

e) For products manufactured for 50 Hz use, that do not carry or qualify for UL labels, a manufacturer's certification is required that the product meets the minimum requirements of Internationally Recognized Testing Laboratories (IRTL) meeting the requirements of International Electro Commission (IEC), which are deemed equal to UL and other U.S. testing laboratories.

1.6 Delivery, Storage and Handling:

a) Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-and damage and prevent entrance of dirt, debris and moisture.

b) Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

c) Protect flanges, fittings and piping specialties from moisture and dirt.

1.7 Sequencing and Scheduling:

a) Coordinate mechanical equipment installation with other building components.

b) Arrange for chases, slots and openings in building structure during progress of construction, to allow for mechanical installations.

c) Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.

d) Sequence, coordinate and integrate installations of mechanical materials and equipment for efficient flow of the work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

e) Coordinate connection of mechanical systems with utilities and services. Comply with requirements of governing regulations, service companies, and consultants.

f) Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.

g) Coordinate installation of identifying devices after completion of covering and painting, where devices are applied to surfaces. Install identifying devices prior to installation of acoustical ceilings and similar concealment.

1.8 Shop Drawings:

a) Shop drawing detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

b) Coordination drawings for access panel and door locations.

c) Prepare coordination drawings to a 1:50 scale or larger. Detail major elements, components and systems of mechanical equipment and materials in relationship with other systems, installations and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the work. Include the following:

i) Proposed locations of piping, ductwork, equipment and materials. Include the following:

- Planned piping layout, including valve and specialty locations and valve stem movement.
- Planned duct systems layout, including elbows radii and duct accessories.
- Clearances for installing and maintaining insulation.
- Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
- Equipment services connections and support details.
- Wall penetrations.
- Fire-rated wall and floor penetrations.
- Sizes and location of required concrete pads and bases.

ii) Scheduling, sequencing, movement and positioning of large equipment into the building during construction.

iii) Floor plans, elevations and details to indicate penetrations in floors, walls and ceilings and their relationship to other penetrations and installations.

iv) Reflected ceiling plans to coordinate and integrate installations, air outlets, and inlets, light fixtures, communications systems components, sprinklers and other ceiling-mounted items.

1.9 Warranty:

Manufacturer shall guarantee the equipment against defects in materials and/or workmanship for a period of 18 months from data of shipment, unless otherwise stated elsewhere in this document.

PART-2: PRODUCTS

2.1 General:

2.1.1 Pipe and Pipe Fittings

a) Refer to individual piping system specification Sections for pipe and fitting materials and jointing methods.

b) Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.1.2 Joining Materials

a) Refer to individual piping systems specification Sections in Division 15 for special joining materials not listed below.

b) Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

1. ASME B16.21, non-metallic, flat, asbestos-free, 3.2mm maximum thickness, except where thickness or specific material is indicated.
    i) Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
    ii) Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.
2. ASME B16.20 for grooved, ring-joint, steel flanges.
3. AWWA C110, rubber, flat face, 3.2mm thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

c) Flange Bolts and Nuts: ASME B18.2.1 Carbon steel, galvanised, except where other material is indicated.

d) Solder Filler Metal: ASTM B 32.
1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent), and silver (approximately 5%), having 0.10-percent lead content.

e) Brazing Filler Metals: AWS A5.8.
1. BAg1: Silver alloy.

f) Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

g) Flanged, Ductile-Iron Pipe Gasket, Bolts and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

2.1.3 Piping Specialties

a) Escutcheons: Manufactured wall, ceiling and floor plates; deep-pattern type, where required to conceal protruding fittings and sleeves.
i) Inside Diameter: Closely fit around pipe, tube and insulation of insulated piping.
ii) Outside Diameter: Completely cover opening,
iii) Cast Brass: One-piece, with set-screw, with chrome plated finish.
iv) Cast-Iron Floor Plate: One-piece casting.
v) Finish: Polished chrome plate.

b) Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
i) Description: Combination of copper alloy and ferrous; threaded, solder, plain and weld neck end types and matching piping system materials.
ii) Insulating Material: Suitable for system fluid, pressure and temperature.
iii) Dielectric Union: Factory-fabricated, union assembly, for 17.5 kg/cm^2 minimum working pressure at 82°C temperature.
iv) Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 10.5 or 21 kg/cm^2 minimum pressure to suit system pressures.
v) Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers and steel backing washers.
Provide separate companion flanges and steel bolts and nuts for 10.5 or 21 kg/cm^2 minimum working pressure to suit system pressures.
vi) Dielectric Couplings: Galvanized-steel coupling, having inert and non-corrosive, thermoplastic lining, with threaded ends and 21 kg/cm^2 minimum working pressure at 197 degrees C temperature.

c) Mechanical Sleeve Seals: Modular, watertight, mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

d) Sleeves: The following materials are for wall, floor, slab and roof penetrations:
1. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends or BS 1387 (medium grade).

2. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets and pipe sleeve, with 1 mechanical-joint and conforming to AWWA C110 and 1 plain pipe-sleeve end.

   i) Penetrating Pipe Deflection: 5 percent without leakage.

   ii) Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.

   iii) Pipe Sleeve: AWWA C151, ductile-iron pipe.

   iv) Housing-to-Sleeve Gasket: Rubber or neoprene, push-on type of manufacturer's design.

3. Cast-Iron Sleeve Fittings: Commercially made, sleeve having integral clamping flange, with clamping ring, bolts and nuts for membrane flashing.

2.1.4 Grout

Nonshrink, Non-metallic Grout: ASTM C 1107, Grade B.

i) Characteristics: Post-hardening, volume-adjusting, dry hydraulic-cement grout, nonstaining, no corrosive, nongaseous and recommended for interior and exterior applications.

ii) Design Mix: 350 kg/cm^2, 28-day compressive strength.

iii) Packaging: Premixed and factory-packaged.

2.1.5 Spares

Provide spares as indicated under EQUIPMENT DATA SHEET.

PART-3: EXECUTION

3.1 Foundation (Included in the scope of work as per data sheets submitted):

Equipment shall generally be installed on concrete foundations constructed by others. This bidder shall supply dimensional drawings of the foundation, suitable to accommodate the equipment, in accordance with the manufacturer's recommendations.

3.2 Piping Systems – Common Requirements:

a) General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 15 specify piping installation requirements unique to the piping systems.

b) General Locations and Arrangements: Drawings (plans, schematics and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

c) Install all piping with slopes to provide low point drainage.

d) Install components having pressure rating equal to or greater than system operating pressure.

e) Install piping in concealed interior and exterior location, except in equipment rooms and service areas.

f) Install piping free of sags and bends.

g) Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited.

h) Install piping tight to slabs, beams, joists, columns, walls and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

i) Install piping to allow application of insulation plus 25mm clearance around insulation.

j) Locate groups of pipes parallel to each other, spaced to permit valve servicing.

k) Install fittings for changes in direction and branch connections.

l) Install couplings according to manufacturer's printed instructions.

m) Install pipe escutcheons for all pipe penetrations of concrete and masonry walls, wall board partitions and suspended ceilings.

n) Install sleeves for all pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

   i) Cut sleeves to length for mounting flush with both surfaces. Exception; Extend sleeves installed in floors of mechanical equipment areas or other wet areas 10mm above finished floor level, unless otherwise indicated on drawings.

ii) Build sleeves into any new walls and slabs as work progresses.

iii) Install large enough sleeves to provide 6mm annular clear space between sleeve and pipe or pipe insulation.

1. Steel Pipe Sleeves: For pipes smaller than 150mm.

2. Steel Sheet-Metal Sleeves: For pipes 150mm and larger, penetrating gypsum-board partitions.

3. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 50mm above finished floor level.

1) Seal space outside of sleeve fittings with nonshrink, non-metallic grout.

iv) Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using approved elastomeric joint sealants.

o) Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 25mm annular clear space between pipe and sleeve for installation of mechanical seals.

i) Install steel pipe for sleeves smaller than 150mm.

ii) Install cast-iron “wall pipes” for sleeves 150mm and larger.

iii) Assemble and install mechanical seals according to manufacturer’s printed instructions.

p) Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings and floors at pipe penetrations. Seal pipe penetrations with approved fire stopping sealant material.

q) Verify final equipment locations for roughing-in.

r) Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system specification Sections

i) Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

ii) Remove scale, slag, dirt and debris form inside and outside of pipe and fittings before assembly.

iii) Soldered Joints: Construct joints according to AWS “Soldering Manual’, Chapter 22 “The Soldering of Pipe and Tube”.

iv) Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream thread pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.

2. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).

3. Align threads at point of assembly.

4. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.

5. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe section that have cracked or open welds.

s) Piping Connections: Except as otherwise indicated make piping connections as specified below.

i) Install unions, in piping 50mm and smaller, adjacent to each valve and at final connection to each piece of equipment having 50mm or smaller threaded pipe connection.

ii) Install flanges, in piping 60mm and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

iii) Dry Piping Systems (Gas): Install dielectric unions and flanges to connect piping materials of dissimilar metals.

iv) Wet Piping Systems (Water): Install dielectric coupling and nipple sittings to connect piping materials of dissimilar metals.

3.3 Direction of Metal Supports and Anchorage:

a) Cut, fit and place miscellaneous metal supports accurately in location, alignment and elevation to support and anchor mechanical materials and equipment.

b) Field Welding: Comply with AWS D1.1 “Structural Welding Code-Steel”.

3.4 Demolition:

a) Disconnect, demolish and remove work specified under Division 15 and as indicated.

b) Where pipe, ductwork, insulation or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

c) Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

d) Removal: Remove all demolished materials and equipment from the project site.

e) Temporary Disconnection: Remove, store, clean, reinstall, reconnect and make operational equipment indicated for temporary or permanent relocation.

3.5 Cutting and Patching:

a) Cut, channel, chase and drill floors, walls, partitions, ceilings and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved. Obtain prior approval of Consultant before performing work.

b) Repair cut surfaces to match adjacent surfaces.

3.6 Grouting:

a) Install non-metallic, nonshrink, grout for mechanical equipment base bearing surfaces, pump and other equipment base plates and anchors. Mix grout according to manufacturer's printed instructions.

b) Clean surfaces that will come into contact with grout.

c) Provide forms for placement of grout, as required.

d) Avoid air entrapment when placing grout.

e) Place grout, completely filling equipment bases.

f) Place grout on concrete bases to provide a smooth bearing surface for equipment.

g) Place grout around anchors.

h) Cure placed grout according to manufacturer's printed instructions.

3.7 Cleaning:

Remove labels after work is complete.
Remove all splashed paint, cement splatter, protective paper, etc after work is complete, & deliver chiller in clean condition.

3.8 Protection of Finished Work:

Protect all equipment & work from deterioration from any condition, till handing over.

3.9 Installation Bidder's Responsibilities:

a) Install equipment to provide the maximum possible headroom, where mounting heights are not indicated.

b) Install equipment according to approved submittal data. Portions of the work are shown only in diagrammatic form. Refer conflicts to the Consultant.

c) Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

d) Install mechanical equipment to facilitate servicing, maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

e) Install equipment giving right-of-way to piping systems installed at a required slope.

3.10 Reference Specification:

The following specifications shall be construed to be part of these specifications.

- 23 05 01 - Basic Mechanical Requirement
- 23 05 02 - Basic Mechanical Materials and Methods
- 23 05 10 - Equipment Installation
- 23 05 13 – Motors
- 23 05 29 - Supports & Anchors
- 23 05 48 - Vibration Isolation Control

- 23 05 50 - Painting & Coating
- 23 05 53 - Mechanical Identification

END OF SECTION 23 05 02

EQUIPMENT INSTALLATION

The Bidder shall install equipment as & where shown on the drawings and shall perform the following work.

1. Equipment Foundation Bases:

A. Unless otherwise indicated on drawings, equipment shall generally be installed on a 100mm to 150mm high concrete base. Base shall be constructed of 1:2:4 (210 kg/cm^2, 28 day compressive strength) approved concrete with nominal reinforcement. Base shall be finished with 5mm cement plaster, or approved tiles as shown on drawings. Edges shall be provided with 25x25x3mm galvanized angle iron frame work. Base dimension shall not be less than 100mm larger in both directions than supported equipment. Manufacturer's supported recommendation shall be followed, using anchor bolts at tie-in locations. Drawings shall be submitted to the Consultant for approval.

2. Lifting & Shifting Equipment onto Foundations:

A. The bidder shall be solely responsible for safe lifting of the equipments from place of storage on site to location of final installation and finally on the foundations.

B. Prior to lifting the equipments the following procedure shall be adopted:

1. Submit comprehensive insurance policy for the full value of the equipment to the Engineer/Procuring Agency from approved insurance company, insurance cover is the responsibility of bidder.
2. Submit complete information of specialist firm of lifters/riggers to the Engineer & obtain approval.
3. Submit complete procedure & equipment to be used for lifting the equipment in place. Identify on plans location of tripods, hoist, etc. that will transfer weight to the equipment, to the structure & obtain approval.
4. All the above to be completed with one month before the date of lifting of equipment.

3. Equipment Installation Responsibility:

A. The Bidder shall ensure that the equipment is installed totally in accordance with the manufacturer's instructions (equipment installation manual must be obtained & read), and as directed by the Consultant. Correct alignment & levelling must be ensured.

B. Field assemble equipment (if required) in accordance with instructions in the manufacturer's installation bulletin.

C. Install the equipment on the foundation. Neoprene isolation pads or spring vibration isolators as specified for the equipment shall be placed under the equipment.

D. Insure that structure, piping or other equipment adjacent to this equipment do not restrict operation & maintenance requirements of the equipment.

E. Install all piping, cable, and other connections with all fittings, to the equipment. All material and labor required for a complete installation shall be supplied by the Bidder.

F. Connect equipment control panel to all operating external safety and auxiliary control devices.

G. Provide and install gauge cocks and thermometer wells for temperature and pressure readings at the inlet and outlet of all fluid flows.

H. Provide and install a flow switches on water circuits wherever necessary, and interlock it with the starting control circuit of the unit.

I. Install any control components provided by the manufacturer for installation external to the machine.

END OF SECTION 23 0510

PIPE WELDING

1. Fabrication Requirements:

A. End Preparation

1. Butt welding ends shall be bevelled. Bevelling shall be done by grinding or machining and the finished bevel shall be free of nicks or grooves. Prior to welding, the bevelled surface and the adjacent surface within 6mm of the weld joint shall be cleaned of all foreign material, rust loose mill scale etc., before being placed in alignment for welding.

B. Weld Joint Alignment

1. The parts to be welded shall be aligned by suitable means such as external clamps, yokes etc. Yokes, if used, shall be tack welded using electrodes compatible with the parent metal. After joint fit-up yokes shall be ground flush.
2. Tack welding shall be done by qualified welders only and shall conform to the quality of root weld.

C. Nozzles and Piping

1. Pipes below Ø 25mm shall be cut by pipe cutter only: flame cutting is not allowed. Larger sizes may be flame cut provided edges are prepared by grinding or machining, after cutting.
2. Bolt holes shall straddle the axis of pipe for all flanged connections.
3. The center line of branch connections shall intersect the centre line of the header.

2. Welding:

A. Welder Qualification

1. Welding shall be carried out by qualified welders. Welder qualification shall be carried out in accordance with ASME Section IX Welding & Brazing Qualifications.
2. The Bidder shall provide all material, consumables and labour needed for welder qualification tests. The Bidder shall also arrange and pay for all the test required at a testing facility acceptable to the Procuring agency.

B. Production Welding Requirements

1. All production welding including repair welding shall be carried out according to qualified welding procedures and by qualified welders only. The Procuring agency reserves the right, at any time, to make changes in the welding procedure to ensure production of acceptable welds.
2. Scale and slag shall be removed from each weld bead and groove before depositing the next weld bead. Cleaning shall be done by power grinders and wire brushes.
3. Fillet welding shall be done for reinforcing pads, sockets welding fittings and slip-on flanges. Fillet welds shall be continuous, unless otherwise specified in the drawings. Size of fillet welds shall be as indicated on the drawings. Where no size is given, it shall be equal to the thickness of the thinner of the two parts being welded.
4. Arc burns shall be removed by grinding. Grinding shall have a smooth contour. After grinding, the remaining wall thickness in the area shall not be less than 90% of the nominal wall thickness.

3. Inspection and Testing:

A. *Hydrostatic Testing:* The piping shall be tested with water and all welds carefully inspected for leaks. The pressure shall be raised slowly and steadily until test pressure is reached. The pressure shall be maintained while a thorough examination is made to ensure that all welding are sound and show no leaks or undue distortion.

B. *Repairs & Welds:* Defective welds found during pressure test shall be cut out for a distance of not less than 25mm on either side of the defect and shall be rewelded.

C. *Repeat Pressure Test:* Following the execution of any repairs found to be necessary, the piping shall again be tested in accordance with the above specs.

D. *Record:* Bidder shall keep a record of all tests performed and shall record the date of test, test conditions and results. These reports shall be signed by the Procuring agency's representative and Bidder's representatives.

Bidder shall provide all material and labour required for testing.

END OF SECTION 23 05 11

ELECTRIC Motors

PART-1: GENERAL

1.10 Section Scope:

A. These specifications apply to all motors installed on all equipment on the project and are over-ruled by relevant specifications for motors given in other Sections & EQUIPMENT DATA SHEET.

B. This Section includes requirements for single and three phase motors that are used with equipment specified in other Sections.

C. Commissioning & Testing.

1.11 Submittals:

A. Tendering Stage Submittals

1. Brands of motors to be indicated & country of origin.

B. Construction Stage Submittals

1. Motor catalogue.
2. Conformance statement to these specifications.

C. Close-Out Submittals

1. Commissioning Reports, as per manufacturer's standard, duly signed by the commissioning engineer.

1.12 Reference Standards:

A. IEC Electric Motor Standards

B. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators

C. ANSI/NEMA MG-1 Motors and Generators

1.13 Reference Specifications:

A. The following specifications shall be construed to be part of this Section.

1. 23 05 01 - Basic Mechanical Requirement

1.14 Quality Assurance:

A. Standard & Regulatory Requirements

1. Equipment manufacturer shall be a company specializing in manufacture, assembly, and field performance of motors with a minimum of ten (10) years' experience.

B. Factory Test

1. Manufacturer's standard factory test shall be carried out as per standards/requirements specified at clause 2.3.

1.15 Delivery, Storage, and Handling:

A. Motors shall be stored and handled in accordance with the manufacturer's recommendations.

B. Protect motors from entry of foreign material, dust, water & falling objects. Motor shall be kept encased in protective polythene until commissioning stage.

1.16 Warranty:

A. Manufacturer shall guarantee the motor against defects in materials and/or workmanship for a period as stated in Section-300, Conditions of Particular Application/Contract Data.

1.17 Electrical Coordination:

A. Consultant drawings and/or specifications show horsepower rating of all motors. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be found for any motor or other electrical equipment after contracts are awarded, Bidder is to immediately notify the Consultant of such discrepancy.

B. Costs involved in any minor changes required due to re-sizing of motor will be the responsibility of this bidder.

C. All starters, overload relays, heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment

shall be furnished and installed by this Bidder, except as specifically noted elsewhere in Specifications/BOQ.

D. This Bidder will provide all power wiring and control wiring, unless otherwise specified in the BOQ.

E. Furnish project specific wiring diagrams to Electrical Bidder for all equipment and devices furnished by this Bidder and indicated to be wired by the Electrical Bidder.

PART-2: PRODUCTS

2.1 General:

A. Motors to conform to all applicable requirements of standards indicated in Clause 1.3 and shall be listed by U.L. for the service specified, where so indicated in other Sections.

B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splash proof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations or indicate in EQUIPMENT DATA SHEET.

C. All motors shall be to IP55, and be rated at least at 125% of rated shaft power.

D. The motors shall be suitable and able to give required output under site conditions i.e. maximum ambient temperature of 120°F (50°C) and altitude indicate in EQUIPMENT DATA SHEET.

E. The motors shall be tropicalised, with insulation class as indicated in EQUIPMENT DATA SHEET.

F. Motors rated 25 HP and above shall be fitted with thermistors in the three phase windings, along with a suitable relay in the MCC to trip the starter if the motor overheats.

G. Motors for Cooling Towers shall be purpose built for cooling tower application, & shall be totally enclosed with air-overcooling.

2.2 Motor Efficiency:

A. The energy efficiency classes of motor shall be in accordance with IEC 60034-30 as follows:

- 0.75 kW to 375 kW - Efficiency Class IE3.
- 0.75 kW to 375 kW – at least Efficiency Class IE2 in combination with variable speed control.

2.3 Three Phase, Single Speed Motors:

A. All motors shall be NEMA rated for 400 volt, three phase, 50 Hertz motors for all motors 1/2 HP and larger unless specifically indicated and shall be suitable for operation at 400V ±10%.

B. Use NEMA continuous duty, normal starting torque, with Class F. Use totally enclosed fan-cooled, motors unless otherwise specified in EQUIPMENT DATA SHEET.

C. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/ capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 50,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

D. For motors located in contaminated air stream, furnish epoxy sealed or coated motor windings & protect rotor & stator surfaces with epoxy enamel.

E. All motors shall have a 1.15 service factor.

2.4 Single Phase, Single Speed Motors:

A. Use NEMA rated 230 volt, single phase, 50 hertz motors for all motors 3/4 HP and smaller.

B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class-D insulation. Service factor to be not less than 1.35.

C. Fractional horsepower motors shall be provided with inherent over-temperature protection.

2.5 Two-Speed Motors:

A. Unless otherwise indicated, three phase two speed motors to be two winding, variable torque and single phase motors to be capacitor start capacitor run type having two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

2.6 Motors Used on Variable Frequency Drives:

A. In addition to the requirements specified above, the motor must be suitable for use with Variable Frequency Drive as specified in EQUIPMENT DATA SHEET, including but not limited to motor cooling. Motor shall comply with NEMA MG1 Part 31 to provide windings capable to withstand up to 1600 peak

Volts with a rise time of 0.1 µs. Provide bearing protection grounding rings to bleed current from the motor shaft to the motor casing. Manufacturers: Aegis SGR, Inpro/Seal CDR, or equal Spares.

2.7 Spares:

A. No motor spares are to be provided unless specified elsewhere.

PART-3: EXECUTION

3.1 Installation:

A. Install motors in accordance with manufacturer recommendations.

B. Install required power supply & earth wiring to the motors as per manufacturer's instruction.

C. Connect motor starter to all operating external safety and auxiliary control devices.

D. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure & level installation.

E. When motor is flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.

F. When motor is connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation (Recommendation of NEBB).

G. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

H. Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

3.2 Commissioning & Testing:

A. The Commissioning Engineer shall subject the motor(s) to tests recommended by the manufacturer and these test reports shall be submitted to the Consultants by the Bidder in suitable test forms.

END OF SECTION 23 05 13

Meters & Gauges

a) Thermometers:

The ranges of thermometers shall comply with the system parameters ensuring normal indication in the mid-region. Ranges much under or above the required readings shall not be acceptable, unless specifically approved by the Consultant.

A. *Pipe Thermometers:* These shall be adjustable angle type, with brass separable socket. Case shall be smooth die cast aluminum with metallic blue-black finish. Window shall be clear acrylic plastic or double strength glass, held in place with removable stainless steel caps. Tube shall have lens front with red appearing mercury tubing. Scale shall be on white background with jet black embossed figures and markings, of specified or suitable scale, in combination of °F-°C.

- Scale size:

  175mm

- Stem length:

  90mm up to 150mm diameter pipes

  150mm above 150mm diameter pipes

- Insertion length:

  65mm for 90mm stem length 125mm

  for 150mm stem length

B. *Duct Thermometers:* These shall be adjustable angle type and shall conform to specifications given above for pipe thermometers, except that the duct thermometer shall be supplied with 75mm OD reversible aluminum flange and perforated aluminum bulb guard. Stem insertion length shall be 300mm.

C. *Thermometer Wells:* These shall be of brass suitable for pipeline mounting. Wells for insulated piping shall be provided with extension necks compatible to insulation thickness, to allow thermometer to clear the insulation.

D. *Installation:* Thermometers shall be installed wherever shown on the drawings. Installation on both ducts and piping shall conform to the manufacturer's recommendations. On thermally insulated ducts, casing, equipment or piping, stand off mounting brackets, bases, adopters or extended tubes shall be provided. These items shall provide clearance not less than the thickness of the insulation. Thermometers shall have ranges suitable for the fluid being served.

b) Pressure Gauges:

Pressure gauges shall be of scale range as required, for service condition, graduated in both Psi and Kg/cm^2. On open circuit pump suction line and wherever necessary install compound gauges.

A. *Case:* shall be of cast aluminum, black finished. Ring shall be close type, chrome plated. Window shall be clear acrylic. Dial shall be white with jet black embossed figures and graduations. Pointer shall be micrometer type, black finished and red tipped. Movement shall be stainless steel, rotary type. Bourdon tube shall be phosphor bronze. Socket shall be forged brass. Accuracy shall be 1% of the scale range. Connection shall be 6mm NPT. Dial size shall be Ø 4.5 inches.

B. *Installation:* Pressure gauges shall be installed where shown on drawings. These shall be installed with ball valves to serve as gauge cocks. For pressure gauges installed on steam line, a coil siphon shall be installed. Gauges shall be screwed in so that no leakage exists, and shall be installed in a neat and workmanlike manner and the dials aligned for convenient reading.

c) Magnehelic Gauges:

A. *General:* Magnehelic differential pressure gauges shall be of scale range as required for the application.

B. *Construction:* Housing shall be of die cast aluminium. Test case and aluminium parts irradiate dipped to withstand 168 hours (minimum) salt spray test. Exterior finish shall be baked dry grey hammertoe. Pointer shall be red tipped of heat treated aluminium. Diaphragm shall be silicon rubber diaphragm with integrally moulded "O" ring shall be supported by front and rear plates. It shall be locked and sealed in a position with a sealing plate and retaining ring. Diaphragm motion shall be restricted to prevent damage due to over pressure. Accuracy shall be ± 2% of full scale connection shall be 3mm NPT, dial size shall be minimum Ø100mm.

C. *Installation:* Magnehelic gauges shall be flush or surface mounted with standard hardware supplied and shall be installed as follows:

1. At Filters: Each bank of high efficiency filter and HEPA filter shall be provided with an appropriate station to determine pressure drop, consisting of Magnehelic gauge, probes, flexible tubes and mounting arrangement.
2. At Positive or Negative Pressurized Areas: At the outside of each positive or negative pressure areas, install a Magnehelic gauge to read room pressure with respect to adjoining space pressure. For this purpose probes shall be installed in the room and in the adjoining corridor/space, and connected with flexible tubing to the Magnehelic gauge.
3. As shown on drawings or as required.

END OF SECTION 23 05 19

VALVES & STRAINERS

a) Butterfly Valves:

Butterfly valves shall be used applications requiring 50mm or larger diameter valves, and shall have a rating suitable for the service intended, but a minimum of 10 bars.

Butterfly valves shall be wafer type with modular cast iron body, suitable for mounting between ANSI 150 lb flanges. Two flanges plus required nuts and bolts shall be provided with the valves.

The center disc shall be of stainless steel, with extended shaft for accommodating insulation depth.

The liner shall be replaceable, of Nitrile or EPDM rubber. Each valve shall be provided with one replaceable

liner as spare.

Actuator shall be worm gear type of aluminum or cast iron, weather proof to IP65, complete with hand wheel,

position indicator, and with adjustable stops at both fully open and fully closed positions. The actuator shall be self-locking, lubricated for life and free of maintenance.

b) Gate Valves:

A. *Ø 50mm (2 inch) & Smaller*

125 psi (860 kPa) SWP, 250°F (120°C), threaded ends, bronze body, union bonnet, non-rising stem, wedge disc. Hand wheel nut, packing nut, gland, stuffing box, bonnet, bonnet ring, disc and body shall be of bronze. Hand wheel shall be of malleable iron. Packing shall be suitable for specified usage but shall not use asbestos. Stem shall be manganese bronze.

B. *Ø 65mm (2½ inch) & Larger*

125 psi (860 kPa) SWP, 250°F (120°C), cast iron body bronze mounted with flanged ends. These shall be of solid wedge disc type, with outside screw and yoke (rising stem). Body and bonnet shall be of cast iron. Wedge shall be of cast iron with bronze disc. Seat rings shall be bronze. Packing shall be suitable for specified usage but shall not use asbestos. Packing gland shall be cast iron. Yoke shall be of cast iron and yoke nuts shall be of bronze. Hand wheel shall be of cast iron.

c) Globe Valves:

A. *Ø 50mm (2 inch) & Smaller*

125 psi (860 kPa) SWP, 250°F (120°C), bronze, threaded ends. Body, bonnet, disc holder, stem lock nut, packing nut and disc lock nut shall be of bronze. Hand wheel shall be of malleable iron with stem of manganese bronze. Renewable composition disc shall be provided suitable for water & steam. Packing shall be suitable for specified usage, but shall not use asbestos.

B. *Ø 65mm (2½ inch) & Larger*

125 psi (860 kPa) SWP, 250°F (120°C), cast iron body, bronze mounted with bronze faced disc and yoke bonnet, and shall be flanged. Hand wheel, gland, bonnet and body shall be of cast iron. Stem shall be of manganese bronze. Packing shall be suitable for specified usage but shall not use asbestos. Stem lock nut, disc and seat ring shall be of bronze. Disc shall be renewable composition type.

d) Ball Valves:

A. *Ø 50mm (2 inch) & Smaller*

125 psi (860 kPa) SWP, Screwed; two-piece cast bronze body, chrome plated brass ball, Teflon ball and flange seals, rods silicon brass stem, Teflon and Viton "O" ring stem seals, zinc plated carbon steel handle with vinyl grip and brass handle nut.

e) Swing Check Valves:

A. *Ø 50mm (2 inch) & Smaller*

125 psi (860 kPa) SWP; 250°F (120°C), threaded ends. Cap, hinge pin, body, hinge, disc nut and disc shall be of bronze.

B. *Ø 65mm (2½ inch) & Larger*

125 psi (860 kPa) SWP; 250°F (120°C), cast iron body, including valve cap and disc. Hinge pin, seat ring and disc ring shall be of bronze. Ends shall be flanged.

f) Guided Check Valves:

A. *Ø 80mm (3 inch) & Smaller*

125 psi (860 kPa) SWP, Screwed, (pump discharge): bronze or cast steel wafer body, bronze or stainless steel trim, centre guided, silent type.

B. *Ø 100mm (4 inch) & Larger*

125 psi (860 kPa) SWP, Flanged, (pump discharge): bronze or cast steel globe body, bronze or stainless steel trim, centre guided, silent type, flanged.

g) Y-Strainers:

A. *Ø 50mm (2 inch) & Smaller*

125 psi (860 kPa) SWP; 250°F (120°C), "Y" type, with bronze body and threaded ends. Screen shall be of 20 mesh monel.

B. *Ø 65mm (2½ inch) & Larger*

125 psi (860 kPa) SWP; 250°F (120°C), cast iron body with flanged ends. Screen cover shall be provided with blow off taping. Screen shall be of perforated stainless steel, (33 holes per sq.cm.), with 1.1mm diameter and 0.41mm thickness.

h) Bucket Strainers:

A. Shall be fabricated from Ø 300mm, Black Steel, Schedule 40 pipe. Flanges shall conform to ANSI B16.5. After fabrication the entire assembly shall be hot dipped galvanized. Bolts shall be galvanized. The strainer shall consist of a brass perforated screen bucket. Perforation shall be as approved.

i) Pressure Reducing Valves (PRV):

A. Pressure Reducing Valves (PRV's) shall be pilot operated.

B. PRV's shall be suitable for the service specified & shall be able to maintain downstream pressure at all flow rates & shall be sized for the maximum flow & pressure specified or required on the basis of manufacturers published data.

C. PRV's upto Ø 40mm shall be of bronze with screwed ends, while higher size PRV's shall be of cast-iron body with flanged ends. Nominal working pressure shall be 16 barg. PRV shall be able to sustain working temperature upto 70°C (158°F). Pilot shall be adjustable for 1.4 barg to 12 barg.

j) Float Valve:

A. Shall be best quality heavy duty type provided with Ø 150mm copper ball and heavy duty bronze float arm. Valve shall provide tight shut off at full closed position.

k) Foot Valve for Pump Suction Line:

A. Shall be installed where required or indicated on the drawing. Foot valve shall be of brass, and shall be provided with integral strainer. Foot valve shall be provided with a spring loaded vertical check disc with gasket for tight shut-off.

l) Gaskets:

A. ***General***: non-asbestos, compressed gasket material with high-strength aramid fibres bonded with high grade nitrite NBR synthetic rubber, suitable for 750°F (400°C) and 1450 psi (10000 kPa).

m) Thread Lubricant:

A. ***General***: non-hardening, non-poisonous as approved.

n) Dielectric Couplings:

A. ***General***: provide sweat-to-screw dielectric couplings at junction of copper pipe to steel pipe and insulation bushings for flanged connections to steel or cast iron valves and fittings.

o) Installation of Valves and Strainers:

A. All gate valves, globe valves, check valves, control valves, butterfly valves, drain cocks, etc. necessary for satisfactory operation of the system shall be provided whether indicated or not. All valves having stem over 2m height shall be provided with galvanized chain operators. Valves in horizontal lines shall be installed with stem horizontal or above. Isolation gate valves shall be installed on each side of each piece of equipment as pumps, coils and other similar items; at the midpoint of all looped mains; and at any other points indicated or as required for draining, isolation or sectionalizing purposes. Each valve shall be identified with not less than 35mm round or square black over white laminated plastic tags secured to valve with a suitable brass chain. Tags shall be engraved to identify valve by number and valve function. Strainers shall be installed wherever necessary to protect equipment and control valve, where proper functioning would be affected by dirt on the seat or scoring of the seat. Strainers shall be arranged not to clog piping and allow easy disconnection for change. All strainers 50mm and above shall be provided with Ø20mm ball valves for blow-off. Strainers shall allow removal of accumulated dirt and screen replacement without disconnecting main piping.

END OF SECTION 23 05 23

SUPPORTS & ANCHORS

PART-1: GENERAL

1.18 System Description:

A. Furnish labour, materials, equipment, ladders, scaffolding, protective covers, other items required to prepare and finish surfaces of work specified herein or in any of the other sections.

1.19 Submittals:

A. The bidder shall submit to the Consultant Technical Submittals and obtain Consultant's approval before proceeding to the next work stage. The submittal submission shall be a four stage process till completion of the project as noted below, and as also detailed under Section 23 05 02 - Basic Mechanical Material & Methods:

1.4.5 Tendering Stage Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section 23 05 02, Clause 1.4, as well as any special requirements noted below.

1.4.6 Technical Approval Stage Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section 23 05 02, Clause 1.4, as well as any special requirements noted below.

1.4.7 Construction Stage Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section 23 05 02, Clause 1.4, as well as any special requirements noted below.

1.4.8 Close-Out Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section 23 05 02, Clause 1.4, as well as any special requirements noted below.

1.20 Delivery, Storage, and Handling:

A. Deliver, store & handle equipment as directed by the manufacturer and in accordance with specifications given under Section 23 05 02, Clause 1.3.

1.21 Warranty:

A. All supports and anchors shall be guaranteed against defects in materials and/or workmanship for a period of one year from date of Substantial Completion. Galvanizing shall have extended warranty as usually offered by the support manufacturers.

PART-2: PRODUCTS

3.1 General:

A. All pipe supports, including supporting rods, concrete fasteners, etc, shall be manufactured by specialist pipe support manufacturers, such as Hilti, Sikla, Fisher, etc as indicated in Section 23 90 10, List of Approved Manufacturers.

B. All supports shall be Hot Dipped galvanized.

C. Pipe hangers, brackets, saddles, inserts, clamps and pipe rolls including rods, bolts, turn buckles, bases and protection shields shall conform to standard recommended engineering practice and shall be all sourced from approved manufacturers of support system.

D. For field fabricated supports, design generally accepted as exemplifying good engineering practice, using stock or production parts shall be utilised, and drawings and samples shall have Consultants approval.

E. Chain, wire, strap or other make shift devices will not be permitted as hangers or supports.

F. Pipe hangers shall be capable of supporting the pipe in all conditions of operations, and shall be selected for 2 times the supported weight. Hangers shall be supported with beam-clamps, concrete inserts, Phillips concrete fasteners, or rawl-bolts. Concrete inserts when used shall be installed in the exact location prior to the pouring of the concrete.

G. All support rods shall be fully threaded, & hot dip galvanized.

H. Piping shall be supported by adjustable hangers or supports, which shall provide a means of vertical & horizontal adjustment after erection.

PART-3: EXECUTION

3.1 Suspended Piping Supports:

A. Unless otherwise indicated on drawings maximum spacing between pipe supports for straight runs of copper pipe shall be in accordance with recommended spacing shown in the table given below:

	Nominal Pipe Size, Ø inch										
	5/8	7/8	1 1/8	1 5/8	2	2 1/8	3 1/8	3 5/8	4 1/8	5 1/8	6 1/8
Maximum Span, ft	5	6	7	9	9	10	12	13	14	14	14
Rod Size, Ø inch	3/8	3/8	3/8	3/8	3/8	1/2	1/2	1/2	1/2	5/8	5/8

B. Pipe hangers and supports shall be spaced not over 5ft apart at heavy fittings and valves. A hanger shall be installed at not over 12inch from each change in direction of piping.

C. Vertical Piping shall be guided or supported in the centre of each riser but not over 8ft on centres and shall be supported at the base of the riser on a base elbow or tee with a pipe stand only where required.

3.2 Pipe Sleeves:

A. Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction or afterwards if necessary. Each sleeve shall extend through its respective wall, floor or roof and shall be cut flush with each surface. Sleeves shall be of such size as to provide a minimum of 6mm all around clearance between bare pipe and sleeve or between jacket over insulation and sleeve. Sleeves shall be of steel pipe or cast iron pipe.

3.3 Other Supports:

A. Equipment and any other plant component requiring supporting and anchoring shall be provided with properly engineered supports and anchors, as shown on the drawings, or as per manufacturer's recommendation or as directed by the Consultant/Engineer in all cases drawings & submittals for supports & anchor system shall be submitted to the consultant and approval obtained.

3.4 Reference Specification:

A. The following specifications shall be construed to be part of these specifications.

1. 23 05 01 - Basic Mechanical Requirement
2. 23 05 02 - Basic Mechanical Materials and Methods

END OF SECTION 23 05 29

VIBRATION ISOLATION AND CONTROL

PART-1: GENERAL

1.22 Performance Requirements:

A. The Bidder shall install vibration isolation and control products as specified herein and ensure that unacceptable vibration is not transferred to the building structure.

1.23 Submittals:

A. Tendering Stage Submittal

The tenderer shall indicate the vibration isolation device he intends to use and shall provide their source.

B. Construction Stage Submittal

The bidder shall provide complete details of all vibration control devices to be used, and shall obtain Consultants approval.

1.24 Quality Assurance:

A. During installation & during operation checking shall be carried out to ensure that vibration isolation products are performing as desired.

1.25 Warranty:

A. Manufacturer shall guarantee the equipment and components against defects in materials and/or workmanship for a period of one year from date of initial operation or 18 months from data of shipment, whichever occurs first, unless otherwise stated elsewhere in this document.

PART-2: PRODUCTS

2.1 Equipment:

A. Flexible Connectors for Pipelines

Flexible connectors shall be constructed of rubber, tetrafluoroethylene resin, or corrosion resisting steel, bronze, monel or galvanised steel. The material used and the configuration shall be suitable for pressure, vacuum, temperature and circulation medium. The flexible sections may have threaded, welding, soldering, flanged or socket ends and shall be suitable for service intended. The flexible section may be reinforced with metal retaining rings, with built in reinforcement and restriction bolts or with wire braid cover suitable for the service intended. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel within limits standard with the manufacturer. Unless otherwise shown on the drawings, the length of the flexible connector shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners shall be provided when recommended by the manufacturer suitable for the circulating medium. Covers to protect the bellows will be provided where necessary or directed. Flexible connectors shall be designed for a minimum of 125 Psi (8.5 bars) service, and 250°F (120°C), or higher as required.
Flexible pipe connectors shall be installed on piping connected to equipment where indicated on the drawings. Installation shall be in accordance with manufacturer's recommendations.

B. Flexible Duct Connectors for Air-Moving Equipment

All air ducts attached to a fan, air handling unit or other mechanical equipment shall be provided with an air-tight flexible joint to isolate the vibration & noise.
This shall consist of an air-tight flexible fabric mechanically intertwined into sheet metal seems at its two edges to provide a 3 inch fabric and 3 inch metal connector on both sides of the fabric. Fabric shall be a heavy glass fibre fabric coated with neoproene.

C. Vibration Isolators

1. Rubber Pads or Mounts: Rubber isolators shall be either pad type or molded mount type. Material of molded isolators shall be in the range of 30-70 durometer. Isolators shall be designed for up to 0.5 in. deflection, but used where 0.3 in. or less deflection is required. Solid rubber and composite fabric and rubber pads shall be used as noise barriers under columns and for pipe supports where shown on drawing or where needed. Metal loading plates shall be used for even distribution of load on the pad surface.

2. Pre-Compressed glass fibre isolation pads: Glass fiber pads shall be used for the isolation of concrete foundations and floating floor construction or for application where shown. Pre-compressed glass fiber isolation pads shall be of inorganic inert material and shall be available in thickness of 1 to 4 in. and in capacities of up to 500 psi. The manufacturing process shall assure long life and a constant natural frequency of 7 to 15 Hz over the entire load range. Pads shall be covered with an elastomeric coating to increase damping and to protect the glass fiber.

3. Spring Isolators:

   All spring isolators shall have a rubber acoustical barrier to reduce transmission of high-frequency vibration and noise that can migrate down the steel spring coil. They should be corrosion-protected if installed outdoors or in a corrosive environment.
   - Open spring isolators shall consist of a top and bottom load plate with an adjustment bolt for levelling. Springs shall be designed with a horizontal stiffness at least 100% of the vertical stiffness to assure stability, 50% travel beyond rated load and safe solid stresses.
   - Restrained spring isolators shall have hold-down bolts to limit vertical movement. Spring criteria shall be the same as for open spring isolators, and restraints shall have adequate clearance so that they are activated only when a temporary restraint is needed.
   - All Boilers, chillers and cooling towers shall be provided with Restrained Spring Isolators.

4. Air Springs:

   For applications where the resulting deflection with spring type isolators is more than 6 inch and/or where natural frequency of equipment is 1.33 Hz or below, air springs shall be used to replace high deflection springs with the approval of the Consultant.

5. Isolation Hangers:

   Isolation Hangers shall be used for suspended pipe and equipment and shall have rubber, springs,

or a combination of spring and rubber elements. Criteria should be the same as for open spring isolators. Swivel or traveller arrangements may be necessary for connections to piping systems subject to large thermal movements.

D. Vibration Isolated Bases

1. Concrete Base/Inertia Base:

   Concrete bases shall consist of a steel pouring form with welded-in reinforcing bars, provision for equipment hold-down, and isolator brackets. It shall have a depth equal to one-tenth the longest span between isolators, with a minimum of 6 in. Base depth shall not exceed 12 in. unless specified.
2. Curb Mounted Base:

   Curb isolation systems shall have spring isolation with a watertight and airtight curb assembly. The roof curbs must accommodate the small diameter of the springs within the rails, with static deflection in the 1 to 3 in. range.
3. Structural Base:

   Structural bases shall be used where equipment cannot be supported at individual locations and/or where some means is necessary to maintain alignment of component parts in equipment. These bases can be used with spring or rubber isolators and should have enough rigidity to resist all starting and operating forces without supplemental hold-down devices. Bases are made in rectangular configurations using structural members with a depth equal to one-tenth the longest span between isolators, with a minimum depth of 4 in. maximum depth is limited 12 in. unless specified.
4. Structural Rails:

   Structural rails shall be used to support equipment that does not require a unitary base or where the isolators are outside the equipment and the rails act as cradle. Structural rails can be used with spring or rubber isolators and should be rigid enough to support the equipment without fixing. Use structural members with a depth one-tenth of the longest span between isolators with a minimum depth of 4 in. maximum depth is limited to 12 in. unless otherwise specified.

E. Floating Floors

1. General:

   a) The extent of the sound isolation floor is shown on the drawings.

   b) Concrete, reinforcement and water-proofing shall conform to specifications given for civil works.

   c) The floating floor shall be completely isolated from the building structure by resilient isolation mounting supporting the floating floor, and by resilient perimeter isolation material at all adjoining curbs. All penetrations e.g. piping, ductwork, drains shall be isolated from the floating floor so that no rigid contact exists between floating floor and structure.

   d) All sound isolation materials shall be provided by a single manufacturer to assure single responsibility for proper performance.

   e) Installation of materials is to be done by workmen familiar with this type of work.
2. Materials:

   a) Pre-compressed glass fibre isolation materials shall consist of 2" high isolation mounts bonded to a 1½" thick low density fibreglass noise absorption blanket. Mount spacing and location shall be as per manufacturer's recommendation and drawings.

   b) Perimeter isolating boards shall be ¾" thick, closed cell neoprene/expanded polyethylene.

   c) Perimeter sealant shall be non-hardening, non-drying, and non-bleeding rubber based sealant.

   d) Plywood pouring forms shall be minimum ½" thick exterior grade attached using metal junction plates.

   e) Polyethylene sheeting for bond breaker and temporary water proofing shall be of 6 mil thickness.

   f) Isolated drains shall consist of a two member housings designed to be cast into floating slab and structural slab with no rigid contact between the two members.

PART-3: EXECUTION

3.1 Installation:

A. For Floating Floor

1. Ensure all areas to receive sound isolation are dry, and cleared of debris.

2. Set and adhere perimeter isolating boards to all curbs and penetrations.
3. Roll out isolation material with mounts and acoustical blanket attached in accordance with manufacturer's drawings and installation instructions. Insert additional mounts for high load area as detailed in drawings.
4. Lay plywood pouring form sheets on top of isolation mounts, staggering joints, and connect edges using junction plates and screws as per manufacturer's recommendations.
5. Install two layers of polyethylene sheet over entire floor area, extending up and over perimeter isolation. Seams shall be overlapped 4" and continuously taped to prevent against concrete leakage.
6. Install reinforcing and pour floating slab.
7. After concrete has cured, remove filler strip from perimeter and caulk all joints with perimeter sealant.

3.2 Field Quality Control:

A. For Floating Floors

Notification shall be given by the Bidder to the Architect, Consultant and field representative of the isolation material manufacturer to inspect the installation at the following stages:

1. Upon completion of all areas prior to the placement of the isolation materials. All surfaces shall receive Consultants approval before installation of isolation materials.
2. Upon completion of placement of isolation material prior to placement of form-work. The manufacturer's representative shall be on hand to assist in the initial stages of placement of isolation material to insure the proper procedures and techniques are strictly followed.
3. Upon completion of the finished floor and installation of sealant. The final inspection of the isolation system shall be made at this time. Any evidence of faulty performance shall be evaluated and such imperfections shall be corrected at no cost to the Procuring agency.

END OF SECTION 23 05 48

PAINTING AND COATING

PART-1: GENERAL

1.1 *System Description:*

a) Furnish labour, materials, equipment, ladders, scaffolding, protective covers, other items required to prepare and finish surfaces of work specified herein or in any of the other sections.

b) Paint colour scheme shall be specified at the time of painting or earlier and shall be based on American Standard "Scheme for Identifications of Piping System" ASA A-13.1 of 1975 & shown on FND detail drawing no: FND/D/57 & 58, which form part of these specifications.

1.2 *Submittals:*

1.4.9 Tendering Stage Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section-23 05 02, Clause 1.4, as well as any special requirements noted below.

1.4.10 Technical Approval Stage Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section-23 05 02, Clause 1.4, as well as any special requirements noted below.

1.4.11 Construction Stage Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section-23 05 02, Clause 1.4, as well as any special requirements noted below:

- Sample of pipe, with paint & coatings applied. The sample shall show progressive application of layers with colour added to show separate layers. The preparing of piping surface, as specified, shall also be shown.

1.4.12 Close-Out Submittals

Bidder shall submit all required documentation to establish conformance to specifications, as indicated in Section-23 05 02, Clause 1.4, as well as any special requirements noted below.

1.3 *Delivery, Storage, and Handling:*

Paint and coatings shall be stored in accordance with the manufacturer's recommendations. Care shall be taken as all paints and coatings are inflammable.

1.4 *Warranty:*

Bidder shall guarantee the paint work carried out against defects in materials and/or workmanship for a period of one year from date of Substantial Completion.

PART-2: PRODUCTS

2.1 Paint:

a) Primer for Iron Surfaces shall be Dulux Synthetic Red Primer as manufactured by ICI. This shall be Lead free.

b) Primer for Galvanised Surfaces shall be ETCH PRIMER AND "ZINC CHROMATE YELLOW PRIMER" as manufactured by ICI.

c) Finishing Paint shall be generally enamel paint, unless the application requires special paint, in which case suitable special paint shall be used.

d) All paint supplied from factory shall be ready for application. The application of thinners or any other material shall be subject to approval by the Consultant. In any case all instructions of the paints manufacturer shall be strictly followed.

2.2 Galvanising:

a) Galvanising shall comply with BS 729. The term 'galvanised' shall apply to hot dip or electrolytic galvanising, zinc spraying or cadmium plating. All surfaces shall be degreased, washed with mineral turpentine and given a coat of latex based primer prior to the application of final coats.

b) After fabrication, pickle or abrasive blast clean all steelworks to be hot dipped galvanized.

2.3 Powder Coating:

a) All surfaces to be powder coated shall be cleaned as for galvanising. Powder shall be applied by using an electrostatic gun in a clean atmosphere to ensure that no dust particles or other impurities blemish the final product.

b) Coated components shall be baked in special ovens at controlled and accurately predetermined temperatures, and powder applied to a thickness of 0.0125mm on wearing surfaces and 0.01mm on non-wearing surfaces, unless otherwise specified.

PART-3: EXECUTION

3.1 General:

a) All material shall be applied in strict accordance with the paint manufacturer's directions unless otherwise specified.

b) Paint shall be applied by brush, spray or any other paint manufacturer's approved method in such a manner that a uniform thickness (as per manufacturer's recommendation) is maintained in each coat and no defects are produced in the previous coats.

c) Each coat shall preferably be of a different colour so as to produce a contrast assuring complete covering by the next coat. Sufficient time shall be allowed between coats to permit drying. A minimum of 24 hours between applications on any one surface shall be allowed unless otherwise specified by the manufacturer.

d) No painting work shall be done on exterior surfaces during rainy, damp, foggy or dusty weather and no painting material shall be applied if the temperature is above 122°F (50°C) or below 41°F (5°C). Painting work shall be avoided in cases where the surface is damp or when there is dirt and dust deposition due to blowing winds. The Procuring agency's representative shall determine whether the conditions are suitable for painting or not.

e) The primer coat of paint shall be applied as soon as possible after the surface preparation but, in any case, on the same day.

f) Before application of painting material, the Procuring agency's/Engineer's representative shall inspect and approve the quality of surface preparation and the preparation of painting material.

3.2 Paint System:

3.2.1 Materials & Equipment

All materials & equipment factory fabricated, imported or otherwise shall be provided with a fresh coat of paint of same colour as the original factory paint, if in the opinion of the Consultant the same has deteriorated to an extent to require fresh painting. Paint shall be applied as per the accepted norms and as directed by the Consultant.

3.2.2 Un-insulated Surfaces

Piping, valves, and fittings, tanks, etc., shall be painted with two coats of primer followed by two coats of enamel paint.

3.2.3 Insulated Surfaces

Piping, valves, fittings, vessels, etc., shall be painted with two coats of primer.

3.2.4 Insulated Piping

Provided with cladding, installed in ceiling cavities & concealed shafts, need not be painted. Exposed insulated piping and piping in Mechanical Equipment Rooms, with or without cladding, shall be painted with galvanising primer and two finish coats of enamel paint.

3.2.5 Galvanised Piping

Exposed to view shall be painted with special primer and two coats of enamel paint.

3.2.6 Hangers & Supports

All supports shall be hot-dipped galvanised, and need not be painted.

3.2.7 Copper piping

Copper piping shall not be painted.

3.3 *Surface Preparation:*

a) Surface to be painted shall be dry and free from burrs, weld spatter, flux, dirt, dust, rust, loose mill scale, grease, oil and other foreign matter before any paint is applied.

b) All rust and loose mill scale etc. shall be removed by thoroughly chipping, scraping and wire brushing. Oil, grease, dust etc. shall be removed by washing down with a suitable solvent, as recommended by the paint manufacturer, and wiping with clean rags.

c) The minimum acceptable standard for surface preparation shall be SSPC-SP2, 'Hard Tool Cleaning'.

d) All tools shall be used in such a manner so as not to leave rough or sharp surfaces. No cuts shall be made on steel surfaces.

e) Before applying the finish coat the primed surface shall be scuffed lightly with sand paper recommended by the paint manufacturer.

3.4 *Field Quality Control:*

Perform Work in accordance with relevant paint manufacturer's recommendations. Ensure that surface preparation is properly done and get Consultant's approval before painting. Also get approval after each coat of paint is completed.

3.5 *Reference Specification:*

The following specifications shall be construed to be part of these specifications.

- 23 05 01 - Basic Mechanical Requirement
- 23 05 02 - Basic Mechanical Materials and Methods

END OF SECTION 23 05 50

MECHANICAL IDENTIFICATION

a) General:

The Bidder shall install mechanical identification tags, shield, plates, etc., where specified below, shown on drawings, or directed by the Consultants. All components of the identification system shall be submitted to the Consultants for approval & approval obtained prior to installation.

b) Manufacturer's Equipment Name Plates:

All equipment shall be provided by manufacturer installed metal nameplate with operational data engraved or stamped; permanently fastened to equipment at an accessible & visible location. Nameplate shall have name of manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances and similar essential data.

a) Manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1 shall also be accepted.

c) Equipment Data Plates:

(i) Bidder shall install Equipment Data Plates on all equipment; Equipment Data Plates shall be permanently fastened at a suitable accessible and visible location of the equipment. Data plates shall be of minimum 3mm thick laminated plastic of suitable size (min. 150mm x 100mm) fastened securely to the equipment. The plates shall generally display the following data:

a) Consultant's equipment identification symbol/number.

b) Fluid flow rates.

c) Pressure, pressure drops.

d) Cooling capacities or other capacities.

e) Motor data.

f) Any other matter required by the Consultants.

(ii) Size of Name Plate: Name plates shall be 200mm x 150mm or as approved by the Consultant.

(iii) Lettering Size: Main identification letters shall be 20mm high, with smaller size for subsequent text, as approved by the Consultant.

(iv) Text of Signs: Provide text as approved by the Consultant. Text shall inform operator of operational requirements, indicate safety and emergency precautions and warn of hazards and improper operations, in addition to name of identified unit.

d) Labelling & Identifying Piping:

The Bidder shall attach a stencil near each valve on the pipe, indicating the name of the fluid. Also an arrow should be painted next to the legend indicating the direction of flow in pipe. The legend shall be placed in a location so that it can be easily read from the floor. The legend shall conform in size of letters and colour to ASA A-13.1 of 1975, "Scheme for the Identification of Piping System", but shall not be less than 32mm letters for duct work, and not less than 19mm letters for access door sign & similar operational instructions.

Install pipe markers as follows on each system, wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations. Include arrows showing normal direction of flow:

i. Near each valve and control device.

ii. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.

iii. Near locations where pipes pass through walls, floors, ceilings or enter non-accessible enclosures.

iv. At access doors, manholes and similar access points that permit view of concealed piping.

v. Near major equipment items and other points of origination and termination.

vi. Spaced at a maximum of 15 meters intervals along each run. Reduce intervals to 8 meters in congested areas of piping and equipment.

vii. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

e) Labelling & Identifying Valves:

Identification Tags shall be installed on all valves, controls and other parts of the system where necessary. Tags shall be either of engraved laminated plastic as approved by Consultant, 3mm thick (black in front and white behind) 1.6 inches (40mm) round or square with letters or numbers 0.5 inches (12mm) high and fastened securely with brass "S" hooks or chains.
The Bidder shall further provide charts, diagrams, of size and type as approved designating numbers, service or function and location of each tagged item.

f) Labelling & Identifying Ducts:

a) Duct Systems: Identify air supply, return, exhaust, intake and relief ducts with stencilled signs and arrows, showing duct system service and direction of flow.

i) Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 15 meters.

b) Adjusting: Relocate identifying devices, which become visually blocked by work of this Division or other Divisions.

END OF SECTION 23 05 53

FIRE STOP SYSTEM FOR PENETRATIONS THROUGH FIRE BARRIER WALLS & FLOORS

It is the intent of these specifications that all penetrations or openings between two fire compartments and/or between a fire compartment and a non-fire compartment shall be sealed in a manner specified below:

1. Opening Protectives:

1.1. Every opening in a fire barrier shall be protected to limit the spread of fire and restrict the movement of smoke from one side of the fire barrier to the other. The fire protection rating for opening protectives shall be as follows:

a) 2 hour fire barrier: 1½" hour fire protection rating.

b) 1 hour fire barrier: 1hour fire protection rating where used for vertical openings or exit enclosures, or ¾" hour fire protection rating where used for other than vertical openings or exit enclosures.

1.2. Pipes, conduits bus, ducts, cables, wires, air ducts, pneumatic tubes and ducts, and similar building service equipment that pass through fire barriers shall be protected as follows:

1.2.1. The space between the penetrating item and the fire barrier shall:

a) be filled with a material capable of maintaining the fire resistance of the fire barrier, or

b) be protected by an approved device designed for the specific purpose.

1.2.2. Where the penetrating item uses a sleeve to penetrate the fire barrier, the sleeve shall be solidly set in the fire barrier, and the space between the item and the sleeve shall:

a) be filled with a material capable of maintaining the fire resistance of the fire barrier, or

b) be protected by an approved device designed for the specific purpose.

1.2.3. Insulation and coverings for pipes and ducts shall not pass through the fire barrier unless:

a) the material is capable of maintaining the fire resistance of the fire barrier, or

b) the material is protected by an approved device designed for the specific purpose.

1.2.4 Where designs take transmission of vibration into consideration, any vibration isolation shall:

a) be made on either side of the fire barrier, or

b) be made by an approved device designed for the specific purpose.

2. Fire Stopping Materials:

All fire stopping materials shall comply with BS-476.

2.1 Fire Damper:

Shall be provided where shown on drawings & shall be similar to model FK as manufactured by TROX. Fire doors and fire dampers shall be automatic operating type approved for the protection of openings in one, two and four hour fire-rated walls and partitions and shall be installed in accordance with the Consultant's directives. Suitable hand hole openings with tightly fitted access covers or doors shall be provided in the fire dampers to make all fire doors and fire dampers accessible for inspection and maintenance. Unless otherwise shown, the installation details given in SMACNA Fire Damper Guide for fire dampers shall be followed except minimum thickness of metal for all sleeves provided for the fire dampers shall not be lighter than 14 gauge (1.90mm). All necessary items associated with the fire doors and fire dampers such as retaining angles, sleeves, breakaway connections and access doors shall be provided. The fire dampers shall have a mechanism to show the open-closed status of the fire dampers by means of an indicating lever visible below the false ceiling.

Materials shall be as follows: Casing .....steel, minimum 12 gages

Blade.....Steel, minimum 12 gages

Fusible Link.....to operate at 72°C

Bushes.....Stainless Steel

2.2 Fire Prevention Sealant:

For sealing of narrow gaps e.g. joints between sheet metal, construction joints, joints between steel and concrete components, etc. neutral elastic silicon based sealant equivalent to Hilti CP-601S elastic fire stop sealant shall be used. Non-flammable mineral wool of minimum 100kg/m^3 density as backfilling material shall be used.

2.3 Fire Prevention Mortars for Sealing Cable Penetration:

For sealing of medium sized to very large openings and penetrations, with provision for installing pipes or cables at a later date, fire resistant cement mortar equivalent to Hilti CP-636 fire prevention mortar shall be used.

2.4 Sealing of Inflammable Pipes:

a) Sealing of Inflammable Pipes of Outer Diameter Less than 50mm

For sealing of inflammable pipes less than 50mm outer diameter, water based intumescent acrylic based sealant equivalent to Hilti CP 611A shall be used. If the pipe passes through metallic/plastic sleeve, the gap between the sleeve and fire penetration wall/floor shall be filled with fire prevention sealant as specified have in above. Non-flammable mineral wool of minimum 100kg/m^3 density shall be used as backfilling material.

b) Sealing of Inflammable Pipes of Outer Diameter 50mm and Larger

For sealing of inflammable pipes outer diameter 50mm and larger, fire prevention jacket consisting of zinc plated sheet steel housing with intumescent insert and appropriate number of fastening hooks shall be installed. Jacket shall be similar in construction to Hilti CP-642 fire prevention jacket. If inflammable pipe passes through a wall, a pair of fire prevention jackets shall be installed, one on each fire zone. If inflammable pipe passes through a ceiling, only one fire prevention jacket shall be installed.

2.5 Reference Specification:

- 23 05 01 - Basic Mechanical Requirement
- 23 05 02 - Basic Mechanical Materials and Methods

END OF SECTION 23 05 91

Cleaning, TESTING, ADJUSTING & BALANCING

Cleaning and Adjusting:

Pipe shall be cleaned free of scale and thoroughly flushed of all foreign matter & further flushed using an approved proprietary chemical used in accordance with manufacturer's recommendations. Temporary bypass shall be provided for all water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned of all debris and blown free of all small particles of rubbish and dust before installation of outer faces. Equipment shall be wiped clean of all traces of oil, dust and paint spots removed. Temporary filters shall be provided for all fans that are operated during construction, and after all construction dirt has been removed from the building, new filters will be installed. Bearings shall be properly lubricated with oil or grease as per recommendations of the manufacturer. Belts shall be tightened to proper tension. All control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to speed indicated by the manufacturer to meet the specified conditions.

Balancing:

Water piping system shall be balanced to produce water quantities as indicated with all automatic control valves open. This shall apply to steam piping also.

Duct system shall be balanced to produce air quantities within 5% of that indicated.

Performance Tests:

After cleaning, balancing, and testing operations have been completed, as here in before specified, the system shall be tested as a whole to see that all items perform as an integral part of the system, and that temperature and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated, at no additional cost to the Procuring agency.

Test Data:

System test-data shall be obtained by an independent testing agency, arranged by the Procuring agency, who shall provide the Consultant with typewritten schedules of readings taken during the balancing and testing operation for the following items. The Bidder shall be responsible to carry out all

rectification measures to adjust and balance the system to provide operation compatible to the design.

Air Balance:

Fans: Size, type, speed in revolutions per minute, static pressure in inches of water, air quantity in cubic feet per minute and motor load in amperes and voltage.

Coils: Size, face velocity in feet per minute, air-condition on-and-off uni-wet-bulb and dry-bulb temperature in °F., water temperature drop through heating/ cooling coil, temperatures entering coil in °F.

Ducts: Size, velocity in feet per minute, and air quantity in ft^3/min.

Air Outlets and Inlets: Size, velocity in feet per minute, and air quantity in cubic feet per minute.

Water Balance:

Pumps: GPM, suction head, discharge head, rpm, motor load in amperes and voltage.

Chillers: Evaporator gpm, evaporator pressure drop, evaporator entering and leaving water temperature, condenser gpm, condenser pressure drop, condenser entering and leaving water temperature; power consumption, suction temperature and pressure; discharge temperature and pressure, oil pressure and temperature.

Air Handling Unit/Fan Coil Unit: GPM through each Air Handling Unit/Fan Coil Unit.

Cooling Tower: Air quantity in cubic feet per minute at full load operation, entering air dry bulb and wet bulb temperature, leaving air dry bulb and wet bulb temperature, motor load in amperes and voltage.

END OF SECTION 23 05 93

Test Run

1. After satisfactory commissioning of the entire system, the Bidder shall carry out a Test Run in summer for a period stated in the BOQ. The Completion Certificate shall be provided on completion of the test run period to the satisfaction of the Consultant and in keeping with the stipulations of relevant clauses of the General and Special Conditions of Contract. This Test Run shall be construed to form a part of the "Performance Tests" specified here in before.
2. If winter heating is specified the Bidder shall return in winter to carry out the heating test run, which shall be conducted for a period indicated in the BOQ.
3. During the Test Run Period the Bidder shall maintain logs of all the operational parameters of all the equipment, & shall also log any operational difficulties/shortages indicated during the Test Run Period. He shall also remove all such deficiencies/shortages immediately to the satisfaction of the Consultant.
4. The format of the log data sheets shall be submitted to the Consultant & approval obtained.
5. The Bidder shall submit the filled logs to the Consultant & Engineer on a daily basis the satisfactory completion of the Test Run.

END OF SECTION 23 05 94

Duct WORK Insulation

a) Insulation:

All supply air ducting and return air ducting shall be insulated with insulation indicated in INSULATION EQUIPMENT DATA SHEET (Section 2). Panels shall be cut to size to fit duct being insulated, and shall be fixed to the duct with approved adhesive. Adhesive shall cover at least 75% of duct area. Sheet metal hooks will not be allowed. The insulation is to be installed flush with the duct, but so as not to lessen the thickness of the insulation. Insulation shall be continuous, and no gaps, crevices, or other discontinuities shall be acceptable. The insulation shall be held in place additionally by using polyethylene packaging bands, 10mm wide.

b) Jacket:

To provide mechanical protection to the insulation shall be provided in mechanical rooms, on ducts which

are installed at or below 2m height. Jacket shall be as indicated under INSULATION EQUIPMENT DATA SHEET (Section 2), pasted to insulation using approved adhesive. All circumferential and longitudinal joints shall be over-lapped at least 40mm.

c) Cladding:

All insulated ducting exposed to the atmosphere shall be provided with a cladding of 24 gauge (0.70mm) G.I sheet over the insulation. All joints shall be sealed with "Silicon Sealant", so that the cladding becomes completely water-proof. Cladding shall also be installed at all other locations shown on the drawings.

d) Insulation Tapes:

At all insulation joints use 75mm wide self-adhesive tape consisting of reinforced aluminum foil and white Kraft paper.

e) Adhesive:

Adhesive shall be rubber reinforced co-polymeric compound, equivalent in all respects to Zahabiya (Pakistan) ZGPA-7/223. Or equivalent

f) Reference Specification:

The following specifications shall be construed to be part of these specifications.

- 23 05 01 - Basic Mechanical Requirement
- 23 05 02 - Basic Mechanical Materials and Methods

END OF SECTION 23 07 13

PIPING INSULATION
(HVAC)

a) Piping Insulation:

A. ***Insulation Installation:*** No insulation shall be applied to any system of piping until all foreign matter has been removed from the surface to be insulated, and until the piping has been tested, cleaned out and made tight and painted. All insulation shall be applied in a manner consistent with good practice and methods. All longitudinal joints of pipe shall be top and bottom. Insulation shall be continuous through walls, floors, ceiling and partitions etc.

B. ***Insulation:*** All cold & hot water piping shall be insulated as indicated under INSULATION EQUIPMENT DATA SHEET (Section 2). Insulation shall be in preformed sections with tongue and groove attachment. All insulation shall be fixed to the pipe with approved adhesive. Insulation shall be continuous and gaps if any shall be filled up. Circumferential and longitudinal joints of vapour barrier and jacket shall be over-lapped at least 50mm.

C. ***Vapour Barrier:*** shall be as specified under INSULATION EQUIPMENT DATA SHEET (Section 2). Vapour barrier shall be fixed to the insulation with approved adhesive covering at least 75% area. All circumferential and longitudinal joints shall be over-lapped at least 40mm. Vapour barrier shall be completely continuous. All scratches, tears, etc., shall be made good by pasting fresh layers of the vapour barrier on the discontinuity.

D. ***Jacket:*** shall be as specified under INSULATION EQUIPMENT DATA SHEET (Section 2). All circumferential and longitudinal joints shall be overlapped at least 40mm. The jacket shall be stretched tight over the insulation using adhesive which shall cover 100% area. Cut edges shall not be visible. All longitudinal joints shall be on top for horizontal piping and hidden from view for vertical piping. Circumferential joints shall be equally distant and equal to the width of the jacket roll. Patches shall not be permitted.

E. ***Vapour Barrier Coating:*** shall be as specified under INSULATION EQUIPMENT DATA SHEET (Section 2).

F. ***Cladding:*** All chilled and hot water piping shall be provided with cladding as specified below.

b) Valves, Fittings & Other Specialities:

A. shall be insulated with preformed adjoining insulation, cut to suitable shapes and sections, to closely fit around valves and fittings. Insulation thickness shall not be less than the adjoining straight pipe insulation thickness. The adjoining insulation near these fittings shall be mitred and trimmed into suitable sections to fit closely around the valves, flanges and fittings. All trimmed sections shall be secured by wrapping of approved type of self-adhesive tape to form a complete vapour seal. There shall be a clear break between adjoining pipe insulation & valve/specialities insulation; so that when valve/specialities insulation is opened for maintenance the adjoining pre insulation is not affected.

c) Condensate Drains:

A. shall be insulated as specified under INSULATION EQUIPMENT DATA SHEET (Section 2).

d) Cladding:

A. All insulated pipes shall be provided with a cladding of 26 gauge 0.55mm G.I. sheet. At all flanges and valves the cladding shall be openable type. Valves shall be provided with valve boxes with quick opening clamps. Large valve boxes may be held together using "Jubilee Clamps".

e) Buried Steel Piping:

A. The bare steel piping, or the steel cladding of an insulated pipeline shall be externally painted with one coat of Asphalt primer 2000 (National Petrocarbon Pvt. Ltd.) followed by two coats of Hykote Enamel (National Petrocarbon) reinforced with one layer of glass fibre wrap. The primer and enamel shall be applied strictly in accordance with manufacturer's recommendations.

f) Adhesive:

A. shall be "MOWLITH" as manufactured by HOEST, Pakistan.

g) Insulation Tapes:

A. At all insulation joints use 75mm wide self-adhesive tape consisting of reinforced aluminium foil and white Kraft paper.

h) Reference Specification:

A. The following specifications shall be construed to be part of these specifications.

1. 23 05 01 - Basic Mechanical Requirement
2. 23 05 02 - Basic Mechanical Materials and Methods

END OF SECTION 23 07 19

Building Management System & CONTROLS (BMS) (Mandatory for bidder to quote)

Scope of Work

1.1 General

The Building Management System (BMS) bidder shall:

- furnish and install
- commission
- test
- operate & maintain for **1** year
- train Client staff with bi-monthly assessments of the skills acquired by client trained workforce on operation and maintenance of the BMS system.
- hand-over to Client
- provide after-sales support

For a fully Building Management System, incorporating direct digital control (DDC) equipment monitoring and control, for energy management and subsystems with open communications capabilities as herein specified.

The system shall use **an** IP Client Server architecture based around hot backup servers, utilizing an open architecture with capabilities to support a multi-vendor future integration and scalability. To accomplish this effectively, system shall be capable of utilizing standard protocols given below, as well as be able to integrate third-party systems via existing vendor protocols.

- BACnet according to ASHRAE standard ANSI/ASHRAE 135-2001.
- Modbus
- Integration with a third-party devices and applications through the latest software standards.

The BMS bidder shall provide all electrical, networking, and mechanical materials and works for installation of above including control room.

The BMS shall provide integrated control & management of the following sub-systems, as

hereinafter specified:

a. Building Management System (HVAC, Plumbing, Electrical, etc)

b. Variable Frequency Drives

c. 3rd Party systems such as:

- Chiller microprocessor interface.
- BTU / SI meters.
- Digital energy (power) meters (Already procured).
- UPS System.
- Computer Room Air Conditioning (CRAC).

All the above systems shall communicate with central BMS on LAN/WAN to produce a converged network solution.

1.1.1 Network

The BMS Network's vertical riser shall be completely on Fiber backbone with redundancy and the core network switche(s) shall also be redundant.

1.2 System Architecture

1.2.1 General

a) The system shall allow the distribution of system functions such as monitoring and control and graphical user interface etc. across the network to allow maximum flexibility and performance.

b) The architecture shall include support of various Wide Area Networks using standard hardware and software to link nodes into a single integrated system.

c) The network protocol used shall be industry standard TCP/IP.

d) The BMS system shall allow communications with a wide variety of control devices utilizing off-the shelf driver packages.

1.2.2 Hot Backup Servers

a) Hot Back-up Servers shall be provided to operate the BMS in high availability mode.

b) The system shall be capable of running a pair of similarly configured computers in a hot backup configuration where at any point in time; one is the acting Primary and the other acting as the Hot Back-up. The solution shall offer full software and hardware redundancy. An on-line database duplication mechanism must be supported.

c) The database duplication shall be performed on a per-transaction for critical parameters basis to:

- To ensure that the duplicated Backup database is consistent at all times with the Primary database.
- To avoid unnecessary loading of field devices caused by duplicate polling.

d) It shall be possible to remove one of the redundant systems for maintenance without interrupting operation, and upon its reinstatement, re-synchronize the databases, again without interruption to system operation. A method of manually initiating a fail over shall be provided to assist with such maintenance operations. Failure of either system shall be announced audibly and visually via the alarming subsystem.

e) To accommodate recoverable faults, the failed system shall be able to reboot automatically after non-fatal errors and assume the role of acting as Hot Backup automatically.

f) This facility shall allow the system to be operational from either of the machines during the software updates and upgrades. Updates and upgrades shall not need the entire system to be shut down.

1.3 Work Included

Building Management System (BMS) Bidder shall provide and install all electrical, mechanical, cabling, software works required for completion of works:

The intent is to use the Operator Workstations provided under this contract or authorized Client workstations (future tenants) to communicate with selected control systems provided in this contract. This shall allow the user to have a single seat from which to perform daily operation.

Provide system graphics for each controlled device and/or integrated systems as required by the

procuring agency. Origin of information shall be transparent to the operator and shall be controlled, displayed, trended, etc. as if the points were hardwired to the BMS.

Provide front-end computer equipment & all accessories for installation in Control Room.

1.4 Integration and Monitoring of Various Systems

Following integration shall be provided as a minimum:

1.4.1 HVAC Control System

DDC Controllers, with standalone intelligence as specified, shall monitor & control the HVAC System consisting of pumps, cooling towers, air-handling units, FCU's, VAV units, etc. as specified & shown on drawings.

1.4.2 BTU Metering

Chilled water consumption and flow in the plant area as well at floor level to be recorded and monitored through Digital BTU meters.

The integration with BMS to be done through OPC server to allow tenants access to monitor their consumption through BMS client software.

Software for continuous health check as well complete tenant billing and accounting system is also to be provided by the bidder.

1.5 Training

Engage a factory-authorized service representative and provide on-site or classroom training throughout the contract period for personnels designated by the Procuring agency. Each session shall be a minimum of four hours in length and must be coordinated with the building Procuring agency with at-least 7-days advance notice. Train the designated staff of Procuring agencys Representative and Procuring agency to enable them to:

1. Proficiently operate the system
2. Understand control system architecture and configuration
3. Understand DDC system components
4. Understand system operation, including DDC system control and optimizing routines (algorithms)
5. Operate the workstation and peripherals
6. Log on and off the system
7. Access graphics, point reports, and logs
8. Adjust and change system set points, time schedules, and holiday schedules.
9. Recognize malfunctions of the system by observation of the printed copy and graphical visual signals.
10. Understand system drawings, and Operation and Maintenance manual.
11. Understand the job layout and location of control components.
12. Access data from DDC controllers.
13. Operate portable operator's terminals.

1.6 Operation & Maintenance

1.6.1 Introduction

In addition to the contractual obligations of the Bidder to a maintenance period of one (1) calendar year as defined in the Conditions of Contract, the Bidder shall be required to undertake the complete Operation and Maintenance of the Integrated Building Management System for a period of 01 year. The period of contractual operation and maintenance shall be deemed to have commenced when the Client instructs the Bidder in writing to undertake the same, starting from the date of issue of the Substantial Completion Certificate by the Client/Procuring agency.

Under the contractual operation and maintenance program, the Bidder shall be required to operate and maintain the complete Integrated Building Management System as per details given in Table-1; Operation & Maintenance schedule below:

Table-1:

System	Operation			Maintenance		
	Executor	Duration		Executor	Duration	
		Office Hour 8am-6pm	**Non Office Hour 6pm-8am**		**Office Hour 8am-6pm**	**Non Office Hour 6pm-8am**
BMS	Bidder	□	□	Bidder	□	□

The Bidder shall ensure that as a minimum the staff given in Table-2 below is available at the CLIENT Building to operate and maintain the BMS System. Should this staffing level prove to be inadequate, as judged by the Client/Procuring agency, the Bidder shall increase staff as necessary to ensure compliance with contractual requirements of providing a smooth operation and proper maintenance of the BMS System:

Table-2

Staff Designation	Qualifications	Minimum Quantity	
On-Site Staff		**Office Hours 8am-6pm**	**Non Office Hours 6pm-8am**
O & M Manager	Engineering graduate; minimum 5 years BMS experience; certification by BMS manufacturer	1 (must be available on call and on requirement ensure availability)	-
O & M Engineer	Diploma engineer; minimum 10 years BMS experience; certification by BMS manufacturer	1	-
O & M Technician	Diploma; minimum 5 years BMS experience.	1	1

1.6.2 Scope of Work for Operation & Maintenance (O&M)

The Integrated Building Management System works are to be Operated and Maintained on a round the clock, full time basis for the specified period to a high international standard. The Procuring agency expects the Bidder to take full responsibility of Operation and Maintenance of the Integrated Building Management Systems covered by this contract.

The price quoted by the Bidder shall remain firm for the full duration of the contract. No price change will be admitted due to a lack of understanding of the contractual conditions or inadequate study of the present conditions of contract or improper understanding of the level of plant and machinery installed in the building or improper assessment of manpower, spares, equipment, supervision or any other reasons whatsoever.

The work is for Operation and Maintenance under single point responsibility and shall be with modern systems and services of International Quality, integrating all functions necessary to support the daily operation and maintenance smoothly, deploying competent, trained and experienced work force under a well structured system and using modern management techniques including hardware and software support. Maintenance of BMS shall be ensured as 'Life Time Care' with planned preventive maintenance schedules, procedures, self-audit and continuous improvement.

The bidder shall carry out and complete the work in every respect in accordance with this Contract and with the directions of and to the satisfaction of the Procuring agency. The Procuring agency may in his absolute discretion and from time to time issue further details and/or written instructions, written directions and written explanations all of which are collectively referred to as Procuring agency's instructions. The operation and maintenance of the BMS System shall be subject to the following conditions:

a) The bidder will be responsible for the complete operation, servicing and maintenance of the BMS System, including all equipment, components & accessories of mechanical control systems that make up the complete BMS.

b) The scope of work includes all repairs, and replacement of parts required to ensure smooth operation of the BMS over the one (01) year period .

c) The bidder will be responsible to operate the system 24 hrs a day, 365 days a year. On public holidays, the BMS system will be operated on holiday mode, with a skeleton staff as required and approved by the procuring agency.

d) The O & M Manager shall be a senior graduate engineer having more than five year experience in operation & maintenance of relevant systems.

e) All engineers, technicians deputed by the bidder to operate and maintain the BMS shall have been trained and certified by relevant system manufacturers for operation and maintenance of the installed systems. The bidder shall provide proof of certification to the procuring agency.

f) The annual down time of the system and system component shall not exceed 2.5% of total operating hours, and the downtime at any one time shall not exceed 2 hours.

g) The Bidder shall make suitable arrangements to train at least five (5) staff of the Procuring Agency during the installation and maintenance period.

h) Operation & maintenance of each system shall be done as per manufacturer's recommendations including periodic testing with daily operation and maintenance logs and monthly/annually testing reports to be kept at both in hard copy and digital format.

i) The above man power is minimum requirement for 24x7 Hours operation and maintenance of Integrated Building Management Systems. In case of annual maintenance, major break downs, emergency situations, etc., bidder has to provide required manpower, tools, tackles, etc., to full-fill the contractual requirement. If Bidder feels that the above minimum manpower is not adequate for operation and maintenance of Integrated Building Management System, the bidder shall engage more manpower within the quoted price.

j) The Bidder shall inform CLIENT at least one month in advance In the case of replacement of any operation & maintenance staff deployed on the project, and such staff shall be forthwith replaced by another staff of similar & adequate caliber. Frequent replacements of staff shall be avoided. No staff shall be relieved/replaced from this project, without the concurrence of the Procuring agencys.

k) The O&M Manager will be responsible for ensuring that the operation & maintenance of the BMS is carried out to the true meaning & intent of the Contract Document, Equipment Data Sheet of Quantities, Technical Specifications, and Procuring agency instructions and directions, all to the satisfaction of the Procuring agency. Any directions or instructions given to him by the Procuring agency or his authorized representative shall be followed completely.

l) The Bidder must ensure the proper functioning of the BMS System. In case of unsatisfactory functioning or failure of the BMS System on account of negligence of the Bidder, his agent or employees, of which the Procuring Agency shall be the sole judge, the Procuring Agency will have the right to terminate the operation and maintenance contract by giving a written notice of three months. In case the Procuring Agency requires immediate termination, he shall pay the charges for two months in lieu of the notice requirements.

m) The Bidder shall submit estimate to the Procuring Agency for approval before carrying out any major repairs, which become necessary in due course. The estimate would be submitted expeditiously so as not to disrupt the plant operation.

n) The Bidder must ensure good behaviour by his staff and bidder's Supervisor should liaison with and follows the instructions of the Procuring Agency's Representative particularly regarding the entry of the bidder's staff to the building occupied areas.

1.6.3 Adequacy of Bidder's Staff

It is understood that the service activities are to be performed with utmost diligence and expediency so as to minimize plant or equipment down time. To achieve this, Bidder shall maintain on site and all times an adequate level of staff, and not less than the minimum list of man power indicated in Table-2, with the indicated qualifications, experience and competence.

If, at any time, during the currency of the Contract, Bidder's staffing, in the opinion of procuring agency, is inadequate to meet the requirements of Contract services, Procuring agency may so notify Bidder, who shall thereupon take immediate steps to increase its staff at site. Bidder shall effect such increases within a period of maximum seven days following the procedure outlined elsewhere in the contract agreement.

Bidder shall provide written operation & maintenance procedures for Procuring agency's approval, which shall be based upon good engineering practice in order to maintain the equipment at a high level of efficiency and to provide safe working conditions. If any question arises between Bidder and Procuring agency regarding particular work procedure followed or proposed to be followed by Bidder, Bidder must justify to Procuring agency the soundness of such procedure

and shall obtain Procuring agency's written approval before the same may be affected. Provision or otherwise of such approval shall not relieve Bidder of any of its obligations under this Contract.

If Bidder fails to perform any of the services then Procuring agency has the undisputable right to claim damages and hire a third party to perform such services, and the incurred amount i.e. the additional amount payable to the third party/parties by virtue of assigning services until expiry date of Contract shall be recovered from any monies due to Bidder under the Contract.

In the event that Bidder fails to progress the services in accordance with the accepted Schedule of work and thereby incurs Procuring agency in additional cost and/or expense through the re-organization and/or re-scheduling of dependent third party claims in consequence thereof, then to the extent that Bidder is at fault, Bidder shall reimburse all such direct and verifiable costs and expenses to Procuring agency and Procuring agency may deduct such sums from the value of any invoice submitted by Bidder or from any sums due or owing or which may become due or owing to Bidder.

2. System Architecture

2.1 General

The Building Management System (BMS) system shall use a Client Server architecture based around a modular PC network, utilizing industry standard operating systems, networks and protocols.

The system shall allow the distribution of system functions such as monitoring and control and graphical user interface etc. across the network to allow maximum flexibility and performance. The architecture shall include support of various Wide Area Networks using standard hardware and software to link nodes into a single integrated system. The network protocol used shall be industry standard TCP/IP.

The BMS system shall allow communications with a wide variety of control KNX devices utilizing off the shelf driver packages. It shall support BACnet, Modbus and OPC standards for open system communications.

2.2 Hot Backup Server

This facility shall enable the system server to operate in high availability architecture with no single point of failure. To achieve this, the facility must provide specific features.

The system must be capable of running a pair of similarly configured computers in a hot backup configuration where at any point in time; one is the acting Primary and the other acting as the Hot Backup. An on-line database duplication mechanism must be supported.

Simply scanning I/O on two separate systems and processing independently is not acceptable. The database duplication must be performed on a per-transaction for critical parameters:

- To ensure that the duplicated Backup database is consistent at all times with the Primary database.
- To avoid unnecessary loading of field devices caused by duplicate polling.

It must be possible to remove one of the redundant systems for maintenance without interrupting operation, and upon its reinstatement, re-synchronize the databases, again without interruption to system operation. A method of manually initiating a fail over must be provided to assist with such maintenance operations.

Failure of either system must be announced audibly and visually via the alarming subsystem.

To accommodate recoverable faults, the failed system must be able to reboot automatically after non-fatal errors and assume the role of acting as Hot Backup automatically.

2.3 Communications Redundancy

The system must provide and support fully duplicated communications links to Operator Workstations and field devices that support this type of connection.

Capabilities must exist to interface to devices via:

- Direct Serial Connection (or modem)
- Serial Connection via Ethernet connected terminal servers. Using back-to-back terminal servers will be deemed unacceptable. The system must be able to directly communicate with the Terminal servers via Ethernet.

The system and its associated Operator Workstations must be capable of connecting to two fully independent Ethernets run in parallel. No repeater or bridge connection between the Ethernets is

acceptable as a means of achieving this function.

Operator Workstations must be capable of switching automatically between the two server computers in the event of a fail over, and switching between two Ethernets automatically in the event of an Ethernet failure.

2.4 Distributed System Servers

A method shall be provided for monitoring and control of points on remote BMS servers. Specifically, real-time and history values in any BMS server must be available to any other server for monitoring and control. Features supported must include:

Access: Access to data shall be global, such that users at Operator Workstations on one server can access data, history, point detail displays, etc. for points on any other server. It shall not be necessary to configure more than one point for each data value or signal, regardless of the number of servers accessing the data.

Security/Filtering: It shall be possible to nominate sets of points to be accessed on a server-by-server and user-by-user basis. The mechanism shall be the same as the mechanism to control individual operator and workstation access to data for single server systems.

Alarms/Messages: Operators and workstations at any server must be able to see alarms from any other server. It shall not be necessary to configure alarms more than once, regardless of the number of servers accessing the data.

Trending: It shall be possible to configure real time and historical trends that combine data from any connected server on a single trend. It shall not be necessary to configure more than one point for each data value or signal, regardless of the number of servers accessing the data.

Graphics/Reports/Applications: All graphics, reports, and applications at a server shall have the same distributed access to data on other servers as described above for operators and workstations. It shall not be necessary to configure more than one point for each data value or signal, regardless of the number of servers accessing the data..

2.5 Network

The Server Computer and Operator Workstation hardware shall be capable of interfacing to an IEEE 802.3 Standard Local Area Network (LAN), and also capable to operate using IEEE 802.11 Wireless Local Area Network (WLAN).

The LAN shall use shielded twisted pair for horizontal distribution and fiber backbone.

2.6 Networking & Cabling

Structure data (IP) cabling for complete IP based BMS system based on EIA/TIA 568 standards.

All structured cabling material shall be procured from 3M Pakistan or Schneider Electric Pakistan approved installers. The structured cabling system must be warranted & certified by 3M or Schneider Electric.

2.7 Hardware

2.7.1 Server Computer

Main System server and hot backup server computer each shall comprise of the following minimum hardware:

- Rack Mounted
- Quad Core Intel® Xeon® Latest, 3.0 GHZ
- Video management card minimum 4 screen utilization
- 16GB RAM
- Hard Disk storage to meet system requirements
- Dual redundant fiber 1000 Mbs NIC for network connection to the other components of the DVRMS
- Latest Windows Server 64-bit edition

- Microsoft SQL Server latest with Service Pack
- Latest Microsoft Internet Explorer with Latest Service Pack or higher
- Dual Power Supply

2.7.2 Operator Workstation

The system shall be capable of supporting up to 3 simultaneous Operator Workstation connections using a TCP/IP Local Area Network (LAN). The Network connection must allow an unlimited number of casual users access to the 30 connections on a first-come-first-served basis.

The Operator Workstation shall comprise the following minimum hardware:

Core i7 Intel 12th Gen Up To 4.9GHz Latest

32 GB RAM

Hard Disk storage to meet system requirements

1000 Mbps NIC for network connection

Latest Windows Server 64-bit edition Microsoft

SQL Server latest with Service Pack

Latest Microsoft Internet Explorer with Latest Service Pack or higher

2.8 Communications

The BMS system shall provide communications over a variety of physical media topologies as follows:

- RS-422 / 485
- Ethernet
- Proprietary Networks

The system shall be capable of supporting communications links to networks of control devices. Each connection shall operate independently of the others and facilities shall be provided by system displays to individually place these links in service or out of service.

Given the sufficient level of system privilege, it shall be possible to view, manipulate and analyze all data in the system from any Operator Workstation in the system, including those operating remotely via dial-up modem links or internet connection.

Once a control device is configured and placed in service, the system shall automatically begin background diagnostic scanning of the device to ensure that communications are monitored independently of any monitoring scanning.

The system shall perform checks on data integrity of all data acquired from the device. If an invalid or time out response is received, the data shall be ignored and the system will record the transaction as an error. Statistics shall be kept and displayed by the system on errors encountered in communication by means of a communications barometer. The barometer shall increment for every failed call and decrement for each successful call. In addition, the system shall alarm separate marginal and failure conditions based on user-defined limits to advise the operator of the device and link that has failed. Communications statistics shall be displayed as standard on the system and shall also be available as part of the reporting system or custom displays.

2.9 System Software

The BMS system server shall be based around the Microsoft Windows 64 bit multi-tasking environment. The BMS system shall be a true 64-bit application to take advantage of Microsoft Windows enabling technologies. Any 16-bit/32-bit system running on the Microsoft platform (such as those originally based on MS-DOS and Microsoft Windows 3.x) shall not be acceptable.

Standard services supported by the server computer operating system will include the following:

- Multi-Tasking Multi-User Support
- TCP/IP Network Support
- Graphic Display Building Editor

- Application Software

Software at the Operator Workstation shall comprise of:

- Latest Window Server
- Graphic Display Building Editor
- Application Software
- TCP/IP Networking

The networking software shall use the industry standard TCP/IP LAN protocol.

The server computer or an alternative network connected computer shall be capable of acting as a File Server for graphic displays and cardholder photo images. All LAN connected Operator Workstations shall be able to view custom displays and photo images from the server computer.

All system peripherals shall be capable of being connected to the server computer via the LAN.

2.10 Operator Interface

2.10.1 General

The operator interface provided by the system shall allow for efficient communication of operational data and abnormal conditions. It shall provide a consistent framework for viewing of information. Critical areas (such as alarm icons) shall be visible at all times. A predefined area on the screen shall provide operator messaging, and this area shall also be visible at all times. A set of standard displays for configuration, and navigation around the BMS system are to be provided with every system and shall not require any engineering. The BMS shall also have an unlimited number of custom (facility specific) displays created to meet the needs of the specific facility.

The operator interface software shall be capable of running in the latest Windows server environment. The operator interface shall be interactive and totally graphics and/or icon based. Graphics shall be capable of supporting at least 65,000 colors at a HD resolution. The operator interface shall also be compatible with Windows Terminal Services allowing remote PDA devices to be used as mobile operator interfaces.

The operator interface shall employ standard Windowing conventions so as to reduce required Operator training. In particular, standard tool bar icons and drop-down menus shall be available on all standard and custom displays to allow easy access to common functions. The tool bar and pull down menus shall be fully configurable. Similarly, such functions shall also be available via a standard set of Function-Key based pushbuttons without requiring configuration.

The operator interface shall support the ability to “full screen lock” the window so users cannot access other applications. If “full screen lock” is not enabled, support for copy and paste facilities shall be provided between the operator window and other Microsoft applications.

2.10.2 Web Browser Operator Interface

The operator interface shall also be fully available through the internet via an Internet Explorer browser. From Microsoft’s Internet Explorer, an operator shall be able to perform all functions on the same standard and custom graphics as used in the standard operator interface. All custom graphics, alarm graphics and standard graphics shall be available without modification or reengineering through the Internet in an Internet Explorer browser user interface and shall be fully functional.

The browser interface shall provide login and security authentication in the same way as the standard operator interface. It shall be possible to operate the facility through the browser user interface in the same way as the standard user interface and perform all functions described in section 2.10.6 for example: acknowledge alarms, view graphics, control points, execute reports, and modify configuration settings and the like. A large number of casual users shall be permitted without any additional licensing burden. Licensing shall be based on the number of simultaneous operator connections on a “First Come First Served” basis. Those users with casual access shall automatically disconnect from the BMS server after an idle timeout period.

2.10.3 Operator Interface Connection

The operator interface shall be flexible in its connection to the BMS server. An Ethernet LAN or Internet connection shall be used between the Server and the Operator Workstations and Browser Clients. The operator interface shall provide standard remote access support using

industry standard tools like VNC, RADMIN, and Windows Terminal Services. Where used, these remote connections must use password protected user authentication and encrypted network/internet protocols.

The operator interface LAN connection shall also be flexible to support both permanent and casual access to the BMS server either through the standard operator interface. A large number of casual users shall be permitted without any additional licensing burden. Licensing shall be based on the number of simultaneous operator connections on a “First Come First Served” basis. Those users with casual access shall automatically disconnect from the BMS server after an idle timeout period.

To minimize bandwidth on LAN links, it shall be possible for the operator interface to only require updated dynamic information from the BMS server. All static information (such as display backgrounds) can be stored locally.

2.10.4 Operator Interface Characteristics

The system shall provide a Windows operator interface with the following minimum capabilities as standard. No custom programming or scripting shall be necessary to produce these:

- Window re-size, Zoom in, Zoom out with display resolutions continuously resized to fit available window size.
- Dedicated icons and Pull Down Menus to perform the following:
- Associated Alarm Display
- Alarm Summary
- Alarm Acknowledgement
- Display Sequence Forward/Backward
- Previous Display Recall (minimum of 4 displays, 42”)
- Graphic Call-up
- Trend Call-up
- Point Detail Call-up
- Card Holder Detail
- Pop up face plates
- Alarm Banner showing highest priority, most recent (or oldest) unacknowledged alarm
- System Date and Time Zone
- Current security Level
- Workstation connection number
- Alarm Annunciation
- Communications Fail Annunciation
- Operator Message Zone

2.10.5 Pointing and Input Devices

The operator interface shall be capable of being mouse driven and simultaneously support keyboard data input. Both fixed menus and configurable function keys shall be supported to aid novice and experienced operator respectively. The interface shall also be capable of supporting a touch-screen for pointing and command input.

The operator interface shall use a Tool Bar for common operator commands. The operator shall be able to request display of commonly used displays and activate system functions via Drop-Down menus.

All operator interface input shall be possible using only the pointing device and QWERTY section of the keyboard.

Fast access to common functions shall be possible using predefined function keys on the keyboard. A Keyboard overlay shall be available to assist operators with using these function keys.

2.10.6 Operator Functions

The following functions shall be performed through the operator interface:

- Display and control of field equipment
- Acknowledge alarms on a priority basis
- Initiate printing of reports
- Archive and retrieve event logs
- View historical plant information on predefined trend windows.
- View intranet or information from the Internet in a secure environment
- View ActiveX documents
- Use ActiveX controls
- Change own password
- Monitoring of data communications channels
- Configure system parameters

2.10.7 Operator Security and Sign-On

2.10.7.1 *Security*

If necessary, each operator may be assigned a user profile that defines the following:

- Security and/or Control Level
- Operator Identifier
- Unique Password
- Operator Scope of Responsibility Assignment
- Start Graphic for that operator
- Timeout Value for that operator

All actions initiated by the operator shall be logged in the Event database by operator identifier. In addition, any control actions to a given point shall only be allowed if the control level configured in the operator's profile exceeds the level assigned to the controlled point.

Utilities shall be provided to allow administration of the operator passwords.

2.10.7.2 *Security Levels*

The system shall support at least six levels of operator security. The functions allowed from each security level shall be as follows:

Level 1: Signed Off mode - View start-up display only.

Level 2: View only - The operator shall be able to view displays. Typically used for an inexperienced operator.

Level 3: Permit all Level-1&2 functions and in addition the operator shall be permitted to control points such as start/stop, disable/enable, etc. and acknowledge alarms as they occur.

Level 4: Permit all Level-1 through Level-3 functions in addition to accessing master time schedules, system peripherals allocation, change point engineering parameters, build reports and use most standard system configuration displays. This level shall typically be reserved for the building supervisor.

Level 5: Permit all Level 1 through Level 4 functions in addition to accessing the engineering functions such as building and linking displays, allocating keyboard push button assignments, etc. Reserved for the building engineer.

Level 6: This is the highest level of station security and shall allow the user unlimited access to all station functions. This is typically reserved for the building manager.

2.10.7.3 *Sign-On/Sign-Off*

The operator shall be permitted to sign on to the system if the correct Operator Identity and the Operator Password have been entered. This password shall be

encrypted. It shall also be possible to have the system authentication integrated directly into Windows, Windows Group Accounts, or an LDAP Server such that the operator uses the pre-existing account details to sign on to the BMS system. This ensures that operators only need to remember 1 set of credentials.

After a series of three (3) unsuccessful attempts to sign-on the Operator Workstation interface shall be locked for a configurable period of time. The lockout period shall be set via system configuration displays. During Operator Workstation lockout the other Windows functions of the computer running the Operator Workstation software shall not be affected.

It shall be possible to assign operators either single or multi-user accounts. Single user accounts enable the operator to sign-on to only a single Operator Workstation thus preventing simultaneous sign-on by the same operator from different workstations. Operators with the highest sign-on security level who may require simultaneous access to more than one Operator Workstation would typically use the multi-user password.

Each operator shall be assigned a password and a defined Scope of Responsibility which defines the locations in the facility that may be managed and controlled by the individual operator.

The operator may sign-off at any time by issuing a sign-off command.

A keyboard time-out feature shall be provided such that the operator shall be automatically signed off after a defined period of keyboard inactivity. It shall be supported to configure automatic call-up of a "logged-out" display when this occurs to hide restricted information for example.

2.10.7.4 Location Assignment/Scope of Responsibility Profile

Each operator shall be assigned one or more specific areas of the building with the appropriate monitoring and control responsibility (no view, view only, alarm acknowledge only or full control). A Location shall be defined in this context as a logical entity comprising of a set of points in the system. This in turn may represent a physical space in the building. Locations shall be used to partition the BMS database in such a way as to assign operators control over certain areas and prevent unauthorized access to other areas.

The system shall support individual tenant access by means of Scope of Responsibility assignment. Likewise, an operator's ability to control or monitor certain parts of a facility can be controlled by means of Scope of Responsibility assignment.

The BMS system shall support the creation of Scope of Responsibility profiles, which combine locations and time periods, and which can be assigned to operators with the same location access requirements. By using scope of responsibility profiles in this way, location access can be specified to apply during certain time periods, allowing different areas of access at different times of the day or week.

With cardholder management and access control, the BMS system shall allow each cardholder to be assigned to an Organization in the system. For example a company name. Once assigned, the BMS shall allow all operators to be assigned to view one or more organizations in the systems, thereby ensuring Security persons may not see or monitor cardholder details for Organizations not in their scope of responsibility.

2.10.7.5 Duress

The system shall support an operator duress function, so that an operator may discretely indicate that they are signing in the BMS system under duress. The system shall recognize that the operator is signing on under duress and it shall then be able to issue a control to alert appropriate assistance.

2.10.7.6 Command Partitioning

It shall be possible to assign each operator a set of allowed commands for each assigned Location. These commands can be mapped against the output state of any given digital point in the respective area to determine whether a control command is allowed for the particular operator.

With this feature, it shall for example be possible to configure an operator to set a digital point to ON, but to disallow the same operator from setting the same

digital point to OFF.

2.10.8 Standard System Displays

The following displays shall be included as part of the system:

- Alarm Summary Display
- Event Summary Display
- Point Detail Template Displays (for each point in the database)
- Trend Set Template Displays
- Group Control and Group Trend Template Displays
- Communications Status Displays
- System Status Displays
- Operator Scratch-pad Display
- Face Plates for all common point types
- Configuration Displays

In the case of the Trend and Group displays, configuration of these displays shall only require entry of a point name to completely configure the display. The Alarm Summary, Event Summary, Point Detail, Communications Status, System Status shall not require any configuration.

Systems where standard graphical displays, showing all parameters for each system Point, do not exist shall not be acceptable.

2.10.9 System Status Display

A system status display shall be available on each Operator Workstation. This system status display shall be automatically built by the BMS system and shall require zero engineering to add additional devices to be monitored. It shall display the following information in a hierarchical system tree:

- Points in alarm condition pending ACKNOWLEDGE command.
- Points which remain in an alarm state but which have been acknowledged.
- Communication failures
- Printer status
- Operator Workstations status
- Communication links status
- Controller status
- System interfaces status
- Additional connected server status

2.10.10 Administration Displays

The system shall provide the following full screen displays:

- Master system menu
- Report summary
- Alarm summary
- Event summary
- Display summary
- System Status display
- System parameters configuration
- Operator Workstation configuration
- Scope of Responsibility assignment
- Time Schedule assignment
- Calendar assignment (Holidays/special occasions)

- History assignment
- Push-button assignment
- Operator definition
- Operator message board
- Events archive and retrieval
- Time Period summary and configuration
- Point Detail for every configured Point

2.10.11 Creating custom Displays

2.10.11.1 Graphic Display Building Editor

The BMS shall provide a Graphic Display Building editor for the creation of site specific graphic displays. It shall allow one-step online building of display static and dynamic objects. It shall be a WYSIWYG editor (what you see is what you get) allowing the displays drawn using the editor to appear exactly the same when viewed from an Operator Workstation.

Displays shall be created in the HTML (Hypertext Markup Language) format. This is essential so that the displays can also be viewed through a web browser as well as the normal BMS operator interface. The displays shall be saved in the standard HTML format. All graphic elements shall be available as HTML elements. It is not acceptable to have an HTML format which merely links to a proprietary object or bit map of the entire display. It shall be possible to view and edit the resulting HTML file using a text editor. Systems which do not support HTML displays will not be acceptable.

Static objects created using the Graphic Display Building Editor shall include static text, rectangles, arcs and circles. However, it shall be possible to animate static objects to give the dynamic characteristics of the real-world object the point represents.

It shall be possible to link dynamic objects to the BMS database. They shall allow information to be displayed from the database or to allow an operator to interact with them in order to make changes in the database and to perform control actions. Dynamic objects shall include dynamic text, push buttons, indicators, charts, check boxes, combo boxes, pop up boxes, ActiveX controls and scroll bars.

It shall be possible to include static and dynamic display objects on the one display. The editor shall allow display objects to be manipulated by pointing, clicking and dragging. The editor shall allow display objects to be drawn, re-sized, copied, grouped, rotated, aligned and layered over each other. It shall be possible to copy and paste objects within and between displays.

The Graphic Display Building Editor shall support the following features:

- One step display building (both background and dynamic information)
- Point and click operation
- Paste to and from the Clipboard
- Absolute positioning object placement
- Ruler and grid
- Configurable tool, color and line palettes
- Dialog boxes for definition of object properties
- Shape and page building
- On-line help
- Import graphics from third party packages including WMF, BMP, TGA, GIF and JPEG formats.
- Standard library of BMS industry objects
- Live video element
- Building of Face Plates
- ActiveX controls
- ActiveX documents

- Display Scripts written in either JavaScript or VBScript
- Multilevel undo and redo
- Object manipulation including combine, union, intersection
- Polyline node editing
- Transparent images
- Popup Displays
- Standard Alarm symbols
- Real time and historical trend object supporting up to 32 points on 1 trend

2.10.11.2 *Display Scripting*

It shall be possible to further animate display elements using standard HTML scripts such as JavaScript or VBScript. A script editor supporting one of the standard script languages shall be provided. By using script programs, individual elements on the display may be manipulated. A proprietary scripting language or additional scripting and drawing package shall not be acceptable. It shall be possible to perform a variety of animations, which include but are not limited to:

- Move objects
- Resize objects
- Recolor objects
- Pop up messages and dialog boxes etc.

Scripts may be activated on displays using the following events:

- On mouse click
- On mouse enter
- On mouse move
- On page call-up
- On a timer
- On value or state change of a point on the display

2.10.11.3 *Live Video*

Both the Graphic Display Building Editor and the Operator Interface shall have built in support for the creation and display of live video objects without the need for programming. The size and position of the video object shall be configured on a per display basis.

Systems, which show the live video object in a separate window from the operator interface, or on a separate monitor screen, shall not be acceptable.

2.10.11.4 *Web Technology*

Displays created in the Graphic Display Building editor shall be usable in a Web Browser such as Microsoft's Internet Explorer without modification. All displays shall be usable in this manner enabling operators to completely operate the system through a web browser via the internet. Displays may also incorporate data from an intranet, the Internet, or ActiveX documents along with other building data.

2.10.11.5 *Launching External Applications*

It shall be possible to launch applications (such as Microsoft Word, Excel, custom help files or any third party applications) from a custom display. If supported by the application, it shall be possible to launch the application with a specified file opened within the launched application. Launching of such applications shall also be possible from the Operator Workstation pull down menus or from a push button on a custom display.

2.11 Help and Documentation

The BMS operator interface shall also have access to online help and online full system documentation. Online help shall be fully searchable and cross referenced to all relevant sections of the documentation. It shall be possible to browse the online help and set "favorites" which link to commonly used sections of the help information. All manuals shall be available online.

2.12 Monitoring and Control

2.12.1 Monitoring

The system shall support acquisition of data using the following techniques:

- Periodic Scanning
- Report by Exception
- Data on demand

In order to minimize communications traffic, the system shall automatically group together data requests using contiguous addresses and the scan intervals to generate scan packets, optimizing throughput for a given scanning load. The system shall also provide utilities to examine scan packet allocation for each scan interval, and compile aggregate statistics on communication link usage.

Where supported by the controlling device, Report by Exception (RBE) protocols shall be used to reduce the scanning load of the system while improving system response. If necessary, periodic scanning may be used in conjunction with RBE to ensure data integrity.

2.12.2 Device Control

Control transactions issued by the operator shall be communicated to control devices using a write followed by read to ensure the integrity of the transaction. If the read following the write to the device indicates that the control action has failed, the operator shall be informed by means of a control failure alarm. The priority of the control failure alarm shall be configurable by the user.

It shall be possible to optionally assign a control confirmation message to individual points. This message shall request the operator confirm the requested supervisory control action prior to sending the entered value to the controller.

2.12.3 Single and double signature control

In highly regulated environments, it shall be possible to provide an additional level of control by enforcing signoff of certain controls with either a single or a double signature. A single signature requires the operator to re-enter their Operator Identity and password along with selecting a reason for issuing the control. This ensures that a control is performed by the nominated operator and that the control is logged for future reporting purposes in the event summary. A double signature requires the operator to re-enter their Operator Identity and password along with selecting a reason for issuing the control. In addition to this, a supervisory operator must also enter their Operator Identity and password to confirm the operation. This functionality shall be required for any BMS system being used to control a regulated environment such as that found in a Pharmaceutical plant.

2.12.4 System Database

The system shall provide a real-time database incorporating data from analog, logical or pulse inputs. The database shall be configurable by the end user without the need for any programming and shall be able to be modified on-line without interrupting operation of the system. In addition to point-based information, the database shall also provide historization capabilities for analog, digital, pulse and event based information. This information shall be accessible by all facilities of the system such as custom displays, reports, trends, user written applications, etc.

2.12.5 Database Structure

The real-time database shall support collection of data and storage using the following structures:

- Access Point Structures
- Analog Point Structures
- Status Point Structures
- Accumulator Point Structures
- Flexible Point Structures
- Historical Data Structures
- Event Data Structures
- User Defined Structures

Each of the Point database structures shall be comprised as a composite point with a number of associated parameters, which may be referenced relative to a single tag name. Specifically,

each of these parameters shall be accessible by various sub-systems such as the Graphical Operator Interface, Report Generation system and Application Program Interface in a simple POINT.PARAMETER format without the need to know any internal storage mechanism.

The system shall maintain portions of the database requiring frequent high-speed access as memory resident information and other less frequently accessed data as disk resident data. Memory resident data shall be checkpoint to disk every minute to minimize loss of data in the event of loss of power or other system failure.

Database backup shall be possible with the system on-line including backup of historical based data. The backup shall be possible via standard Microsoft Windows operating system utilities.

Point data shall be stored in a composite point database structure that provides a wide range of configurable information including but not limited to:

- Point name and description
- Multiple locations for data storage and device scanning addresses
- Scan period
- Multiple types and instances of alarms
- Multiple dead-band or hysteresis settings (analog points)
- Monitoring and Control access restriction information
- Location of operator alarm handling instructions
- Location of ancillary information associated with the point.
- A list of all recent events pertaining to that point
- All points shall display all recent events on their point detail displays, using a direct link to the BMS Event System.

2.12.6 Access Points

Access points represent card readers when using access control with the BMS. The point represents the state of the card reader and whether access was granted to a cardholder or whether access was denied.

2.12.7 Analog Points

Analog data shall be stored in an analog point type in the database. This is a composite point type, which consists of multiple point parameters. For example, it is possible to have the analog set point, process variable and output all represented in one single point in the BMS.

2.12.8 Status Points

Status (digital) information shall be stored in a Status Point type in the database. The status point shall be a composite point capable of processing from a single to a three-bit digital input, allowing up to eight possible states.

2.12.9 Accumulator Points

Data associated with pulsed inputs shall be stored in the system in a composite point database structure that shall provide automatic tracking of instrument rollover.

2.12.10 Flexible Points

Data from some devices does not fit neatly into the standard point types defined above. In this case, it shall be possible to define flexible point types which can be structured to meet the requirements of the data structure they are being used to represent.

2.12.11 Grouping of Points

The BMS system shall provide a means by which a number of alarm inputs, outputs and other related points can be grouped together for more convenient monitoring and control without the need for custom graphics.

2.12.12 History Management

Collection of historical point data shall be configurable as part of the point definition. Once configured, this historical data shall be collected automatically. Historical data collection shall be provided for both snapshots and averages with intervals ranging from 1 second to 24 hours.

Once assigned to history, point data shall be available by POINT. PARAMETER access used in conjunction with a history offset to locate the particular value of interest. The graphical

operator interface, trend, report generation and application interfaces shall be able to access historical data.

Modifications to the history collection of a point shall be possible on-line without the loss of previously collected data for the point being changed or any other points in the system currently being historized.

History shall be easily configurable to be archived to an alternative file system or offline media. Different archive settings shall be available for different history types.

2.12.13 Trending

The system shall provide flexible trending allowing real-time, historical or archived data to be trended in a variety of formats. Trend data types shall be able to be combined to allow for comparisons between data e.g. current real-time data versus archived data. In addition, event database information shall be available for comparison and analysis purposes in the same display and shall allow filtering of the event data display based on time and location.

2.12.13.1 Trend Capabilities

The system shall provide trending capability with the following functions:

- Real time trending
- Historical trending
- Up to 32 points on each trend window
- 1000 separate trend displays
- Trend with Event Summary integration
- Archived History trending
- Trend Scrolling (using scroll bar or by directly entering the beginning and ending time of interest)
- Trend Zoom
- Engineering Unit or Percent
- Auto-scaling trended values
- Cursor readout of trend data

Trend comparisons between archived, real-time and historical data (for example, this year vs. last year). Comparisons between the same point offset in time, or different points must be possible.

Trend De-cluttering via per-pen enable/disable on multi-plot style trends.

Independent Y-axis per point on multi-plot style trends. It must be possible to display the Y-axis for any point on the trend by simply selecting the point using the mouse or keyboard.

Copying the currently displayed trend data to the clipboard for pasting into spreadsheet or document.

Configuration of trends shall only require the entry of the Point Name into the desired trend template to produce the trend. All trend configurations must be possible on-line without interruption to the system. Historization of data shall not be affected by changes to trend configuration. All configurations to the trend configuration shall be possible from any operator interface. It shall be possible to save any changes made to the trend configuration from any operator interface. Systems that only provide trending via a third party package will not be acceptable.

The trend must also support annotations with system events within the one display window, allowing operators to view historical plant information in a real time window with system events. This shall include support for filtering the events by location and other standard filters available within the event management system.

2.12.13.2 Trend Types

The system shall be able to present real-time, historical or archived data in a variety of formats, including single, dual and multiple value trends of up to 32 points. For each trend set display it shall be possible for operators to configure the number of historical samples and ranges displayed. Points configured in trend sets shall be changeable on-line.

The system shall allow the operator to display the trend data in multiple different views. User shall have the option to view a full screen of the trend only, view trend with events, and trend

with tabular history. Each of the views shall have the option to hide or show the legend. It shall be possible to filter the event summary details by the trend time as well as by selecting the location of interest from the hierarchical location pane. Icons indicating the correct event type shall be displayed in the timeline of the trend view to facilitate analysis.

Operators shall be able to zoom in on information displayed on trend sets for closer inspection by dragging out an area of interest with the mouse or other pointing device. From such a selection, it shall be possible to copy the underlying data to the Windows clipboard for subsequent pasting into a spreadsheet application such as Microsoft Excel. Systems that do not provide support for Microsoft Excel in this respect shall not be acceptable.

Scroll bars as well as time selectors for direct entry of beginning and ending times shall be available to move the Trend set backwards and forwards across the historical records. The trend sets shall automatically access archived history files without operator configuration.

It shall be possible to embed trend objects as part of custom displays. The following formats shall be available:

- Bar Trend
- Line Trend
- Numeric Trend
- Tuning Trend
- Trend with Events
- Pie Trend
- X-Y Plot

2.13 Event Management

As a standard function, the BMS shall log all events such that it shall be journalized in the event file and optionally printed on the event printer. The journal shall contain the following event information:

- Alarms
- Alarm Acknowledgements
- Return to Normal
- Operator Control Actions
- Operator Login & Security Level Changes
- On-line database Modifications
- Communications Alarms
- System Restart Messages
- Database changes

Standard Displays shall be provided to show the current journal file with the most recent event at the top of the display. Subsequent page forward actions shall allow display of progressively older events. Sorting and filtering of the journal shall be possible directly on screen. Filters shall be able to be saved for future use. Filtered events shall be able to be printed as an event report directly from the Event display.

The event database entries shall contain the following information as a minimum:

- Time & Date Stamp
- Database partition code
- Source
- Operator
- Event Type
- Condition
- Action
- Alarm Priority
- Description
- Value

- Engineering Units
- Comments

Events may be sorted by time and date, database partition or source of the event. It shall be possible to apply filters to the list of events to limit the view of events to those which match the filter. Filters may include multiple dimensions and wildcards and shall also be able to be saved and restored for reuse.

There may be additional fields which are relevant for different types of events. It shall be possible to enter comments on all events so that operators can annotate an event with relevant information.

It shall be possible to manually create an event if the operator wishes to record an incident on the site which is unrelated to system equipment.

The event database must also be accessible from other sub-systems such as the Operator Interface, Report Generation and Application Programmers Interface.

It shall be possible to have an on-line event file as large as the disk capacity can accommodate. For example, given the appropriate disk space it shall be capable of storing more than 1,000,000 (one million) events on-line.

The event file shall store events online. The system shall be able to automatically or manually archive these online events periodically, at a time period specified by the user. Operators shall be notified by an alarm that event archiving is required if manual operation is chosen. Events may be archived to tape, or to other media such as CD, Zip drive or to other file systems. If archiving does not take place, the event system shall continue to collect events until it reaches a nominated disk space limit. It shall then overwrite the oldest events until archiving takes place or more disk space is made available.

Archived events may be restored to the BMS at a later time if required for reporting purposes. Multiple archives shall be able to be restored at any one time. The BMS shall indicate to the operator the range of events in a particular archive file.

The event management system shall be fully integrated with the standard reporting system. The system shall automatically reference the restored archive file if a report is requested containing a time search window covered by the current archive file.

The operator shall be able to restore previously archived files and review or print them from the Operator Workstations. However, it shall be possible to directly generate a report from the event database filtered online without necessarily using the reporting system.

2.14 Alarm Management

The BMS shall support several different types of alarms for analog points, including:

- High Alarm
- High High Alarm
- Low Alarms
- Low Alarm
- Deviation High Alarm
- Deviation Low Alarm
- Rate of Change Alarm
- Unreasonable Value Alarm

Any four of these alarms shall be assignable to each Analog or Accumulator point on an individual point basis as part of the point configuration process.

Status points shall allow each individual state to be alarmed.

2.14.1 Alarm Priorities

Each monitored point in the system shall be able to be assigned one of four alarm priorities to individual states. The meaning of the priorities shall be as follows:

Journal

Changes of state shall be journalized to the Alarm/Event Log and optionally printed on the Alarm/Event printer.

Low

Change of state will generate a Low priority alarm, which will appear on the Alarm Summary. Optionally, the alarm may be printed on the Alarm/ Event printer or generate an audible tone.

High

Change of state will generate a High priority alarm, which will appear on the Alarm Summary. Optionally, the alarm may be printed on the Alarm/ Event printer or generate an audible tone.

Urgent

This is the highest priority. Change of state will generate an Urgent priority alarm, which will appear on the Alarm Summary. Optionally, the alarm may be printed on the Alarm/Event printer or generate an audible tone.

Within each of the four alarm types there shall be 15 sub-priorities available.

Each alarm priority shall have a configurable color, which shall automatically be presented to the operator in all graphics and alarm display across the BMS system. There shall be no engineering effort to support this alarm priority color from being synchronized across the BMS system.

It shall be possible to configure a time such that if a low priority alarm is not acknowledged within this time the alarm's priority is elevated to high priority. If a high priority alarm is not acknowledged within a configured time, its priority is elevated to urgent priority.

For each alarm priority, it shall be possible to configure a point such that if any alarms of this priority occur, the point is controlled to the configured state. This could be used to drive external enunciators such as sirens or lights.

When an alarm is acknowledged, it shall be possible to automatically issue a reset to a controller to indicate the alarm is acknowledged and to attempt to reset the alarm point.

2.14.2 Alarm Enunciation

Alarms shall be enunciated by:

- Most recent, highest priority alarm message appearing on dedicated alarm banner on the operator interface.
- Alarm message appearing on alarm summary display.
- Available Tone - based on a "*.wav" or other sound file for each alarm priority.
- Alarm message printed on the alarm printer.
- Alarm indicator flashing on the operator interface.

Alarms shall be enunciated at the Operator Workstation even if there is no operator currently signed-on. This feature shall be available on network connected Operator Workstations when the computer running the Operator Workstation software remains logically connected to the network. If the Operator Workstation is minimized in the Windows environment, then the Operator Workstation icon will indicate an alarm. An audible tone shall be able to be generated and this tone shall be specified by a "*.wav" or other sound file for each alarm priority.

Points shall be enunciated while in alarm. If a point is set to alarm inhibited the point shall no longer cause annunciation. If a point goes into an alarm state whilst inhibited and then is still in the alarm state when the point is set to alarm enabled, the point shall immediately cause annunciation.

2.14.3 Alarm Processing

Assigning an alarm to the point shall automatically cause the system to perform the following actions when an alarm occurs:

- The alarm shall be time stamped to the nearest second and logged in the Event database with the Point Name (source), Alarm type, Alarm Priority, Point Description, New value and Engineering Units
- The point value which is in alarm shall turn red (or other configurable color) and flash on any standard or custom display which uses that point.
- An Unacknowledged alarm entry shall be made in the system alarm summary for Low, High and Urgent Alarms.
- The audible alarm shall sound (if configured).
- The alarm annunciation indicator shall flash.

In addition, the alarm banner of the Operator Interface must show the most recent (or optionally oldest), highest priority, unacknowledged alarm in the system.

When used for Life Safety applications such as fire alarm or smoke control, the alarm management system shall be automatically configured to comply with the requirements of UL864 Category UOJZ and the system shall be so listed.

2.14.4 Alarm Summary

Alarms shall be able to be viewed in a consolidated alarm summary which shows all current or pending alarms on the system. This summary display shall be a standard display and require zero engineering to setup and commission. The Alarm Summary display shall support filtering by time and date, database partition or source of the alarm. The fields shown on the alarm summary must be configurable and it shall be easy to move or change the alarms fields displayed. It shall be possible to apply filters to the list of alarms to limit the view of alarms to those which match the filter. Filters may include multiple dimensions and wildcards and shall also be able to be saved and restored for reuse. More detail about an alarm shall be obtained from a configurable details screen which shows all fields associated with that alarm. It shall be possible for the operators to add comments to the alarm and these comments shall be stored with the alarm.

The alarm summary shall be capable of displaying a summary of the current alarms by location as well as the highest priority alarm within the corresponding location. The alarm summary shall be filtered based on the selected locations from the location pane.

The alarm summary shall support a simple method to reconcile recurring alarms into a common alarm message. This will prevent nuisance alarms from flooding the alarm summary display. When the same alarm from a plant device recurs, the alarm display shall use a counter to represent how many times this alarm has occurred since last acknowledged. This alarm counter shall be a filterable field in the alarm display for all alarms. Each time an alarm recurs, the count shall be increased by 1 and the alarm message must have its date/time updated with the newest alarm instance. Each alarm message shall indicate when each alarm first occurred and how many times it has recurred since last acknowledged. Whilst this alarm consolidation shall minimize alarm messages for the operator, the BMS will always track each new alarm into the Event Subsystem thereby ensuring all alarms are present regardless of how often they have recurred.

2.14.5 Dedicated Alarm Banner and Alarm Indicator

A dedicated alarm banner shall appear on all displays showing either the most recent or oldest (configurable), highest priority, unacknowledged alarm in the system. This banner shall be clear when there are no unacknowledged alarms for the operator to process.

An alarm indicator shall also appear on all displays. This indicator will flash red (or another configured color) when there are any unacknowledged alarms pending in the system. This indicator will remain solid red if there are alarms, which have not returned to normal but which have all been acknowledged. The indicator will be clear if there are no points in an alarm condition.

2.14.6 Alarm Logging

As well as being logged on the printer, alarms shall be logged to an event file for future retrieval in alarm reports or archived to removable media.

2.14.7 Alarm Response Function Keys

The following dedicated function keys shall be provided on the keyboard for alarm action:

1. *ACKNOWLEDGE*

After moving the cursor to the point in alarm on the screen and selecting the point the operator shall be able to acknowledge an alarm by pressing this key. This action shall be logged in the event file and on the printer showing the operator ID with the alarm.

2. *ALARM SUMMARY*

By pressing a dedicated key at any time the operator shall be able to view a display showing all currently active alarms. The alarm messages shall be color-coded showing priorities. The operator shall be able to view the alarms according to priority or sorted based on other fields. It shall be possible to acknowledge alarms from this display and also go to the associated display defined for the point.

3. *ASSOCIATED DISPLAY*

After moving the cursor to the point in alarm on the screen and selecting the point the operator shall be able to bring up the display applicable to that alarm by pressing this key. Just selecting the associated display key directly will bring up the associated display for the point currently on the alarm banner. This is generally a custom graphic showing the location

of the alarm in the facility.

2.14.8 Alarm Acknowledgement

The system shall provide for efficient alarm acknowledgement in a number of ways as follows:

- Selection of any POINT.PARAMETER from a custom graphic and pressing the dedicated acknowledge push-button.
- Right-clicking on any POINT.PARAMETER from a custom graphic and selecting 'Acknowledge Alarm' from the drop-down menu.
- Selection of the alarm banner and pressing the dedicated acknowledge button.
- Selection of the alarm in the alarm summary display and pressing the dedicated acknowledge button.
- By performing a page acknowledge from the alarm summary display. In UL restricted BMS systems this page acknowledgement shall be disabled.

On acknowledgement by the operator, the flashing indicator shall turn steady, and the point value shall remain colored with the alarm priority color, on any system or custom graphic. The acknowledgement shall also be logged in the Event database identifying the operator or station that acknowledged the alarm. If the point goes out of alarm before being acknowledged by the operator, the alarm shall be shown by a different indication and remain in the list until specifically acknowledged by the operator. If a point is not acknowledged within a configurable period of time, then an additional alarm can be generated and reassigned to another Location to allow other operators to take action.

2.14.9 Alarm Filtering

The Alarm Summary shall be able to filter the alarms displayed to the operator. All columns on the alarm summary shall be able to be used as part of a filter allowing sophisticated filters to be configured e.g. all alarms from this particular point, with this value, during this period. Filters shall be able to be saved and restored so that previously configured filters can be reused. It should also be obvious to operators when a filter has been applied to the Alarm Summary.

2.14.10 Print Alarms as a Report

The filtered alarm summary should be able to be printed directly as a report. From the alarm summary page, it shall be possible to view the current filtered list of alarms via a print preview button. This shows what the alarms will look like when printed to the configured report printer. From the alarm summary, it shall be possible to print the alarms directly using the print button.

2.14.11 Additional Alarm Information

The BMS system shall provide support for an additional message to be tagged to the alarm. This message shall provide the operator with additional information on the alarm but shall not clutter the alarm summary. It shall appear in a separate message summary at the same time as the alarm appears in the alarm summary. The messages can be pre-configured and then simply attached to individual points by means of a message ID.

2.14.12 Advanced alarm management

The BMS shall be capable of advanced alarm management, which includes set stages of alarm handling. The stages shall be:

- Silence alarm condition
- Acknowledge and action alarm condition
- Respond to alarm condition by using pre-defined responses
- Optionally reset alarm

All actions shall be recorded in the event file for retrieval and auditing purposes.

When an alarm is silenced, an instruction page for the alarm will be displayed. The alarm may then be acknowledged from this page and alarm handling action completed.

Once the alarm is acknowledged and appropriate action has been taken, the operator may move to the response page to select from up to 100 user-defined responses to be logged in the event file. Alternatively, the operator shall be able to enter his or her own response, which will also be logged in the event file. At the same time the alarm is removed from the alarm file. Optionally, the point shall remain on the alarm summary until a manual reset

operation is performed.

It shall be possible to enable/disable this feature on a point-by-point basis given the appropriate system privilege level.

2.15 Reporting

The system shall support a flexible reporting package to allow easy generation of report data. The reports provided shall include pre-configured standard reports for common requirements such as Alarm Event reports and custom report generation facilities that are configurable by the user.

2.15.1 Standard Reports

The following pre-formatted reports shall be available on the system:

- Alarm/Event Report
- Operator Trail Report
- Point Trail Report
- Alarm Duration Report
- All Point Report
- After Hours Alarm Report
- Point Attribute Report
- Generic or Custom Report
- Microsoft Excel Report
- ODBC Report
- SQL Reporting services based custom report

(Note: additional application specific reports shall be described later in this document).

Configuration of these reports shall only require entry of the schedule information, and other parameters such as Point Name or wildcard, filter information, time interval for search and destination printer to fully configure the report. Specifically, no programming or scripting shall be required.

2.15.2 Alarm/Event Report

A report shall be provided to produce a summary of all events of a specified type for nominated points occurring in a time period. The time period may be specified as an absolute start and end date and time, or as a period relative to the current time. This report shall also be able to produce a summary of all changes made by a specific operator.

2.15.3 Operator Trail Report

A report shall be provided to produce a summary of all operator actions relating to a specific operator in a specified period.

2.15.4 Point Trail Report

A report shall be provided to produce a summary of all events of a specified type occurring in a period on nominated points.

2.15.5 Alarm Duration Report

A report shall be provided which calculates the total amount of time a nominated point or group of points has been in an alarm condition over a given time period. The time period may be specified as an absolute start and end date and time, or as a period relative to the current time.

2.15.6 All Point Report

A report shall be provided to produce a list of point information, including point name, description, point type, engineering units, and current values. Report configuration shall allow filtering based on a wide variety of criteria.

2.15.7 After Hours Alarms Report

A report shall be provided to produce a summary of all Alarms occurring during the period specified by the operator as “After Hours”.

2.15.8 Point Attribute Report

A report shall be provided to points selected by one of the following attribute criteria:

- Out-of-service
- Alarm suppressed
- Abnormal input levels
- In Manual mode

2.15.9 Additional Generic or Custom Reports

In addition, configurable report generation facilities must be provided to allow custom reports to be produced. They shall be able to be configured at any time with the system online, and shall be able to access any database values. At least two methods of custom report generation shall be available, including the following:

2.15.10 Microsoft Excel

The BMS shall provide the facility for the use of Microsoft Excel as a reporting tool – allowing calculations such as summations, maximal, minimal and standard deviations, and the production of graphs, charts and tables. Systems that do not provide support for Microsoft Excel in this respect shall not be acceptable.

Data accessible for Excel reporting shall include alarms, events, and point parameter values.

2.15.11 ODBC

The BMS shall be capable of providing selected data in an ODBC format for the purpose of extracting data and creating custom reports. It shall be possible to access tables of data from the BMS through an ODBC compliant tool such as Crystal Reports or SQL Server.

It shall be possible to incorporate the activation of custom reports created through the ODBC compliant tool through the standard BMS report subsystem. Example reports shall be provided to illustrate how to access the ODBC data in the BMS.

A report detail display shall allow naming of reports, scheduling information and the destination of the report. The report destination shall be a printer, operator interface or internal file. The report output format shall be HTML (Hypertext Mark-up Language), Microsoft Word or RTF format.

2.15.12 SQL Reporting Services Custom Report

Being based on SQL Server, the FMSBMS system shall support a simple custom report format using the SQL reporting services. This shall enable customer reports to be designed in either Reporting Services, or Visual Studio and shall enable access to all point data, cardholder data and alarm and event data. The design of the SQL Custom Reports solution shall be available from any of the LAN connected Operator Workstations. No addition license fees shall be required to utilize this standard custom reporting solution. To facilitate rapid development of simple custom reports the system shall be delivered with template reports.

2.15.13 Report Activation

Reports shall be activated in one or more of the following ways:

- Periodic activation at user specified intervals
- Operator Demanded
- Event Initiated e.g. Change in point value
- Application Initiated
- Printed directly from the alarm/event summary

2.15.14 User Definable database

In order to support other types of data such as user entered or calculated data from application programs, the system shall also provide a User Definable database area that can be fully integrated into the system. Data contained in this database must be accessible by:

- Custom Graphics
- Custom Reports
- Application Programs
- Network Applications using a Network API

2.15.15 Point Initiated Programs (PIPS)

In addition to standard point processing functions, the system shall allow additional

processing through the use of standard PIPS that may be attached to any points. Typical functions to be provided by these PIPS are listed below:

- Arithmetic Calculation
- Boolean Calculation
- Maximum/Minimum Value
- Composite Alarms
- Integration
- Run Hours Totaled
- Group Alarm Inhibit
- Report Request by Point Change
- Application Program Request (By point value change or cyclic period)
- Alarm Transportation
- Value Transportation
- Door Activity Task Request
- Security Area Seal/Unseal
- Alarm or Point Value Change Graphic Call-up
- Value Change Group or Area Alarm Inhibit

2.15.16 Historical Data Archiving

The system shall support archiving of historical data to allow a continuous record of history to be built up over a period of time. Archived data may be stored on the hard disk of the system. The number of archives maintained on the system before transferal to off-line media shall only be limited by the size of the hard disk or remote network drive. The system shall allow the user to define the specific intervals of history to be archived to avoid archiving of unnecessary data.

Once archived, the data shall be available for re-trending through the system trend facilities in combination with the current on-line history or other archives. Providing the archived history is present on the BMS Server's hard disk or remote network drive, the trend facilities must be able to access it transparently for display, when a user scrolls beyond current on-line history limits.

The BMS will support display of trend data from up to 2 years of age. Any required upgrades or updates to the BMS system shall also be capable to preserve the Historical information to enable review of data from any earlier release of the system.

2.15.17 Time Schedules

It shall be possible to specify time schedules for the control of all BMS points. It shall be possible to control a range of a single point to a large number of points from a single schedule. A single time schedule shall define the control to any combination of day and time.

The BMS scheduling management system must be more flexible than providing weekly schedules with a provision for a finite number of special occasions/holidays. The BMS scheduling system shall allow schedules to be entered that recur on a non-weekly basis or only occur once on a given day in the future.

Examples:

- Schedules shall be capable of recurring on any multiple of weeks (every 1 week, every 2 weeks, every 7 weeks, etc.)
- It shall be possible to enter a schedule that only occurs once on any given day in the future.

The BMS time schedule must also provide the ability to override the normal schedule for holidays or special occasions. The user shall be able to create multiple different grouping of dates (Calendars) that can be assigned to individual points as applicable.

Examples:

- Daily or weekly recurring time schedules; capable of recurring until a specified date or without end (Mon-Fri 7:00 to 18:00, Thursday 7:00 to 22:00)
- Time schedules active for greater than 24 hours (Saturday-Sunday 9:00 to 14:00)
- Time schedules that occur on a specified group of Calendar Days (e.g. Holidays)

Configuring time schedules must be done through a graphical user interface whereby the operator selects the appropriate time span from a calendar. Systems where times and days must be manually entered or managed by an external spreadsheet type form are not acceptable. The user interface must support the capability of navigating to any future date to allow the user to enter a time schedule. The user interface must provide graphical feedback to indicate to the user whether the time schedule is a:

- One-off exception schedule
- Part of a recurring series
- Recurring schedule that has been altered from the series
- Part of a calendar schedule
- Active Schedule
- Schedule that has completed
- Successfully downloaded schedule to the device (if applicable)

The user interface must allow the user to view time schedules that have been configured in the past, present, and future in a graphical calendar interface. It shall be possible to increase or decrease the amount of time on a schedule which is currently active.

Where the control device supports an internal time schedule program, the BMS shall be able to upload, display, modify and download the control device time schedules. Support for the control device time schedules shall be in addition to the BMS time schedules.

2.16 Open Integration

Any of the following Open Protocol Standards shall be used for integration of 3 rd party devices or systems

2.16.1 Modbus

2.16.2 BACnet (ANSI/ASHRAE 135)

2.16.3 BACnet Operator Workstation

2.16.4 BACnet Gateway

2.17 Data Exchange

The BMS system shall have the capability to interface to the point database of other BMS systems (i.e. nodes) on a TCP/IP network. This shall enable both the acquiring of point data and issuing control outputs to and from connected BMS systems.

2.18 Data Exchange with Microsoft Excel

The system must be capable of exporting bulk data to Microsoft Excel. As a minimum the following shall be supported:

- Allow retrieval of data either periodically or snapshot
- Allow retrieval of data via POINT.PARAMETER requests
- Allow retrieval of tag names, descriptions etc.
- Allow retrieval historical data
- Writing of values from Excel back to the supervisory system

2.19 Accessing the BMS from Third Party Web Pages

Web-page controls and a web server interface to the BMS shall be optionally provided, which allow tenants or other users to monitor & control a variety of BMS-supervised functions via their own Web pages created for their own Intranet or Internet and viewed from a standard web-browser. For example, it shall be possible for building tenants to be able to view floor graphics via a dedicated or existing building Intranet, and to be able to monitor and control floor lighting and ambient temperature

information.

It shall be possible to limit web browser access to BMS facilities by means of standard web and networking techniques.

2.20 Paging and External Annunciation of System Alarms

The BMS shall optionally provide a facility for sending alarm text from configured points to the following external systems:

- Digital mobile phones with text message (SMS) support
- Email

Each point's paging priority threshold shall be individually configurable, and individually enabled or disabled. Each external device configured in the system shall have individually selectable times and days of operation, an alarm priority threshold, and an alternative device for use in escalation of unacknowledged alarms.

2.21 Database Configuration Tool

A database configuration tool shall be provided with the BMS system that shall allow configuration of all point records, printers, controllers, and Operator Workstation connections. This utility shall be in the form of a relational database and operate in a true 64 bit graphical environment such as Windows 11 Professional or Windows 10 Server. The utility shall also have the ability to export information to and import information from Microsoft applications such as Microsoft Excel. Systems that do not provide support for Microsoft Excel in this respect shall not be acceptable.

Users with sufficient security access shall be able to configure the database while the system is on-line. Configuration shall not require the need for any programming, compiling or linking and shall not require shutting down or restarting of the system. In addition, historical data collection shall not be interrupted for points not affected by configuration changes.

It shall be possible to launch the database configuration tool from the operator workstation interface. The utility shall have the ability to configure database changes and download them either from the BMS server directly or remotely via the network. The remote download is to provide password protection.

It shall be possible to modify a range of communications and other parameters for each device. The parameters of a particular device made available for modification shall be specific to the device or hardware item being configured– for example baud rate, parity, data and stop bit information in the case of serial devices. Hardware configuration utilities that rely solely on text-based configuration files shall not be acceptable.

All documentation for the configuration utility shall be provided on-line. The help facility shall operate using standard Microsoft features such as context sensitive help using the F1 function key.

The utility shall provide features that reduce configuration time of the BMS system. These features shall include adding multiple points, controllers etc. at once. The utility shall automatically increment names or numbers of any information that is required to be unique by the BMS system (such as point names). The user shall be able to select multiple items (such as points) and then edit fields that are common to all selected items to assist in global changes. Standard copy and paste facilities are to be provided by the utility.

The utility shall provide functionality to create a hierarchical structure of locations to model the system. This model is to be used to manage system information (such as points) as well as user scope of responsibility. The hierarchical model shall support a 10-layer deep architecture. It shall be possible for the locations in this model to span multiple servers.

The utility shall also support free format text fields, which the user can use for additional information such as cabinet or wire numbers. These additional fields shall be simple extensions to existing items in the database such as BMS points.

A filtering mechanism shall be provided with the utility so that the user need view only relevant information. The filter shall provide standard choices for the user to select, and also provide user defined filtering.

Database management reports shall be provided by the utility as standard. The utility shall also provide support for ad-hoc reporting facilities for engineering use.

2.22 Application Programming Interface

Two types of Application Programming Interface (API) are required, the first is for applications written on the BMS server and the second is for applications that are required to run on network based clients

(that are not necessarily Operator Workstations).

The BMS system API's must have support for either Visual Basic or C++ or both. Proprietary programming languages are not acceptable.

The API on the BMS server requires the following functions as a minimum:

- Read and write to points in the database
- Access to historical data
- Initiate supervisory control actions
- Access to the alarm/event subsystem
- Access to user-defined database
- Provide a prompt for operator input.

The API on the network-based clients requires the following functions as a minimum:

- Read and write to points in the database
- Access to historical data
- Initiate supervisory control actions
- Access to user-defined database

2.22.1 Server Scripting Engine

The BMS system must have the ability to extend its functionality easily by the addition of small script code to certain server functions. This will enable additional customer specific functionality to be easily added to point, report and server processing. For example, a script shall enable a calculation to be performed and a number of points to be controlled based on another point going into alarm state. Scripts shall be able to be attached to point processing, report generation, server startup and shutdown, or executed on a periodic basis.

The scripting engine must support a standard scripting language such as Microsoft's VBScript. Access to the scripts shall be through an inbuilt scripting editor which provides key work support and syntax checking as well as an extensive range of online help including a large number of worked examples. Proprietary scripting languages shall not be acceptable.

Scripting functionality shall be in addition to a full Application Programming Interface as described in section 2.22.

2.22.2 Diagnostic Capabilities

The BMS system must enable easy diagnostics of the health of the system.

2.22.3 Diagnostic Framework

The BMS system must make all diagnostic information viewable through an easy to use user interface and shall be able to be easily exported as a stand-alone collection of material for later analysis. The capabilities shall include the ability to run automated tests, record the reproduction of a failure, as well as collection and organization of all available diagnostic information (files, logs, and system settings).

Automated tests shall be possible to determine the health of the BMS. The automated tests shall automatically set the appropriate debugging parameters and store the results for viewing at any time. The results shall be stored in a file that can be sent for assistance in remotely diagnosing an issue.

The ability to record all system information at the time of issue reproduction shall be automated from within the diagnostic framework. The recordings shall be capable of being defined to capture the necessary level of system information at the time of issue reproduction.

All available BMS diagnostic information shall be collected and organized for viewing as well as to create a diagnostic package to simplify remote issue resolution. This information shall include the following:

- Communications traces to selected controllers
- All system log files
- Details on system software installation
- Application status information

It shall not be necessary to be an expert user in the system to gather diagnostic information.

3. Building Management Specification

3.1 General

The Integrated Building Management System (BMS) to be provided shall perform the following general functions:

Building Management and Control

Monitoring and control of controllers, remote devices and Programmable Logic Controllers including sensors, actuators, environmental delivery systems (chillers, boilers, room climate control, lighting systems, electrical systems etc.)

- Operator Interface to allow general supervision of room controls
- Video display integration
- Data collection and historization
- Alarm Management
- Trending
- Report Generation
- Network Integration
- Data exchange and integration with a diverse range of other computing and facilities systems using industry standard techniques.

The system shall employ all standard features and functions to monitor and control building equipment. At a minimum, the following data shall be accessible:

- Space temperature
- Space temperature set point
- Occupancy status
- Operating mode
- Window status
- Valve positions
- Air volume flow
- Percent terminal load
- Time schedules
- Zero energy bands
- Room name
- Terminal type e.g. fan coil

In the event of a power failure or disconnection from the BMS, the controllers shall continue to be fully operational with full time program capability.

3.2 Specific Building Management Functions

3.2.1 Controller Scheduling

A controller scheduling tool shall be provided for creating, editing and maintaining controller time schedules. The controller scheduling tool shall be constructed in a way that allows compatibility with new controller types with minimal additional development.

The controller scheduling tool shall allow downloading of schedules to several (supported) controllers in a single operation by provision of an integrated graphical interface.

The controller scheduling tool shall provide a clear, graphical indication of the status of each downloadable schedule element, and shall automatically recover and complete any schedule download which, for any reason, has failed or been interrupted.

3.2.2 System Control and Monitoring over the web

For building tenants or other people without access to an Operator Workstation, the BMS shall provide the ability to control and monitor site resources via a standard touch-tone telephone or through an Intranet site.

The facility's configuration tool shall provide a simple graphical interface to allow:

- User authorization to be configured by assigning each user or group of users a password code that allows restricted access to certain building locations.
- Configuration of service charges on a point-by-point basis for the creation of billing information, and to allow production of billing reports against each user or group of users for a specified time period.

As an example of the facility's use, an intranet or internet connected user might switch on lights and air-conditioning after hours, or view and change the settings of analog points from any IE connected browser.

A monthly report could then be generated to charge this caller for the services used during that period.

3.2.3 Smoke and Critical Process control

The building management portion of the BMS shall be able to provide for control and monitoring of HVAC functions associated with smoke control and when used with appropriate hardware shall be listed by ULI under category UUKL for this purpose.

3.3 BACnet Network Router / Controllers (NRC)

3.3.1 General

Network Controllers shall combine both network routing functions and control functions into a single unit. NRC's shall route communications between the BACnet/IP network and the BACnet MS/TP field network. They may also be responsible for monitoring and controlling their own HVAC equipment such as an AHU or boiler. A sufficient number of NRCs shall be supplied to fully meet the requirements of this specification and the attached point list.

Each NRC shall be classified as a "native" BACnet device, supporting the BACnet Advanced Application Controller (B-AAC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NRCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as Advanced Application Controllers (B-AAC).

3.3.2 Hardware Specifications

3.3.2.1 *Memory:*

Both the operating system of the controller, plus the application program for the controller, shall be stored in non-volatile, FLASH memory. Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.

3.3.2.2 *Communication Ports:*

Each NRC shall provide communication to both the Workstation(s) and the field buses. An on board 10/100bT Ethernet port shall be provided, as well as a RS-485 port for communications to a maximum of 127 MS/TP devices. All TCP/ IP settings, including IP address, default gateway and subnet mask, shall be stored in non-volatile memory.

3.3.2.3 *Local Status Indicator Lamps:*

Provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each output, provide LED indication of the value of the output (On/Off). For each output module provide an LED which gives a visual indication of whether any outputs on the module are manually overridden.

3.3.2.4 *Real Time Clock (RTC):*

Each NRC shall include a battery-backed, real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. The system shall automatically correct for daylight savings time and leap years and be Year 2000 compliant.

3.3.2.5 *Power Supply:*

The power supply for the NRCs shall be auto sensing, 10-28VDC and 24VAC, 60/50 Hz power, with a tolerance of +/- 20%. Line voltage below the operating range of the system shall be considered outages. The controller shall contain over voltage surge protection, and require no additional AC power signal conditioning.

3.3.2.6 *Automatic Restart after Power Failure:*

Upon restoration of power after an outage, the NRC shall automatically and without human intervention: update all monitored functions; resume operation based on current, synchronized time and status, and implement special start-up strategies as

required.

3.3.2.7 *Battery Backup:*

The NRC shall include an on-board lithium battery to back up the controller's RAM memory. The battery shall have a shelf life of over 10 years, and provide accumulated backup of all RAM and clock functions for at least 3 years. In the case of a power failure, the NRC shall first try to restart from the RAM memory. If that memory is corrupted or unusable, then the NRC shall restart itself from its application program stored in its FLASH memory.

3.3.2.8 *Spares Capacity*

Each controller must be provided with a 15% spare capacity of I/O points, with a minimum of 2 digital and 2 analog points in each controller.

3.3.3 Software Specifications

3.3.3.1 *General*

The NRC shall contain FLASH memory to store both the resident operating system AND the application software. There will be no restrictions placed on the type of application programs in the system. Each NRC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.

3.3.3.2 *User Programming Language:*

The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and set points. The source program shall be English language-based and programmable by the user. The language shall be structured to allow for the easy configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, passwords, and histories. The language shall be self-documenting. Users shall be able to place comments anywhere in the body of a program. Program listings shall be configurable by the user in logical groupings.

Controllers that use a "canned" program method will not be accepted.

3.3.3.3 *Control Software:*

The NRC shall have the ability to perform the following pre-tested control algorithms:

- Proportional, Integral plus Derivative Control (PID)
- Self-Tuning PID
- Two Position Control
- Digital Filter
- Ratio Calculator
- Equipment Cycling Protection

3.3.3.4 *Mathematical Functions:*

Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

3.3.3.5 *Energy Management Applications:*

NRCs shall have the ability to perform any or all of the following energy management routines:

- Time of Day Scheduling

- Calendar Based Scheduling
- Holiday Scheduling
- Temporary Schedule Overrides
- Optimal Start
- Optimal Stop
- Night Setback Control
- Enthalpy Switchover (Economizer)
- Peak Demand Limiting
- Temperature Compensated Duty Cycling
- CFM Tracking
- Heating/Cooling Interlock
- Hot/Cold Deck Reset
- Free Cooling
- Hot Water Reset
- Chilled Water Reset
- Condenser Water Reset
- Chiller Sequencing

3.3.3.6 *History Logging:*

Each controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system can be logged in history. A minimum of 1000 values shall be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to the Operator Workstation for long term archiving based upon user-defined time intervals, or manual command.

3.3.3.7 *Alarm Management:*

For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the NRC and can result in the display of one or more alarm messages or reports.

Upto 8 alarms can be configured for each point in the controller.

Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided.

If communication with the Operator Workstation is temporarily interrupted, the alarm will be time-stamped and buffered in the NRC. When communications return, the alarm will be transmitted to the Operator Workstation if the point is still in the alarm condition.

Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

3.3.3.8 *Web Server Interface*

The Network Controller/Router shall include a built-in web server, such that all point values may be viewed and controlled from a standard browser environment. Custom web pages, password-protected, must be able to be stored within the network controller for access by technicians for troubleshooting and maintenance. Each web page may be configured as dynamic, with an automatic refresh rate.

3.3.3.9 *Local Keypad/Display:*

For each NRC, provide a local display of at least 4 lines, providing current display of all critical inputs and outputs that the NRC is controlling. Provide a keypad such that an operator can log on, scroll through point values, and change set points that are changeable. The keypad/display must be capable of being mounted either on the controller, or on a control panel door.

4. Field Devices

Field devices, including valves, actuators and sensors, shall be selected from the following types, wherever possible.

4.1 Actuators

The following actuator ranges provide maximum flexibility in component selection.

4.1.1 Small Linear Actuators without Spring Return

The small linear actuators shall provide floating or modulating control together with small linear valves. These actuators are used in fan coil units, induction units, small re-heaters, re-coolers, zone control and for domestic hot water applications. They are employed in electronic temperature control systems using hot and/or cold water as the controlled medium.

The small linear actuators shall be suitable for controllers using floating or modulating outputs or communications interfaces based on any of the above mention technologies. Controllers with floating outputs track the precise valve position whereas with controllers with modulating outputs the actuators operate continuously to the requested valve position. These actuators shall be well-suited for applications where space is limited and where minimal power consumption is required. These small linear actuators shall have a flexible platform which can be adapted to meet requirements for color, cable-length, auxiliary switches, mechanical interface, and integrated manual adjustment.

4.1.2 Large Linear Actuators

The large linear actuators shall be used together with controllers providing switched or floating single-pole/double-throw outputs or controllers with modulating control outputs. These actuators shall have a standard mechanical interface where no linkage is required, and no calibration or adjustments shall be necessary. The actuators shall feature force-limiting end switches to guarantee that no power is consumed in the end positions and synchronous motors to ensure a long life span. They shall be capable of simple manual operation and the option of spring-return and non-spring-return models to guarantee a wide range of applications. The modulating actuators without spring return shall also provide a failsafe function in case of a faulty connection. It shall be possible to add auxiliary switches or a high temperature kit for high performance applications. They shall be suitable for heating, ventilation, air conditioning, district heating, domestic hot water or any other application from small to large buildings and semi-industrial environments.

4.1.3 Damper Actuators without Spring Return

The direct coupled damper actuators without spring return shall be compatible with a proportional controller or a floating single-pole/double-throw control switch. These actuators shall be able to be mounted directly on round and square damper shafts, and the angle of rotation shall be able to be limited to certain angles. Simple installation and maintenance shall be ensured by a declutch button for manual adjustment, field-added or directly-implemented auxiliary switches, and a position indicator. These products shall be suitable for air dampers, ventilation flaps, louvers, air handlers and VAV units.

4.1.4 Damper Actuators with Spring Return

The spring return actuators shall combine safety and control functionality and provide on/off, floating, and modulating control interfaces with a wide range of available accessories. These actuators shall have a bidirectional fail safe functionality and a self-centering shaft adapter or exchangeable hub insert to fit on all dampers quickly and securely. Quick start-up and service shall be ensured by a manual override, a highly-visible position indicator, dual-point mounting options and auxiliary switches. These products shall be suitable for ventilation and air-conditioning systems for ventilation flaps and air handlers where the fail safe functionality is required.

4.2 Valves

4.2.1 Small Linear Valves

The small linear 2 or 3 way valves shall be operated with small linear actuators and thermoelectric actuators for modulating or on/off control of hot and/or chilled water for fan coil units, small re-heaters and re-coolers or for steam in HVAC systems. These valves shall be well suited for applications where space is limited such as in fan coil units and manifold systems. They shall be designed for reliable long time use and feature high quality specifications.

feature pressure compensation to ensure optimized flow control in hydraulic systems with high differential pressures and high temperatures.

4.2.2 Threaded Large Linear Valves

The threaded large linear 2 or 3 way valves shall be used with large linear actuators for modulating control in heating, ventilation and air conditioning systems with hot and/or chilled water, open circuits with fresh water, as well as steam applications. Both 2-way and 3-way valves shall provide a long lifespan and feature optimized rangeability, leakage rate, temperature range, close-off pressure and flow characteristics.

4.2.3 2-Way Flanged Large Linear Valves

The 2-way flanged large linear valves shall be used with large linear actuators for modulating control of hot and chilled water or steam in heating, ventilating and air conditioning systems. For district heat applications these valves shall be approved to DIN 32730. Metal to metal seating and self-adjusting packing shall ensure long life, and the valves shall provide high quality specifications to ensure state of the art temperature control.

4.2.4 3-Way Flanged Large Linear Valves

The 3-way flanged large linear valves shall be used with large linear actuators for modulating control of hot and chilled water or steam and heating, ventilating and air conditioning systems. Metal to metal seating and self-adjusting packing shall ensure long life, and the valves shall provide high quality specifications to ensure state of the art temperature control.

4.2.5 Bubble Tight Butterfly Valves

The butterfly valves shall employ an EPDM - HT liner to meet upcoming heating system standards. No additional linkage shall be required for mounting standard actuators. These valves are preferred for use in heating and cooling applications as well as hydraulic shutters for boiler cascades.

4.2.6 Pressure Independent Control Valves (PICV)

4.2.6.1 Pressure Independent Control Valves (15-40mm)

The valve should be self-balancing flow control valves that are pressure independent, two-way, modulating to accept digital or analog input signals and provide flow feedback signal to the control system. The valve shall meet the specified flow within either +/- 10% +/- 2% of the maximum cartridge flow rate. Valves shall contain replaceable, visible cartridge that are externally field adjustable. The relations between the setting and the flow rate shall be available in the supplier's literature. The cartridge shall be available in at least two pressure ranges, ranging between 16-400 kPaD. Larger ranges then mentioned is accepted, but not lower ranges.

The Valve Actuator housing shall be rated to IP43. The actuator shall be driven by a 24V AC power supply, and accept 2-10V DC, 4-20mA signal. The actuator shall be capable of proving 0-10V DC feedback signal to the control system. The actuator shall use full span and provide full authority. The actuator cover shall be fireproof.

4.2.6.2 Pressure Independent Control Valves (25-150mm and above)

The valve shall meet the specified flow within either +/- 5%,+/- 2% of the maximum flow rate. Each valve should have an adjustable maximum flow rate setting to enable flow limitation and balancing to the coils. It should be externally field adjustable. The actual setting and thereby flow rate needs to be available from the outside by looking at the DIP switch settings itself. The relations between the setting and the flow rate shall be available in the supplier's literature. The valve shall be available between 35-400mm kPaD pressure ranges. Larger ranges then mentioned is accepted, but not lower ranges. The specific range is selected based upon the system requirements.

The actuator shall be microprocessor based with a self-calibrating feature. The actuator shall be capable of providing 4-20mA or 2-10V DC feedback signal to the control system. External LED read-out of current valve position and maximum valve position setting shall be available.

Valve actuator housing shall be rated to IP42. The actuator shall be driven by a 24V AC/30V DC power supply, and shall accept 2-10V DC, 4-20mA, 3-point floating or pulse width modulating electric signal and shall include resistor to facilitate any of these signals.

position in case of power failure shall be available.

External LED read-out of current valve position and maximum valve position setting shall be available.

4.3 Sensors

4.3.1 Temperature Sensors

Passive temperature sensors with NTC 20K ohm, Balco500 and PT1000 elements shall be available for different applications.

- Outdoor temperature sensors (also combined with humidity sensors) with extra covers for protection and shielding the sun. Prewired and terminal block versions shall be available. Their temperature range shall be –40 to +60°
- Earth temperature sensors for greenhouse applications. These prewired NTC 20 sensor shall be rated to IP65. Their temperature range shall be –50 to +90°C.
- Room temperature sensors (also combined with set-point adjustment and fan/presence switches). These shall be available with NTC 20, PT1000 and Balco500 elements in an attractive, appealing housing, with terminal blocks for wiring. Models shall also be available with LEDs. Their temperature range shall be –20 to +50°C.
- Air duct temperature sensors. Pre-wired and terminal block versions shall be available to mount in and outside the duct. Their temperature range shall be –40 to +120°C.
- Strap-on temperature sensors. These shall be used measure the temperature in a water pipe. Prewired and terminal block versions shall be available and shall be mounted on the pipe with a clamp. Their temperature range shall be –50 to 110°C.
- Immersion temperature sensors. These shall be used to measure the temperature in a water pipe. Prewired and terminal block versions shall be available and shall be mounted in the pipe with a well. Lengths from 95 to 300 mm shall be available. Material shall be copper, brass or stainless steel depending on type. Their temperature range shall be –50 to +130°C.
- Fast temperature sensors. These shall be used with domestic hot water applications in district heat stations and shall detect fast temperature changes. These shall be pre-wired stainless steel sensors and be available with a NTC 20 element. They shall be mounted directly into the pipe. Sensor lengths shall be 75, 220 and 300mm. The length shall be adjustable to pipe diameters.

4.3.2 Average Temperature Sensor For Air Ducts

A single PT 1000 sensor over a length of 3.6m shall be used for sensing the average temperature in large air ducts with. Sensor holders shall be included for installation.

4.3.3 Stainless Steel Temperature Sensors and Transmitters

Stainless steel temperature sensors shall be available with PT 100 and PT 1000 elements and stainless steel temperature transmitters. They shall feature a 2-wire-system, 4-20 mA output, 12-36 VDC supply voltage, and shall meet protection class IP-65.

4.3.4 Humidity Sensors

Active humidity sensors shall be available in combination with temperature sensing with NTC 20K ohm, Balco500 and PT1000 elements for different applications. The operating voltage for the capacitive humidity sensing element shall be 24V. The following types shall be available:

- Outdoor humidity sensors with terminal blocks and a temperature range of –30 to +50°C & humidity range of 0-95%.
- Capacitive room humidity sensors with NTC 20, PT1000 and Balco 500 temperature sensors, and with terminal blocks, output for humidity of 0 to 1 or 0 to 10V, and a humidity range of 0-95%.
- Capacitive air duct humidity sensors with NTC 20, PT1000 and Balco500 temperature sensors, and with terminal blocks, output for humidity of 0-1 or 0-10V, a humidity range of 0-95% and mountable on the air duct.

4.3.5 Pressure Transmitters

Differential pressure transmitters are used for controlling pressure in air conditioning or other ventilation applications, such as filter monitoring, pressure or flow control, maximum pressure control, etc. The transmitters can be used for overpressure, vacuum or differential pressure measurement with non-aggressive gaseous media. The range of the transmitters

4.3.6 Differential Pressure Transmitters For Air Conditioning

These transmitters shall have an output signal of 0 to 10V, pressure ranges selectable by jumper, zero point adjustment by potentiometer, and shall conform to protection class IP 65. Accessories such as 2m silicone pressure hose and pressure joints shall be included. The following pressure ranges shall be available:

- 0 to 500 / 1000 Pa selectable by jumper, set to 500 Pa
- 0 to 1000 / 500 Pa selectable by jumper, set to 1000 Pa
- 0 to 2000 / 1000 Pa selectable by jumper
- –500 to + 500 Pa fixed
- –1000 to +1000 Pa fixed

Additional versions shall be available with a 3-½ digit LCD display. These transmitters shall be available in LON versions conforming to pressure profile 1030, with service and operation LED visible and Neuron button accessible from outside. Provide as / if shown on the drawings.

4.3.7 Pressure Transmitters for Heating, District Heating, Cooling and Other Applications

These pressure transmitters shall be available with welded stainless steel sensors, an output signal of 0 to 10V, supply voltage of 24Vac +/- 20 % or 24-26Vdc, pressure ranges selectable by jumper, zero point adjustment by potentiometer, and shall conform to protection class IP 65.

The following pressure ranges (selectable by jumper) shall be available:

- 0-1 / 0.5 / 0.2 bar max 3 bar
- 0-3 / 1.5 / 0.6 bar max 7.5 bar
- 0-6 / 3 / 1.2 bar max 18 bar
- 0-10 / 5 / 2 bar max 30 bar
- 0-25 / 12.5 / 5 bar max 70 bar
- 0-40 / 20 / 8 bar max 80 bar

A 2-½ digit LED display module shall also be available. These transmitters shall be available in LON versions conforming to pressure profile 1030, with service and operation LED visible and Neuron button accessible from outside.

4.3.8 Differential Pressure Transmitters For Heating, District Heating, Cooling And Other Applications

These pressure transmitters shall be available with a welded stainless steel sensor, a pressure connection G ½" (DIN 16 288), an output signal of 0 to 10V, a supply voltage of 24Vac +/- 20 % or 24-26Vdc, pressure ranges adjustable through zero point and end point potentiometer, and shall conform to protection class IP-65. The following types shall be available:

Pressure Range	Smallest Range	Max. Pressure
0-500 mbar	125 mbar	10 bar
0-1 bar	250 mbar	15 bar
0-2.5 bar	0.7 bar	15 bar
0-5 bar	1.25 bar	15 bar
0-10 bar	2.5 bar	25 bar

A 2-½ digit LED display module shall also be available. These transmitters shall be available in LON versions conforming to pressure profile 1030, with service and operation LED visible and Neuron button accessible from outside.

4.3.9 Air Quality Sensors

Air quality sensors measure the concentration of CO_2 or mixed gases (VOC) in the air and are used to initiate an action such as causing dampers to open or fans to speed up to bring fresh air in. Sensor elements shall be, depending on type, metalloxide semiconductors, CO_2 sensors, Non Dispersion Infrared (NDIR) and thermistors. The sensors shall be powered by 24V, with an output signal of 0-10V. The operating range shall be 0 to 45°C. Versions with a display and

Provide as/if shown on the drawings.

END OF SECTION 23 09 10

HYDRONIC Piping & Specialties

a) Piping Material:

a) ***Seamless Black Steel Piping:*** Seamless black-steel piping, Schedule 40 conforming to ASTM A53.

b) ***Mild Steel Pipe:*** conforming to BS1387 (medium series), screwed upto 50mm (2 inch) & welded above Ø 50mm (2 inch).

c) ***Mild Steel Pipe:*** conforming to ASTMA53, Schedule-40, screwed upto 50mm (2 inch).

d) ***Galvanised Iron Pipe:*** G.I. Pipe shall conform to BS1387 of 1957 (Medium Series), welded type. Fittings shall be of galvanised malleable iron. Fittings upto 100mm shall be screwed.

e) ***Copper Tubing:*** shall be type 'K' hard seamless, confirming to BS1172 and manufactured to BS2871; Pt.1, Table X. Fittings shall be of wrought copper conforming to BS864, Pt.2.

f) *UPVC Piping: Pressure piping conforming to ASTM D1785 or BS3505 of 1968. Jointing shall be solvent welded. Fittings shall be injection moulded of high density & shall be imported.*

b) Application:

a) ***Chilled/Hot & Condenser Water Piping*** shall be of material as specified under PIPING SCHEDULE in EQUIPMENT DATA SHEET (Section 2).

b) ***Natural Gas Piping*** shall be of material as specified under PIPING SCHEDULE in EQUIPMENT DATA SHEET (Section 2).

c) ***Fan Coil Unit connections*** shall be of material as specified under PIPING SCHEDULE in EQUIPMENT DATA SHEET (Section 2).

d) ***Make-up Water & Drain Lines*** shall be of material as specified under PIPING SCHEDULE in EQUIPMENT DATA SHEET (Section 2).

c) Fittings & Flanges:

a) Fittings shall be forged, compatible to the pipe. Welded fittings shall be butt-welding type. Galvanised piping shall be provided with galvanised fittings with threads. All fittings shall be rated for minimum 10 bars SWP.

b) Flanges shall be slip-on type & shall conform to ANSI B16.5. Galvanised piping shall be provided with galvanised threaded flanges. All flanges shall be rated for minimum 10 bars SWP.

d) Valves & Strainers:

Refer Section 23 05 23, VALVES & STRAINERS.

e) Drains:

Shall be provided at all low points to ensure complete drainage of the piping. Drains from steam lines shall be provided with steam traps. All air handling units and fan coil units shall be provided with condensate drains, which shall be installed with a gradient of 1% (one percent) in the direction of the flow. Drains indicated to be connected to sanitary sewer system shall be connected by means of an indirect waste. Clean-outs and water seals shall be provided for cleaning. Water seals shall be provided in the condensate drains of all units. The depth of the seal shall be at least equal to 1.5 times the total static pressure rating of the unit to which the seal is connected. Water seals shall be constructed of two tees and an appropriate U-bend, with the open end of each tee plugged tight. All drains connected to pressurised circuit shall be provided with Ø 20mm gate valves.

f) Automatic Air Vents for Liquid Systems:

Automatic air vents shall be suitable for liquid systems. Body and cover shall be of malleable iron. Float & Valve seat shall be of stainless steel. Valve head shall be of Vitone (Synthetic Rubber). Connections shall be 13mm or 20mm as specified, screwed BSP. Vents shall be suitable for service upto 125 SWP (8.5bars) & 250°F (120°C) service.

Vents shall be similar to model AE 550 manufactured by SPIRAX-SARCO.

Air vents shall be provided at all high points, on all water coils, and where shown on the drawings to ensure adequate venting of the piping system. A ball valve shall be provided to isolate the vent. The vent outlet shall be piped to a nearby convenient drain using suitable diameter flexible transparent PVC tubing.

g) Expansion Joints:

a) Where indicated on the drawings, expansion joints shall be provided. Expansion joints shall also provided in all lines subject to temperature changes where indicated or required to relieve strain developed in lines due to temperature increase or decrease.

b) Pipe alignment guides shall be installed as recommended by the joint manufacturer but in any case not more than

1.5m on each side of expansion joint, except in lines 100mm or smaller they may not be over 600mm on each side of joint.

c) Anchors shall be provided wherever necessary or indicated to localise expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles wherever required. Anchors, supports or stays shall be attached in places where such supports will not injure the construction during installation or damage the structure by the weight or expansion of the pipeline. Detailed drawings of pipe anchors shall be submitted for approval before installation.

h) Flexible Connectors:

Flexible connectors shall be constructed of rubber, tetrafluoroethylene resin, or corrosion resisting steel, bronze, monel or galvanised steel. The material used and the configuration shall be suitable for pressure, vacuum, temperature and circulation medium. The flexible sections may have threaded, welding, soldering, flanged or socket ends and shall be suitable for service intended. The flexible section may be reinforced with metal retaining rings, with built in reinforcement and restriction bolts or with wire braid cover suitable for the service intended. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel within limits standard with the manufacturer. Unless otherwise shown on the drawings, the length of the flexible connector shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners shall be provided when recommended by the manufacturer suitable for the circulating medium. Covers to protect the bellows will be provided where necessary or directed. Flexible connectors shall be designed for 125Psi (8.5 bars) service, and 250°F (120°C).
Flexible pipe connectors shall be installed on piping connected to equipment where indicated on the drawings. Installation shall be in accordance with manufacturer's recommendations.

i) Flow Switches:

a) Flow switches shall be as per manufacturer's standard, comprising a water or air-immersed vane, deflection of which activates an adjustable electrical switch.

b) Vane and spindle assembly shall be fabricated from stainless steel, the joint between vane and spindle being argon arc welded.

c) The instrument head shall comprise a switch unit and terminal block enclosed in a cast aluminium alloy housing with bolted cover and neoprene gasket.

d) The mounting unit shall be of brass, and be screwed 25mm for insertion in the pipe work.

e) Flow switches shall be suitable for the working pressures and temperatures encountered.

j) Installation:

a) *General:* Pipes shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Layout drawings required under the title of "Approvalof Material & Equipment" shall show locations of all supports, the load imposed on each fastening or anchor, typical details for special anchorage, for suspended piping, valves, tank, pumps, converters, and other mechanical equipment. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided and detailed. Pipe shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints and hangers. Changes in direction shall be made with fittings, except that bending of pipe 100mm and smaller will be permitted provided a pipe bender is used and wide-sweep bends are formed. The centre line radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening or other malformations will not be accepted. All piping shall be installed with sufficient pitch to ensure adequate drainage and venting. Piping connections to equipment shall be provided with unions or flanges. Open ends of pipelines or equipment shall be properly capped or plugged during installation to keep dirt and other foreign matters out of the system.

b) *Screwed joints:* shall be made with tapered threads properly cut. Joints shall be made tight with a stiff mixture of lethargy and glycerine, or polytetrafluoroethylene (PTFE) tape, or approved thread joint compound applied to the male thread only. Not more than three threads shall show after the joint is made up. For steam piping do not use PTFE tape.

c) *Welded joints:* shall be fusion welded by metal arc welding method unless otherwise required. Changes in direction of piping shall be made with welding fittings only. Mitering or notching pipe to form elbows & tees or other similar construction will not be permitted. Branch connections shall be made with welding tees or forged welding tees or forged welding outlets.

Field and shop bevels shall be in accordance with the recognised standards and shall be done mechanically by means of flame cutting. Where bevelling is done by flame cutting, surfaces shall be clean of scale and oxidation prior to welding.

Before welding, the component parts to be welded shall be aligned so that no strain is placed on the weld when finally positioned. Height shall be so aligned that no part of the pipe wall is offset by more than 20% of the wall thickness. Flanges and branches shall be set true. This alignment shall be preserved during the welding operation.

Removing and replacing defective welds shall be at no additional cost to the Procuring agency. Repairing of defective welds by adding new material over the defects or by peeling will not be permitted. Electrodes shall be stored in a dry heated area and shall be kept free of moisture or dampness during fabrication operations. Electrodes that have lost part of their coating shall be discarded.

d) *Flanges and Unions:* shall be faced true. Flanges shall be provided with 1.6mm gasket of material suitable for specified usage, but shall not use asbestos, and made square and tight. Except where copper tubing is used, union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment such as coils, pumps, control valves & other similar items.

k) Pipe Supports:

Refer Section 23 05 29, SUPPORTS & ANCHORS.

l) Pressure Testing:

Water and steam piping shall be hydrostatically tested at a pressure equal to 150% of the maximum operating pressure, but not less than 150psi (10 bars), for a period of time sufficient to inspect every joint in the system but in no case less than two hours. No loss of pressure will be allowed. Leaks found during tests shall be repaired by rewelding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed piping shall be tested in place before concealing. Tests shall be conducted in the presence of the Consultant or the Consultant's representative who shall be given 10 days notice before any test is to be conducted. All material, equipment or instruments required for tests shall be provided by the Bidder.

m) Reference Specification:

The following specifications shall be construed to be part of these specifications.

- 23 05 01 - Basic Mechanical Requirement
- 23 05 02 - Basic Mechanical Materials and Methods
- 23 05 10 - Equipment Installation
- 23 05 11 - Pipe Welding
- 23 05 23 - Valves & Strainers
- 23 05 29 - Supports & Anchors
- 23 05 48 - Vibration Isolation & Control
- 23 05 50 - Painting & Coating
- 23 05 53 - Mechanical Identification

END OF SECTION 23 21 13

REFRIGERANT PIPING & ACCESSORIES

a) General:

Refrigerant copper pipes shall be of the type and size as specified by the manufacturer of the air-conditioning units. Refrigerant piping shall be copper tubing, hard drawn type 'K' and shall conform to ASTM specifications B-88 and cleaned in accordance with ASTM B-280 refrigeration industry standard. Fittings shall be forged or wrought copper with sweat or soldered joints. Cast fittings shall not be acceptable.
Refrigerant piping shall include all piping and piping specialities between the condensing units and evaporator-compressor units. All piping specialities such as shut off valves, filter driers, sight-glass, moisture indicator, gauge ports, strainers, expansion valves, etc., as required for proper operation of the system, whether indicated or not shall be provided. Double suction riser shall be provided according to the mounting location of the condensing units and evaporator units, and as recommended by the manufacturer.

b) Stop Valves:

Shall be installed wherever necessary for proper operation of the system, whether indicated or not. Stop valves used shall be those manufactured expressly for refrigeration service. They should be easy to operate

and free of leaks. Valves using packing around the stem shall be provided with "Back Seating" construction, which will allow the valve disc to close against a secured seat to prevent the leakage of refrigerant through the valve stem packing or also out of the back seat port, when the valve is complete open. As an added preventive, cap seals shall be provided.

c) Charging Valves:

Shall be installed on liquid line. Valves shall be provided with flare seal caps.

d) Driers:

Shall be installed with three valve by passing arrangement to allow removal of drier, recharging and installation, without interrupting the operation. The drier shall be packed with a dehydrating agent retained in the body of the drier. Driers shall also act as filters and neutralisers.

e) Sight Glass:

Shall be installed ahead of the expansion valve. Sight glass shall have two lenses, one at top and the other at the bottom to permit use of light behind the glass. Sight glass shall be those manufactured expressly for refrigerant service. They should be provided with cap seals.

f) Installation of Copper Piping:

a) *Cleaning:* All copper tubing shall be properly cleaned prior to use. The following cleaning procedure shall be adopted.

i) A clean lint less cloth shall be drawn through the tubing by means of a wire to remove all coarse particles of dirt and dust.

ii) A clean lint less cloth saturated with trichloroethylene shall be pulled through pipe and the procedure repeated till no further discoloration of the cloth is observed.

iii) A clean cloth saturated with compressor oil squeezed dry shall be drawn through pipe. Finally a clean cloth shall be drawn through pipes.

b) *General Instructions*

i) Pipe shall be cut accurately to measurements established at the job site and worked into place without springing or forcing, properly clearing all windows, doors, and other openings. Excessive cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Shop drawings shall show locations of all supports, and typical details for anchorage. Changes in direction shall be made with fittings, except that bending of pipe 4 inches (100mm) and smaller will be permitted, provided a pipe bender is used and wide-sweep bends are formed. The centre line radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkless, flattening or other malformations shall not be accepted. All piping shall be installed with sufficient pitch as indicated on drawings. Open ends of pipeline or equipment shall be properly capped or plugged during installation to keep dirt and other foreign material out of the system.

ii) Tubing shall be cut so ends are perfectly square and will "bottom" in the fitting. There shall be no gaps left through which solder can run into the line. If possible, a pipe cutter shall be used. If a hacksaw must be used, it shall always be guided with a mitre-box to ensure a square, even cut. Tubing shall be reamed to remove burr being careful not to expand tubing while reaming.

iii) The outside of the copper pipe and the inside of the fitting, where solder will be applied, shall be burnished. Fine crocus cloth or tight fitting brushes especially made for this type of work shall be used. Surfaces shall be burnished until all dirt and oxide is removed. Cleaned surface shall not be touched with hands or gloves.

iv) A light coat of brazing flux shall be applied to both pipe and fittings. An acid flux such as muriatic (hydrochloric acid) shall never be used as the resulting corrosion can seriously affect the pipe and composition for brazing.

v) Joint shall be heated to proper brazing temperature being sure that it is uniformly hot so brazing material will flow to all parts of the joint. The brazing material shall be fed to the joint until a uniform line of brazing material appears around the pipe at the end of the fitting.

vi) 95-5 solders which is an alloy of 95% tin and 5% antimony shall be used.

vii) When solenoid stop valves are being installed, the coil shall be removed to prevent the heat of soldering from ruining the insulation. When sight glasses are being installed, the glass shall be removed to prevent cracking. No heat shall be applied near the bulb of the expansion valve or any other place where an excessive temperature may cause damage.

viii) Pipe insulation shall not be installed nor the piping anchored until testing is completed and all leaks have been properly eliminated.

c) *Pipe Supports:*

i) *General:* Pipe hangers, brackets, saddles, inserts, clamps, and pipe rolls including rods, bolts, shall conform to standard recommended practice. Design generally accepted as exemplifying good engineering practice, using stock or production parts shall be utilised wherever possible. Chain, wire, strap or other make shift devices will not be permitted as hangers or supports.

ii) Hangers shall be supported from clamps, concrete inserts, Philips concrete fasteners, or Rawl bolts. Concrete inserts when used, shall be installed in the exact location prior to the pouring of concrete.

iii) *Suspended Horizontal Piping:* shall be supported by adjustable hangers or supports, which shall provide means of vertical adjustment after erection. Unless otherwise indicated on drawings maximum spacing between copper pipe supports for straight runs of pipe and tubing shall be in accordance with recommended spacing shown in the table below:

Maximum Spacing between Copper Tubing Supports

NOM. TUBING SIZE - INCH	½"	5/8	7/8	1 1/8	1 3/8	1 5/8	2 1/8	2 5/8	3 1/8	3 5/8
MAXIMUM SPAN-FEET	5	6	6	7	8	9	10	10	11	12

Pipe hangers and supports shall be spaced not over 5 feet apart at heavy fittings and valves. A hanger shall be installed not over 1 foot from each change in direction of piping.

Vertical piping shall be guided or supported in the centre of each riser but not over 8 feet of centres and shall be supported at the base of the riser, on a base elbow or tee, with pipe stand only where required. For un-insulated brass or copper tubing, the riser clamp shall be compatible non ferrous or electrolytically coated steel as for hangers.

END OF SECTION 23 23 15

DUCT WORKS & ACCESSORIES

a) Sheet Metal:

Sheet metal duct work shall be constructed of galvanised sheet steel conforming to ASTM A653, lock-forming quality, uncoiled, regular spangle and having a minimum coating of 275 g/m^2.

b) Duct Construction and Installation Standards:

a) All duct construction and installation shall be carried out in accordance with current SMACNA HVAC Duct Construction Standards and SMACNA Accepted Industry Practice for Industrial Duct Construction, unless otherwise indicated herein.

b) Each duct system shall be constructed for the specific duct pressure requirements of the project as per the external static pressure.

- 1" WG pressure class shall be the minimum basis of compliance with the standards, regardless of the velocity in the duct, except when the system is variable volume. Measurement of duct velocity to be entirely the responsibility of the Bidder.
- All variable volume duct up-stream of VAV boxes shall have a 2" minimum basis of compliance. Measurement of duct velocity to be entirely the responsibility of the Bidder.
- 2" WG pressure class shall be the minimum basis of compliance for all ducts having velocity greater than 2000fpm and less than or equal to 2500fpm. Measurement of duct velocity to be entirely the responsibility of the Bidder.
- 3" WG pressure class shall be the minimum basis of compliance for all ducts having velocity greater than 2500fpm and less than or equal to 4000fpm. Measurement of duct velocity to be entirely the responsibility of the Bidder.

c) Minimum sheet thickness to be used shall be as follows, unless static pressure requirements dictate higher thickness as per SMACNA standards see TABLE-3 & 4 on pages 23 31 13-7 & 23 31 13-8 respectively.

Table-1A: (Applicable for Duct Velocities ≤ 2000fpm)

Largest Dimension of Ducting Inches (mm)	U.S.S. Gauge	Minimum Nominal Thickness Inches (mm)
Upto 27" (675mm)	24	0.028 (0.70)
28" – 51" (700mm-1275mm)	22	0.034 (0.86)
52" – 81" (1300mm-2000mm)	20	0.04 (1.02)
Above 81" (2025mm)	18	0.052 (1.32)

In the event U.S.S gauge sheets are not available, the minimum nominal thickness indicated shall be followed.

Table–1B: (Applicable for Duct Velocities > 2000fpm & ≤ 4000fpm)

Largest Dimension of Ducting Inches (mm)	U.S.S. Gauge	Minimum Nominal Thickness Inches (mm)
Upto 12" (300mm)	22	0.034 (0.86)
13" – 40" (325mm-1000mm)	22	0.034 (0.86)
41" – 60" (1025mm-1500mm)	20	0.04 (1.02)
61" – 90" (1525mm-2250mm)	18	0.052 (1.32)

d) Ducts shall be sealed in accordance with TABLE-2 below:

Table-2: Duct Sealing Requirements

Seal Class	Sealing Required	Static Pressure Construction Class
A	All transverse joints, longitudinal seams and duct wall penetrations	4" w.g. and up
B	All transverse joints and longitudinal seams	3" w.g
C	Transverse joints	2" w.g
	In addition to the above any variable air volume system duct of 1" and ½" w.g construction class that is upstream of the VAV boxes shall also meet Seal Class C.	

e) Unless otherwise specified or allowed rectangular ductwork shall be constructed in accordance with TABLE-3 to 6 herein.

f) Unless otherwise specified, reinforcement shall be galvanised steel.

g) Duct sides that are 19" and over and are 20 gauge or less with more than 10 sq.ft. of unbraced panel area shall be beaded.

h) Fittings shall be reinforced similarly to sections of straight duct. On size change fittings the greater fitting dimension determines the duct gauge.

i) For ducts 97 inches & above, tie rods shall be provided to provide internal support to ducts. The tie-rod shall be located at equal sub-divisions of width, but spacing shall not exceed 60 inches.

j) Tie rod shall be galvanised steel of ⅜" inch (10mm) minimum diameter.

k) Transverse joints shall be selected and used consistent with the static pressure class, applicable sealing requirements, materials involved, duct support intervals and other provisions for proper assembly of duct work outlined in the SMACNA Standards.

l) Where bar or angle stock is incorporated in a joint it shall be secured with a fastener. Fastener shall be steel if used on a steel duct & shall be zinc or cadmium coated.

m) Longitudinal Seams shall be suitably selected for the material, pressure classification and other construction details applicable for the service as recommended in the SMACNA Standards.

n) Installation Standards for rectangular ducts using flexible liner.

o) Unless otherwise indicated, the net free area of the duct dimension given in the contract drawings shall be maintained. The duct dimensions shall be increased as necessary to compensate for liner thickness.

p) Unless otherwise approved ducts shall conform accurately to the dimensions indicated and shall be straight and smooth on the inside, with joints neatly finished. Ducts shall be secured to the structural slab in the building, and the method of anchoring and/or fastening shall be as detailed on the drawings. Ducts shall be constructed and installed so as to be completely free from all vibrations under all conditions of operation. Layout drawings required under the clause APPROVAL OF MATERIALS AND EQUIPMENT shall show, for suspended duct work, the location of all supports, typical details for anchorages, and details for special anchorages.

q) Curved elbows shall have a centreline radius not less than 1.5 times the width or diameter of the duct.

r) Transformations shall be made with sides pitched not to exceed a maximum of 20° or 40° included angle, for diverging air flow and 30°, or 60° included angle, for converging air flow, or as indicated on the drawings.

s) Splitter dampers, quadrant volume dampers, air deflectors, fire doors and fire dampers, duct access doors and duct test holes shall be installed where shown on the drawings and where required for the proper operation of the system even though not shown on the drawings.

t) Other details for duct construction, casing construction, access doors, hangers and supports, duct joints, volume damper, penetration of casing, casing curb detail, hood construction etc., shall be as indicated on the drawings or as per SMACNA Duct Construction Standards, or as directed by the Consultant. All connections of ducting to air handling units, dampers, plenums, etc., shall be through removable flanges. Installation of items not shown in detail or not covered by detailed specifications shall be as set forth in the SMACNA Construction Standards.

u) Ducts passing through walls shall be provided with 20 gauge GI Sheet sleeve covering the full width of wall, and fabricated with necessary edges and stiffness.

v) All joints shall be sealed with an approval duct sealant such as Silicon Sealant or approved equivalent. Putty shall not be used.

c) Round Duct Construction Standards:

a) Round ducts shall be constructed in accordance with TABLE-5.

b) Fittings shall be wall thickness not less than that specified for longitudinal seams straight ducts.

c) For round ducts with static pressure between 4 to 7 inches, maximum reinforcing shall be at 96 inches distance.

d) Where other limitations are not provided, mitred elbows shall be based on velocity of flow and shall be constructed to apply with following TABLE-6.

Table-5: *Round Duct Gauge Selection Galvanised Steel*

Duct Diameter in Inches	Maximum 2" w.g Static Positive		Maximum 10" w.g Static Positive		Maximum 2" w.g Static Negative	
	Spiral Seam Gauge	Longitudinal Seam Gauge	Spiral Seam Gauge	Longitudinal Seam Gauge	Spiral Seam Gauge	Longitudinal Seam Gauge
3 through 8	28	28	26	24	28	24
9 through 14	28	26	26	24	26	24
15 through 26	26	24	24	22	24	22
27 through 36	24	22	22	20	22	20
37 through 50	22	20	20	20	20	18
51 through 60	20	18	18	18	18	16
61 through 84	18	16	18	16	16	14

Table-6: Mitred Elbows

Duct Velocity	R/D Ratio Centreline Radius to Duct Diameter	Number of Mitred Pieces		
		90°	60°	45°
Upto 1000 fpm	0.6	3	2	2
1001 to 1500 fpm	1.0	4	3	2

Above 1500 fpm	1.5	5	4	3

d) Hanging & Supporting System:

Rigid round, rectangular metal ducts shall be installed with support systems indicated in TABLE-7&8 given below, and additionally as required to maintain alignment. Horizontal ducts shall have a support within 2 feet of each elbow and within 4ft of each branch intersection.

Table-7: Rectangular Duct Hangers Minimum Size

Maximum Half of Duct Perimeter (Inches)	Rod Dia Pair (Inches)	Maximum Spacing (Ft.)
30	3/8"	10'
72	3/8"	8'
96	3/8"	8'
120	3/8"	8'
168	3/8"	5'
192	3/8"	4'
193 & UP	Special Analysis Required as Approved by Engineer.	

Table-8: Minimum Hanger Sizes for Round Duct

Dia	Maximum Spacing	Rod
10" dn.	12'	¼"
11-18"	10'	3/8"
19-24"	10'	3/8"
25-36"	10'	3/8"
37-50"	10'	Two 3/8"
51-60"	10'	Two 3/8"
61-84"	08'	Two 3/8"

e) Duct Leakage Test:

Ducts, Plenums and casings shall be tested and made substantially air tight at static pressure indicated for the system before covering with insulation or concealing in the masonry. The term substantially air tight shall be construed to mean that no air leakage is noticeable through the senses of feeling or hearing.
For Low Pressure System, up to 2" w.g. (500 Pa), all joints shall be sealed with sealant and physically inspected for light penetration from outside to inside. For system operating pressure above 2 inches of Wg. (500 Pa), smoke test will be performed by connecting a fan to the duct system to build up the operating pressure, and checking for leakage at all joints, which shall then be sealed with silicone sealant and the system retested.
All ducting and related airside equipment and accessories for low grain application (40 grains-14 grains) must be fully sealed with silicone sealant only and made fully air-tight.

f) Galvanising:

All hangers, angle iron bracing & other iron work shall be hot dip galvanised. Cut surfaces shall be painted with two coats of primer paint.

g) Ductwork Accessories:

a) ***General:*** Following ductwork accessories shall be installed where specified and shown on drawings. All accessories shall be constructed of galvanised iron sheet metal conforming to specifications given.

b) ***Splitter Damper:*** Shall be fabricated of sheet metal, two gauges heavier than the duct gauge in which the damper is installed. Damper shall be fabricated of wood of an aerofoil shape, over which sheet metal shall be formed to completely cover the wood. Damper shall be operated by a 10mm dia rod brought through the side of the duct with brass locking set-screw and bushing. Two operators shall be required on splitters over 8"(200mm) wide. For insulated ducts, bushing shall be of thickness equal to the thickness of the duct insulation. Locking set screw shall be Ø ¼" (6mm), arranged for easy locking of the damper operator at the desired position. Damper shall be installed with full length hinge. Rubber gaskets shall be installed to minimise air leakage. Damper operator shall be galvanised and shall be designed for convenience of operation.

c) ***Quadrant Volume Damper:*** shall be multi-leaf opposed blade type, with a maximum blade width of 8" (200mm) operated by a train of gears installed within the damper casing with the gears protected against direst impingement of the air stream. Dampers shall be constructed of galvanised sheet metal, machine formed of aerofoil design to provide tight shut-off & low leakage. Leakage data at various pressure differentials shall be submitted. They shall be operated by quadrant operators manufactured of brass. Bushing shall be of brass, nylon or hard acetal. Operators shall be provided with stand-off mountings on thermally insulated ducts to provide clearance between the ducts surface and operator, equal to the thickness of the insulation. Quadrant operator shall be heavy duty, capable of being locked at desired position conveniently. The casing width shall

be larger than the full open width length of the blades. Damper shall be provided with flanges for duct connection.

Dampers for smoke control application shall be heavy ducting with material selected to with stand fire exposure as per NFPA recommendations.

d) ***Air Deflectors:*** shall be provided in all square elbows, duct mounted supply outlets, take-off or extension collars to supply outlets and tap-in-branch take-off connections. Air deflectors will be factory-fabricated units consisting of curved turning vanes or louver blades for uniform air distribution and change of direction with minimum turbulence and pressure loss. Square elbows shall be provided with curved vanes.

e) ***Duct Access Doors:*** Hinged access doors shall be provided at all volume control dampers, splitter dampers, automatic dampers, fire dampers, coils, thermostats, plenums, filters and other apparatus requiring services and inspection in the duct system. Doors shall be 15" to 18" (380 to 450mm) wide unless otherwise required. Where size of duct will not accommodate this size, the doors shall be made as large as practical. Doors shall be rigid and provided with airtight rubber gaskets. Doors shall be provided with galvanised hinges with bronze pins and two approved brass fasteners. Doors 24 by 24 inches 600mm by 600mm or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be of the insulated type, with the insulation fully enclosed between sheet metal unless otherwise indicated, doors shall so swing that fan pressure or suction holds the door closed.

f) ***Duct Test Holes:*** At suitable points throughout the duct work system including mains and all branches, where the air flow is stable, duct test holes shall be in-stalled suitable for pitot tube insertion. On each duct test hole shall be installed a "Duct Test Hole Attachment" consisting of a die-formed attachment & provided with a rubber sealing cap with hand screw tightening arrangement.

g) ***Fire Dampers:*** shall be provided where shown on drawings & shall be similar to model FK as manufactured by TROX. Fire doors and fire dampers shall be automatic operating type approved for the protection of openings in one, two and four hour fire-rated walls and partitions and shall be installed in accordance with the Consultant's directives. Suitable hand-hole openings with tightly fitted access covers or doors shall be provided in the fire dampers to make all fire doors and fire dampers accessible for inspection and maintenance. Unless otherwise shown, the installation details given in SMACNA Fire Damper Guide for fire dampers shall be followed except minimum thickness of metal for all sleeves provided for the fire dampers shall be not lighter than 14 gauge (1.90mm). All necessary items associated with the fire doors and fire dampers such as retaining angles, sleeves, breakaway connections and access doors shall be provided. The fire dampers shall have a mechanism to show the open-closed status of the fire dampers by means of an indicating lever visible below the false ceiling.

Materials shall be as follows:

- Casing.....steel, minimum 12 gages
- Blade.....Steel, minimum 12 gages
- Fusible Link.....to operate at 72°C
- Bushes.....Stainless Steel

h) Reference Specification:

The following specifications shall be construed to be part of these specifications.

- 23 05 01 - Basic Mechanical Requirement
- 23 05 02 - Basic Mechanical Materials and Methods
- 23 05 10 - Equipment Installation
- 23 05 29 - Supports & Anchors
- 23 05 48 - Vibration Isolation Control
- 23 05 50 - Painting & Coating
- 23 05 53 - Mechanical Identification

TABLE 3 – RECTANGULAR DUCT THICKNESS & REINFORCEMENT

STATIC PRESSURE	1" WG	2" WG	3" WG	4" WG	6" WG
GREATER DUCT DIMENSION IN INCHES	MINIMUM RIGIDITY CLASS, THICKNESS & REINFORCEMENT	MINIMUM RIGIDITY CLASS, THICKNESS & REINFORCEMENT	MINIMUM RIGIDITY CLASS, THICKNESS & REINFORCEMENT	MINIMUM RIGIDITY CLASS, THICKNESS & REINFORCEMENT	MINIMUM RIGIDITY CLASS, THICKNESS & REINFORCEMENT
24 US SHEET METAL GAUGE					
10 & BELOW	NO REINFORCEMENT	NO REINFORCEMENT	NO REINFORCEMENT	NO REINFORCEMENT	A 3/4"x1/8" @ 5' C/C MAX
11, 12	↓	A 3/4"x1/8" @ 8' C/C MAX	A 3/4"x1/8" @ 5' C/C MAX	A 3/4"x1/8" @ 5' C/C MAX	↓
13, 14	A 3/4"x1/8" @ 10' C/C MAX				A 3/4"x1/8" @ 10' C/C MAX
15, 16					↓
17, 18		↓		↓	B 3/4"x1/8" @ 4' C/C MAX
19, 20	↓	B 3/4"x1/8" @ 6' C/C MAX	↓	B 3/4"x1/8" @ 4' C/C MAX	↓
21, 22	A 3/4"x1/8" @ 8' C/C MAX		B 3/4"x1/8" @ 5' C/C MAX	↓	C 3/4"x1/8" @ 4' C/C MAX
23, 24	↓	↓	↓	C 3/4"x1/8" @ 4' C/C MAX	C 3/4"x1/8" @ 3' C/C MAX
25, 26	↓	↓	C 3/4"x1/8" @ 5' C/C MAX	↓	↓
22 US SHEET METAL GAUGE					
27, 28	C 3/4"x1/8" @ 10' C/C MAX	C 3/4"x1/8" @ 6' C/C MAX	C 3/4"x1/8" @ 5' C/C MAX	D 1"x1/8" @ 5' C/C MAX	D 1"x1/8" @ 4' C/C MAX
29, 30	↓	↓	↓	↓	↓
31-36	D 1"x1/8" @ 8' C/C MAX	D 1"x1/8" @ 5' C/C MAX	D 1"x1/8" @ 4' C/C MAX	E 1 1/2"x1/8" @ 4' C/C MAX	E 1 1/2"x1/8" @ 3' C/C MAX
37-42	D 1"x1/8" @ 6' C/C MAX	↓	↓	E 1 1/2"x1/8" @ 3' C/C MAX	E 1 1/2"x1/8" @ 2 1/2'C/C MAX
43-48	D 1 1/2"x1/8" @ 6' C/C MAX	D 1"x1/8" @ 4' C/C MAX	D 1"x1/8" @ 3' C/C MAX	↓	G 1 1/2"x3/16" @ 2 1/2'C/C MAX
20 US SHEET METAL GAUGE					
49-54	E 1 1/2"x1/8" @ 6' C/C MAX	E 1 1/2"x1/8" @ 4' C/C MAX	G 1 1/2"x3/16" @ 3' C/C MAX	G 1 1/2"x3/16" @ 3' C/C MAX	H 2"x1/8" @ 2 1/2'C/C MAX
55-60	G 1 1/2"x3/16" @ 5' C/C MAX	G 1 1/2"x3/16" @ 4' C/C MAX	↓	H 2"x1/8" @ 3' C/C MAX	↓
61-72	↓	H 2"x1/8" @ 3' C/C MAX	H 2"x1/8" @ 3' C/C MAX	I 2"x3/16" @ 2 1/2' C/C MAX	I 2"x3/16" @ 2' C/C MAX
18 US SHEET METAL GAUGE					
73-84	I 2"x3/16" @ 5' C/C MAX	E 1 1/2"x1/8" @ 4' C/C MAX	J 2 1/2"x1/8" @ 3' C/C MAX	J 2 1/2"x1/8" @ 2 1/2'C/C MAX	K 2 1/2"x3/16" @ 2'C/C MAX
85-96	I 2"x3/16" @ 4' C/C MAX	G 1 1/2"x3/16" @ 3' C/C MAX	K 1 1/2"x3/16" @ 2 1/2'C/C MAX	K 2 1/2"x3/16" @ 3' C/C MAX	L 2 1/2"x1/4" @ 2' C/C MAX
96-UP	H 2"x1/8" @ 2 1/2'C/C MAX	H 2"x1/8" @ 2 1/2'C/C MAX	H 2"x1/8" @ 2' C/C MAX	L 2 1/2"x1/4" @ 2' C/C MAX	H 2"x1/8" @ 2' C/C MAX

NOTES:

1. ALL REINFORCEMENT IS OF EQUAL ANGLE IRON OF SPECIFIED SIZE.
2. TRANSVERSE JOINTS GIVEN IN TABLE-3 ARE TO BE SELECT ON THE

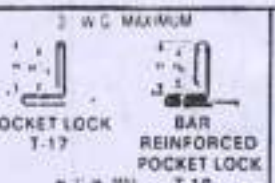
TABLE 4 - TRANSVERSE JOINT RENFORCEMENT

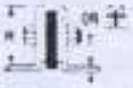
MINIMUM RIGIDITY CLASS		T-2 STANDING DRIVE SLIP		T-10 STANDING S		T-11 STANDING S		T-12 STANDING S		T-13 T-14	
	EI	H x T	WT LF	H x T	WT LF	H x T	WT LF	H x T	WT LF	H x T + HR	WT LF
A	0.5	↑		↑		1/2 x 26 ga.	.5	↑		↑	
B	1.0	1 1/8 x 26 ga.	.5	↑		1/2 x 22 ga.	.7	↑		↑	
C	2.5	1 1/18 x 22 ga.	.8	1 x 26 ga.	.6	1 x 26 ga.	.6	↑		↑	
D	5	NOT GIVEN		1 x 24 ga.	.7	1 x 24 ga.	.7	1 1/8 x 26 ga.	.7	↑	
E	10	↑		1 1/8 x 20 ga. w = 3/16"	.9	NOT GIVEN		1 1/8 x 18 ga.	1.4	↑	
F	15	↑		1 5/8 x 22 ga. w = 3/16"	1.0	↑		1 1/2 x 24 ga.	1.0	1 1/2 x 24 ga. 1 1/2 x 1/8 Bar	1.5
G	25	↑		1 5/8 x 18 ga. w = 3/16"	1.5	↑		1 1/2 x 18 ga.	1.7	1 1/2 x 22 ga. 1½ x 1/8 Bar	1.6
H	50	↑		NOT GIVEN		↑		NOT GIVEN		1 1/2 x 20 ga. 1½ x 1½ x 3/16	2.9
I	75	↑		↑		↑		↑		2 x 20 ga. 2 x 2 x 1/8 ga.	2.9
J	100	↑		↑		↑		↑		2 x 20 ga. 2 x 2 x 3/16	3.7
K	150	↑		↑		↑		↑		NOT GIVEN	
L	200	↓		↓		↓		↓		↓	

See page 1-15. Nominal EI equals number listed times 10^5.

Joints T-2 and T-10 through T-14 are restricted to 30" length at 4" w.g., to 36" length at 3" w.g. and are not recommended for service above 4" w.g.

TABLE 5 - TRANSVERSE JOINT REINFORCEMENT





MINIMUM RIGIDITY CLASS		T-17 POCKET LOCK / T-18 BAR REINFORCED POCKET LOCK / T-19 ANGLE REINFORCED POCKET LOCK			T-20 CAPPED FLANGE			T-22 COMPANION ANGLES		T-23 FLANGED		T-24 FLANGED	
	EI	H	LOCK T, DUCT T, HR	WT/LF	H x T	U	WT/LF	H x T	WT/LF	H x T	WT/LF	H x T	WT/LF
A	0.5		↑					↑		↑		↑	
B	1.0				3/4 x 26 ga.	24 ga.	.4						
C	2.5	T-17 1"	26 ga. Lock on 26 ga.	.6	1 x 24 ga.	24 ga.	.5			1 x 24 ga.	1.0		
D	5	T-17 1"	24 ga. Lock on 24 ga.	.7	1 x 22 ga.	22 ga.	.6			1 x 22 ga.	1.0	1 x 24 ga.	
E	10	T-18 1"	22 ga. Lock 1 x 1/8 Bar	1.4	1 1/2 x 24 ga.	22 ga.	.8	TWO 1 x 1/8	1.7	1 x 16 ga. 1 1/2 x 24 ga.	1.0	1 3/8 x 24 ga.	
F	15	T-17 1½"	22 ga. Lock	1.0	1 1/2 x 20 ga.	20 ga.	1.0	↑		1 1/2 x 22 ga. 1 1/2 x 20 ga.	1.0 1.0	1 3/8 x 20 ga.	
G	25	T-18 1½"	22 ga. Lock 1 1/2 x 1/8 Bar	1.6	↑	↑		TWO 1 1/4 x 1/8	2.1	1 1/2 x 18 ga.	1.5	↑ 1 3/8 x 18 ga. WITH TWIN TIE RODS **	
H	50	T-19 1½"	20 ga. Lock 1 1/2 x 3/16 Angle	2.9	2 x 16 ga.	20 ga.	1.5	TWO 1 1/2 x 1/8	2.6	2 x 18 ga.	1.5		
I	75	T-19 1½"	20 ga. Lock 2 x 1/8 Angle	2.8	2 x 16 ga. **			TWO* 1 1/2 x 3/16	3.7	2 x 16 ga.	2.0		
J	100	T-19 1½"	20 ga. Lock 2 x 3/16 Angle	3.5	↓			TWO* 1 1/2 x 1/4	4.7	2" x 18 ga. WITH TIE RODS		↓	
K	150	T-19 1½"	20 ga. Lock 2 1/2 x 3/16 Angle	4.2				TWO* 2 x 3/16	4.9	↓			
L	200		NOT GIVEN		↓			TWO* 2 x 1/4	6.5	↓			

a page 1-15 Nominal EI equals number listed times 10^5

Tie rod option also: Use Class H plus one tie rod. **A tie must be used on each mating flange within 1" of joint center.

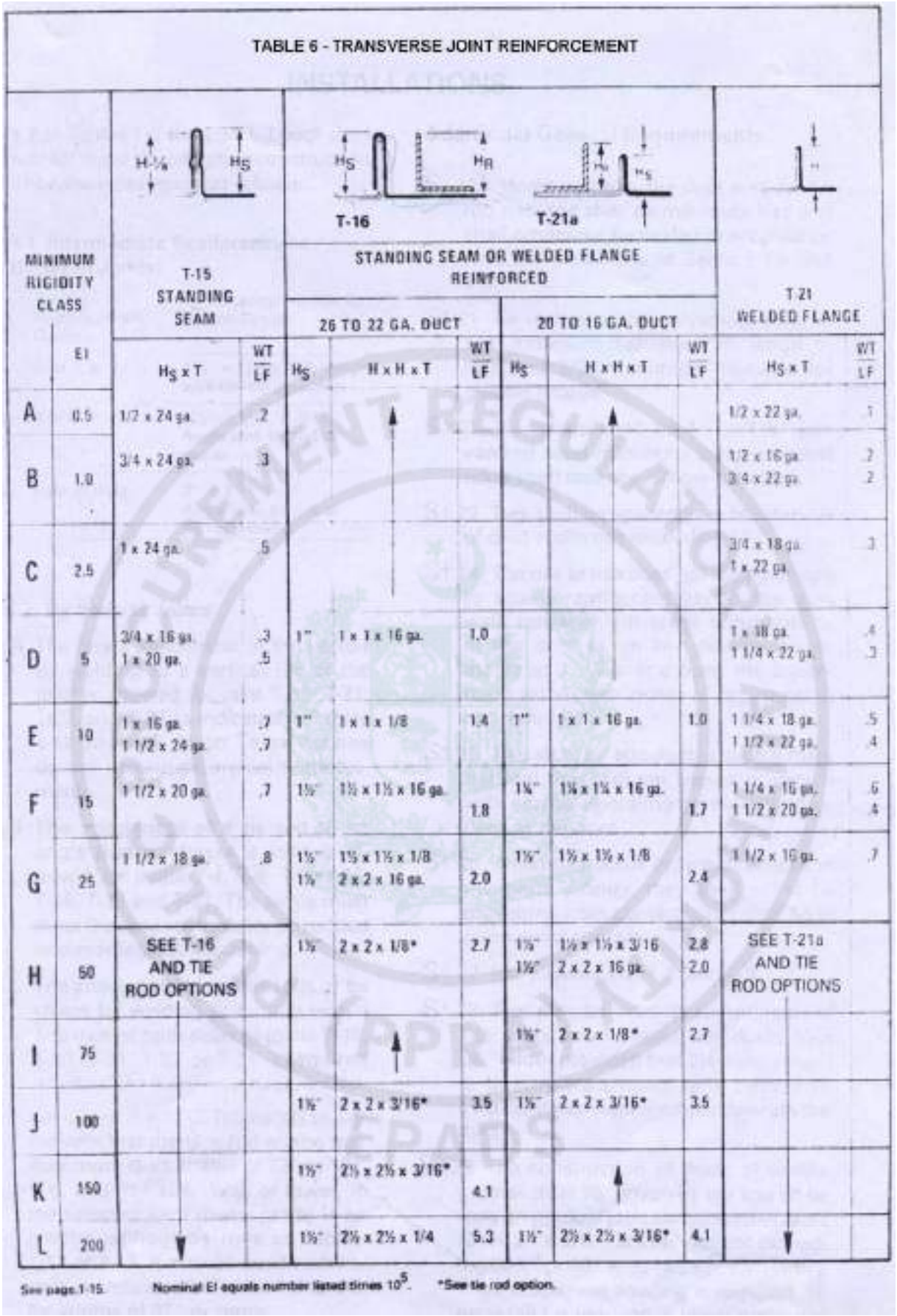


TABLE 6 - TRANSVERSE JOINT REINFORCEMENT

MINIMUM RIGIDITY CLASS		T-15 STANDING SEAM		STANDING SEAM OR WELDED FLANGE REINFORCED						T-21 WELDED FLANGE	
				26 TO 22 GA. DUCT			20 TO 16 GA. DUCT				
	EI	$H_S \times T$	WT/LF	H_S	H x H x T	WT/LF	H_S	H x H x T	WT/LF	$H_S \times T$	WT/LF
A	0.5	1/2 x 24 ga.	.2							1/2 x 22 ga.	.1
B	1.0	3/4 x 24 ga.	.3							1/2 x 16 ga. 3/4 x 22 ga.	.2 .2
C	2.5	1 x 24 ga.	.5							3/4 x 18 ga. 1 x 22 ga.	.3
D	5	3/4 x 16 ga. 1 x 20 ga.	.3 .5	1"	1 x 1 x 16 ga.	1.0				1 x 18 ga. 1 1/4 x 22 ga.	.4 .3
E	10	1 x 16 ga. 1 1/2 x 24 ga.	.7 .7	1"	1 x 1 x 1/8	1.4	1"	1 x 1 x 16 ga.	1.0	1 1/4 x 18 ga. 1 1/2 x 22 ga.	.5 .4
F	15	1 1/2 x 20 ga.	.7	1½"	1½ x 1½ x 16 ga.	1.8	1¼"	1¼ x 1¼ x 16 ga.	1.7	1 1/4 x 16 ga. 1 1/2 x 20 ga.	.6 .4
G	25	1 1/2 x 18 ga.	.8	1½" 1½"	1½ x 1½ x 1/8 2 x 2 x 16 ga.	2.0	1½"	1½ x 1½ x 1/8	2.4	1 1/2 x 16 ga.	.7
H	50	SEE T-16 AND TIE ROD OPTIONS		1½	2 x 2 x 1/8*	2.7	1½" 1½"	1½ x 1½ x 3/16 2 x 2 x 16 ga.	2.8 2.0	SEE T-21a AND TIE ROD OPTIONS	
I	75						1½"	2 x 2 x 1/8*	2.7		
J	100			1½"	2 x 2 x 3/16*	3.5	1½"	2 x 2 x 3/16*	3.5		
K	150			1½"	2½ x 2½ x 3/16*	4.1					
L	200			1½"	2½ x 2½ x 1/4	5.3	1½"	2½ x 2½ x 3/16*	4.1		

See page 1-15. Nominal EI equals number listed times 10^5. *See tie rod option.

END OF SECTION 23 31 13

CONTROL DAMPERS & ACTUATORS

a) General:

Dampers shall consist of: a 20 gauge galvanized steel channel frame with 5" depth; triple V type blades fabricated from 16 gauge galvanized steel; blades shall be completely symmetrical relative to their axle

pivot point, presenting identical resistance to airflow in either direction or pressure on either side of the damper ½" dia plated steel axles turning in synthetic (acetal) sleeve bearings; extruded vinyl blade seals for 180F maximum temperature; jamb seals shall be flexible aluminium; and external (out of the airstreams) blade-to-blade linkage. Damper manufacturer's printed application and performance data including pressure, velocity and temperature limitations shall be submitted for approval showing damper suitable for pressure to 6" w.g., velocities to 4000 fpm and accordance with AMCA Standard 500. Dampers larger than 48" width and/or 74" height will be factory fabricated of multiple equal sections, jack shafted together.

Damper shall be provided with flanges for duct connection or mounting on wall.

Actuator shall be heavy duty floating type actuator of torque as required for the specified size of damper shall be able to directly mount to damper shaft.

b) Reference Specification:

The following specifications shall be construed to be part of these specifications.

- 23 05 01 - Basic Mechanical Requirement
- 23 05 02 - Basic Mechanical Materials and Methods
- 23 05 10 - Equipment Installation
- 23 05 29 - Supports & Anchors
- 23 05 48 - Vibration Isolation Control
- 23 05 50 - Painting & Coating

END OF SECTION 23 33 13

SOUND ATTENUATION

PART-1: GENERAL

1.26 Section Scope:

A. This section describes the technical and workmanship requirements for the following sound attenuation material and equipment for air conditioning and ventilation equipment and systems:

2. Selection of HVAC Equipment
3. Accoustic Duct Lining
4. Circular and Rectangular Sound Attenuators
5. Packless Silencers
6. Air Transfer/Cross Talk Attenuators with Spigot Ends
7. Acoustic Louvers with Infill
8. Acoustic Enclosures
9. Flexible Duct Connectors-Acoustic Performance
10. Acoustic Insulation Flexible System

B. Furnish all labor, materials, plant, equipment and appliances and perform all necessary operations required to execute the work of this section.

1.27 Related Documents:

A. Drawings and General & Special Conditions of Contract apply to this Section.

B. The following specifications shall be construed to be part of these specifications.

1. 23 05 01 - Basic Mechanical Requirement
2. 23 05 02 - Basic Mechanical Materials and Methods
3. 23 05 10 - Equipment Installation
4. 23 05 29 - Supports & Anchors
5. 23 05 48 - Vibration Isolation Control

1.28 Reference Standards:

A. The minimum standards for products specified in this section shall be those standards referred to below or equivalent relevant standards.

1. BS EN ISO 7235:2009-Acoustics. Laboratory measurement procedures for ducted silencers and air-terminal units. Insertion loss, flow noise and total pressure loss.
2. BS EN ISO 354:2003-Acoustics. Measurement of sound absorption in a reverberation room.
3. BS EN ISO 10140: 2010-Acoustics. Laboratory measurement of sound insulation of building elements.
4. ASTM 477-99-Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencer.
5. NFPA 255-Standard Method of Test of Surface Burning Characteristics of Building Materials.
6. ASTM E84-13A (UL No. 723): Standard Test Method for Surface Burning Characteristics of Building Materials.
7. DW/144-2013: Specification for Sheet Metal Ductwork Low, medium and high pressure/velocity air systems.
8. BS EN ISO 9001- Quality Management System.

1.29 Submittals for Review:

A. Submit samples, specifications, compliance statement, engineering calculations, catalogue cut sheets, description of product and installation method in accordance with the Contract Documents. Submissions shall indicate all dimensions, details of construction, details of installation, relation and connections with adjoining work.

B. The Sound Power levels indicated in the EQUIPMENT DATA SHEET are estimated. The Bidder/Supplier shall re-verify the data by submitting calculations for each Sound Attenuator arrangement, using actual sound data of equipment selected, to verify that proposed Sound Attenuators and acoustic treatment will ensure space NC Ratings as specified at Para 2.2D are not exceeded. The bidder shall engage a specialist third party acoustic engineer/consultant to produce all calculations and engineering submissions.

C. Provide certified insertion loss data in accordance with BS EN ISO 7235:2009. Provide certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance.

D. Where equipment is manufactured in modules ensure performance ratings apply to complete unit.

1.30 Quality Assurance:

A. Equipment/material manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment with a minimum of five (5) years experience.

1.31 Qualifications:

A. Equipment shall meet or exceed the certification requirements specified.

1.32 Mock-Up:

A. Install mockup of acoustic duct liner in ducts, enclosures, etc. and obtain Consultants approval.

B. Install Circular or Rectangular Sound Attenuator as mockup and obtain Consultants approval.

1.33 Environmental Requirements:

A. The sound attenuation material and equipment shall be suitable for the environment in which they are sited and for the air that flows through it.

B. The external environment shall be considered to be hot (up to 46ºC), humid (up to 32ºC saturated and moisture contents up to 0.030 kg/kg), dusty (up to 70mg/m^3). Installations close to shoreline cities shall also consider a saline environment.

1.34 Warranty:

A. Submit Manufacturer's Warranty in accordance with contract requirements specified elsewhere.

PART-2: PRODUCTS

2.1 Approved Manufacturer or Product:

A. Refer section 23 90 10- List of Approved Manufacturer's.

2.2 Product / Performance Requirements:

A. Material and all HVAC equipment shall be selected and installed to ensure that the noise level in the spaces served, in any adjacent rooms or buildings and within plant rooms does not exceed the maximum acceptable NC Rating indicated in Para D below.

B. Attenuators and other noise control equipment shall be selected and installed to achieve the stated noise ratings with minimum resistance to airflow. Sound absorbent material that contain and/or require the use of CFCs in their manufacture shall not be used.

C. The Bidder shall submit calculations to substantiate, that 'NC' levels specified at Para-D below are met using the sound power levels of equipment actually selected for installation. Should the specified 'NC' levels not be met during actual operation, the Bidder shall summit proposals to the Consultant for rectification, and obtain approvals before taking all necessary steps for rectification, until 'NC' levels are achieved.

D. It is the intent of this specification that noise levels due to air conditioning and/or ventilating equipment, ducts, grilles, registers, diffusers, dampers, etc., will permit attaining sound pressure levels in occupied spaces conforming to the following NC (Noise Criteria) curves as explained in the latest issue of the ASHRAE Handbook and Product Directory (Systems Volume). Bidders shall ensure the inclusion of all necessary sound attenuation equipment and materials to meet these conditions.

Form of Occupancy	**NC Rating**
Residential	
Private residence	25-30
Apartments	30-35
Hostels/Motels	
Individual rooms or suites	30-35
Halls, corridors, lobbies	35-40
Service/supports areas	40-45
Offices	
Executive	25-30
Conformance Rooms	25-30
Private	30-35
Open plan areas	35-40
Public circulations	40-45
Hospitals & Clinics	
Private rooms	25-30
Wards	30-35
Operating rooms	25-30
Laboratories	35-40
Corridors	30-35
Public areas	35-40
Churches	**30-35**
Schools	
Lecture & classrooms	25-30
Open-plan classrooms	35-40

E. Maximum permissible sound-power at various octave bands due to airborne transmission through the combination of grilles, registers and diffusers when operated in installed condition as per plans and specifications shall be as follows:

Noise Criteria	**Octave Band**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
NC-20	51	40	33	26	22	19	17	16
NC-30	57	48	41	35	31	29	28	27
NC-40	64	57	51	45	41	39	38	37
NC-45	67	60	54	49	46	44	43	42

2.3 Acoustical Duct Lining:

A. Acoustical duct lining for low velocity system shall be fiberglass designed exclusively for acoustic lining of ducts. The air-side surface of the liner shall be capable of withstanding air velocity of 4,000ft/minute (20 m/sec.) without delamination or erosion for service in duct systems. Sound absorption coefficient for the thickness provided shall be not less than indicated below:

Octave Bands	**2**	**3**	**4**	**5**	**6**	**7**
Mid frequency, Hertz	125	250	500	1000	2000	4000

Sound Absorption Coefficient (Type- I)	0.23	0.50	0.49	0.63	0.73	0.82
Sound Absorption Coefficient (Type-II)	0.13	0.44	0.63	0.90	0.83	0.76

The density of the lining including any surface coating or facing shall not be less than 1.35lbs/ft^3 (21.6 Kg/m^3).

B. The liner composition may be uniform density, graduated density or dual density, as standard with the manufacturer, and shall be coated to prevent delamination. Lining shall not be less than 25mm thick. Acoustic liner shall be provided up to a length necessary to meet the sound performance specifications given herein, but not less than 3m length from fan discharge point.

C. Flame and spread rating of the acoustic lining shall be not less than the following; when tested in accordance with NFPA-255.

1. Flame spread classification - 20
2. Smoke development rating - 20

D. Fixing of Acoustic Lining:

1. Accoustic lining shall accurately fit the internal surfaces of the duct. The insulation shall be fixed using adhesive spread over the entire surface, supplemented by piercing fasteners as necessary, finished flush with the insulation surface.
2. In addition to adhesive and piercing fasteners, acoustic insulation shall be contained behind securely fixed perforated metal enclosures.
3. All exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of fire-resistant adhesive, to prevent delamination of the glass fibres.
4. No lining shall be installed within 1m of any fire damper.
5. Duct sizes shown on the drawings shall be increased to compensate for the thickness of the lining used.

2.4 Circular and Rectangular Sound Attenuators:

A. General:

The bidder shall supply and install Rectangular or Circular Sound Attenuators at locations shown on drawings, and in accordance with data provided in the EQUIPMENT DATA SHEET, and where it is necessary to attenuate equipment noise.

B. Infill Material:

Acoustically absorptive fill shall be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compressions to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture proof and impart no odor to the airstream.

C. Casing:

1. Units shall be constructed in accordance with the ASHRAE Guide recommendations for high pressure duct work. Seams shall be lock formed and mastic filled. Rectangular casing seams shall be in the corners of the silencer shell to provide maximum unit strength and rigidity. Interior partitions shall be fabricated from single piece; margin perforated sheets and shall have die-formed entrance and exit shapes so as to provide the maximum aerodynamic efficiency and minimum self-noise characteristics in the sound attenuator. Blunt noses or squared off partitions will not be accepted.
2. The interior partitions shall be attached to the casing by means of an interlocking track assembly. Tracks shall be solid galvanized steel and shall be welded to the outer casing. Attachment of the interior partitions to the tracks shall be such that a minimum of 4 thicknesses of metal exist at this location.
3. The track assembly shall stiffen the exterior casing, provide a reinforced attachment detail for the interior partitions, and shall maintain a uniform airspace width along the length of the silencer for consistent aerodynamic and acoustic performance.
4. Sound attenuating units shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge from inside to outside the casing.
5. Unless otherwise indicated in EQUIPMENT DATA SHEET, the silencers shall be constructed of galvanized steel of thickness noted at Para 2.2C(2).

6. End flanges shall be fabricated from mild steel angles, and galvanized after manufacture. End flanges shall be welded to the casings. Welding areas shall be cleaned and coated with zinc-rich paint.

7. Casings and flanges shall be to the following minimum thickness/sizes.

Casing Long Side (mm)	Sheet Metal Thickness (mm)	Angle Iron (mm)
Up to 450	0.9mm	40 x 40 x 5
450 to 915	1.1mm	40 x 40 x 5

8. Galvanized perforated metal shall be used as protection to prevent delamination & erosion of the acoustic lining.

9. For special applications, stainless steel shall be used and where so indicated in the EQUIPMENT DATA SHEET.

D. Acoustic Performance:

1. Silencer ratings shall be determined in a duct-to-reverberant room test facility which provides for airflow in both directions through the test silencer in accordance with ASTM Specification E477-99, in an accredited test facility. Data from a non-accredited laboratory will not be acceptable. The test set-up and procedure shall be such that all effects due to end reflection, directivity, flanking transmission, standing waves and test chamber sound absorption are eliminated.

2. Acoustic ratings shall include Dynamic Insertion Loss (DIL) and Self-Noise (SN) Power Levels both for FORWARD FLOW (air and noise in same direction) and REVERSE FLOW (air and noise in opposite directions) both at 1000 & 2000 fpm entering face velocity.

3. Silencers shall provide the minimum dynamic insertion loss values dB as indicated on the silencer schedule at the design air velocities.

4. The sound power level produced by self-generated silencer noise in dB re: 10^{-12} watts shall not exceed the scheduled values at design flow rates.

E. Aerodynamic Performance:

1. Static pressure loss of silencers shall not exceed those listed in the silencer EQUIPMENT DATA SHEET at the airflow indicated. Airflow measurements shall be made in accordance with ASTM specification E477-99 and applicable portions of ASME, AMCA, and ADC airflow test codes. Tests shall be reported on the identical units for which acoustic data is presented.

F. Certification:

1. With submittals, the manufacturer shall supply certified test data on Dynamic Insertion Loss, Self-Noise Power Levels, and Aerodynamic Performance for Reverse and Forward Flow test conditions, tested in accordance with BS EN ISO 7235:2009. Test data shall be for a standard product.

G. Stainless Steel Sound Attenuators: All areas such as medical operation theaters, procedural departments, general laboratory exhaust, fume hood, bio-safety cabinet, radioisotope hood, vivarium supply and exhaust systems and where indicated on the drawings or EQUIPMENT DATA SHEET shall be provided with Stainless Steel Sound Attenuators. These shall be subject to routine decontamination.

H. Silencers installed outdoors shall be constructed watertight and all metal surfaces inside and out shall be painted with epoxy based paint to suit the duty.

I. The attenuators shall have blanking pieces of 8mm plywood securely bolted and taped to the full face of the attenuator flanges to prevent damage.

2.5 Packless Silencers:

A. Where shown on the drawings or in the EQUIPMENT DATA SHEET, Pack less Silencers shall be installed.

B. These shall generally be used for applications in chemical plants, clean rooms, fume cupboards, indoor shooting ranges, electronics manufacturing, food production plants, hospital operating theatres, forensic laboratories, microchip manufacturing plants, nuclear processing plants.

C. The Packless Silencers general construction shall follow the specifications given in Para 2.2 for Sound Attenuators with exception noted herein.

D. Material:

1. No sound absorptive material of any kind is to be used in the Packless Silencers. The silencers shall attenuate air/gas transmitted noise solely by virtue of controlled impedance membranes and broadly tuned resonators.

2. Tuned perforated resonant chambers to achieve broad-band attenuation.

E. Casing: As per specifications given in Para 2.2 for Sound Attenuators.

F. Accoustic Performance: As per specifications given in Para 2.2 for Sound Attenuators.

G. Aerodynamic Performance: As per specifications given in Para 2.2 for Sound Attenuators.

H. Certification: As per specifications given in Para 2.2 for Sound Attenuators.

2.6 Air Transfer / Cross Talk Attenuators with Spigot Ends:

A. Provide attenuators for air transfer and cross talk applications where shown on the drawings, to allow air to flow through while sound or cross-talk is attenuated.

B. Cross talk attenuators shall be fabricated from ducts with acoustic lining inside, conforming to specifications given under Para 2.2.

2.7 Acoustic Louvers with Infill:

A. Performance

1. Provide certified acoustic performance data measured in accordance with BS EN ISO 140-3.
2. Ensure louver withstands specified wind loads and prevents ingress of rain.

B. Construction

1. Construct louvre frame and aerodynamically profiled louvre blades from galvanized mild steel or aluminum as appropriate. Provide integral drainage channels.
2. Provide acoustic infill conforming to specifications given under Para 2.2.
3. Retain infill on louver blades by perforated sheet of galvanized mild steel or aluminum as appropriate.

C. Bird Screen

1. Fit a bird screen using mesh no coarser than 12mm, across inside face of louvers.

2.8 Acoustic Enclosures:

A. Where indicated, an acoustic enclosure shall be provided to isolate the noise producing equipment from the room in which it is installed. The required noise reduction or the maximum permitted ambient noise rating (NR) shall be as indicated. Removable panels shall be given access to items requiring cleaning, adjustment, replacement and other maintenance. Where enclosures are designed for personnel access, internal lighting and viewing panels shall be provided. Access doors shall be open-able from both sides.

B. The enclosure shall be isolated from the noise producing equipment and shall also be isolated from the building structure.

C. Provisions shall be made to dissipate heat emitted from the noise-producing equipment where necessary.

D. Provide acoustic enclosure/jacket to all high noise producing equipment like compressors etc.

E. Acoustic enclosure shall be made by mounting acoustic panels in an angle-iron structure suitable for the arrangement.

2.9 Flexible Duct Connectors- Acoustic Performance:

A. All flexible ducts (Section 23 33 46-Flexible Ducts) shall provide acoustic insertion loss as noted below:

Flexible Duct Static Insertion Loss measurements – 1 meter length.

DIA	FREQUENCY (Hz)							
	63	125	250	500	1K	2K	4K	8K
102	7.2	15.8	31.3	41.9	50.0	54.9	35.7	24.7
152	6.2	18.2	25.1	28.7	30.9	23.4	21.5	17.36
203	4.1	10.4	16.0	17.5	15.6	14.0	14.8	9.0
304	10.0	9.5	9.5	8.3	7.6	8.9	10.9	5.7

2.10 Acoustic Insulation Flexible System:

A. Continuous quilted glass fibre mat with sandwich layer of lead, minimum 1mm thick, with mass of 7 kg/m^2. Ensure surface finish complies with BS-476 Part 7, Class 1. Overlap and seal all joints with adhesive and external reinforcing tape.

PART-3: EXECUTION

3.1 Examination:

A. Before ordering any materials/commencing work, verify that building structure associated with the

system is within tolerance and take full account of shape configuration and material properties of the structure.

3.2 Handling And Storage:

A. Deliver Attenuators to site, completely identified with Consultant's identification number.

B. Store above ground in dry conditions. Properly protect from weather and construction activities by wrapping in polythene maintained in sound condition until the attenuators are ready for installation.

C. Any damaged or soiled attenuators shall be removed from the site and replaced with factory new equipment, at no additional cost to the Client. Site repairs are not acceptable.

3.3 Installation:

A. Before beginning installation in any area, examine all parts of the adjoining work into which applicable work is to be placed. Should any conditions be found which will prevent the proper execution of the work, installation shall not proceed in that area until such conditions are corrected by the bidder.

B. Install the sound attenuation material and equipment in accordance with these specifications, following good working practice, and as recommended by the manufacturer.

C. Inspection covers shall be provided at both ends of attenuators.

D. Supply steel section supporting frames or brackets where silencers are fixed to the walls of air chambers.

3.4 Field Quality Control:

A. Provide field quality control according to the Bidder’s approved Project Quality plan.

3.5 Cleaning:

A. Refer Section 23 05 93.

B. Remove labels after work is complete.

C. Remove all splashed paint, cement splatter, protective paper, etc after work is complete, & deliver Fans in clean condition.

3.6 Protection of Finished Work:

A. Protect all equipment & work from deterioration from any condition, till handing over.

3.7 Commissioning & Testing:

B. Sound Pressure Level Readings: The Bidder shall arrange a firm having proper credentials, as approved by the Consultant, to measure sound pressure levels at the inlet and outlet of the attenuators and in the space, using certified instruments.

C. These readings shall be used to confirm that the NC requirements of the space are met. Test reports shall be submitted to the Consultants by the Bidder in suitable test forms and approval obtained.

D. In the event that NC requirements are not met, the Bidder shall be responsible to take all steps necessary to meet the NC requirements.

END OF SECTION 23 33 19

REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
HVAC WORKS

SUMMARY OF BILL OF QUANTITIES September-2026

ITEM NO.	DESCRIPTION	MATERIAL AMOUNT (RS.)
1.0	AIR HANDLING UNITS (SECTION 23 72 13, 23 73 10 & 23 73 25 & DS/1606-23 73 10 & 23 73 25)	
2.0	FANS (SECTION 23 34 13, 23 34 16 & DS/1606-23 34 13, 23 34 16)	
3.0	WATER HUMIDIFIER SYSTEM (Only CONDAIR MODEL NORTEC EL SPACE)	
4.0	METER & GAUGES (SECTION 23 05 19)	
5.0	SUPPLY & INSTALLATION OF PIPING (SECTION 23 21 13 & DS/1606-23 21 13)	
6.0	SUPPLY & INSTALLATION OF VALVES & SPECIALITIES (SECTION 23 05 23)	
7.0	SUPPLY & INSTALLATION OF DUCT WORK (MACHINE MADE) (SECTION 23 31 13)	
8.0	SUPPLY & INSTALLATION OF THERMAL INSULATION & CLADDING (SECTION 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)	
9.0	SUPPLY & INSTALLATION OF AIR DEVICES (SECTION 23 37 13)	
10.0	CLEANING, BALANCING & TESTING (SECTION 23 05 93)	
11.0	PAINTING & FINISHING AND MECHANICAL IDENTIFICATION (SECTION 23 05 50 & 23 05 53)	
12.0	SUPPLY & INSTALLATION OF ELECTRICAL WORKS (SECTION 23 87 10 & 23 87 15 DS/1606-23 87 15)	
13.0	BUILDING MANAGEMENT SYSTEM (SECTION 23 09 10 & DS/1606-23 09 10)	
14.0	TOOLS AND INSTRUMENTS (SECTION 23 89 11)	
15.0	TEST RUN (SECTION 23 05 94)	
16.0	MISCELLANEOUS	
	GRAND TOTAL =	
	COST OF 18% GST (ON MATERIAL) AND 15% SST (ON INSTALLATION) =	
	GRAND TOTAL =	

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REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
HVAC WORKS

BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
1.0	AIR HANDLING UNITS (SECTION 23 72 13, 23 73 10 & 23 73 25 & DS/1606-23 73 10 & 23 73 25) (OWNER FURNISHED)		
1.1	Installation of Owner Furnished Air Handling Unit (AHU/BF-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.2	Installation of Owner Furnished Air Handling Unit (AHU/BF-02) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.3	Installation of Owner Furnished Air Handling Unit (AHU/BF-03) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.4	Installation of Owner Furnished Air Handling Unit (AHU/GF-01) with Outdoor (Section 23 73 10 & DS/1606-23 73 10)	2	Nos.
1.5	Installation of Owner Furnished Air Handling Unit (AHU/GF-02) (Section 23 73 10 & DS/1606-23 73 10)	6	Nos.
1.6	Installation of Owner Furnished Air Handling Unit (AHU/GF-03) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.7	Installation of Owner Furnished Air Handling Unit (AHU/GF-04) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.8	Installation of Owner Furnished Air Handling Unit (AHU/GF-05) (Section 23 73 10 & DS/1606-23 73 10)	2	Nos.
1.9	Installation of Owner Furnished Air Handling Unit (AHU/GF-06) (Section 23 73 10 & DS/1606-23 73 10)	3	Nos.
1.10	Installation of Owner Furnished Air Handling Unit (AHU/GF-07A) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.11	Installation of Owner Furnished Air Handling Unit (AHU/GF-07B) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.12	Installation of Owner Furnished Air Handling Unit (AHU/GF-07) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.13	Installation of Owner Furnished Air Handling Unit (AHU/GF-08A) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.14	Installation of Owner Furnished Air Handling Unit (AHU/GF-08) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.15	Installation of Owner Furnished Air Handling Unit (AHU/GF-09) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.16	Installation of Owner Furnished Air Handling Unit (AHU/GF-10 (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.17	Installation of Owner Furnished Air Handling Unit (AHU/GF-11A) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.18	Installation of Owner Furnished Air Handling Unit (AHU/GF-11) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.19	Installation of Owner Furnished Air Handling Unit (AHU/GF-12) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.20	Installation of Owner Furnished Air Handling Unit (AHU/GF-13) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.21	Installation of Owner Furnished Air Handling Unit (AHU/GF-14) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.22	Installation of Owner Furnished Air Handling Unit (AHU/OF-BF-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.23	Installation of Owner Furnished Air Handling Unit (AHU/OF-GF-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.24	Installation of Owner Furnished Air Handling Unit (AHU/OF-1F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.25	Installation of Owner Furnished Air Handling Unit (AHU/OF-2F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.26	Installation of Owner Furnished Air Handling Unit (AHU/OF-3F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.27	Installation of Owner Furnished Air Handling Unit (AHU/OF-4F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.
1.28	Installation of Owner Furnished Air Handling Unit (AHU/GF 01A x 2)(AHU/GF 05A)(GF 06A)	4	No.
1.28	Supply & Installation of Foundation / Supports (construction of foundations for 40 AHUs included)	40	Nos.
1.29	Supply & Installation of Flexible Duct Connector for AHUs	36	Lots
1.30	Assistance in Commissioning & Testing	36	Lots
1.31	Dismantling and removal of existing ahus AHUs from installation area (Disposal of salvage as per market salvage price is responsibility of contractor)	1	Lot
			Sub-total Carried to Summary

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REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
HVAC WORKS

BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
2.0	FANS (SECTION 23 34 13, 23 34 16 & DS/1606-23 34 13, 23 34 16)		
2.1	Supply & Installation of Centrifugal Fans (FN/EF-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.2	Supply & Installation of Centrifugal Fans (FN/EF-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.3	Supply & Installation of Centrifugal Fans (FN/EF-03) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.4	Supply & Installation of Centrifugal Fans (FN/EF-04) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.5	Supply & Installation of Centrifugal Fans (FN/EF-05) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.6	Supply & Installation of Centrifugal Fans (FN/EF-06) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.7	Supply & Installation of Centrifugal Fans (FN/EF-07) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.8	Supply & Installation of Centrifugal Fans (FN/EF-08) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.9	Supply & Installation of Centrifugal Fans (FN/EF-09) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.10	Supply & Installation of Centrifugal Fans (FN/EF-11) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.11	Supply & Installation of Centrifugal Fans (FN/EF-12 (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.12	Supply & Installation of Centrifugal Fans (FN/EF-14) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.13	Supply & Installation of Centrifugal Fans (FN/EF-15) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.14	Supply & Installation of Centrifugal Fans (FN/EF-16) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.15	Supply & Installation of Centrifugal Fans (FN/EF-17) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.16	Supply & Installation of Centrifugal Fans (FN/EF-18) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.17	Supply & Installation of Centrifugal Fans (FN/EF-19) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.18	Supply & Installation of Centrifugal Fans (FN/EF-20) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.19	Supply & Installation of Centrifugal Fans (FN/EF-21) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.20	Supply & Installation of Centrifugal Fans (FN/EF-22) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.21	Supply & Installation of Centrifugal Fans (FN/EF-23) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.22	Supply & Installation of Centrifugal Fans (FN/FA-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.23	Supply & Installation of Centrifugal Fans (FN/FA-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.24	Supply & Installation of Centrifugal Fans (FN/FA-03) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.25	Supply & Installation of Centrifugal Fans (FN/RE-BF-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.26	Supply & Installation of Centrifugal Fans (FN/RE-BF-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.27	Supply & Installation of Centrifugal Fans (FN/RE-BF-03) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.28	Supply & Installation of Centrifugal Fans (FN/RE-GF-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.29	Supply & Installation of Centrifugal Fans (FN/RE-GF-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.30	Supply & Installation of Centrifugal Fans (FN/RE-GF-04) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.31	Supply & Installation of Centrifugal Fans (FN/RE-GF-05) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.32	Supply & Installation of Centrifugal Fans (FN/RE-GF-07B) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.33	Supply & Installation of Centrifugal Fans (FN/RE-GF-07) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.34	Supply & Installation of Centrifugal Fans (FN/RE-GF-08A) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.35	Supply & Installation of Centrifugal Fans (FN/RE-GF-09) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.36	Supply & Installation of Centrifugal Fans (FN/RE-GF-10) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.37	Supply & Installation of Centrifugal Fans (FN/RE-GF-11A) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.38	Supply & Installation of Centrifugal Fans (FN/RE-GF-12) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.39	Supply & Installation of Centrifugal Fans (FN/RE-GF-13) (Section 23 34 16 & DS/1606-23 34 16)	1	No.
2.40	Supply & Installation of Axial Fan (FN/EF-10) (Section 23 34 13 & DS/1606-23 34 13)	1	No.
2.41	Supply & Installation of Axial Fan (FN/EF-13) (Section 23 34 13 & DS/1606-23 34 13)	1	No.
2.42	Spares for Fans (Section 23 34 13, 23 34 16 & DS/1606-23 34 13, 23 34 16)	41	Lots
2.43	Lifting & Shifting of Equipment to Designated Areas	41	Lots
2.44	Supply & Installation of Foundation & Supports for Fans	41	Lots
2.45	Commissioning & Testing	41	Lots
			Sub-total Carried to Summary

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BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
3.0	**WATER HUMIDIFIER SYSTEM (CONDAIR MODEL NORTEC EL SPACE)**		
3.1	Supply and Installation of Water Humidifier System with Remote blower pack, On/Off humidistats, Humidity Sensors, Remote user interface, In-line water filter and replacement filter elements, Condensate pump, Pocket hygro-thermometer digital display, Transformer, plug-In, 120 VAC to 24 VAC, Water Supply Piping(PPR PN-20), Drain pipe (uPVC Non Pressure Class), ON/OFF Control, (System Should be provided With ON/OFF Control.)	15	Nos.
3.2	Commissioning & Testing of Water Humidifier System	15	Lots
			Sub-total Carried to Summary
4.0	METER & GAUGES (SECTION 23 05 19)		
4.1	Thermometers Wells for Pipe Thermometer (Section 23 05 19)	72	Nos.
4.2	Pipe Thermometers (Section 23 05 19)	72	Nos.
4.3	Pressure Gauges on Pipes (Section 23 05 19)	72	Nos.
4.4	Gauge Outlets with Cock (Section 23 05 19)	72	Nos.
			Sub-total Carried to Summary
5.0	SUPPLY & INSTALLATION OF PIPING (SECTION 23 21 13 & DS/1606-23 21 13)		
5.1	**Chilled Water Piping**		
5.1.1	Ø 16" (Ø 400mm)	20	Rm
5.1.2	Ø 14" (Ø 350mm)	40	Rm
5.1.3	Ø 12" (Ø 300mm)	250	Rm
5.1.4	Ø 10" (Ø 250mm)	-	Rm
5.1.5	Ø 8" (Ø 200mm)	150	Rm
5.1.6	Ø 6" (Ø 150mm)	400	Rm
5.1.7	Ø 5" (Ø 125mm)	305	Rm
5.1.8	Ø 4" (Ø 100mm)	300	Rm
5.1.9	Ø 3" (Ø 75mm)	575	Rm
5.1.10	Ø 2 ½" (Ø 65mm)	195	Rm
5.1.11	Ø 2" (Ø 50mm)	155	Rm
5.1.12	Ø 1 ½" (Ø 40mm)	30	Rm
5.1.13	Ø 1 ¼" (Ø 32mm)	55	Rm
5.1.14	Ø 1" (Ø 25mm)	-	Rm
5.2	Pipe Sleeves	1	Lot
5.3	Pipe Supports as per as per Engineered Support System	1	Lot
5.4	Pipe Pressure Testing	1	Lot
			Sub-total Carried to Summary

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REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
HVAC WORKS

BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
6.0	SUPPLY & INSTALLATION OF VALVES & SPECIALITIES (SECTION 23 05 23)		
6.1	**Butterfly Valves with Material/Flanges/Unions etc.**		
6.1.1	Ø 12" (Ø 300mm)	-	No.
6.1.2	Ø 10" (Ø 250mm)	-	No.
6.1.3	Ø 8" (Ø 200mm)	-	No.
6.1.4	Ø 6" (Ø 150mm)	-	No.
6.1.5	Ø 5" (Ø 125mm)	2	Nos.
6.1.6	Ø 4" (Ø 100mm)	2	Nos.
6.1.7	Ø 3" (Ø 75mm)	36	Nos.
6.1.8	Ø 2 ½" (Ø 65mm)	10	Nos.
6.1.9	Ø 2" (Ø 50mm)	52	Nos.
6.1.10	Ø 1 ½" (Ø 40mm)	2	Nos.
6.1.11	Ø 1 ¼" (Ø 32mm)	4	Nos.
6.1.12	Ø 1" (Ø 25mm)	-	No.
6.2	**Gate Valves with Material/Flanges/Unions etc (Section 23 05 23)**		
6.2.1	Ø 4" (Ø 100mm)	-	No.
6.2.2	Ø 3" (Ø 75mm)	-	No.
6.2.3	Ø 2 ½" (Ø 65mm)	-	No.
6.2.4	Ø 2" (Ø 50mm)	-	No.
6.2.5	Ø 1 ½" (Ø 40mm)	-	No.
6.2.6	Ø 1 ¼" (Ø 32mm)	-	No.
6.2.7	Ø 1" (Ø 25mm)	-	No.
6.2.8	Ø ¾" (Ø 20mm)	-	No.
6.2.9	Ø ½" (Ø 15mm)	-	No.
6.2.10	Ø ¼" (Ø 8mm)	-	No.
6.3	**Globe Valve with Material/Flanges/Unions etc (Section 23 05 23)**		
6.3.1	Ø 10" (Ø 250mm)	-	No.
6.3.2	Ø 8" (Ø 200mm)	-	No.
6.3.3	Ø 6" (Ø 150mm)	-	No.
6.3.4	Ø 5" (Ø 125mm)	-	No.
6.4	**Check Valve with Material/Flanges/Unions etc (Section 23 05 23)**		
6.4.1	Ø 10" (Ø 250mm)	-	No.
6.4.2	Ø 8" (Ø 200mm)	-	No.
6.4.3	Ø 6" (Ø 150mm)	-	No.
6.4.4	Ø 5" (Ø 125mm)	-	No.
6.4.5	Ø 4" (Ø 100mm)	-	No.
6.4.6	Ø 3" (Ø 75mm)	-	No.
6.4.7	Ø 2 ½" (Ø 65mm)	-	No.
6.4.8	Ø 2" (Ø 50mm)	-	No.
6.4.9	Ø 1 ½" (Ø 40mm)	-	No.
6.4.10	Ø 1 ¼" (Ø 32mm)	-	No.
6.4.11	Ø 1" (Ø 25mm)	-	No.
6.5	**Ball Valve with Material/Flanges/Unions etc (Section 23 05 23)**		
6.5.1	Ø 1 ½" (Ø 40mm)	-	No.
6.5.2	Ø 1 ¼" (Ø 32mm)	-	No.
6.5.3	Ø 1" (Ø 25mm)	-	No.
6.5.4	Ø ¾" (Ø 20mm)	-	No.
6.5.5	Ø ½" (Ø 15mm)	-	No.
6.6	**Flexible Connector with Material/Flanges/Unions etc (Section 23 05 23)**		
6.6.1	Ø 12" (Ø 300mm)	-	No.
6.6.2	Ø 10" (Ø 250mm)	-	No.
6.6.3	Ø 8" (Ø 200mm)	-	No.
6.6.4	Ø 6" (Ø 150mm)	-	No.
6.6.5	Ø 5" (Ø 125mm)	2	Nos.
6.6.6	Ø 4" (Ø 100mm)	2	Nos.
6.6.7	Ø 3" (Ø 75mm)	36	Nos.
6.6.8	Ø 2 ½" (Ø 65mm)	10	Nos.
6.6.9	Ø 2" (Ø 50mm)	16	No.
6.6.10	Ø 1 ½" (Ø 40mm)	2	No.
6.6.11	Ø 1 ¼" (Ø 32mm)	4	Nos.
6.6.12	Ø 1" (Ø 25mm)	-	No.

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BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
6.7	**Flow Balancing & Shut-off Valve with Material/Flanges/Unions etc (Section 23 86 20)**		
6.7.1	Ø 12" (Ø 300mm)	-	No.
6.7.2	Ø 10" (Ø 250mm)	-	No.
6.7.3	Ø 8" (Ø 200mm)	-	No.
6.7.4	Ø 6" (Ø 150mm)	-	No.
6.7.5	Ø 5" (Ø 125mm)	1	No.
6.7.6	Ø 4" (Ø 100mm)	1	No.
6.7.7	Ø 3" (Ø 75mm)	18	Nos.
6.7.8	Ø 2 ½" (Ø 65mm)	5	Nos.
6.7.9	Ø 2" (Ø 50mm)	8	Nos.
6.7.10	Ø 1 ½" (Ø 40mm)	1	No.
6.7.11	Ø 1 ¼" (Ø 32mm)	2	Nos.
6.7.12	Ø 1" (Ø 25mm)	-	No.
6.8	**Strainers with Ball valve with Material/Flanges/Unions etc (Section 23 05 23)**		
6.8.1	Ø 12" (Ø 300mm)	-	No.
6.8.2	Ø 10" (Ø 250mm)	-	No.
6.8.3	Ø 8" (Ø 200mm)	-	No.
6.8.4	Ø 6" (Ø 150mm)	-	No.
6.8.5	Ø 5" (Ø 125mm)	1	No.
6.8.6	Ø 4" (Ø 100mm)	1	No.
6.8.7	Ø 3" (Ø 75mm)	18	Nos.
6.8.8	Ø 2 ½" (Ø 65mm)	5	Nos.
6.8.9	Ø 2" (Ø 50mm)	8	Nos.
6.8.10	Ø 1 ½" (Ø 40mm)	1	No.
6.8.11	Ø 1 ¼" (Ø 32mm)	2	Nos.
6.8.12	Ø 1" (Ø 25mm)	-	No.
6.9	**Strainers with Material/Flanges/Unions etc (Section 23 05 23)**		
6.9.1	Ø 2 ½" (Ø 65mm)	-	No.
6.9.2	Ø 2" (Ø 50mm)	-	No.
6.9.3	Ø 1 ½" (Ø 40mm)	-	No.
6.9.4	Ø 1 ¼" (Ø 32mm)	-	No.

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BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
6.10	**Automatic Air Vents with Material/Flanges/Unions etc. (Section 23 21 13)**		
6.10.1	Ø 1 ½" (Ø 40mm)	-	No.
6.10.2	Ø 1 ¼" (Ø 32mm)	-	No.
6.10.3	Ø 1" (Ø 25mm)	-	No.
6.10.4	Ø ¾" (Ø 20mm)	72	Nos.
6.11	**Pressure Reducing Valve (PRV) with Material/Flanges/Unions etc.**		
6.11.1	Ø 2" (Ø 50mm)	-	No.
6.11.2	Ø 1 ½" (Ø 40mm)	-	No.
6.11.3	Ø 1 ¼" (Ø 32mm)	-	No.
6.11.4	Ø 1" (Ø 25mm)	-	No.
6.12	**Solenoid Valve with Material/Flanges/Unions etc.**		
6.12.1	Ø 3" (Ø 75mm)	-	No.
6.12.2	Ø 2 ½" (Ø 65mm)	-	No.
6.12.3	Ø 2" (Ø 50mm)	-	No.
6.12.4	Ø 1 ¼" (Ø 32mm)	-	No.
6.12.5	Ø 1 ½" (Ø 40mm)	-	No.
6.13	**Flow Meter with Material/Flanges/Unions etc.**		
6.13.1	Ø 3" (Ø 75mm)	-	No.
6.13.2	Ø 2 ½" (Ø 65mm)	-	No.
6.13.3	Ø 2" (Ø 50mm)	-	No.
			Sub-total Carried to Summary

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BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
7.0	SUPPLY & INSTALLATION OF DUCT WORK (MACHINE MADE) (SECTION 23 31 13)		
7.1	Sheet Metal Duct Work (Air Conditioning) (Supply/Return), Machine made Ducts (Section 23 31 13)	22300	m²
7.2	Sheet Metal Duct Work (Fresh Air) Machine made Ducts (Section 23 31 13)	550	m²
7.3	Sheet Metal Duct Work (Exhaust Air) Machine made Ducts (For Toilet & Others Areas) (Section 23 31 13)	350	m²
7.4	**Sheet Metal Duct Work (Air Conditioning) (Supply/Return), Machine made Ducts (Section 23 31 13) - Round Duct**		
7.4.1	Ø 32" (Ø 800mm)	10	Rm
7.4.2	Ø 30" (Ø 750mm)	15	Rm
7.4.3	Ø 24" (Ø 600mm)	10	Rm
7.4.4	Ø 20" (Ø 500mm)	10	Rm
7.4.5	Ø 22" (Ø 550mm)	5	Rm
7.4.6	Ø 18" (Ø 450mm)	10	Rm
7.4.7	Ø 14" (Ø 350mm)	5	Rm
7.4.8	Ø 10" (Ø 0250mm)	15	Rm
7.4.9	Ø 8" (Ø 200mm)	25	Rm
7.4.10	Ø 6" (Ø 150mm)	20	Rm
7.5	Quadrant Volume Dampers	40	m²
7.6	**Butterfly Dampers**		
7.6.1	Ø 8" (Ø 200mm)	-	No.
7.6.2	Ø 6" (Ø 150mm)	-	No.
7.6.3	Ø 4" (Ø 100mm)	-	No.
7.7	**Flexible Ducts (Section 23 33 46)**		
7.7.1	Ø 8" (Ø 200mm)	-	Rm
7.7.2	Ø 6" (Ø 150mm)	-	Rm
7.7.3	Ø 4" (Ø 100mm)	-	Rm
7.8	Duct Test Holes	1	Lot
7.9	Duct Supports as per Engineered Support System	1	Lot
7.10	300 x 300 Access Doors for Ceiling (To be installed below VCD, Fire Dampers, Valves & FCUs)	1	Lot
7.11	G.I Frame as Duct Sleeve	1	Lot
7.12	Fire Dampers	-	No.
7.13	Wire Mesh on Duct Opening	1	Lot
			Sub-total Carried to Summary
8.0	SUPPLY & INSTALLATION OF THERMAL INSULATION & CLADDING (SECTION 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)		
8.1	Insulation of Supply Air Duct-Air Conditioned Space/Air Conditioned Ceiling Cavity (I/D1) (Section 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)	12800	m²
8.2	Insulation of Supply/Return Air Duct-Non Air Conditioned Space (I/D2) (Section 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)	1500	m²
8.3	Insulation of Supply/Return Air Duct in Mechanical Room or Exposed to Atmosphere or Susceptible to Damage (I/D3) (Section 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)	8000	m²
8.4	Sound Liner 50mm Thick	-	m²
8.5	**Chilled Water Piping Insulation Including Vapor Barrier, Jacketing & Cladding (Section 23 07 19 & DS/1606-23 07 19)**		
8.5.1	Ø 16" (Ø 400mm)	20	Rm
8.5.2	Ø 14" (Ø 350mm)	40	Rm
8.5.3	Ø 12" (Ø 300mm)	250	Rm
8.5.4	Ø 10" (Ø 250mm)	-	Rm
8.5.5	Ø 8" (Ø 200mm)	150	Rm
8.5.6	Ø 6" (Ø 150mm)	400	Rm
8.5.7	Ø 5" (Ø 125mm)	305	Rm
8.5.8	Ø 4" (Ø 100mm)	300	Rm
8.5.9	Ø 3" (Ø 75mm)	575	Rm
8.5.10	Ø 2 ½" (Ø 65mm)	195	Rm
8.5.11	Ø 2" (Ø 50mm)	155	Rm
8.5.12	Ø 1 ½" (Ø 40mm)	30	Rm
8.5.13	Ø 1 ¼" (Ø 32mm)	55	Rm
8.5.14	Ø 1" (Ø 25mm)	-	Rm

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BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
8.6	**Cladding of Valves & Specialities (Openable boxes with Insulation) (Section 23 07 19 & DS/1606-23 07 19)**		
8.6.1	Ø 12" (Ø 300mm)	-	No.
8.6.2	Ø 10" (Ø 250mm)	-	No.
8.6.3	Ø 8" (Ø 200mm)	-	No.
8.6.4	Ø 6" (Ø 150mm)	-	No.
8.6.5	Ø 5" (Ø 125mm)	5	Nos.
8.6.6	Ø 4" (Ø 100mm)	5	Nos.
8.6.7	Ø 3" (Ø 75mm)	90	Nos.
8.6.8	Ø 2 ½" (Ø 65mm)	25	Nos.
8.6.9	Ø 2" (Ø 50mm)	76	Nos.
8.6.10	Ø 1 ½" (Ø 40mm)	5	Nos.
8.6.11	Ø 1 ¼" (Ø 32mm)	10	Nos.
8.6.12	Ø 1" (Ø 25mm)	-	No.
8.6.13	Ø ¾" (Ø 20mm)	72	Nos.
			Sub-total Carried to Summary
9.0	SUPPLY & INSTALLATION OF AIR DEVICES (SECTION 23 37 13)		
9.1	Supply Air Recatangular Diffuser (Tuttle & Bailey)	9	m²
9.2	Return Air Rectangular Diffuser (Tuttle & Bailey)	9	m²
9.3	Supply Air Square Diffuser (Tuttle & Bailey)	60	m²
9.4	Return Air Square Diffuser (Tuttle & Bailey)	7	m²
9.5	Supply Air Fixed Bar Grill & Register (Tuttle & Bailey)	115	m²
9.6	Return Air Fixed Bar Grill & Register (Tuttle & Bailey)	33	m²
9.7	Exhaust Air Fixed Bar Grill & Register (Tuttle & Bailey)	6	m²
9.8	Supply Air Linear (Tuttle & Bailey) (Series 6000 3/4" - 20mm x 2 Slots) with Factory Supplied & Field Installed Plenum	53	Rm
9.9	Return Air Linear (Tuttle & Bailey) (Series 6000 3/4" - 20mm x 3 Slots)	40	Rm
9.10	Supply Air Circular Diffuser (Ø 36") (Ø 900mm)	2	Nos.
9.11	Supply Air Circular Diffuser (Ø 24") (Ø 600mm)	1	No.
9.12	Exhaust Air Disc Valve Exhaust (Ø 6") (Ø 150mm)	1	Nos.
9.13	Fresh Air & Exhaust Air Louvers	30	m²
			Sub-total Carried to Summary
10.0	CLEANING, BALANCING & TESTING (SECTION 23 05 93)		
10.1	Cleaning & Adjusting	1	Lot
10.2	Balancing (Assistance to TAB Contractor)	1	Lot
10.3	Provisional Sum for Testing & Balancing by Independent Agency to be Appointed by Owner	1	Lot
			Sub-total Carried to Summary
11.0	PAINTING & FINISHING AND MECHANICAL IDENTIFICATION (SECTION 23 05 50 & 23 05 53)		
11.1	Painting & Finishing (Section 23 05 50)	1	Lot
11.2	Stencilling of Pipes & Ducts (Section 23 05 53)	1	Lot
11.3	Identification Tags on Valves, etc. (Section 23 05 53)	1	Lot
11.4	Equipment Data Plates (Section 23 05 53)	1	Lot
			Sub-total Carried to Summary
12.0	SUPPLY & INSTALLATION OF ELECTRICAL WORKS (SECTION 23 87 10 & 23 87 15 DS/1606-23 87 15)		
12.1	Motor Control Centers (MCC-R-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.2	Motor Control Centers (MCC-R-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.3	Motor Control Centers (MCC-R-03) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.4	Motor Control Centers (MCC-R-04) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.5	Motor Control Centers (MCC-R-05) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.6	Motor Control Centers (MCC-GF-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.7	Motor Control Centers (MCC-GF-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.8	Motor Control Centers (MCC-GF-03) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.9	Motor Control Centers (MCC-BF-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.10	Motor Control Centers (MCC-BF-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.11	Motor Control Centers (MCC-OF-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.12	Motor Control Centers (MCC-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.
12.13	Lifting & Shifting of Equipment to Designated Areas	12	Lots
12.14	Outgoing Power & Earthing to all Equipments & MCCs (Section 23 87 15 & DS/1606-23 87 15)	12	Lots
12.15	Commissioning & Testing of Electrical Works	12	Lots
			Sub-total Carried to Summary

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BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
13.0	BUILDING MANAGEMENT SYSTEM (SECTION 23 09 10 & DS/1606-23 09 10)		
13.1	**Front End Equipment**		
13.1.1	Liscened BMS software with Full Function	1	Lot
13.1.2	Operator PC (Plant Room) 42 inch HD LED Screen (minimum 4 no.s)	1	Lot
13.1.3	BMS cause & effect programming, integration & graphic mapping	1	Lot
13.1.4	Networking, Cabling, raceway Supports, Hangers, Sleeves, Core Drilling etc.	1	Lot
13.1.5	Supply of rack mounted server, Supports, Hangers, Sleeves, Core Drilling etc.	1	Lot
13.1.6	Any other item to ensure system integration & synchronization (Provide separate list)	1	Lot
13.1.7	Provision in the Central BMS and Front End Equipment will be required for Air Side Equipment (Refer BMS DWG No. 11,12, 13 & 16) for information	1	Lot
13.1.8	Provision of dedicated Network and IP pool (optional)	1	Lot
13.2	**Controls for Chilled & Condesor Water Plant**		
13.2.1	Field Device: IP Based DDC Controller.	1	Lot
13.2.2	Communication with Chiller Control Panel/Chiller Plant Optimizer	1	Lot
13.2.3	Field Device: Differential Pressure Sensor (for VFD control of Pumps) with adjustment range of 50 to 1000 pa static pressure	1	No.
13.2.4	Field Device: Differential Pressure Switch (DPS) for Pumps with pressure adjustment range of .5 to 4 mbar and switching difference of 0.2 mbar or less	20	Nos.
13.2.5	Field Device: PT-1000 Pipe temperature sensor with brasswells	29	Nos.
13.2.6	Field Device: Water Flow Switch (For Chilled Water Application)	10	Nos.
13.2.7	Field Device: Outdoor Temperature & Humidity Sensor	1	No.
13.2.8	BTU Meters with Temperature Sensors (Refer 23 09 10 /11)	2	Nos.
13.3	**Supply & Installation of Controls for AHUs**		
13.3.1	Field Device: IP Based DDC Controller	1	Lot
13.3.2	Field Device: PT-1000 Temperature Sensor with Brasswells (For Chilled & Hot Water Application)	72	Nos.
13.3.3	Field Device: Air Duct Temperature Sensors. Prewired and Terminal Block Versions shall be Available to Mount in and Outside the Duct. Temperature Range shall be –40 to +120°C	72	Nos.
13.3.4	Field Device: 2-Way Motorized Control Valve. Modulating proportional valve actuator with reversible synchronous motor 0-10 VDC. (For Chilled Water Application)	36	Nos.
13.3.5	Field Device: Differential Pressure Switch (DPS) with Pressure Adjustment Range of .5 to 4 mbar and Switching Difference of 0.2 mbar or Less	105	Nos.
13.3.6	Field Device: Relative Humidity Sensor	15	Nos.
13.3.7	Field Device: CO_2 Sensor	-	No.
13.3.8	Field Device: Fire Stat	40	Nos.
			Sub-total Carried to Summary
13.4	**Supply & Installation of Controls for FCUs**		
13.4.1	Field Device: IP/MSTP Based Local DDC Controller (Nearest or other Controller can be considered)	1	Lot
13.4.2	Field Device: Differential Pressure Switch (DPS) with pressure adjustment range of .5 to 4 mbar and switching difference of 0.2 mbar or less	2	Nos.
13.4.3	Field Device: Two Way Motorized Valve with modulating proportional valve actuator with reversible synchronous motor 0-10 VDC. (With 50-70% authority)	2	Nos.
13.4.4	Wall Mounted Room Thermostat with Display	2	Nos.
			Sub-total Carried to Summary
13.5	**Supply & Installation of Controls for Fans**		
13.5.1	Field Device: IP/MSTP Base DDC Controller (Nearest or other Controller can be considered)	1	Lot
13.5.2	Field Device: Differential Pressure Switch (DPS) with pressure adjustment range of .5 to 4 mbar and switching difference of 0.2 mbar or less	44	Nos.
			Sub-total Carried to Summary
13.6	**Supply & Installation of Miscellaneous**		
13.6.1	Complete Control & Power Cabling for above Systems	1	Lot
13.6.2	Supports & Hangers for Complete for above Systems	1	Lot
13.6.3	Programming, Commissioning & Testing of Complete BMS System & 3 Months Test Run	1	Lot
13.6.4	Operation & Maintenance for One Year (as per general specs BMS Schedule 24 hours)	1	Lot
13.6.5	Training of Employers Personnel for Complete BMS System	1	Lot
13.6.6	Operation & Maintenance Manuals for Complete BMS System	1	Lot
13.6.7	As Built Drawings	1	Lot
13.6.8	Spare Parts Inventory for 2 Years as recommended by Manufacturer (Submit Complete Detail with Individual Pricing)	1	Lot
13.6.9	UPS 5KVa and related cabling for uniterrputed power supply	1	Lot
			Sub-total Carried to Summary
14.0	TOOLS AND INSTRUMENTS (SECTION 23 89 11)		
14.1	Instruments	1	Lot
14.2	Tools	1	Lot
			Sub-total Carried to Summary

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REFURBISHMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION
HVAC WORKS

BILL OF QUANTITIES Sep-2026

(1)	(2)	(3)	(4)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT
15.0	TEST RUN (SECTION 23 05 94)		
15.1	Two Month Test Run	1	Lot
			Sub-total Carried to Summary
16.0	MISCELLANEOUS		
16.1	Shop Drawings	1	Lot
16.2	As Built Drawings	1	Lot
16.3	Operation & Maintenance Manuals	1	Lot
16.4	Structural Openings, Core Cuts & Pipe Sleeves	1	Lot
16.5	Plant Operation for One Year	1	Lot
16.6	Fire Prevention Jacket for all Pipes, Duct, Trays etc. Crossing a Fire Barrier Wall/Floor	1	Lot
16.7	Dismantling of Existing Piping System/material that will not remain in use	1	Lot
16.8	Dismantling of Existing HVAC System/material that will not remain in use	1	Lot
16.9	**Removal of Existing Ducts**		
16.9.1	Sheet Metal Duct Work (Air Conditioning) (Supply/Return/Exhasut Air), Machine made Ducts (Section 23 31 13)	13000	m^2
16.9.2	**Sheet Metal Duct Work (Air Conditioning) (Supply/Return/Exhasut Air), Machine made Ducts (Section 23 31 13) - Round Duct**		
16.9.2.1	Ø 32" (Ø 800mm)	10	Rm
16.9.2.2	Ø 30" (Ø 750mm)	15	Rm
16.9.2.3	Ø 24" (Ø 600mm)	10	Rm
16.9.2.4	Ø 20" (Ø 500mm)	10	Rm
16.9.2.5	Ø 22" (Ø 550mm)	5	Rm
16.9.2.6	Ø 18" (Ø 450mm)	10	Rm
16.9.2.7	Ø 14" (Ø 350mm)	5	Rm
16.9.2.8	Ø 10" (Ø 0250mm)	15	Rm
16.9.2.9	Ø 8" (Ø 200mm)	25	Rm
16.9.2.10	Ø 6" (Ø 150mm)	20	Rm
			Sub-total Carried to Summary

Note

1- Optional item can be fully or partially dropped by PSPC.
2- Contractor is bound to start the execution after receiving of PO without any delay.
3- Bidder shall filled the offering description / specification in above column or submit separate sheet.
4- Any additional work required for dismantling works is included in the scope of work and without additional cost.
5- The warranty period of supplied AHU is 18 months from the date of successful commissioning.
6- In case of any item missing in above BOQ but present in drawing, it must be quoted separately and added in BOQ
7- Bidder must quote all the items of BOQ
8- UPS backup must be atleast 30 minutes, approved brands: Eaton/Schnieder/eq)
9- Removal works includes clearance of any existing hindrance

Public Procurement Regulatory Authority (PPRA) EPADS

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BILL OF QUANTITIES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
1.0	**AIR HANDLING UNITS (SECTION 23 72 13, 23 73 10 & 23 73 25 & DS/1606-23 73 10 & 23 73 25) (OWNER FURNISHED)**								
1.1	Installation of Owner Furnished Air Handling Unit (AHU/BF-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.2	Installation of Owner Furnished Air Handling Unit (AHU/BF-02) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.3	Installation of Owner Furnished Air Handling Unit (AHU/BF-03) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.4	Installation of Owner Furnished Air Handling Unit (AHU/GF-01) with Outdoor (Section 23 73 10 & DS/1606-23 73 10)	2	Nos.						
1.5	Installation of Owner Furnished Air Handling Unit (AHU/GF-02) (Section 23 73 10 & DS/1606-23 73 10)	6	Nos.						
1.6	Installation of Owner Furnished Air Handling Unit (AHU/GF-03) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.7	Installation of Owner Furnished Air Handling Unit (AHU/GF-04) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.8	Installation of Owner Furnished Air Handling Unit (AHU/GF-05) (Section 23 73 10 & DS/1606-23 73 10)	2	Nos.						
1.9	Installation of Owner Furnished Air Handling Unit (AHU/GF-06) (Section 23 73 10 & DS/1606-23 73 10)	3	Nos.						
1.10	Installation of Owner Furnished Air Handling Unit (AHU/GF-07A) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.11	Installation of Owner Furnished Air Handling Unit (AHU/GF-07B) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.12	Installation of Owner Furnished Air Handling Unit (AHU/GF-07) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.13	Installation of Owner Furnished Air Handling Unit (AHU/GF-08A) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.14	Installation of Owner Furnished Air Handling Unit (AHU/GF-08) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.15	Installation of Owner Furnished Air Handling Unit (AHU/GF-09) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.16	Installation of Owner Furnished Air Handling Unit (AHU/GF-10 (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.17	Installation of Owner Furnished Air Handling Unit (AHU/GF-11A) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.18	Installation of Owner Furnished Air Handling Unit (AHU/GF-11) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.19	Installation of Owner Furnished Air Handling Unit (AHU/GF-12) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.20	Installation of Owner Furnished Air Handling Unit (AHU/GF-13) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.21	Installation of Owner Furnished Air Handling Unit (AHU/GF-14) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.22	Installation of Owner Furnished Air Handling Unit (AHU/OF-BF-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.23	Installation of Owner Furnished Air Handling Unit (AHU/OF-GF-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.24	Installation of Owner Furnished Air Handling Unit (AHU/OF-1F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.25	Installation of Owner Furnished Air Handling Unit (AHU/OF-2F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.26	Installation of Owner Furnished Air Handling Unit (AHU/OF-3F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.27	Installation of Owner Furnished Air Handling Unit (AHU/OF-4F-01) (Section 23 73 10 & DS/1606-23 73 10)	1	No.						
1.28	Installation of Owner Furnished Air Handling Unit (AHU/GF 01A x 2)(AHU/GF 05A)(GF 06A)	4	No.						
1.28	Supply & Installation of Foundation / Supports (construction of foundations for 40 AHUs included)	40	Nos.						
1.29	Supply & Installation of Flexible Duct Connector for AHUs	36	Lots						
1.30	Assistance in Commissioning & Testing	36	Lots						
1.31	Dismantling and removal of existing ahus AHUs from installation area (Disposal of salvage as per market salvage price is responsibility of contrac	1	Lot						
	Sub-total Carried to Summary								
2.0	**FANS (SECTION 23 34 13, 23 34 16 & DS/1606-23 34 13, 23 34 16)**								
2.1	Supply & Installation of Centrifugal Fans (FN/EF-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.2	Supply & Installation of Centrifugal Fans (FN/EF-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.3	Supply & Installation of Centrifugal Fans (FN/EF-03) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.4	Supply & Installation of Centrifugal Fans (FN/EF-04) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.5	Supply & Installation of Centrifugal Fans (FN/EF-05) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						

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BILL OF QUANTITIES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
2.6	Supply & Installation of Centrifugal Fans (FN/EF-06) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.7	Supply & Installation of Centrifugal Fans (FN/EF-07) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.8	Supply & Installation of Centrifugal Fans (FN/EF-08) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.9	Supply & Installation of Centrifugal Fans (FN/EF-09) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.10	Supply & Installation of Centrifugal Fans (FN/EF-11) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.11	Supply & Installation of Centrifugal Fans (FN/EF-12 (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.12	Supply & Installation of Centrifugal Fans (FN/EF-14) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.13	Supply & Installation of Centrifugal Fans (FN/EF-15) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.14	Supply & Installation of Centrifugal Fans (FN/EF-16) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.15	Supply & Installation of Centrifugal Fans (FN/EF-17) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.16	Supply & Installation of Centrifugal Fans (FN/EF-18) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.17	Supply & Installation of Centrifugal Fans (FN/EF-19) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.18	Supply & Installation of Centrifugal Fans (FN/EF-20) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.19	Supply & Installation of Centrifugal Fans (FN/EF-21) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.20	Supply & Installation of Centrifugal Fans (FN/EF-22) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.21	Supply & Installation of Centrifugal Fans (FN/EF-23) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.22	Supply & Installation of Centrifugal Fans (FN/FA-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.23	Supply & Installation of Centrifugal Fans (FN/FA-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.24	Supply & Installation of Centrifugal Fans (FN/FA-03) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.25	Supply & Installation of Centrifugal Fans (FN/RE-BF-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.26	Supply & Installation of Centrifugal Fans (FN/RE-BF-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.27	Supply & Installation of Centrifugal Fans (FN/RE-BF-03) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.28	Supply & Installation of Centrifugal Fans (FN/RE-GF-01) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.29	Supply & Installation of Centrifugal Fans (FN/RE-GF-02) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.30	Supply & Installation of Centrifugal Fans (FN/RE-GF-04) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.31	Supply & Installation of Centrifugal Fans (FN/RE-GF-05) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.32	Supply & Installation of Centrifugal Fans (FN/RE-GF-07B) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.33	Supply & Installation of Centrifugal Fans (FN/RE-GF-07) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.34	Supply & Installation of Centrifugal Fans (FN/RE-GF-08A) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.35	Supply & Installation of Centrifugal Fans (FN/RE-GF-09) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.36	Supply & Installation of Centrifugal Fans (FN/RE-GF-10) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.37	Supply & Installation of Centrifugal Fans (FN/RE-GF-11A) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.38	Supply & Installation of Centrifugal Fans (FN/RE-GF-12) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.39	Supply & Installation of Centrifugal Fans (FN/RE-GF-13) (Section 23 34 16 & DS/1606-23 34 16)	1	No.						
2.40	Supply & Installation of Axial Fan (FN/EF-10) (Section 23 34 13 & DS/1606-23 34 13)	1	No.						
2.41	Supply & Installation of Axial Fan (FN/EF-13) (Section 23 34 13 & DS/1606-23 34 13)	1	No.						
2.42	Spares for Fans (Section 23 34 13, 23 34 16 & DS/1606-23 34 13, 23 34 16)	41	Lots						
2.43	Lifting & Shifting of Equipment to Designated Areas	41	Lots						
2.44	Supply & Installation of Foundation & Supports for Fans	41	Lots						
2.45	Commissioning & Testing	41	Lots						

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BILL OF QUANTITIES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
	Sub-total Carried to Summary								
3.0	**WATER HUMIDIFIER SYSTEM (CONDAIR MODEL NORTEC EL SPACE)**								
3.1	Supply and Installation of Water Humidifier System with Remote blower pack, On/Off humidistats, Humidity Sensors, Remote user interface, In-line water filter and replacement filter elements, Condensate pump, Pocket hygro-thermometer digital display, Transformer, plug-In, 120 VAC to 24 VAC, Water Supply Piping(PPR PN-20), Drain pipe (uPVC Non Pressure Class), ON/OFF Control, (System Should be provided With ON/OFF Control.)	15	Nos.						
3.2	Commissioning & Testing of Water Humidifier System	15	Lots						
	Sub-total Carried to Summary								
4.0	**METER & GAUGES (SECTION 23 05 19)**								
4.1	Thermometers Wells for Pipe Thermometer (Section 23 05 19)	72	Nos.						
4.2	Pipe Thermometers (Section 23 05 19)	72	Nos.						
4.3	Pressure Gauges on Pipes (Section 23 05 19)	72	Nos.						
4.4	Gauge Outlets with Cock (Section 23 05 19)	72	Nos.						
	Sub-total Carried to Summary								
5.0	**SUPPLY & INSTALLATION OF PIPING (SECTION 23 21 13 & DS/1606-23 21 13)**								
5.1	**Chilled Water Piping**								
5.1.1	Ø 16" (Ø 400mm)	20	Rm						
5.1.2	Ø 14" (Ø 350mm)	40	Rm						
5.1.3	Ø 12" (Ø 300mm)	250	Rm						
5.1.4	Ø 10" (Ø 250mm)	-	Rm		Rate Only		Rate Only		Rate Only
5.1.5	Ø 8" (Ø 200mm)	150	Rm						
5.1.6	Ø 6" (Ø 150mm)	400	Rm						
5.1.7	Ø 5" (Ø 125mm)	305	Rm						
5.1.8	Ø 4" (Ø 100mm)	300	Rm						
5.1.9	Ø 3" (Ø 75mm)	575	Rm						
5.1.10	Ø 2 ½" (Ø 65mm)	195	Rm						
5.1.11	Ø 2" (Ø 50mm)	155	Rm						
5.1.12	Ø 1 ½" (Ø 40mm)	30	Rm						
5.1.13	Ø 1 ¼" (Ø 32mm)	55	Rm						
5.1.14	Ø 1" (Ø 25mm)	-	Rm		Rate Only		Rate Only		Rate Only
5.2	Pipe Sleeves	1	Lot						
5.3	Pipe Supports as per as per Engineered Support System	1	Lot						
5.4	Pipe Pressure Testing	1	Lot						
	Sub-total Carried to Summary								

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BILL OF QUANTITIES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
6.0	**SUPPLY & INSTALLATION OF VALVES & SPECIALITIES (SECTION 23 05 23)**								
6.1	**Butterfly Valves with Material/Flanges/Unions etc.**								
6.1.1	Ø 12" (Ø 300mm)	-	No.		Rate Only		Rate Only		Rate Only
6.1.2	Ø 10" (Ø 250mm)	-	No.		Rate Only		Rate Only		Rate Only
6.1.3	Ø 8" (Ø 200mm)	-	No.		Rate Only		Rate Only		Rate Only
6.1.4	Ø 6" (Ø 150mm)	-	No.		Rate Only		Rate Only		Rate Only
6.1.5	Ø 5" (Ø 125mm)	2	Nos.						
6.1.6	Ø 4" (Ø 100mm)	2	Nos.						
6.1.7	Ø 3" (Ø 75mm)	36	Nos.						
6.1.8	Ø 2 ½" (Ø 65mm)	10	Nos.						
6.1.9	Ø 2" (Ø 50mm)	52	Nos.						
6.1.10	Ø 1 ½" (Ø 40mm)	2	Nos.						
6.1.11	Ø 1 ¼" (Ø 32mm)	4	Nos.						
6.1.12	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2	**Gate Valves with Material/Flanges/Unions etc (Section 23 05 23)**								
6.2.1	Ø 4" (Ø 100mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.2	Ø 3" (Ø 75mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.3	Ø 2 ½" (Ø 65mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.4	Ø 2" (Ø 50mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.5	Ø 1 ½" (Ø 40mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.6	Ø 1 ¼" (Ø 32mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.7	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.8	Ø ¾" (Ø 20mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.9	Ø ½" (Ø 15mm)	-	No.		Rate Only		Rate Only		Rate Only
6.2.10	Ø ¼" (Ø 8mm)	-	No.		Rate Only		Rate Only		Rate Only
6.3	**Globe Valve with Material/Flanges/Unions etc (Section 23 05 23)**								
6.3.1	Ø 10" (Ø 250mm)	-	No.		Rate Only		Rate Only		Rate Only
6.3.2	Ø 8" (Ø 200mm)	-	No.		Rate Only		Rate Only		Rate Only
6.3.3	Ø 6" (Ø 150mm)	-	No.		Rate Only		Rate Only		Rate Only
6.3.4	Ø 5" (Ø 125mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4	**Check Valve with Material/Flanges/Unions etc (Section 23 05 23)**								
6.4.1	Ø 10" (Ø 250mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.2	Ø 8" (Ø 200mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.3	Ø 6" (Ø 150mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.4	Ø 5" (Ø 125mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.5	Ø 4" (Ø 100mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.6	Ø 3" (Ø 75mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.7	Ø 2 ½" (Ø 65mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.8	Ø 2" (Ø 50mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.9	Ø 1 ½" (Ø 40mm)	-	No.		Rate Only		Rate Only		Rate Only

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
6.4.10	Ø 1 ¼" (Ø 32mm)	-	No.		Rate Only		Rate Only		Rate Only
6.4.11	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.5	**Ball Valve with Material/Flanges/Unions etc (Section 23 05 23)**								
6.5.1	Ø 1 ½" (Ø 40mm)	-	No.		Rate Only		Rate Only		Rate Only
6.5.2	Ø 1 ¼" (Ø 32mm)	-	No.		Rate Only		Rate Only		Rate Only
6.5.3	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.5.4	Ø ¾" (Ø 20mm)	-	No.		Rate Only		Rate Only		Rate Only
6.5.5	Ø ½" (Ø 15mm)	-	No.		Rate Only		Rate Only		Rate Only
6.6	**Flexible Connector with Material/Flanges/Unions etc (Section 23 05 23)**								
6.6.1	Ø 12" (Ø 300mm)	-	No.		Rate Only		Rate Only		Rate Only
6.6.2	Ø 10" (Ø 250mm)	-	No.		Rate Only		Rate Only		Rate Only
6.6.3	Ø 8" (Ø 200mm)	-	No.		Rate Only		Rate Only		Rate Only
6.6.4	Ø 6" (Ø 150mm)	-	No.		Rate Only		Rate Only		Rate Only
6.6.5	Ø 5" (Ø 125mm)	2	Nos.						
6.6.6	Ø 4" (Ø 100mm)	2	Nos.						
6.6.7	Ø 3" (Ø 75mm)	36	Nos.						
6.6.8	Ø 2 ½" (Ø 65mm)	10	Nos.						
6.6.9	Ø 2" (Ø 50mm)	16	No.						
6.6.10	Ø 1 ½" (Ø 40mm)	2	No.						
6.6.11	Ø 1 ¼" (Ø 32mm)	4	Nos.						
6.6.12	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.7	**Flow Balancing & Shut-off Valve with Material/Flanges/Unions etc (Section 23 86 20)**								
6.7.1	Ø 12" (Ø 300mm)	-	No.		Rate Only		Rate Only		Rate Only
6.7.2	Ø 10" (Ø 250mm)	-	No.		Rate Only		Rate Only		Rate Only
6.7.3	Ø 8" (Ø 200mm)	-	No.		Rate Only		Rate Only		Rate Only
6.7.4	Ø 6" (Ø 150mm)	-	No.		Rate Only		Rate Only		Rate Only
6.7.5	Ø 5" (Ø 125mm)	1	No.						
6.7.6	Ø 4" (Ø 100mm)	1	No.						
6.7.7	Ø 3" (Ø 75mm)	18	Nos.						
6.7.8	Ø 2 ½" (Ø 65mm)	5	Nos.						
6.7.9	Ø 2" (Ø 50mm)	8	Nos.						
6.7.10	Ø 1 ½" (Ø 40mm)	1	No.						
6.7.11	Ø 1 ¼" (Ø 32mm)	2	Nos.						
6.7.12	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.8	**Strainers with Ball valve with Material/Flanges/Unions etc (Section 23 05 23)**								
6.8.1	Ø 12" (Ø 300mm)	-	No.		Rate Only		Rate Only		Rate Only
6.8.2	Ø 10" (Ø 250mm)	-	No.		Rate Only		Rate Only		Rate Only
6.8.3	Ø 8" (Ø 200mm)	-	No.		Rate Only		Rate Only		Rate Only
6.8.4	Ø 6" (Ø 150mm)	-	No.		Rate Only		Rate Only		Rate Only
6.8.5	Ø 5" (Ø 125mm)	1	No.						

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BILL OF QUANTITIES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
6.8.6	Ø 4" (Ø 100mm)	1	No.						
6.8.7	Ø 3" (Ø 75mm)	18	Nos.						
6.8.8	Ø 2 ½" (Ø 65mm)	5	Nos.						
6.8.9	Ø 2" (Ø 50mm)	8	Nos.						
6.8.10	Ø 1 ½" (Ø 40mm)	1	No.						
6.8.11	Ø 1 ¼" (Ø 32mm)	2	Nos.						
6.8.12	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.9	**Strainers with Material/Flanges/Unions etc (Section 23 05 23)**								
6.9.1	Ø 2 ½" (Ø 65mm)	-	No.		Rate Only		Rate Only		Rate Only
6.9.2	Ø 2" (Ø 50mm)	-	No.		Rate Only		Rate Only		Rate Only
6.9.3	Ø 1 ½" (Ø 40mm)	-	No.		Rate Only		Rate Only		Rate Only
6.9.4	Ø 1 ¼" (Ø 32mm)	-	No.		Rate Only		Rate Only		Rate Only
6.10	**Automatic Air Vents with Material/Flanges/Unions etc. (Section 23 21 13)**								
6.10.1	Ø 1 ½" (Ø 40mm)	-	No.		Rate Only		Rate Only		Rate Only
6.10.2	Ø 1 ¼" (Ø 32mm)	-	No.		Rate Only		Rate Only		Rate Only
6.10.3	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.10.4	Ø ¾" (Ø 20mm)	72	Nos.						
6.11	**Pressure Reducing Valve (PRV) with Material/Flanges/Unions etc.**								
6.11.1	Ø 2" (Ø 50mm)	-	No.		Rate Only		Rate Only		Rate Only
6.11.2	Ø 1 ½" (Ø 40mm)	-	No.		Rate Only		Rate Only		Rate Only
6.11.3	Ø 1 ¼" (Ø 32mm)	-	No.		Rate Only		Rate Only		Rate Only
6.11.4	Ø 1" (Ø 25mm)	-	No.		Rate Only		Rate Only		Rate Only
6.12	**Solenoid Valve with Material/Flanges/Unions etc.**								
6.12.1	Ø 3" (Ø 75mm)	-	No.		Rate Only		Rate Only		Rate Only
6.12.2	Ø 2 ½" (Ø 65mm)	-	No.		Rate Only		Rate Only		Rate Only
6.12.3	Ø 2" (Ø 50mm)	-	No.		Rate Only		Rate Only		Rate Only
6.12.4	Ø 1 ¼" (Ø 32mm)	-	No.		Rate Only		Rate Only		Rate Only
6.12.5	Ø 1 ½" (Ø 40mm)	-	No.		Rate Only		Rate Only		Rate Only
6.13	**Flow Meter with Material/Flanges/Unions etc.**								
6.13.1	Ø 3" (Ø 75mm)	-	No.		Rate Only		Rate Only		Rate Only
6.13.2	Ø 2 ½" (Ø 65mm)	-	No.		Rate Only		Rate Only		Rate Only
6.13.3	Ø 2" (Ø 50mm)	-	No.		Rate Only		Rate Only		Rate Only
	Sub-total Carried to Summary								

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
7.0	**SUPPLY & INSTALLATION OF DUCT WORK (MACHINE MADE) (SECTION 23 31 13)**								
7.1	Sheet Metal Duct Work (Air Conditioning) (Supply/Return), Machine made Ducts (Section 23 31 13)	22300	m^2						
7.2	Sheet Metal Duct Work (Fresh Air) Machine made Ducts (Section 23 31 13)	550	m^2						
7.3	Sheet Metal Duct Work (Exhaust Air) Machine made Ducts (For Toilet & Others Areas) (Section 23 31 13)	350	m^2						
7.4	**Sheet Metal Duct Work (Air Conditioning) (Supply/Return), Machine made Ducts (Section 23 31 13) – Round Duct**								
7.4.1	Ø 32" (Ø 800mm)	10	Rm						
7.4.2	Ø 30" (Ø 750mm)	15	Rm						
7.4.3	Ø 24" (Ø 600mm)	10	Rm						
7.4.4	Ø 20" (Ø 500mm)	10	Rm						
7.4.5	Ø 22" (Ø 550mm)	5	Rm						
7.4.6	Ø 18" (Ø 450mm)	10	Rm						
7.4.7	Ø 14" (Ø 350mm)	5	Rm						
7.4.8	Ø 10" (Ø 0250mm)	15	Rm						
7.4.9	Ø 8" (Ø 200mm)	25	Rm						
7.4.10	Ø 6" (Ø 150mm)	20	Rm						
7.5	Quadrant Volume Dampers	40	m^2						
7.6	**Butterfly Dampers**								
7.6.1	Ø 8" (Ø 200mm)	–	No.		Rate Only		Rate Only		Rate Only
7.6.2	Ø 6" (Ø 150mm)	–	No.		Rate Only		Rate Only		Rate Only
7.6.3	Ø 4" (Ø 100mm)	–	No.		Rate Only		Rate Only		Rate Only
7.7	**Flexible Ducts (Section 23 33 46)**								
7.7.1	Ø 8" (Ø 200mm)	–	Rm		Rate Only		Rate Only		Rate Only
7.7.2	Ø 6" (Ø 150mm)	–	Rm		Rate Only		Rate Only		Rate Only
7.7.3	Ø 4" (Ø 100mm)	–	Rm		Rate Only		Rate Only		Rate Only
7.8	Duct Test Holes	1	Lot						
7.9	Duct Supports as per Engineered Support System	1	Lot						
7.10	300 x 300 Access Doors for Ceiling (To be installed below VCD, Fire Dampers, Valves & FCUs)	1	Lot						
7.11	G.I Frame as Duct Sleeve	1	Lot						
7.12	Fire Dampers	–	No.		Rate Only		Rate Only		Rate Only
7.13	Wire Mesh on Duct Opening	1	Lot						
	Sub-total Carried to Summary								
8.0	**SUPPLY & INSTALLATION OF THERMAL INSULATION & CLADDING (SECTION 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)**								
8.1	Insulation of Supply Air Duct-Air Conditioned Space/Air Conditioned Ceiling Cavity (I/D1) (Section 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)	12800	m^2						
8.2	Insulation of Supply/Return Air Duct-Non Air Conditioned Space (I/D2) (Section 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)	1500	m^2						
8.3	Insulation of Supply/Return Air Duct in Mechanical Room or Exposed to Atmosphere or Susceptible to Damage (I/D3) (Section 23 07 13 & 23 07 19 & DS/1606-23 07 13 & 23 07 19)	8000	m^2						
8.4	Sound Liner 50mm Thick	–	m^2		Rate Only		Rate Only		Rate Only
8.5	**Chilled Water Piping Insulation Including Vapor Barrier, Jacketing & Cladding (Section 23 07 19 & DS/1606-23 07 19)**								
8.5.1	Ø 16" (Ø 400mm)	20	Rm						

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
8.5.2	Ø 14" (Ø 350mm)	40	Rm						
8.5.3	Ø 12" (Ø 300mm)	250	Rm						
8.5.4	Ø 10" (Ø 250mm)	–	Rm		Rate Only		Rate Only		Rate Only
8.5.5	Ø 8" (Ø 200mm)	150	Rm						
8.5.6	Ø 6" (Ø 150mm)	400	Rm						
8.5.7	Ø 5" (Ø 125mm)	305	Rm						
8.5.8	Ø 4" (Ø 100mm)	300	Rm						
8.5.9	Ø 3" (Ø 75mm)	575	Rm						
8.5.10	Ø 2 ½" (Ø 65mm)	195	Rm						
8.5.11	Ø 2" (Ø 50mm)	155	Rm						
8.5.12	Ø 1 ½" (Ø 40mm)	30	Rm						
8.5.13	Ø 1 ¼" (Ø 32mm)	55	Rm						
8.5.14	Ø 1" (Ø 25mm)	–	Rm		Rate Only		Rate Only		Rate Only
8.6	**Cladding of Valves & Specialities (Openable boxes with Insulation) (Section 23 07 19 & DS/1606-23 07 19)**								
8.6.1	Ø 12" (Ø 300mm)	–	No.		Rate Only		Rate Only		Rate Only
8.6.2	Ø 10" (Ø 250mm)	–	No.		Rate Only		Rate Only		Rate Only
8.6.3	Ø 8" (Ø 200mm)	–	No.		Rate Only		Rate Only		Rate Only
8.6.4	Ø 6" (Ø 150mm)	–	No.		Rate Only		Rate Only		Rate Only
8.6.5	Ø 5" (Ø 125mm)	5	Nos.						
8.6.6	Ø 4" (Ø 100mm)	5	Nos.						
8.6.7	Ø 3" (Ø 75mm)	90	Nos.						
8.6.8	Ø 2 ½" (Ø 65mm)	25	Nos.						
8.6.9	Ø 2" (Ø 50mm)	76	Nos.						
8.6.10	Ø 1 ½" (Ø 40mm)	5	Nos.						
8.6.11	Ø 1 ¼" (Ø 32mm)	10	Nos.						
8.6.12	Ø 1" (Ø 25mm)	–	No.		Rate Only		Rate Only		Rate Only
8.6.13	Ø ¾" (Ø 20mm)	72	Nos.						
	Sub-total Carried to Summary								
9.0	**SUPPLY & INSTALLATION OF AIR DEVICES (SECTION 23 37 13)**								
9.1	Supply Air Recatangular Diffuser (Tuttle & Bailey)	9	m²						
9.2	Return Air Rectangular Diffuser (Tuttle & Bailey)	9	m²						
9.3	Supply Air Square Diffuser (Tuttle & Bailey)	60	m²						
9.4	Return Air Square Diffuser (Tuttle & Bailey)	7	m²						
9.5	Supply Air Fixed Bar Grill & Register (Tuttle & Bailey)	115	m²						
9.6	Return Air Fixed Bar Grill & Register (Tuttle & Bailey)	33	m²						
9.7	Exhaust Air Fixed Bar Grill & Register (Tuttle & Bailey)	6	m²						
9.8	Supply Air Linear (Tuttle & Bailey) (Series 6000 3/4" - 20mm x 2 Slots) with Factory Supplied & Field Installed Plenum	53	Rm						
9.9	Return Air Linear (Tuttle & Bailey) (Series 6000 3/4" - 20mm x 3 Slots)	40	Rm						
9.10	Supply Air Circular Diffuser (Ø 36") (Ø 900mm)	2	Nos.						
9.11	Supply Air Circular Diffuser (Ø 24") (Ø 600mm)	1	No.						

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
9.12	Exhaust Air Disc Valve Exhaust (Ø 6") (Ø 150mm)	1	Nos.						
9.13	Fresh Air & Exhaust Air Louvers	30	m²						
	Sub-total Carried to Summary								
10.0	**CLEANING, BALANCING & TESTING (SECTION 23 05 93)**								
10.1	Cleaning & Adjusting	1	Lot						
10.2	Balancing (Assistance to TAB Contractor)	1	Lot						
10.3	Provisional Sum for Testing & Balancing by Independent Agency to be Appointed by Owner	1	Lot						3,000,000
	Sub-total Carried to Summary								
11.0	**PAINTING & FINISHING AND MECHANICAL IDENTIFICATION (SECTION 23 05 50 & 23 05 53)**								
11.1	Painting & Finishing (Section 23 05 50)	1	Lot						
11.2	Stencilling of Pipes & Ducts (Section 23 05 53)	1	Lot						
11.3	Identification Tags on Valves, etc. (Section 23 05 53)	1	Lot						
11.4	Equipment Data Plates (Section 23 05 53)	1	Lot						
	Sub-total Carried to Summary								
12.0	**SUPPLY & INSTALLATION OF ELECTRICAL WORKS (SECTION 23 87 10 & 23 87 15 DS/1606-23 87 15)**								
12.1	Motor Control Centers (MCC-R-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.2	Motor Control Centers (MCC-R-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.3	Motor Control Centers (MCC-R-03) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.4	Motor Control Centers (MCC-R-04) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.5	Motor Control Centers (MCC-R-05) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.6	Motor Control Centers (MCC-GF-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.7	Motor Control Centers (MCC-GF-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.8	Motor Control Centers (MCC-GF-03) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.9	Motor Control Centers (MCC-BF-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.10	Motor Control Centers (MCC-BF-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.11	Motor Control Centers (MCC-OF-01) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.12	Motor Control Centers (MCC-02) (Section 23 87 15 & DS/1606-23 87 15)	1	No.						
12.13	Lifting & Shifting of Equipment to Designated Areas	12	Lots						
12.14	Outgoing Power & Earthing to all Equipments & MCCs (Section 23 87 15 & DS/1606-23 87 15)	12	Lots						
12.15	Commissioning & Testing of Electrical Works	12	Lots						
	Sub-total Carried to Summary								

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
13.0	**BUILDING MANAGEMENT SYSTEM (SECTION 23 09 10 & DS/1606-23 09 10)**								
13.1	**Front End Equipment**								
13.1.1	Liscened BMS software with Full Function	1	Lot						
13.1.2	Operator PC (Plant Room) 42 inch HD LED Screen (minimum 4 no.s)	1	Lot						
13.1.3	BMS cause & effect programming, integration & graphic mapping	1	Lot						
13.1.4	Networking, Cabling, raceway Supports, Hangers, Sleeves, Core Drilling etc.	1	Lot						
13.1.5	Supply of rack mounted server, Supports, Hangers, Sleeves, Core Drilling etc.	1	Lot						
13.1.6	Any other item to ensure system integration & synchronization (Provide separate list)	1	Lot						
13.1.7	Provision in the Central BMS and Front End Equipment will be required for Air Side Equipment (Refer BMS DWG No. 11,12, 13 & 16) for information	1	Lot						
13.1.8	Provision of dedicated Network and IP pool (optional)	1	Lot						
13.2	**Controls for Chilled & Condesor Water Plant**								
13.2.1	Field Device: IP Based DDC Controller.	1	Lot						
13.2.2	Communication with Chiller Control Panel/Chiller Plant Optimizer	1	Lot						
13.2.3	Field Device: Differential Pressure Sensor (for VFD control of Pumps) with adjustment range of 50 to 1000 pa static pressure	1	No.						
13.2.4	Field Device: Differential Pressure Switch (DPS) for Pumps with pressure adjustment range of .5 to 4 mbar and switching difference of 0.2 mbar or less	20	Nos.						
13.2.5	Field Device: PT-1000 Pipe temperature sensor with brasswells	29	Nos.						
13.2.6	Field Device: Water Flow Switch (For Chilled Water Application)	10	Nos.						
13.2.7	Field Device: Outdoor Temperature & Humidity Sensor	1	No.						
13.2.8	BTU Meters with Temperature Sensors (Refer 23 09 10 /11)	2	Nos.						
13.3	**Supply & Installation of Controls for AHUs**								
13.3.1	Field Device: IP Based DDC Controller	1	Lot						
13.3.2	Field Device: PT-1000 Temperature Sensor with Brasswells (For Chilled & Hot Water Application)	72	Nos.						
13.3.3	Field Device: Air Duct Temperature Sensors. Prewired and Terminal Block Versions shall be Available to Mount in and Outside the Duct. Temperature Range shall be -40 to +120°C	72	Nos.						
13.3.4	Field Device: 2-Way Motorized Control Valve. Modulating proportional valve actuator with reversible synchronous motor 0-10 VDC. (For Chilled Water Application)	36	Nos.						
13.3.5	Field Device: Differential Pressure Switch (DPS) with Pressure Adjustment Range of .5 to 4 mbar and Switching Difference of 0.2 mbar or Less	105	Nos.						
13.3.6	Field Device: Relative Humidity Sensor	15	Nos.						
13.3.7	Field Device: CO_2 Sensor	-	No.		Rate Only		Rate Only		Rate Only
13.3.8	Field Device: Fire Stat	40	Nos.						
	Sub-total Carried to Summary								
13.4	**Supply & Installation of Controls for FCUs**								
13.4.1	Field Device: IP/MSTP Based Local DDC Controller (Nearest or other Controller can be considered)	1	Lot						
13.4.2	Field Device: Differential Pressure Switch (DPS) with pressure adjustment range of .5 to 4 mbar and switching difference of 0.2 mbar or less	2	Nos.						
13.4.3	Field Device: Two Way Motorized Valve with modulating proportional valve actuator with reversible synchronous motor 0-10 VDC. (With 50-70% authority)	2	Nos.						
13.4.4	Wall Mounted Room Thermostat with Display	2	Nos.						

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
	Sub-total Carried to Summary								
13.5	**Supply & Installation of Controls for Fans**								
13.5.1	Field Device: IP/MSTP Base DDC Controller (Nearest or other Controller can be considered)	1	Lot						
13.5.2	Field Device: Differential Pressure Switch (DPS) with pressure adjustment range of .5 to 4 mbar and switching difference of 0.2 mbar or less	44	Nos.						
	Sub-total Carried to Summary								
13.6	**Supply & Installation of Miscellaneous**								
13.6.1	Complete Control & Power Cabling for above Systems	1	Lot						
13.6.2	Supports & Hangers for Complete for above Systems	1	Lot						
13.6.3	Programming, Commissioning & Testing of Complete BMS System & 3 Months Test Run	1	Lot						
13.6.4	Operation & Maintenance for One Year (as per general specs BMS Schedule 24 hours)	1	Lot						
13.6.5	Training of Employers Personnel for Complete BMS System	1	Lot						
13.6.6	Operation & Maintenance Manuals for Complete BMS System	1	Lot						
13.6.7	As Built Drawings	1	Lot						
13.6.8	Spare Parts Inventory for 2 Years as recommended by Manufacturer (Submit Complete Detail with Individual Pricing)	1	Lot						
13.6.9	UPS 5KVa and related cabling for uniterrputed power supply	1	Lot						
	Sub-total Carried to Summary								
14.0	**TOOLS AND INSTRUMENTS (SECTION 23 89 11)**								
14.1	Instruments	1	Lot						
14.2	Tools	1	Lot						
	Sub-total Carried to Summary								
15.0	**TEST RUN (SECTION 23 05 94)**								
15.1	Two Month Test Run	1	Lot						
	Sub-total Carried to Summary								
16.0	**MISCELLANEOUS**								
16.1	Shop Drawings	1	Lot						
16.2	As Built Drawings	1	Lot						
16.3	Operation & Maintenance Manuals	1	Lot						
16.4	Structural Openings, Core Cuts & Pipe Sleeves	1	Lot						
16.5	Plant Operation for One Year	1	Lot						
16.6	Fire Prevention Jacket for all Pipes, Duct, Trays etc. Crossing a Fire Barrier Wall/Floor	1	Lot						
16.7	Dismantling of Existing Piping System/material that will not remain in use	1	Lot						
16.8	Dismantling of Existing HVAC System/material that will not remain in use	1	Lot						
16.9	**Removal of Existing Ducts**								
16.9.1	Sheet Metal Duct Work (Air Conditioning) (Supply/Return/Exhasut Air), Machine made Ducts (Section 23 31 13)	13000	m^2						
16.9.2	**Sheet Metal Duct Work (Air Conditioning) (Supply/Return/Exhasut Air), Machine made Ducts (Section 23 31 13) – Round Duct**								
16.9.2.1	Ø 32" (Ø 800mm)	10	Rm						
16.9.2.2	Ø 30" (Ø 750mm)	15	Rm						
16.9.2.3	Ø 24" (Ø 600mm)	10	Rm						

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BILL OF QUANTITIES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	MATERIAL		INSTALLATION		TOTAL	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)
					(5) x (3)		(7) x (3)	(5) + (7)	(6) + (8)
16.9.2.4	Ø 20" (Ø 500mm)	10	Rm						
16.9.2.5	Ø 22" (Ø 550mm)	5	Rm						
16.9.2.6	Ø 18" (Ø 450mm)	10	Rm						
16.9.2.7	Ø 14" (Ø 350mm)	5	Rm						
16.9.2.8	Ø 10" (Ø 0250mm)	15	Rm						
16.9.2.9	Ø 8" (Ø 200mm)	25	Rm						
16.9.2.10	Ø 6" (Ø 150mm)	20	Rm						
	Sub-total Carried to Summary								

Note

1- Optional item can be fully or partially dropped by PSPC.
2- Contractor is bound to start the execution after receiving of PO without any delay.
3- Bidder shall filled the offering description / specification in above column or submit separate sheet.
4- Any additional work required for dismantling works is included in the scope of work and without additional cost.
5- The warranty period of supplied AHU is 18 months from the date of successful commissioning.
6- In case of any item missing in above BOQ but present in drawing, it must be quoted separately and added in BOQ
7- Bidder must quote all the items of BOQ
8- UPS backup must be atleast 30 minutes, approved brands: Eaton/Schnieder/eq)
9- Removal works includes clarance of any existing hindrance

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Affidavit for Bidder's Blacklisting Status

ITB No: _____
Title: _____
Bidder: _____

[Required on non-judicial stamp paper; value of Rs. 100 stamp paper should be as per required value as per Stamp Duty Act]

To:

Deputy General Manager (Purchase)
Purchase Department
Pakistan Security Printing Corporation (Pvt.) Ltd
Jinnah Avenue, Malir Halt,
Karachi –Pakistan

Affidavit for Bidder's Blacklisting Status

Dear Sir,

I/We hereby confirm and declare that I/We, [Manager], has/have not been Blacklisted/Sanctioned by any Federal or Provincial Government Department, National Counter Terrorism Authority (NACTA), Agency, Organization or Autonomous Body anywhere in Pakistan during last 05 (five) years.

Detection of false declaration / statement at any stage of the entire Bidding Process / Currency of the Contract shall lead to Disqualification and forfeiture of Bid Security and/or Performance Guarantee and termination of contract.

Seal & Signature of Bidder: _____

Date: _____

Code of Conduct & Undertaking

Objective

This Code of Conduct aims to establish PSPC's business and employment practices on the highest standards of ethical behavior, integrity, accountability, courage and excellence.

It also aims to ensure that all concerned adhere to PSPC's defined core values, act with prudence, protect the interests of PSPC and maintain a positive work environment.

Scope

This Code of Conduct is applicable on all PSPC Employees, Contract Employees, Trainees, Apprentices, Deputationist, Outsourced Workforce, and other stakeholders.

General Behavior

The ethical principles of the Corporation prevail over the concerned individual's personal origins, beliefs, values, opinions, preferences, or habits at all times. All concerned, while they are in PSPC's service, shall strictly adhere to the following rules of General Behavior at all times which include, but are not limited to, the following responsibilities:

3.1. Comply with all applicable laws, including, but not limited to, those pertaining to general employment, anti-fraud, corruption, bribery, anti-discrimination, anti-harassment, health, safety and environmental protection.

3.2. Conduct themselves honestly and carry out their duties diligently and impartially to the best of their abilities, in compliance with the applicable rules, regulations, policies and procedures, as defined by PSPC from time to time.

3.3. Maintain highest standards of ethics and professionalism and devote their working activities to the service of PSPC.

3.4. Not guarantee or promise employment of any type to anyone for any length of time.

3.5. Assist and advise colleagues and show openness and transparency in all dealings with them.

3.6. Do not withhold information from concerned colleagues that may affect the conduct of business, particularly in order to gain a personal advantage. Providing false, inaccurate or exaggerated information, refusing to cooperate with colleagues or demonstrating any form of obstructive behavior is strictly not allowed.

3.7. Not indulge in any activity during off duty hours that directly or indirectly undermines the provisions of this Code, other PSPC rules, policies and procedures, or brings disrepute to PSPC.

3.8. Refrain from indulging in any illegal and unlawful activity including but not restricted to substance abuse and consumption of alcohol, drugs or any kind of intoxicant(s), as well as, any sort of gambling/betting activities, etc.

3.9. Officers of PSPC performing supervisory functions/roles on behalf of PSPC shall take every possible care to act within the delegated authority as provided by any law, rules or regulations under which such officers may purport to act.

Fraud, Embezzlement & Misrepresentation

4.1. All concerned shall not commit, or assist any activity that involves making false statements, fraud, forgery, misappropriation, theft, embezzlement, bribery, misrepresentation, violation of PSPC rules and regulations, policies and procedures or any similar activity that harms, or may harm the interest and reputation of PSPC.

4.2. Be honest in conveying professional conclusions, opinions, research and findings for whatever purpose and shall not manipulate the system for personal gains.

4.3. Refrain from indulging in any illegal and unlawful activity.

4.4. Abstain from any false or intentionally misleading information and declarations, bogus documents, and submit false or misleading claims with wrong information.

Discrimination and Harassment

5.1. All concerned shall treat all internal and external stakeholders with respect, fairness and courtesy and avoid all such forms of behavior that create or may create an atmosphere of harassment, hostility, intimidation and discrimination of any kind, especially involving age, gender, health, ancestry, physical disability, race, religion, length of service, political beliefs, marital status or family structure.

5.2. Shall not propagate in any manner whatsoever sectarianism, ethnic / regional hatred / animosity and take part in sectarian, ethnic, linguistic or parochial activities, as well as partiality or favoritism on these bases, indulge in nepotism, victimization, willful abuse of power, and unwarranted negative criticism and gossip about other employees.

5.3. Avoid creating / sending / forwarding electronic or any other form of communication that contains statements or material, which is discriminatory, offensive, defamatory, illegal or constituting harassment.

5.4. Refrain from engaging in any form of inappropriate relationship with persons with whom they have a professional relationship.

Confidentiality

6.1. All concerned shall maintain strict confidentiality of PSPC and its constituents affairs and shall not communicate directly or indirectly to their colleague(s) or (ex) employee(s) belonging to other department(s) or profession or to the press or public, any document or information which has come into their possession in the course of their official duties, or has been prepared or collected by them in the course of their duties, whether from official sources or otherwise, unless compelled to do so by judicial or other authority or unless instructed to do so by a superior officer in the discharge of his / her duties.

This confidentiality must be maintained by the employee even after the cessation of their employment with PSPC.

6.2. All concerned shall not give any evidence, document, or any information before a public committee without the prior approval of the Competent Authority.

6.3. Interaction or communication directly or indirectly on behalf of PSPC with foreign governments, media, and missions in Pakistan without seeking clearance from the competent authority is not permissible.

Use of PSPC Assets and Resources

7.1. All concerned are required to use PSPC assets such as properties, office equipment, supplies etc. for PSPC's business purposes and not for gain or benefit of persons or entities other than PSPC, including self.

7.2. Material information such as information contained in any file, document, note, report, letter, fax, USB, email, instrument, etc. held by the concerned must be used solely for the purpose of PSPC business and returned to PSPC upon cessation of employment / contract agreement.

7.3. Official information, documents, reports, proposals, research papers, software, etc. developed using PSPC time and resources constitute PSPC's intellectual property. All concerned will neither have the right to claim these as their own, nor shall they use/exploit the same for personal gain or benefit of persons or entities other than PSPC during or beyond cessation of their employment with PSPC.

Political Affiliation

8.1. No employee of PSPC shall take part in or subscribe in aid of or assist in any way, any political activity / movement in Pakistan or relating to the affairs of Pakistan, or take part in, or in any way assist, any movement or activity, which is, or tends directly or indirectly to be, subversive to Government as by law established in Pakistan or detrimental to the ideology or integrity of Pakistan.

8.2. Employees shall not canvass or otherwise interfere with or use their influence in connection with or take part in any election to a legislative body, whether in Pakistan or elsewhere, provided that an employee who is qualified to vote at such election may exercise their right to vote; but if he/she does so, he/she shall give no indication of the manner in which he/she proposes to vote or has voted.

Attendance and Punctuality

9.1. All concerned shall not leave the office or absent himself / herself from duty, without prior permission of the Competent Authority.

9.2. Strictly adhere to defined break timings, as defined by PSPC from time to time.

Conflict of Interest

10.1. All concerned are required to recognize and disclose activities that might give rise to conflicts of interest or the perception of conflicts and to ensure that such conflicts are properly managed or avoided. All disclosure should be made at the time the conflict arises, or when it is recognized that a conflict may be perceived, in writing to the supervisor. If the supervisor also has an interest in the matter, the disclosure shall be made to the next higher level of authority.

10.2. While an officer is serving in PSPC, their spouse, children and siblings will henceforth not be eligible for recruitment in PSPC, SBP and/or any of its other subsidiaries.

Gifts and Entertainment

11.1. Except as permitted, employees shall neither receive nor give any gift(s) or favor(s), in cash or any kind, from / to any organization, including those stakeholders (individual, entities or person created by law) who are in contact with PSPC.

11.2. The above instructions will not be applicable in case;

a. A gift received for value of up to Rs 10,000 provided aggregate value of gifts received / given from / to during a fiscal year from same source does not exceed Rs 20,000;
b. Advertising materials including trade discounts that an individual or entity normally offers to its general customers;

11.3. The intended recipient will politely refuse the offer of gifts valuing above. However, where such refusal may impact the official relationships, the gift so received would be immediately, but not later than 72 hours, surrendered to HR.

Prohibitions

12.1. Smoking or other use of tobacco products (including, but not limited to, cigarettes, pipes, cigars, electronic Cig, snuff, or chewing tobacco) is not permitted within the office premises. Employees may smoke outside in open air, at the designated areas, without compromising on the working hours.

12.2. Use of any sort of drug including Pan, Gutka, Naswar, etc. within the office premises is not allowed.

Self-Disclosure of Criminal Conviction

All employees are required to self-disclose any criminal offence for which any investigating agency have taken cognizance and for which a conviction has been decided against such an employee by any court of law while being professionally engaged with PSPC irrespective of the nature of engagement.

Health & Safety

All employees must take measures to promote safe working practices, and follow the instructions given by the Health, Safety, and Environment Team from time to time.

Whistleblowing

All concerned are responsible to immediately report any alleged ethical misconduct or fraud. The employees may raise their concerns through a written report or email at whistleblower@pspc.gov.pk. For more information on the applicability of this policy, refer to Whistleblowing Policy.

Compliance with the rules of conduct

Role of line managers

16.1.1. Line managers shall take the necessary measures to encourage respect for the rules of conduct within the entities for which they are responsible.

16.1.2. Managers should ensure that employees placed under their authority are aware of this code.

16.1.3. Apart from the vigilance, line managers are expected to behave in an exemplary manner as regards respect for the principles and rules set out in this code.

16.2. Any information pertaining to violation of this Code must immediately be reported to Director Human Resources.

16.3. If Director Human Resources is found to be violating this Code, MD may be reported. In case of violation by MD, Chairman PSPC may be reported.

Reporting Confidentially

17.1. All stakeholders when reporting to Director HR shall be deemed to have made such report in strict confidence.

17.2. Human Resource Department shall not disclose the identity of concerned employee to other parties unless it is in the interest of the Corporation or it is required by law.

Consequences of Violating the Code

18.1. Any employee who violates the Code shall be subject to disciplinary action.

18.2. Failure to report deviations of the Code by all concerned may result in disciplinary action. Similarly, failure to report deviations of the Code by other stakeholders may result in the termination of their relationship with the Corporation.

Interpretation

This policy shall supersede all previous policies on the subject. In case of any ambiguity in understanding this Policy, the interpretation of the Managing Director will be treated as final. Any exception to the policy shall be approved by the Managing Director on the recommendation of Director HR and shall be reported to Board Human Resource Committee for ratification.

Undertaking for Compliance with Code of Conduct

Bidder Name: _____

Bidder Representative (If any): _____

Date: _____

I, the undersigned, on behalf of [Bidder Company Name], hereby acknowledge that I have received, read, and understood the Code of Conduct established by [Procuring Agency Name].

As a bidder participating in the procurement process, I undertake to:

1. Adhere to the highest standards of integrity and professionalism in all interactions with PSPC
2. Ensure that all communications and representations made during the bidding process are truthful and transparent.
3. Comply with all applicable laws, regulations, and policies outlined in the Code of Conduct.
4. Avoid any conflicts of interest and disclose any potential conflicts promptly.
5. Report any unethical behavior or violations of the Code of Conduct to the appropriate authorities within PSPC.

I understand that any breach of this undertaking or the Code of Conduct may result in disqualification from the bidding process and potential legal consequences.

Authorized Signature: _____

Date: _____

Declaration for Ultimate Beneficial Owners Information

ITB No: _____
Title: _____
Bidder: _____

Declaration of Ultimate Beneficial Owners Information for Public Procurement Contracts

1. Name:
2. Father's Name/Spouse's Name:
3. CNIC/NICOP/Passport no:
4. Nationality:
5. Residential address:
6. Email address:
7. Date on which shareholding, control or interest acquired in the business:
8. In case of indirect shareholding, control or interest being exercised through intermediary companies, entities or other legal persons or legal arrangements in the chain of ownership or control, following additional particulars to be provided:

1	2	3	4	5	6	7	8	9	10
Name	Legal form (Company/Limited Liability Partnership/Association of Persons/Single Member Company/ Partnership Firm/ Trust/Any other individual, body corporate (to be specified))	Date of incorporation/	Name of registering authority	Business Address	Country	Email address	Percentage of shareholding, control or interest of BO in the legal person or legal arrangement	Percentage of shareholding, control or interest of legal person or legal arrangement in the Company	Identity of Natural Person who ultimately owns or controls the legal person or arrangement

9. Information about the Board of Directors (details shall be provided regarding number of shares in the capital of the company as set opposite respective names).

1	2	3	4	5	6	7	8
Name and surname (InBlock Letters)	CNIC No. (in case of foreigner ,Passport No)	Father's/ Husband's Name in full	Current Nationality	Any other Nationality (ies)	Occupation	Residential address infull or the registered/ principal office address for a subscriber other thannatural person	Number of shares taken by each subscriber (in figures and words)
Total number of shares taken (in figures and words)							

10. Any other information incidental to or relevant to Beneficial Owner(s).

Name & signature
(Person authorized to issue notice on behalf of the company)

Seal & Signature of Bidder: _____

Date: _____

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

UPLOAD JV DOCUMENTATION HERE

Non-Disclosure Agreement

Rs. 500/- Stamp Paper Print

P.O.#: _____

NON-DISCLOSURE AGREEMENT (NDA)

This agreement is entered into as of ……. day of……Year

between

Pakistan Security Printing Corporation (Pvt.) Limited, Manufacturer of Banknotes and Prize Bonds registered under the laws of Pakistan, having its registered office at Jinnah Avenue Malir Halt, Karachi, through its authorized representative_____(hereinafter referred to as '**PSPC',** which expression, where the context so requires and permits, shall mean and include its successors–in-interest, administrators, executors, legal representatives and permitted assigns);

and

_____**,** having its registered office at……through its authorized representative (hereinafter referred to as '**……..**' which expression, where the context so requires and permits, shall mean and include its successors–in-interest, administrators, executors, legal representatives and permitted assigns).

(PSPC and _____are hereinafter collectively referred to as the "Parties" and individually as a "Party").

Agreement' means this Agreement and all written amendments and revisions made thereto from time to time.

"Effective Date" means the date of execution of this Agreement.

'**State'** means the territory of the Islamic Republic of Pakistan.

WHEREAS

The Parties to this Agreement wishes to enter into an Agreement concerning the disclosure of certain proprietary and confidential information, whereby it will be necessary for each party (the "**Disclosing Party**") to disclose to the other Party (the "**Receiving Party**"), as the case may, information of a confidential or proprietary nature for the purposes as defined in the Agreement (**Authorized Purpose**) (irrespective of the form of presentation or communication including, but not limited to data, notes, analyses, compilations, studies, physical objects, samples, financial information, technical information, cost information, techniques, , material, methods, processes, sources and any other information, however, described, which is or could be valuable in the type of business in which Disclosing Party is engaged) provided that any disclosure of information made in writing shall be marked confidential or with words of similar effect and that any disclosure made orally shall subsequently be reduced to writing by the Disclosing Party and marked confidential or with words of similar effect with a copy sent to the Receiving Party within 30 days of disclosure ("Information").

IT IS AGREED AS FOLLOWS:

1. This Agreement will apply to any disclosure of Information on the Effective Date. This Agreement may be terminated by any Party after giving a prior notice of 30 (Thirty) days' in writing; or immediately if the Disclosing Party has reason to believe that the Receiving Party is in breach of any of the obligations contained herein. Such termination shall not affect any obligation imposed by this Agreement with respect to Information received prior to such termination.

2. Receiving Party shall hold and protect the Confidential Information in the same manner as it protects its own confidential information and in any event such protection shall not be less than that which a reasonable person or business would take in protecting its own confidential information; and shall use the Confidential Information for the sole and exclusive benefit of the Disclosing Party. Receiving Party shall carefully restrict access to Confidential Information and only disclose Information on a need-to-know basis to such of its employees, contractors, agents, representatives and consultants as is reasonably required, and are under similar obligations of confidentiality as contained in this Agreement, the use whereof shall be restricted for Authorized Purpose only.

   Receiving Party shall not, without the prior written approval of the Disclosing Party, use publish, copy, or otherwise disclose the Confidential Information to others, or permit the use by others for any purpose other than the Authorized Purpose. Receiving Party shall, forthwith upon receipt of a written request from the Disclosing Party or on termination:

(i) return all information supplied by the Disclosing Party as well as items and materials relating to or derived from the Information;
(ii) deliver to the Disclosing Party or at its request destroy immediately all items and materials made by the Receiving Party containing Information, that are not returned pursuant to paragraph (i) above;
(iii) not keep copies or duplicates of any items or materials referred to in paragraphs (i) or (ii) above; and
(iv) provide a certificate signed by a senior officer of the Receiving Party confirming that the provisions of this clause have been complied with.

3. This Agreement shall not apply to any Information which the Receiving Party: (a) can show is or becomes publicly available through no fault of the Receiving Party; (b) can show was in its possession prior to the date of disclosure; (c) may subsequently receive from any third party legally in possession of the Information and who was not restricted from disclosing it; (d) can show is independently acquired by the Receiving Party as a result of work carried out by an employee, consultant or contractor of the Receiving Party to whom no disclosure of Information has been made; or (e) is required to disclose pursuant to a court order or any law/rules/regulations provided that the Receiving Party shall have given prior written notice to the Disclosing Party.

4. This Agreement shall not be deemed to confer or imply the grant or agreement to grant by the Disclosing Party to the Receiving Parties of any of its rights under copyright, patents, trademarks, design rights or other similar rights. All Information supplied hereunder is supplied on an “as is” basis and the Disclosing Party gives no representation or warranty as to its accuracy, completeness or fitness for any purpose other than the Authorized Purpose. The Disclosing Party shall not be liable for any loss or damage suffered by the Receiving Parties as a result of any Receiving Party’s use of the Information.

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5. This Agreement does not create any agency or partnership relationship and each party shall act as an independent entity. This Agreement will not be assignable or transferable by the Parties. All additions or modifications to this Agreement must be made in writing and signed by the Parties.

6. Notices shall be delivered personally, or by prepaid first class mail, or transmitted by facsimile to the Parties at such address or number as the parties shall specify from time to time.

7. The Receiving party may obtain consent of the Disclosing party for any waiver of rights, to share information received under this Agreement to a third party for the Authorized Purpose. Any waiver of any right under this Agreement is only effective if it is in writing and applies to the specific circumstance for which it has been given.

8. In the event of a breach, Disclosing Party shall be entitled, in addition to any other remedies and damages available at law or in equity, to an injunction to restrain the violation thereof by Receiving Party, or its employees, contractors, agents, representatives and consultants,

1. This Agreement shall be governed by and shall be construed in accordance with the laws of Pakistan. In case of any dispute and difference which may arise in connection with the execution of the contract, the matter shall be referred to Director Operations of Corporation, who shall take decision in the matter. In case the dispute remains unresolved, the matter will be resolved through arbitration as per the Arbitration Act, 1940.

In WITNESS WHEREOF, the parties have executed this Agreement and shall be effective as of the date first above written.

For and on behalf of
Pakistan Security Printing Corporation

For and on behalf of

This Agreement has been executed in the presence of the following witnesses:

1. Full Name: _____

   Address: _____

   Signature: _____

   CNIC No: _____

2. Full Name: _____

   Address: _____

   Signature: _____

   CNIC No: _____

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Undertaking for Compliance with Health, Safety & Environment (HSE) Policy of PSPC

Bidder Name: _____

Bidder Representative (If any): _____

Date: _____

As a bidder participating in the procurement process, I undertake to comply with all applicable HSE laws, regulations and industry standards; and with all following HSE requirements of PSPC:

1. Suppliers / Contractors are responsible for the health, safety and well-being of their employees. The contractors will also be responsible to provide relevant personal protective equipment (PPEs) to their workforce where required.

2. Suppliers / Contractors who have their own HSE management system, shall provide details of the same on request.

3. The contractor / suppliers must take all necessary safety precautions related to the performance of contract in order to protect all worksites, including all personnel and property of the PSPC, the contractor, all third parties and the communities.

4. Contractor shall ensure that all personnel are adequately trained & skilled to perform the task assigned.

5. Supplier / Contractor shall ensure compliance with PSPC policies, procedures and applicable legal and regulatory requirements after award of contract and during execution. These policies and procedures can be obtained upon request from Purchase Department.

6. Contractor shall adhere to set standards and requirements for environmental protection.

I, the undersigned, on behalf of [Bidder Company Name], hereby acknowledge that I have received, read, and understood the HSE requirements of PSPC.

Authorized Signature: _____

Date: _____

To be executed at 0.35% N.J. Stamp Paper

PURCHASE CONTRACT (SERVICE)

SUBJECT: - _____

This agreement made on the _____ day of _____ effective from _____day of _____ between Pakistan Security Printing Corporation (Pvt.) Ltd. Situated at Jinnah Avenue, Malir Halt, Karachi Pakistan, hereinafter referred to as the "Corporation" (which expression shall unless repugnant to the context, mean and include their successors and assigns) of the FIRST PART, and Messer. _____ having is registered office at_____ hereinafter referred to as contractor (which expression unless repugnant to the context, mean and include its successors and assigned) of the SECOND PART: -

Whereas, the CORPORATION has entered into a CONTRACT with the Contractor for the above mentioned work at the premises of the Corporation as per specifications and details given in the Purchase order No._____ dated _____ amounting to Rs._____ (_____) as per following terms and conditions.

1. **Commencement of work:**
   That the contractor should commence the work within _____ days of Purchase order.

2. **Completion of Work:**
   That the whole work should be completed before _____ (_____ days) as given in purchase order.

3. **Liquidated Damages:**
   That if the said work is not completed within the stipulated period, a fine of 2% per month or part of the month will be imposed as penalty provided that damages shall not exceed 10% of the total price payable under the Purchase Contract. The contractor shall pay the liquidated to the Corporation otherwise the Corporation shall make deduction from contractor's bill.

4. **Force Majeure**:
   - **i.** That the Contractor shall not be held responsible for late or non-delivery of the goods due to strikes and generally recognized force majeure causes. However, in such cases, the Contractor shall deliver to the Corporation a certificate of the accident issued by the competent Government Authority and/or the Chamber of Commerce at the place where the accident occurred as evidence thereof, reasonable extension shall be granted at the option of the Corporation.
   - **ii.** That if any hindrance arises on site during execution such as un-accessibility to the site due to security reasons or any other reason or un availability of material services or some technical reasons from the "Corporation" side, the time so lost will be added to the agreed period of completion of the work provided such delays should be recorded in writing & duly forwarded to Purchase department.
   - **iii.** In case of delay, the Corporation shall have the right to complete the remaining work either departmentally or through another contractor at the risk and cost of contractor.

5. **Supervision:**

That the work will be done under the supervision of the user or his representative up-to their satisfaction, however, such supervision shall not absolve contractor from the responsibility & liability of completion of job according to contracted specification nor shall be interpreted in any way to imply acceptance/ satisfaction of contractor.

6. **Re- Execution of Job:**

That the work will be executed as per specification providing in tender & if it finds that the execution of the work is not in accordance with the satisfaction or the workmanship/ material is below standard, user Department of the Corporation shall order re-execution at the risk & cost of contractor.

7. **Lump Sum Basis:**

That quantities given in the B.O.Q, are provisional and can vary either way (Increase or decrease) and that the payment will be made to the contractor for actual work done and measured according to the prevalent Engineering practice, and if some extra item is required for the adequate and proper completion of the work and its rates are not available in B.O.Q, then the rates and the time of the same will be mutually discussed and decided. For any additional work, the prior approval from Purchase department will be required.

8. **Sub Letting:**

That the contractor shall not transfer or assign directly to any person or person any portion of this contract without prior written consent of the Corporation.

9. **Performance Guarantee:**

05% Performance Guarantee is required of the total contract amount (excluding taxes) for the period exceeding 28 days of contract period. The Performance Guarantee shall be in the form of an unconditional Bank Guarantee or insurance guarantee (PACRA Rating AAA & AA++ only) enforceable in Pakistan as per Performance Guarantee form specified in the Bidding Documents. Otherwise, Bid Security submitted with the tender document will be considered as part of performance guarantee and remaining amount will be deducted from the first bill of the contractor.

This amount will be refunded to the Contractor, after 30 days successful performance of the contract by them. The period of 30 days will be counted from the date of completion of the awarded job/work. The guarantee furnish by the Contractor shall only be in the nature of security for performance of the contract and the Corporation shall not be precluded from claiming any amount in excess of the sum mentioned in the guarantee by way of damages for the breach of contract.

10. **Claim:**

That if the Contractor fails to execute the job within the period stipulated in the contract, or if the workmanship is below the standard, or if contractor is failed to execute the job up to the satisfaction even after re-execution or if the material used is not in conformity with the contracted specification or reference samples, the Corporation shall have the right in addition to and not withstanding their right to claim compensation for breach of contract,

to terminate the un-executed part of the contract and make purchases from other sources at the risk and cost of the Contractor. The Contractor shall settle all claims referred by the Corporation within fifteen days of the receipt of the same and in the event of their failure to do so, shall be liable to pay interest @ 14% per annum of the amount claimed.

11. Payment:

Advance or part payment, if any, as per terms & conditions of Purchase Order/ BOQ. Payment/ part payment will be made by the Corporation through cheque within 30 days (95% in case of non-submission of Performance Guarantee) of receipt of invoice / bill by the General Manager (Finance & Accounts) of the Corporation, after completion/ partial completion of the job & receipt of all necessary documents from contractor & satisfactory completion certificate.

12. Taxes & Duties:

That the Contractor shall pay all taxes & charges with respect to transaction of business under this contract agreement liable under any law enforce for the time being which may subsequently enforce during the execution of this agreement.

13. Arbitration:

In case of any dispute and difference which may arise in connection with the execution of the contract, shall be referred to Managing Director of Corporation. The decision of whom shall be binding on both the parties. In case the dispute remains unresolved, the matter will be resolved through arbitration as per the Arbitration Act, 1940.

14 Termination:

The Corporation, without prejudice to any other remedy for breach of contract, by written notice of default sent to the Contractor, may terminate this contract in whole or in part:

A- If the Contractor fails to deliver any or all of the goods within the period(s) specified in the contract, or within any extension thereof.

B- If the Contractor fails to perform any other obligations(s) under the contract.

C- If the Contractor, in the judgment of purchaser, has engaged in corrupt or fraudulent practices in competing for or in executing the contract. In the event the purchaser terminates the contract in whole or in part, the purchaser may procure, upon such terms and in such manner as it deems appropriate, goods & services similar to those undelivered, and the supplier shall be liable to the purchaser for any excess costs for such similar goods or services. However, the contractor shall continue performance of the contract to the extent not terminated.

15. Other Conditions:

i. Any damage to PSPC property/ equipment during execution of job will be contractor's responsibility. The contractor shall repair/replace the damage property/equipment to the satisfaction of the Corporation.

ii. The Contractor shall maintain the work place & shall restore it to original condition in case of disturbance.

iii. The contractor will be responsible for supervision of job, provision of labor, tools, machines & material.

iv. No escalation in prices will be accepted.

16. CLOSURE OF CONTRACT

After satisfactory completion of the awarded job and payment to contractor this contract shall be considered as closed.

IN WITNESS WHEREOF the parties hereto have set their respective hands and seals on the day and year first above mentioned.

For and on behalf of CORPORATION

For and on behalf of the CONTRACTOR

Signature.: _____ Name. _____ **PAKISTAN SECURITY PRINTING CORPORATION (PVT.) LTD.** Jinnah Avenue, Malir Halt, Karachi.	Signature. _____ Name. _____ _____ _____ _____
W I T N E S E S: - Signature : _____ Name : _____ Address : _____ _____ _____ N.I.C. NO. : _____	**W I T N E S E S: -** Signature : _____ Name : _____ Address : _____ _____ _____ N.I.C. NO. : _____

Payment Terms for Air Side Local Works Tender

Sr.	Payment Stage	Deliverables / Conditions for Payment	Remarks
1	Engineering, Design & Submittal, Approval	Approved shop drawings, equipment schedules, material submittals, method statements, HSE Plan, QA/QC Plan, approved phasing/shutdown programme and mobilization of the project team at PSPC site.	Upon Approval from Consultant and PSPC
2	Material Supply & Delivery	Progressive payment against supply and delivery to PSPC site of approved BOQ items, including: 1. Fans 2. Water Humidifier System 3. MCCs 4. BMS complete controls 5. Tools and instrument	Progressive payment against actual approved supply/delivery, please refer to IPC format supply and services/ installation amount to be added separately
3	Installation of items	Progressive payment against installation of supplied approved BOQ items including: 1. Meters & Gauges 2. Piping 3. Valves & Specialties 4. Ducting with insulation & cladding 5. Power cabling 6. Earthing 7. Air Devices 8. Other applicable miscellaneous BOQ items.	Please refer to IPC format supply and services/ installation amount to be added separately
4	Phased Works – Demolition & Installation	Progressive payment against execution/installation of the following BOQ items: 1. Foundation pads for owner furnished AHUs 2. Owner-Furnished AHUs 3. Fans 4. Water Humidifier System 5. MCCs 6. BMS 7. Other applicable items including complete dismantling, removal and disposal of old HVAC system i.e. AHUs, Ducting with accessories, piping and supports.	Progressive payment against measured work. Department-wise dismantling and installation of ductwork, piping, AHUs shall be acceptable for IPC purposes, please refer to IPC format supply and services/ installation amount to be added separately
5	Pressure testing and allied works	Completion of pressure testing, flushing, cleaning, electrical testing, equipment checks, control-loop verification, point-to-point verification and submission of relevant test records.	Upon satisfactory completion

Sr.	Payment Stage	Deliverables / Conditions for Payment	Remarks
6	Testing, Adjusting & Balancing (TAB)	Successful completion and acceptance of airside and water-side balancing, adjustment of system parameters and submission/acceptance of TAB reports.	Upon satisfactory completion
7	Integrated Commissioning & BMS Functional Testing	Successful integrated operation of HVAC systems, BMS graphics, alarms, interlocks, control sequences, monitoring/control functions, setpoints, automatic/manual functions and functional testing of integrated systems.	Upon satisfactory functional testing
8	Complete HVAC System Test Run & Performance Demonstration	Successful completion of the contractual test run and demonstration of specified HVAC performance parameters, including applicable airflow, chilled-water flow, temperature, humidity, pressure and other specified performance criteria, hands on training for operations and maintenance of complete.	Upon successful performance demonstration
9	Training of PSPC team	Successful completion of the training of PSPC team for Operations and Maintenance of HVAC system including BMS.	Please refer to IPC format supply and services/ installation amount to be added separately
10	Taking-Over / Completion & Handover	Substantial completion of the works; closure of major punch-list items; submission and acceptance of as-built drawings, O&M manuals, testing and commissioning records, equipment schedules, training records, BMS backup/database, software/licenses, spare parts, tools and other required handover documentation.	Documents with complete details
11	Defects Liability Period (DLP)	Rectification of defects, deficiencies and operational issues arising during the DLP, including repair/replacement of defective components and submission of relevant rectification records.	Payment/retention release subject to DLP requirements as per PSPC Purchase terms and conditions

Commercial Terms as per Purchase Recommendation	
Completion Period of Project	8 to 10 months (After award of contract)
Performance Guarantee	**i)** The Performance Guarantee of 5% of the total value of contract shall be submitted at the time of award of contract in the form of an unconditional Bank Guarantee enforceable in Pakistan, or insurance guarantee *(PACRA Rating "AAA, AA++")*. The guarantee must be valid for a period exceeding 28 days after completion of contract and Defect Liability Period/warranty period. **ii)** The bidder will submit the performance guarantee within 10 days of the issuance of Letter of Intent. Already submitted earnest money will be released upon receipt of performance guarantee.
Mobilization advance (10%):	An advance of ten percent (10%) of the total Contract value shall be payable against Bank Guarantee/Insurance Guarantee *(PACRA Rating "AAA, AA++")*, to be recovered proportionately through deductions of ten percent (10%) from each Interim Payment Certificate (IPC).
Payment Mode	Payments shall be made through Interim Payment Certificates (IPCs) as per attached format.
Defect Liability Period & Performance Guarantee	The Defects Liability Period shall be two (2) years from the date of Completion of the Project.

REPLACEMENT OF HVAC SYSTEM AT PAKISTAN SECURITY PRINTING CORPORATION , KARACHI

Project Name:

RUNNING BILL # –

DATE:

ITEM NO.	DESCRIPTION AS OER BOQ	BOQ QUANTITY	UNIT	BOQ				PREVIOUS IPC				CURRENT IPC				BALANCE AMOUNT			
				MATERIAL/ SUPPLY		INSTALLATION / SERVICES		MATERIAL / SUPPLY		INSTALLATION / SERVICES		MATERIAL / SUPPLY		INSTALLATION / SERVICES		MATERIAL / SUPPLY		INSTALLATION / SERVICES	
				RATE (Rs.)	AMOUNT (Rs.)	RATE (Rs.)	AMOUNT (Rs.)	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY	AMOUNT	QTY TOTAL	AMOUNT	QTY TOTAL	AMOUNT
1.0	-																		
1.1	-																		
Sub-total Carried to Summary																			
MATERIAL + INSTALLATION						+													
TOTAL FINAL AGREED VALUE (excluding taxes)																			

Contractor's Representative and Key Personnel Schedule

Bidders should provide the names and details of the suitably qualified Contractor's Representative and Key Personnel to perform the Contract. The data on their experience should be supplied using the Form PER-2 below for each candidate.

Contractor' Representative and Key Personnel

1.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
2.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
3.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
4.	**Title of position:**	
	Name of candidate:	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]

	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
5.	**Title of position:**	
	Name of candidate	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]
6.	**Title of position:** *[insert title]*	
	Name of candidate	
	Duration of appointment:	[*insert the whole period (start and end dates) for which this position will be engaged*]
	Time commitment: for this position:	[*insert the number of days/week/months/ that has been scheduled for this position*]
	Expected time schedule for this position:	[*insert the expected time schedule for this position (e.g. attach high level Gantt chart*]

Form PER-2:
Resume and Declaration
Contractor's Representative and Key Personnel

Name of Bidder

Position [*#1*]: [*title of position from Form PER-1*]		
Personnel information	**Name:**	**Date of birth:**
	Address:	**E-mail:**
	Professional qualifications:	
	Academic qualifications:	
	Language proficiency: *[language and levels of speaking, reading and writing skills]*	
details		
	Address of Employer:	
	Telephone:	**Contact (manager / personnel officer):**
	Fax:	
	Job title:	**Years with present Employer:**

Summarize professional experience in reverse chronological order. Indicate particular technical and managerial experience relevant to the project.

Project	**Role**	**Duration of involvement**	**Relevant experience**
[main project details]	*[role and responsibilities on the project]*	*[time in role]*	*[describe the experience relevant to this position]*

Declaration

I, the undersigned *[insert either "Contractor's Representative" or "Key Personnel" as applicable]* , certify that to the best of my knowledge and belief, the information contained in this Form PER-2 correctly describes myself, my qualifications and my experience.

I confirm that I am available as certified in the following table and throughout the expected time schedule for this position as provided in the Bid:

Commitment	**Details**
Commitment to duration of contract:	*[insert period (start and end dates) for which this Contractor's Representative orKey Personnel is available to work on this contract]*
Time commitment:	*[insert period (start and end dates) for which this Contractor's Representative orKey Personnel is available to work on this contract]*

I understand that any misrepresentation or omission in this Form may:

(a) be taken into consideration during Bid evaluation;

(b) result in my disqualification from participating in the Bid;

(c) result in my dismissal from the contract.

Name of Contractor's Representative or **Key Personnel: [*insert name*]**

Signature: _____

Date: (day month year): _____

Countersignature of authorized representative of the Bidder:

Signature: _____

Date: (day/month/year): _____

Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as specified in Eligibility and Qualification Criteria.

No.	**Source of financing**	**Amount (Eq. PKR)**
1		
2		
3		

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Past Experience / Contracts

Contracts over *[insert amount]* during the last three years:				
Procuring Agency	Value	Year	Goods/Services Supplied	Country of Destination

PUBLIC PROCUREMENT REGULATORY AUTHORITY (PPRA) EPADS

Historical Contract Non-Performance, and Pending Litigation and Litigation History

[The following table shall be filled in for the Applicant and for each member of a Joint Venture]

Applicant's Name: *[insert full name]*
Date: *[insert day, month, year]*
Joint Venture Member Name: *[insert full name]*
IFP No. and title: *[insert IFP number and title]*
Page *[insert page number]* of *[insert total number]* pages

☐ Not debarred due to deviation from commitment of Bid Securing Declaration-☐ Not debarred due to non-performance			
Year	**Non-performed portion of contract**	**Contract Identification**	**Total Contract Amount (current value, currency, exchange rate and PKR equivalent)**
[insert year]	*[insert amount and percentage]*	Contract Identification: *[indicate complete contract name/ number, and any other identification]* Name of Procuring Agency: *[insert full name]* Address of Procuring Agency: *[insert street/city/country]* Reason(s) for nonperformance: *[indicate main reason(s)]*	*[insert amount]*
Pending Litigation, in accordance with Section III, Qualification Criteria and Requirements			
☐ Pending litigation in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.3 as indicated below.			

Year of dispute	**Amount in dispute (currency)**	**Contract Identification**	**Total Contract Amount (currency), ~~US$~~ PKR Equivalent (exchange rate)**

[insert year]	*[insert amount]*	Contract Identification: [indicate complete contract name, number, and any other identification] Name of Procuring Agency: *[insert full name]* Address of Procuring Agency: *[insert street/city/country]* Matter in dispute: *[indicate main issues in dispute]* Party who initiated the dispute: *[indicate "Procuring Agency" or "Supplier"]* Status of dispute: *[Indicate if it is being treated by the Adjudicator, under Arbitration or being dealt with by the Judiciary]*	*[insert amount]*
☐ No consistent history of court/arbitral award decisions in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.4. ☐ Consistent history of court/arbitral award decisions in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.4 as indicated below.			
Year of award	**Outcome as percentage of Net Worth**	**Contract Identification**	**Total Contract Amount (currency), PKR Equivalent (exchange rate)**
[insert year]	*[insert percentage]*	Contract Identification: [indicate complete contract name, number, and any other identification] Name of Procuring Agency: *[insert full name]* Address of Procuring Agency: *[insert street/city/country]* Matter in dispute: *[indicate main issues in dispute]* Party who initiated the dispute: *[indicate "Procuring Agency" or "Supplier"]* Court/ arbitral award decision: *[Indicate if the award decision was against the Applicant or any member of a joint venture.]y]*	*[insert amount]*

Current Contract Commitments / Works in Progress

Bidders and each member to a JV should provide information on their current commitments on all contracts that have been awarded, or for which a letter of intent or acceptance has been received, or for contracts approaching completion, but for which an unqualified, full completion certificate has yet to be issued.

Current Contract Commitments					
No.	Name of Contract	**Employer's Contact Address, Tel, Fax**	**Value of Outstanding Work [Current Eq. PKR]**	**Estimated Completion Date**	**Average Monthly Invoicing Over Last Six Months [Eq. PKR/month)]**
1					
2					
3					
4					
5					

Average Annual Turnover (Annual Sales Value)

[The following table shall be filled in for the Applicant and for each member of a Joint Venture]

Applicant's Name: *[insert full name]*
Date: *[insert day, month, year]*
Joint Venture Member Name: *[insert full name]*
IFP No. and title: *[insert IFP number and title]*
Page *[insert page number]* of *[insert total number]* pages

Annual Turnover Data			
Year	**Amount** **Currency**	**Exchange rate*** **(If applicable)**	**PKR equivalent**
[indicate calendar year]	*[insert amount and indicate currency]*		
		Average Annual Turnover **	

* Refer ITA for date and source of exchange rate.

** Total PKR equivalent for all years divided by the total number of years. See Section III, Qualification Criteria and Requirements, ITA.