**FORM OF BANK GUARANTEE/BOND FOR ADVANCE PAYMENT**

(For Imported goods only as per PCC 33.1.1.a)

Guarantee No._____
Executed on_____
Expiry date _____

[Letter by the Guarantor to the Employer]

WHEREAS the _____ (hereinafter called the Employer) has entered into a Contract for _____ _____ _____ (Particulars of Contract), with _____ _____ (hereinafter called the Contractor).

AND WHEREAS the Employer has agreed to advance to the Contractor, at the Contractor's request, an amount of Rupees_____ (Rs._____) which amount shall be advanced to the Contractor as per provisions of the Contract.

AND WHEREAS the Employer has asked the Contractor to furnish Guarantee to secure advance payment for performance of his obligations under the said Contract.

AND WHEREAS _____ (Bank) (hereinafter called the Guarantor) at the request of the Contractor and in consideration of the Employer agreeing to make the above advance to the Contractor, has agreed to furnish the said Guarantee.

NOW THEREFORE the Guarantor hereby guarantees that the Contractor shall use the advance for the purpose of above mentioned Contract and if he fails, and commits default in fulfillment of any of his obligations for which the advance payment is made, the Guarantor shall be liable to the Employer for payment not exceeding the aforementioned amount.

Notice in writing of any default, of which the Employer shall be the sole and final judge, as aforesaid, on the part of the Contractor, shall be given by the Employer to the Guarantor, and on such first written demand payment shall be made by the Guarantor of all sums then due under this Guarantee without any reference to the Contractor and without any objection.

This guarantee shall come into force as soon as the advance payment has been credited to the account of the Contractor.

This guarantee shall expire not later than _____
by which date we must have received any claims by registered letter, telegram, telex or telefax.

It is understood that you will return this Guarantee to us on expiry or after settlement of the total amount to be claimed hereunder.

_____
Guarantor (Bank)

Witness:

1. _____
_____
Corporate Secretary (Seal)

Signature _____
Name _____

Title _____

2. _____
_____
Name, Title & Address

_____
Corporate Guarantor (Seal)

## FORM OF DECLARATION OF NO BLACKLISTING AND LITIGATION

*(To be submitted on non-judicial stamp paper or e-stamp paper)*

I/we _____, address _____, do hereby solemnly affirm and declare as under:-

- That our firm has not been blacklisted/ debarred from any Government/ Semi Government/ Autonomous/ Public Sector Organization or any Agency.
- That the firm has not been involved in any kind of litigation.
- That there is no litigation between partners of the firm.

We further, affirm and declare that above is true to best of our/my knowledge and that nothing has been concealed or hidden therein.

Signature of authorized signatory
Name: _____
Designation: _____
CNIC: _____
Seal/ Stamp: _____
Date: _____

**Note:**

i. Duly signed by owner/CEO of the company or authorized representative having authority letter.
ii. To be submitted on non-judicial stamp paper.

# ANNEXURES OF BID DOCUMENT

Annexures attached are as follows:

Annexure - 1. Form of Bid
Annexure - 2. Eligibility Information
Annexure - 3. Bill of Quantities with Approved Manufacturers List & Origin of Goods/Equipment and Technical Specification
Annexure - 4. Drawings

**ANNEXURE – 01**

## FORM OF BID
(LETTER OF OFFER)

Bid Reference No. _____

_____
_____
(Name of Works)

To:

_____
_____
_____

Gentlemen,

1. Having examined the Bidding Documents including Instructions to Bidders, Conditions of Contract, Specifications, Drawings, Schedule of Prices and Addenda Nos. _____ for the execution of the above-named Works, we, the undersigned, being a company doing business under the name of and address _____
_____
and being duly incorporated under the laws of _____ hereby offer to execute and complete such Works and remedy any defects therein in conformity with the said Documents including Addenda thereto for the Total of Rs._____(Rupees_____
_____) or such other sum as may be ascertained in accordance with the said Documents.

2. We understand that all the Schedules attached hereto form part of this Bid.

3. As security for due performance of the undertakings and obligations of this Bid, we submit herewith a Bid Security in the amount of _____
_____ drawn in your favour or made payable to you and valid for a period twenty eight (28) days beyond the period of validity of Bid.

4. We undertake, if our Bid is accepted, to commence the Works and to deliver and complete the whole of the Works comprised in the Contract within the time(s) stated in Preamble to the Conditions of Contract.

5. We agree to abide by this Bid for the period of _____ days from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiration of that period.

6. Unless and until a formal Agreement is prepared and executed, this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.

7. We undertake, if our Bid is accepted, to execute the Performance Security referred to in Clause 10 of Conditions of Contract for the due performance of the Contract.

We understand that you are not bound to accept the lowest or any Bid you may receive.

9. We do hereby declare that the Bid is made without any collusion, comparison of figures or arrangement with any other person or persons making a Bid for the Works.

10. We confirm, if our Bid is accepted, that all partners of the joint venture shall be liable jointly and severally for the execution of the Contract and the composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer. (Please delete in case of Bid from a single firm).

Dated this _____ day of _____ 2024

Signature _____ in the capacity of _____ duly

authorized to sign bids for and on behalf of _____

(Name of Bidder in Block Capitals)

(Seal)

Address

_____

_____

_____

Witness:

(Signature)_____

(Name)_____

Address:_____

_____

Occupation_____

**ANNEXURE – 02**

**ELIGIBILITY AND QUALIFICATION INFORMATION**

**[The Bidder should complete this schedule and attach relevant supporting documents]**

**2.1 STATUS OF BIDDER:**

| | |
|---|---|
| Bidder's Legal Name: | |
| Owner's Name(s) and CNIC (s) | |
| Country of Registration: | |
| Address in Country of Registration: | |
| Year of Registration with SECP; | |
| Pakistan Eng. Council License No | |
| Tax Identification Number | |
| Mobile No of Authorized Representative for this Tender | |
| Landline Contact Number | |
| Valid Email Address | |

## 2.2 SIMILAR NATURE OF ASSIGNMENTS

| **Contract No 1** | | |
|---|---|---|
| Contract Name: | | |
| Award Date:<br>Completion Date: | | ____ %age completed |
| Role in Contract (Contractor or Sub Contractor): | | |
| Brief Description of Work undertaken | | |
| Total Contract Amount in PKR | | |
| If partner in a JV or subcontractor, specify participation of total contract amount: | Percentage of Total: | |
| Employer's Name<br>Address<br>Telephone Number<br>Fax Number<br>e-mail address | | |

*(ADD MORE SHEETS BASED ON EVALUATION CRITERIA)*
*(ALSO ATTACH COMPLETION CERTIFICATES, WORK ORDER/LETTER OF ACCEPTANCE OF EVERY ASSIGNMENT)*

## 2.3 ANNUAL TURNOVER OF THE FIRM FOR THE LAST THREE YEARS

| Year | Total Amount for the Year in Millions of PKR |
|---|---|
| | |
| | |
| | |

## 2.4 PROPOSED TEAM

| Name | Role/Responsibility | Qualifications & General experience (years) | Experience in proposed post (years) |
|---|---|---|---|
| | Project Manager | | |
| | Site Supervisor | | |
| | | | |
| [*complete and attach CV for the nominee(s)*] | | | |

## 2.5 APPROACH AND METHODOLOGY AND BAR CHART

*To be provided on by the Bidders on their standard formats*

## 2.6 Attach certificate of No litigation and Non-Blacklisting of the company from any Govt. / Semi Government / Private organization

| | | | |
|---|---|---|---|
| Authorized Signature: | | Date | |
| Name & Title of Signatory: | Name:<br>Title: | | |

Duly authorized to sign on behalf of

| | | |
|---|---|---|
| Company Name of Bid | | Seal or stamp |

## Bill of Quantities (BOQ)

**ANNEXURE - 03**

Enclosed are approved vendor/Manufacturer List and Technical Specification

**Permeable**

1. Bill of Quantities (BOQ) with approved vendor/Manufacturer List and Technical Specification is issued in a separate booklet Form/ File and construes mandatory part of this Tender Document.

2. Detailed Bill of Quantities (BOQ) to be filled by Bidders without changing the line item or specification.

3. Eligibility of goods & services shall be as per BOQ with approved vendor/Manufacturer List and Technical Specifications, Drawings (Annexure – 04).

4. Pursuant to Para 2 above, the successful contractor shall have to submit technical submittals as per Schedule – A.

5. Overwriting is not acceptable however in minimal circumstances it shall be crossed signed with bidder's seal.

**ANNEXURE - 04**

## DRAWINGS

Detailed Drawings' separate booklet/ File, issued to bidder as a mandatory part of this tender document. Bidder should duly sign and stamp each page and submit with technical proposal.

# CINEPLEX AND COMMERCIAL COMPLEX

## SUMMARY OF TOTAL ESTIMATED COST

### 415V DIESEL GENERATOR SETS

| SR. NO. | DESCRIPTION | TOTAL AMOUNT (RS.) |
|---|---|---|
| | | |
| 1 | Supply of Generators | |
| 2 | Installation, Testing and Commissioning of Generators including Sales Tax | |
| | | |
| TOTAL AMOUNT EXLUSIVE OF SERVICE TAX (PKR) | | - |

# CINEPLEX AND COMMERCIAL COMPLEX
## BILL OF QUANTITIES

| SR.NO. | DESRCIPTION | UNIT | QUANTITY | RATE (RS.) | AMOUNT (RS.) |
|---|---|---|---|---|---|
| E-2 | **DIESEL STANDBY GENERATORS** | | | | |
| 2.1 | **GENERATORS** | | | | |
| 2.1.1 | Supply of 415Volts, Three phase four wire, 50 Hz Skid mounted, 900 KVA - Prime Rating (at 45C') Brand New Diesel Generator Set including Canopy and built-in fuel tank and all required accessories complete in all respects | Nos. | 2 | | |
| 2.1.2 | Supply of 415Volts, Three phase four wire, 50 Hz Skid mounted, 250 KVA - Prime Rating (at 45C') Brand New Diesel Generator Set including Canopy and built-in fuel tank and all required accessories complete in all respects | Nos. | 1 | | |
| | **TOTAL AMOUNT (RS.)** | | | | - |

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# CINEPLEX AND COMMERCIAL COMPLEX
## BILL OF QUANTITIES

| SR.NO. | DESRCIPTION | UNIT | QUANTITY | RATE (RS.) | AMOUNT (RS.) |
|---|---|---|---|---|---|
| E-2 | **DIESEL STANDBY GENERATORS** | | | | |
| 2.1 | **GENERATORS** | | | | |
| 2.1.1 | Installation and Commissioning and testing of 415Volts, Three phase four wire, 50 Hz Skid mounted, 900 KVA - Prime Rating (at 45C') Brand New Diesel Generator Set including Canopy and built-in fuel tank and all required accessories complete in all respects | Nos. | 2 | | |
| 2.1.2 | Installation, Commissioning and testing of 415Volts, Three phase four wire, 50 Hz Skid mounted, 250 KVA - Prime Rating (at 45C') Brand New Diesel Generator Set including Canopy and built-in fuel tank and all required accessories complete in all respects | Nos. | 1 | | |
| | **TOTAL AMOUNT (RS.)** | | | | - |
| | **ADD SERVICE SALES TAX @ 16%** | | | | - |
| | **GRAND TOTAL WITH SERVICE SALES TAX (PKR)** | | | | - |

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## Annexure "A" to B.O.Q.

### LIST OF APPROVED MANUFACTURERS AND SUPPLIERS FOR ELECTRICAL WORKS & LOW CURRENT SYSTEMS

**(To be signed by the Tenderer)**

The Contractor shall use material only from the following approved manufacturers in the Works. The Contractor shall provide samples / literature etc. of the items to the Client/ Consultant for all materials for his selection and approval.

| S. No. | Equipment / Material | Make/Supplier/Manufacture |
|---|---|---|
| 1. | Oil Filled Indoor Transformer | PEL<br>M-Tech<br>Elmetec<br>or Approved Equivalent |
| 2 | Diesel Generator | Engine:<br>Caterpillar<br>PERKINS<br>CUMMINS or approved equivalent<br>Alternator:<br>Stamford or Mcalte or approved equivalent.<br>(*Locally Coupled Engine shall not be approved See Coupling Systems details in Technical Specifications*) |
| 3. | Main Panel Boards,<br>Sub Main Panel Boards and<br>Distribution Boards, | Electrech<br>M-Tech<br>Ercon<br>Capital Electro<br>Or approved Equivalent |
| 4. | PFI Plant | Electrech<br>M-Tech<br>Ercon<br>Capital Electro<br>Or approved Equivalent |
| 5. | Moulded Case Circuit Breakers,<br>Miniature<br>Circuit Breaker, Air Circuit<br>Breaker | Terasaki<br>Legrand<br>General Electric<br>Schneider<br>ABB<br>Or approved Equivalent |

| | | |
|---|---|---|
| 6. | Current Transformers | Fico<br>Lovato<br>Entes, Frer, Siba or<br>Equivalent |
| 7. | Ammeters (Digital)<br>Voltmeters (Digital) | Autonics,<br>Emzed F & G,<br>Togami<br>Entes,<br>Frer,<br>Lumel or Equivalent |
| 8 | Relays | Finder<br>Samwha<br>Emirel<br>Schneider Electric or approved equivalent |
| 9 | Timers | Nias<br>Samwha<br>Panasonic<br>Autonics<br>or approved equivalent |
| 10 | Selector Switches (Ammeter Selector) ASS<br>(Voltmeter Selector) VSS | Kelvin & Breter,<br>Kraus & Niamer,<br>Bremas, Merz or<br>Equivalent |
| 11 | Contactors | Hitachi,<br>Terasaki<br>Telemecanique Schneider<br>Fuji<br>Siemens, ABB<br>or Equivalent |
| 12 | Instrument Protection Fuses | Legrand,<br>Socomec Kaleporselen,<br>Siba or Equivalent |
| 13 | Indication Lamps | Fuji,<br>Legrand, GE<br>or Equivalent |

| | | |
|---|---|---|
| 14 | Wiring Terminals | Ciama,<br>Legrand,<br>Cabur, GE or Equivalent |
| 15 | L.T Cables 600/1000 V or as per BOQ. | Pakistan Cables,<br>Fast Cables<br>Newage Cables<br>or Equivalent |
| 15 | H.T Cables 15 kV or as per BOQ. | Pakistan Cables,<br>Fast Cables<br>or Equivalent |
| 16 | Stranded copper conductor<br>Copper strip | Pakistan Cables,<br>Fast Cables<br>Newage Cables<br>or Equivalent |
| 17. | ON / OFF Push Buttons | Fuji,<br>Legrand,<br>Maruyasu or Equivalent |
| 18. | Isolators | Katko<br>Socomec |
| 18. | PVC Conduits &<br>Accessories Fan Hooks | Popular,<br>Beta,<br>DADAX<br>or Equivalent |
| 19. | Ceiling fans<br>Wall bracket fans<br>Exhaust Fans<br>Revolving Fans | Pak Fans,<br>Royal Fans,<br>GFC<br>or Equivalent |
| 20. | Light Fixtures | Philips<br>Sunlight<br>Pierlite<br>Global Lighting<br>Or Equivalent |
| 21 | Switch & Socket Outlets | Clipsal<br>MK<br>Legrand<br>ABB or Equivalent |

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| | | |
|---|---|---|
| 22 | Emergency / Exit Lights | Bardic (Honeywell)<br>Marshall<br>Menvier (Cooper) or approved equivalent |
| 23 | Back Box, Pull Box, Junction Box | Clipsal<br>Hussain & Co.<br>Electroline Davis<br>or approved equivalent |
| 24 | Lightning Protection System | Furse (ABB)<br>Erico (nVent) LPI<br>or approved equivalent |
| 25 | Cable Tray / Trunking | M-Tech<br>SRA International<br>Green T&D<br>Capital Electro<br>Or approved Equivalent |
| 26 | G.I. / Steel Conduits & Accessories | IIL<br>Steelex<br>Hilal Industriel or approved equivalent |
| 27 | Cable Glands, Lugs, Terminals, Labelling accessories, etc | Cembre<br>Hubbell / Hawke or approved equivalent |
| **28** | | |
| 28.1 | Voice / Telephone Faceplate, I/O Socket | Norden,<br>3M,<br>Clipsal or Equivalent |
| 28.2 | Voice / Telephone Cat-6A UTP Cable or as per BOQ. | Norden,<br>3M, Clipsal or Equivalent |
| 28.3 | Main Distribution Frame & Telephone Distribution Board | Norden,<br>3M, Clipsal or Equivalent |
| 28.4 | For all other Items required to complete the Job. | Norden,<br>3M, Clipsal or Equivalent |
| **29** | | |
| 29.1 | Data Faceplate, I/O Socket | Norden,<br>3M,<br>Clipsal or Equivalent |

| | | |
|---|---|---|
| 29.2 | Data & Voice Cabinet (DVC) as specified in BOQ/ Tender | Norden,<br>3M,<br>Clipsal or Equivalent |
| 29.3 | Data Cable Cat-6A UTP or as per BOQ | Norden,<br>3M,<br>Clipsal or Equivalent |
| 29.4 | For all other Items required to complete the Job. | Norden<br>3M,<br>Clipsal or Equivalent |
| **30** | **Fire Alarm System** | |
| 30.1 | Smoke Detectors, Heat Detectors, Fire Bell, Manual Call Stations | Notifier<br>Gent<br>Honeywell,<br>Copper Menvier<br>or Equivalent |
| 30.2 | Fire Alarm Control Panel, as specified in BOQ/tender. | Notifier<br>Gent<br>Honeywell or Equivalent |
| 30.3 | Fire Retardant Cable | Fast Cables<br>Coppergat Cables<br>Pakistan Cables or Equivalent |
| **31** | **CCTV System** | |
| 31.1 | Dome & Bullet Type Cameras | Pelco<br>Honeywell<br>Bosch<br>Hikvision<br>Dahua<br>CPplus or Equivalent |
| 31.2 | Network Video Recorder (NVR) | Pelco<br>Honeywell<br>Dahua<br>Bosch or Equivalent |
| 31.3 | Switches | Cisco<br>HP<br>TP Link<br>Dahua<br>Huawei or Equivalent |

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| | | |
|---|---|---|
| 31.4 | Cat-6A UTP for wiring of CCTV System | Norden<br>3M<br>Schneider<br>Clipsal<br>Systemix or Equivalent |

Note:

1- The Electrical Contractor is advised to mention the name of make / vendor / supplier or manufacturer on which the bid is based. The contractor shall submit delivery challan, shipping documents and ISO certificate of supplier/manufacturer. Contractor shall ensure that the supplied equipment shall have country of origin from which Govt. of Pakistan has bilateral relations.

SIGNATURE OF CONTRACTOR

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# SECTION 3: DIESEL GENERATORS

## PART ONE: GENERAL

### 3.1.1 SCOPE OF WORKS

The scope of work shall cover the supply, design, manufacture, packing, delivery to site, unloading, hoisting to location, installation, testing and commissioning of all components with all the necessary accessories in accordance with this technical specification.

### 3.1.2 SHOP DRAWINGS

The Contractor shall include the following with the shop drawings:

- Outline drawings of unit and base.
- Total weight of unit and base.
- Air required for combustion and cooling (1/5).
- Heat radiated from engine and generator (kW).
- Weight and dimensions of muffler.
- Fuel consumption at 1/4, 1/2, 3/4 and full load, at 510m above sea level.
- Outline drawings and details of batteries, rack, and charger.
- Outline drawing and details of control panel.
- Schematic diagrams of all systems, wiring diagrams and layout drawings.
- Bill of materials listing all replaceable components by manufacturer and catalog number.
- Complete detailed description of engine, alternator, exciter and auxiliary equipment.
- Certificate of manufacturer's inspection of the crankshaft, including statement of inspection method.
- Tripping curves of main circuit breaker, showing damage and decrement curves on alternator for normal load, overload, and short circuit conditions, for alternators rated 100 used large.

### 3.1.3 INSTRUCTION MANUAL

The Contractor Shall Provide 3 copies of an Instruction Manual for the set, including the following:

- Outline drawing of unit and base.
- Maintenance and operating bulletins for engine, alternator, exciter, voltage regulator and governor.

- Parts list of all replaceable components, by manufacturer's name and catalog number.
- Schematic diagram of lubrication system.
- Schematic diagrams of engine start up and shut down systems alternator auxiliaries and controls.
- Wiring diagrams of engine start up and shutdown systems, alternator, control panels and exciter.

### 3.1.4 CLIMATIC CONDITIONS

Equipment and materials supplied shall withstand under all conditions of continuous operation and without developing any defects, the following environmental conditions.

- Maximum temperature: +50 deg. C
- Minimum temperature: -05 deg. C
- Relative humidity: 90%

### 3.1.5 EQUIPMENT PROTECTION

Unless otherwise stated all equipment supplied shall conform as a minimum to the following protection classes: Indoor I.P. 40 Outdoor I.P. 55

### 3.1.6 TESTING AND COMMISSIONING

On completion of the works and before commissioning of the equipment. The entire System including wiring shall be tested and commissioned by the manufacturer's engineer and test / performance results to be submitted in five copies. All equipment / instruments for the tests are to be provided by the Contractor at no extra cost.
Operation tests and commissioning of the entire Genset System installation including all equipment.
Reports of such tests shall be submitted in five copies.

### 3.1.7 MAINTENANCE AND WARRANTY

The Contractor shall be responsible for the entire electrical works and all equipment supplied by him and warranty the same for a period of twelve months from the date of the completion certificate. Any defect due to the workmanship or equipment failure shall be replaced by the Contractor free of charge during that period.

### 3.1.8 AS-BUILT DRAWINGS

On completion of the works the Contractor shall supply one reproducible and five copies of as-built drawings which clearly indicate all amendments, junction boxes, pull boxes, etc. These shall be provided at no extra cost.

### 3.1.9 SITE CONDITIONS

The Contractor shall visit the site before submitting his quotation and acquaint himself with the site conditions, and check the specifications, design drawings and the bill of quantities.
Omissions/errors, if any, are to be brought to the attention of the Consultant before submission of bid. After the award of the contract no claims shall be entertained.

### 3.1.10 OPERATION AND MAINTENANCE MANUALS

The Contractor shall submit five copies sets of manuals for all the equipment supplied and installed by him which shall include detailed operation and maintenance instructions for each items as recommended by the manufacturer. These manuals shall be submitted on completion of the works.

### 3.1.11 ASSOCIATED CIVIL WORKS

The cost of any civil works, (cutting, chasing, excavation, backfilling, grouting, drilling etc. and making good) associated with any item of the generating system works shall be included in the quoted price for the item. The Contractor shall be responsible for carrying out these civil works and making good and the cost shall be deemed to be included in the quoted price.
The Contractor shall take care not to damage the structure during execution of his work. If so done, he shall repair and make good all losses at his own cost.

### 3.1.12 NOTES FOR SUPPLIERS

- Samples / Catalogues of all materials and Construction Drawings of equipment to be manufactured are to be submitted to the Architect / Owner / Consultant for approval before purchase or fabrication / installation.
- All equipment of Gen Set to be compatible with each other for proper and successful functioning of the system.
- Training: The Contractor shall provide training to 2 people, as designated by them.
- Any item(s) not mentioned in the Bill of Quantities, but it is required to complete the system as described in the specification, the cost of these works to be in built in the Prices quoted by bidder in the Bill of Quantities.

## PART TWO: TECHNICAL SPECIFICATIONS

### 3.2.1 GENERAL

The scope of supply shall include but not be limited to:

- Set mounted radiator with engine driven blower type fan and protecting guards.
- AC generator with excitation and control system and surge suppression equipment.
- CT's and VT's for AVR Control.
- Built in/day fuel service tank, if any (suitable for 8 Hours operation at full Load)
- Heavy duty fabricated steel skid type base frame with anti-vibration mountings. Four lift points for single crane lift
- Spreader beams if required.
- Oil spillage tray with drainage plug.
- Topside structure is to be a solid steel plate.
- Fuel Transfer Pumps.
- Local engine panel incorporating engine 'gauge board and alarms.
- Remote control panel including 380 volts, 50kA Molded case circuit breaker 4 pole with associated protection and automatic starting and synchronizing equipment.
- Engine starting batteries and chargers.
- Driver suitable flexible couplings
- Jacket water heater
- All fastener/nuts/bolts.
- Complete system and piping harness for cooling/ flushing/ draining/ lubrication etc.
- Spares for two years' operation of all manufacturers supplied equipment.
- Commissioning spares
- Manufacturer data, drawings, and test certificates
- A complete set of special tools and devices necessary for the lifting, erection, testing and maintenance of the generator set.
- Complete Automatic fuel transfer system with level sensor etc. in Day tank and associated controls and pump.

The standby power system shall be a complete operating engine-alternator set, capable of functioning fully automatically and supplying power to essential loads during outages.

The set shall be standard commercial type, for which parts and service are readily available in Islamabad, Pakistan. This shall be verified on the request of the

Engineer, by a letter from the manufacturer stating the location of the ware house and a list of parts stocked.

The set shall be an integral unit mounted on a rigid steel base.

All fuses and other replaceable components shall be readily accessible for replacement or maintenance.

### 3.2.2 CODES & STANDARDS

The following diesel engine standards are referenced in this specification:

| | |
|---|---|
| BS ISO 3046-1 | Reciprocating internal combustion engin Performance. Declarations of power, fuel and lubricat oil consumptions, and test methods. Additio requirements for engines for general use |
| EEMUA 107 | Recommendations for the Protection of Diesel Engines Use in Zone 2 Hazardous Areas |

The generating set shall conform in design, materials and performance with all applicable codes and regulations and the current edition of the following standards.

| | |
|---|---|
| IEC 60034 | Rotating Electrical Machines |
| BS 4999 | Rotating Electrical Machines |
| BS 5000 | Rotating Electrical Machines |

### 3.2.3 OPERATING CHARACTERISTICS

The generating set shall start automatically on mains failure and transfer the loads & re-transfer the loads on return of the mains. The output quoted above is for site conditions and the set must be suitably de-rated for that purpose.

The generator must satisfy the following operating performance requirements.

- Load Acceptance: The set must accept 60% of the rated load in a single step from initial startup conditions.
- Governing: The set shall satisfy the following governing requirements.

a) Removal of rated load shall result in transient frequency change not exceeding 15% recovering to 5% change within 15 seconds.
b) Appication or rejection of 60% of rated load shall result in a transient frequency not exceeding 10% change recovering to 3% change within 10 seconds.
c) Application or removal of any step of 25% of rated load shall result in a transient frequency change not exceeding 4% recovering to 1.5% change within 5 seconds.
d) The steady load speed band shall not exceed 5% of the rated speed.

- Voltage Regulation: With the engine governing operating within limits specified above the voltage regulating of the AC generator shall satisfy the following conditions.

a) At any balanced steady load between zero and rated load and at any load power factor from 0.8 lag - 1.0 and at any normal service condition of temperature the output voltage shall lie between the limits ±1.0% of rated value.
b) The instantaneous voltage dip shall not exceed 15% of rated voltage when full 3 phase load at rated power factor is applied to the alternator, with a recovery time of less than 10 seconds to the limit for steady state voltage regulation and remaining constant within plus or minus 1 %, complying to clause 2.6(V).

- The engine shall shut down automatically in case of high coolant temperature, low lubricating oil pressure, over speed or over cranking.
- The generator must be capable of withstanding, without damage, 150% of current rated output for 60 seconds with minimum deviation of rated voltage.
- The generator shall be capable of withstanding, without damage, a three phase, line to line, line to earth or two line to earth, short circuit condition for a period of three seconds when operating at the rated speed, and excitation equal to 5% over voltage at no load.
- The generator shall be capable of operating continuously at full load on an unbalanced system with negative sequence currents up to 8% of phase currents, with none of the phase currents exceeding the rated current.
- High generator and exciter shall withstand an over speed of at least 20% above the rated speed for two minutes without mechanical damage or permanent distortion.
- Generator reactance and excitation equipment are to be selected to satisfy the sudden, load application and voltage drop requirements as specified on data sheet.
- The generator shall be of the salient pole rotating field type with enclosure to IP

21 and air cooled by means of fans on the rotor shaft.

- The stator windings are to be star connected. All six winding ends to be brought out. The alphabetical sequence of the line connected are to correspond to the item sequence of the phases at the required direction of rotation winding end markings:
    - Line UVW
    - Star point XYZ
- Insulation shall be class H with Class B temperature rise after taking account of the maximum site ambient temperature.
- Generator bearings are to be provided with the following:
    - Earth link on drive end bearing
    - Bearings insulated from frame.
- Generator protection current transformers shall be located within the generator terminal boxes and not at the switch gear.

### 3.2.4 ALTERNATOR

- Alternators cre to be specifically suited for direct coupling to the diesel driving engines previously specified. They are to be suitable for mounting on a combined engine / alternator base plate.
- The alternator is to be brushless, self-ventilated, three-phase, salient pole synchronous type. The revolving field shall be incorporated on a common shaft, with the excitation system and the rotating diode assembly.
- Alternator rating to be defined on a continuous base in accordance with BS5000 Part 3 and capable of sustaining a 10 % overload for one hour in any 12 hours' period.
- Low voltage power supply to the automatic voltage regulator and the excitation system is to be made via an auxiliary power wiring connection are to be made at terminal blocks at one location in the unit.
- Alternator is to be fitted with surge suppression equipment to protect the rotating diodes against the effect of external faults and faulty synchronizing.
- The alternator should be of single bearing type with solid forged half coupling for bolting tc the engine flywheel.
- The alternator bearing is to be of the oil lubricated sleeve type, ring of the disc lubricated and insulated to eliminate the risk of shaft / bearing currents.

### 3.2.5 EXCITATION

- The excitation system shall comprise a rotating main AC exciter, pilot exciter and automatic voltage regulator.
- The rotating main and pilot exciters are to be of the brushless type with the rotating rectifier assembly being carried on the main exciter. Solid state

hermetically sealed rectifiers are to be mounted directly on the generator armature.

- The enclosure, cooling system and insulation for the exciters are to be similar to the main generator covered above.
- The exciter rectifier output shall be directly connected to the revolving generator field windings without brushless, slip ring or commutators.
- The AVR is to be of the static type to maintain the voltage to within plus or minus 1% of the set voltage at any load from no load to full load, at power factor 0.8 to 1, with machine cold or warm at a speed drop of approximately 3% of the nominal speed and have a selectable characteristic for reactive load sharing. The voltage level is to be adjustable within plus or minus 5%.
- Voltage regulation shall be as follows:
  a) **Steady state conditions:** Grade 3.11 (VR3) as per BS 4999 Pt 140
  b) **Transient conditions:** Grade 2.32 (VR2.32) as per BS 4999 Pt 140
- The exciter shall be provided with short circuit support equipment to maintain three times the rated current for three seconds to ensure proper fault clearance in outgoing feeders.

### 3.2.6 DIESEL ENGINE

- The diesel engine continuous power and bare engine output shall be rated in accordance with the specification and BS ISO 3046-1. The diesel engine shall be guaranteed to deliver the rated output at the rated speed for specific type of service and site conditions with no negative tolerance. The actual engine fuel heat rate shall not exceed the guaranteed heat rate by more than 4%.
- The Engine shall be capable of delivering the Rated Prime Power output plus 10% overload for 1 hour in 12.
- The engine design is to be four stroke cycle, direct injection, turbo charged industrial type.
- The engine shall operate on fuel to BS 2869: 1983 Class A.

### 3.2.7 COUPLING SYSTEM

The Engine and Generator shall be assembled and coupled by the Engine manufacturer or 3rd party agent authorized for coupling by the OEM. It shall be a close coupled design of unit construction which forms Engine and generator into one unit of exceptional strength and perfect alignment. The generator housing shall be directly bolted to the engine flywheel housing. The engine torque is transmitted through flexible steel plates to the generator rotor. The whole assembly shall be mounted on a structural steer base frame.

### 3.2.8 VIBRATION AND CRITICAL SPEEDS

Vibration, Noise & Seismic Controls shall conform to Section 134800, Division 1.

### 3.2.9 FUEL SYSTEM AND MUFFLER

- The fuel system shall include:
  a) Air cleaner with reusable cleanable dry element.
  b) Engine-mounted gear type fuel transfer pump, suitable for minimum 1800mm lift.
  c) Fuel filters
  d) Manual fuel priming pump, for use after maintenance work on the fuel system. Flexible connections to fuel pump and injectors.
- The exhaust muffler shall be residential type for 29dB attenuation, designed to meet all applicable noise and emission standards, and shall include 500mm flexible bellows with standard pipe flanges. Ensure that the bellows are suitable for 30mm lateral and 30mm longitudinal movement due to expansion and contraction of the exhaust piping.
- The exhaust pipe shall be made of stainless steel and shall be extended 30 feet above ground level to ensure exhaust fumes are dissipated above the building. Rain covers to also be provided.

### 3.2.10 LUBRICATION SYSTEM

- The lubrication system shall include:
  a) Force feed type gear pump, providing positive full pressure lubrication to all bearings and gears.
  b) Pressure relief valve.
  c) Full flow oil filter with replaceable element and spring loaded bypass valve.
  d) Oil level indicator.
  e) Oil cooler with viscosity level bypass to maintain stable oil temperature.
  f) Priority lubrication system to turbocharger bearings, on turbocharged engines.
- The oil sump shall be readily accessible for cleaning and the drain plug shall be located to permit convenient and complete draining.
- Pre-priming of lubricating oil shall not be required before starting the engine.

### 3.2.11 ENGINE COOLING SYSTEM

- The engine shall be water cooled by an engine driven fan cooled radiator.
- The cooling system shall provide automatic control of the engine inlet water

temperature. Thermostatically controlled bypass valves shall be arranged so that cooling water flow cannot be shut-off.

- The cooling system shall be provided with connections for filling the system, checking coolant level, and adding make-up water when necessary. The system shall be such as to allow for complete drainage of the engine and all ancillary equipment and for complete venting.
- Radiators shall be sized to achieve stable conditions at 130% of the rated output or 50 °C whichever is higher and a fouling factor of 0.0004 w/m2C on the water side.
- Cooling water shall be inhibited for corrosion protection.
- The fan shall be capable of 125Pa static pressure for ducts and louvers.

### 3.2.12 EXHAUST SYSTEM

- Engine exhaust gases are to be ducted from the engine mounted turbocharger outlet flanges to a higher performance type exhaust silencer.
- Exhaust silencers are to be residential type, vertical cylinder with side entry and top outlet.
- Exhaust silencers are to be adequately supported on the unit.
- Exhaust silencers are to be provided with flanged inspection and cleaning points, positioned to allow all parts of their interiors to be inspected and cleaned with appropriate equipment.

### 3.2.13 BATTERIES AND CHARGER

- The engine shall be started automatically by a 12 volt or 24 volt starting system, including positive engagement starting motor, solenoid switch, batteries and charger.
- Batteries shall be Heavy Duty Lead Acid type, mounted in a suitable rack on the engine base and sized to provide 5 consecutive cranking intervals of second's duration each, separated by second rest periods, without recharging, at an ambient temperature of 10°C. The voltage level after the last interval shall be adequcte to maintain performance of all DC relays and timers in the control system.
- The battery charger shall be automatic constant voltage static type providing float and equalizing charge rates, with manual control and terminating timer on the equalizing charge.
- The timer on the equalizing charge shall be adjustable from 16 to 24 hours.
- The charger shall include a voltmeter, charge rate ammeter, float- equalize switch, on-off switch and pilot light.
- The charger shall be capable of recharging the batteries fully within 2 hours after the 5 consecutive cranking intervals.

- When the engine is running, the batteries shall be charged from an engine-mounted charging system including alternator, rectification and relays.

### 3.2.14 AUTOMATIC STARTING FACILITY

- **Automatic mode.** Following a loss of normal mains supply, the emergency diesel generator unit should start automatically on receiving a signal from the mains monitoring relays brought to rated speed and voltage. All accessories required for starting and completion of sequence of operation for the above purpose shall be provided.
- Immediately after the generator set reaches rated speed and rated voltage, voltage and frequency monitoring relays located in control panel shall extend an impulse for closing generator breaker.
- **Manual start in service mode.** This shall be effective in manual position of auto/manual switch and service position of service/test selector switch located in control panel. The scheme of operation shall be same as of auto mode as per (i) above except that starting impulse shall be extended manually through the push button either in local control panel or purchaser's control panel.
- **Manual test mode.** This shall be effective in test position of service/test selector switch. The scheme of operation shall be same as that of manual start in service mode as per clause (ii) above except that the closing impulse for generator breaker shall not be extended automatically.

### 3.2.15 CONTROL PANELS

- Control panels shall be dead front, front access, (IP45) enclosed, rust proofed and finished in powder coated protective corrosion resistant finish light grey. The front of the main panel shall be hinged.
- The engine control panel shall be shock-mounted on the engine or base and shall include the following:

| | IND | ALARM | TRIP |
|---|---|---|---|
| Engine Failing to Start | X | | |
| Hours Run Meter | X | | |
| Engine Tachometer | X | | |
| Engine Over speed | | | HH |
| Engine Jacket Outlet Temperature | | | HH |
| Coolant Level | X | L | |
| Exhaust Gas Temperature | X | H | |
| Fuel Inlet Pressure Gauge | | | |
| Fuel Filter Differential Pressure | X | | |
| Engine Oil Inlet Temperature | X | | |
| Engine Oil Pressure | X | | |

| | | | |
|---|---|---|---|
| Engine Oil Filter Differential Pressure | X | | |
| Engine Oil Level | X | | |

X = Provide
H = High
HH = High High
L = Low
LL = Low Low

- The supplier shall provide all alarms and trip circuits in addition to the switch inputs.
    c) Over speed
    d) Fail to start.
    e) High Coolant temperature
    f) Low lube oil pressure

- The control panel shall be an integral part of the generator set, and shall include the following:
    a) AC ammeter with 4 Position phase selector switch.
    b) AC voltmeter with phase selector switch.
    c) Frequency meter, reed or dial type.
    d) Voltage adjusting rheostat, with minimum range of plus or minus 5%.

- Main circuit breaker, molded case type, with long-time only trips to protect against short circuits lasting 10 seconds and thermal overload and short circuit conditions. (May be mounted in separate enclosure on side of engine).
    a) Auxiliary circuit breaker for power to damper motors (if required).
    b) Kilowatt (kW) meter.
    c) Run-stop-auto switch, heavy-duty oil-tight type, with contacts arranged so that transfer switch does not operate when testing engine, except as required by failure of normal source.
    d) Lamp type annunciator, with individual signals for each cause of emergency, shutdown i.e. low oil pressure, High water pressure, over speed, high engine temperatures, Earth fault etc.
    e) Cranking limiter.
    f) Terminal blocks for remote wiring.
    g) All necessary equipment, devices and wiring for operation of the set.
- Meters and controls shall be flush mounted on the front of the panel. Other equipment: shall be readily accessible behind the hinged front panel.
- All equipment on or in the panel shall be identified by limacoid nameplates with white letters on a black background.
- All control and alarm wiring extending beyond the panel and all points required

for maintenance or testing shall be brought to identified terminal blocks. Wires shall be identified by cable markers at each point of connection or termination.

- All switches shall be load-break heavy duty type. All fuses shall be non-deteriorating HRC cartridge pressure fitted, link type. The contractors shall be of air-break type having AC-3 duty rating. Thermal overload relays shall be three elements, positive acting, ambient temperature compensated type with adjustable setting range and built-in protection feature against single phasing. All Indicating instruments shall be moving iron, flush mounting type and of 72mm x 72mm square pattern: Air control/selector switches shall be rotary back connected type having a com-operated contact mechanism, with knob type handle. Stop push buttons shall be stay put type.
- Wiring for power control and signaling circuits shall be done with PVC insulated copper conductors having 600/1000V grade insulation. The minimum size of control wires shall be 2.5mm2.
- An adequately sized earth bus shall be provided in the panel for connection to the main earth grid. All non-current carrying metallic parts of the mounted equipment's shall be earthed. Doors and movable parts shall be earthed using flexible copper connections.
- The control panel shall be mounted on the Generator set and should be visible and accessible through the canopy. The control panel indication should have backlit digital display for all metering.

### 3.2.16 SOUND PROOF CANOPY

The Generator set shall be with locally manufactured sound proof canopy. The enclosure shall incorporate internally mounted exhaust silencer. Three large doors shall be provided on each side for maintenance of the Generator set. The enclosure shall be made from galvanized steel with suitable painting.

The locks and hinges shall be stainless steel. A control panel viewing window shall be provided. An emergency stop button shall be provided on the enclosure exterior. The maximum free field noise level shall not exceed 65 dB at a distance of 1 meter from the enclosure.

### 3.2.17 DIGITAL CONTROL PANEL

- The Digital Control Panel (DCP) shall have the following monitoring and protection features:

  i) The DCP shall be compact and user friendly. It shall have a large LCD backlit digital display and shall be menu driven to indicate the various functions called for in the Control Panel details provided above.

ii) The DCP shall allow for the remote control of the Gensets via a PC on a LAN (hardwired) or via a modem on the Internet.

iii) The DCP shall have an open communication protocol and shall be compatible with the BMS systems being installed in the building or other supervisory controls.

iv) The DCP shall be fully automatic and configurable and shall not require any other tools or devices to operate it.

v) The following additional features

a) Digital based circuitry
b) Digital power metering
c) Digital engine parameter metering
d) Open protocol or Modbus communication interface (RS-422 and RS-485
e) Option for Windows compatible remote monitoring packages
f) Programmable spare output which, when remotely activated, can be utilize for a variety of functions.
g) Optional 20 channel annunciator
h) Sheet steel cabinet
i) Four-line alpha-numeric liquid crystal display (Characters 10 x 5 mm)
j) Backlit display
k) Membrane keypad with tactile feedback
l) AC metering accuracy ± 1.5% @ 25°C (plus CT accuracy)
m) Engine parameter accuracy ± 1.0% @ 25°C (plus sender accuracy
n) Fault log memory
o) Start sequence diagnostic LEDs
p) Password protected operator levels
q) Custom configuration using the integral keypad or a laptop PC
r) Configuration stored in non-volatile memory Detailed requirements are indicated in the Table below.

| FUNCTION | FEATURES |
|---|---|
| Metering | AC voltage (phase to phase and phase to neutral) current.<br>Frequency (Hz)<br>kW, kVAr, kVA, pf (cos φ), kWhr Tachometer (rpm)<br>Lube oil pressure Coolant temperature Battery volt<br>Hours run.<br>Start attempt counter |

| | |
|---|---|
| Controls | Run/Off/Auto control switch.<br>Emergency lock down stop button (red) Remote s<br>delay<br>Crank delay Crank Duration Crank repeats<br>Remote stop delay (including cool down) He<br>control — 3 circuits 220/240 volts AC Static bat<br>charger (5 amp) 220/240 volts AC |
| Shutdowns | Fail to start shutdown.<br>High coolant temperature shutdown<br>Low lube oil pressure shutdown<br>Stop button operated shutdown.<br>Over speed shutdown<br>Overvoltage shutdown<br>Under voltage shutdown<br>Over frequency shutdown<br>Under frequency shutdown<br>Low fuel level shutdown<br>High lube oil temperature shutdown |
| Alarms | Approaching high coolant temperature al<br>Approaching low oil pressure alarm<br>Battery charger failure alarm<br>Low battery voltage alarm<br>Not in auto mode alarm<br>Low fuel level alarm<br>Low coolant temperature alarm |
| Remote Signals/ Contacts | Volts free contact — common alarm<br>Volts free contact — generator running Terminals<br>connection to remote stop button |
| Status Indicators | Visual alarm (with priority flashing)<br>Panel mounted audible alarm |
| Remote Communications | Remote monitoring and control via modem (incluc<br>PC software) |

### 3.2.18 GOVERNOR

- The engine speed shall be maintained automatically by an electronic isochronous governor with Vernier adjustment.
- Fuel pumps shall be restricted to prevent delivery of more fuel than the engine

can accept without overloading.

- The governor shall be suitable for maintaining the frequency within specified limits (BS ISO 3046-1 class A type).

### 3.2.19 TOOLS AND ACCESSORIES

- Vibration isolators shall be spring type, which transmit a maximum of 1% of engine vibrations to the floor. Quantities shall be as recommended by the manufacturer of the set.
- Provide a drip pan under the engine.
- Provide a transformer for damper controls and connect to the auxiliary breaker in the control panel (where required).
- Provide a complete set of any special tools required for the proper operation, maintenance and adjustment of the equipment.

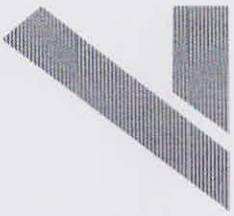
### 3.2.20 TESTING AND VERIFICATION

- Carry out complete tests in the manufacturer's plant.
- Carry out tests with a controllable and adjustable load bank capable of providing a steady load, free from fluctuations, at 1.0 power factor.
- The test procedure shall be as follows:
  a) Start the set. Adjust the voltage and frequency to the related value and the load.
  b) Maintain full load on the set until the coolant temperature stabilizes, and in any case for a period of not less than two (2) hours.
  c) Read and record the following data at the beginring of the test and each half hour thereafter.
  d) Frequency or speed
  e) Voltage and current in all phases
  f) Load
  g) Coolant temperature
  h) Ambient temperature at engine block level
  i) Lubricating oil pressure
  j) Fuel consumption
  k) Do not adjust voltage or frequency during the test. Adjust the load bank as required to maintain full load on the set.
  l) At the end of the run, increase the load to 110% of rated for 1 hour, and takes the above readings every 15 minutes.
  m) Apply full three phase load at unity power factor to the set. The voltage drop shall not exceed 12%, and the unit shall return to stable operation within three (3) seconds, with the terminal voltage within the limit for steady state voltage regulation and remaining constant within plus or minus 1 %.
  n) Demonstrate high coolant temperature shutdown by blocking the air circulation through the radiator.

o) Demonstrate low oil pressure shutdown by closing a valve in the lubricating oil line to the pressure switch, without interfering with engine lubrication.
p) Demonstrate over speed shutdown by operating the over speed contacts.
q) Perform a mechanical inspection of the set.
r) Install strip chart recorder to record frequency and voltage variations during load switching procedures. Delay each load change until unit has reached steady state condition. Load switching is to be as follows:
   a) No load to full load
   b) No load to 20% 1oad
   c) No load to 50% load
   d) No 1oad to 75% load
   e) 20% load to 50% load
   f) 50% load to 75% load

s) After the complete unit is installed on site, this Contractor shall arrange and pay for test at an ambient temperature of 45°C and with a variable load bank.
t) In addition, demonstrate the following to the Engineer:
   a) Startup, transfer of load to generator set, retransfer to normal source and shutdown on automatic control.
   b) Startup and shutdown on Manual control.
   c) Startup and shutdown on Test control
   d) Startup and shutdown on Engine Start control.
   e) Correct operation on timing devices and safety shutdown devices.

- The site test shall be conducted in the presence of the Engineer and Owner representative.
- All consumables related to testing shall be the responsibility of the contractor.
- The Contractor shall carry out the testing of the diesel generator plant and all ancillary equipment both at the manufacturers works and on site in accordance with the specifications. The manufacturer standard test certificate shall be supplied with the generator.
- The Contractor shall provide at his own expense all materials, equipment, and service necessary to perform the tests given below, but not being limited to fuel, electricity, water, labor and test instrumentation.
- Any other tests or inspection deemed necessary by the Engineer to prove that the plant complies with the specifications.



# PART THREE: EXECUTION

### 3.3.1 INSTALLATION

- Mount the base on vibration isolators, except where the engine is shock-mounted to the skid.
- Provide adequate guards on the exhaust manifold, fan, and other parts of the equipment for the protection of operating personnel. Guards shall be readily removable and shall not obstruct normal maintenance operations.
- Make all electrical connections between the engine, alternator, and associated equipment.
- Mount the muffler so that its weight is not supported by the engine.
- Provide exhaust piping up to and including the flexible connection on the outlet side of the muffler.
- After installation, carry "out further tests under the supervision of a qualified representative of the manufacturer, to the satisfaction of the Engineer. Instruct the Owner's personnel in the correct operation and maintenance procedures for the set.