|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ISSUE FOR PURCHASE ORDER** | | | | | | | |
|  |  |  |  |  | |  | |
| 0 | Purchase order specification | 2020-09-18 | J.H. Cha | H. B. Bae | | S.W. Choi | |
| Rev | Description | Date | Prepared | Reviewed | | Approved | |
| Owner: | | | | | | | |
| Owner’s Engineer: | | | | | | | |
| Contractor: | | | | | | | |
| Project Title:  **FUJAIRAH F3 INDEPENDENT POWER PLANT** | | | | | | | |
| Drawing/Document Title  **MR FOR IPB** | | | | | | | |
| Drawing/Document No.  19CN-00BAA10-E36-0001 | | | | | Page no. | | Rev |
| 29 | | 0 |

REVISION LOG

|  |  |  |
| --- | --- | --- |
| Rev. No. | Date | Description |
| 0 | 2020-09-18 | PO Specification |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

Table of Contents

[1 GENERAL 4](#_Toc50313887)

[2 SCOPE 5](#_Toc50313888)

[3 DESIGN CONDITIONS 11](#_Toc50313889)

[4 TECHNICAL REQUIREMENTS 11](#_Toc50313890)

[5 DRAWING AND DOCUMENTATION REQUIREMENTS 28](#_Toc50313891)

[6 ATTACHMENT 29](#_Toc50313892)

1. GENERAL

This specification covers the design, engineering, manufacture, delivery, factory testing at Supplier’s and/or his Sub-supplier’s works and inspection, delivery to site, supervision of installation, site testing and performance testing of Isolated Phase Busduct (IPB) with all accessories complete in every aspect for F3 power generation plant with a net power capacity of 2,000 to 2,400 MW to be within the Fujairah power and water complex, approximately 300 km north-east of the city of Abu Dhabi in the Emirate of Fujairah .

The plant comprises of 3 Nos. (three) of GTG units, each with one downstream HRSG unit and 2 Nos. (two) of STG units.

Generating power is transmitted through two-winding Generator Step-Up (GSUT) transformer and generator circuit breaker.

It is not the intent to specify completely herein, all the details of design and construction of the equipment. However, the equipment shall conform in all aspects to high standards of engineering, design and workmanship and be capable of performing in continuous commercial operation up to the supplier’s guarantee period in a manner acceptable to the PURCHASER who will interpret the meaning of specifications and drawings and shall reject any work or material which in his judgment is not in full accordance therewith.

Bidder may also propose/include in bid document the suggestions for more reliable and cost-effective solution as part of value engineering. Purchaser will review Bidder’s suggestions and convey acceptance/rejection during bid review stage.

The Supplier shall furnish high quality IPB meeting the requirements of this specification and applicable codes and standards.

The Supplier shall be responsible for any discrepancies, errors or omissions in the drawings and information supplied by him. Any deviation other than accepted in Deviation Sheet shall not be accepted. Supplier shall be only permitted to issue clarification if required.

All equipment under this specification shall be manufactured and tested in accordance with the latest revision of the relevant IEEE/IEC standards. However, for some applications if the Transco- Abu Dhabi transmission and dispatch company standards have higher requirements, in such specific cases, the Transco- Abu Dhabi transmission and dispatch company specification / standard shall take precedence over the IEEE/IEC standard requirements.

The supplier shall carry out all necessary coordination with regard to sub-supplier equipment. The PURCHASER will communicate only with the Supplier for all matters pertaining to this contract.

The supplier shall bring any conflict between within the specification and Transco- Abu Dhabi transmission and dispatch company practice to the attention of the Purchaser for resolution prior to any further action.

The power plant (including electrical equipment in the scope of supply) shall be designed for a minimum lifetime of 25 years when operated according to the defined program. The design shall take into account heavy duty operation: the power plant is designed to be daily started and stopped. So, the IPBD system and its accessories shall be also able to withstand a daily energizing (up to full load) and de-energizing throughout its whole life. Protective coatings shall have a minimum design life of 10 years. Civil and structural infrastructure shall have a design life of 40 years.

1. SCOPE
   1. This specification covers the design, engineering, manufacture, delivery, factory testing at Supplier’s and/or his Sub-supplier’s works and inspection, delivery to site, supervision of installation, site testing and performance testing of Isolated Phase Busduct (IPB) with all accessories.
   2. The necessary supervision, labor, tools, materials and equipment required to design, furnish materials for fabrication, test, inspection, clean, paint, prepare for shipment and deliver the equipment complete with appurtenances as specified herein.
   3. The Supplier shall furnish the services and equipment, including all necessary features, components, accessories and appurtenances for the safe, efficient and reliable erection, operation and maintenance whether mentioned in this Specification or not. The cost of the same shall be included in the contract price.
   4. The supplier shall arrange all specialized equipment/services necessary for proper erection, commissioning and performance testing of all items of the equipment covered under this contract.
   5. Supplier shall follow Transco - Abu Dhabi transmission and dispatch company standard practices for the safety procedures, Operating procedures and energization and shutdown procedures. All drawings and documents shall be prepared as per Transco- Abu Dhabi transmission and dispatch company standard procedure and submitted to Purchaser for approval.
   6. All routine and acceptance tests at Factory and Site acceptance test shall be conducted as part of the contract with prior notice to Purchaser. Supplier shall mobilize required test equipment. Equipment shall also have valid type test certificates not older than 5 years from the date of bid opening.
   7. Any conflict between this specification and its references shall be brought to the attention of the Purchaser for resolution prior to any further action by the Supplier.
   8. Scope of Supply by Supplier
      1. The scope of work includes the supply, supervision of erection, commissioning, site testing and performance testing of following by the Supplier, but not limited to the followings:

| S/N | KKS Code | Description | Quantity (m) |
| --- | --- | --- | --- |
|  | 11BAA10 | Isolated Phase Busducts (IPBs) for Gas Turbine Generator unit 11 (GTG-11) |  |
|  |  | Main Run IPB from GTG-11 to GSUT-11 via GCB (20kV, 20500A, 145kArms, 398kAp) | Total 240m = (80m/Ph x 3Ph). |
|  |  | Tap off IPB from GTG-11 to UAT-11 (20kV, 2500A, 265kArms, 730kAp). | Total 33m = (11m/ph x 3Ph). |
|  | 12BAA10 | Isolated Phase Busducts (IPBs) for Gas Turbine Generator unit 12 (GTG-12) : |  |
|  |  | Main Run IPB from GTG-12 to GSUT-12 via GCB (20kV, 20500A, 145kArms, 398kAp). | For Main Run: Total 240m = (80m/Ph x 3Ph) |
|  |  | Tap off IPB from GTG-12 to UAT-12 (20kV, 2200A, 265kArms, 730kAp). | For Tap off to UAT: Total 33m = (11m/ph x 3Ph) |
|  | 21BAA10 | Isolated Phase Busducts (IPBs) for Gas Turbine Generator unit 21 (GTG-21) |  |
|  |  | Main Run IPB from GTG-21 to GSUT-21 via GCB (20kV, 20500A, 145kArms, 398kAp) | Total 240m = (80m/Ph x 3Ph) |
|  |  | Tap off IPB from GTG-21 to UAT-21 (20kV, 2200A, 265kArms, 730kAp) | Total 33m = (11m/ph x 3Ph) |
|  | 10BAA10 | Isolated Phase Busducts (IPBs) for Steam Turbine Generator unit 10 (STG-10) |  |
|  |  | Main Run IPB from STG-10 to GSUT-10 via GCB (21kV, 20000A, 145kArms, 398kAp) | Total 168m = (56m/Ph x 3Ph) |
|  |  | Tap off IPB from STG-10 to Excitation Transformer (ET) (21kV, 200A, 260kArms, 720kAp). | Total 15m = (5m/ph x 3Ph). |
|  | 20BAA10 | Isolated Phase Busducts (IPBs) for Steam Turbine Generator unit 20 (STG-20) |  |
|  |  | Main Run IPB from STG-20 to GSUT-20 via GCB (18kV, 12000A, 100kArms, 275kAp). | Total 159m = (53m/Ph x 3Ph) |
|  |  | Tap off IPB from STG-20 to Excitation Transformer (ET) (18kV, 200A, 180kArms, 500kAp). | Total 15m = (5m/ph x 3Ph). |

Notes:

1. The indicated quantity is total are tentative, along with the bid Contractor has to submit the Unit rate of each item listed and supplied as per the contract and technical specification requirement.
2. Refer enclosed IPBD SLD (Attachment-3) and IPBD Phase diagram (Attachment-5). The drawings are tentative and shall be finalised during detailed engineering.
   * 1. Miscellaneous Item:

Air Pressurization system including pressurizing control panel and air piping.

Seal off bushings and wall frame assemblies.

Sun shield for complete portion of the bus duct.

All accessories like flexible connectors, metallic / rubber bellows, enclosure flanges, etc. for connecting IPB to various equipment such as Generator, GCB, GSUT, UAT and Excitation Transformer.

If Adaptor box required to terminate IPB for the others supplied Equipment, then it will be under the scope Supplier’s.

Earthing studs for the equipment supplied by the Supplier’s. Earthing studs shall be provided on IPB.

Indoor and outdoor Steel support structure for above listed Main run IPB & Tap-off IPB.

Expansion type foundation anchor bolts, nuts and washers for indoor support structures and cubicles including steel support structures. ‘J’ shaped anchor bolts, nuts and washers for outdoor support structures.

Any special tools recommended by the Suppliers, for installation and erection of the supplied equipment.

Spare parts and consumables for installation, commissioning, testing, start-up and performance test.

Spare parts for two (2) years operation for the supplied equipment.

Special tools for maintenance and services.

Control and power cables for the supplied equipment. If both end of Equipment Terminals are supplied by Supplier’s, then supply of required cables will be under the scope of Supplier.

Anti-vibration joints.

* + 1. Coordination with the Supplier of Generator, GCB, GSUT, UAT and Excitation Transformer for the design of flexible connectors, IPB connection flange and other items which may affect the design of IPB.
    2. Required drawings, documents and design calculations to be submitted by supplier.
    3. Sizing calculation of IPB and its associated equipment for approval of Purchaser’s. It shall include the calculation on temperature rise test for conductor and enclosure.
    4. Supplier shall furnish all data, information, drawings and documents including instruction manuals required for installation, site test/commissioning, operation and maintenance. These shall be submitted with electronic source files English language.
    5. All equipment shall be suitable for smooth, efficient and trouble-free operation for the site conditions and power supply variations.
    6. The equipment shall be designed to give efficient and reliable performance under heavily polluted atmosphere, shall meet the design requirement coastal area, seismic zone and for outdoor equipment solar radiation design.
    7. Supplier’s shall carry out detailed engineering (Including Support structure) in 3D environment.
    8. Test equipment for site test/commissioning by use and return basis.
    9. All material required for field welding including welding rod.
    10. Other materials like Name Plate (SS), Cleaning and painting, Furnishing sufficient quantity of field touch-up paint etc.
    11. Supervision for installation, commissioning and site test, guarantee and warrantee for all equipment supplied.
    12. Support work for Local Authorities (Governments) Approval and coordination including all preparation of document and procedure.
    13. Equipment classification (by KKS numbering) and labelling.
    14. Supplier to note that, the indicated quantities are tentative. It may change during detail engineering, Addition and deletion of items during detail engineering will be governed by the unit price accepted by the Purchaser at the bid stage.
    15. Supplier shall note that, during detail engineering the supply any other items which are required to complete the system shall be supplied without any extra price implication to the Purchaser.
    16. Supplier has to indicate the required Auxiliary power in kVA or kW for supplied equipment. i.e., power requirement of 400V A.C, 230V A.C and 220V DC (if any).
    17. Supplier shall submit all the 3D CAD Models in accordance with the following minimum requirements but not limited.

The 3D Model shall be included the outline shape of all components with removal space such as Foundations, Structures, Equipment, Piping, Electrics and Instrumentation.

The submitted file format of 3D Model shall be Micro Station (.dgn / V7 Version).

 The Colors used in the 3D Model shall be in accordance with actual color.

* + 1. In addition to the Supplier's scope of supply specified in other section of this specification, the Supplier shall furnish the services and equipment, including all necessary features, components, accessories and appurtenances for the safe, efficient and reliable erection, operation and maintenance whether mentioned in this specification or not. These shall include, but not be limited to the attached Summary of Scope of Work.
  1. Exclusions
     1. The following items of work are not included in the scope of SUPPLIER.

GTG & STG Generators

Generator Step up Transformers

Generator Circuit breakers

Unit auxiliary Transformers

Instrument transformers

Civil foundation and its works.

Below ground earthing.

Cable tray work for supplied cables.

Installation of the Equipment.

Cables required, if one end equipment is under scope of Purchaser’s.

* 1. Terminal Points

| S/N | Items | Description |
| --- | --- | --- |
|  | At Generator connections | IPB supplier shall match the terminal enclosure flange of generator. The flexible connection to Generator terminals with associated bolts shall be included in scope. |
|  | At GCB connections | IPB supplier shall match the terminal enclosure flange of GCB. The flexible connection to terminals GCB with associated bolts shall be included in scope. |
|  | At GSUT, UAT and excitation transformer connections | IPB supplier shall match the terminal bushing flange of GSUT, UAT and excitation transformer. The flexible connection to terminals of GSUT, UAT and excitation transformer with associated bolts shall be included in scope. |
|  | Auxiliary power supply: | The following power supply will be provided by the Purchaser to the supplier distribution board incoming terminal: 400V AC 3ph,/ 230V AC 1ph, 50Hz (The other voltages if necessary shall be derived by Bidder). |
|  | Pressurization air | Purchaser will provide instrument air at a single point of the pressurizing unit. |
|  | Foundation bolts/nuts/washers and channel base for the Bidder's cubicles | To be supplied by the Bidder as loose materials |
|  | Grounding pads with clamps or studs on the equipment | Grounding pads with clamps or studs on the equipment shall be supplied by the Bidder. |
|  | Grounding connections | Supplied by the Purchaser |

1. DESIGN CONDITIONS
   1. Site Conditions

For site climatic conditions, refer to Attachment -1 General Technical Requirements.

1. TECHNICAL REQUIREMENTS
   1. Codes and Standards
      1. The design, material, construction, manufacture, inspection, testing and performance of metal enclosed isolated phase busducts and associated equipment/accessories shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the Supplier of this responsibility.
      2. The equipment and materials shall conform to the latest edition of IEEE/IEC Recommendations and International and European standards mentioned below and Transco- Abu Dhabi transmission and dispatch company’s standards. In case of conflict between the applicable standards and this specification, this specification shall govern the specific requirement of the equipment.

|  |  |
| --- | --- |
| IEEE C37.23 | Standard for metal enclosed busduct |
| IEEE C37.24 | [Guide for Evaluating the Effect of Solar Radiation on Outdoor Metal-Enclosed switchgear](http://ieeexplore.ieee.org/xpl/articleDetails.jsp?tp=&arnumber=1270351&contentType=Standards&sortType%3Dasc_p_Sequence%26filter%3DAND%28p_Publication_Number%3A8963%29) |
| IEEE Std C37.20.2 | IEEE Standard for Metal-Clad Switchgear |
| IEEE Std C37.81 | IEEE Guide for Seismic Qualification of Class 1E Metal-Enclosed Power Switchgear Assemblies |
| IEC 60529 | Degrees of protection provided by enclosures (IP Code) |
| IEC 62271-1 | Common specifications for high voltage switchgear and control gear standards |
| IEC 62271-200 | A.C. metal enclosed switchgear and control gear for rated voltages above 1kV up to and including 52kV |
| IEC 60273 | Characteristic of indoor and outdoor post insulators for systems with nominal voltages greater than 1000 V |
| IEC 60137 | Insulating bushings for alternating voltages above 1000V |
| IEC 60105 | Recommendation for commercial-purity Aluminium busbar material |
| IEC 60028 | International standard of resistance for copper |
| IEC 60038 | IEC standard voltages |
| IEC 60865-1 | Short circuit current – Calculation of effects |
| IEC 60909-0 | Short-circuit currents in three-phase a.c systems – Part 0: Calculation of currents |
| DIN 43675-2 | Connectors for terminal studs; flat connectors for outdoor transformer bushings; U<(Index) m> 24 and 36 kV, 5 and 8 kA |
| DIN 43675-5 | Octagon connectors for terminal studs, rated over 10000 A, for transformer-bushing |
| NFPA 70 | National Electrical Code |
| UL 857-2001 | Busways |
| IACS | International Annealed Copper Standard |
| All codes and standards mentioned above shall be the latest version on the date of offer made by the Supplier. | |

* 1. Constructional Conditions
     1. General
        1. It is not the intent to specify completely herein all details of design and construction of the equipment. However, the equipment shall conform in all respects to the highest standards of engineering, design and workmanship.
        2. All material used shall be of best quality and of the class most suitable for working under the conditions specified and shall withstand the variations of temperature and atmospheric conditions without distortion or deterioration or the setting up of undue stresses in any part, and also without affecting the strength and suitability of the various parts for the work which they have to perform.
        3. The bus duct shall be designed for the following and the Supplier shall submit design calculation in support of the same:

1. Sizing of the bus conductors and enclosure vis-à-vis thermal capability to withstand rated continuous current and short circuit current.
2. Spacing of the insulators vis-à-vis mechanical strength to withstand forces due to momentary short circuit current.
3. Heat loss and temperature rise calculations for conductor and enclosure.
4. Calculations for arriving at the number of bellows/ flexible in the enclosure /conductor to take care of thermal expansion.
5. Rigorous / adverse weather conditions and seismic forces as specified in relevant sections of the specification.
6. All formulae and other information from which the heat losses and short circuit forces have been arrived at shall be listed together with authoritative source from which such formulae and information have been obtained.
   * 1. Busbar Ratings
        1. The busbars rating shall be as indicated in the forms of proposal.
        2. Maximum absolute temperature of conductor and enclosure shall be limited to 105oC (for silver plated joints) and 80oC respectively at site design ambient condition for selected IPB ratings in line with Table-5, cl. no. 5.4.1 of IEEE C37.23 standard.
        3. The IPB rated voltage shall be selected based on generator rated voltage with voltage variation as specified and various system operating highest system voltage conditions.
        4. The entire bus duct shall be designed for outdoor installation with a dust and vermin-proof construction. The IPB will be made of aluminium conductors, fully enclosed pressurised enclosure with degree of protection IP65.
        5. The enclosures of the three phases will be electrically short-circuited at both ends near to the generator, the GSUT, UAT and Excitation Transformer.
        6. The conductors will be installed concentrically inside the enclosures supported by three cast resin support insulators at each supporting point. The three insulators will be radial displaced by 120° at the circumference of the enclosure.
        7. The name plate for the IPB shall incorporate all the data as indicated in IEEE-C-37.23. The name plate shall also display the actual site rating of equipment.
        8. For testing and maintenance purposes, the IPB will be equipped with a manually operated short-circuit device (SCD). The SCD will be directly connected at the IPB between the generator and the generator circuit breaker. The SCD shall be designed for the full short circuit current for 1 s duration. One SCD set common for GTG units (i.e., GTG-11, GTG-12 & GTG-21) shall be provided and One SCD set for each STG unit shall be provided. Total quantity of SCD units shall be three (3) nos. Supplier shall ensure that SCD set provided for GTG units shall be suitable for testing of all GTG-11/GTG-12/GTG-21.
     2. Markings
        1. All components of the isolated phase busduct and the supporting structure shall be distinctly marked for erection in accordance with the erection drawings to be prepared and furnished by the Supplier. These marks shall be made in a manner as not to be obliterated and erased in transit or to damage the galvanizing of the supporting structure.
        2. All danger boards, rating plates, name plates, etc. of outdoor installation equipments shall be of stainless steel.
     3. Bus enclosure
        1. The bus enclosure shall be continuous bonded type.
        2. The bus enclosure shall be made of Aluminium 99.5 (as per ISO 209). Equivalent grade of Aluminium as per International standard shall be selected.
        3. The cross section of the bus enclosure shall be circular.
        4. The enclosures shall be the minimum flux type, designed to minimize circulating currents in adjacent structural members, and shall have not more than 5 % of the total conductor flux outside the enclosure. The Supplier shall provide the criteria for preventing harmful heating of the adjacent structural steel and/or concrete reinforcing steel.
        5. Bus enclosures shall be electrically isolated from steel bus supports to ensure that enclosure sections are not earthed at more than one point.
        6. Component hottest spot temperature rise shall be in accordance with ANSI C37.23, Tables 5&6. In addition, the effect of solar radiation shall be considered in the rating of the bus in accordance with ANSI C37.24 and IEC 60068. Steel supporting structures and other equipment shall not be factored in as a heat sink for Vendor’s bus.
        7. An enclosure dry air pressurization system shall be provided to prevent the entrance of moisture or the development of condensation. The enclosures shall be designed and manufactured with proper alignment and gasketing to preclude enclosure leaks, such that enclosures will maintain positive pressurization upon removal of air supply with vent ports closed. Post installation field testing will be required to verify the integrity of the seals of each bus section. Venting of pressurization air shall only be from controlled dedicated adjustable vent ports. The vent ports may be the same device as the drain plugs. The Vendor shall provide pressure regulators for the incoming air supply. Pressure gauges shall be supplied by stainless steel line, indicating the pressure at the remote end from the supply end. Provide a dry contact within the dry air purge package to alarm to the plant control system upon loss of air pressure.
        8. Enclosures shall be designed to exclude dust and moisture. Air pressurized systems shall operate on the positive pressure principle.
        9. Painting

The inside of the bus enclosure shall be painted as per manufacturer standard.

The outside of the enclosure shall be given paint shade as per painting specification document enclosed along with this specification.

All welded joints shall be cleaned with stainless steel wire brush and white spirit to remove all dirt, grease, oil or any other foreign matter.

Primer painting shall consist of a coat of etch primer followed by two coats of epoxy primer. The mixing ratios shall be as recommended by primer manufacturer.

* + - 1. Successive sections of enclosures shall be connected by providing circular bonding enclosures with adequate overlap and welding the same to the main enclosure at site.
      2. Enclosure Bellow Joints at Terminations
         1. Joints consisting of rubber bellows shall be provided on the bus enclosure at the following points:

On Generator phase side, between Generator terminal box and the busducts.

At termination to Generator step up transformer (GSUT).

At termination to Unit Auxiliary transformer (UAT).

At termination to excitation transformer (ET).

* + - * 1. Bellow joints in outdoor locations shall be provided with rain-hood to protect the same from rain and sunlight.
      1. Enclosure Flexible Expansion Joints
         1. Flexible expansion joints for the enclosures shall be provided in the run of the bus duct wherever deemed necessary, by the Supplier.
         2. Expansion joints in the run of the bus duct can be metallic or of rubber.
         3. For continuously bonded type of enclosure, when metallic bellows are provided, these shall be able to carry the longitudinal enclosure current without exceeding the specified enclosure temperature. In case rubber bellows are provided in the run of the bus duct then enclosures of the individual phases on either side of the rubber bellows shall be connected using flexible of adequate cross sectional area. In case the cross section of metallic bellow is inadequate then the arrangement mentioned for rubber bellow shall be adopted.
      2. Terminal Enclosures and Flanges
         1. Isolated phase terminal enclosures shall be provided with flanged ends with drilling dimensions to suit the flanges at equipment like Power Transformers and STG Excitation transformer etc.
         2. The terminal enclosures shall be of non-magnetic material and shall be insulated from the body of other equipment. These enclosures shall be separately connected to station earth bus.
         3. Necessary arrangement shall be made in the terminal enclosures to reduce the excessive heat due to the eddy current circulation. If required, Contractor shall provide insulating barriers, insulating bolts/ nuts, etc., in the terminal enclosures to mitigate the effects of eddy current. Suitable shielding arrangement shall be provided between busducts and the other associated equipment for reducing the effect of eddy currents.
         4. The flanges shall be provided with gaskets, nuts, bolts with insulating sleeves, washers, etc.
         5. To prevent ingress of moisture/dust into the busduct enclosure during plant shutdown or maintenance, aluminium end caps shall be provided at generator transformer ends and auxiliary transformer ends.
         6. At the locations of insulators, current transformers, removable flexible joints, disconnecting links, etc., inspection covers shall be provided on the bus enclosure for periodic inspection of interior parts. The inspection covers shall be large enough to permit maintenance and removal of interior parts. These shall be provided with flanged ends with neoprene rubber gaskets and shall be of bolted type. The assembly shall be dust and weather-proof.
         7. Filter type drain plugs shall be installed at low points along the run of the busduct. The drain plugs shall be fitted with porous filter elements. The filter elements shall be easily removable for cleaning purposes. In addition to porous filter, activated carbon or any suitable material shall be filled in the drain plugs to absorb hydrogen sulphide gas.
      3. Gaskets

The gasket material and thickness shall be so selected as to satisfy the operating conditions imposed by temperature, weathering durability, etc. Care shall be exercised to ensure that covers fit easily, that the required compression of the gaskets can be obtained without damage to the inspection covers by bolts and that covers do not bend after this compression has been applied. Over-compression of the gaskets shall be avoided by provision of mechanical stoppers.

The material of the gasket shall preferably be neoprene closed-cell sponge rubber or equivalent.

Flange gaskets shall be provided at the terminal enclosures of Power Transformers, Unit auxiliary transformer, excitation transformer etc.

* + - 1. Isolated Phase Bus ducts shall be provided with clamping bands made of the same material as that of the bus enclosure and welded to the enclosure. By these clamping bands the bus duct shall be supported on to the transverse support beams with 1.1 kV grade insulators made of DMC with polyester resin that has been stabilized against U.V. radiation. The thickness of the insulators shall be adequate for ease of visual inspection of its healthiness, and shall be preferably at least 40 mm. The cantilever strength of the insulators shall be not less than 2.5 times the short circuit forces on the enclosure. The fixing arrangement shall be in such a way that they will allow expansion/contraction of the bus duct with respect to the transverse support beams.
      2. The busduct shall not have any through bolts. All nuts and bolts shall be mild steel hot dip galvanized. M.S. spring washers shall be provided for making satisfactory joints. Clamps, splice plates etc. shall be provided wherever necessary.
      3. Earthing of IPB:

All bus enclosures, support structures, and associated equipment shall be effectively connected to earth. Compression type terminals shall be provided for connecting the support structures and auxiliary equipment enclosures to the station earth grid. The conductor size for the earthing of IPBD shall be determined by the bidder. Calculation for the conductor size shall be furnished for approval.

The main sections of the isolated phase bus housings shall be earthed by welded connections to the generator circuit breakers or to the earth grid at the approximate end point when there is no breaker. The main sections of the housings shall be electrically isolated from the generator terminal and transformer terminal enclosures with isolating baffles. The short sections beyond the baffles shall be earthed by bonding to the generator terminal housing and transformer tanks. The Vendor shall ensure there are no galvanic loops for induced current to flow at the generator and transformer interfaces.

* + 1. Bus Conductor
       1. The material of the main IPB conductor shall be Aluminium alloy 99.5% and for Tap off IPB it shall be Aluminium alloy 97.5%.
       2. Bus conductors shall be mounted on insulators. The insulators shall be designed to withstand the electrical, mechanical, and thermal forces imposed by electrical tests, loads, short circuits, and shipping. Furthermore, the insulator shall not be subject to damage from generator circuit breaker operation.
       3. Bus conductors will have the capacity to carry continuously the rated current without exceeding the hottest spot temperature in accordance with IEEE C37.23 at the maximum site design ambient air temperature outside the enclosure.
       4. Flexible joints, bus extensions or flex connectors shall be provided in bus runs to accommodate relative movement due to temperature change and vibration and for all terminations. All the necessary hardware to make the terminations shall also be provided. One side of these joints shall be factory welded. All flexible joints shall be of braided copper with silver plated copper flats that can be bolted. It shall be ensured that it is suitable for termination at aluminum bus.
       5. All connections to the generator main step-up transformer, generator circuit breaker, auxiliary transformer, and generator terminal enclosure (GTE) shall be made with bolted flexible connectors silver surfaced on all contact areas. The cross-sectional area and ampacity of the flexible connectors shall not be less than that of the bus.
       6. The section of the bus conductors used shall be tubular type for main busduct.
       7. The bus conductors shall withstand without permanent deformation and deterioration of conductor material, the stresses consistent with the self-weight, momentary short circuit current and seismic forces specified in relevant sections of the specification.
       8. Bolts for bus joints shall be of non-corrosive material compatible with the metals being joined, and shall be non-magnetic.
       9. Bus support insulators shall be designed and located to withstand the momentary and short-circuit stresses that the IPB may experience in service. Insulators shall be interchangeable, high creep, high strength type. Insulator support clamps shall be arranged to permit thermal expansion and contraction of the bus. Attachment of insulators to the structure and the bus shall permit insulator replacement without disturbing the bus.
       10. All bus support insulators shall be interchangeable and easily removed. Insulators shall be provided with removable enclosure covers to allow inspection.
       11. Joints
           1. Joints in the bus conductors shall provide an efficient, electrically continuous and mechanically strong connection. The cross sectional area of the links shall be larger than that of the main conductor.
           2. Joints between adjacent sections of the bus conductor shall normally be of rigidly welded type. Joints shall be of highest quality done as per the recognized methods of welding practice.
           3. Flexible joints, bus extensions or flex connectors shall be provided in bus runs to accommodate relative movement due to temperature change and vibration and for all terminations. All the necessary hardware to make the terminations shall also be provided. One side of these joints shall be factory welded. All flexible joints shall be of braided copper with silver plated copper flats that can be bolted. It shall be ensured that it is suitable for termination at aluminum bus.
           4. All connections to the generator main step-up transformer, generator circuit breaker, auxiliary transformer, and generator terminal enclosure (GTE) shall be made with bolted flexible connectors silver surfaced on all contact areas. The cross-sectional area and ampacity of the flexible connectors shall not be less than that of the bus. The flexible connectors shall have flexibility in all the directions. The joints shall be suitably designed to take care of the vibration at the terminals as well as the expansion and contraction of the bus conductors.
           5. Flexible copper braid connectors shall be provided for use as disconnecting means at the connection to the generator, generator step-up transformer and auxiliary transformer to allow dielectric testing of this equipment. The disconnecting means shall have electrical and mechanical characteristics equal to those of the associated bus. Buses shall be rigidly supported adjacent to the disconnecting point. These connectors shall be sized to provide minimum clearance when removed. The Vendor shall coordinate design of disconnecting devices with the low frequency and impulse characteristics of the bus offered.
           6. Mill volt drop values from the ideal factory tested joints shall be furnished which shall form the basis for accepting the joints done at site. This shall be indicated as part of the quality plan document.
       12. Clamps and Hardware
           1. The bus conductor clamps and insulators shall be designed to withstand the forces due to momentary short circuit current. They shall permit free longitudinal movement of the bus conductor during expansion and contraction. The material of the clamps shall be aluminium alloy. Suitable aluminium/copper spacers shall be provided wherever necessary.
           2. All bolts, nuts and lock washers used in the bus assembly shall be of high tensile steel, plated for corrosion resistance. Spring washers of “Belleville” type or equivalent shall be used.
           3. Suitable splice plates and bimetallic connectors shall be provided wherever necessary.
    2. Cooling

The busduct shall be ‘natural air cooled’. The Supplier shall enclose with his Bid, curves showing the current rating of the busduct Vs ambient temp for the specified final temperature of bus conductor and bus enclosure.

* + 1. Pressurization system:

The isolated-phase enclosed busbars shall be lightly pressurized with instrument air (cleaned and dry filtered air). The Supplier will provide separate positive pressurization systems for each IPB. The pressurization system shall include all air connections together with a unit local control panel. The control panel shall contain the filters, dry air filters, valves, safety valves and control devices associated with the system. The air supply for the pressurization system shall be taken from the station instrument air system. Drain plugs shall be provided at the lowest parts of the enclosures. Remote (to DCS) and local alarms of high and low Air pressurization shall be provided. The required provision to send the alarms to DCS shall be provided at the control panels. In addition to pressure status, Alarm on power supply status of the control panels shall be considered to DCS and Local.

* + 1. Supporting steel structure
       1. The Supplier shall furnish the frames and members required to assemble the bus into an integral unit, as well as all framework, columns, and hangers necessary for support of the equipment. If magnetic flux might cause deleterious induction heating of structural members, the structure shall be of non-magnetic material. All other structural members shall be of steel. The Purchaser will provide drawings of the turbine building, outdoor and pedestal (based on Supplier’s input) for use of Supplier.
       2. The design of the equipment supporting structure shall be subject to the Purchaser/ Owners approval before fabrication. The supporting structure shall take full advantage of building columns, beams, etc. Any inter-column, inter-beam or miscellaneous steel required, same shall be supplied by the Supplier.
       3. Supporting structures shall be hot-dipped galvanized steel. The hot dip galvanizing shall be in accordance with International standards. The supports shall be designed to accommodate variations of ± 15mm in building or foundation locations. Drawings showing details of the supports (location, actual loading, required footing details, foundation anchor details, etc.) shall be submitted within two (2) weeks after contract award. Support structures shall be anti corrosive.
       4. Structural supports including all members, brackets, hangers, longitudinal and transverse beams, channels, nuts, foundation bolts for outdoor structures, insulating pads, insulating washers and all other hardware which are necessary for the erection and support of the entire busduct installation shall be provided. All necessary materials including fixing bolts, foundation bolts, nuts, washers and embedded material, etc. shall be anti-corrosive.
       5. Expansion type foundation anchor bolts, nuts and washers for indoor support structures and ‘J’ shaped anchor bolts, nuts and washers for outdoor support structures shall be supplied.
       6. The IPB interconnection joints with conductors/flanges of other’s equipment as well as wall sealing points shall not be considered for IPB supporting points. In addition to the busbars weight itself, the loads of the wind, snow, frost - as applicable - and any stresses caused by expansion and short-circuits shall be considered in support structure design calculation.
       7. Supporting structure shall be connected with the earthing grid at several points. A single structure shall be earthed at both legs. For a structure consisting of several bays, each leg shall be earthed. Common structure base with two earthing pads are diametrically opposite with each other.
       8. The supporting structures shall be designed to withstand the dead weight of the busduct, the short circuit forces under maximum fault conditions, maximum wind load, forces due to seismic acceleration and various combinations of these factors.
       9. Calculations shall be furnished to substantiate the above for Purchaser’s approval.
       10. Miscellaneous:

Studs, nuts, bolts and tapped holes shall conform to the relevant standards. Only hexagonal nuts shall be used. All bolt holes shall be spot faced for nuts.

Castings and forgings shall conform to respective material specifications and shall be free from flaws. They shall be machined true as per good workshop practice. Welding shall be performed in accordance with relevant recognized standards.

All threaded pipe connections and fittings, pipe flanges and tube fittings shall comply with relevant standards.

* + 1. Bus support insulators
       1. Within the busduct, the bus conductor shall be mounted and supported on insulators. The insulators can be mounted on resilient pads provided in the bus enclosure or free mounted withdrawable arrangement can be offered.
       2. Material

The insulators shall be made of Cast resin. The insulator material shall not deteriorate under normal operating temperatures or due to temperature rise under fault conditions.

* + - 1. The insulators shall possess sufficient mechanical strength to withstand the weight of the bus conductor, the seismic forces and the forces due to momentary short circuit currents. The spacing of the conductor support insulators shall be decided giving due factor of safety and to avoid resonance close to natural frequency of oscillation. Factor of safety considered shall be minimum 3.0.
      2. The insulators shall have power frequency, impulse withstand characteristics and creepage distance of 31 mm/kV. Insulators utilized for Outdoor connections shall have a creepage distance of minimum 50 mm/kV.
    1. Seal-Off Bushing
       1. Each phase of the busduct shall be equipped with seal-off bushings wherever necessary. The seal-off bushings shall be flanged type. Seal off bushings shall be provided at the following locations :

Between indoor and outdoor portions of busduct

At the terminal of Generator.

At the terminal of Generator Step-up transformer.

At the terminal of Unit auxiliary transformer, excitation transformer.

* + - 1. Bushing shall be porcelain or epoxy, with suitable mounting frames, and shall not limit the continuous or momentary ratings of the bus. The mechanical and electrical properties of the bushings shall be as specified for bus support insulators.
    1. Wall Frame Assembly:

Suitable flange plates and flashing shall be provided for each wall penetration as required to ensure complete weatherproofing. The wall frame shall be fabricated of non-magnetic material suitable for grouting in the wall.

* + 1. Short circuit link

Short circuiting link, a device for the purpose of checking stability of protective relays before commissioning, continuously rated same as that of the main bus conductor current shall be supplied at a location adjacent to the disconnecting links or as specified in Data Sheet.

This shall have drilling dimension matching those of the main bus conductor disconnecting links. Suitable supporting structures and support insulators for the shorting links shall also be provided.

* 1. Interfaces

The Vendor is solely responsible for all IPB interfaces including other equipment, structural steel and civil foundations.

* + 1. Generator Ratings and Interface

The isolated-phase bus duct connecting the combustion turbine generator to a generator step-up transformer shall require one (1) bus tap section for connection of a unit auxiliary transformer. A generator circuit breaker will be installed in line with the IPB between the generator and generator step-up transformer (GSUT).

Continuous current rating of isolated-phase bus duct at 55°C ambient temperature shall be defined by the Vendor at the detailed design stage based on the final combustion gas turbine generators nominal ratings plus safety margin.

* + 1. Generator Step-Up Transformer Ratings and Interface

The combustion turbine generator will be connected by isolated-phase bus duct to the 400 kV GIS through a two-winding transformer and the rating of the GSUT shall be informed to the Vendor at the detailed design stage. Isolated-phase bus duct design shall consider combustion turbine GSUT ratings. GSUT general arrangement drawing including HV terminal flange drawing will be provided to IPB Vendor during detailed design stage.

* + 1. Auxiliary Transformer Ratings and Interface

The isolated-phase bus for the combustion turbine generator will be connected to the Unit auxiliary transformer (UAT) / Excitation Transformer and the rating of the UAT/Excitation transformer shall be informed to the Vendor at the detailed design stage. Isolated-phase bus duct design shall consider the transformer nominal ratings. Transformer general arrangement drawing including HV terminal flange drawing will be provided to IPB Vendor during detailed design stage.

* 1. Performance Guarantee
  2. The Supplier shall guarantee that the system and its components proposed shall be entirely suitable for the conditions of service described herein.
  3. The Supplier shall guarantee that the system furnished and its components are free from fault in design, workmanship and material and of sufficient size, capacity and of proper materials to fulfil satisfactorily the operating conditions specified.
  4. The IPB shall be able to deliver the power generated by generator without exceeding the temperature limits of conductor and enclosure as mentioned in the specification at all operating conditions.
  5. All the tests and inspection for the supplier’s equipment shall be conducted in accordance with the applicable codes and standards, including prudent practices in the utility industries, unless otherwise specified in this specification.
  6. Any inspection carried out by the Purchaser/Owner’s will not relieve the Supplier’s of any responsibility for conformance with stated conditions and shall not be considered as a waiver of warranty or other rights.
  7. The Purchaser/owner’s Inspector(s) shall have free access to the Supplier’s shop for the purpose of inspecting the work and witnessing tests on equipment to be furnished by the Supplier’s.
  8. Incase Purchaser and/or Client will indicate its intention to attend the plant inspection & test on the inspection & test plan (ITP), the Supplier’s shall give the relevant information to the purchaser at least before 4 weeks for the expected inspection/test date.
  9. The Supplier shall prepare and submit to the Purchaser, test and inspection procedures/plan at shop and field for approval.
  10. When witness testing is required, the test required shall be witnessed by the Purchaser or its authorized representative unless waived in writing, and the equipment shall not be shipped until it has been approved for shipment by the Purchaser.
  11. The Supplier shall conduct required test & inspection and reassemble components prior to shipment in accordance with the applicable codes and standards, including prudent practices in the utility industries, unless otherwise specified in the Specification.
  12. All manufacturing and test procedures, as well as all inspection and test reports, shall be made available in the Supplier’s manufacturing facility for the Purchaser’s review.
  13. Routine tests

All routine tests as specified in IEC/ IEEE/ other International standards for IPB.

* 1. Type tests:

The Supplier shall submit type test certificate with their offers from an independent testing station to demonstrate that his equipment (and its component parts) have been fully tested in accordance with the associated IEC and IEEE, such as ANSI C37.23 and same shall not be older than 5 years from date of bid opening.

In case the type test reports are not found to be meeting the specification requirements or older than five years, the Supplier shall conduct all such tests under this contract free of cost and submit the reports for approval to Purchaser.

Type test assembly shall comprise of all the major components such as flexibles, bends, Seal-off bushings, enclosure bellows, welded joints, disconnecting links, etc., and shall depict the actual site installation. The components used in the type test assembly shall not be used in the busduct sections being supplied for the project.

Supplier shall submit the following type test certificates for IPB as per IEEE& IEC standards:

* Dielectric tests (Power frequency withstand voltage tests and Lightning impulse voltage tests),
* Temperature rise test of bus conductor, enclosure and connection,
* Momentary withstand current tests,
* Short time withstand current tests,
* Air tightness and water tightness tests.
  1. Workshop Tests:

The Supplier shall maintain records and reports of all tests required by this specification and its applicable references.

All instrumentation to be supplied shall be calibrated by the components’ manufacturer in accordance with the manufacturer’s standard practices. The calibration data shall be provided to the Purchaser.

Requisite factory tests shall be given to each component as necessary to determine that works and materials are free of defects and to establish that the design and construction meet the requirement of this Specification.

Dye penetration test as routine factory test shall be carried out on 5% of the transversal welding points.

Weld repair procedures are subject to approval of the Purchaser.

Supplier shall conduct required test & inspection and reassemble components prior to shipment in accordance with the applicable codes and standards, including prudent practices in the utility industries, unless otherwise specified in the Specification.

Following factory tests shall be conducted on the Busduct:

* Checking the hardness of the joints
* Inspection of the welds
* Dielectric withstand strength

If the results of shop tests indicate that the equipment fail to comply with the performance guarantees, the Supplier shall immediately proceed with developing proposed equipment modifications to obtain the guaranteed performance. Proposed modifications shall be subject to the Purchaser/ owner review and acceptance prior to implementation. Modifications which do not comply with this specification, or in the opinion of the Purchasers, could result in a decrease in equipment reliability, will not be acceptable.

If the Supplier proposed modifications are acceptable, the Supplier shall immediately proceed with such modifications and retesting. However, acceptance does not relieve the Supplier’s of the responsibility for meeting guarantees.

Material test certificates shall be submitted.

Factory test shall be executed in accordance with the provisions of contractual standards. The Supplier’s shall submit a test program for approval.

* 1. Galvanizing Test

Samples selected by Supplier’s of all galvanized material shall be subjected to the galvanizing tests set out in BS EN 10244-2 (Testing of Zinc Coating on Galvanized Wires) or BS EN ISO 1461 (Testing of Zinc Coating on Galvanized Articles other than Wire) whichever is applicable.

* 1. Test Reports.

Certified test reports shall be prepared and submitted to the Purchaser. The report shall include test arrangement, instrumentation and calibration data, test procedure, test data, and test results.

* 1. Packing for Shipping and Transport
     1. Export packing and shipping shall conform to the Purchaser’s shipping and packing instruction.
     2. The Supplier shall clean all components and preserve and protect them on the basis that equipment and all accessories will be stored unprotected in the field for a minimum period of six (6) months.
     3. All openings, nozzles, flanged, threaded and weld-end connections shall be provided with protection to prevent damage, corrosion and entrance of foreign matter during shipment and storage.
     4. All openings shall be provided with substantial wooden or metal closure.
     5. Flanged connections shall be protected by a 12mm or thicker plywood disc bolted to the face of the flange.
     6. Threaded connections shall be protected with screwed or snap-in (snap-on) type plastic protectors.
     7. Metal straps, fasteners or covers shall not be tag-welded to any manufactured part.
     8. Equipment shall be adequately supported for shipment. All loose parts shall be crated or boxed for shipment. Each box shall be approximately marked for identification purposes.
     9. The supplier shall make suitable treatment for prevention of the rust and corrosion on the surfaces of the equipment and components during the sea transportation.

1. DRAWING AND DOCUMENTATION REQUIREMENTS

Drawings and documents as listed in " VENDOR DATA REQUIREMENTS” in TBE sheet shall be provided. Master document list (MDL) shall be discussed and mutually agreed during Kick Off Meeting (KOM).

1. ATTACHMENT

|  |  |
| --- | --- |
| **Attachment No.** | **Description** |
| Attachment 1 | General Technical Requirements |
| Attachment 2 | Forms of Proposal \_IPB |
| Attachment 3 | IPBD Single line diagram |
| Attachment 4 | Approved Laboratory list |
| Attachment 5 | IPBD Phase Diagram |
| Attachment 6 | Overall Key Single Line Diagram |
| Attachment 7 | Painting Specification |
| Attachment 8 | IPB Isometric Drawing |
| Attachment 9 | Bid Document of Powergear |