VOLUME-IA PART –I CHAPTER -IX
GENERAL

THE SCOPE OF THE WORK WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.9.1 **In addition to the clause 2.8 of General Conditions of Contract (Volume- 1C of Book-II) the contractor shall comply with the following.**

1.9.1.1 The Contractor should Register their Establishment under BOCW Act 1996 read with rules 1998 by submitting Form I (Application for Registration of Establishment) and Form IV (Notice Of Commencement / Completion of Building other Construction Work) to the respective Labour Authorities i.e.

a) Assistant Labour Commissioner (Central) in respect of the project premises which is under the purview of Central Govt.– NTPC, NTPL etc
b) Inspector of Factories in respect of the project premises which is under the purview of State Govt.

1.9.1.2 The Contractor should comply with the provisions of BOCW Welfare Cess Act 1996 in respect of the work awarded to them by BHEL

1.9.1.3 The contractor should ensure compliance regarding Registration of Building Workers as Beneficiaries, Hours of work, welfare measures and other conditions of service with particular reference to Safety and Health measures like Safety Officers, safety committee, issue of Personal protective equipments, canteen, rest room, drinking water, Toilets, ambulance, first aid centre etc

1.9.1.4 The contractor irrespective of their nature of work and manpower (Civil, Mechanical, Electrical works etc) should register their establishment under BOCW Act 1996 and comply with BOCW Welfare Cess Act 1996.

1.9.2 Identification of equipment at storage yard, technical assistance for checking and making the shortage/damage reports, taking delivery at storage yard and pre-assembly of equipment wherever required, erecting the equipment, aligning, fastening, supporting, cleaning, checking and carrying out statutory tests as required, trial operation, pre

commissioning, commissioning and post commissioning activities up to the time of completion of commissioning activities and commercial operation of the unit and handing over to customer or till completion contract period whichever is earlier, along with the supply of all consumables, tools and tackles and testing instruments.

1.9.3 Scope of work covered under this specification requires quality workmanship, engineering and construction management. The contractor shall ensure timely completion of work. The contractor shall have adequate tools, measuring instruments, calibrating equipment etc. in his possession. He shall also have adequate trained, qualified and experienced engineers, supervisory staff and skilled personnel. The manpower deployment identified by contractor shall match with above scope of works.

1.9.4 **In case any requirement is there to compress the schedule of activities to achieve project completion, then the additional expenses if any incurred will be discussed mutually and settled. BHEL decision in this regard is final and the issue is not arbitral.**

1.9.5 The contractor shall have valid **ELECTRICAL CONTRACTOR LICENSE, Workmen Compensation Policy** as required to carry out the scope / job mentioned in the Bill of Quantity (BOQ).

1.9.6 All the necessary certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.

1.9.7 It is not the intent to specify herein all details of material. Any item related this work not covered by this but necessary to complete the system will be deemed to have been included in the scope of the work.

1.9.8 Site testing wherever required shall be carried out for all items / materials installed by the contractor to ensure proper installation and functioning in accordance with drawings, specifications and manufacturer's recommendations and Field quality plans of BHEL.

1.9.9 The contractor shall co-ordinate and provide assistance for satisfactory testing, pre-commissioning, commissioning and trial run of the connected equipment under overall guidance of BHEL and shall locate any cause of malfunction and rectify the same for proper operation. Testing shall also include any additional tests, which the Engineer feels necessary because of site conditions and also to meet system specification.

1.9.10 The work shall be executed under the usual conditions without affecting power plant construction and in conjunction with other operations and contracting agencies at site. The contractor and his personnel shall co-operate with the personnel of other

agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.9.11 All the work shall be carried out as per instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the contractor.

1.9.12 Contractor shall erect all items / materials etc. as per sequence prescribed by BHEL at site. BHEL engineer depending upon the availability of materials / work fronts etc will decide the sequence of erection / commissioning methodology. No claims for extra payment from the contractor will be entertained on the grounds of deviation from the methods of erection / commissioning adopted in erection/commissioning of similar job or for any reasons whatsoever.

1.9.13 During the course of erection, testing and commissioning of electrical work, certain rework / modification / rectification / repairs / fabrication etc. may be necessary on account of feedback from other power stations or units already commissioned and / or units under erection and commissioned and also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously.

1.9.14 After completing all the works, contractor shall hand over all remaining extra materials with proper identification tags in a packed condition to BHEL/Customer stores. In case of any use over actual design requirements, BHEL reserves the right to recover the cost of material used in excess or misused. Decision of BHEL engineer in this regard will be final and binding on the contractor.

1.9.15 Contractor shall, transport all materials to site and unload at site / working area, or pre-assembly yard for inspection and checking. All material handling equipment required shall be arranged by the contractor.

1.9.16 Contractor shall retain all T&P / Testing instrument / Material handling equipments etc at site as per advice of BHEL engineer and same shall be taken out from site only after getting the clearances from engineer in charge.

1.9.17 The contractor at his cost shall arrange necessary security measures for adequate protection of his machinery, equipment, tools, materials etc. BHEL shall not be responsible for any loss or damage to the contractor's construction equipment and materials. The contractor may consult the Engineer-in-Charge on the arrangements made for general site security for protection of his machinery equipment tools etc.

1.9.18 The Contractor may have to execute work in such a place and condition where

other agencies also will be under such circumstances. However completion time for erection agreed will be subject to the condition that contractor's work is not hampered by the agencies.

1.9.19 wherever erection sequences are furnished by BHEL, the contractor shall follow the same sequence.

1.9.20 If required by BHEL, the contractor shall change the sequence of his operation so that work on priority sectors can be completed within the projects schedule. The contractor shall afford maximum assistance to BHEL in this connection without causing delay to agreed completion date.

1.9.21 Any wrong erection shall be removed and re-erected promptly to comply with the design requirements to the satisfaction of Site Engineer.

1.9.22 Contractor has to work in close co-ordination with other erection agency at site. BHEL engineer will co-ordinate area clearance. In a project of such magnitude, it is possible that the area clearance may be less / more at a particular given time. Activities and erection program have to be planned in such a way that the milestones are achieved as per schedule/ plans. Contractor shall arrange & augment the resources accordingly.

1.9.23 The contractor must obtain the signature and permission of the security personnel of the customer for bringing any of their materials inside the sit premises. Without the Entry Gate Pass these materials will not be allowed to be taken outside.

1.9.24 Contractor shall remove all scrap materials periodically generated from his working area in and around power station and collect the same at one place earmarked for the same. Load of scraps is to be shifted to a place earmarked by BHEL. Failure to collect the scrap is likely to lead to accidents and as such BHEL reserves the right to collect and remove the scrap at contractor's risk and cost if there is any failure on the part of contractor in this respect. All the package materials, including special transporting frames, etc. shall be returned to the BHEL stores / customer's stores by the contractor.

1.9.25 The contractor shall ensure that his premises are always kept clean and tidy to the extent possible. Any untidiness noted on the part of the contractor shall be brought to the attention of the contractor's site representative who shall take immediate action to clean the surroundings to the satisfaction of the Engineering- Charge.

1.9.26 The contractor is strictly prohibited from using BHEL's regular components like angles, channels, beams, plates, pipe / tubes, and handrails etc for any temporary supporting or scaffolding works. Contractor shall arrange himself all such materials. In case of such misuse of BHEL materials, a sum as determined by BHEL engineer will be recovered from the contractor's bill. The decision of BHEL engineer is final and binding on the contractor.

1.9.27 The contractor will be responsible for the safe custody and proper accounting of all materials in connection with the work. If the contractor has drawn materials in excess of design requirements, recoveries will be effected for such excess drawls at the rate prescribed by manufacturing units.

1.9.28 No member of the already erected structure / platform, pipes, grills, platform, other component and auxiliaries should be cut without specific approval of BHEL engineer.

1.9.29 Contractors shall ensure that all their Staff / Employees are exposed to periodical training programme conducted by qualified agencies/ personnel on ISO 9001 – 2008 Standards.

1.9.30 For other agencies, such as civil, transformer, piping, insulation etc., to commence their work from / on the equipments coming under this scope, Contractor has to clear the front, expeditiously and promptly as instructed by BHEL Engineer. Some time it may be required to re-schedule the activities to enable other agencies to commence/continue the work so as to keep the overall project schedule.

1.9.31 The terminal points decided by BHEL are final and binding on the contractor for deciding the scope of work and effecting the payment for the work done up to the terminals.

1.9.32 Crane operators deployed by the contractor shall be tested by BHEL and have valid Driving Licensee before he is allowed to operate the cranes.

1.9.33 For the purpose of planning, contractor shall furnish the estimated requirement of power (month wise) for execution of work in terms of maximum KW demand.

1.9.34 On Completion of work, all the temporary buildings, structures, pipe lines, scaffolding, cable etc. shall be dismantled and levelled and debris shall be removed as per instruction of BHEL by the contractor at his cost. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor. The decision of BHEL Engineer in this regard is final.

1.9.35 Prior to erection of any components internal inspection to be done for any foreign materials and damages and they are to be attended as per directions of BHEL engineer.

1.9.36 All the equipments /material to be taken inside the plant building shall be cleaned thoroughly before taking them inside and erect.

1.9.37 It is the responsibility of the contractor to do the alignment of busduct with our structure if any minor modification like that of structure cutting and welding done by contractor free of cost basis. If necessary, repeatedly to satisfy BHEL Engineer / Customer Engineers with all the necessary tools and tackles, manpower etc. without any extra cost. The alignment will be completed only when jointly certified so, by the BHEL Engineer & Customer. Also the contractor should ensure that the alignment is not disturbed afterwards

.

1.9.38 Void

1.9.39 The scope of specification covers the installation, testing and commissioning of the erected equipment/ instrument along with accessories as detailed in Bill of Quantity.

1.9.40 **SITE INSPECTION**

The owner / employer or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost what so ever such duplication of inspection of work be entertained.

BHEL / Customer will have full power and authority to inspect the works at any time, either on the site or at the contractor's premises. The contractor shall arrange every facility and assistance to carry out such inspection. On no account will the contractor be allowed to proceed with work of any type unless such work has been inspected and entries are made in the site inspection register by customer / BHEL.

Wherever the performance of work by the contractor is not satisfactory in respect of workmanship, deployment of sufficient labour or equipment, delay in execution of work or any other matter, **BHEL shall have the right to engage labour at normal ruling rates and get the work executed through other agency and debit the cost to the contractor and the contractor shall have no right to claim compensation thereof.** In such a case, BHEL shall have the right to utilize the materials and tools brought by the contractors for the same work.

1.9.41 **MANPOWER REQUIREMENT**

1.9.41.1 Manpower requirement for Erection and Commissioning shall as follows:

a. There shall be a Resident manager as Site In Charge at site, under whom there shall be sufficient area engineers who shall take care of the erection activities.

b. One Safety Engineer, One Quality Engineer & One Planning Engineer deployed at site which have a minimum qualification of Engineering Degree or Diploma in Engineering with minimum 02 years of experience.

c. Supervisor should have a minimum qualification of Diploma in Engineering or any graduate with minimum 2 years of experience in Thermal Power Station.
d. Contractor should have one Qualified Store Keeper who have responsible for daily basis stock of material in store yard and properly stacking of material , Receipt of Bhel material ,Issue of Bhel material for erection work and entry in material inward and outward register.
e. Three no. of Al.welder should be deployed at site for execution. All the welders have to be certified by BHEL/Customer and then inducted into the mainstream.
Arrangements towards the sample testing (DP/Radiography) will be carried out by contractor.

1.9.41.2 Each engineer shall be provided with minimum one supervisor and adequate number of Technicians / electricians and other erection staff and T&P etc.

1.9.41.3 The Site in charge shall be provided with PCs and good communication facilities like telephone, fax, email etc. at the cost and expense of the contractor. Lack of communication facilities will not be an excuse for extension of completion date.

1.9.41.4 All instructions from BHEL / Customer will be directed to the contractor through the Site in-charge and he shall be responsible for all the contractor's activities at site. The contractor shall name his authorized representative prior to or immediately on commencement of operations at site.

1.9.41.5 The Site In charge shall be present at site during all normal working hours and his contact address after normal working hours shall be made available to BHEL so that if any emergency arises, the presence of the contractor's site Representative at site can be called for.

1.9.41.6 The contractor shall not change the site Representative without the consent of BHEL. Should BHEL require the replacement of the contractor's site Representative for justifiable reasons (including inadequate progress of work) the contractor shall ensure that replacement is made as soon as possible and work is not allowed suffering delay on this account.

1.9.41.7 The contractor shall provide to the satisfaction of BHEL sufficient and qualified staff for the execution of works. If and whenever any of the contractor's staff is found guilty of any misconduct or be incompetent or insufficiently qualified in the performance of his duties the contractor shall remove them from site as directed by Site Engineer.

1.9.41.8 The contractor shall ensure that all his supervisor's staff and workmen conduct themselves in a proper manner. They shall all be persons who are familiar with and skilled at the jobs allocated to them. Any misconduct / inefficiency noted on the part of the contractor's personnel shall be brought to the attention of the contractor's site

representative who shall immediately take such action as necessary including the removal of such misconducting / inefficient persons, if so required by the Engineer-in-Charge.
1.9.41.9 The contractor shall ensure that replacement for such persons removed from site is provided immediately and the work is not allowed to suffer delay on that account.

1.9.41.10 Contractor shall deploy required number. of qualified Al. Welder certified by BHEL/CUSTOMER through the sample testing.

1.9.42 **DOCUMENTATION**

1.9.42.1 The following information shall be furnished by the bidder within two weeks of award of contract for purchaser's approval

a) Bar chart covering planned activities at site.
b) Detailed organization chart.
c) Details of T&P available with contractors with documents proofs.

1.9.46.2 The following information shall be furnished by the bidder after testing and inspection: Test certificates of various tests conducted at site. All inspection and test certificates shall be signed by customer's representative also, wherever called for as per field quality plan.
1.9.46.3 As built drawings:
After successful completion, testing and commissioning of installation work, Purchaser's drawings / documents shall be updated in line with the actual work carried out and as built drawings / documents shall be submitted by the contractor as agreed for the project.

1.9.47 **VOLUME-IA PART- II CHAPTER-3 of this booklet contains general guidelines for Installation, Testing and Commissioning of supply items of bus duct package.**

FOUNDATIONS AND GROUTING

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.10.1 Foundation for the equipments (Bus duct Structure, Beam etc) to be erected shall be provided by BHEL / clients of BHEL. The dimension of the foundation and anchor bolt pits shall be checked by the contractor for their correctness as per drawings. Further, top elevation of foundations shall be checked with respect to bench mark etc. All adjustments of foundations surfaces, enlarging the pockets in foundations etc. as may be required for the erection of equipments plants shall be carried out by the contractor.

1.10.2 Cleaning of foundation surfaces, pocket holes and anchor bolt pits etc., dewatering, making them free of oil, grease, sand and other foreign materials by soda wash, water wash, compressed air or any other approved methods etc., form/shuttering work are within the scope this work.

1.10.3 It shall be contractor's responsibility to check the various equipment foundations for their correctness with respect to level, orientation, dimensions etc., and ascertained dimensions shall be measured and submitted to BHEL for approval before erection. Also minor chipping, dressing of foundations up to 30 mm for obtaining proper face for packer plates/shims, and may be required for the erection of the equipment/plants will have to be carried out by the contractor without extra cost.

1.10.4 The surface of foundations shall be dressed to bring the surface of the foundations to the required level and smoothness prior to placement of equipments.

1.10.5 Foundation pockets are to be cleaned thoroughly before placing the columns/equipments. Verticality of foundation bolts to be checked along with correctness of the threads and freeness of the nuts movement. If required cleaning of the threads to be done with proper dies.

1.10.6 Void

1.10.7 Works such as minor rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin etc. are covered in the scope of work.

MATERIAL HANDLING AND SITE STORAGE

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.11.1 The equipment should be preferably in its original package and should not be unpacked until it absolutely necessary for its installation. The equipment should be best protected in its cases. It should be arranged away from walls.

1.11.2 The wooden pallet provided for packing itself can be retained for raised platform to protect equipment from ground damps, sinking into around and to circulate air under the stored equipment. This will also help in lifting the packing with fork-lift truck.

1.11.3 Due care should be taken to ensure that the equipment is not exposed to open atmosphere etc. which can affect the colour shade and also rusted. Structure material, GI Pipe, Earthing Strip etc to be laid on the gravelled area not directly laying on ground.

1.11.4 All the equipment, materials and goods kept in the store room should be identified and registered in a book. Inspection report should be recorded. Any discrepancy observed should be communicated to BHEL site Engineer.

1.11.5 Packing material shall be retained if the cubicle to be repacked after inspection.

1.11.6 Sub-Assemblies

a) All sub-assemblies should be kept in a separate place where it is easily accessible.

b) Sub-assemblies should have a protective cover in case it is stored without wooden packing / case to prevent accumulation of dust. Silica gel packets should also be kept along with it.

c) Sub-assemblies should not be stacked one above the other.

1.11.7 Loose items (wherever applicable)

The loose items supplied for the main equipment falling into various categories like fastner, seal off bushing, current transformer, rubber bellow, wall frame ,cu. flexible ,cu. connector, splice plate, cable, space heater marshalling box, al. coupler etc. are to be categorised and stored separately.

1.11.8 Materials shall be stacked neatly, preserved and stored in the contractor's shed / work area in an orderly manner. In case it is necessary to shift and restack the materials

kept at work area / site to enable other agencies to carry out their work, same shall be done by the contractor at no extra cost.

1.11.9 The contractor shall provide any fixtures, concrete blocks & wooden sleepers, which are required for temporary supporting / storage of the components at site. Wooden block is used for assembly for structure and structure & bus duct laying on it.

1.11.10 Contractor has to arrange required fire resistant tarpaulins to protect the machined components / assembled parts during the erection/welding work at site.

1.11.11 The contractor shall take delivery of item, materials, from the storage yard / stores / sheds of BHEL / customer which is within a radius of 5 kms. He shall also make arrangements for safe custody, watch and ward of equipment after it has been handed over to him till they are fully erected, tested and commissioned. If any theft of material takes place before commissioning, contractor will be responsible and suitable payment deductions against theft material may be initiated in upcoming invoices.

1.11.12 The contractor shall note that items/materials shall be transported to erection site / assembly yard etc. by the prescribed route without disturbing and causing damage to other works in the most professional manner. Items, Hardware, etc. shall be stored in appropriate manner as per BHEL's instructions.

1.11.13 Loading at BHEL / Customer stores and storage yard, transport to site, unloading at site / working area of equipment placement on respective foundation/location, fabrication yard, pre-assembly bay or at working area are in the scope of work. The scope includes taking materials / Equipments from customer stores / storage yard also. Contractors Quoted / Accepted rate shall be inclusive of the same. Required cranes, tractors, trailer or trucks / slings / tools and tackles / labour including operators Fuel lubricants etc for loading & unloading of materials will be in the scope of contractor.

1.11.14 The equipments / materials from the storage yard shall be moved in sequence to the actual site of erection / location at the appropriate time as per the direction of BHEL Engineer so as to avoid damage / loss of such equipment at site.

1.11.15 At the time of receiving of materials, contractor store keeper should properly verify the quantity received and inspect physically for any damages. Any damages, discrepancies (shortfall/excess) found, should be intimated to BHEL for raising MDR/SCRA/SAR.

1.11.16 All the received materials entry to be done in the shipping list by contractor storekeeper.

PROGRESS OF WORK

The scope of the work will comprise of but not limited to the following:

(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.13.0 Refer forms F -14 to F-18 of volume I D (Forms & Procedure) of volume –ID of Book-II. Plan and review will be done as per the formats.

1.13.1 The progress reports shall indicate the progress achieved against plan, Indicating reasons for delays, if any. The report shall also give remedial actions which the contractor intends to make good the slippage or lost time so that further works can proceed as per the original plan the slippages do not accumulate and affect the overall programme.

1.13.2 It is the responsibility of the contractor to provide all relevant information on a regular basis regarding erection progress, labour availability, equipment deployment, testing, etc with all necessary document.

1.13.3 During the course of erection, if the progress is found unsatisfactory, or if the target dates fixed from time to time for every milestone are to be advanced, or in the opinion of BHEL, if it is found that the skilled workmen like fitters, operators, technicians employed are not sufficient BHEL will induct required additional workmen to improve the progress and recover all charges incurred on this account including all expenses together with BHEL overheads from contractor's bills.

1.13.4 Contractor is required to draw mutually agreed monthly erection programs in consultation with BHEL well in advance. Contractor shall ensure achievement of agreed program and shall also timely arrange additional resources considered necessary at no extra cost to BHEL.

1.13.5 Progress review meetings will be held at site during which actual progress during the week vis-a-vis scheduled program shall be discussed for actions to be taken for achieving targets. Contractor shall also present the program for subsequent week. The contractor shall constantly update / revise his work program to meet the overall requirement. All quality problems shall also be discussed during above review meetings. Necessary preventive and corrective action shall be discussed and decided upon in such review meetings and shall be implemented by the contractor in time bound manner so as to eliminate the cause of nonconformities.

1.13.6 The contractor shall maintain a record in the format as prescribed by BHEL of all operations carried out on each weld and maintain a record indicating the number of welds,

the names of welders who welded the same, date and time of start and completion, preheat temperature, radiographic results, DP Result of each joint, rejection if any, percentage of rejection etc. and submit copies of the same to the BHEL Engineer as required.

1.13.7 The contractor shall submit daily, weekly and monthly progress reports, manpower reports, materials reports, consumables (gases / electrodes / ferules / lugs) report, cranes availability report and other reports as per Performa considered necessary by the Engineer as per the BHEL formats.

1.13.8 The contractor shall submit weekly / fortnightly / monthly statement report regarding consumption of all consumables for cost analysis purposes.

1.13.9 The manpower reports shall clearly indicate the manpower deployed, category wise specifying also the activities in which they are engaged.

1.13.10 The monthly report shall be submitted at the end of every month as a booklet and shall contain the following details :-

a) Colour Progress photographs.

b) Erection progress in terms of tonnage, percentage of work completion, welding joints, DP tests, stress relieving, etc., completed as relevant to the respective work areas against planned.

c) Site Organization chart of engineers & supervisors as on the last day of the month with further mobilization plan

d) Category- wise man hours engaged during the previous month under the categories of fitters, welders, riggers, khalasis, grinder-men, gas-cutters, electricians, crane operations, store keepers, helpers, security etc.

e) Consumables report giving consumption of all types of gases and electrodes during the previous month.

f) Availability report of cranes

g) Safety implementation report in the format

h) Pending material and any other inputs required from BHEL for activities planned during the subsequent month.

TESTING AND COMMISSIONING

THE SCOPE OF THE WORKS WILL COMPRISE OF BUT NOT LIMITED TO THE FOLLOWING:
(All the works mentioned hereunder shall be carried out within the accepted rate unless otherwise specified.)

1.14.1 SCOPE OF PRE-COMMISSIONING / COMMISSIONING AND POST COMMISSIONING WORKS:

1.14.1.1 Scope of pre-commissioning / commissioning starts with the commissioning of various equipment erected by the contractor and making them available to commission various materials / systems and main power plant.

1.14.1.2 The contractor shall co-ordinate with BHEL and other contractor's during the main plant commissioning to ensure successful commissioning of total plant.

1.14.1.3 The pre-commissioning activities of the main power plant will start with energizing of start up power supply systems followed by trial run of various drives prior to light up of boiler. Commissioning operations shall continue till trial operation of the unit. The contractor shall simultaneously start checking cables erected by him to match with the various milestone activities /commissioning programme of the project. All these works need specialised testing engineers, supervisors including electricians in each area to coordinate with BHEL Engineers and other agencies round the clock to match with commissioning schedule of unit. Contractor shall earmark separate manpower for various commissioning activities. The manpower shall not be disturbed or diverted for erection work.

1.14.1.4 The mobilization of testing team shall be planned in time and shall be undertaken round the clock. Contractor shall discuss on day to day / weekly / monthly basis the requirement of testing manpower, consumables, tools and tackles with BHEL engineer and arrange for the same. If at any time the requisite manpower, consumables, T & P are not arranged then BHEL shall make alternate arrangements and the cost will be recovered from contractor.

1.14.1.5 Prior to commissioning and after commissioning, protocols have to be made with BHEL / Customer. The formats will be given by BHEL and have to be printed by the contractor in adequate numbers. It shall be specifically noted that above personnel of the contractor may have to work round the clock along with BHEL commissioning engineers which may involve over time payment which forms part of Contractors Scope.

1.14.1.6 Any rework / rectification / modification is required to be done because of contractor's faulty erection, which is noticed during commissioning at any stage, the same has to be rectified by the contractor at his cost. During commissioning, any improvement rework / rectification / modification due to design improvement / requirement is involved, the same shall be carried out promptly and expeditiously. Claims if any, for such works from the contractor shall be governed by clauses covered elsewhere.

1.14.1.7 Minimum requirement of Man Power for testing/checking works shall be as follows: (Requirement given below is per unit):

FOR BUSDUCT PORTION:

	Bus Duct
Engineer	---
Supervisor	1
Technician	2

The above testing / checking group shall be identified at the Pre commissioning time. The above commissioning group shall have the knowledge of various systems referred in the tender and possess adequate experience in testing. The above manpower for commissioning is only tentative and if any additional manpower required as per site requirement, the same shall be arranged by the contractor. If the contractor fails to deploy the above Engineer / Supervisor / Technician at appropriate time of commissioning, no payment shall be made against commissioning activities as per terms of payment.

1.14.1.8 All testing activities shall be carried out as per relevant standard, code of practice, manufacturer's instructions and BHEL norms. The contractor shall follow the checklist of BHEL prior to taking up testing & commissioning activities and the activities shall be carried out in accordance with the checklist. All the above will be witnessed by BHEL engineer and the reports signed jointly.

1.14.1.9. All the tests at various stages shall be repeated till all the equipment satisfy the requirement of BHEL / Customer. Any rectifications required shall have to be done / redone by the contractor at his cost.

1.14.1.10 It shall be the responsibility of the contractor to provide various categories of workers in sufficient numbers along with Supervisors during pre commissioning, commissioning and post commissioning of equipment and attending any problem in the equipment erected by the contractor till handing over. The contractor will provide necessary consumables, T&Ps, IMTEs etc., and any other assistance required during this period. Association of BHEL's / Client's staff during above period will not absolve contractor from above responsibilities.

1.14.1.11 The contractor shall carryout any other test as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-

commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor

1.14.1.12Contractor to provide necessary commissioning assistance from precommissioning state onwards and up to continuous operation of the unit & handing over to customer. The category of personnel to be as per site requirement and to meet the various pre-commissioning and commissioning programmes made to achieve the schedule agreed with customer.

1.14.1.13 During commissioning any improvement / repair / rework / rectification / fabrication / modification due to design improvement / requirement is involved, the same shall be carried out by the contractor promptly and expeditiously.

1.14.1.14 The contractor shall carryout any other test not listed in the tender as desired by BHEL Engineer on erected equipment covered under the scope of this contract during testing, pre-commissioning, commissioning, and operation, to demonstrate the completion of any part or whole work performed by the contractor.

DRAWINGS

Attached separately.

1. IPBD

A. Layout for IP Busduct drawing
B. Foundation layout for IP Busduct drawing
C. Support structure Assy for IPBD.

2. SPBD

A. Layout for SP Busduct drawing
B. Foundation layout for SP Busduct drawing
C. Support structure Assy for SPBD.

3. FQP

1. Approved FQP

INSTALLATION, TESTING, COMMISSIONING OF SUPPLY ITEMS OF BUSDUCT PACKAGE.

3.1 INSTALLATION, TESTING & COMMISSIONING IN GENERAL:

The stages of completion of various works shall be as follows:

Equipment shall be considered to be completely erected when the following activities have been completed:

a) Moving of all equipment to the respective foundations.
b) Fixing of anchor bolts or tack welding as required.
c) Levelling and alignment of equipment.
d) Assembling of all accessories such as relays, CTs, PTs, meters, instruments etc. as described in the job specification.
e) Sub assemblies of bus ducts(SP &IP) and erection of the same.
f) Conduit laying, termination with continuity check.
g) Installation of sunshade for outdoor portion of IPBD.
h) Applying of final coat of paint on busduct.

All the equipment shall be tested at site to know their condition and to prove suitability for required performance. The site tests and acceptance tests to be performed by contractor are detailed below. The contractor shall be responsible for satisfactorily working of complete integrated system and guaranteed performance.

3.2 Site Tests and Checks

3.2.1 General

All the equipment shall be tested at site to know their condition and to prove suitability for required performance.

The test indicated in following pages shall be conducted after installation. All tools, accessories and required instruments shall have to be arranged by contractor. Any other test which is considered necessary by the manufacturer of the equipment, contractor or mentioned in commissioning manual has to be conducted at site.

In addition to tests on individual equipment some tests / checks are to be conducted / observed from overall system point of view. Such checks are highlighted under miscellaneous tests but these shall not be limited to as indicated and shall be finalized with consultation of client before charging of the system.

The contractor shall be responsible for satisfactory working of complete integrated system and guaranteed performance.

3.2.2 Bus ducts – Isolated / segregated phase busducts

3.2.2.1 ERECTION OF STRUCTURE SP/IP.

Foundations for column erection are the start point of erection wherein we have to be careful & precise while erecting of structures. Any deviation in the structure erection will escalate to misalignment & consequent rework in busduct at height. It also affects the quality and aesthetics of erected bus duct. Following steps needs to be followed from initial level of erection:

3.2.2.1.1 OUTDOOR PORTION:-

a) Handing over of foundation bolt set to customer by proper format. Format will be given by BHEL.
b) Ask for load test certificate for foundation pocket from customer. It is to ensure load carrying capacity of foundation pockets.
c) Joint protocol to be signed between civil contractor of customer and BHEL sub contracting agency/representative for measuring the level of foundation bolt & physical condition of foundation bolt after civil work in proper format. Appropriate drawings may be referred. Format will be given by BHEL.
d) Check nut fixed on foundation bolt and set zero reference level as given by customer.
e) Cleaning of foundation bolt threads may be done with wire brush, if required.
f) Required structure as per the drawing from the received material may be taken out with the help of requisite equipment and clean it before erection by wire brush/cloth. Must ensure that hole in column base plate is as per drawing.
g) Assemble vertical members by nut bolt with jointing plate at ground and check for straightness with magnetic spirit level. Afterwards, erect on foundation pockets by the help of requisite crane.
h) Check verticality of structure by the magnetic sprit level/ plum bob method after erection. If verticality is proper, then install foundation nut, plain washer & spring washer as per drawing and proper tightness may be ensured as per recommended standard.
i) Earthing of structure will be done after the bus duct & accessory erection. Touch paint on earthing joint may be done with Alumium Zinc rich paint after welding.
j) Ensure that no gap is found between the horizontal and vertical member of structure joint after bolting. If found, rectify it with required welding at the location and apply touch up paint.
k) Cutting and welding on structures for alignment of structures can be done after taking necessary permissions from Customers and BHEL. Cold galvanising paint (zinc rich paint) should be applied at the welded/modified/rectified portions.

3.2.2.1.2 INDOOR PORTION:-

a) Structure identified and segregated from the received lot and shifts it inside the switchgear room & near generator bushing location for spbd & ipbd erection by the help of tested chain block. Use tested sling for shifting purpose.
b) Structure may be modified/bolted/welded for required length as per drawing for erection purpose.
c) Gas cutting permission for cutting and making holes at required location in structures may be taken from customer/BHEL.
d) Touch up paint on cutting and welding portion by Zinc rich Al. paint .
e) Earthing of structure will be done after the busduct & accessory erection.

3.2.2.1.3 NGR STRUCTURE ERECTION:-

a) Check for embedded plate on wall and match with our ref. Drg.
b) Either EP plate or anchor fastener bolts as the case may be as per drg. May be ensured before civil work is completed. After fixing EP bolts/anchor fastener bolt may be grouted.
c) Structure may be modified if found necessary.
d) NGR must be mounted on epoxy based insulator for proper insulation of our structure.

3.2.2.2 ERECTION OF SPBD:-

During the SPBD erection we have to be careful in busduct erection. Any problem found at testing stage huge rework in busduct at height like open inspection window cover, checking loose aluminium/copper flexible connecting joint, phase clearance & physical inspection of epoxy insulator.Following steps needs to be followed from initial level of busduct erection:

i. **REMOVING PACKING OF BUSDUCT**

The busducts are in packed conditions; therefore, great care is necessary in handling. Ensure that:

a) While lifting enclosure assemblies manila ropes are passed round the bus duct enclosure near the support channels.

b). All shipping steel clamps are to be tightened and bus bars do not slip out while handling, if the bus bar is assembled in the enclosure.

c). While inserting and mounting the bus bar in the enclosure care is taken that the bus bar does not hit and damage the insulators.

d). Eye bolts are used while lifting the cubicles.

Packing of busduct is removed and visually check all dimension of busduct, conductor & hole match as per drg , proper fitment of thermostat and space heater wiring and condition of epoxy insulator.

ii. **SHIFTING OF BUSDUCT FROM STORE TO PROJECT SITE**

After proper inspection of busduct lifting by requisite crane and loading on trailer if required by the help of strap belt and provide wooden support for proper stacking.

Busduct is tightened on trailer if required by the help of ratchet belt for avoiding unwanted scratch/damage on the enclosure of busduct.

iii. UNLOADING OF BUSDUCT AT PROJECT SITE

Busduct is unloaded by requisite crane and proper care should be taken during unloading. Guide rope must be fixed at the end of busduct for avoiding any wobbling at site.

Busduct to be unloaded at paved/levelled area which is provided by customer and proper stacking to be ensured.

iv. SHIFTING AND READYNESS OF SPBD INSIDE AREA.

a) Inside busduct identified by ref drg and taken out from the stacked materials and lifted by tested chain block and tightened with strap belt & shift in switch gear room manually.
b) Open inspection window cover of each busduct. Existing hardwares of inspection window should be taken care during opening.
c) Proper cleaning of aluminium conductor and epoxy insulator by the help of cloth to be ensured.
d) Check setting of space heater thermostat as mention in technical data sheet.

v. ASSEMBLY & ERECT OF BUSDUCT IN SWITCH GEAR ROOM.

a) Assemble two adjacent busduct as per drg.
b) N.B.cork gasket is fixed on the end flange of busduct by fevicol SR-998. Must be ensuring that edge of gasket is overlapping with each other.
c) Hole to be created in gasket after fixing on busduct flange with the help of power hand drill.
d) Adjacent busduct flange must be bolted joint and must ensure that N.B cork gasket is fixed between two adjacent ducts.
e) Proper cleaning of aluminium splice plate by cloth /wire brush and fixed at the joint of aluminium conductor of two adjacent busduct. Must ensure that at jointing area black matt paint is removed from surface of conductor.
f) Torque spanner may be used at this joint and check for as per recommended torque.

Bolt size recommended torque	Torque spanner capacity
M10 = 0.85 to 1.3 nm (20-30 ft-lb)	0.85 to 1.3 nm (20-30 ft-lb)
M12 =1.3 to 1.7 nm (30-40 ft-lb)	0.85 to 4.3 nm (20-100 ft-lb)
M16 =1.7 to 2.1 nm (40-50 ft-lb)	0.85 to 4.3 nm (20-100 ft-lb)
M20 =2.1 to 2.5 nm (50-60 ft-lb)	0.85 to 4.3 nm (20-100 ft-lb)

g) Closing of inspection window cover
h) Before erection of this set cleaning by compressed/service air and take IR value of this set.
i) Finally SPBD jointed set of busduct is erected with the help of tested chain block.

vi. SHIFTING AND READYNESS OF SPBD OUTSIDE AREA.

a) Outside busduct identified by ref drg and taken out from the stacked material by requisite crane.
b) Open inspection window cover of each busduct. Hardwares of inspection window should be take care during opening.
c) Proper cleaning of aluminium conductor and epoxy insulator by the help of cloth.
d) Check setting of space heater thermostat as mention in technical data sheet.

vii. ASSEMBLY & ERECTION OF BUSDUCT IN OUTSIDE AREA.

a) Assemble three adjacent busduct as per drg.
b) N.B.cork gasket fixed on the end flange of busduct by fevicol SR-998.
c) Make holes in gasket after fixing on busduct flange with the help of power hand drill.
d) Adjacent busduct flange must be bolted joint and must ensure that N.B cork gasket is fixed between two adjacent duct.
e) Proper cleaning of aluminium splice plate by cloth /wire brush and fixed at the joint of aluminium conductor of two adjacent busduct. Must ensure that at joint area black matt paint is removed.
f) Torque spanner applied on this joint and check as per recommended torque.

Bolt size recommended torque	torque spanner capacity
M10 = 0.85 to 1.3 nm (20-30 ft-lb)	0.85 to 1.3 nm (20-30 ft-lb)
M12 =1.3 to 1.7 nm (30-40 ft-lb)	0.85 to 4.3 nm (20-100 ft-lb)
M16 =1.7 to 2.1 nm (40-50 ft-lb)	0.85 to 4.3 nm (20-100 ft-lb)
M20 =2.1 to 2.5 nm (50-60 ft-lb)	0.85 to 4.3 nm (20-100 ft-lb)

g) Closing of inspection window cover.
h) Before erection of this set cleaning by compressed/service air and IR value of this set must be taken.
i) Rain hood fixed on the top of the flange joint and bolted.
j) Finally set of busduct is erected with the help of tested requisite crane tight with strap belt and guide rope is used during the lifting at both end for avoiding wobbling.

viii. RUBBER BELLOW ERECTION.

Rubber bellow is provided in SPBD route for dismantling and adjusting of minor misalignment of length horizontally & vertically.

a) Remove packing of rubber bellow.
b) Visually inspection for rubber bellow crack to be carried out.
c) Location and erection of rubber bellow as per ref. Drg.
d) Rubber bellow is to be installed with adjacent duct by means of bolted joint.
e) Rubber bellow joints at the end has to be covered by rain hood.

ix. EARTHING OF SEGREGATED BUSDUCT.

Leakage current in SPBD is grounded by earthing arrangement. In SPBD single continuous earthing is used for heat dissipation. Size of recommended earthing strip is 10 x65 mm/as indicated in BOQ.

a) Remove paint on earthing pad of all SPBD enclosure including SWGR/TRF hood by grinder.
b) Make required holes in earthing strip by magnetic drilled m/c and gas cutting set.
c) Must ensure that overlap portion of earthing strip is (3 x65 mm (wide))195 mm and properly bolted.
d) Grounding of earthing strips to be carried out at both ends, i.e. transformer side as well as switchgear side.
e) Jumper shape of earthing strip at rubber bellow portion or suitable copper cable is used.

x. ERECTION OF SPACE HEATER MARSHALLING BOX AND CONDUTING PIPE.

Space heaters are used for maintaining the ref. temperature in SPBD and remove moisture from SPBD insulators.

a) Remove the packing of space heater marshalling box and check the rating of box and as per our ref. Drg.
b) Installed space heater marshalling box as per ref. Drg. and mount 1.8 mtr from the ref level.
c) Install conduit pipe on insulator support channel and fixed with clamp arrangement.
d) GI conduit flexible pipe is used for covering wires near space heater terminal box with suitable size AL.coupler arrangement.
e) Circuit for each seven duct is terminated in one TB of space heater marshalling box.
f) Cu. Lug is used for termination with proper clamping in heater terminal box and marshalling box.
g) Earthing of space heater marshalling box is to be carried out.
h) Proper tags for identification of space heaters inside each marshalling boxes for incoming route is to be carried out.
i) Identification marking of each marshalling box is to be carried out properly.

xi. ERECTION OF SEAL OFF BUSHING AND WALLFRAME.

Seal off bushing is used for sealing the ducts compartment wherever required in the route of bus duct. This may be near adopter chamber, terminating ducts on GT's, UT's & ST's in IPBD & differentiating inside and outside portion of SPBD to protect the ducts.

a) Remove the packing of seal off bushing and check the rating of bushing as per our ref. Drg.

b) Install SOB & wall frame at the wall of TG building in each route of SPBD coming from from switchgear room. Steel portion of wall frame is grouted. Must ensure proper sealing of SWGR wall cutout area.
c) Ensure easy accessibility of window cover near the wall frame for inspection purpose during the maintenance work.
d) During the erection of seal off bushing insert 9 mm N.B.cork gasket between surface of wall frame and seal of bushing and nylon washer is used between hardwares.
e) Cu./Al flexible joint with seal off bushing palm alongwith bimetallic strip is inserted between these joints. Ensure that Cu.surface of bimetallic strip is facing towards Cu. Surface of seal off bushing and AL Surface of bimetallic strip is facing towards AL.couductor of busduct.
f) Recommended torque tightness to be checked.

xii. ERECTION OF BREATHER BOX ASSEMBLY:-

Breather box is used for absorbing moisture, if accumulated inside the busduct with the help of silica gel.

a) Breather pad to be fixed on both sides of wall frame on the SPBD enclosure either at top side or bottom side.
b) Jointing arrangement of breather pad must be insulated.
c) With the help of conduit pipe, both sides of wall frame joint, drop the pipe at one location where breather box is to be installed.
d) Remove breather box packing and ensure proper care of glass cover of breather box so that to avoid breakage.
e) Breather box installed with anchor fastener or clamping arrangement.
f) Before HV testing of SPBD, silica gel has to be filled in breather box.

xiii. ERECTION OF COPPER FLEXIBLE.-

Cu.flexible is installed to connect between two conductor terminals of bus ducts, conductor with switch gear panel copper connections, conductor with transformer bushing end.

a) Remove the packing of cu.braided flexible and visually inspect and check material required as per drawing.
b) Bimetallic strips, wherever given in drawing is to be used at this location. Ensure that cu.surface of bimetallic strip is facing towards cu. Surface of cu.flexible and AL. Surface of bimetallic strip is facing towards AL.couductor surface of busduct.
c) Torque tightness check as per recommended torque.

3.2.2.3. ERECTION OF IPBD:-

During the IPBD erection, care regarding the welding work at joints must be taken and visually inspection of insulator for cracks to be done. In IPBD all joint is AL.welded and is high rating current carrying path.

REMOVING PACKING OF BUSDUCT:-

Packing of busduct is removed and visually checked for all dimensions of busduct, conductor, backing plate & insulator support & BOM nos. Packing on silver plating on palms should not be removed at this stage.

i. SHIFTING OF BUSDUCT FROM STORE TO PROJECT SITE

Identify the busduct which is needed for erection at project site. Issue it from stores after proper entries. Lift the busduct by requisite crane and load on trailer, if required by the help of strap belt and provide wooden support for proper stacking on it. Busduct is tightened on trailer if required by the help of ratchet belt to avoid scratch/damage, toppling on the enclosure of busduct.

ii. UNLOADING OF BUSDUCT AT PROJECT SITE

Busduct is unloaded by requisite crane and proper care should be taken during unloading. Guide rope must be fixed at the end of busduct for avoiding any wobbling at site. Busduct to be unloaded at paved/proper levelled area and proper stacking with the support of wooden strip to be carried out.

iii. SHIFTING AND READYNESS OF IPBD INSIDE AREA.

a) 0Inside busduct identified by ref drg and taken out from the stacked/stored material and lifted by tested chain block and tight with strap belt & shifted near the generator.

b) Proper cleaning of aluminium conductor and epoxy insulators by the help of cloth.

c) Visually inspect the condition of black paint on IPBD conductor and inside portion of IPBD enclosure. If paint has peeled off then touch up paint will be require on peel off area.

iv. ASSEMBLY & ERECTION OF BUSDUCT IN TG HALL.

a) Measurement of embedded plates size inside the TG Hall and check as per ref. Drg.

b) Bolting on support leg with our structures. Both leg pins to be inserted in IPBD support channel ring clamp. If insulations provided then arrangement of insulation as per our ref drg. May be carried out. Size of bolts installed must be same.

c) Positioning of busduct to be done by the help of chain block and match the conductor overlapping on backing tube with adjacent duct. Tight with ratchet belt and tag weld the joints. All joints and dimensions to be checked as per our ref drg.

d) Proper cleaning of jointing area by wire brush and removal of black paints & burr. To be done. 5 mm to 12 mm gap is to be created on backing tube and adjacent conductor for further welding.

Welding conditions for MIG process:

Filler wire:	1.6mm dia (NG21 with 5% silicon)
Angle:	10° to 15° forehand
Cleaning:	decrease and scratch brush

Setting: 250A to 320A, 28 to 30 volts (dependent on thick)
Process: 4 off 25mm long equispaced tack welds
Gas supply: 50 cu. Ft/hr argon – 10-12 lits/min.argon
Shield: 5/8" dia
Purity: 99.98%

e) Root welding on IPBD conductor by certified welder has to pass DP Test/Radiography test, if mentioned in FQP.
f) After root welding cleaning by wire brush and perform dye penetration test on it.
   i. Apply cleaner on welded portion.
   ii. Spray penetration on welded portion.
   iii. Spray developer on welded portion. Leave 15 min for developing time. If pin spots found then grinding has to be done on this portion and it is to be rewelded. Again DP test to be conducted on this joint.
   iv. Finally cleaner is used to clean the layers and ready for final welding.
g) After final welding on this joint, again dye penetration test is to be carried out. If joint passes the test then proper cleaning by wire brush and black matt paint to be applied on this joint.
h) Again cleaning of conductor and insulator before closing the enclosure by makeup pieces.
i) Clean the edges with grinder of the makeup pieces and enclosure and fitting by the help of ratchet belt and tag welding/final welding on it. After welding on makeup piece grinder is used for remove burr and apply touch up paint on the joints.

v. SHIFTING AND READYNESS OF IPBD OUTSIDE AREA.

a) Outside busduct identified by ref drg and taken out from the stacked material by requisite crane.
b) Proper cleaning of aluminium conductor and epoxy insulator by the help of cloth.
c) Visually inspect the condition of black paint on IPBD conductor and inside portion of IPBD enclosure. If paint has peeled off then touch up paint has to be applied on peeled off area.

vi. ASSEMBLY & ERECTION OF BUSDUCT IN TRANSFORMER YARD.

a) Positioning of busduct by the help of requisite crane and match the conductor overlapping on backing tube with adjacent duct and tight with ratchet belt and tag welded on this joint. All sub-assembly to be prepared at ground floor.
b) Proper cleaning of jointing area by wire brush and remove all black paint & burr. 5 mm to 12 mm gap to be created on backing tube and adjacent conductor.
c) Root welding on IPBD conductor by certified welder has to pass DP Test/Radiography test, if mentioned in FQP.
d) After root welding cleaning by wire brush and perform dye penetration test on it.
   i. Apply cleaner on welded portion.
   ii. Spray penetration on welded portion.

iii. Spray developer on welded portion. Leave 15 min for developing time. If pin spots found then grinding has to be done on this portion and it is to be rewelded. Again DP test to be conducted on this joint.
iv. Finally cleaner is used to clean the layers and ready for final welding.

e) After final welding on this joint, again dye penetration test is to be carried out. If joint passes the test then proper cleaning by wire brush and black matt paint to be applied on this joint.
f) Again cleaning of conductor and insulator before closing the enclosure by makeup pieces.
g) Clean the edges with grinder of the makeup pieces and enclosure and fitting by the help of ratchet belt and tag welding/final welding on it. After welding on makeup piece grinder is used for remove burr and apply touch up paint on the joints before erection of assembled set of IPBD by the help of requisite crane.
h) Assembled IPBD needs to be erected on structure with IPBD support leg matching with our IPBD cross structure and proper bolting of AL.leg and insert both leg pin in the AL.support channel ring. If insulation is provided then arrangement of insulation has to be carried out as per our ref drg. Size of bolts must be same.

vii. IPBD RUBBER BELLOW ERECTION.

Rubber bellow is provided in IPBD route for maintanance and adjustment of minor misalignment during erection horizontally & vertically.

a) Removing packing of rubber bellow.
b) Visual inspection of rubber bellow for cracks.
c) Location and erection of rubber bellows as per ref. Drg.
d) Rubber bellow is erected with adjacent duct by means of bolted joint.
e) Rubber bellow joint is covered by rain hood if required as per drg.

viii. EARTHING OF ISOLATED PHASE BUSDUCT.

Leakage current in IPBD is grounded by earthing arrangement. In IPBD, shunt plates is used for shorting all three phase of IPBD. Shunt arrangement will be provide as per layout drg. Earthing arrangement for the same shall be made. Size of recommended earthing strip is 10 x65 mm/as per TDS.

a) Remove paint on shunt plate where jointing has to take place by the help of grinder.
b) Create required hole in earthing strip by magnetic drilled m/c and gas cutting set for bolting arrangement.
c) Must ensure that overlap portion of earthing strip is (3 x65 mm (wide))195 mm and proper bolted.

ix. ERECTION OF CURRENT TRANSFORMER.

Current transformer is used in IPBD for metering purpose of the equipment.

a) Remove the packing of current transformer carefully and visually check for any damages. Take out the Brass and SS spacers from inside the packing.
b) Polarity ratio test to be conducted on CT before erection.

c) After testing current transformer, install in busduct at ground level with brass/ss spacers and fixed with hardwares and nylon washers.
d) Assembled busduct with current transformer to be erected by requisite crane.

x. ERECTION OF CURRENT TRANSFOREMR MARSHALLING BOX.

Supply is provided in current transformer by means of CT marshalling box.

a) Remove the packing of current transformers marshalling box and visually inspect the condition of marshalling box. Match with our ref. Drg.
b) Termination at CT stud with lug and wire be laying of cable tray and tied with plastic strips.
c) CT marshalling box fitted as per drg. by the help of anchor fasteners and 1.8 mtr from the ground level.
d) Wire is terminated in the marshalling box by fitting proper cu.lug.
e) Identification and marking inside the ct marshalling box for wires may be correctly done.

xi. ERECTION OF IPBD WALL FRAME.

Erection of wall frame in IPBD at the TG hall wall in the route to be carried out as per ref drg. Rubber gasket is providing between the IPBD enclosure and innner surface of wall frame.

xii. ERECTION OF SEAL OFF BUSHING.

Seal off bushing is used for sealing the ducts compartment wherever required in the route of bus duct. This may be near adopter chamber, terminating ducts on GT's, UT's & ST's in IPBD to protect the ducts.

a) Remove the packing of seal off bushing and visually inspect the condition of seal off bushing and match with our ref. Drg. And rating.
b) Proper care should be taken during the erection in IPBD flange.
c) Neoprene cork gasket may be inserted between surface of AL. flange of IPBD and surface of seal off bushing.
d) Nylon washer is fixed on the surface of seal off bushing and proper nut bolt fixed.
e) Must ensure that air doesnot not passes from the seal off bushing. If any air leakage detected, then arrest by the help of sealant.

xiii. ALIMUNIUM TERMINATIONS/DISCONNECTING LINKS IN IPBD.

In IPBD high rating current flows, so that following step should be considered during the jointing of aluminium /cu. Plates at terminals.

a) In IPBD terminating palms silver plating is done on respective palms. Packing of palm assembly to be removed before erection.
b) Aluminium plate is cleaned by soft cloth to remove the oxide layer on the surface.
c) Densol compound to be applied on aluminium plates for preventing any oxidation to re-occur.
d) Nut bolt arrangement is used for fitting this splice plate on IPBD palm and check with recommended torque tightness.

xiv. ERECTION OF IPBD AL/COPPER FLEXIBLE JOINT IN IPBD:-

Cu.flexibles are used inside the rubber bellow for terminations at busduct end with other connecting equipments.

a) Remove the packing of cu.braided flexible and visually inspect and check as per required drg./rating.
b) Bimetallic strip is used at this location. Ensure that cu.surface of bimetallic strip is towards cu. surface of cu.flexibles and AL. surface of bimetallic strip is towards with AL. Conductor surface of busduct.
c) Torque tightness check as per recommended torque settings.

xv. ERECTION OF NEUTRAL GROUNDING CUBICLE.

Neutral grounding cubicle is provided for at the neutral side of generator bushing to ground the current.

a) Remove the packing of neutral grounding cubical and check all accessories in this packing list.
b) Shift the cubicle at desired location as per our layout drg.
c) Installed all accessories in NGC as per our ref. Drg.
d) Earthing of NGC body to be done at the end.

xvi. ERECTION OF AIR PRESSURIZATION/~~HOT AIR BLOWER.~~

This system is used for maintain the pressure/dry up inside the busduct above the atmospheric pressure/for moistures and attend sufficient temperature.

a) Remove the packing of air pressurization and hot air blower system and physically check the entire accessory as mention in dispatch document.
b) Shift the system at desired location and installed all piping scheme as per our layout drg/scheme.
c) Respective vendor of this system is will be called for commissioning after proper installation of all accessories.
d) Hand over the system after successfully commissioning.

xvii. ERECTION OF SHORTING BAR

During the short circuit test at site all three phase of IPBD will be shorted by the help of shorting bar.

a) Shifting short circuit arrangement at desired installation location by the requisite mechanism.
b) Erect shorting bar with the help of chain block pulley and prepare the structure as per ref. Drg/Scheme.
c) Install insulator on the structure.
d) Install all aluminium splice plates with shorting links and get inspected by the inspection authority with recommended torque tightness.

e) After inspection all aluminium splice plates to be dismantled and handed over to customer in proper format.

3.2.2.4 **Power Frequency High Voltage Test**

Preparation:

Following equipment must be disconnected from busbars removing the bolted link and grounded suitably prior to conducting this test:

a. Generator terminals
b. Unit auxiliary transformer terminals
c. Generator transformer terminals
d. Neutral grounding transformer HV terminal
e. Lightening arresters
f. Capacitors
g. Potential transformer.

It is important to ensure that secondary of all the current transformers mounted on busbars are shorted and grounded properly before conducting this test.

Ensure that all insulators seal-off bushings are cleaned free from any dust, grease and moisture etc before test.

During the test, ensure the following

a. The generator rotor is kept stationary.
b. H.V. Circuit breakers on system side are kept in the open position.

Test Voltage:

The test voltage shall be alternating current on any frequency between 25 hertz to 100 Hz and approximately of sine-wave form.
The r.m.s. value shall be as given in table-1 below:
For A.C. voltage duration of test shall be one minute.
The test with D.C. at a voltage not in excess of the values given in below table , Column-3 for the corresponding rated voltage may be substituted for the AC test prescribed. For D.C. voltage duration of test shall be fifteen minutes.

Rated Highest System Voltage(KV) -Upto & Including	Test Voltage (A.C.)-KV	Test Voltage (D.C.)-KV
3.6	16.8	16.8
7.2	21.6	21.6
12	28	28
24	44	44

36	60	60

3.2.2.5 IR Value Checks:

Before the application of high voltage, check the insulation of each bus conductors by applying 2.5 KV/5 KV from IR Testing machine. A value of 100 mega ohms expected under normal conditions. However, mainly during season this value may fall down considerably and drying up by hot air may be necessary before the test. After the application of high voltage the insulation value is checked gain.

Note :

The test specified above for all the electrical equipment are not exhaustive. Any other pre-commissioning and field tests not included in the above list but necessary as per relevant standards, Electricity rules, code of practice and instructed by the manufacturer of the equipment shall also have to be carried if deemed necessary shall be carried out as per requirement either at free of cost or at additional cost. Decision of Engineer in charge will be the final regarding additional cost for testing. The contractor shall take the full responsibility of testing, commissioning, trial run and successful operation of the equipment under overall guidance of BHEL engineer.

TECHNICAL CONDITION OF CONTRACT
VOLUME- II - PRICE BID

For Bus Duct Installation Package at
NTPGCL, Nabinagar, Bihar-3X660MW

SL NO.	DESCRIPTION	QUANTITY (IN MTR)	RATE PER UNIT MTR (IN RS)	AMOUNT (IN RS)
1	**24 KV ISOLATED PHASE BUSDUCT** Handling at Site Stores/Storage Yard, Transportation to Site of Work, Pre-assy, Erection, Testing and Commissioning of Bus Duct- For Unit-03.			
1.A	MAIN RUN LENGTH	185		
1.B	DELTA RUN LENGTH	90		
1.C	TAP-OFF RUN LENGTH	135		
1.D	**SUB-TOTAL** (1.A+1.B+1.C)			
2	**11 KV SEGREGATED PHASE BUSDUCT** Handling at Site Stores/Storage Yard, Transportation to Site of Work, Pre-assy, Erection, Testing and Commissioning of Bus Duct- For Unit-03			
2.A	SPBD RUN LENGTH	393		
2.B	**SUB-TOTAL** (2.A)			
3	**TOTAL** (1.D + 2.B)			
4	**GST @ 18% (or as applicable at present)**			
5	**GRAND TOTAL** (3+4)			

(In words:
Rupees.....
.....)

Note: Selection of L-1 party will be based on cost arrived in Total (ROW No.: -03)