भारत हेवी इलेक्ट्रिकल्स लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT HEAVY ELECTRICALS LIMITED
(A Govt. of India Undertaking)

TCN - 01

Ref: PSER:SCT:KLN-C1865:TCN-01 Date: 24-11-2017

Sub	Tender Change Notice (TCN) - 01.	
Job	PACKAGE-12: Construction of 275 M tall twin flue GRP liner RCC chimney and other incidentals complete as detailed in the specification including raft foundation at 2x660 MW Maitree STPP, Rampal, Bangladesh.	
Ref	1.0	Tender no PSER:SCT:KLN-C1865:17.
	2.0	BHEL's NIT, vide reference no PSER:SCT-KLN-C1865:6285, Date: 21-11-2017.
	3.0	Other References, if any.

With reference to above, following points/ documents, relevant to tender, may please be noted and complied with while submitting the offer.

1. Revised specification for Duct (GRP) at FGD Outlet attached superseding earlier issued specification along with NIT.

2. Introduction of Loading of Flue Gas Duct Drawing for general guidance and tender purpose only.

3. Revised BOQ cum Price Schedule, VOLUME-III-PRICE SCHEDULE-R-01 is attached superseding VOLUME-III -PRICE SCHEDULE-R-00 issued earlier along with NIT. Bidder shall quote as per this revised Volume-III, Rev-01 only. Bidders are also requested to submit a declaration in techno - commercial offer that they have submitted their price bid as per REVISED price schedule format (VOLUME-III- PRICE SCHEDULE, REV-01).

4. Revised `No deviation certificate' is attached. Bidder to submit `No deviation certificate' as per attached format only.

5. All other terms & conditions shall remain unchanged.

Thanking you,

Yours faithfully,
for BHARAT HEAVY ELECTRICALS LTD

Sr. Engineer (SCT)

Encl: As above.

पावर सेक्टर पूर्वी क्षेत्र (मुख्यालय)
POWER SECTOR EASTERN REGION, DJ-9/1, SALT LAKE CITY, KOLKATA - 700 091
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BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPALLI-620 014

DUCTS / PE (BOILERS)

SPECIFICATION
FOR
DUCT(GRP) AT FGD OUTLET

REVISION HISTORY

REV. NO.	PAGE	REVISION HISTORY	DATE	PRPD	CHED	APPD
01	4	Details of Condensate extraction system added.	10/10/2017	DAVID ABEL	HARI	BMK
	18	Revised sketch (Rev:02) attached.	10/10/2017	DAVID ABEL	HARI	BMK
02	19	Gas characteristics data revised.	16/10/2017	DAVID ABEL	HARI	BMK
03	18	Revised sketch (Rev:03) attached.	21/11/2017	DAVID ABEL	HARI	BMK

TABLE OF CONTENTS

Clause No.	DESCRIPTION
1.0	**PROJECT DESCRIPTION**
1.1	**GENERAL** GRP (Glass reinforced plastic) duct for the two units shall be 100m length. GRP duct shall be supported on steel platforms as shown in Annexure I. Suitable thickness for GRP duct shall be selected based on design temperature and pressure.
1.2	**FLUE GAS CHARACTERISTICS** The GRP duct shall be working with FGD in line mode, with flue gas characteristics as given in Annexure-II. However, the maximum temperature for GRP duct system design shall be considered as 90 deg centigrade for 2 hours.
1.3	**GENERAL CONFIGURATION (Refer Annexure 1):** The GRP duct configuration along with scope shall be as given in Annexure-I. However, during detailed engineering, minor modification can be done with BHEL's consent.
2.0	**SCOPE OF WORK**
2.1.a	**SCOPE** The scope of work includes Engineering, procurement, supply, fabrication and erection of the GRP duct system as follows:-
2.1.a.1	Analysis, Design, preparation of engineering/fabrication drawings, material supply, Handling, transportation, storage, preserve, pack and furnish with adequate packing, test for quality and fabrication and assembly of GRP parts that will be successfully erected up to the chimney flue. The following may be considered as broad subcategories in above mentioned scope of works: o GRP duct, including expansion joints/expansion compensator, manholes with covers, and other accessories required in ducts so as to work as complete flue gas duct system for wet stacks. o Duct Support system in the duct assembly

	o Duct stiffeners (including metal parts, and their finish). o GRP field joints of the connecting duct modules. o Bounding of steel parts to GRP
2.1.a.2	All necessary parts, and works necessary for transport, storage and erection purposes.
2.1.a.3	Submission of the design/drawings/fabrication drawings for complete GRP duct system, and getting the same approved from BHEL/BIFPCL.
2.1.a.4	The Bidder shall furnish all design, labor, materials, tools and equipment necessary for the completion of the scope as indicated and specified herein.
2.1.a.5	The Work shall include everything requisite and necessary to finish the Work properly, not withstanding that every item of labour or materials or accessories required to make the installation complete may not be specifically mentioned.
2.1.a.6	The GRP duct for each Unit shall be fabricated and installed, complete with appurtenances and accessories, to form a complete system which will achieve and assure safe and reliable operation with best overall intended performance.
2.1.a.7	All components, appurtenances and accessories shall be of proven design, verified by past Power Plant Operation usage.
2.1.a.8	Changes in design and drawings already approved by the owner are normally unaccepted. However, should such changes become necessary on an exceptional basis, the Bidder shall obtain the owners approval prior to introducing any such change.
2.1.b	Providing (supplying), fabricating and erecting, at all levels, Condensate extraction system inside/outside FGD outlet to inlet of chimney flue within the subject scope of works, based on the approved design as per gas-flow-model study, complete with all bends, flanges, stiffeners, all other flue attachments, including drains inside liners, GRP gutters, pipes, bends, joints, GRP pipe outside liners up to condensate drain sump (condensate drain sump is not included in the item), including support system, collars, and other accessories, cost of all labour, material, equipment, surface finishing, sealing, testing for quality, transporting, lifting to all heights, setting in place, cutting, grinding, bending, curing, lamination, moulding, testing, guarantee/warranty etc. complete as per drawings, specifications, manufacturer's recommendations, relevant BS or equivalent international standards and/or as

	approved by BIFPCL/BHEL.
2.2	**BIDDER SERVICES:** Field personnel provided by the Bidder shall be capable and qualified to perform the required duties to the satisfaction of BHEL.
2.2.1	**COMMISIONING AND START UP SERVICES:** Bidder shall provide, during all period of commissioning and startup, the services of competent supervisors to direct Purchaser's personnel and assure proper, complete and successful commissioning, starting, and placing into service of the duct system provided under this Contract.
2.3	**TERMINAL POINTS AND TERMINAL CONNECTIONS** Bidder shall terminate the Equipment (duct along with other appurtenances) provided under this Specification at the agreed upon terminal points with the appropriate terminal connections.
3.0	**SPECIAL EQUIPMENT, TOOLS AND INSTRUMENTS** Bidder shall provide all special equipment's, tools and instruments required for fabrication, safe and secure transport, handling and storage of all components from ex works to final destination at the concrete chimney, installation of duct system up to chimney flue and for testing and maintenance of Equipment provided under this Contract.
4.0	**STANDARDS AND CODES:**
4.1	Standards and Codes referenced in this Specification and in the Supplements to this Specification, form an Integral part of this Specification -to the extent their requirements are consistent and conform to the requirements specifically set forth herein. All such Standards and Codes are to the issue, including all amendments, supplements, etc., current as of the date of the Contract, unless indicated otherwise. In the event of a variance between the requirements of the Standards and Codes and the particular requirements set forth in the Specification, the requirements specifically set forth in the Specification shall take precedence.
4.2	The duct system to be provided under this Specification, including all appurtenances and accessories, shall be designed, fabricated, inspected, tested, stamped and preserved to the extent indicated in said referenced Standards and Codes. Where this Specification does not include such reference. The duct system, or any of its components, shall be designed, fabricated, inspected, tested and preserved, as applicable, to comply with currently recognized International and/or Bidder's Standards, Whichever are tighter and

	more restrictive.
4.3	The Bidder may propose Standards and Codes as alternates for, or additions to those specified herein. A copy of each proposed Standard and code, if any, shall be submitted (in English) for Purchaser's approval. In case Purchaser's approval is granted, the Bidder shall remain responsible for the compatibility of the design and the physical interfaces between the supplied Equipment and the equipment supplied by others.
4.4	Subject to the provisions stated above, the equipment shall be designed, manufactured, erected, tested operated and maintained in accordance with the standards, regulations, directives and publications of the following agencies and organizations: 1) For Wind and seismic codes a) Bangladesh National Building Code - Code of Practice for Wind Load b) Bangladesh National Building Code - Code of Practice for Seismic Load (Additional parameters shall be taken from the recommendation of site specific seismic study of the site furnished by the owner) 2) The GRP duct material, design, fabrication, erection, quality assurance and quality control, storage, testing, tolerances etc. all complete shall be as per ASTM D 5364, "Standard Guide for Design, fabrication and Erection of Fiberglass Reinforced Plastic Chimney liners with Coal Fired Units" and CICIND “Model code for FRP liners”. The terminology in the specification is consistent with ASTM D 883 and ASTM D 5364. 3) American society of mechanical engineers (ASME) • ASME C582, "Reinforced thermoset plastic corrosion resistant equipment" 4.9 American society of testing materials (ASTM) • ASTM D 638, "Test method for

tensile properties of plastics"

- ASTM D648, "Test Method for Deflection Temperatures of Plastics Under Flexural Load in the Edgewise Position"
- ASTM D695, "Test Method for Compressive Properties of Rigid Plastics"
- ASTM D790, "Test Method for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials"
- ASTM D 792, "Test Method for Density and Specific Gravity (Relative Density) of Plastics by Displacement"
- ASTM D883, "Definitions of Terms Related to Plastics"
- ASTM D2393, "Test Method for Viscosity of Epoxy Resin and Related Components"
- ASTM D2471, "Standard Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins"
- ASTM D 2583. 'Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol lmpressor"
- ASTM D2584, 'Test Method for Ignition Loss of Cured Reinforced Resins"
- ASTM D4398, "Test Method for Determining the Chemical Resistance of Fiberglass Reinforced Thermosetting Resins by One-Side Panel Exposure"

- ASTM D 5364, "Standard Guide for Design. Fabrication and Erection of Fiberglass Reinforced Plastic Chimney liners with Coal Fired Units"
- ASTM E 84, "Test Method for Surface Burning Characteristics of Solid Materials"
- ASTM E 228, "Test Method for linear Thermal Expansion of Solid Materials With a Vitreous Silica Dilatometer"
- ASTM D2996 “Standard specification for filament wound fibre glass”

4) National Fire Protection Association (NFPA)

- NFPA 77, "Recommended Practice on Static Electricity"

5) European standard

- 8S-4994: British Standard Specification for Design and Construction of Vessels and Tanks in Reinforced Plastics.
- EN 13121: GRP tanks and vessels for use above ground.
- DIN 1BS20: GIass fiber reinforced unsaturated polyester (GF-UP) and phenacrylic (GF-PHA) resin structural composites.
- CICIND Model code for FRP liners

5	**QUALITY ASSURANCE AND QUALITY CONTROL**
5.1	The Bidder shall submit upon request a copy of Its Quality Assurance Manual including Quality Procedures.
5.2	The Bidder shall conduct an inspection and testing program which shall record and verify the essential properties of the constituent materials and the finished duct.
5.3	The Bidder shall conduct test to verify the mechanical properties of the laminate.
5.4	Quality assurance procedures shall be documented by the equipment manufacturer during the course of design and fabrication and shall be made available to owner.
5.5	Unless otherwise specified the bidder's standard tests shall be performed on all equipment furnished. The owner may or may not elect to witness tests, but the bidder shall notify the Owner's Quality Assurance Department no later than 10 days in advance of all scheduled tests.
6.0	**SAFETY, ENVIRONMENT REQUIREMENTS**
6.1	**SAFETY**
6.1.1	Bidder shall obtain all required approvals from concerned Bangladesh government agencies as per the requirement of Bangladesh Statutory Norms including environmental norms.
6.2	**ENVIRONMENT DATA**
6.2.1	Wind Load Wind load shall be as per Bangladesh National Building Code - Code of Practice for Wind Load. For the subject site, the basic design wind velocity shall be Vb=73.3 m/sec.
6.2.2	Earthquake Loads Earthquake loads shall be as per Bangladesh National Building Code - Code of Practice for Seismic Load (Additional parameters shall be taken from the recommendation of site specific seismic study of the site).
6.2.3	Loads Combination Load combinations for design of GRP flue duct shall be as per ASTM D 5364.

7.0	**TECHNICAL REQUIREMENTS**
7.1	**DESIGN PARAMETERS**
7.1.1	Duct considerations The GRP duct shall be design for a long life of minimum 35 years. The GRP parts will be prepared to allow for the shorter erection period. The GRP duct will be designed with adequate thickness all along its length. The duct shall be designed to allow for free expansion and contraction for the temperature variations resulting from plant operation and ambient conditions. The GRP duct design shall be as per provisions of ASTM D 5364, "Standard Guide for Design, fabrication and Erection of Fiberglass Reinforced Plastic Chimney liners with Coal Fired Units" and CICIND “Model code for FRP liners”, Whichever are tighter and more restrictive. The terminology in the specification is consistent with ASTM D 883 and ASTM D 5364. The duct shall be laterally braced/guided to the available platform steel structure with stayrods, guides or bumpers. The stayrods, guides or bumpers shall laterally restrain the duct while permitting free, unrestrained horizontal movement. Stayrods, if used, shall span from structure part to structure part and shall be connected to the liners by means of a sliding assembly which shall not restrain horizontal movement. Turnbuckles shall be provided in each stayrod for adjusting the stay rod tension and elevation.
7.1.2	Measurements ports Measurement ports will be installed in the GRP duct, the quantity, size and location may be changed during the GRP liner detail design. All ports will be supplied with flanged ends, with blind flanges or plugs as appropriate.
7.1.3	Manholes Manholes for access to the GRP duct for periodic inspections and maintenance will be provided at appropriate location. Inspection port will be of flanged and bolted manhole, with hinged and lockable doors, installed on the GRP duct.
7.2	Design operating conditions Operating conditions shall be as per annexure I Ash load shall be taken according to ASTM D5364 recommendations.

7.3	**PERFORMANCE REQUIREMENTS**
7.3.1	GRP duct will be designed in such a way that they will not require unscheduled outages for repair except for planned and scheduled routine maintenance and inspections.
8.0	**DESIGN REQUIREMENTS**
8.1.1	General o Design requirements of this specification are to be regarded as minimum requirements. If the Fabricator's design and/or experience dictate these minimum requirements should be exceeded, the design should be performed accordingly. o The design report shall include both a global design of the GRP duct and, as required, localized designs of joints, support ledges, bumper pads, lugs, stay rod brackets, etc. o Requirements of stiffeners for GRP duct shall be as per ASTM D 5364
8.1.2	Materials Materials certificates to be used for the manufacture of GRP duct shall be submitted to BHEL.
8.1.2.1	Resin • Resin used in the fabrication of all GRP components shall be vinyl ester throughout, so as to sustain the design conditions as given in the specification. • The resin should have been successfully used under comparable operating conditions and have been evaluated for chemical resistance as per

	ASTM D5364. • Ultra-violet absorbers (UVA) shall be added (alongwith white pigments) to all surfaces which will be exposed to sunlight, to improve weathering characteristics. UVA shall also be added to the interior and exterior surface of the minishell.
8.1.2.2	Surfacing Veil The surfacing veil will be carbon veil. Only carbon veil that is specifically recommended by the veil Bidder for use in the intended manner, and which is shown to satisfy the conductivity requirements of ASTM D 5364, shall be used for conductive surfaces.
8.1.2.3	Glass Fiber Reinforcements • All reinforcing glass veil used in the corrosion barrier shall be Chemical resistant glass, Grade "C". • Except for the corrosion barrier, all reinforcement glass fiber shall be “E” or “E-CR” type, having a vinyl ester compatible finish. • Final selection of glass fiber reinforcement is subject to owner’s approval.
8.1.2.4	Material For Manway And Flange Penetrations • Access openings/manways/gas sampling ports in the main liners shall be of RTP- II • Flanged nozzles shall be of monolithic, RTP- II

8.1.2.5	Steel Parts Steel parts shall be of the specified grade of steel and shall be hot dipped galvanized after welding.
8.1.2.6	Laminate All cylindrical liner components shall be fabricated using the filament winding process.
8.1.3	Calculations • Design of the GRP ducts must be performed by a professional engineer with adequate experience in the design of custom vinyl ester GRP corrosion resistant ducts. The Design Engineer must be well acquainted with ASTM D 5364. • The GRP duct system design shall be as per provisions of ASTM D 5364, "Standard Guide for Design, fabrication and Erection of Fiberglass Reinforced Plastic Chimney liners with Coal Fired Units" and CICIND “Model code for FRP liners”, Whichever are tighter and more restrictive. • All the irregular/noncircular elements/bends/corners etc. shall be designed with local FEA or adequate formulation calculation so as to ensure that in any point of the duct system and in any case load or combination the stresses are within allowable limits. • Shell-to-shell joints shall be of butt joints No longitudinal shell joints are permitted. Flue CAN to CAN design as per ASTM D5364 or CICIND • Flame spread rating for GRP shall be as per Bangladesh national building

	code or other international codes approved by BHEL/BIFPCL. The flame spread shall be determined in accordance with ASTM D 5364.
9.0	**FABRICATION REQUIREMENTS** Responsibility of fabricator- The responsibility of the fabricator shall be to fabricate the GRP duct system in accordance with the complete designs and details set forth solely by the GRP duct designer and shall warrant all workmanship to be in accordance with specified designs. Fabrication facility shall be as per ASTM D 5364 taking into consideration the local climatic conditions of the region.
9.1.1	The GRP flue ducts are normally constructed from individual cylindrical sections, called "cans," of the diameter set forth by the design The length of the cans would be determined by the feasible opening size in the shell from design of shell and raft point of view. However, the cans shall be of minimum 5m length. Fabrication shall comply with the provisions of ASTM D5364, except as modified herein.
9.2	Tolerances The GRP duct designer (bidder) is responsible to set consistent tolerances for the manufacturing of the GRP cans and the steel components that are attached to the cans. Tolerances shall take into account limitations with respect to methods of manufacturing shall be ASTM D 5364 or CICIND, whichever is more stringent.
9.3	Laminate construction GRP duct laminates shall consist of a corrosion barrier layer, a structural layer, and an outer layer. The fabrication process is typically filament winding. The laminates shall be in accordance with the provisions of ASTM D 5364 and the following:
9.3.1	Corrosion Barrier A conductive carbon veil will be provided on all inner surfaces to insure static charge dissipation.
9.3.2	Structural Wall:

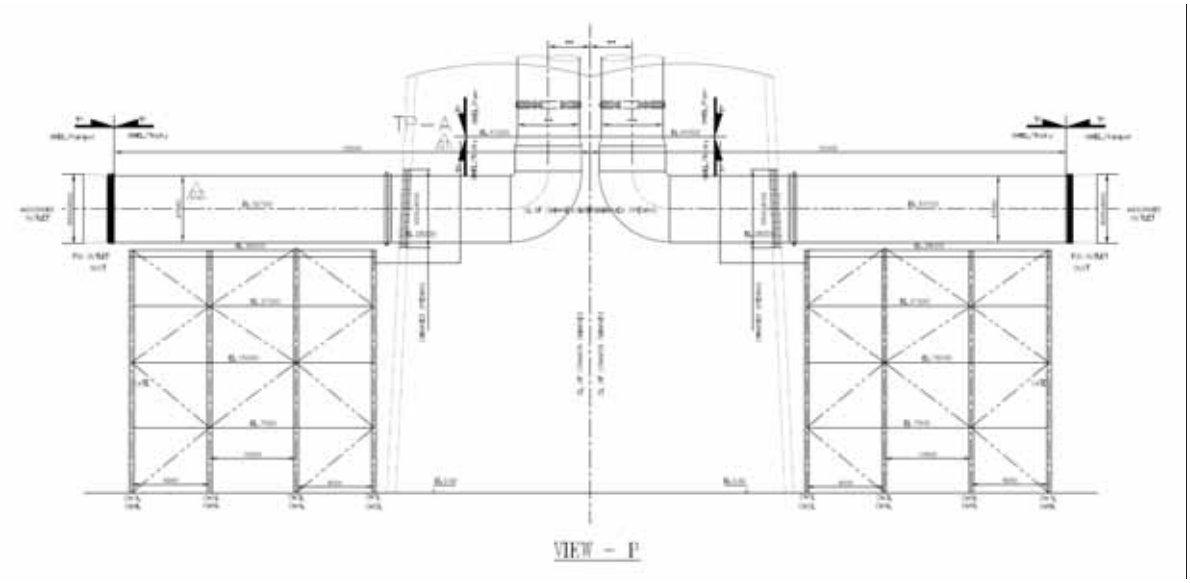
	Prior to the start of component winding, the Fabricator shaII demonstrate that the chosen winding method (winding roving weight, band width, number of strands in band and resin bath system) produce a well wet-out laminate. It is the Fabricator's responsibility to determine the thickness, location and frequency of chopped glass layers required to prevent excessive voids
9.3.3	Outer Surface The outer surface shall be resin rich and shall provide resistance to exterior environmental degradation. Pigments are not allowed in any portion of the liner section apart the exposed to sun surfaces where a white pigment should be added, The minishell shall be provided with an exterior corrosion layer identical to the Interior corrosion layer. Cap the top edge of the liner with a corrosion barrier that Wraps minimum 100 mm down onto both the interior and exterior surfaces.
9.4	**SPECIAL FABRICATION DETAILS:**
9.4.1	Thickness transitions: Thickness transitions at laminate build-ups, such as filament wound support shoulders, hand-laid joints and other secondary laminations, must be evenly tapered using a minimum ratio of 6:1.
9.4.2	Steel Components bonding to GRP Steel lugs or stay rod brackets attached with filament wound bands will be designed and fabricated with end ramps such that the winding bands are in complete contact with the surface and do not bridge or leave gaps.
9.4.3	Laminated Joint Structural joints for shop fabrication and field installation shall be butt-and-strap type. The specific joint requirements shaII be determined according to design requirements. Butt and strap joints shall be balanced between the inside and the

	outside, the corrosion barrier shall be built on the inside. The physical and corrosion resistant properties of the laminate shall meet or exceed the specified requirements for the fabrication of the adjoined sections.
10.0	**MARKING, PACKAGING AND TRANSPORTING**
10.1	Each fabricated piece will be stamped with the can or component number and indexing marks as indicated on shop and erection drawings.
10.2	All GRP duct sections will be properly handled in a safe manner that will not allow damage, scuffing or overstressing. Impact of any hard objects shall be avoided as nonvisible Impact damage may occur to GRP components
10.3	All shipments shall be adequately package, brace and cradle in order to prevent damage during transit. Ends shall be protected from damage.
11.0	**HANDLING, STORAGE AND PROTECTION**
11.1	Facilities
11.1.1	Bidder shall construct adequate facilities for the storage of material and for the fabrication of the ducts. Upon completion of fabrication, the Bidder shall remove the fabrication/storage facility from the site and return the area to the pre-construction condition.
11.1.2	Field winding and fabrication must be done in a suitable enclosure adequate ventilation as per ASTM D5364.
11.2	Storage
11.2.1	Materials shall be stored in a dry area and within the temperature and humidity limits recommended by the material Bidders. Do not allow shelf-life limits, as determined by the Bidder, to be exceeded.
11.2.2	The temperature of materials and laminate surfaces shall be maintained during fabrication as per ASTM 5364. Records shall be maintained daily of temperature and humidity during curing process to ensure proper curing of the resins.
11.2.3	Materials and laminate surfaces shall be protected from dust, fog, rain and other contaminants.

11.2.4	Affected plies shall be removed if any of the above requirements are not met during final surface preparation or lamination. The surface exposed due to the removal of the plies shall be abraded and prepared, per this Specification, before applying new plies.
12.0	**JOB SITE INSPECTION AND PREPARATION**
12.1	In coordination with the chimney supplier, the Fabricator should submit a construction plan detailing the erection sequence and methods to be employed, including moving, handling, storage, erection, fit up and the methods to be used for environmental protection of the field joining area during lamination.
12.2	Upon arrival at the chimney jobsite, the Fabricator and BHEL or BHEL's third party inspector should jointly inspect the cans and components. Non Conformity Reports should be generated if any defective parts are found and disposition accordingly.
13.0	**FIELD ASSEMBLY AND INSTALLATION REQUIREMENTS**
13.1	Prior to GRP duct erection, the Bidder shall:
13.1.1	Formulate construction plan detailing the erection sequence and methods to be employed,
13.1.2	Give consideration to the loads imposed on the GRP duct during handling, storage, and erection. Conditions such as ovalling and localized stresses at lifting points shall be considered.
13.2	The Fabricator should use the best possible techniques for the alignment of cans and components to minimize wall offset.
13.3	Butt-and-strap and miter joints overlay between sections will be done in accordance with the thickness, ply sequence, and width requirements of the Design Report.
13.4	Control the temperature of the liner sections and resin, and the environmental conditions in the joining area as per this Specification and the Bidder's recommendations, prior to, and during, the field joining process.
13.5	Before moving or lifting successive duct sections, field joints shall be cure to safely support the applied load.
13.6	GRP duct outside the chimney will be exposed to open sunlight. Hence there is prone for damage due to UV rays and wind forces. These environmental and technical issues shall be taken care by the bidder with special coating or any advanced methods during fabrication stage.

	Complete insulation shall be in the scope of bidder. The sketch is provided for tendering process only. The same may be changed during detailing stage. BOQ was provided for Trichy scope duct only as shown in the sketch.

ANNEXURE- 1 (FGD outlet to Chimney DUCT SKETCH)
Refer Drg no:0-00-273-30273/03



ANNEXURE II
Gas characteristics (FGD MODE)

FGD data of gas composition, density, pressure, as per the table below:

DATA FOR CHIMNEY DESIGN

GENERAL DATA

Boiler Application	Utility	No.of Chimneys	One Common for Two Boilers
Boiler Capacity	660MW	Type of Chimney	BY PEM
No. of Boilers	Two(2)	Chimney Arrangement	BY PEM
Fuels Fired	Coal	Height of Chimney	BY PEM

OPERATING CONDITIONS

SUMMER SITE CONDITIONS- (AMBIENT TEMPERATURE-36.9 Deg C)

DESCRIPTION / LOAD	Unit	105% MCR Performance Coal	105% MCR Worst Coal	105% MCR Best Coal	100% MCR Performance Coal
FGD Outlet Flue Gas Flow	t/h	2800.67	2840.14	2803.51	2602.85
FGD Outlet Flue Gas Volume	m3/s	740.92	758.58	727.81	688.58
Flue Gas Temperature	°C	56.5	58.3	54.5	56.4
Flue Gas Density	kg/m3	1.05	1.04	1.07	1.05
Humidity	(H_2O/Dry)	0.12	0.13	0.1	0.12
FLUE GAS COMPOSITION % BY WEIGHT – (WET BASIS)					
H_2O	Wt% (Wet)	10.51	11.53	9.41	10.39
SO_2	Wt% (Wet)	0.014	0.014	0.014	0.014
SO_3 (Gas)	ppm(Dry) @ actual O_2	<1	<1	<1	<1
H2SO4 mist	mg/Nm3(Dry)	61	32	391	53
NH3	ppm(Dry) @ actual O_2	0	0	0	0
CO_2	Wt% (Wet)	18.41	17.52	19.61	18.41
O_2	Wt% (Wet)	4.50	4.44	4.46	4.50
N_2	Wt% (Wet)	66.57	66.51	66.51	66.68
(NH4)2SO4	ppm(Dry)	0	0	0	0
HCl	ppm (Dry)	6.5	7.2	5.9	6.5
HF	ppm (Dry)	1.2	1.3	1.1	1.2
Dust	mg/Nm3(Dry)	<50	<50	<50	<50

REMARKS :*APPLICABLE ONLY FOR COAL FIRING

a) FGD Outlet flue gas flow is calculated at Summer site conditions- Maximum Ambient temperature (36.9 deg C) and Max Process water temperature in FGD design (36.9 deg C) .

b) The elevation of breeching line of duct and the chimney opening size shall be designed by Chimney designer.

c) The above mentioned flue gas characteristics is for one (1) boiler.

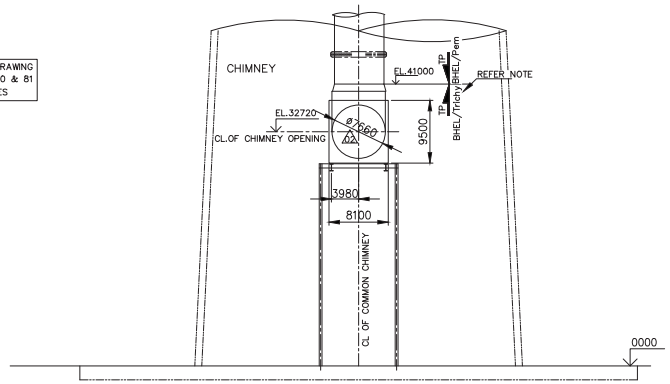
d) Whenever FGD is out of service, Boiler has to be shut down since the customer has not envisaged bypass ducting arrangement. In the intermittent period to avoid damage of internals inside FGD, quenching system is installed in FGD to reduce the temperature of FGD inlet gas to 70-75 deg C at all gas conditions. This condition may prevail only for 15-30 minutes after which the boiler has to get shut down.

Customer / Plant: **MAITREE- 2x660 MW, Bangladesh**

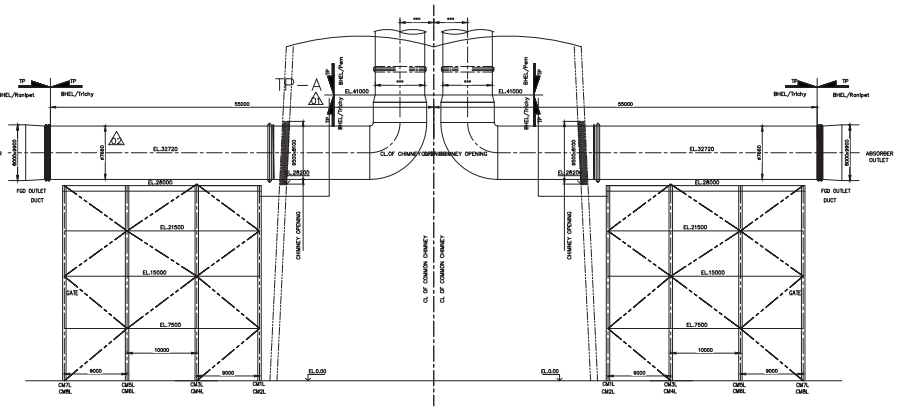
Contract.No.:	R00		R01		R02
	Date	Sign	Date	Sign	Date
Engineer KABILASH	25.07.17		21.08.17		
Reviewer SK DASH	25.07.17		21.08.17		
Approver RL	25.07.17		21.08.17		

D-00-273-30273
DRAWING NO.

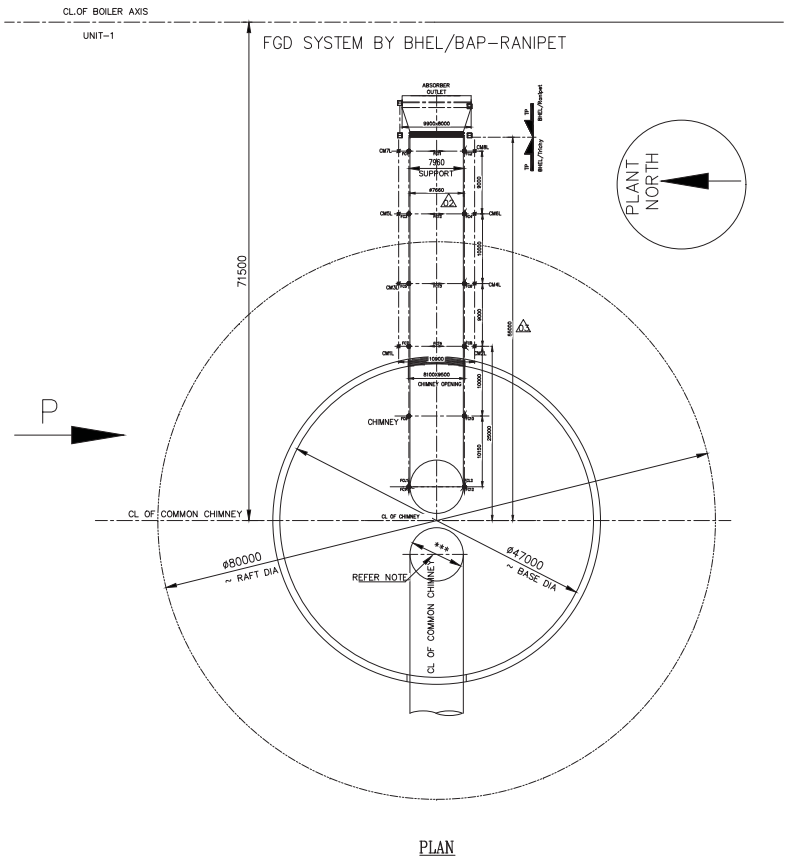
REFER LAYOUT DRAWING
0-00-020-77280 & 81
FOR FINAL VALUES



SIDE ELEVATION



VIEW - P



PLAN

NOTE1 :

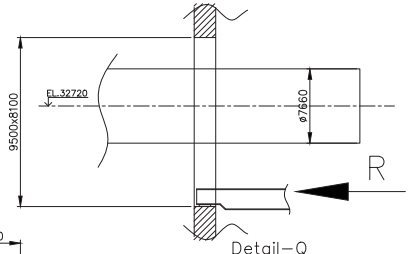
1. TP-A refers to terminal point between duct inside chimney and chimney flue as shown above in view-P.
2. TP-B refers to terminal point between FGD outlet and duct from FGD to chimney as shown above in view-P.
3. The duct portion between TP-A and TP-B is supposed to release by BHEL-Trichy. Since the material of duct between TP-A and TP-B is GRP, we request BHEL-PEM to supply the duct between TP-A and TP-B along with supports as shown above in view-P.
4. Following shows the loading table considering duct material as steel. GRP duct vendor to provide loading table to BHEL/Trichy for providing structural beam to support GRP duct (Duct supports are in the scope of GRP vendor) duct loads are provided in the Load table.
5. Duct supports shown are tentative and are to be confirmed by GRP duct vendor to ensure the availability of duct support beam.

VERTICAL LOADS

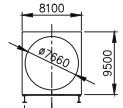
SUPPORT DESIGNATION	DEAD LOAD	LIVE LOAD	ASH LOAD	PRESSURE LOAD	EXPANSION JOINT LOAD	SUPPORT ELEVATION(mm)
FC-1	9800	500	5000			28000 TOS
FC-2	9800	500	5000			28000 TOS
FC-3	14300	750	7350			28000 TOS
FC-4	14300	750	7350			28000 TOS
FC-5	14300	750	7350			28000 TOS
FC-6	14300	750	7350			28000 TOS
FC-7	14300	750	7350			28000 TOS
FC-8	14300	750	7350			28000 TOS
FC-9	15050	775	7750			Restraint Floor
FC-10	15050	775	7750			Restraint Floor
FC-11	24750	450	4500	+/- 5300		Restraint Floor
FC-12	24750	450	4500	+/- 5300		Restraint Floor

HORIZONTAL LOADS

SUPPORT DESIGNATION	WIND LOAD	LIVE LOAD	ASH LOAD	PRESSURE LOAD	EXPANSION JOINT LOAD	SUPPORT ELEVATION(mm)
FCT-1	23200					28000 TOS
FCT-2	33915					28000 TOS
FCT-3	33915					28000 TOS
FCT-4	24100					28000 TOS
FCL-1	10750			+/-5300	+/-2000	Restraint Floor
FCL-2	10750			+/-5300	+/-2000	Restraint Floor



Detail-Q



View-R(Chimney opening)

REV	DATE	ALTERED :	REV	DATE	ALTERED :	REV	DATE	ALTERED :
03	20.11-2017	HARIKRISHNAN CHD & APPD : MUTHUKUMAR	02	12.10.2017	HARIKRISHNAN CHD & APPD : MUTHUKUMAR	01	22.08.2017	HARIKRISHNAN CHD & APPD : MUTHUKUMAR
ZONE	GRP DUCT LOAD TABLE CORRECTED DUE TO LAYOUT CHANGE.		ZONE	GRP DUCT SIZING REVISED.		ZONE	TERMINAL POINT LOCATION CHANGED FROM EL.39000 TO EL.41000 AT CHIMNEY INLET.	

CUSTOMER NO. 1725,1726

2X660MW MAITREE SUPER THEMAL POWER PROJECT
RAMPAL, BANGLADESH(EPC MAIN PLANT PACKAGE

OWNER: BANGLADESH-INDIA FRIENDSHIP POWER COMPANY (PVT.) LIMITED, BANGLADESH

OWNER CONSULTANT: M/S FICHTNER GmbH & Co KG Stuttgart, GERMANY

BHARAT HEAVY ELECTRICALS LIMITED.,
BOILER PLANT UNIT: TIRUCHIRAPALLI-INDIA-620 014
EQUIPMENT : STEAM GENERATOR

TITLE: LOADING OF FLUE GAS DUCT AFTER FGD

PREPARED : M.V.Ramana | SCALE
CHECKED : B.Muthukumar | DATE 08-09-2016
APPROVED : M.Shanmugam

JOB NO. | BHEL DRAWING NO. 0-00-273-30273 | REV 03

ANNEXURE-2

FORMAT FOR NO DEVIATION CERTIFICATE
(To be submitted in the bidder's letter head)

BHARAT HEAVY ELECTRICALS LIMITED,
Power Sector - Eastern Region,
Plot no 9/1, DJ Block, Sector – II, Salt Lake City,
Kolkata – 700 091

Sub	No Deviation Certificate.	
Job	PACKAGE-12: Construction of 275 M tall twin flue GRP liner RCC chimney and other incidentals complete as detailed in the specification including raft foundation at 2x660 MW Maitree STPP, Rampal, Bangladesh.	
Ref	1.0	Tender no PSER:SCT:KLN-C1865:17.
	2.0	BHEL's NIT, vide reference no PSER:SCT-KLN-C1865:6285, Date: 21-11-2017.
	3.0	BHEL's TCN-01, vide reference no PSER:SCT-KLN-C1865:TCN-01, Date: 24-11-2017.
	4.0	All other pertinent issues till date.

Dear Sirs,

With reference to above, this is to confirm that as per tender conditions, we have visited site before submission of our offer and noted the job content & site conditions etc. We also confirm that we have not changed/ modified the tender documents as appeared in the website/ issued by you and in case of such observance at any stage, it shall be treated as null and void.

We hereby confirm that we have not taken any deviation from tender clauses together with other references as enumerated in the above referred NIT. We hereby confirm our unqualified acceptance to all terms & conditions, unqualified compliance to technical specification, integrity pact (if applicable) and acceptance to reverse auctioning process.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null & void.

We confirm to have submitted/uploaded offer/documents in accordance with tender instructions with acceptance of the terms & conditions of the tender by us and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized representative of the bidder)