BHARAT HEAVY ELECTRICALS LIMITED
TIRUCHIRAPPALLI - 620 014

FUEL SYSTEMS / PE/ FOSSIL BOILERS

TITLE SHEET

Specification for
36 inch Inlet, 7 Feet Centre Distance
GRAVIMETRIC FEEDER

SPECIFICATION NUMBER: ***GF-371*** *REVISION No. : 03*

03	*04/07/12*	*General updation* *Cl. 2.6.4: Electronic current sensing relay for COC drive protection included.*	*JVVA/MTP/SVS*
02	*19/05/11*	*Clause 2.6.3 updated*	*MCHG/JVVA*
01	*07/10/10*	*Annexure-IV added.*	*-sd-*
Rev.No.	*Rev. Date*	*Description*	*Updated/Chd./Appd.*

	Name	Signature	Date
Prepared	K.Rajmohan	-sd-	06/02/2010
Checked	M.Thandapani	-sd-	06/02/2010
Approved	S.Sivaramulu	-sd-	06/02/2010

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1.0 SCOPE OF SUPPLY:

1.1 Design, manufacture, testing, certification, marking and identification and packing for shipment of 36 inch ID inlet 7 ft. center distance, electronic weighing type raw coal gravimetric feeder assembly comprising of items listed in this specification.

1.2 Mounting of feeder integral cabinet on to the feeder and wiring of all the feeder mounted electrical items viz. drives, micro switches etc to feeder integral cabinet using conduit and connectors.

NOTE:

The extent of supply stated herein is not necessarily exhaustive and shall not relieve the Supplier from his responsibility to provide goods and services necessary to satisfy the Purchaser's performance criteria and required life, to be complete for installation and to be fit for purpose, safe, reliable, easily maintained and efficient in operation.

The supplier is requested to state the items that are to be supplied to meet the intent of the requirements, which will be used during the evaluation. The make of components shall be as per BHEL/CUSTOMER approved list applicable. The prime function of the feeder is to feed the raw coal from the bunker into the pulveriser in controlled and varied quantities corresponding to the boiler load demand. In order to accomplish this objective, the raw coal feeders are generally provided with an A.C.Motor with gear reducer coupled with ~~Eddy Current Clutch~~/VFD, which enables the controlled variation of the feeder speed. The make of ac motor shall be as per BHEL/CUSTOMER approved list.

2.2 Working environment:

Feeder should be suitable to operate in damp, dusty, polluted atmospheres of 100% relative humidity at an ambient temperature of -20^0 C to + 70^0 C.

2.3 Description:

The Gravimetric coal feeder is a precision coal-feeding device, which conveys coal on a rubber belt inside a pressure tight housing, designed to withstand internal pressure as per NFPA standard 85 requirements. The

conveying belt is driven by the drive pulley and passes around the tension pulley at the other end. Adequate supporting arrangement under the belt at the coal feed inlet column is provided to support the coal column weight. The belt that is wider than the inlet opening ensures minimum spilling of coal on the belt sides due to the projections provided at either sides of the belt. Below the belt arrangement, a mechanical drag link conveyor (clean-out conveyor) is provided to clear the spilled coal, on a continuous operating cycle. The feeder also houses important diagnostic and operational features like coal on belt switch assembly, feeder discharge pluggage switch assembly, inspection window glass assembly with lighting fixtures, water spray nozzles etc. to take care of efficient and safe operation of the feeder. The feeder has a provision or reverse rotation to facilitate emptying.

For feeder arrangement, dimensions and end connection detail refer **Annexure-IV** (Gravimetric feeder arrangement) of this specification.

2.4 Principle of operation:

The electronic weighing type of Gravimetric feeder uses two precision strain gauge type load cells, which are temperature compensated, barometrically insensitive and environmentally sealed and measures the weight of coal acting on the weighing span. These load cells supporting half the load of the weighing span attached to weighing roller at the center of the span. The weighing span is defined by two fixed rollers, precisely located in the feeder body. A third roller is located midway on the span, suspended on each side by a load cell. As coal passes over the span, the center roll transmits a force to the cells, which is directly proportional to the load acting between the fixed rollers.

The feeder delivery rate in computed as follows:

A measurement sample is taken from the output of load cell and converted into a digital signal. After checking this signal for acceptable limits, it is stored in memory. Same operation is performed on the output of other load cell signal. Once the signals are validated, the two outputs are summed and the tare is subtracted. This result is multiplied by a factor determined during calibration of feeder to arrive at the weight of material per unit of belt length.

The belt speed is determined by measuring the period of output frequency of an AC tacho-generator attached to the motor shaft. This frequency signal is multiplied by another calibration factor determined during feeder calibration to arrive at a number that represent belt travel speed per second. Finally the belt speed and weigh are multiplied together to arrive at the feed rate. This result is compared to the demanded feed rate to determine the error and to operate the speed control.

Weight (kg/cm) x Belt speed (cm/s) = Feed rate (kg/s)

The feed rate, representing the feeder output is then compared with Customer's fuel demand signal. The result of this comparison is used to control the belt speed. Belt speed is varied by the speed variation facility provided in the feeder drive system.

The feeder is driven by an AC motor with ~~Eddy Current Clutch~~/VFD and gear box.

2.5 Features:

2.5.1 Feeder type : Gravimetric belt type with size of 36" (914mm)

2.5.2 Maximum feed rate capacity: (refer Annexure-I/II to Specification)

2.5.3 Environment: (a) Ambient temperature 70°C (max)
(b) Explosion pressure : 3.5 kg/cm^2
(c) Other environmental conditions envisaged.

2.5.4 Feeder weighing Accuracy : ± 0.5%

Repeatability: 0.1%

2.5.5 System shall be capable of tolerating large supply voltage variation.

2.5.6 All site equipment shall be suitable for 70°C ambient temperature and other environment conditions envisaged.

2.5.7 "NO COAL" flow detection to be provided to stop the feeder when no coal is detected on the conveyor belt and when pluggage occur at feeder outlet.

Paddle type coal alarm switch shall be provided for this purpose at the following location:

(a) Over the feeder conveyor belt: For indication of loss of coal flow & tripping the feeder.

(b) At the feeder discharge: To stop the feeder in the event of Coal pluggage at the feeder outlet.

2.5.8 The feeder casing shall be designed to withstand an explosion pressure of 3.5 kg/cm² (g). However, a minimum thickness of 10mm shall be provided for feeder casing.

2.5.9 The feeder belt shall be of multiply reinforced rubber of single piece construction with arrangement for tracking and to prevent spillage.

2.5.10 Width of the belt shall have sufficient margin while operating in conjunction with the feeder inlet opening provided. However, width of belt shall not be less than 1168mm.

2.5.11 All raw coal feeder components coming in contact with coal (except belt), shall be made of stainless steel.

2.5.12 Suitable arrangement to adjust belt tension shall be provided.

2.5.13 The following provisions for the feeders shall be provided.

(a) Spraying water inside the casing

(b) Purge air to feeder

2.5.14 Adequate doors (end doors & weigh compartment doors) shall be provided on the feeder, for easy access.

2.5.15 Easy access to any part of the feeder internals shall be possible without dismantling the complete casing.

2.6.0 Major sub assemblies:

The feeder shall consist of the following major sub assemblies.

2.6.1 Feeder Body

Feeder design shall exceeds NFPA Code 85 requirements and shall withstand an explosion pressure of 3.5 kg/cm² (50 psi). All parts in contact with active coal flow shall be fabricated of type 410 stainless steel. Side skirting is to be provided to contain the coal on the belt and a leveling bar near the feeder inlet to shear the coal column to form a profile conducive to maximum weighing accuracy.

Dust-tight doors are to be provided at both ends and each side of the feeder for access to critical components.

Bulls-eye viewing ports in the doors to permit observation of the feeder interior during operation. From the common air header, suitable hose connections shall be provided to each bulls-eye for cleaning the same before viewing the feeder internals through the glass while feeder in operation. A work light mounted above each end door shall be designed to allow bulb changing from outside the feeder.

2.6.2 Belt and drive system:

2.6.2.1 The feeder belt shall be supported by a machined drive pulley near the outlet, a slotted take-up pulley and adequate number of belt support rollers at the inlet end, a weighing idler in the middle of the feeder. A counter weighted scraper with replaceable rubber blade continuously cleans the carrying surface of the belt after the coal is delivered to the outlet. Proper belt tracking is to be accomplished by crowning the take-up pulley. In addition to the above, to prevent lateral movement of belt (belt tracking) either grooved pulleys to accept a molded V-guide in the belt or an arrangement with belt track rollers is to be provided. The pulleys shall be easily removable for belt changing and bearing maintenance

Belt tension is to be applied through downward pressure exerted by the tensioning idler on the return strand of the belt. Proper tension is to be obtained when the round protrusion at the center of the tension pulley/ spring take up arrangement is in line with the center indicator mark on the tension indicator plate. The tension roll indicator is to be found on the

drive

motor side of the feeder and is to be visible through the viewing port in each tension roll access door. Tension adjustments can be made with the feeder operating or at rest by turning the two belt take-up screws which protrude through the inlet end access door.

2.6.2.2 The drive system for the belt consists of a four pole, 3 phase induction motor, coupled to a speed reducing gear box via an ~~Eddy Current Clutch~~/VFD control. The motor is ~~5.5KW for ECC~~/7.5KW for VFD, 1450 rpm, Totally Enclosed Fan Cooled motor (or inverter duty TENV). Two numbers of Tachogenerator shall be in-built at the output shaft of the clutch to give redundant isolated output. The make of LT motor shall be from any one of the following makes.
M/s Siemens, KEC, NGEF, Alsthom (GEC), ABB, CGL, BBL and KEC.

2.6.2.3 A paddle-type alarm is to be mounted above the center of the belt to detect the presence or absence of coal on the belt. The alarm consists of a stainless steel paddle mounted on one end of a horizontal shaft and a dust tight switch housing on the other end, accessible on the outside of the feeder. Four single pole switches, are to be mounted in the switch housing. The switches are to be actuated by adjustable cams mounted on the end of the shaft inside the switch housing. The make of micro switches shall be as per BHEL approved vendor list.

2.6.3 Weigh sensing components:

The feeder weighing signal is generated by two load cells of adequate capacity which support a weighing roller. Located on each side of the weighing roller are two weigh span rollers, which accurately define a given length of belt on which the coal is weighed. The weighing module (load cell assembly) shall be of reputed make subjected to Purchaser's approval.

2.6.4 Clean-out Conveyor:

The Clean out conveyor are made of two strands of malleable iron drag chain with alternately spaced wing links are to be used to automatically clean coal from the bottom pan of the feeder. The clean out conveyor is to be driven by a 0.25 KW totally enclosed non ventilated drive motor through a gear head and a reduction gear box to an operating speed of

approximately 60 cm per minute. The make of LT motor shall be as specified in clause 2.6.2.2 above.

In addition to electrical overload protection, a shear pin in the gear box limits the output torque to prevent mechanical overload and damage. Shear pin breakage results in contact closure of limit switch LSCC, stopping the drive and actuating a remote alarm annunciator. As an alternate to the mechanical shear pin arrangement, an equivalent drive protection system with electronic current sensing relay is also acceptable.

2.6.5 Feeder Integral Cabinet:

Fully assembled feeder integral cabinets – one per feeder will be supplied along with mounting fasteners. The feeder mounted electrical items viz. main drive motor, clean out conveyor motor, coal on belt and discharge pluggage paddle switches and feeder work lights are to be wired to the feeder integral cabinet through flexible conduit and end fittings. These conduit fittings shall be fixed onto the feeder body through fixing clamps for aesthetic appearance. Necessary conduits and connectors, cables and accessories are to be carried out by the vendor both at the component side and at the feeder integral cabinet. **The feeder integral cabinet is excluded from scope of this specification.** (covered in C&I specification of feeder-TCI :283)

2.6.7 Feeder discharge paddle alarm:

An alarm paddle is to be mounted in the feeder outlet to detect the presence of coal plugging the discharge. As the coal backs up to the level of the paddle, it pushes the paddle towards the feeder end plate and closes the contacts of limit switch LSFD, stopping the belt drive motor. The alarm consists of a stainless steel paddle mounted on one end of a horizontal shaft and a dust tight switch housing on the other end, accessible on the outside of the feeder. Three numbers of micro switches mounted in the housing are actuated by adjustable cams on the end of the shaft. The make of micro switches shall be as per BHEL approved vendor list.

2.6.8 Reverse operation of feeder:

A reversing drive motor selector switch mounted in feeder integral cabinet enables the feeder belt to be driven forward, for normal operation, or in

reverse. Reverse operation is a safety feature to quickly discharge burning coal from the feeder or to clear the belt in the event of pulveriser failure. Reverse can also be used to conveniently remove coal from a bunker through a temporary discharge chute attached to the inlet end of the feeder or to facilitate removal of an interior pluggage or obstruction. A reverse rotation emptying chute shall be supplied along with each feeder.

2.6.9 Grease Hoses:

Grease connection hoses along with end fittings shall be mounted on the feeders. Drawing for the same shall be furnished.

2.7.0 End connections :

2.7.1 Feeder Inlet :

Feeder inlet chute shall be of 914mm ID, 10 mm thickness, SS410 material. OD of the inlet chute shall be suitable to connect the feeder inlet with the outlet collar of raw coal gate by means of a Slip-on pipe coupling (refer ANNEXURE-IV).

2.7.2 Feeder Outlet :
For Feeder outlet and mounting details, refer ANNEXURE-IV.

2.7.3 Fire quenching water spray connections :
½"BSP (F) at 2 places as per ANNEXURE-IV.

2.7.4 Purge air connection :
As per View-P of ANNEXURE-IV.

2.7.5 Manometer connection :
As per ANNEXURE-IV.

2.8.0 Fasteners :

All fasteners coming in the feeder assembly shall be Metric and cadmium plated.

2.9.0 Bearings :

All bearings shall be of SKF make or equivalent . Vendor shall furnish the list of bearings indicating the model number, load detail etc. with catalogues.

2.10.0 Painting :

Painting shall be done as per the applicable specification for the contract.

2.11.0 Special Tools :

The following special tools shall be supplied along with each feeder.

a) Test weight for calibration - 1 no. per feeder
b) Shear pin (COC) - 2 nos.per feeder
c) Shear pin Hub (COC) - 1 no. per feeder
d) Bar- Pulley lift assembly - 1 no. per boiler.
e) Turn buckle assembly - 1 no. per boiler
f) Pulley removal tool - 1 no.per boiler
g) Rail extension -RH - 1 no.per boiler
h) Rail extension –LH - 1 no.per boiler
i) Checking bar - 2 nos.per boiler
j) Shim set for calibration - 2 sets per boiler

If any other tools / tackles are required, the Vendor may specify.

3.0 Quality requirement:

Vendor shall submit the Quality Plan for the approval of the owner and shall comply to the requirement of the owner.
Feeder calibration and feeder weighing accuracy test shall be carried out by the vendor at their works after interconnecting the remote power cabinet indented for the feeders, as per applicable test procedures.

The following tests as per the attached test procedure (Annexure-III) shall be done on feeders and test certificate shall be produced by the supplier.

a) Hydrostatic test
b) Leak test
c) Accuracy test (Type test)

4.0 Guarantee:

Vendor shall furnish guarantee for the trouble free service and for the intended performance stated in the specification for a period of 18 months from the date of operation.

5.0 Documents:

5.1 The following documents / details shall be furnished along with the offer.

i) Assembly and sub assembly drawings with bill of material.
ii) Total cross sectional assembly drawing with BOM.
iii) BELT cross sectional Drawing with details
iv) Filled in data sheet (Annexure-I/II)
v) Drive (Main drive and COC drive) selection calculations
vi) Commissioning spares, if required
vii) List of spares for 2 years trouble free operation
viii) Suppliers' catalogues for feeders.
ix) List of Boilers supplied with the specified equipment.
x) Compliance to each clause of this specification and QP.

5.2 The following documents shall be furnished after placement of purchase order.

i) Filled in data sheet (for approval)
ii) General Arrangement and Cross Sectional Drawing (for approval)
iii)Quality plan (for approval)
iv)Lubrication details
vi) Feeder Speed Vs Capacity curve
viii) Test certificate for each feeder.

5.3 The documents to be supplied along with the main supply shall include the following.

i) 10 sets (Minimum) of Operation and instruction manuals
ii) 4 sets of test certificates for each feeder
iii) Packing and shipping details

5.4 O & M manuals:

O&M manuals are to be supplied both in CD and hard copy.

Hard copy Manuals shall be in printed form.

Drawings shall be of printed or laser printed only.

Spiral or comb bound copies should be totally avoided.

If manuals are supplied in folders, the folder shall have 3 hole punching system.

O & M manuals, shall be submitted to BHEL/ Tiruchirappalli prior to despatch of the equipment

Manuals, generally should contain the following:

i) Data sheet for components and drives
ii) Brief description of the equipment
iii) Storage, installation and Operation procedure
iv) Maintenance (including lubrication, where necessary) and service., Recommended spares list for 2/3 years trouble free service.
v) Calibration and trouble shooting procedures
vi) Assembly drawings with part list, dimensional drawings & other certified drawings.
vii) Manuals should pertain only to the type or model supplied for a particular order. Copies shall be sent to BHEL / Tiruchirappalli

6.0 Packing:

The feeder shall be packed in such a way that it does not get damaged during transport. It shall be properly covered with thick tear proof polythene sheet and dispatched in suitable moisture proof wooden / steel crates.

7.0 Deviation :

Vendor shall highlight the deviations from the specification (if any) or special features of the feeders, which are not covered in the specification during the offer stage itself.

8.0 List of attachments:

~~i) Annexure - I (Data sheet- ECC)~~
ii) Annexure - II (Data sheet-VFD)
iii) Annexure – III (Feeder test procedures)
iv) Annexure - IV (General arrangement drawing)

Project : NTPC LARA
Cust No. / Qty. : 1834-1835 / 18 no.s

Annexure -II to Specification GF-371
Feeder Data sheet-VFD

(To be filled by Vendor)

Sl.no	Description		As per Specification	Quoted by Vendor
1	Type of Feeder		Gravimetric, belt feeder, composite type with **Zipping facility having automatic tensioning feature** and Electronic weighing Microprocessor based control system.	
2	Feeder Designation / Model		Vendor to furnish	
3	Material to be handled & size		Coal - upto 2"	
4	Feeder inlet size		36" ID	
5	Centre Distance (inlet - outlet)		7 Feet	
6	Overall dimension (lxbxh)		Vendor to furnish	
7	Total Weight of feeder		Vendor to furnish	
8	Feeder capacity (max), TPH		**117**	
9	Weighing Accuracy		+ / - 0.5%	
10	Type of Feeder Control		Electronic weighing - MicroProcessor based Control	
11	No.of Load cells and make		2 nos. Make to be indicated by vendor.(Subject to purchaser's approval)	
12	Turn down ratio		10:1	
13	Feeder Belt width / Thk.		1168 mm (minimum) / 8.4 mm	
***14	Belt material & Make	(Refer Notes below)	Nylon-Nylon fabric impregnated with natural rubber	
15	Type of Feeder Drive		VFD	
16	Motor rating		Vendor to furnish	
17	Motor Speed		1450 rpm	
19	Gear box ratio		Vendor to furnish	
20	C.O.C.Drive motor rating		0.25 KW	
21	Gear Ratio		1041:1	
22	No.of Bullseye glass		Vendor to furnish	
23	No.off bullseye cleaning hoses provided		Vendor to furnish	
24	No.of inlet support rollers		To be indicated by vendor	
25	No.of weigh span rollers		2	
26	Weigh Span		Vendor to furnish	
27	Location, Type and Make of Bearings		Vendor to furnish	
28	Feeder body material & thickness		Carbon steel / 10 thk	
29	Feeder inlet chute material & thk.		SS 410, 12 thk(min)	
30	C.O.C trough material		SS410	
31	C.O.C.Chain Link matl.		ASTM A47-77 Gr.32510/Equivalent	
32	All Fasteners		Cadmium plated -Metric	
33	List of Special tools		Vendor to furnish	
34	Emptying chute for feeder Reverse rotation		Vendor to furnish	
35	Water spray nozzle size, Location and no.off.		1/2"BSP(F), 2 nos.	
36	Manometer connection		1/2"BSP(F)	
37	Painting shade and code		Vendor to furnish	
38	Feeder leak test certificate		Vendor to furnish	
39	Hydrostatic test certificate		Vendor to furnish	
40	Feeder accuracy test		Vendor to furnish	
41	Commissioning Spares to be supplied with Feeder		Vendor to Confirm	
*** 1	**zip type belt shall be provided**			**vendor to confirm**
2	**The particular type and make of equipment/system should be rated at least for the duty specified / required and shall be in successful operation in at least two (2) separate plants for a minimum period of two (2) years as on the date of submission of bid documents. Alternatively, the design of all equipment/ system shall be got vetted from the respective Collaborators / original equipment designers. If the proven design is not used then testing of the prototype or the type test shall be done compulsorily, the cost of which shall be deemed to be included in the quoted prices of the Bidder.**			**vendor to confirm**

Prepared	Bimal Chowdhury		
Chec Checked	M Venkateswarlu		
Approved	Srinivas Arugula		

HYDROSTATIC TEST PROCEDURE

1. **SCOPE:**
This specification covers the requirements for Hydrostatic Testing of Feeders.

2. **HYDROSTATIC GENERAL REQURIMENTS :**

2.1. Notification of the Hydrostatic test will be given to the Quality Assurance Department, customer or customer's agent as per specification or contractual obligations.

2.2. Items to be tested manufactured or stainless steel will suitably protected to eliminate the possibility of contamination.

2.3. Pressure gauges will be calibrated against a standard dead-weight tester or calibrated master gauge prior to each test or series. Pressure gauges should have a range of two (2) times but not less than one-half (1 ½) times the Hydrostatic Test Pressure.

2.4. A trained technician will be available to conduct the test.

2.5. A representative from Quality Control will be present to witness the test.

3. **PREPARATION FOR TEST:**

3.1. Water used for testing shall be at a temperature min.60 Degree F, and max.120 Degree or unless otherwise specified by the customer specification.

3.2. The pressure gauge shall be connected directly to the part(s) to be tested. The pressure gauge is to be located so that the Technician can monitor pressurization.

3.3. Vents shall be provided at all high points of the feeder in the position in which it is to be tested to purge possible air pockets while the feeder with water.

3.4. Sufficient time will be allowed for the water temperature and feeder temperature to stabilize prior to running the actual Hydrostatic Test.

3.5. Before applying pressure, the test equipment shall be examined to see it is tight and that all low pressure filling lines and other appurtenances that should not be subject to test pressure have been disconnected and suitably blanked off.

3.6. Unless otherwise specified or permitted by the applicable requirements, tests shall be made after all heat treatment and weld repairs have been completed.

4. HYDROSTATIC TEST :

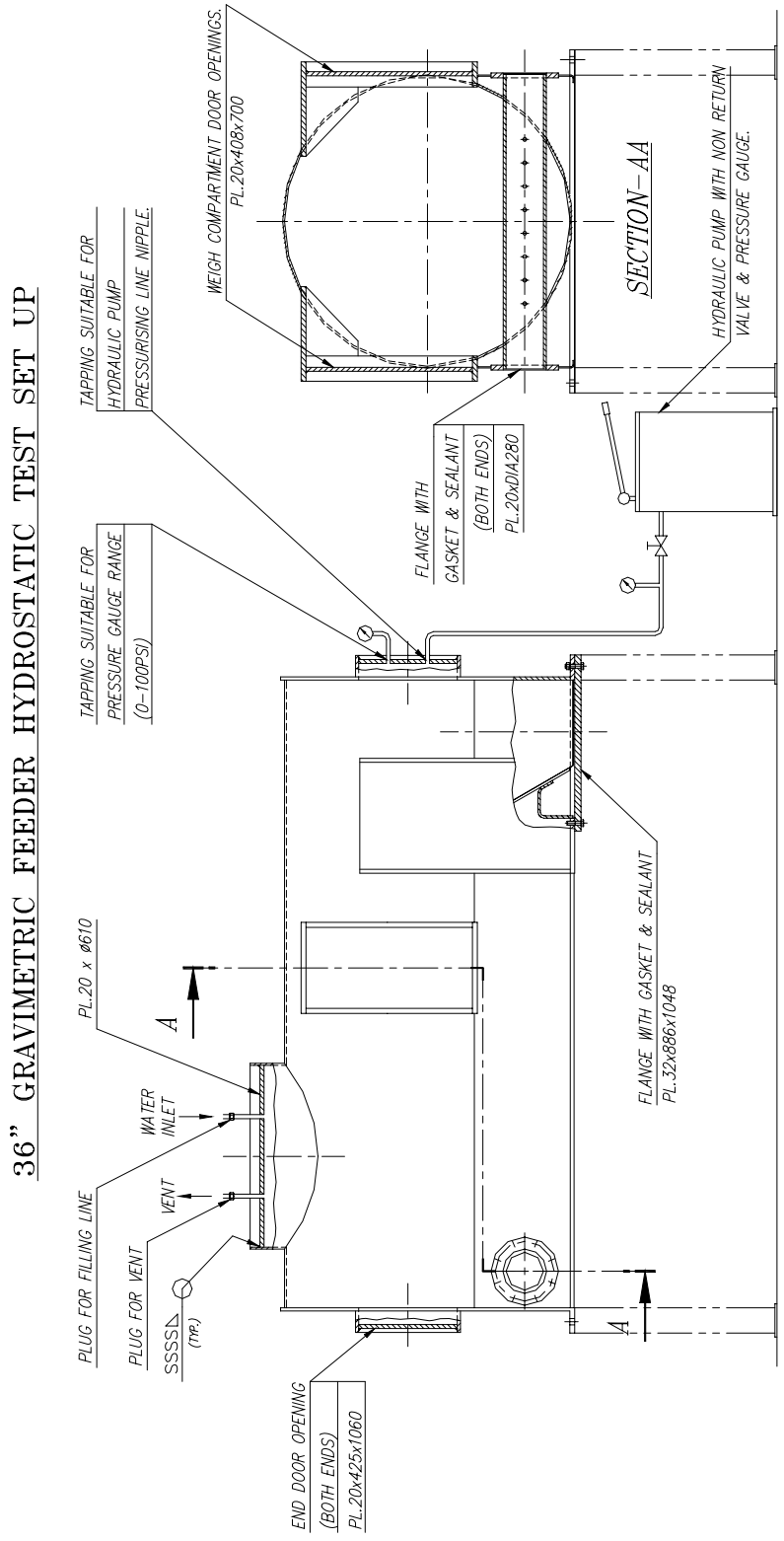
4.1. The Hydrostatic Test Pressure of the feeder will be per engineering specifications. Allowable working pressure will take into consideration feeder loadings, temperatures and materials of construction. The exact pressure of the Hydrostatic test will be specified on the Engineering drawing or in accordance with customer specifications.

4.2. Following the application of the Hydrostatic Test pressure, an inspection will be made of all joints and connections. This inspection shall be made at a pressure not less than two-thirds of the test pressure. The test pressure shall be held for a maximum of 30 minutes. If the cognisant Engineer feels a minimum or longer holding time is required for this Hydrostatic Test, he will indicate this on the drawing by specific call out.

4.3. Upon completion of the Hydrostatic Test, the pressure gauge will be checked against a standard dead-weight tester or calibrated master gauge at the pressure.

4.4. Hydrostatic Test report form will be completed upon acceptance of the test.

4.5. All equipment will be drained and dried.


36" GRAVIMETRIC FEEDER HYDROSTATIC TEST SET UP
WEIGH COMPARTMENT DOOR OPENINGS. PL.20x408x700
TAPPING SUITABLE FOR HYDRAULIC PUMP PRESSURISING LINE NIPPLE.
TAPPING SUITABLE FOR PRESSURE GAUGE RANGE (0-100PSI)
FLANGE WITH GASKET & SEALANT (BOTH ENDS) PL.20xDIA280
SECTION-AA
HYDRAULIC PUMP WITH NON RETURN VALVE & PRESSURE GAUGE.
PL.20 x ø610
A
WATER INLET
VENT
PLUG FOR FILLING LINE
PLUG FOR VENT
SSSSD (TYP.)
FLANGE WITH GASKET & SEALANT PL.32x886x1048
END DOOR OPENING (BOTH ENDS) PL.20x425x1060
PRESSURISING PROCEDURE:
1. FILL IN WATER INSIDE THE FEEDER BODY THRU' THE WATER INLET OF FEEDER INLET DUMMY PLATE KEEPING THE VENT HOLE OPEN.
2. VENT HOLE AND WATER INLET HOLE ARE TO BE CLOSED WITH THE PLUG AFTER FEEDER BODY IS COMPLETELY FILLED WITH WATER (VENT OVER FLOWING).
3. PRESSURISE THE FEEDER BODY USING HYDRAULIC PUMP UNTIL FEEDER BODY PRESSURE GAUGE READING INDICATE 50PSI AND HOLD THE SAME FOR 5 MINUTES.
NOTE:-
ALL OTHER OPENINGS IF ANY TO BE BLANKED BY 12mm THICK PLATE.

Leak Test Procedure

1. **SCOPE :**

This procedure shall be used for leak testing feeders.

2. **PROCEDURE :**

2.1 Prior to leak testing, all parts to be assembled to the feeder must be inspected for proper assembly and tightness.

2.2 Blank (false) steel test covers with the specified mounting bolt hole pattern are to be attached at all external openings. ¼ " thick plate as a minimum will be used for test covers. One (1) side of the plate is to be flat and a ¼" min. thick rubber (or equal) gasket is to be inserted between the plate and the part opening. Fasteners and other closures are to be assembled and tightened as required.

2.3 One (1) blank cover is to be fitted with a ¼" pipe tap for the air inlet line connection. Similar pipe gapes are to be provided in the remaining blank covers for attaching a pressure gage and a manual air release valve.

2.4 The test gage must be calibrated before running the test.

2.5 Once all covers, closures, relief valve and the test gage have been installed. Air will be slowly admitted until the test pressure (not to exceed 2 PSI) has been reached. The test pressure will be maintained for 15 minutes prior to leak testing. (See paragraph 2.8).

2.6 All exterior connections, fittings and welds are to be checked for air leakage.

2.7 A soapy type liquid is recommended to be applied to the various feeder areas to indicate leakage. Ordinary household soap or detergents are not permitted as substitutes for bubble testing solutions.

2.8 To measure the leakage rate, the air supply to the feeder shell is shut off and the pressure decay is monitored. With the pressure at 2PSI. begin timing the decay rate for 15 minutes, then take anther pressure reading. The accepted limit for this test is a decay of 1PSIG in 15 minutes.

3. **INSPECTION :**

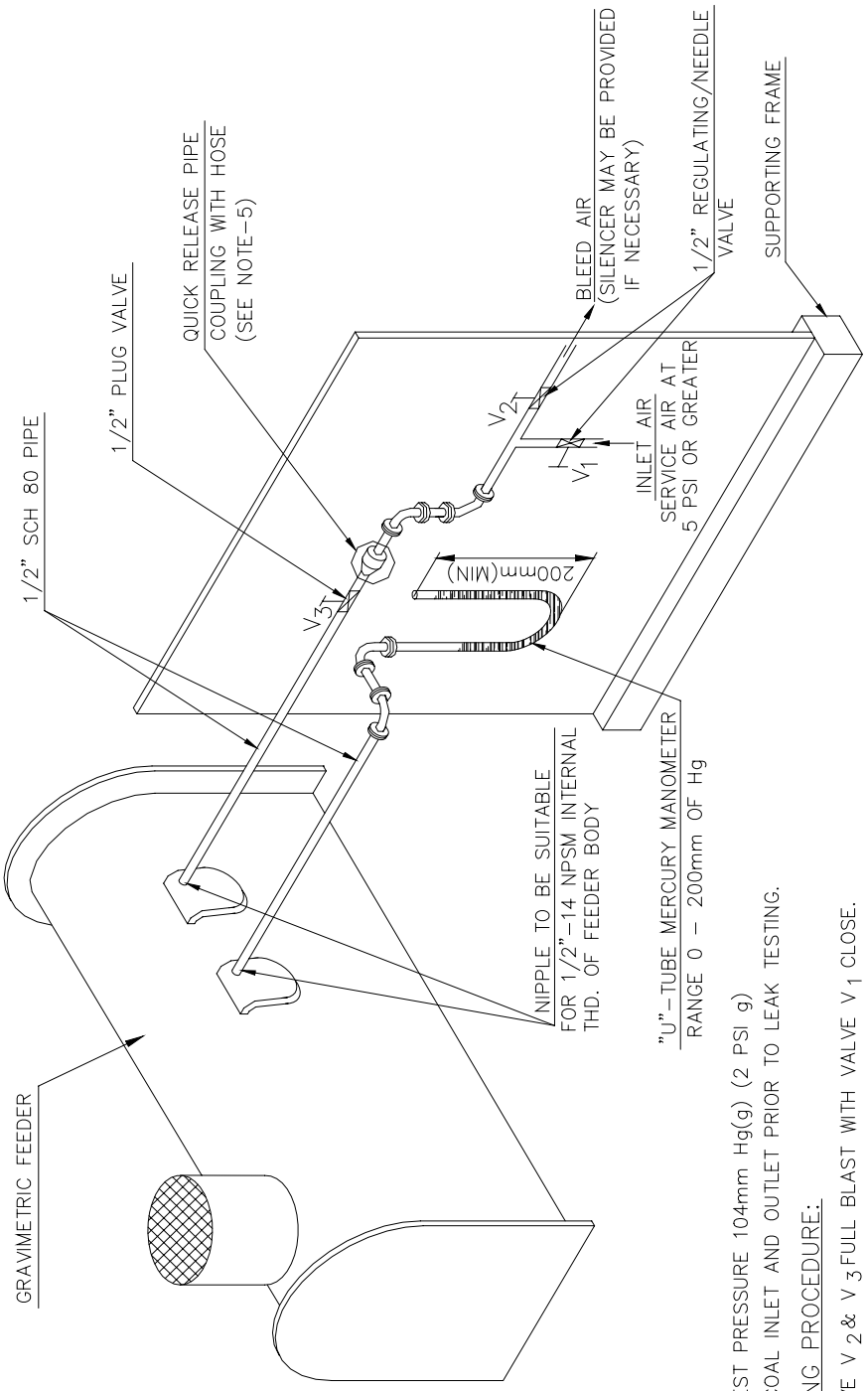
3.1 All work under this specification will be inspected by Stock Equipment Company inspection personnel.

3.2 Bubble indications at any air leak proof area are unacceptable.

3.3 Leakage rates for items not identified as air tight shall not exceed engineering approved rates.

3.4 All areas requiring repair due to unacceptable leakage shall be retested after repairs have been completed.

36inch inlet, 7ft Centre Distance Gravimetri Feeder Test Procedure (Annexure – III to Specification GF-371)



GRAVIMETRIC FEEDER

LEAK TEST SCHEME

NOTE:

LEAK TEST TEST PRESSURE 104mm Hg(g) (2 PSI g)

BLANK RAW COAL INLET AND OUTLET PRIOR TO LEAK TESTING.

PRESSURISING PROCEDURE:

1. OPEN VALVE V_2 & V_3 FULL BLAST WITH VALVE V_1 CLOSE.
2. OPEN VALVE V_1 GRADUALLY TO PRESSURISE FEEDER.
3. ADJUST V_1 & V_2 TO HOLD THE FEEDER BODY PRESSURE AT 104mm Hg(g)(2 PSI g).
4. CLOSE THE VALVE V_3 TO HOLD PRESSURE INSIDE FEEDER BODY.
5. QUICK RELEASE PIPE COUPLING WITH HOSE, CONNECTING VALVE V_3 ON THE UPSTREAM SIDE TO BE UNCOUPLED WHILE HOLDING THE PRESSURE (2 PSI g) INSIDE FEEDER BODY.

Accuracy Test Procedure

OBJECTIVES :

To compare the amount of coal that the feeder delivers with the amount of coal registered on the totalizer.

1. SCOPE :

This test shall be done on complete feeder assembly in the test tower.

2. REFERENCE DOCUMENTS :

This procedure is prepared based on related stock procedure.

3. TEST PROCEDURE :

3.1. Install the feeder in test tower and interconnect the same with the remote and integral cabinets.

3.2. Calibrate the feeder as per feeder calibration procedure.

3.3. Keeping the outlet gate of feeder inlet bunker closed, fill coal in the inlet bunker.

3.4. Weigh the empty outlet trolley and place it under the feeder discharge.

3.5. Ensure the outlet gate of feeder inlet bunker is closed.

3.6. Start and run the feeder for 10 minutes at about 700 RPM.

3.7. Stop the feeder.

3.8. Set demand signal corresponding to the desired feed rate.

3.9. Open the outlet gate of feeder inlet bunker.

3.10. Note the feeder totalizer reading.

3.11. Start and run the feeder till all the coal in the inlet bunker is delivered to the outlet bunker.

3.12. Note the feeder totalizer reading on completion of coal delivery.

3.13. Weigh the outlet trolley with coal.

3.14. Repeat steps 4.3 to 4.13 for 10 runs with different feed rates.

3.15. Record Data in the format.

4. COMPUTATION OF PERCENTAGE ERROR.

4.1. Compute actual coal delivered in each run in Kgs. as measured in weigh scale = Gross weight of outlet trolley with coal – Tare weight of outlet trolley (Empty).

4.2. Compute coal delivered in each run as per totalizer = Feeder totalizer after run – Feeder totalizer before run.

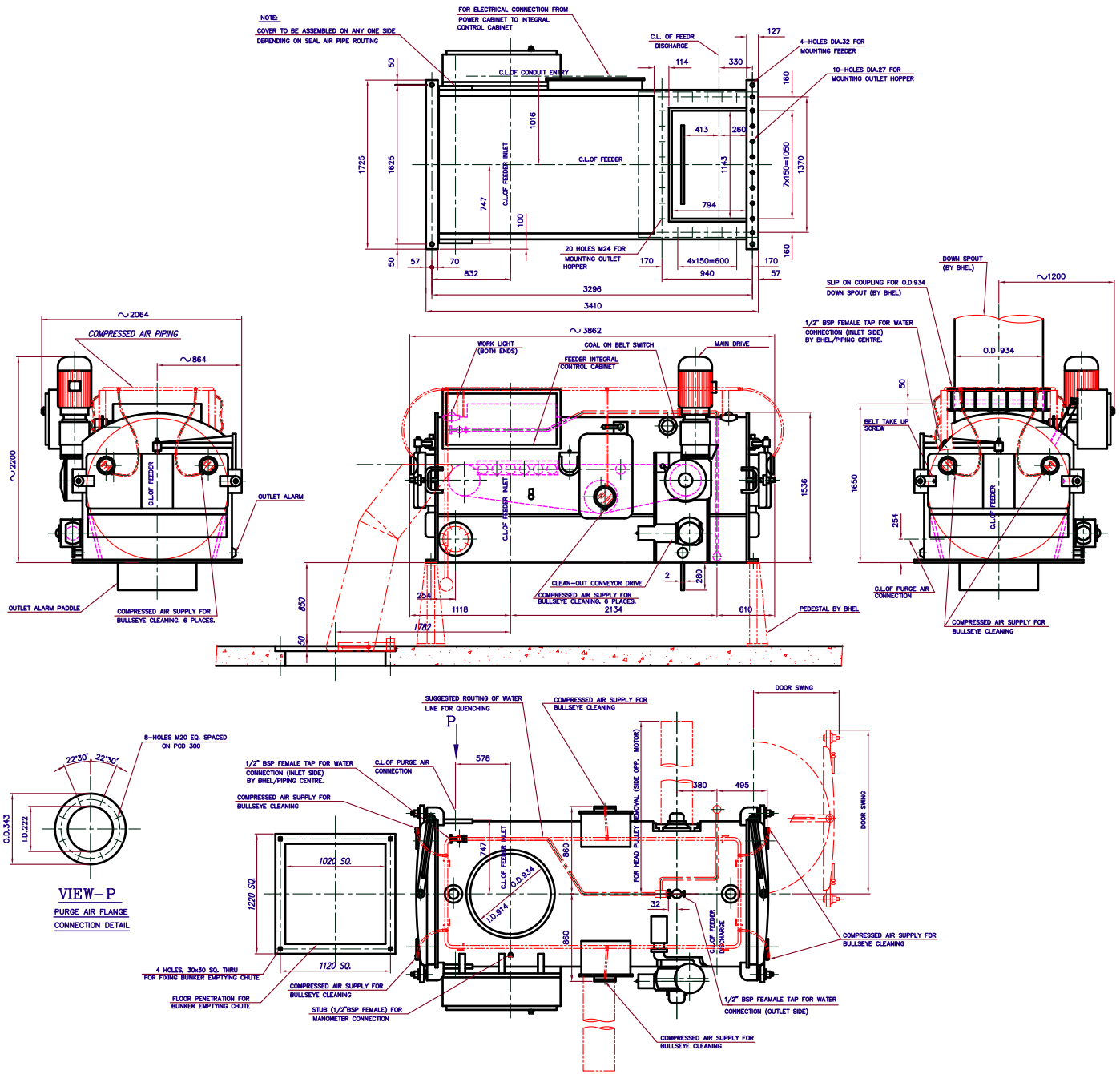
4.3. Add the actual coal delivered for 10 runs.

4.4. Add coal delivered as indicated by totalizer for 10 runs.

4.5. Percentage Error = $[(W_A – W_T) / W_A] \times 100$

Were W_A = Weight actual coal deliver

W_T = Weight of coal delivered as indicated by totalizer.



NOTE:

01. PAINTING SHALL BE AS PER APPLICABLE PAINTING SCHEDULE FOR THE CONTRACT.
02. ALL FASTENERS ARE TO BE ASSEMBLED AFTER THE APPLICATION OF THREAD SEALANT. (LOGTITE 270 OR EQUIVALENT)
03. LUBRICATE WITH GREASE SERVOGEM EP2 OR EQUIVALENT.
04. FILL THE GEAR BOXES WITH GEAR BOX OIL SERVOMESH SP-320 OR EQUIVALENT TO REQUIRED AMOUNT.
05. LEAK TEST AT 2 PSI SHOULD BE DONE ACCORDING TO QA PROCEDURE.
06. CALIBRATION SHOULD BE DONE BEFORE SHIPPING. PROCEDURE.
07. WHILE SHIPPING:
    POSITION TENSION ROLL BLOCKING (WOOD) AT EACH TENSION ROLL ACCESS DOOR, SO THAT ROLL DOES NOT REST ON BELT.

END CONNECTIONS:

FIRE QUENCHING WATER	1/2" BSP(F)
PURGE AIR	REFER VIEW-P
MANOMETER	1/2" BSP(F)

ANNEXURE-IV TO SPECN. GF-371

REV.No.01

Controls & Instrumentation / FB

Technical Specification for Microprocessor Based Gravimetric Feeder Control System

Remote Power Cabinet & Feeder Integral Cabinet

Rev	Date	Description	Prepared	Checked	Approved
00	20-05-2025	Initial Release	[SKS]	[KV]	[DK]

1. Scope of supply for microprocessor based gravimetric feeder controls:

1.1. Remote power cabinet housing the microprocessor controls

1.2. Feeder Integral/Local (Field) Cabinet for local operation.

1.3. All Feeder related local instruments required for complete feeder operation.

1.4. Feeder Calibration instrument & accessories (as applicable to the design) – 2 sets / boiler

1.5. All Interconnecting Power, Control and Instrumentation cables between the feeder, the feeder mounted integral/local cabinet and the remote power cabinet.

1.6. Power and Control cable to Bunker coal flow monitor from Remote power cabinet to Bunker coal flow monitor junction box.

1.7. Type tests requirements indicated in clause no. 10 shall be taken care.

1.8. Commissioning spares comprising of the following items

Vendor shall replace any component failures during commissioning of the system for any number of feeders without any commercial implications to BHEL.

1.9. Document Submission

Documents listed in clause 23 of the specification to be submitted within 15 days after placement of purchase order for approval.

1.10. Commissioning support

As per clause 24 of this specification.

1.11. Customer approved vendor list as per Annexure -I

2. Specification for feeder controls with microprocessor based control system:

2.1. Proven Microprocessor based Gravimetric feeder control system based on VFD (Variable frequency drive) with required instruments shall be provided and shall suitable to process signal from two independent speed sensors and shall comprise of associated amplifiers etc. for each of the coal feeders. Output from the speed sensors shall be processed to provide six numbers of 4-20 mA DC analog signals representing actual federate and any other signal(s) required for the control of coal feeder.

Weighing system of the equipment shall be based on dual load cells and shall have the high resolution by proper selection of load cell range.

Alphanumeric display of feed rate; density; motor speed; total weight, automatic and manual calibration of the weighing system and adjustment of system drift, non-volatile memory to store information and program data, self diagnostic facility, alarm generation automatic transfer from gravimetric to volumetric in case of failure of load cell, status LED, keyboard for configuration.

Electronic modules mounted local to the feeder body shall be suitable for operating in a non-air-conditioned area in a suitable enclosure to combat the effect of noise, vibration, entry of dust etc. Coal feeder controller shall be located in the CER (Control Equipment Room).

The control cabinet shall be provided with individual lights to signal the individual internal trip/status conditions as applicable to the feeder design

Free standing weather-proof remote power cabinet containing MPCB with door interlock, control transformers, main drive AC motor starter, cleanout conveyor motor starter (continuous operation), start circuit relay, extra relays for contacts, time delay relays for feeder trip, slave relays to meet contact ratings, LED for indication lamps, selector switches, power reed relay etc. shall be provided.

All interlocks and control hardware required for feeder start, stop/trip and run shall be taken care of in the cabinet.

All the electrical and electronic components provided in the cabinet shall suitable for operating continuously trouble free at an ambient temperature of 60°C.

All feeder body mounted equipments/instruments shall be suitable for 70°C ambient temperature and other environment conditions envisaged.

Coal feeder system shall include local & remote indication of rate of flow & totaliser counter.

3. Remote Power Cabinet (RPC) / Feeder Integral Cabinet (FIC) Fabrication & Construction Details

3.1. The cabinet of reputed make shall be of professional quality welded / modular construction made from CRCA Grade-D sheet steel as per IS-513

3.2. Thickness of Sheet :

3.0 mm for faces supporting instruments / terminals.
2 mm for other sides and top.

3.3. **Gland plates :** Removable 4 mm thick (bottom)

3.4. **Cable entry :** Bottom

3.5. Doors :

3.5.1. Double, recessed, turned back edges
3.5.2. Thickness of Sheet : 2 mm
3.5.3. Hinges : Stainless steel
3.5.4. Door latches : Three point type
3.5.5. Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure.
3.5.6. Opening of the doors : Outward
3.5.7. Louvers : With removable wire mesh to ensure dust and vermin proof.

3.6. Door operated limit switch shall be provided to light up cabinets illumination lamp.

3.7. Component mounting plate shall be rigidly fixed and made from 3mm thick GI sheet steel or Zinc passivated to 15-20 microns. Necessary stiffeners / supports shall be provided to avoid bowing and bending. Component mounting plate shall not be fixed directly on to the cabinet enclosure.

3.8. Four number of lifting hooks shall be provided on top of the panel.

3.9. Aluminium anodized nameplates shall be provided for all door mounted and inside mounted components. The nameplates provided on the door of the cabinet shall be fixed using screws in addition to pasting. For inside mounted components, the nameplates shall be fixed by using suitable adhesive compound.

3.10. Indicating lamps, selector switches shall be provided by vendor on the panel front

3.11. Remote power cabinet:

3.11.1. Cabinet Environmental protection : IP-42

3.11.2. Necessary defeat mechanism shall be provided for the power isolation switch for opening the door without switching OFF the incoming power supply.

3.11.3. Cabinet dimension: {2200+15+100(H)x1200(W)x600(D)}mm

3.11.4. Anti vibration pad- 15 mm. Predrilled base channel ISMC - 100 or equivalent for all sides.

3.11.5. Temperature rise inside cabinet shall not be more than 10 deg C with respect to ambient temperature in any condition. Dual blowers/fan with blower/fan failure alarm shall be provided in each cabinet with proper enclosure. Suitable louvers

with wire mesh shall be provided on the cabinet. Contractor shall furnish detailed calculation of heat dissipation of various components housed in the cabinet, during detailed engineering to ensure that temperature rise is limited as specified above. Further, temperature sensor (RTD) shall be provided in each system cabinet to monitor temperature inside cabinet and suitable alarms shall be configured to indicate high temperature inside the cabinet.

3.11.6. Clean out conveyor on/off provision shall be provided on remote power cabinet.

3.11.7. Foundation bolts, nuts and washers shall be supplied along with the cabinet.

3.11.8. Enclosures with VFD must be designed to avoid harmonic and inductive heating effects and to shield any outside equipment from interference, enclosing and shielding the complete to eliminate any radio frequency interference. The construction of the panel shall provide effective protection against electromagnetic emissions.

3.11.9. Each cabinet must be equipped with a "Z Bracket for Smoke Detector" installed at the top, as shown in attached drawing no. 4-659-43- 00299 Rev 03. 2CX1.5 Sq.mm control cable should be routed through a cable duct from the 6-way TB and terminated near the smoke detector bracket. The return 2CX1.5 Sq.mm control cable should be routed through the cable duct and terminated back at the same 6-way TB as per the BOM. Additionally, two suitable cable glands for the above purpose should be provided

3.11.10. Suitable canopy at the top shall be provided to prevent ingress of dripping water.

3.12. Feeder Integral cabinet:

3.12.1. Cabinet Environmental protection: IP-55

3.12.2. Cabinet dimension: Vendor standard

3.12.3. Cabinet door shall be suitable for 120° opening.

3.12.4. Cabinet shall be securely mounted on the mechanical feeder and designed to withstand vibrations generated by the mechanical feeder.

4. Surface Preparation and Painting

4.1. Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish color shall be applied to

all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. As an alternative, single coat of anodic dip coat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.

4.2. The finish color for exterior and interior surfaces shall conform to the following shades:
Exterior Front & Rear – RAL 9002.
Exterior Sides - RAL 5012.
Interior – RAL 9002.

4.3. Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.

5. Grounding

5.1. Separate Protective and Electronic grounding system shall be provided.

5.2. All panels and cabinets shall be provided with a continuous tinned copper ground bus of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.

5.3. The panel / enclosure ground shall have two (2) bolt drilling with GI bolts and nuts at back side of panel to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.

5.4. Each circuit requiring grounding shall be individually and directly connected to the panel ground bus by lugs.

5.5. For electronic system cabinets the electronic system ground bus shall be similar but insulated from the cabinet enclosure and shall be separately connected to the system ground. The same ground may be used to earth the shield of shielded signal cables if recommended by equipment manufacturer, otherwise a separate ground bus shall be provided for connecting the shields of signal cable. Cable shields shall be grounded at the panel end only and shall never be left open. The ground in between panels of a shipping section shall be firmly looped.

6. Terminal Blocks

6.1. Terminals shall be chromated galvanized DIN rail mounted screw less cage clamp type or maxi termi type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm2.

6.2. Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.

6.3. Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.

6.4. At least 20 percent spare unwired terminals shall be provided for all panels. This shall be in addition to 20% spare wired terminals of spare IO channels.

6.5. Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.

6.6. Other requirements of the terminal blocks are as follows:

6.6.1. The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.

6.6.2. For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.

6.6.3. Where more than one connection to a terminal block is required, two tier terminals shall be used.

6.6.4. Terminal blocks shall

6.6.5. preferably be assigned different color depending upon voltage and current levels.

7. Wire dressing spiral **of** polyethylene material of adequate size shall be used for neat dressing of door-mounted components wiring.

8. Cabinet wiring and accessories:

8.1. Over voltage (+ 15%) and under voltage (-15%) shall be set in phase failure relay at vendor works itself. However, the phase failure relay shall have facility for adjusting the over voltage and under voltage setting.

8.2. Wire duct of adequate size shall be provided for better layout and easy maintenance.

8.3. Grouping and termination of power and control wiring inside the RPC shall be done neatly.

8.4. All control and instrument wiring used within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Sufficient clearance shall be provided for all Control & Instrumentation leads.

8.5. All wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal.

8.6. Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge wire so that multiple door openings will not cause fatigue failure of the conductor.

8.7. Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.

8.8. Panels /cabinets /desks shall be provided with removable gasket cable gland plates and cable glands. Split type grommets shall be used for prefab cables.

8.9. Wire shall be multi stranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test as per IPCEAS-1981.

8.10. Wire sizes used for internal wiring shall not be lower than the followings:

8.10.1. Control wiring : 1.5 Sq. mm (Such as switches, ammeters etc.)
8.10.2. Power supply/receptacle/ illumination wiring :2.5 sq. mm or higher as per load.
8.10.3. 4-20mA DC current : 0.5 Sq. mm and low voltage signal up to 48V DC

8.11. Schematic drawing, interconnection drawing shall clearly indicate the terminal block detail. The ferrule number shall be clearly indicated in the scheme and interconnection diagram.

8.12. All control, power and shielded cable wiring to terminal blocks shall be done using cable lugs.

9. Variable Frequency Drive (VFD):

9.1. VFD controller shall be housed in Remote Power Cabinet.

9.2. The VFD controller shall include a built-in LCD/LED display for monitoring selected parameters, diagnostics, etc. The vendor shall provide a detailed list VFD programming parameters and list of available display features in the controller.

9.3. For the VFD, suitable AC input and output chokes with Insulation Class-F shall be provided. The output choke must be designed to accommodate the 350-meter distance between the VFD and the Gravimetric Feeder Motor. Special attention shall be given to ensure the output choke operates efficiently without overheating under normal conditions.

9.4. The VFD controller shall be compatible with electromagnetic interference and comply with the EN61800-3: Category C3 standard.

10. Quality Assurance Requirements

10.1. **Type Test Requirements** –Vendor shall furnish Type test report for following:

10.1.1. Surge Withstand Capability (SWC) for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI / IEEE C37.90.1.. Hence, all front end cards/ devices which receive external signals like Analog input & output modules, Binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI / IEEE C37.90.1. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to compliance to ANSI / IEEE C37.90.1, the system shall comply to IEC-61000-4-4, IEC-61000-4-5 and IEC-61000-4-18.

10.1.2. Dry Heat test as per IEC-60068-2-2 or equivalent.

10.1.3. Damp Heat test as per IEC-60068-2-30 or IEC-60068-2-78 or equivalent.

10.1.4. Vibration test as per IEC-60068-2-6 or equivalent.

10.1.5. Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.

10.1.6. Radio frequency immunity test as per IEC 61000-4-6 or equivalent.

10.1.7. Electromagnetic Field immunity as per IEC 61000-4-3 or equivalent.

10.2. Burn-in and Elevated Temperature Test

The fully equipped panel is kept energized for 24 hrs. continuously. Out of the 24 hrs., for first 10 hrs., the cabinet/equipment is kept in temp. controlled oven at 50 deg.C +/- 2 deg. C. This 10 hrs. period is divided into 5 cycles of 2 hrs. duration each. In each cycle the voltage varied between 100% for 1 hr, 110% for ½ hr, and 90% for ½ hr. For the balance 14 hrs, the cabinet/ equipment will be kept in ambient temperature prevalent at that time with nominal voltage. Functional test will be performed after this test. During the test, temp. rise inside the cubicle/equipment should not exceed 10 deg.C over ambient. The above test will be carried out for 1 no. of panels for a particular system.

10.3. Routine and Acceptance test rquirements for Remote power cabinet & Feeder Integral Cabinet

Raw Material/BOI Inspection:

All raw materials, including purchased items and accessories, must undergo thorough testing before assembly. Test reports will be reviewed and verified by BHEL/TPIA.

Final Inspection:

The Quality Plan must include all necessary inspections, such as dimensional checks, paint shade verification, high voltage/insulation resistance (HV/IR) testing, functional checks, and bill of materials (BOM) verification. BHEL/TPIA will witness the final inspection.

11. The following Potential free contact shall be wired at Terminal block in Remote Power Cabinet for customer use:-

11.1. Feed Rate >=50% (NO)
11.2. Feeder Run (NO)
11.3. Feeder Off (NC) – 2 Nos.
11.4. Feeder in Remote (NO)
11.5. Coal on Belt (NO)
11.6. Feeder Trip (NO)
11.7. Feeder Discharge Plugged Alarm (NO)
11.8. Clean out conveyor overload mechanism acted alarm (NO)
11.9. No Coal flow in bunker downspout (NC)
11.10. Belt Motion Monitor (Zero speed sensor) Alarm (NO)
11.11. Cleanout Conveyor RUN (NO)
11.12. Cleanout Conveyor OFF (NC)

(NO) – Normally Open
(NC) – Normally Close

In addition to the above, any other potential free contacts relevant to the feeder system design and required for customer use shall be wired to the terminal block.

All the above potential free contacts shall be rated for minimum 5 amps. At 240 volt AC or 0.5 amp. At 220 volt DC.

12. **Indication lamps at Remote power cabinet / Feeder Integral cabinet**

Necessary indication lamps shall be provided on the cabinets, based on the feeder system design and its operational requirements. The supplier shall determine and supply these as required.

13. **Trip conditions:**

All necessary and mandatory feeder trip conditions shall be incorporated into the feeder control system, as per the feeder design, to ensure the safety of the overall feeder controls, operators, workmen, and the coal feeding process to the boiler.

14. Programmable parameters:

All programmable parameters applicable to the feeder design, such as local speed, feed rate settings corresponding to the 4-20mA demand input, and coal density, shall be addressed and clearly listed in the drawings/documents.

15. HMI display in Remote power cabinet:

15.1. Actual feedrate (in metric tonnes per hour)
15.2. Raw load cell signal
15.3. Historic density
15.4. Motor actual speed or Belt speed
15.5. Gravimetric mode material total (in metric tonnes)
15.6. Volumetric mode material total (in metric tonnes)
15.7. Material total (gravimetric + volumetric) (in metric tonnes)

Any other display parameters as applicable to the feeder design shall be taken care.

16. Feedrate feedback signal to customer (4-20 mA):

6 Nos. (Analog outputs) from feeder controller representing actual feed rate feedback signals shall be provided to the customer..

17. Speed feedback signal to customer (4-20 mA):

2 Nos. actual speed feedback signals shall be provided to the customer..

18. Demand signal from customer (4-20 mA):

The feeder control system shall be designed to accept a 4-20 mA current demand signal from the customer, where 20 mA corresponds to the maximum feed rate set in the program parameters by the boiler operator, and 4 mA corresponds to the minimum feed rate.

Note: All the above Analog Inputs (AI) and Analog Outputs (AO) shall be galvanically isolated.

19. Feeder Start/Stop Provision:

19.1. Feeder START command is through normally open potential free contact from FSSS system.
19.2. For Normal local operation: By way of HMI in feeder remote control cabinet.

20. Power supply:

BHEL will provide following incoming power supplies to the remote control panel at a single point, the vendor shall handle the further distribution of power to the required points based on their design.

20.1. One no. 415V, 3ph, 3 wire, 50 Hz (voltage variation ±10% and frequency variation ±5%) and combined variation 10% (absolute sum) power supply will be given to each remote control panel for drives.

20.2. One no. 230VAC, 1ph, 50 Hz UPS (voltage variation ±10% and frequency variation ±5%) and combined variation 10% (absolute sum) power supplies will be provided for each RCP for feeder controls.

Any other power supply required for controls mounted inside RCP & Field cabinet shall be derived accordingly by the vendor.

20.3. The 240VAC, 1ph, 50 Hz (voltage variation ±10% and frequency variation ±5%) and combined variation 10% (absolute sum) power supply will be provided for illumination & panel cooling fan purpose only.

20.4. For Bunker coal flow monitor which is in BHEL scope of supply, the 240VAC UPS power required for the same shall be made available in local control panel.

20.5. 1 No. Industrial grade plug & sockets 3-way (15A, 240V AC) with fuse and surge protection shall be provided with rigid supporting bracket with protective cover and warning sticker in control room cabinet & feeder integral cabinet.

20.6. Incoming power supplies to be terminated in terminal block prior to wiring to disconnect switch/MPCB.

20.7. Electronics handling caution sticker (anodised aluminium) shall be engraved and fixed on the inner side of the control cabinet door.

20.8. Caution sticker over the shrouding of power terminal blocks and transformers shall be provided.

21. Cables

21.1. The vendor's scope of supply includes all interconnecting power, control, and instrumentation cables between the feeder, the feeder-mounted integral/local cabinet, and the remote cabinet. All feeder-mounted sensors, limit switch feedbacks, bunker coal flow monitor contact and motors shall be wired to the feeder-mounted integral cabinet, which will then be interconnected with the remote control panel. The scope of all such cables shall be in vendor scope.

21.2. Vendor to supply the cables from the below listed cable varieties:-

Control Cable	Instrumentation Cable	Power Cable
2C X 2.5 Sq.mm	2P X 0.5 SQ.MM. Pair & Overall Shielded	3C X 2.5 SQ.MM (CU)
3C X 2.5 Sq.mm	4P X 0.5 SQ.MM. Pair & Overall Shielded	3C X 16 SQ.MM (AL)
5C X 2.5 Sq.mm	8P X 0.5 SQ.MM. Pair & Overall Shielded	
7C X 2.5 Sq.mm	12P X 0.5 SQ.MM. Pair & Overall Shielded	
10C X 2.5 Sq.mm		
12C X 2.5 Sq.mm	2P X 0.5 SQ.MM. Overall Shielded	
16C X 2.5 Sq.mm	4P X 0.5 SQ.MM. Overall Shielded	
	8P X 0.5 SQ.MM. Overall Shielded	
	12P X 0.5 SQ.MM. Overall Shielded	

Any other cable varieties apart from power cables required by feeder vendor for their system requirements, the same shall be supplied with additional 500M or 5% of total quantity whichever is more as spare cable along with their main feeder cable requirements.

The contract specification, type tests, routine tests & acceptance tests for cables are detailed in Annexure II for power cable, Annexure III for control cable , Annexure IV for for Instrumentation cable F type & Annexure V for for Instrumentation cable G type. Test requirements of Power,Control & Instrumentation cables are as per annexure VI.

21.3. The distance between the Field Integral Cabinet and the Remote Power Cabinet located in the control equipment room is 350 meters. The vendor shall calculate required quantities of power, control, and instrumentation cables based on this distance for all feeders provided under this contract.

21.4. Double Compression Nickel plated brass cable glands for all incoming & outgoing cables shall be in vendor scope.

21.5. Considering above points, along with offer, Bidder to furnish complete list of cables, No. of cores, Type of cable, No. of runs, Size of cable etc. to BHEL in the offer stage itself.

22. Motors

22.1. All AC Motors shall be squirrel cage induction type. All the motors shall be rated for continuous duty.

22.2. Energy efficient level: IE3 as per IS 12615 – 2018 (For LT AC Motors).

22.3. For the purpose of design of equipment/systems, an ambient temperature of 50 deg. Centigrade and relative humidity of 95% shall be considered. The equipment shall operate in a highly polluted environment.

22.4. Fault level for 415 V systems - 50 kA rms for 1 second

22.5. Vendor to provide the cable entry and supply cable-glands suitable for 3C-16mm2 (AL) cable.

22.6. Degree of Protection: IP 55 (Additional Canopy to be provided)

22.7. Applicable standard Three phase induction motors : IS15999/IEC:60034

22.8. Squirrel cage induction motor suitable for direct-on-line starting.

22.9. Continuous duty LT motors Output rating (at 50 deg.C ambient temperature), shall be Premium Efficiency class-IE3, conforming to IS 12615,or IEC:60034-30.

22.10. Motor operating through variable frequency drives shall be suitable for inverterduty with VPI insulation. Also these motors shall comply the requirements stipulated in IEC: 60034-18-41 and IEC: 60034-18-42 as applicable.

22.11. **Starting Time**

22.11.1. For motors with starting time upto 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time.

22.11.2. For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

22.11.3. For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

22.11.4. Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

22.12. Torque Requirements

22.12.1. Accelerating torque at any speed with the lowest permissible starting voltage shall beat least 10% motor rated torque.

22.12.2. Pull out torque at rated voltage shall not be less than 205% of rated torque. It shall be 275% for crane duty motors.

22.13. **Starting voltage requirement:** Up to 85% of rated voltage

22.14. All motors shall be either Totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or Closed air circuit air cooled (CACA) type. VFD driven motors can be offered with forced cooling type with machine mounted fan or pump driven by separate electric motor.

22.15. Winding and Insulation

22.15.1. Electrolytic grade Copper conductor, Nonhygroscopic, oil resistant, flame resistant Insulation.

22.15.2. Starting duty: Two hot starts in succession, with motor initially at normal running temperature

22.15.3. Thermal Class (B) or better

22.16. Noise level for all the motors shall be limited to 85 dB(A) except for BFP motor for which the maximum limit shall be 90dB(A). Vibration shall be limited within the limits prescribed in IS:12075 / IEC 60034-14 . Motors shall withstand vibrations produced by driven equipment.

22.17. Motor body shall have two earthing points on diagonally opposite sides.

22.18. All motors shall be so designed that maximum inrush currents and locked rotor and pullout torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.

22.19. All acceptance and routine tests as per the specification and relevant standards shall be carried out.

23. Document submission schedule

23.1. The vendor shall furnish **the following documents for microprocessor based Gravimetric Feeder Control system along with the offer.**

23.1.1. Clause wise confirmation to this tender specification.

23.1.2. Functional write-up for microprocessor based control system offered
23.1.3. Confirmation for overall dimensions of remote power cabinet and feeder integral cabinet and gland plate size and floor cut out details of remote power cabinet.
23.1.4. Block diagram showing the input/output signals.
23.1.5. Heat loading for the control panel.
23.1.6. List of customer / installations where similar type of MPC based controls with AC motor and variable frequency drive operation have been commissioned.
23.1.7. The vendor shall submit a Vendor Quality Plan (VQP) that addresses the routine, acceptance, and type test requirements for cables and panels, along with the associated C&I items, as covered in this specification as minimum apart from feeder OEM's testing requirements.
23.1.8. Motor Data Sheet – Main drive motor & COC motor.
23.1.9. Complete BOM with exact quantity including make & model.

23.2. In the event of purchase **order the following documents shall be furnished for approval (within 15 days).**

23.2.1. Feeder control schematics.
23.2.2. GA drawings showing internal arrangement with dimensional details for remote power cabinet and feeder integral cabinet.
23.2.3. Feeder logic diagrams.
23.2.4. Complete BOM with make,model no./Part no. of Remote power cabinet, Feeder integral cabinet and Feeder mounted C&I sensors/components.
23.2.5. Internal layout and termination (connection) diagram.
23.2.6. Catalogues for the electrical and electronics components used in the above cabinets.
23.2.7. Wiring schematics, Interconnection drawing between Field cabinet and Remote cabinet.
23.2.8. Gravimetric feeder control write-up including calibration procedure.
23.2.9. The vendor shall submit a Vendor Quality Plan (VQP) that addresses the routine, acceptance, and type test requirements for cables and panels, along with the associated C&I items, as covered in this specification as minimum apart from feeder OEM's testing requirements.
23.2.10. Motor data sheet – Main drive motor & COC motor.

23.3. The O&M manual **shall contain complete details about the system including the following :**

23.3.1. As fitted Wiring schematics of RPC & FIC and interconnection drawing between RPC & FIC.
23.3.2. Full details and drawings of all equipment furnished the testing, operations and maintenance procedures etc. separately on each equipment.
23.3.3. Application software listing

23.3.4. As fitted drawings , Program parameter setting value, VFD programming parameters, complete BOM, Motor & Gear box datasheets, Connection diagram between RPC & FIC.
23.3.5. Relevant catalogues of all the modules / components used in the system
23.3.6. Complete spare parts list, including ordering procedure and complete address(es) of spare part supplier(s)
23.3.7. Storage instruction of components.
23.3.8. Do's and Don'ts
23.3.9. Testing and troubleshooting instructions.
23.3.10. Any other details felt necessary by the Purchaser.

24. Commissioning support:

Supervision of Complete Erection & commissioning shall be in vendor scope.

25. Terminal Point:

Sl.No.	Description	Terminal Point
1.	230VAC,1PH,50Hz,UPS,0.5 KVA	At the terminals of RPC
2.	415VAC,3PH,50Hz,3Wire,10 KVA	At the terminals of RPC
3.	Utility-240VAC,1PH,50Hz,Non-UPS,0.5 KVA	At the terminals of RPC
4.	Signals between RPC and DCS	At the terminals of RPC
5.	Signal & Power between BCFM and Feeder	At the terminals of FIC

Note: For all the above incoming & Outgoing cables of BHEL / Customer, cable glands & lugs to be provided by the vendor.

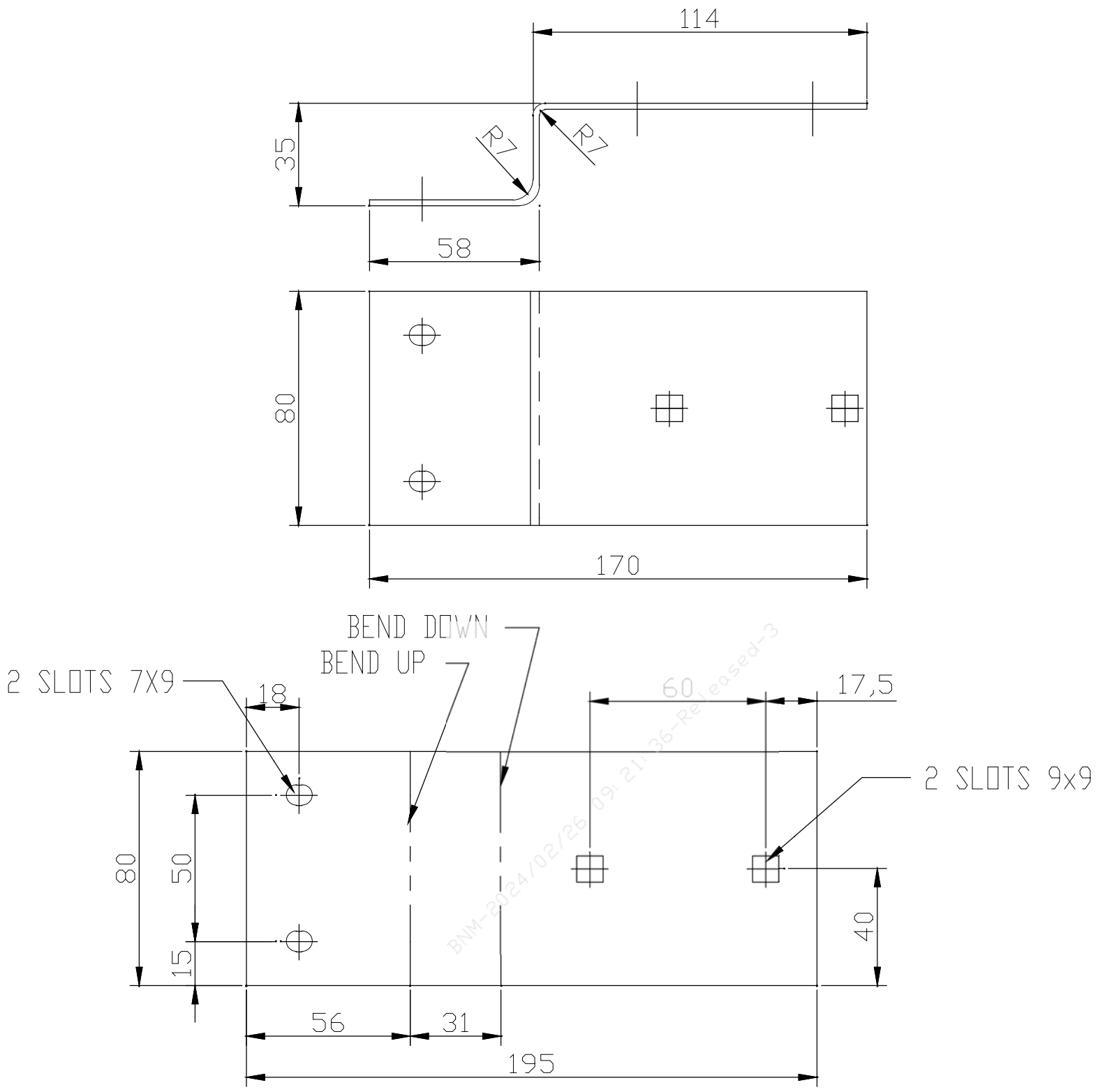
26. Instructions to vendor:

1.1. In the event of order, the entire specification will form part of purchase order for compliance during execution.

1.2. Deviation if any shall be clearly brought out in the “Deviation schedule”. In case of no deviation, ‘NIL’ statement shall be filled in, authenticated and furnished along with the offer. Otherwise it will be construed that the vendor is fully complying with the specification.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

REV.	DATE		REV.	DATE		REV.	DATE	
03	12.12.15	ALTERED MBK CHECKED RR APPROVED RR	02	22.12.04	ALTERED HDH CHECKED SS APPROVED SS	01	27.08.03	ALTERED HDH CHECKED SS APPROVED SS
BEND DOWN/UP RADIUS CHANGED TO R7 FROM R2 BASED ON FAB, FEEDBACK			Dimn. 166 was 149 Matl was 3.15 Thk.			PITCH FOR 9x9 SLOTS WAS 45		



DEVELOPED VIEW

FINISH:-POWDER COATED TO LIGHT GREY SHADE 631 OF IS:5

REF. DRG.NO.						
	01	2THKx80x195 Lg. CRCS SHEET			AA1011715112	0.24

QTY.	ITEM NO.	DESCRIPTION	DRAWING No.	ITEM VAR.	MATERIAL CODE / MATERIAL SPECN.	A C	UNIT Wt. (Kgs.) / QTY.

SIGN & DATE

BHARAT HEAVY ELECTRICALS LIMITED.
ELECTRONICS DIVISION, BANGALORE

	NAME	SIGN.	DATE	No. OF VAR
DRN	HDH		25-06-2003	
CKD	SS		26-06-2003	
APPD	SS		26-06-2003	

INVENTORY NO.

DEPT.		SCALE	WEIGHT (Kg)	REF. TO ASSY. DRG.	ITEM NO.	No. OF ITEM
ENGG.	FOR UNSPECIFIED TOLERANCES REFER ED 0230499	1 : 2.5		3 659 43 00589	35	–
CODE 415						

TITLE
Z BRACKET FOR
SMOKE DETECTOR

DRAWING NO. 4 659 43 00299 REV. 03

SHEET NO. 01 NO. OF SHEETS 01

A4 SIZE

Annexure I

Customer Approved Vendor List

Category	Company Name	Location
Motors	ABB	FARIDABAD
	ABB	BANGALORE
	JYOTI LTD.	VADODARA
	LHP	SOLAPUR
	CGL	AHMEDNAGAR
	NGEF	BANGALORE
	BHARAT BIJLEE	MUMBAI
	KEC	BANGALORE/ HUBLI*
	MARATHON	KOLKATA
Cabinets	Pyrotech Electronics Pvt. Ltd	Udaipur
	Rittal India Private Ltd	Bengaluru
	Hoffman	Bengaluru
	BHEL	Bengaluru
1.1 KV LT Power Cables (Type- XLPE Insulated, PVC sheathed (incl FRLS)	Advance Cable	Bengaluru
	Apar Industries Ltd	Umbergaon
	Cords Cables	Bhiwadi
	CMI	Baddi
	Delton Cable Ltd	Faridabad
	Dynamic Cables	Jaipur
	Gemscabs Industries	Bhiwadi
	Gupta Power Cables	Khurda
	Havells India Ltd.	Alwar
	KEC International	Silvassa , Mysore
	KEI Industries	Bhiwadi
	Paramount Cable	Khushkhera
	Polycab Wires Pvt. Ltd	Daman
	Ravin Cables	Pune
	Special Cables	Rudrapur
	Suyog Cables	Vadodara
	Thermocables	Hyderabad
	Tirupati Plastomatics	Jaipur
	Torrent Cable Ltd	Nadiad
	Universal Cable Ltd.	Satna
LT Control Cable 1.1 KV, Type - PVC (incl FRLS)	Advance Cable	Bengaluru
	Apar Industries Ltd	Umbergaon
	Cords Cables	Bhiwadi
	CMI	Faridabad
	CMI	Baddi
	Delton Cable Ltd	Faridabad
	Elkay Telelink	Faridabad
	Gemscabs Industries	Bhiwadi
	Goyoline Fibres (I) Ltd	Daman
	Gupta Power Cables	Khurda
	Havells India Ltd.	Alwar
	KEC International	Silvassa , Mysore
	KEI Industries	Bhiwadi
	Paramount Cable	Khushkhera
	Polycab Wires Pvt. Ltd	Daman
	Ravin Cables	Pune
	Special Cables	Rudrapur
	Suyog Cables	Vadodara
	Thermocables	Hyderabad
	Tirupati Plastomatics	Jaipur

Annexure I

Customer Approved Vendor List

Instrument Cables (F,G & T/C Cables)	Goyolene Fibers (India) Pvt	Silvassa
	Temsens Instruments Ind Pvt	Udaipur
	Havells India	Alwar
	Paramount Communication	Khuskhera
	Polycab	Daman
	Delton	Faridabad
	KEI	Bhiwadi (Raj)
	Elkey Telelinks	Faridabad
	CORDS	Kaharani
	CORDS	Bhiwadi
	Nicco	Kolkata
	Universal Cable	Satna
	Thermocables	Hyderabad/Mahboobnagar
	Gupta Power Inftrastructure	Khurdha
	CMI	Faridabad
	Advance Cables Pvt Ltd	Bengaluru
	Gemscab Industries Ltd	Bhiwadi (Raj)
	Apar Industries Limited	Valsad
	Suyog Electricals Ltd	Halol (Gujrat)
	Special Cables Pvt Ltd	Rudrapur
	T C Communication	Ghaziabad
	TEW & C	USA
	Habia cables	Sweden
	Kerpen cables	Germany
	Lapp cables	Germany
	Thermo elecrta Bv	Netherland

Annexure -II
Datasheet for Multicore, Armoured, PVC/XLPE Power cable

1	Applicable Standards		IS-3961, IS-4905, IS-5831, IS-8130, IS-9938, IS-10418, IS-10462, IS-10810, IEC-332, IEC-754, IEEE-383, ASTM-D-2843, ASTM-D 2863, SS-4241475, IS:1554 (Part-1), IS:3975, IS-7098 (part-I),	
2	Voltage grade	V	1100	
3	Temperature Rating	^{0}C	70 Deg C for PVC Insulated	90 Deg C for XLPE Insulated
4	Short circuit withstand Rating	^{0}C	160 Deg C for PVC Insulated	250 Deg C for XLPE Insulated
5	Construction of cable		As per Constructional Diagram Enclosed.	
6	Conductor			
a	No. of Cores		2 Core, 3 Core, 4 Core (As per Purchase Enquiry)	
b	Area of Conductor	No. of Strands / Strand Dia.	Material	Grade / Standard
	2.5	7/0.68	Annealed-plain copper	Stranded, High Conductivity, Electrolytic grade Copper, conforming to IS-8130, Class-2
	6	7/1.05		
	6	7/1.05	Aluminium	Multistranded Aluminium, conforming to IS-8130, H2 grade, Class-2 and Non-compacted
	10	7/1.35		
	16	7/1.71		Multistranded Aluminium, conforming to IS-8130, H2 grade, Class-2 and compacted
	25	7/2.20		
	35	7/2.53		
	50	7/3.02		
	70	19/2.2		
	120	19/2.84		
	150	19/3.18		
	240	37/2.88		
7	Insulation			
a	Material		Extruded PVC Type-A	Extruded XLPE
b	Type and Standard		IS: 5831	IS-7098, part-I

Annexure -II
Datasheet for Multicore, Armoured, PVC/XLPE Power cable

c	Thickness of insulation (Nominal)	mm	As per IS-1554 Part -1	IS-7098, part-I
d	Method of application		Extruded	
e	Core Identification		2 Core – Red , Black	
			3 Core – Red, Yellow, Blue	
			4 Core – Red, Yellow, Blue & Black	
f	Volume Resistivity (minimum)	Ω-cm	As per IS 5831	As per IS 7098
g	Insulation resistance constant	MΩ Km	As per IS 5831	-
8	Fillers (wherever applicable)		Flame Retardant, Non-Hygroscopic, moisture resistant material, suitable for the operating temperature of the cable. Fillers shall not stick to the insulation and inner sheath.	
9	**Inner Sheath**			
a	Material		PVC	HR PVC
b	Type and Standard		Type-ST1, as per IS-5831 for PVC Insulated Cable	Type-ST2, as per IS-5831 for XLPE Insulated Cable
c	Thickness of inner sheath (minimum)	mm	As per IS-1554 Part-1	As per IS-7098
d	Method of application		Extruded	
e	Colour		BLACK	
10	**Armouring**			
a	Material		Galvanized Steel	
b	Standard		As per IS-3975 & IS-1554 Part-1	As per IS-3975 & IS-7098
c	Direction of lay		Left Hand	
d	Shape and dimension		Galvanised Steel Round Wire / Galvanised Steel Formed Wire conforming to (i) Type 'b' as per Table-5 of IS 1554 Part-I and (ii) IS 3975	Round Wire or Strip as per IS-7098, Part-I
e	Minimum Coverage		The minimum area of coverage of armouring shall be 90%.	

f	Gap between armour wires		The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire.	
g	Breaking load of joint		The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire	
h	Paint on joint		Zinc rich paint shall be applied on armour joint surface of G.S. wire/ formed wire.	
11	**Outer Sheath**			
a	Material		PVC, With FRLS Properties	HR PVC, With FRLS Properties
b	Type and Standard		Type-ST1, as per IS-5831	Type-ST2, as per IS-5831
c	Thickness (minimum)	mm	As per IS-1554 Part 1	As per IS-7098
d	Method of application		Extruded	
e	Colour		BLACK	
12	Cable Marking on Outer sheath		CABLE SIZE (CROSS SECTION AREA AND NO. OF CORES), VOLTAGE GRADE, WORD 'FRLS', REF. IS, TYPE OF CABLE, CONDUCTOR MATERIAL TYPE OF INSULATION/ SHEATH, MANUFACTURER'S NAME AND/OR TRADE NAME, YEAR OF MANUFACTURE- AT EVERY 5M (BY EMBOSSING). Embossing shall be legible and indelible.	
13	Sequential marking on Outer sheath		Every 1 Metre for Progressive Length by printing / Embossing.	
14	Tolerance on Outer diameter	mm	± 2 (Detailed in Section #29)	
15	Tolerance on Outer diameter for the entire length	mm	1 (Detailed in Section #30)	
16 (a)	Ovality	%	Shall not exceed 2%	
16 (b)	Eccentricity of the core	%	Eccentricity of the core shall not exceed 10%	
17	Recommended Installation Radius		12 x Outer diameter of Cable	
18	Standard Packing Length	m	1000 m – Upto and including, Cables with conductor size of 16 Sq.mm.	

Annexure -II
Datasheet for Multicore, Armoured, PVC/XLPE Power cable

			500 m – Cables with conductor sizes above 16 Sq.mm				
19	Tolerance on individual drum length	%	± 5				
20	Tolerance on overall quantity	%	+ 0 , - 2				
21	Non-standard Length		Last length shall be supplied in single length				
22	**Electrical Parameters**						
a	DC Resistance @ 20 °C						
b1	Area of Conductor (Sq.mm)	2.5	6	6	10	16	25
c1	DC Resistance (Ω/km) maximum	7.41	3.08 (Cu.)	4.61 (Al.)	3.08	1.91	1.20
b2	Area of Conductor (Sq.mm)	35	50	70	120	150	240
c2	DC Resistance (Ω/km) maximum	0.868	0.641	0.443	0.253	0.206	0.125
d	Test Voltage - Between Conductor- Conductor	kV/ minute	3 kV (RMS) for 5 minutes, as per IS-1554 Part 1 3 kV (RMS) for 5 minutes, as per IS-7098 Part-I				
23	**FRLS Properties of Outer Sheath**						
a	Oxygen Index @ ambient temp. Test Method as per IS 10810 part-58	%	Not Less than 29				
b	Temperature Index @ oxygen index 21 As per ASTM-D-2863	^{0}C	Not Less than 250				
c	Smoke density rating As per ASTM-D-2843	%	Shall not be more than 60				
d	Acid gas generation As per IEC 754-Part 1	%	Shall not be more than 20% by weight				
e	Flammability Tests As per IEEE 383, IEC 332, Part-3, Cat-B and SS 4241475,clauseF3		Shall pass				
f	Anti-termite & Anti-Rodent test		YES. Presence of lead will be confirmed.				
24	Quality Plan		As per purchase enquiry				
25	Packing Details		Cables shall be supplied in steel drums of heavy				

		construction. The drum shall be designed on the basis of weight, diameter, bending radius and length of cable. The surface of the drum and the outer most cable layer shall be covered with waterproof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/Rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Drum Number shall be indicated on each drum. Each cable drum should carry the following details stenciled on both sides of drum: a) Manufacturer's name or trade mark, purchasers name, address, contract number, item number b) Type of cable & Voltage grade c) Year of manufacture d) Type of insulation e) No. of core and size of cables f) Cable code g) Length of cable on drum h) No. of length on drum, if more than one i) Direction of rotation, by arrow j) Net gross weight. k) IS/IEC number and ISI mark A tag containing same information shall be attached to the leading edge of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction of rotation in which it should be rolled.
26	General	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

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Annexure III
Technical Data sheet for Multi-Core, Armoured Control Cable

Sl. No.	Parameter		Value/Requirement
1	**Application :** Applications include local Push buttons, Solenoid valves, actuator drives to Local Junction Box and Local Junction box to the system panels for the systems such as FSSS, SADC, SBC, GFC, STLD, APH, as applicable.		
1a	**Applicable Standards**		IS-1554, IS-5831, IS-3961(V), IS-8130, IS-10418, IS-10810, IEEE 383**,** IEC-332, IEC-754,IS-3975, ASTM-D-2843, ASTM-D-2863, SS-4241475
2	**Varieties of cable**		3 Core, 5 Core, 7 Core, 9 Core, & 12 Core
3	**Voltage grade**	V	1100
4	**Temperature Rating & Short circuit withstand Rating**	^{o}C	70 160
5	**Construction of cable**		As per typical Constructional diagram enclosed with this Data sheet Section # 26
6	**Conductor:-**		
a	**Area of Cross Section**	Sq.mm.	2.5
b	**No. of Strands / Strand Diameter (Finished cable)**	No. / mm	7/0.68
			Stranded & Non-compacted, Circular
c	**Material**		Annealed, Plain Copper Conductor
d	**Grade / Standard**		High Conductivity, Electrolytic grade, Class-2 conductors conforming to IS 8130
7	**Insulation :-**		
a	**Material**		PVC
b	**Type and Standard**		Type- A, as per IS-5831
c	**Thickness (Nominal)**	mm	As per IS-1554, Part-I
d	**Method of application**		Extruded

Annexure III
Technical Data sheet for Multi-Core, Armoured Control Cable

Sl. No.	Parameter		Value/Requirement
e	**Core Identification As per IS-1554**		3 core → **Red**, **Yellow** & **Blue**. 5 core → **Red**, **Yellow** , **Blue**., **Black**, **Grey**. For cables having more than 5 cores – All cores shall be Grey in Colour with Number Printing @ 50 mm interval. All the numbers shall be of the same colour which shall be in contrast with the colour of insulation. The numerals shall be legible and indelible.
f	**Volume Resistivity as per IS-5831 (Minimum)**	Ω cm	1×10^{13} @ 27 °C 1×10^{10} @ 85 °C
g	**Mechanical Characteristics**		As per IS-5831
8	**Fillers (wherever applicable)**		Flame retardant, Non-hygroscopic, suitable for the operating temperature of the cable. Fillers shall not stick to insulation and inner sheath. Fillers shall be of same material as of Inner Sheath [ST1]
9	**Inner Sheath :-**		
a	**Material**		PVC with FRLS
b	**Type and Standard**		Type-ST1 as per IS-5831
c	**Thickness (minimum)**	mm	As per IS-1554, Part-I
d	**Method of application**		Extruded
e	**Colour**		BLACK
f	**Mechanical Characteristics**		As per IS-5831
10	**Armouring :-**		
a	**Material**		Single Round Galvanized Steel wire
b	**Standard**		As per IS-3975 & IS-1554, Part-I
c	**Direction of lay**		Left Hand
d	**Shape and dimension**		For all control cable variants galvanized round steel wire armour to be provided. Nominal Dia. of round wire to be as per IS.

Annexure III
Technical Data sheet for Multi-Core, Armoured Control Cable

Sl. No.	Parameter		Value/Requirement
11	**Outer Sheath :-**		
a	**Material**		PVC with FRLS
b	**Type and Standard**		Type- ST1 as per IS-5831 ; Category C2
c	**Method of application**		Extruded
d	**Thickness (minimum)**	mm	As per IS-1554, Part-I
e	**Colour**		BLACK
f	**Mechanical Characteristics**		As per IS-5831
12	**Cable Marking on Outer sheath**		"Manufacturer's name, Year of manufacture, Type of Insulation (PVC), No. of cores & Conductor size, Voltage grade, Type of Cable, FR-LS" embossed @ 1 metre interval. "ISI mark with C/ML number" shall be provided by Inkjet printing @ 1 metre interval.
13	**Sequential marking on Outer sheath**		Every 1 Metre for Progressive Length by non-erasable printing.
14	**Tolerance on Outer diameter**	mm	± 2 (Detailed in Section#29)
15	**Tolerance on Outer diameter for entire length**	mm	1 (Detailed in Section#30)
16	**Ovality**	mm	1 (Detailed in Section #31)
17	**Bending Radius (min)**		12 Times the OD of the Cable
18	**Standard Packing Length**	metre	1000
19	**Tolerance on standard packing length**	%	± 5
20	**Non-standard Length**		Last length, less than the standard packing length will be supplied as a single piece. Cable lengths shall not be less than 500 meters in any case.
21	**Electrical Parameters :-**		**2.5 Sq.mm**

Annexure III
Technical Data sheet for Multi-Core, Armoured Control Cable

Sl. No.	Parameter		Value/Requirement
a	**Conductor DC Resistance (max.) @ 20° C**	Ω / km	7.41
b	**Short circuit rating of conductor for 1 second**	kA	0.2875
c	**Insulation Resistance (min.) @20° C**	MΩ / km	100
d	**Test Voltage - Between Conductor- Conductor**	kV/ minute	3 kV for 5 Minute
22	**FRLS Properties for Inner and Outer Sheath :-**		
a	**Oxygen Index @ ambient temperature as per ASTM-D-2863**	%	Not Less than 29
b	**Temperature Index @ oxygen index 21 as per ASTM-D-2863**	°C	Not Less than 250
c	**Smoke density rating As per ASTM-D-2843**	%	Shall not be more than 60%
d	**Acid gas generation As per IEC 754-Part 1**	%	Shall not be more than 20% by weight
23	**Flammability Tests as per IEC 60332-3 Cat B, IEEE 383 & Swedish Chimney as per SS-4241475, Class F3**		Shall pass
24	**Special Properties for Outer sheath**		Shall have resistance to water, fungus, rodent and termite attack. Test to confirm the presence of lead shall be performed.
25	**Test for rodent & termite repulsion property**		Presence of anti-termite & rodent compound shall be confirmed.
26	**Packing Details :** a) Cables shall be supplied in steel drums of heavy construction. b) The surface of the drum and the outer most cable layer shall be covered with waterproof cover. c) Both the ends of the cables shall be properly sealed with heat shrinkable PVC/Rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. d) Each drum shall carry "Manufacturer's name or trade make, Type of cable, Voltage grade, Year of manufacture, Type of insulation / Sheath (i.e PVC/ FRLS, IE2/SE3/FS.		

Annexure III
Technical Data sheet for Multi-Core, Armoured Control Cable

Sl. No.	Parameter	Value/Requirement
	as applicable), Number of cores & size of conductor, Cable code, FRLS, Length of cable on drum, Drum number/Total number of drums (for the respective variety), Approximate gross mass and ISI number along with ISI mark stencilled on both sides of the drum. e) A tag containing same information shall be attached to the leading ends of the cable. f) An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction of rotation in which it should be rolled.	

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Annexure IV
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-F)

Sl. No.	Parameter		Requirement	
1	Applicable Standards		VDE-0207, VDE-0815, VDE-0816, VDE-0472, IS-8130, IS-10418, IS-10810, IEC-754 (Part-1), IEEE-383, ASTM-D-2843, ASTM-D-2863 & SS-4241475, Clause-F3	
2	Voltage grade	V	225	
3	Temperature Rating	^{o}C	70	
4	Construction of cable		As per Constructional diagram enclosed with this Data sheet	
5	No. of Pairs		2 Pair, 4 Pair, 8 Pair, 12 Pair & 16 Pair	
6	Conductor:-			
a	Area of Conductor	Sq.mm	0.5 Sq.mm	1.5 Sq.mm
b	No. of Strands / Strand Diameter (minimum) - for finished cable	No./ mm	7/0.3	23/0.3
c	Material		Annealed, Bare, Copper conductor	
d	Grade / Standard		High Conductivity, Electrolytic grade Copper to IS-8130	
7	Insulation :-			
a	Material		PVC	
b	Type and Standard		PVC Compound, YI-3, as per VDE-0207, Part-4	
c	Thickness(Minimum/Nominal/ Maximum)		0.25/0.3/0.35	0.8 (Nominal)
d	Method of application		Extruded	
e	Pair Identification		As per Data sheet	
f	Volume Resistivity (Minimum)	Ω-cm	1 x 10^{14} @ 20 °C & 1 x 10^{11} @ 70 °C	
8	Lay for pairing (minimum)	Twist/metre	20	
9	Direction of lay (for pairing)		Right Hand	
10	No. of pairs for making a bundle	Pair	4 pairs laid up to form a bundle (Not applicable to 2 pair cable)	
11	Lay for laid up pairs	Twist/ metre	4 - 6	
12	Lay for laid up Bundle	Twist/ metre	2 – 3 (Not applicable to 2 & 4 pair cable)	
13	Binding Material :-			
a	Type of Material		Melinex Tape	

Annexure IV
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-F)

b	Thickness (minimum)	mm	0.025	
c	Coverage	%	100	
d	Overlap (minimum)	%	20	
14	Filler Material (wherever applicable)		Flame Retardant, Non Hygroscopic material, suitable for the operating temperature of the cable. Fillers shall not stick to the insulation	
15	Shielding:-			
a	Type of Material		Aluminium Backed Mylar Tape	
b	Thickness (minimum)	mm	Pair Shielding → 28 Micron Over all Shield → 55 Micron	
c	Coverage	%	100	
d	Overlap (minimum)	%	20	
16	Drain wire for Shielding :-			
a	Material		Annealed, Tinned Electrolytic Copper	
b	No. of strands / Diameter of strand	No./mm	7/0.3	
c	Area of cross section	sq.mm	0.5 sq.mm	
d	Resistance of Drain wire @ 20°C (maximum)	Ω/km	30	
17	Outer Sheath:-			
a	Material		PVC, With FRLS Properties	
b	Type and Standard		PVC Compound, YM1, as per VDE-0207, Part-5	
c	Thickness (Minimum/Nominal)	mm	1.8	>1.8
d	Method of application		Extruded	
e	Colour		BLUE	
18	Cable Marking on Outer sheath		Manufacturer's Name, Insulation material, Conductor size, Number of pairs, Voltage rating, Type of cable, Year of manufacture @ 625 mm Interval. Printing/Embossing shall be legible and indelible.	
19	Sequential marking on Outer sheath		Every 1 Metre for Progressive Length by printing. Every 5 Metre to read 'FRLS' by Embossing	
20	Tolerance on Outer diameter	mm	± 2	
21	Tolerance on Outer diameter for entire length	mm	1	
22	Ovality	mm	1	
23	Bending Radius (Minimum)		12 Times the OD of the Cable	

Annexure IV
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-F)

24	Standard Packing Length	metre	1000	
25	Tolerance on standard packing length	%	± 5	
26	Non-standard Length		Last length shall be supplied in single length	
27	Electrical Parameters at 20° C :-			
a	DC Resistance (maximum)	Ω/km	36.7	12.1
b	Short circuit rating of conductor for 1 second	KA	0.0575	0.1725
c	Insulation Resistance (minimum)	MΩ/km	100	
d	Mutual Capacitance (maximum) @ 0.8 KHz	nF/km	120	
e	Attenuation (maximum) @ 1 KHz	dB/km	1.2	
f	Cross talk (minimum) @ 0.8 KHz	db	60	
g	Characteristic Impedance (maximum) @ 1KHz	Ω	320	230
h	Test Voltage - Between Conductor- Conductor (minimum)	KV (rms)/ minute	2/1	
i	Test Voltage - Between Conductor - Shield (minimum)	V (rms)/ minute	500/1	
28	FRLS Properties of Outer Sheath :-			
a	Oxygen Index @ ambient temp. As per ASTM-D-2863	%	Not Less than 29	
b	Temperature Index @ oxygen index 21 As per ASTM-D-2863	° C	Not Less than 250	
c	Smoke density rating As per ASTM-D-2843	%	Shall not be more than 60	
d	Acid gas generation As per IEC 754	%	Shall not be more than 20% by weight	
e	Flammability Tests As per IEEE-383, SS-4241475, Clause-F3		Shall pass	
29	Special properties for Outer sheath material		Shall be Resistant to Water, Fungus, Termite & Rodent attack	
30	Quality Plan		NTPC Approved SQP	

Annexure IV
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-F)

31	Packing Details and Marking on Drum	Cables shall be supplied in Non-returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with waterproof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ Rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS-10418. Each drum shall carry Manufacturer's name, Purchaser's name, Address and Contract number, Item number and type, size and length of cable and net, gross weight stencilled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction of rotation in which it should be rolled.
32	Colour coding and Numerical order of cores → As per VDE-0815 The twisted pair of conductors are identified by 8 colours to form 1 Bundle.	

Pair	Colour
1	Blue & Red
2	Grey & Yellow
3	Green & Brown
4	White & Black

The same colours appear in all the Bundles.

The Numerical order of the cores are identified by coloured Rings (ranging from 1 to 4) on the insulation @ 50 mm interval. This clause is not applicable to 2 pair and 4 pair cables.

Cable	8 Pair, 12 Pair, 16 Pair, 20 Pair, 24 Pair, 28 Pair & 32 Pair							
Bundle Number	1st Bundle	2nd Bundle	3rd Bundle	4th Bundle	5th Bundle	6th Bundle	7th Bundle	8th Bundle
Number of Rings	1	2	3	4	1	2	3	4
Colour of Ring	Pink				Orange			

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Annexure V
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-G)

Sl. No.	Parameter		Requirement
1	Applicable Standards		VDE-0207, VDE-0815, VDE-0816, VDE-0472, IS-8130, IS-10418, IS-10810, IEC-754 (Part-1), IEEE-383, ASTM-D-2843, ASTM-D-2863 & SS-4241475, Clause-F3
2	Voltage grade	V	225
3	Temperature Rating	^{o}C	70
4	Construction of cable		As per Constructional diagram enclosed with this Data sheet
5	No. of Pairs		2 Pair, 4 Pair, 8 Pair, 12 Pair & 16 Pair
6	Conductor:-		
a	Area of Conductor	Sq.mm	0.5 Sq.mm.
b	No. of Strands / Strand Diameter (minimum) - for finished cable	No./ mm	7/0.3
c	Material		Annealed, Bare, Copper conductor
d	Grade / Standard		High Conductivity, Electrolytic grade Copper to IS-8130
7	Insulation :-		
a	Material		PVC
b	Type and Standard		PVC Compound, YI-3, as per VDE-0207, Part-4
c	Thickness(Minimum/Nominal/Maximum)		0.25/0.3/0.35
d	Method of application		Extruded
e	Pair Identification		As per Data sheet
f	Volume Resistivity (Minimum)	Ω-cm	1×10^{14} @ 20 °C & 1×10^{11} @ 70 °C
8	Lay for pairing (minimum)	Twist/metre	20
9	Direction of lay (for pairing)		Right Hand
10	No. of pairs for making a bundle	Pair	4 pairs laid up to form a bundle (Not applicable to 2 pair cable)
11	Lay for laid up pairs	Twist/ metre	4 - 6
12	Lay for laid up Bundle	Twist/ metre	2 – 3 (Not applicable to 2 & 4 pair cable)
13	Binding Material :-		
a	Type of Material		Melinex Tape
b	Thickness (minimum)	mm	0.025

Annexure V
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-G)

c	Coverage	%	100	
d	Overlap (minimum)	%	20	
14	Filler Material (wherever applicable)		Flame Retardant, Non Hygroscopic material, suitable for the operating temperature of the cable. Fillers shall not stick to the insulation	
15	Shielding:-			
a	Type of Material		Aluminium Backed Mylar Tape	
b	Thickness (minimum)	mm	Over all Shield → 55 Micron	
c	Coverage	%	100	
d	Overlap (minimum)	%	20	
16	Drain wire for Shielding :-			
a	Material		Annealed, Tinned Electrolytic Copper	
b	No. of strands / Diameter of strand	No./mm	7/0.3	
c	Area of cross section	sq.mm	0.5 sq.mm	
d	Resistance of Drain wire @ 20°C (maximum)	Ω/km	30	
17	Outer Sheath:-			
a	Material		PVC, With FRLS Properties	
b	Type and Standard		PVC Compound, YM1, as per VDE-0207, Part-5	
c	Thickness (Minimum/Nominal)	mm	1.8	>1.8
d	Method of application		Extruded	
e	Colour		BLUE	
18	Cable Marking on Outer sheath		Manufacturer's Name, Insulation material, Conductor size, Number of pairs, Voltage rating, Type of cable, Year of manufacture @ 625 mm Interval. Printing/Embossing shall be legible and indelible.	
19	Sequential marking on Outer sheath		Every 1 Metre for Progressive Length by printing. Every 5 Metre to read 'FRLS' by Embossing	
20	Tolerance on Outer diameter	mm	± 2	
21	Tolerance on Outer diameter for entire Length	mm	1	
22	Ovality at any cross section	mm	1	
23	Bending Radius (Minimum)		12 Times the OD of the Cable	

Annexure V
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-G)

24	Standard Packing Length	metre	1000
25	Tolerance on standard packing length	%	± 5
26	Non-standard Length		Last length shall be supplied in single length
27	Electrical Parameters at 20° C :-		
a	DC Resistance (maximum)	Ω/km	36.7
b	Short circuit rating of conductor for 1 second	KA	0.0575
c	Insulation Resistance (minimum)	MΩ/km	100
d	Mutual Capacitance (maximum) @ 0.8 KHz	nF/km	100
e	Attenuation (maximum) @ 1 KHz	dB/km	1.2
f	Cross talk (minimum) @ 0.8 KHz	db	60
g	Characteristic Impedance (maximum) @ 1KHz	Ω	340
h	Test Voltage - Between Conductor- Conductor (minimum)	KV (rms)/ minute	2/1
i	Test Voltage - Between Conductor - Shield (minimum)	V (rms)/ minute	500/1
28	FRLS Properties of Outer Sheath :-		
a	Oxygen Index @ ambient temp. As per ASTM-D-2863	%	Not Less than 29
b	Temperature Index @ oxygen index 21 As per ASTM-D-2863	° C	Not Less than 250
c	Smoke density rating As per ASTM-D-2843	%	Shall not be more than 60
d	Acid gas generation As per IEC 754	%	Shall not be more than 20% by weight
e	Flammability Tests As per IEEE-383, SS-4241475, Clause-F3		Shall pass
29	Special properties for Outer sheath material		Shall be Resistant to Water, Fungus, Termite & Rodent attack
30	Quality Plan		NTPC Approved SQP

Annexure V
Data sheet for Multi-pair Shielded, Instrumentation Cable (Unarmoured, Type-G)

<table>
<tr><td>31</td><td>Packing Details and Marking on Drum</td><td>Cables shall be supplied in Non-returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with waterproof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ Rubber caps secured by ‘U’ nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS-10418.

Each drum shall carry Manufacturer’s name, Purchaser’s name, Address and Contract number, Item number and type, size and length of cable and net, gross weight stencilled on both the sides of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction of rotation in which it should be rolled.</td></tr>
<tr><td>32</td><td colspan="2">Colour coding and Numerical order of cores → As per VDE-0815

The twisted pair of conductors are identified by 8 colours to form 1 Bundle.

<table>
<tr><th>Pair</th><th>Colour</th></tr>
<tr><td>1</td><td>Blue & Red</td></tr>
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The same colours appear in all the Bundles.

The Numerical order of the cores are identified by coloured Rings (ranging from 1 to 4) on the insulation @ 50 mm interval. This clause is not applicable to 2 pair and 4 pair cables.

<table>
<tr><td>Cable</td><td colspan="8">8 Pair, 12 Pair, 16 Pair, 20 Pair, 24 Pair, 28 Pair & 32 Pair</td></tr>
<tr><td>Bundle Number</td><td>1st Bundle</td><td>2nd Bundle</td><td>3rd Bundle</td><td>4th Bundle</td><td>5th Bundle</td><td>6th Bundle</td><td>7th Bundle</td><td>8th Bundle</td></tr>
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<tr><td>Colour of Ring</td><td colspan="4">Pink</td><td colspan="4">Orange</td></tr>
</table>
</td></tr>
</table>

Annexure VI
Test requirements of Power,Control & Instrumentation cables

A. Power cable & Control cable:

ROUTINE TESTS	**Following routine tests shall be carried out on each drum of finished cables for all types (PVC / XLPE insulated) & sizes.**	
1)	Conductor Resistance test	
2)	High voltage test	
ACCEPTANCE TESTS	**Following Acceptance tests shall be carried out on each size of each type (PVC / XLPE insulated) of cables, in the offered lot.**	
A) For Conductor (as per sampling plan mentioned in IEC Pub 502 (1983)/ BS 6346:1969/ IEC 60502-2 (2005))		
	1)	Annealing test (Copper)
	2)	Tensile Test (Aluminum)
	3)	Wrapping Test (Aluminum)
	4)	Resistance test
B) For Armour Wires / Formed Wires (If applicable) (as per sampling plan mentioned in IEC Pub 502 (1983)/ BS 6346:1969/ IEC 60502-2 (2005))		
	1.	Measurement of Dimensions
	2.	Tensile Tests
	3.	Elongation Test
	4.	Torsion Test For Round wires only
	5.	Wrapping Test
	6.	Resistance Test
	7.	Mass of Zinc coating test For G S wires / Formed wires only
	8.	Uniformity of Zinc coating For G S wires / Formed wires only
	9.	Adhesion test For G S wires / Formed wires only
	10.	Freedom from surface defects
C) For PVC / XLPE insulation & PVC Sheath (as per sampling plan mentioned in IEC Pub 502 (1983)/ BS 6346:1969/ IEC 60502-2 (2005))		
	1)	Test for thickness
	2)	Tensile strength & Elongation before ageing(for tests after ageing see "D")
	3)	Hot set test (For XLPE insulation)

D) Ageing test:		
If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer will carry out ageing test & the test report will be reviewed by owner (quantum of ageing test sample shall be one sample /batch)		
E) Following tests will be carried out on completed cables as per relevant standard on each size of each type (PVC / XLPE insulated)		
	1)	Insulation resistance test (Volume resistivity method)
	2)	High voltage test
F) Following tests shall be carried out on only one size of offered lot (comprising of all sizes & types)		
	1)	Thermal stability test on PVC insulation and outer sheath
	2)	Oxygen index test on outer sheath
	3)	Smoke density rating test on outer sheath
	4)	Acid gas generation test on outer sheath
G) Flammability test as per IEC 60332 - Part- 3 (Category- B) on completed cables as per following sampling plan:		
		This test will be carried out using composite sampling i.e. irrespective of size; cables of one particular type (i.e. armoured PVC insulated, unarmoured PVC insulated, armoured XLPE insulated, unarmoured XLPE insulated) will be bunched together, as per calculations in line with the IEC. All sizes of PVC & XLPE insulated, armoured & unarmoured cables shall be covered. For one particular type, cables with OD less than or equal to 30 mm shall be clubbed together in touching formation while cables with OD greater than 30 mm shall be clubbed together leaving a gap equal to OD of cable having least diameter. Cable OD shall be taken as nominal overall diameter as per approved datasheet.
H) Following tests shall be carried on one length of each size of each type (PVC / XLPE insulated) of offered lot:		
	1)	Constructional / dimensional check, surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Sequential marking, drum / Batch (outer sheath extrusion batch)number marking on sheath
	2)	Measurement of Eccentricity & Ovality
GENERAL NOTE:		
(a) In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by owner and Main Contractor at the time of final inspection. Owner and Main Contractor will also witness routine tests on cables on 10% sample basis. (b) In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre:- Routine Test of manufacturer internal test report are to be verified by Owner at the time of final inspection, Owner will witness routine tests on cables for the first order on 10% sample basis and Main Contractor will witness routine tests on cables for the first order on 100% basis.		

Annexure VI
Test requirements of Power,Control & Instrumentation cables

Type tests:

The reports for the following type tests shall be submitted for one size each of LT XLPE, LTPVC Power and control cables.

S.No.	Type test	Remarks
	Conductor	
1	Resistance test	
	For Armour Wires / Formed Wires	
2	Measurement of Dimensions	
3	Tensile Test	
4	Elongation test	
5	Torsion test	For round wires only
6	Wrapping test	
7	Resistance test	
8(a)	Mass & uniformity of Zinc Coating tests	For GS wires/formed wires only.
8(b)	Adhesion test	For GS wires/formed wires only
	For XLPE insulation & PVC Sheath	
9	Test for thickness	
10	Tensile strength and elongation test before ageing and after ageing	
11	Ageing in air oven	
12	Loss of mass test	For PVC outer sheath only.
13	Hot deformation test	For PVC outer sheath only.
14	Heat shock test	For PVC outer sheath only.
15	Shrinkage test	
16	Thermal stability test	For PVC outer sheath only.
17	Hot set test	For XLPE insulation only
18	Water absorption test	For XLPE insulation only
19	Oxygen index test	For PVC outer sheath only.
20	Smoke density test	For PVC outer sheath only.
21	Acid gas generation test	For PVC outer sheath only.
22	Flammability test as per IEC-332 Part-3 (Category -B)	For completed cable only

Annexure VI
Test requirements of Power,Control & Instrumentation cables

B. Instrumentation cable :

INSTRUMENTATION CABLE

TESTS / ITEMS	Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded															
Conductor(IS-8130)	Y			Y			Y								
Insulation(VDE-207)				Y	Y	Y	Y						Y		Y
Pairing/Twisting				Y	Y		Y								
Shielding				Y			Y			Y					
Drain wire	Y			Y			Y		Y	Y					
Inner Sheath				Y	Y	Y	Y					Y	Y		
Outer Sheath				Y	Y	Y	Y					Y	Y		
Over all cable	Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)				Y			Y								

Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

Note : ® - Routine Test A - Acceptance Test Y - Test Applicable

Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)
- ** Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk (As applicable)

\+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

Annexure VI
Test requirements of Power,Control & Instrumentation cables

Type tests:

S.No.	Type test	Standard
	Conductor	
1	Resistance test	VDE-0815
2	Diameter test	IS-10810
3	Tin Coating test (Persulphate test)	IS-8130
	Insulation	
4	Loss of mass	VDE 0472
5	Ageing in air ovens	VDE 0472
6	Tensile strength and elongation test before and after ageing	VDE 0472
7	Heat shock	VDE 0472
8	Hot deformation	VDE 0472
9	Shrinkage	VDE 0472
10	Bleeding & blooming	IS-10810
	Inner sheath* **	
11	Loss of mass	VDE 0472
12	Heat shock	VDE 0472
13	Cold bend/ cold impact test	VDE 0472
14	Hot deformation	VDE 0472
15	Shrinkage	VDE 0472
	Outer sheath	
16	Loss of mass	VDE 0472
17	Ageing in air ovens	VDE 0472
18	Tensile strength and Elongation test before and after ageing	VDE 0472
19	Heat shock	VDE 0472
20	Hot deformation	VDE 0472
21	Shrinkage	VDE 0472
22	Bleeding & blooming	IS-10810
23	Colour fastness to water	IS-5831
24	Cold bend/ cold impact test	VDE-0472
25	Oxygen index test	ASTMD-2863
26	Smoke Density Test	ASTMD-2843
27	Acid gas generation test	IEC-60754-1
	fillers	
28	Oxygen index test	ASTMD-2863
29	Acid gas generation test	IEC-60754-1
	AL-MYLAR Shield	
30	Continuity test	
31	Shield thickness	
32	Overlap test	

Annexure VI
Test requirements of Power,Control & Instrumentation cables

	Over all cable	
33	Flammability Test	IEEE 383
34	Swedish Chimney Test	SEN 4241475
35	Noise interference	IEEE Transactions
36	Dimensional checks	IS 10810
37	Cross talk	VDE-0472
38	Mutual capacitance	VDE-0472
39	HV test	VDE-0815
40	Drain wire continuity	

1.0 All cables to be supplied shall be of type tested quality. The Contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last Ten years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.0 In case the Contractor is not able to submit report of the type test(s) conducted within last Ten years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Contractor shall conduct all such tests either in an independent laboratory or at manufacturer’s works in presence of Owner’s representative under this contract free of cost to the Owner and submit the reports for approval.

***Applicable for armoured cables only

List of Mandatory Spares
Lara 2X800MW

The list below outlines the mandatory spares required for the coal feeder's C&I/Electrical components. Vendors shall supply the applicable mandatory spares based on the components relevant to their feeder control system design: -

	Item	**Quantity**
Feeder C&I	Motion monitor	2 Nos.
	Speed pick-up (Tachogenerator)	4 Nos.
	Load Cell assembly	4 Nos.
	Electronic cards & Power Supply cards	2 nos. of each type
	Limit switch assembly for coal-on-belt, no coal flow, shear pin failure, etc.	4 nos. of each type
	Relay/Contactor of each type make and model and rating	2 Nos.
VFD	Variable frequency drive	2 Nos.
Feeder Electrical	Control supply transformers	2 Nos. of each type and rating
	LEDs	5 Nos. of each type & colour
	Control switches	2 Nos. of each type
	Selector switches	1 No. of each type
	Push buttons (complete with contact elements)	5 Nos. of each type & colour
	Relays and Timer	10 Nos. of each type and rating
	Auxiliary contactors and bimetallic overload relay set for panel	1 No of each type and rating
	Control fuse base with carrier complete set for panel	1 No of each type and rating
	Any special meter	1 No. of each type

List of Mandatory Spares
Lara 2X800MW

Sl. No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate Coat		Finish coat			Total DFT µm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
8 PS1A1	**Miscellaneous and casing sheets** 04-147,547; 07-409,431,460,461,462,502,503,509,531,560; 12-506,600,906,907;17-919;21-601,604,606; 24-350,351,354, 801,804,805,806,808,809, 24-810,815,817,825,826,835,840,841,855, 24-950,955,960,966 to 969;30-233,234; 36-396,398,611; 38-611; Fuel firing: 41-350,390,500,997; Steam blowing piping 42-001,002,005,010,046,065,070,120,152,154, 42-157,997; 43-004,005,104,105,200,997; 45-200,801,802, 804,805,858,997; 47-281,283, 858,997; Duct plates, expansion joints 48-911,912; Coal Feeding 65-736,997; 67-204,272,276, 283,801,802,803,997; 95-088,091,485;96-186;97-585, 592; $Handling equipment:99-099,100,300,400; Impulse lines: 24-800 Seal air ducting: Cold Air duct:48-012,014, 112,114, 141; Tempering Air: 48-142,144;	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µm per coat	2	--	--	Synthetic Enamel paint (Long Oil Alkyd) to IS 2932 DFT= 20µm per coat	2	Smoke Grey Shade No: 692 of IS5	100

$ - Final Shade is Golden yellow for under hung crane, Chain Pulley Block, Ratchet Lever and Trolley with hoist. Black shade for Hook.

Sl. No.	PGMA / Description	Surface Preparation & Surface Profile	Primer coat		Intermediate coat		Finish coat			Total DFT µm (min)
			Paint	No. of coats	Paint	No. of coats	Paint	No. of coats	Shade	
9 PS3	<u>Components >95° C coming in the gas path, Headers, Commissioning Spares &erection Materials etc.,</u> 06-400,401,431,434,437,441,444, 06-447,451, 453,455,500,501,515,731,732, 06-734,735,737,741,744,745,747,751,752,753, 06-755, 759; 07-309,315,316,318,423, 993; 10-182,183,184,185; 11-474; 12-993;17-174,504,506,900,903; 19-704,753,763,783,793,802,850,851,852; 21-987,988; 24-822,823, 987,988, 989, 993; 30-103,105,212,215,219,223,224,235; 31-010,104; 32-010,210,810; 35-993; 36-993;37-010;38-993; 41-988; 42-858,988; 48-993; 65-200; 67-200; 95-988;96-193; 97-282,287,297,298,407,577,590,591; 97-593,596,599;99-501,514;	SSPC-SP3/ Power Tool Cleaning	Red Oxide Zinc Phosphate Primer (Alkyd Base) to IS 12744 DFT= 30µm per coat	2	--	--	No paint	No paint	Red oxide	60
10 PS6	<u>Hand rails and posts, ladders / rungs</u> 35-821,822,823,851; 36-820,821,822,823,851,852,853; <u>Floor Grills, Step treads</u> 35 – 811,812; 36-811,812,813,814; 38-810,820,850; 39-810,820,850;	SSPC – SP8/ Acid pickling	Hot dip Galvanizing to a coating weight of 610 g/m^2 (minimum) and to a coating thickness of 87µm. Refer Notes given below **							

Notes **: The Guard plates, Hood Ladders, Stringer channels, angles and plates shall be painted as per painting scheme prescribed in Sl. No: 03.

The following sub-assemblies has to procured from BHEL approved sources

1. Main drive gearbox with drive
2. Clean out conveyer(COC) drive gearbox with drive

BHEL Approved Sources

- PREMIUM TRANSMISSION PRIVATE LIMITE
- SHANTHI GEARS LIMITED,
- ELECON ENGG.CO.LTD.,

Technical Pre-Qualification Requirement for Belt type Gravimetric Feeder Assembly with VFD

1. The vendor shall be an established manufacturer of **Belt type Electronic weighing type raw coal Gravimetric Feeder assembly with VFD & state of the art microprocessor based controls (henceforth referred to as Gravimetric Feeder)** having adequate Engineering and Manufacturing facilities. Vendor shall furnish technical backup documents for proof of availability of above facilities.
2. The supplier shall have experience of having supplied state of the art microprocessor based 36 inch or higher sized gravimetric feeder - 7 feet centre to centre distance & with VFD for coal weighing applications in thermal power plants.
3. The proposed Gravimetric Feeder shall be from the regular manufacturing range of the supplier.
4. As proof of above pre-qualifying requirement points, vendor should furnish:
   a. Product catalogue which lists the enquired feeder meeting the above technical requirements.
   b. Vendor shall furnish general reference list with details of Customer name, the feeder parameters, P.O date, customer reference details wherein the vendor has supplied state of the art microprocessor based Gravimetric Feeders meeting the technical requirements stated above.
   c. Minimum ONE end user certificate for satisfactory operational performance of the state of the art microprocessor based Gravimetric Feeder meeting the pre-qualifying requirements stated above.

      OR

      Minimum Two past purchase orders of similar state of the art microprocessor based Gravimetric Feeders meeting the minimum pre-qualifying requirements stated above.
   d. Vendor to attach the corresponding data sheets/ technical documents of the Gravimetric Feeder pertaining to the P.Os / End user certificate (submitted vide point 4.c).
5. In case of order placement, the Vendor shall have the responsibility for the following and same shall be confirmed point wise.
   i) Vendor should have the component replacement responsibility in case of defect / failure of Feeder parts.
   ii) Experts from Vendor's side shall assist in commissioning activities at site, if required.
   iii) Vendor should ensure the product performance during erection & commissioning.

6. DOCUMENT SUBMISSION CHECKLIST FOR THE VENDOR TO MEET PQR

S. No	Document description	Vendor confirmation	Document name
a.	Back-up documents as per pt. 1	☐	
b.	Product Catalogues as per pt. 4a	☐	
c.	General reference list as per pt. 4b	☐	
d.	One end user certificate OR Two P.Os as per pt. 4c	☐	
e.	Data sheets/ technical documents as per pt. 4d	☐	
f.	Confirmation to clause (5)	☐	

Vendor's seal & Sign