	GENERAL SPECIFICATION FOR DOSING SYSTEM	SPEC. No.: ROS 9012
		REV: 03

BHARAT HEAVY ELECTRICALS LIMITED,
RANIPET- 632 406.

GENERAL SPECIFICATION

for

DOSING SYSTEM & ACCESSORIES

03	09.07.16	AJ	DBN	MN	EC&I portion revised
02	17.09.12	DBN sd/-	PP sd/-	SK sd/ -	General painting procedure added
01	28.03.12	ABH sd/-	IMRL sd/-	SK sd/-	Spec. revised
00	20.05.10	RR sd/-	MN sd/-	KSK sd/-	Fresh issue
Rev. No	Date	Prepared	Checked	Approved	Remarks

1.0 EQUIPMENT SPECIFICATIONS

This specification covers the design, skid manufacturing, assembly of pumps with motors , interconnecting piping, valves, instruments, tanks, accessories etc. in the skid, shop testing including hydro testing, supply of the dosing system ~~and erection supervision & commissioning the dosing system at site.~~ (Erection & commissioning is not in vendor scope)

1.1 CHEMICAL DOSING SYSTEM

a. Application : To dose applicable chemical solution through electrical motor operated diaphragm pump.

b. Surrounding : Dusty, humid atmosphere in thermal power plant.

c. Installation : Indoor / Under shade

d. Ambient Temperature : 45 °C Maximum & 5°C Minimum

e. Operation : Continuous / Intermittent

f. Dosing system : Each system normally consists of electro-mechanical diaphragm pumps, Day tank, Preparation tank (if required), Mixer (if required) for the applicable tank with necessary piping, valves & accessories which are mounted on the skid. For additional information refer enclosed detailed technical specification.

2.0 TECHNICAL REQUIREMENT:

Please refer separate Technical Specification for dosing system and accessories.

3.0 GENERAL DESIGN REQUIREMENTS

3.1 Pump & Accessories:

a. Positive displacement, mechanically actuated diaphragm pump with provision for auto / manual stroke adjustment as specified in the technical specification.
b. The pumps with auto operation shall be supplied with suitable components to adjust the stroke length or rate based on the 4-20 mA signal provided by Purchaser These pumps shall also have provision for manual over ride facility.
c. Manual operated pumps shall have provision for adjusting the stroke length.

d. Steady state accuracy : ±1.5% of maximum flow

e. Repeatability at fixed pressure and stroke setting. : ± 3%

f. Flow accuracy at various discharge pressures and specific stroke setting to the entire operating range } : ± 6%

g. Turn down ratio : 10 : 1

h. Stroke adjustment : 10 to 100%(Minimum)

i. Diaphragm : Teflon coated EPDM or better

j. All Wetted parts shall be compatible to chemical being handled and are subjected to BHEL approval.

k. Accessories :

Each dosing pump should consist of one injection head, (to suit process line) one suction strainer, one air release valve, one low level switch for each tank with minimum 5 m length cable(if applicable), one tubular level gauge for each tank. Necessary tube connectors for suction, discharge ports, provision for mounting calibration column at pump suction, pressure gauge (4"dial– with chemical seal diaphragm), pump mounting fasteners (bolt, nut with 2 washers) , flow indicator etc. as per typical scheme of dosing system drawing.

l. Power supply for pump motor :

230 V, AC, single phase 50 Hz, 3 core x 2.5 sq.mm PVCA cable or 415 V, AC, 3phase, 50Hz suitable to terminate 3 core x 2.5 sq.mm PVCA cable. Terminal Block shall be in vendor scope.

m. Mounting arrangement :

The respective dosing pumps for each dosing system must be assembled in a common skid to have positive suction with suction isolation vlave. The delivery of each pump shall be connected to a common discharge CPVC header with dedicated discharge isolation valve. This CPVC common header of each system to be connected to the injection head (fitted in process pipe line) through a common CPVC rigid piping system.

Note:

1. Electronic solenoid operated diaphragm pumps are not acceptable unless otherwise stated elsewhere.

2. Bidder shall quote nearest higher flow capacity pump if the specified capacity is not in their manufacturing range which is subjected to BHEL's acceptance.

3. The operating pressure of the offered pump should meet the pressure requirements stated in technical specification.

3.2 ELECTRICAL MOTORS – A.C

Motors shall be Squirrel cage Induction type. Motors shall be suitable to operate for 415V ±10%, 3 Phase, 50 Hz ±5%, combined voltage & frequency 10% (absolute sum), continuously rated (S1), Direct On-Line (DOL) starting, Starting Current shall be limited to IS-12615 tolerance , Degree of Protection – IP-55 and IP-54 for outdoor & indoor respectively and terminal boxes shall be provided with at least IP-55. Class F insulation with temperature limited to Class B, TEFC enclosure, canopy for outdoor motors & two earthing bolts are to be provided one on either side of the motors and another earthing bolt inside the Terminal box. The applicable standard shall be IS325 & IS 12615. The motor make shall be as per customer approved vendors as indicated in this specification. All Motors shall be energy efficient type (IE2).

Single phase 230 Volts±10%, 50 Hz ±5% motors are also acceptable for dosing pump drives.

3.3 DAY TANK & PREPARATION TANK

FRP Tanks design considerations:

Tanks shall be vertical, cylindrical, (tapered bottom wherever needed) with level indication. The top cover shall be flanged with suitable reinforcing and bracing. The top cover (One segment) shall have opening for chemical loading and this part shall be hinged type for preparation tank and where ever required. A perforated basket for chemical dissolution shall be provided, in the FRP tank, below this opening for chemical loading.

The support pads shall be provided along the outer circumference, at the mid height of the tank with suitable reinforcing and bracing, so that the tank is rigidly held on the support legs in the skid wherever the tank is mounted on the skid. Otherwise the support pads at the bottom of the tank for necessary grouting during erection.

Each tank shall have four support pads with bolt hole & PCD not more than 150 mm beyond the tank diameter. Tank support pad with bolt hole shall be suitable for mounting the tank on the necessary support legs / channel provided in the skid or support floor.

Nozzles on top, sideways and bottom heads shall have a flanged faces perpendicular to the vertical centerline of the tank and nozzles on sidewalls shall have flanges faces perpendicular to radial centerlines. Tolerance on angle of

flange face with respect to tank centerline is ½ degree. All the nozzles with flange shall be molded integrally with tanks. Flanges shall be off CRS.

The tank shall be continuous filament wound type and there shall be no long seam joint in the cylindrical shell. The entire thickness of the cylindrical shell shall be built up prior to removal of the shell from the mandrel. Necessary baffle plate @ 120 deg apart shall be provided for each tank.

Filament would reinforced tanks shall be considered. The minimum total laminate thickness of the filament wound tank shall not be less than 6 mm all around and minimum 10 mm for tank flange, flanged top cover, tank bottom corners and all nozzle flanges without exception.

Each tank shall have inlet, outlet, drain, overflow, service water inlet, level indication nozzles etc. Drain & overflow lines shall be minimum one size higher than the pump discharge line size. ALL FLANGE DRILLING SHALL CONFIRM TO ANSI B-16.5, CLASS 150.

Each day tank should be provided with a suitable low level switch with 1NO+1NC contact type for interlock through DCS for remote low level trip of respective pumps. The MOC of the wetted parts of the level switch must be compatible for the respective chemical used. This is not applicable for preparation tank.

Each tank shall be provided with a removable type basket (for dissolving chemical) attached to the inner periphery of the tank. This shall be rigidly fixed with the tank. 6 to 10 mm - holes shall be made on the basket

Each tank shall be equipped with a flanged level indicator / gauge. The gauge shall include two CPVC isolation ball valve, 20 mm dia glass tube and indicator board calibrated in cm.

Resin used for the tanks shall be a commercial-grade corrosion-resistant thermosetting, fully tested and accepted for the severe conditions. All internal surfaces, exposed to chemical, shall be resin rich and the thickness of this inner layer shall be minimum of 2 mm by vinyl ester resin. Isothalic resin shall be used for rest of the thickness lamination. The glass content of inner layer shall be 25 to 30 % by weight. The glass content of filament wound structural layer shall be 55 to 70 % by weight.

Applicable Dosing System name & tank capacity shall be indicated / painted in the respective tanks with black letters (25mm height minimum) on yellow background.

Suitable opening shall also be provided in these tanks to house slow speed mixer as the case may be. The above guide lines shall be followed for day and

preparation tank. The top cover in these tanks shall be sufficiently rigid enough for mounting the mixers.

3.4 SKID FRAME.

A skid shall be fabricated with MS channel and angles as per the approved drawing with good engineering practice. The MS skid shall be suitable to assemble the day & preparation tanks with mixer, dosing pumps with motor, piping system, overflow & drain arrangements etc. The pump mounting elevation and space between pumps shall be suitably designed to facilitate easy operation for flow adjustment, valve operation, maintenance and chemical loading etc.

Preparation tanks shall be located at suitable elevation in the skid near the respective day tank. Necessary interconnecting piping and valves to connect this tank with day tank shall be provided. Necessary supports & clamps for tank, piping etc. Lifting hook arrangement shall also be provided. Painting shall be followed as given in the technical specification elsewhere.

3.0 **Painting**

3.5.1 GENERAL

a) All the Equipment and steel structures shall be protected against external and internal (if any) corrosion by providing suitable painting as described below unless otherwise specified elsewhere. However, the surfaces of stainless steel, Galvanised steel, Gunmetal, brass, bronze, UPVC pipes, HDPE pipes and non-metallic components shall not be applied with any painting.

(b) All painting shall be carried out in conformity with the paint manufacturer's recommendation.

3.5.2 CLEANING AND SURFACE PREPARATION

All the external and internal surfaces to be painted shall be thoroughly cleaned before erection by wire brushing, shot blasting and air blowing. The steel surface to be applied with painting shall be thoroughly cleaned before applying paint by brushing, shot blasting etc as per the agreed procedure.

After all machining, forming and welding has been completed, all steelwork surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to painting.

Surfaces shall be cleaned to requisite surface preparation by one of the methods given below as per technical specification and all dust remaining after cleaning shall be removed.

Grease or oil contamination shall be removed by either wiping or scrubbing the surface with rags or brushes wetted with white spirit and then wiping down with clean dry cloths. Alternatively emulsifying agents may be used for this purpose.

(a) Manual or hand tool cleaning

The sequence of operation for manual / hand tool cleaning is as follows:

1) Solvent cleaning (if required) will be done to remove oil and grease soluble welding influx residues and salts.
2) Surface will be manually cleaned by hand hammering or hand chipping to remove stratified rust (rust Scale).
3) Brushing/hand scraping will be done to remove all loose mill scale and no adherent rust.

(b) Blast Cleaning

The surface of the metal will be blast cleaned to a finish confirming to SA 2 1/2 as per Swedish standard SIS-05-5900 using any of the following methods after removal of grease, oil and contaminants:

1) Dry sand blasting
2) Shot/grit blasting

3.5.3 PROTECTIVE COATING

As soon as the painting items have been cleaned, within four hours of the subsequent drying, they will be coated with suitable anti-corrosion protection. Immediately after the protective coating all vessels and pipes will be suitably sealed off by discs or caps or approved alternatives to prevent ingress from the surrounds.

No painting or filler shall be applied until all repairs, hydrostatic test and final shop inspection are completed.

All painting works (including surface preparation) on piping or equipment at site shall be commenced only after the required tests have been completed.

Prior to painting, proper care shall be taken to protect nameplates, lettering, gauges, sight glasses, light fittings and similar such items, to ensure that these are in no way defaced or damaged during the work

All primers shall be well marked into the, particularly in areas where pitting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied as per manufacturer's recommendations.

All paints, when applied in a normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks.

Dry Film Thickness(DFT): Each coat of paints will be allowed to harden before the next is applied as per manufacturer's recommendation. The requirements for DFT of the paint and materials to be used for different items will be as per the "schedules of finishes indicated below.

3.6. PIPING SYSTEM.

All the valves, strainer, interconnecting pipes, pump suction and discharge piping shall be of CPVC industrial grade, PN 16 rating, DIN standard or schedule 80 pipe shall be considered.

Prepared solution transfer pipe line from preparation tank to day tank shall be of 1”(DN 25) size minimum. Isolation valves shall also be 1”(DN 25) size.

The distance of discharge piping from the skid to the process line (dosing point) will vary from 10 to 40 meters based on the site layout. The dosing system design should take care of this. The erection of pipe from skid to dosing point will be carried out by others.

ALL FLANGE DRILLING SHALL CONFIRM TO ANSI B-16.5, CLASS 150.

Applicable bill of quantity, for this requirement, to cover all the system shall be separately offered by the bidder as called in the enquiry. Bidder shall also offer unit rates for pipe, fittings & valves etc., to order for any change in requirement based on detailed engineering. The expected quantity variation will be within + or (–) 20% for each item and will be finalized before order. However any minor variation in requirements shall be taken care by the vendor without any commercial implications after ordering.

A “TEE” connection with isolation valve at pump suction shall be provided by the bidder for fixing calibration column / cylinder for calibration of pumps.

3.7 MIXER / AGITATOR

i) Type	: Electrical Operated with mounting flange & SS316fasteners
ii) Power supply	: 415 volts, 3ph, 50Hz.
iii) Speed	: Bidder to provide low speed mixers, preferably less than 300 rpm

3.8 OTHER REQUIREMENTS

a. All the interconnecting piping shall be CPVC, industrial grade Schedule 80.
b. The pipe size shall be minimum of dia 1" (DN 25) for Tank Overflow , Drain, Transfer from Preparation tank to day tank , service water inlet
c. The drain outlet , common pump discharge outlet , terminal points shall be terminated with mating flanges.
d. The valves of union type socket end and the O rings shall be of either EPDM or VITON.
e. All mounting fasteners (Flanges, tank, pump etc.) : SS 316

f. Foundation Bolts : SS 316

Items though not mentioned but needed to make the system complete in all respects as stipulated under these specifications are also to be supplied unless otherwise specifically excluded.

3.9 JUNCTION BOX (IF applicable)

Junction Box for termination of contacts of field instruments .Enclosure material shall be of 2 mm Cold rolled sheet steel. Material of Removable gland plate shall be of 3mm Hot rolled sheet steel. Enclosure protection shall be of IP 55 as per IS 13947.

3.10 **MEASURING INSTRUMENTS**.

Pressure Gauge:

- Diaphragm seal type
- Dial size shall be of 100 mm.
- End connection shall be 1/2 inch NPT (M).
- Accuracy shall be ±2% of span or better.

Level Gauge

- Transparent tubular type with accuracy of +/- 2% of span or better.
- Range shall cover 125% of maximum of scale.
- Length of gauge glass shall not be more than 1400 mm.

Rotameter

- In-line rotameter with isolation & bypass valve arrangement.

Level switches:

- Magnetic Float type level switch.
- MOC of wetted parts shall be PP (chemical compatible).
- 150% of max design pressure.
- Enclosure shall be weather and dust proof as per IP-55.

3.11 SPECIFICATION OF INSTRUMENT CABLE*: (IF applicable*)

Cables shall be of type FRLS HRPVC SCREENED CONTROL CABLES .
Cross section area of the conductor shall not be less than 0.5 sqmm.Construction shall be of multistrand and number of strands shall be 7. IS: 1554(Part-I Generally) & IS: 694 (Latest editions and its amendments) shall be applicable.

4.0 DOCUMENTATION :

The documentation during bid and post order stage shall meet the following requirements.

1. All documents and drawing shall be submitted in English.
2. Hard copies of all documents and drawings, in English, during bid stage to be submitted in duplicate.
3. Hard copies of all drawing and documents for approval shall be submitted in triplicate.
4. Hard copies of all final documents, drawings, erection manual, O&M manual etc., shall be submitted in bound folder in six.
5. Soft copies of all final documents in MS word / MS in the form of CD – 1 set
6. Soft copies of all final calculations in MS word / MS in the form of CD – 1 set
7. Soft copies of all final drawings in Auto Cad, latest version in the form of CD – 1 set

5.0 DOCUMENTS / DETAILS ALONG WITH BID

The following documents/ details shall be submitted along with the bid for scrutiny.

a. Duly filled up data sheet for each dosing system, in Annexure-1 & 2 enclosed.

b. Catalogues & typical drawings indicating system arrangement, dimensional details, Material of constructions etc.

c. Typical Performance curve for each model of the offered pump for the operating pressure range (design to minimum).

d. Typical Quality plan for supply of the above equipment.

e. Reference list

f. Unpriced commercial offer on the scope of supply as per BHEL spec. (Note – 3).

g. All the documents called for in the motor specification

h. Bidder to provide confirmation regarding the compatibility of the offered wetted parts MOC for the medium handled for all systems.

e. Civil requirements.

i. In case of any deviation, the Bidder shall indicate the deviation, clause by clause in the deviation format attached in Annexure-2. If there is no deviation "NIL" statement shall be furnished. In the absence of Annexure-2, it will be construed that the bid confirms strictly to the specification. Acceptance or rejection of the offer with or without deviations (either fully or partially) is sole discretion of the purchaser without seeking further clarification from the bidder.

Note: 1. Bidders to note that failing to submit the above documents, the bid shall be considered as incomplete and liable for rejection.

Note: 2. Bidder to confirm in their offer that the details called in Section 6.0 will be provided after order.

Note: 3. Bidder should provide offer for all the dosing systems as called in the spec. They should also provide price break up for each dosing system, piping system spares etc. If the offer is not for all the dosing systems, it will not be considered for evaluation.

6.0 DOCUMENTS AFTER ORDER:

6.1 The following documents / Drawings shall be furnished for BHEL / customer approval.

i) Duly filled up data sheet Annexure-1 enclosed.
ii) Quality plan for supply of the above equipment in BHEL format (format will be provided after order).
iii) General arrangement drawings with dimension for pump, tank & accessories
iv) Dosing/Injection head details.
v) Cross sectional drawings.

6.2 The following documents/Drawings are to be furnished for BHEL / customer review and acceptance.

i) Performance test report for flow Vs design pressure and flow Vs minimum pressure for each pump. The pump shall be tested at 25%, 50% &100 % of the stroke length. The verification / inspection of test results shall be carried out for one pump of each model in the presence of BHEL inspector or BHEL's authorized inspector.

ii) Performance guarantee certificate

iii) Erection and O&M manuals.

iv) List of despatch details for each system as per BHEL format (format will be provided after order).

Note: Purchase order number& Material code shall be marked / indicated in the system painted / tagged at suitable location for identification of components at site before dispatch.

7.0 INSPECTION

By BHEL's inspector or BHEL's authorized representative at Vendor's works.

8.0: PACKING & FORWARDING

8.1 The Dosing systems assembly shall be packed properly by the vendor, before despatch to ensure safe transportation without any damages.

8.2 The material shall be despatched to site as per shipping list along with complete BOQ approved by BHEL. The shipping list format & QP formats, etc will be given after order.

8.3 All the loose items shall be numbered , detailed in packing slip and shall be sent in closed wooden box with proper packing inside.

Annexure-1

BHEL Enquiry / P.O. Reference No. & Date:

EQUIPMENT DATA SHEET

I. TECHNICAL PARAMETERS

IA. PUMP

a.	Name of Chemical dosing system			:	
b.	Make & Model no			:	
c.	Type			:	
d.	Flow -Design / Min / Max		LPH	:	/ /
e.	Disch. Pr. -Design / Min / Max		Kg/cm^2	:	/ /
f.	Stroke length		mm	:	
g.	Speed	Min / Max	SPM	:	
h.	Stroke adjustment	Min / Max	%	:	
i.	Steady state accuracy (cl.3.1.b)		%	:	
j.	Repeatability (Cl.3.1.c)		%	:	
k.	Flow accuracy (Cl.3.1.d)		%	:	
l.	Power Supply Details		V/Ph/Hz	:	
	-Variation in %		V/Ph/Hz	:	
	-Power consumption		Watt	:	
m.	Material of construction				
	-Dosing Head			:	
	-Fittings			:	
	-Valve balls in the pump			:	
	-Spring in injection head			:	
	-Tubing			:	
	-Mounting fasteners			:	
	-Other Wetted parts			:	
n.	Normal operating life at design capacity			:	
	-Diaphragm		Hrs	:	
	-Ceramic balls		Hrs	:	

o.	Pump overall size	L,W,H	:	
p.	Pump weight	Kg	:	
q.	Tube size at Suction / Discharge - Pressure rating at 20 deg C	Inches	: :	/
r.	Pump control	Manual / Automatic	:	
s.	Type of control -	Stepper motor / Others	:	

II. DAY TANK / PREPARATION TANK			DAY TANK	PREPARATION TANK
a.	Capacity	ltrs	:	
b.	Size - Dia & Height	mm	:	
c.	Tank thickness – Shell /Bottom /Top	mm	:	
d.	Baffle plate size & quantity		:	
e.	Material of construction			
	- Tank & Cover		:	
	- Level indicator		:	
	- Interconnecting valves & piping		:	
f.	Type & make of level switch		:	
g.	Level Indicator make & details		:	
h.	Colour of the Tank		:	
i.	Weight of tank with lid		:	
j.	Type of resin used for FRP tank & cover		: Inner : Outer :	

III. MIXER (if applicable)		DAY TANK	PREPARATION TANK
a. Make& Type	:		
b. Material of construction			
- Impeller	:		
- Shaft	:		
- Protective coating	:		
c. Shaft	Dia x Length :		
d .Impeller	Dia :		
e. Impeller speed	rpm :		
f. Make of gear reducer	:		
g. Model No	:		

IV. MOTOR (AC) particulars

1. Dosing pump motor

i) Application	:
ii) Type	:
iii) Frame size	:
iv) Manufacturer	:
v) Rated output in KW	:
vi) At rated Voltage and frequency	:
a) Full load current (Amps)	:
b) Rated speed	:
c) Full load efficiency	:
d) Full load power factor	:
vii) No load current in Amps.	:
viii) Controller input / output signal for flow adjustment for auto pumps in mA:	
ix) Type of mounting and shaft Orientation	:

IV. MOTOR (AC) particulars

2. Mixer motor

i) Application :

ii) Type :

iii) Frame size :

iv) Manufacturer :

v) Rated output in KW :

vi) At rated Voltage and frequency :
- a) Full load current (Amps) :
- b) Rated speed :
- c) Full load efficiency :
- d) Full load power factor :

vii) No load current in Amps. :

viii) Controller input / output signal for flow adjustment for auto pumps in mA:

ix) Type of mounting and shaft Orientation :

V. Pressure gauge make :
Model number :
Type :

VI. Pressure relief valve make :
Model number :

VII. Calibration Cylinder MOC :
Capacity :

VIII. Level gauge make :
Model number :
Type :

IX. Level Switch make :
Model number :
Type :

X. In-line Rotameter make :
Model number :

IV. GENERAL					
Material Code	Unit				
Dosing system description					
Pump Model No.					
Pump operation Auto / Manual					
Pump Qty / system	Nos.				
Injection Head / system	Nos.				
Suction Strainer"Y-type" / system	Nos.				
Pressure relief valve / System	Nos.				
Pressure gauge - diaphragm type / System	Nos.				
Day tank / system	Nos.				
Preparation tank / system	Nos.				
Fume absorbers / system	Nos.				
Mixer assembly / system	Nos.				
Low level switch / system	Nos.				
No. of skids / system	Nos.				
Skid size L / B / H	Metre				
MOC of skid					
Pr. rating of CPVC pipes & valves					
Make of piping					
Make of valves					
Pump suction / disch. pipe size	Nos.				
Weight of skid assembly	kgs				
Drawing No. – Pump					
Drawing No. – Mixer					
Drawing No. – Day tank / Prpn					

tank					
Drawing No. – skid assembly					
Drawing No. – General Arrgt.					

ANNEXURE 2

TECHNICAL DEVIATIONS

Sl. No	Section no.	Clause No.	Page / No.	Specification	Statement of Deviations/variations	Reason for Deviation	cost of withdrawal

Date:

Signature & seal of the Bidder