न्यूक्लियर पावर कॉर्पोरेशन ऑफ इंडिया लिमिटेड
(भारत सरकार का उद्यम)
NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)
Directorate of Procurement
Nabhikiya Urja Bhavan, Anushaktinaga, Mumbai-400094

EOI No. – NPCIL/PRD(UGP)/2018/01

INVITING EXPRESSION OF INTEREST AND REQUEST FOR PROPOSAL

FOR

MANUFACTURING OF DISTILLATION COLUMNS, INTERNAL PACKING WITH PHOSPHOR BRONZE (PB) WIRE MESH MODULES, TESTING, PERFORFANCE EVALUATION, TRANSPORTATION TO RESPECTIVE SITES AND ERECTION OF DISTILLATION COLUMN ASSEMBLIES FOR NPCIL PROJECTS

1. INTRODUCTION

1.1 Nuclear Power Corporation of India Ltd.(NPCIL) is a Public Sector undertaking under the Department of Atomic Energy (DAE), Government of India. NPCIL is responsible for design, engineering, construction, commissioning and operation of Atomic power stations for generation of electricity, in pursuance of the schemes and programme of Government of India under the Atomic Energy Act.

1.2 Govt. of India has accorded in-principle approval for setting up of additional 12 Nos. of 700 MWe Pressurised Heavy Water Rectors (PHWR) in a phased manner at various locations of the country within a span of next 10-12 years.

1.3 During operation of PHWR, the isotopic purity of Heavy water (D_2O) gets downgraded due to mixing with light water (H_2O)in many ways. The purity of D_2O is required to be maintained as per the specified limit for continuous reactor operation. Heavy Water upgrading plants are set up along with PHWR units to upgrade the downgraded Heavy water to Reactor grade using the vacuum distillation process. Each twin unit of 700 MWe PHWR requires 4 Nos. of distillation column assemblies. Hence 24 nos. of distillation column assemblies are required for the upcoming12 Nos. of reactor units. Each distillation column assembly consists of following items / components:

Sr. No.	Description	Qty for each column assembly (nos.).
1	Column Sections	14
2	Liquid Collectors	14
3	Liquid Distributors	14
4	Top Support Rings	14
5	Bottom Support Rings	14
6	Column Sump	1
7	Reflux condenser - Vapour Hood assembly	1
8	Re-boiler	1
9	Phosphor Bronze (PB) Wire mesh Modules for internal packing of distillation column	238 nos. Modules (from approx. 80 MT &60,000 sq. Meter of PB wire mesh)

2. SCOPE

At present the distillation column assemblies and PB wire mesh (in lots and bands) are manufactured by the NPCIL approved vendors, which are sent to Heavy Water Division (HWD), BARC for further activities like:

- Fabrication of PB wire mesh Modules from PB wire mesh lots and bands
- Cleaning of PB wire mesh Modules using Ultrasonic technologies
- Internal packing of each column section with the cleaned PB wire mesh Modules
- Activation of packed column sections
- Testing and performance evaluation of column sections

The complete design and technology know-how of the above jobs have been developed by HWD, BARC. Now HWD, BARC intends to transfer the complete technology know-how of distillation column assemblies to Private industries.

This Expression of Interest (EOI) is issued to explore the prospective suppliers willing to develop the required infrastructure & facilities for the above activities including manufacture &supply of distillation columns along with PB wire mesh, internal packing, activation & performance evaluation of columns, transportation to the respective site and erection of the column assemblies on single point responsibility for future NPCIL PHWR projects.

Vendors who participate in this EOI shall be evaluated and shortlisted for issue of final tender.

3. TECHNICAL SPECIFICATION

3.1 Manufacturing of Distillation column sections along with internals, Colum Sump, Reboiler, Reflux Condenser

4 nos. of packed bed type Distillation column assemblies are required to upgrade the downgraded Heavy Water getting collected during the operation of 2 x 700 MWe PHWR stations to reactor grade. High efficiency structured packing, manufactured from Phosphor Bronze (PB) wire mesh are further activated and used for increasing the wettability of packing modules for distillation process. The column assembly consists of column sump, column sections, Re-boiler, Vapour hood-reflux condenser assembly and internals viz, liquid collector & distributor, top & bottom support ring. Upgrading is done by continuous distillation under sub-atmospheric (120 mm Hg. absolute pressure) conditions. Each column assembly consists of 14 nos. of column sections having 1050 mm dia. and 3250 mm height. The material of construction of distillation column assembly is generally SS-304L. The details of the assembly are as per the enclosed drg. no GHAVP-1&2/34930/2016/DD

Special requirements for manufacturing of distillation column assemblies

- All raw materials shall meet the requirement of respective material specification and mandatory requirements viz, IGC Test of SS component, UT on forging, Eddy Current Testing on Tubes etc. as specified in technical specifications.

- The manufacturing of SS components shall be carried out in a separate enclosed area to avoid any chances of iron/iron oxide pick-up. Carbon Steel parts shall not come in contact with Stainless Steel parts. Grinding wheel, files, chisels, hammer and other hand tools used for Stainless Steel shall be kept separate. The items used on Carbon Steel components/parts shall not be used on stainless steel components/parts.

- The column sections, column sump, Re-boiler, Vapour hood-reflux condenser assembly shall be designed for full vacuum and manufactured in accordance with the latest edition of ASME Boiler & Pressure Vessel Code, Section-VIII, Div-I and TEMA, Class-C as minimum requirement.

- All welders and welding procedures shall be qualified as per ASME Boiler & Pressure Vessel Code, Section-IX and shall get approval from NPCIL prior to commencement of fabrication. Only qualified welders shall be employed for welding. Welding consumables shall be as per ASME Boiler & Pressure Vessel Code, Section-II Part-C.

- Liquid Penetrant Examination (LPT) and Radiography Examination (RT) will be carried out as per technical specification.
- Vacuum hold test at 40 mm Hg (abs) for distillation column assembly and Helium leak testing for Re-Boiler and Reflux Condenser.
- The entire distillation column assembly consisting of 14 column sections, column sump, vapour hood-Reflux Condenser and Re-boiler shall be so fabricated that when aligned in its final and free erected condition, the verticality shall be within 10 mm as measured in any orientation.
- To ensure meeting the above requirement, the contractor shall carry out alignment testing of column sections in the shop floor in seven sub-assemblies (for each column assembly), consisting three column sections, with liquid collector assembly, in vertical position. Top section of each sub-assembly shall be included as bottom section of next sub-assembly. The out of verticality shall not exceed 1.4 mm for any sub-assembly. Section numbers are to be marked in this sequence. In addition to checking the alignment for the complete assembly in the shop floor, the contractor shall also check verticality of entire column when erected at site.

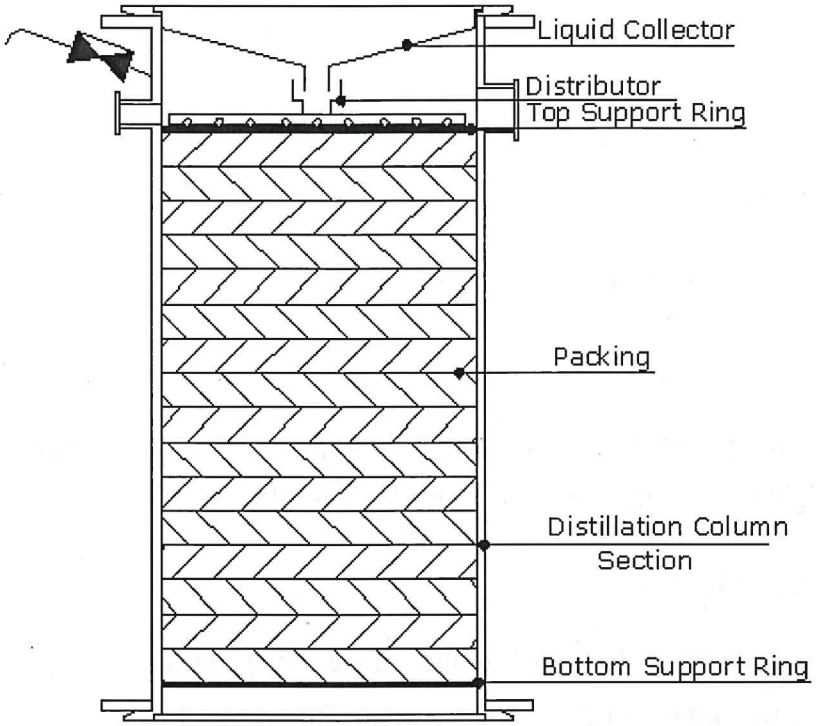
- The final assembly of the distributor shall be checked with the top support ring to ascertain that all the arms of the distributor are properly resting on the semicircular notches provided on the supporting member of top support ring. The distributor shall then be match marked and identified with the corresponding top support ring and column section.

3.2 Internal PB wire mesh packing and testing of column assembly

0.18 mm dia soft annealed Phosphor Bronze wire is woven to 5 shafts Twill Hollander Weave for making wire mesh. Type of mesh: Rectangle 50 x 112 (Nos. of wires/inch) Wire mesh packing of disc-shape-modules is required for internal packing of distillation column sections. The slit and cut pieces of punched wire

mesh are further corrugated and made into circular (Disc) modules and tied with bands.

The packing consists of parallel strips of wire mesh with oblique corrugation, arranged vertically in the form of cylindrical cartridges as shown below.



Tower Internals

The process involves following steps:

- **Fabrication of packing module**
- **Cleaning of packing module**
- **Filling of Modules in column section**
- **Compaction of packing modules**
- **Activation of packing (two sections at a time)**
- **Performance testing (two sections at a time)**

3.2.1 Fabrication of packing Module:

Internal PB wire mesh packing is required in column to make intimate contact between vapour flowing from bottom to top and liquid flowing from top to bottom of the column for effective mass transfer. The packing should offer very less pressure drop across it & provides large surface area per unit volume.

Packing modules are fabricated from strips of phosphor bronze wire mesh having a fixed width & different length to form one half round module.

Procedure involves:

a) Corrugation of PB wire mesh

b) Cutting & setting of half round modules of wire mesh

c) Side grinding

d) Assembly of two half round modules

e) Surface grinding

f) Pneumatic cleaning of modules and banding.

a) Corrugation:

Corrugation of the phosphor bronze wire mesh strips is done in a corrugating machine (straight flutes roller) rotating with a low speed.

b) Cutting & Setting of half round:

Corrugated strips are stacked on a half round wooden template. These strips are then cut with a tin cutter and tied with the help of galvanized iron wire with wooden template.

c) Side grinding:

Excess lengths of the strips are ground with the help of a pneumatically operated hand grinder. A half round matching template is used to achieve the proper shape of the strips.

d) Assembly:

One module of packing is made up of two half round modules. Two such half round modules are assembled on a table by tying with GI wire.

e) Surface grinding:

The surface of packing module shall be even and smooth to avoid any gap arises during filling up in the distillation column sections. Pneumatically operated hand grinder is used for making surface smooth.

f) Pneumatic Cleaning and banding of module:

Surface ground modules are made free from dust, using compressed air and banded with phosphor bronze strips with the help of spot welding before sending out for degreasing in ultra-sonic cleaning system.

3.2.2 Cleaning of packing module:

During fabrication of the packing module, grinding dust, oil & grease may fall on the module. Cleaning of module is done in ultrasonic machine using degreasing solvent, Trichloroethylene. Modules are further cleaned by vapour degreasing.

3.2.3 Module filling in column section:

After receiving fabricated column section and carrying out thorough inspection, cleaning is carried out from inside of column section using detergent. Packing modules are filled in column section one by one after placing column section in vertical position. Care is taken so that gap should not be there between two modules. Suitable material handling equipments are required for filling and alignment of the packing modules. Weight of the one column section after filling packing comes to approximately 3.8 MTe.

3.2.4 Activation:

As shown in the block diagram of the facility below, after filling the packing modules inside the column, these packing are activated for increasing the wettability of the packing. Set of two column sections is installed on sump of test set up along with reflux condenser for Activation. This process involved following steps:

a) Detergent Washing

b) Acid Treatment

c) Alkali Treatment

a) Detergent washing: During filling the packing module, oil/dirt may get deposited on the surface of the packing due to handling; hence the packing are required to be cleaned using detergent.

b) Acid Treatment: Washing the packing with dilute H_2SO_4solution makes the packing chemically clean for further processing.

c) Alkali Treatment: Further Alkali treatment is given to the packing by using dilute NaOH solution in presence of Oxygen gas.

3.2.5 Compaction of packing modules:

After activation of column packing, pressing of the packing modules are required to ensure that no gap is there between two packing modules. Gap between two adjacent packing affect the performance of the packing. Pressing of the packing is done with the help of hydraulic jack.

3.2.6 Performance testing:

After activation and pressing, set of two column sections is installed on sump of test set up along with reflux condenser & Re-boiler for testing the performance of packing. Performance of the packing modules is tested by distillation of light water mixed with small quantity of Heavy water(to be supplied by purchaser). After testing the concentration of heavy water across the length of column section, performance of the packing is evaluated.

3.2.7 Utility requirement:

Following major utilities are required for the activity:

- Air compressor (for running grinders & instrumentation) - 22 kW, 63 LPM at 7 bar (g) pressure
- Steam - 3000 kg/hr of 8 bar (g) steam
- Cooling water (500 TR cooling tower) & Chilled water (8 TR water cooled chiller) (for activation & performance testing),
- Oil free vacuum system which can produce vacuum to the level of 40 mm Hg (Abs)-liquid ring type, 14 LPM seal water supply
- DM water unit -15 LPM
- Electric power -120 kW

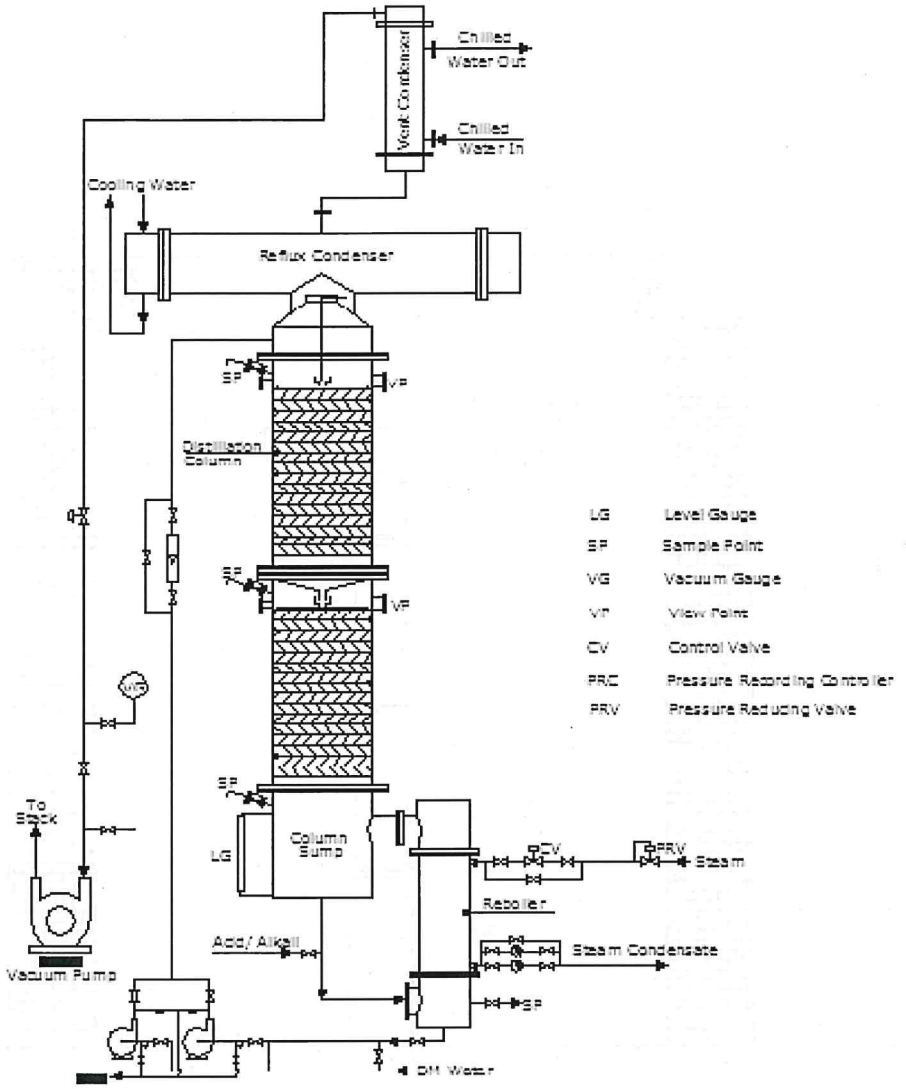
3.2.8 Minimum man power requirement:

For fabrication of packing modules, approximate man power requirement is as follows:

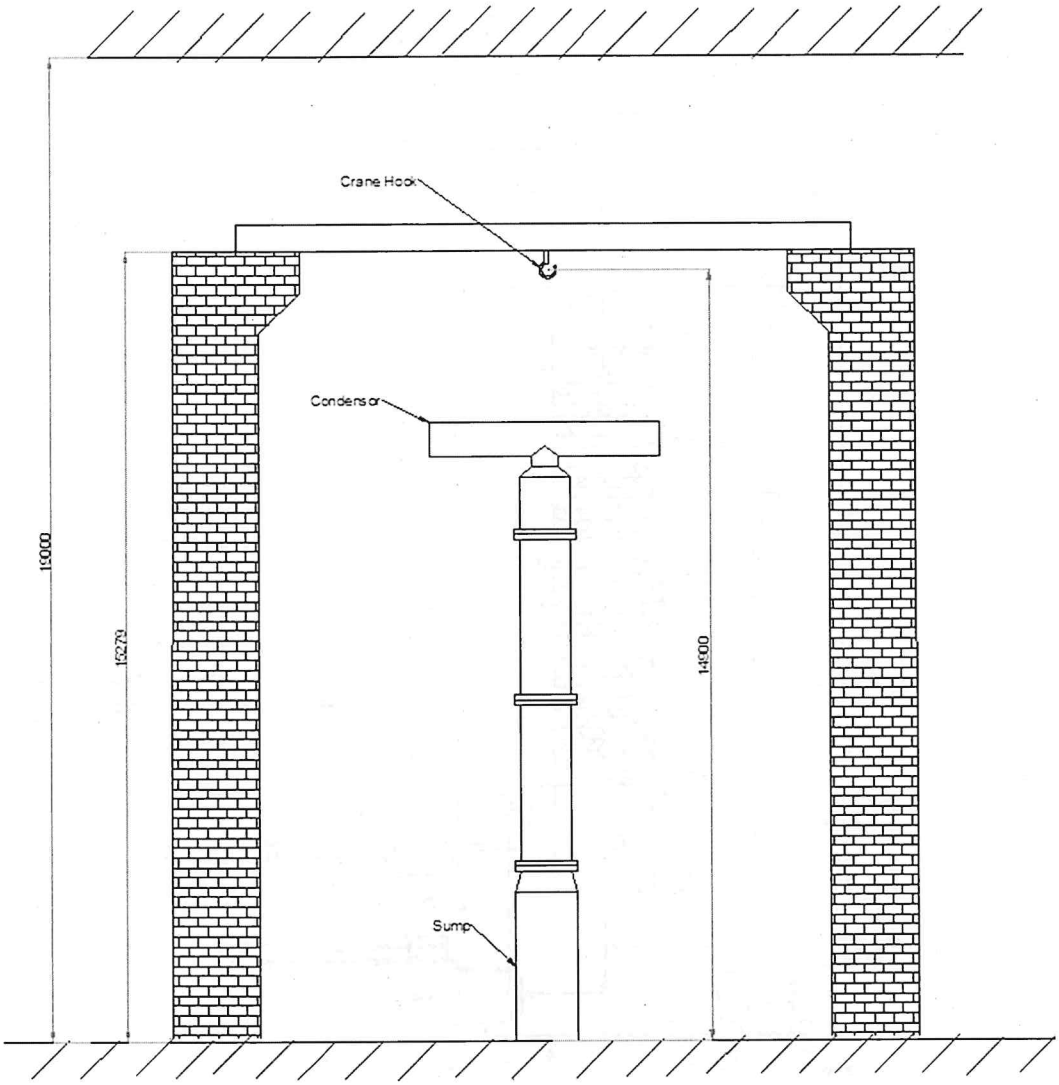
- Fitters – 8-10
- Crane operator - 1
- Welder - 1

3.2.9 Consumables

- Oxygen cylinders (commercial grade, 1120 kg per tower)
- Sulphuric acid (98% w/w, 250 kg per tower)
- Sodium hydroxide (flakes, 1400 kg per tower)
- Sodium bicarbonate (500 kg per tower)
- Nitric acid (500 kg per tower)
- Trichloroethylene (4200 L)



Flow Diagram for 1.05M Dia. Column Test Facality



Head room requirement for column section activation and performance testing set up

3.2.10 Floor space requirements

- Area required for packing fabrication facility:

14 Meter X 7.5 Meter X 4.5 Meter (L X W X H)

Equipment installed shall be generally as follows: (however other similar machines are acceptable subject to meeting the technical requirements)

Corrugation machine, 1 No.

Corrugation Roller size = Ø 125mm x 1.5 Mts.

Corrugation feeding angle = 45°

Teeth shape = V section and teeth angle = 60°.

Number of teeth = 64 nos.

Corrugation Roller RPM = 24.

- Radial grinding machine, 1 No.

  Heavy duty straight grinder
  Speed = 6000 RPM.
  Grinder wheel size = 100 x 25 x 15.88 mm
  Grinder length = 525 mm.
  Air pressure = 6 kg/cm²

- Surface grinding system, 2 Nos.

  Heavy duty straight grinder
  Speed = 6000 RPM.
  Grinder wheel size = 150 x 25 x 15.88 mm
  Grinder length = 525 mm.
  Air pressure = 6 kg/cm²

  Table for surface grinding: 1800mm (L)X 2000 mm (W) X 1000 (H)

  shall have level adjustment system & aluminium top

- Assembly table & storage of fabricated modules etc.

  Assembly & bandage table: 2 Nos. (1 for each work)
  Circular shape top: 1300 mm diameter, aluminium sheet
  Height: 1000 mm

- Area required for packing cleaning & testing:
  6 Meter X 5 Meter X 19 Meter (L X W X H)

- Area required for utility
  Chiller unit: 1 Meter X 2 Meter,

  Cooling tower: 4 Meter X 4 Meter,

  Boiler: 8.4 Meter X 8.4 Meter X 8.5 Meter (L X W X H)

  Air compressor: 1.5 Meter X 3 Meter

- Total Area required for packing related activity (fabrication, cleaning &filling & testing facility) will be around (excluding column section storage):
  20 Meter X 10 Meter X 19 Meter (L X W X H)

3.2.11 Infrastructure requirement for packing fabrication, activation and testing

Type of equipment	Number/Quantity
Reboiler with column sump for test set up (Vertical, falling film type shell and tube reboiler, heat duty = 1700 kW, HT area = 40 sq m, MOC = SS 304L)	1
Reflux condenser (Horizontal, shell and tube condenser with vapour hood, heat duty = 1700 kW, HT area = 62 sq m, MOC = SS 304L) + vent condenser (Horizontal, shell and tube vent condenser, heat duty = 12 kW, HT area = 4 sq m, MOC = SS 304L) for test set up	1
Water ring vacuum pump and associated piping	1
Seal water pump (Centrifugal canned motor pump, seal water flow rate = 14 LPM, 1 kW motor rating)	1
Seal water tank (insulated) (250 L capacity, fitted with cooling coil for chilled water circulation, Armaflex cold insulation over tank surfaces)	1
MS Support structure	As required
Hydraulic Jack-5 T	1
EOT Crane-5 T	1
Chain pulley block-2.5 T	1
Chain pulley block-3 T	1
Plunger assembly	1
Pallet trucks-3 T	2
Ultrasonic degreasing system.	1
Chilled water unit (8 TR capacity)	1
Cooling tower (500 TR)	1
DM Water Unit (15 LPM unit)	1
DM Water Storage Tank (4 m^3)	1
Acid Preparation tank (1.2 m^3)	1
Neutralization tank (5 m^3)	1

Acid alkali circulation pump (Centrifugal pump: capacity = 12 M3/hr, Head: 25 meter & MOC: A351 Gr CF 8M))	2
Sump pump (Centrifugal pump: capacity = 2 m3/hr, Head 20 meter & MOC: SS 304)	2
Alkali Preparation Tank + Mechanical agitator (1.5 m^3)	1
Mass spectrometer	1
pH Meter	1
Piping and instrumentation for test set up	As required
Structured packing fabrication machinery set, like corrugation machine, Radial and surface grinding machines etc	1
Boiler system for steam generation (3000 kg/hr, 8 bar pressure)	1

3.3 Dispatch of column to site:

Column sections which qualify the performance test are crated and sent to respective project site in vertical position on low bed trailer with proper lashing arrangement for installation at site.
The Column Sump, Re-boiler and Reflux Condenser are sent to site directly from manufacturer works.

3.4 Erection of Distillation column assembly at site

The column assembly consisting of Sump, Vapour hood-Reflux Condenser assembly and Re-boiler are erected at respective site. The scope of erection of column assembly includes the following:

- ✓ Erection of Column Sump and Column Sections with the corresponding internals
- ✓ Erection of Vapour hood-Reflux Condenser assembly on the top of the 14th Column Section
- ✓ Erection of Re-boiler with Column Sump
- ✓ Alignment and verticality check of the assembly after erection of every column section and final checking of the entire column assembly. The verticality of the total column assembly shall be within 10 mm as measured in any orientation.

4. DESIRED REQUIREMENT OF VENDORS PARTICIPATING IN EOI

4.1 It is desired that the manufacturers of distillation column assemblies participate in this EOI. However other Vendors who are associated with wire mesh manufacturing or testing of distillation columns can also participate in this EOI and can submit their offers jointly with distillation column manufacturer.

Distillation column manufacturers quoting for this job shall procure the PB wire mesh from NPCIL approved vendors only. Similarly, bidders who are not manufacturer of distillation column assembly are quoting for this job, they shall procure the distillation columns from NPCIL approved vendors only. The names of NPCIL approved vendors will be indicated in the final tender.

4.2 Vendor shall be financially sound with an annual average turnover of minimum Rs. 65.00 crores in the preceding three financial years for participating in the tender.

The net worth of the vendor as at the end of the immediately preceding financial year (2017-18) shall be minimum Rs 25.00 crores. The above information shall be furnished by the vendor duly certified by the auditor / Chartered Accountant

Vendor may respond to this EOI either on his own strength or jointly with other vendors. However, overall responsibility lies with the principal vendor.

5. SUBMISSION OF DOCUMENTS

The vendor shall furnish the information in enclosed Annexure A1 to A7 with his offer.

6. NPCIL ACTION PLAN

The offers against the EOI will be evaluated for qualifying the vendors. The technology know-how from design stage to testing of the distillation column assemblies will be transferred by BARC to the qualified bidders, following the laid down procedures & guidelines and on payment of Technology Transfer charges to BARC (amount to be finalised by BARC; however, it is likely to be maximum Rs. 10 lakhs). The qualified bidders are required to remit the Technology Transfer fees and acquire the technology from BARC within 2 months of communication from NPCIL regarding their qualification. On completion of the process of Technology transfer, limited tender for manufacture, testing, supply and erection at respective sites for the complete distillation column assemblies for six projects, i.e. 24 nos. of distillation column assembly, will be issued by NPCIL only to the qualified bidders who have acquired the technology from BARC. The successful bidder is also required to pay a nominal Royalty fees to Department of Atomic Energy (DAE) on award of contract (as per the stipulation laid down by Govt. of India). The amount of Royalty fees will be indicated in the tender.

A-1 TENDERER'S GENERAL PARTICULARS

1. Name of the Tenderer :
2. Tenderer's offer on his own strength or Jointly with other vendors. If jointly, mention the name of the other vendors :
3. Tenderer's proposal No. and date :
4. Name and designation of the officer of the Tenderer to whom all references shall be made for expeditious co-ordination. :
5. Whether sole Proprietorship/Partnership/ Limited Company/Co-operative Body/ Joint Venture :
6. Names of Proprietor/Partners/Directors :
7. Structure of Organization :
8. Postal Address, Telephone & Fax Nos. and e-mail Address of Registered Office :
9. Registration particulars of partnership/Limited Company/Co-operative Body/Joint Venture :
10. Whether registered for work with Govt./ Quasi Govt./Public Institutions, etc. :
11. Core Competence of business :
12. Areas of other business activity, if any, & Place of such business :

13. Annual turnover for the preceding three financial years. Tenderer shall enclose audited "Balance Sheet" for these years. :

Financial Year	Annual Turnover (Rs. In Crores)
2015-16	
2016-17	
2017-18	

14. The Net worth in the Financial Year 2017-18 (Rs. In Crores). Tenderer shall enclose Net worth value duly certified by the auditor / Chartered Accountant :

Seal of the Company: Date:	Signature: Name & Designation:

A-2 TENDERER'S EXPERIENCE:

The tenderer shall fill in the following format & provide all supporting documents in support of his claim for job experience. For furnishing data against more jobs, tenderer may make copies of the format and fill in separately and enclose)

I) Details of any job executed by the tenderer included in the job indicated in EOI:

a) Work description / scope :

b) Client :

c) Name & Desg. of Officer-In-Charge :

d) Client address, city and country PIN :

e) FAX No./e-mail ID :

f) Phone No. :

g) Start Date :

h) Completion date :

i) Total value of work :

j) Copy of Work order furnished : Yes / No

k) Completion Certificate furnished : Yes /No

II) Indicate whether the following works related to the above jobs were executed by tenderer on his own or through Sub-Contractor(s) or were not included in his scope of work.

a) Detailed Engineering :

b) Procurement, Supply & Inspection of Materials :

c) Fabrication / Erection :

d) Testing & Commissioning :

III) <u>If the work executed through Sub-Contractor(s), give following details for all Sub-Contractors employed for the work</u>.

a) Name of Sub-Contractor :

b) Work Description :

c) Value of Work :

d) Duration :

e) Completion date :

Seal of the Company: Date:	Signature: Name & Designation:

A-3 TENDERER'S DETAILED ACTION PLAN FOR EXECUTION OF THE JOB INCLUDED IN THE SCOPE OF EOI

The tenderer shall bring out herein detailed action plan provided for carrying out following major activities included in the scope of this EOI

1. Manufacturing & testing of Distillation column assembly
2. Manufacturing of PB Wire mesh
3. Fabrication of PB Wire mesh Modules
4. Internal Wire mesh Packing, Activation and Performance evaluation of Distillation column sections
5. Transportation of Distillation column sections to respective sites
6. Erection of Distillation column assembly at site

Seal of the Company: Date:	Signature: Name & Designation:

A-4 TENDERER'S ORGANISATION CHART

The Tenderer shall submit herein the overall Organization Chart of the firm giving Names of key personnel, designation and description of the Organization.

The tenderer shall also provide a resume for each key person (indicated in the Organization chart) to be associated to the contract, containing at least the following information (Additional sheets are to be attached and properly designated, if necessary).

a) Name :

b) Educational Qualifications :

c) Present position in company :

d) Relevant Experience with Employment History :

A-5 TENDERER'S RESOURCES

The tenderer shall furnish herein the details of resources available with him for executing the job.

1. Manpower & facilities available for

   (a) Detailed Engineering

   (b) Procurement activities.

   (c) Manufacturing activities

   (d) Wire mesh packing and performance evaluation of column sections

   (e) Erection activities

2. Tenderer shall submit i) QA/QC Organization with Qualification / Level of certification as per ISNT / ASNT for the QA Personnel and ii) QA manual followed at his works.

3. Particulars of tools, plants and machinery owned which would be available for executing the jobs included in the scope of EOI.

A-6 TIME SCHEDULE

The tenderer shall confirm herein the total time required in months for completion of the entire scope of job covered in EOI for the following stages considering 12 nos. of column assembly.

Sl. No.	Description	Time required in months
1.0	Development of Infrastructure facility	
2.0	Identification of Vendors for sub-ordered items	
3.0	Manufacturing of Distillation Columns.	
4.0	Manufacturing of PB Wire mesh	
5.0	Fabrication of PB Wire mesh modules	
6.0	Filling of PB Wire mesh and activation of Column sections	
7.0	Testing of PB Wire mesh filled Column sections	
8.0	Erection of column assemblies	
9.0	Transportation of tested column sections to site	
10.0	Total Time Required	

Seal of the Company: Date:	Signature: Name & Designation:

A-7 TENDERER'S QUERIES

Tenderer shall list down herein the queries/clarifications needed, if any, from NPCIL on this EOI.

Sl. No.	Subject / Description	Queries / Clarifications Required.

Seal of the Company: Date:	Signature: Name & Designation: