



Subject: Technology Tie-up for Circulating Fluidized Bed Combustion (CFBC) Boilers above 150 MWe rating

1) **Introduction:**

This Expression of Interest (Eoi) seeks response from Original Equipment Manufacturers (OEMs) of CFBC boilers who are meeting the requirements of this Eoi and are willing to be associated with BHEL through a License & Technology Collaboration Agreement on long term basis to enable BHEL to design, engineer, manufacture, assemble, quality control, test, supply, erect, commission, repair, service and retrofit Circulating Fluidized Bed Combustion (CFBC) boilers above 150 MWe rating for thermal power plants and other applications.

1.1) **About Bharat Heavy Electricals Limited (BHEL):**

BHEL is a leading state owned company, wherein Government of India is holding 63.06% of its equity. BHEL is an integrated power plant equipment manufacturer and one of the largest engineering and manufacturing organization in India, catering to the core infrastructure sectors of Indian economy viz. energy, transportation, heavy engineering industry, defence, renewable and non-conventional energy. The energy sector covers generation, transmission and distribution equipment for hydro, thermal, nuclear and solar photo voltaic. BHEL has been in this business for more than 50 years and BHEL supplied equipment account for more than 57% of the total thermal generating capacity in India. BHEL is also listed in Indian stock exchanges. The company has 17 manufacturing units, 4 power sector regions, 8 service centers, 8 overseas offices and 15 regional offices besides host of project sites spread all over India and abroad. The annual turnover of BHEL for the year 2016-17 was US\$ 4.45 Billion*. BHEL's highly skilled and committed manpower of approximately 39821 employees, the state-of-the-art manufacturing facilities and latest technologies, has helped BHEL to deliver a consistent track record of performance. To position leading state owned companies as Global Industrial giant and as a recognition for their exemplary performance, Government of India categorized BHEL as "Maharatna Company" in 2013, empowering the company with enhanced autonomy in decision making. With the current order book exceeding US\$ 16.2 Billion*, BHEL is poised for excellent future growth. Our ongoing major technology tie-ups include agreements with GE Technology GmbH, Switzerland (for Once through Boilers and Coal Pulverisers); Siemens, Germany (for Steam Turbines, Generators and Condensers); Metso Automation Inc., Finland (for Control & Instrumentation); MHI, Japan (for Pumps); MHPs, Japan (for Flue Gas Desulfurization Systems); Vogt Power International, USA (for HRSG); GENP, Italy (for Compressors); Turbo Lufttechnik, Germany (for Fans), Sheffield Forge Masters International, UK (for Forgings) and Kawasaki Heavy Industries Ltd., Japan (for Stainless Steel Metro Coaches & Bogies). More details about the entire range of BHEL's products and operations are available at www.bhel.com.

1.2) **High Pressure Boiler Plant (HPBP), Tiruchirappalli:**

High Pressure Boiler Plant (HPBP), established in 1965 at southern part of India at Tiruchirappalli in Tamilnadu state is one of the major manufacturing units of BHEL dedicated to production of various kinds of Steam Generators. HPBP has established itself as leading reliable boiler manufacturer with worldwide references in numerous overseas territories including Europe, Middle-East, CIS countries and South-East Asia. HPBP not only manufactures pulverized coal fired boilers but also manufactures CFBC boilers, HRSGs, valves, oil field equipment and many other products of strategic importance for defence sector. HPBP has strong global reference base of various kind of boilers ranging from 30 MWe to 800 MWe.

[*Note: Currency conversion rate considered: 1 US \$= Rs. 64.84 as on 31st March 2017



2) Scope of cooperation:

BHEL is seeking Expression of Interest from Original Equipment Manufacturers (OEMs) for License and Technology Collaboration Agreement for CFBC boilers above 150 MWe rating for thermal power plants and other applications.

Prospective collaborator shall be responsible for transferring necessary know-how & know-why to BHEL for Circulating Fluidized Bed Combustion (CFBC) boilers above 150 MWe rating.

Interested reputed OEMs with proven CFBC boiler technology are invited to submit their offer in response to this EoI, as per indicative scope of technology transfer given in Annexure-1.

Upon receipt of responses against this EoI, BHEL will review the responses to ascertain suitability of the offer and shortlist Prospective Collaborators for further discussions. Detailed discussions on commercial and other terms and conditions to finalize the Technology Collaboration Agreement (TCA) shall be held with shortlisted Prospective Collaborators. The detailed terms and conditions for such a paid-up license agreement shall be mutually agreed upon.

Business sharing option, during the initial period of technology assimilation by BHEL may also be considered.

3) Prequalification requirements (PQR):

The Prospective Collaborator shall meet following qualification requirements as on the date of submission of EoI:

- a) Prospective collaborator should have at least ten (10) years of experience in designing, engineering, manufacturing, supply, erection and commissioning of CFBC Boilers. (Prospective collaborator is required to substantiate this PQR by providing supply reference or any other relevant documentary evidence)

And

- b) Prospective Collaborator should have designed, engineered, manufactured, supplied, erected and commissioned / supervised commissioning during the last fifteen (15) years at least two (2) number of CFBC Boilers with Steam/Water cooled cyclone design firing Coal/Lignite, of which at least one (1) number of boiler having capacity of 250 MWe and above rating with supercritical parameters and at least one (1) number of sub-critical boiler having capacity of 250 MWe (>810 TPH) or above rating. Both these references i.e. supercritical & subcritical boilers should be in successful operation for a period of not less than one (1) year as on closing date of this EoI. (Prospective collaborator is required to substantiate this PQR by providing performance certificate issued by end client/customer as documentary proof)

4) Brief Description of EoI Process:

The interested Prospective Collaborator shall ensure that their response along with annexures (Broad technical capabilities of Prospective Collaborator and indicative technical features of CFBC boilers proposed for TCA as per Annexure-2, Experience in the field of CFBC boilers as per Annexure-3 and detailed product reference for major supplies in last 10 years as per Annexure-4) are received by BHEL on or before 25th January 2018. The response shall necessarily be accompanied with details on company background, product



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profile, CFBC boiler technical details, reference list of Customers, performance certificates from customers, product data sheet and annual audited financial reports for last 3 (three) years including auditor's report.

Representative data on the fuels being used for selection of CFBC boilers is provided at Annexure-5 for ready reference.

In case any further information is needed, kindly feel free to contact us.

The respondent shall submit their offer with all annexures duly signed. Your response may be sent to the following address:

General Manager (TL, JV, M&A)
Corporate Technology Management
Bharat Heavy Electricals Limited
BHEL House, Siri Fort
New Delhi - 110049, India
Phone: +91 11 66337210 / 7218
Fax: +91 11 26492974
Email: techeoi@bhel.in

5) Miscellaneous:

5.1.1 Right to accept or reject any or all Applications:

- a) Notwithstanding anything contained in this Eoi, BHEL reserves the right to accept or reject any Application and to annul the Eoi Process and reject all Applications, at any time without any liability or any obligation for such acceptance, rejection or annulment and without assigning any reasons thereof. In the event that BHEL rejects or annuls all the Applications, it may, at its discretion, invite all eligible Prospective Collaborators to submit fresh Applications.
- b) BHEL reserves the right to disqualify any Applicant during or after completion of Eoi process, if it is found there was a material misrepresentation by any such Applicant or the Applicant fails to provide, within the specified time, supplemental information sought by BHEL.
- c) BHEL reserves the right to verify all statements, information and documents submitted by the Applicant in response to the Eoi. Any such verification or lack of such verification by BHEL shall not relieve the Applicant of his obligations or liabilities hereunder nor will it affect any rights of BHEL.

5.1.2 Governing Laws & Jurisdiction:

The Eoi process shall be governed by, and construed in accordance with, the laws of India and the Courts at New Delhi (India) shall have exclusive jurisdiction over all disputes arising under, pursuant to and / or in connection with the Eoi process.



Annexure-1

Indicative Scope of Technology Transfer

a)	Transfer of up-to-date Technical Information relating to the design, engineer, manufacture, assemble, quality control, test, supply, erect, commission, repair, service and retrofit of the CFBC boiler.
b)	Training of BHEL Engineers at Collaborator's design office/manufacturing facilities to enable them design, engineer, manufacture, assemble, quality control, test, erect and commission the CFBC boiler in Thermal Power Plants and other applications.
c)	Transfer of improvements/modifications/developments/up gradations to meet market requirements and environment norms / statutory requirements during the period of TCA.
d)	Transfer of information to enable BHEL to source/procure those items, which the Prospective Collaborator sources from outside (as these are not manufactured by the Prospective Collaborator) for use in the CFBC boiler.
e)	Transfer of site feedback and troubleshooting information
f)	Transfer of applicable proprietary computer programs including logics and source code
g)	Assist BHEL in stabilising manufacturing of various critical components in CFBC boiler. Assist BHEL in identifying sub vendors for all the sub systems and bought out items.
h)	Provide technical assistance and quality surveillance /supervision during design, engineer, manufacture, assemble, quality control, test, supply, erect, commission, repair, service and retrofit of CFBC boiler.
i)	Provide support through engineering services from Collaborator's design office / manufacturing facilities for design vetting of CFBC boiler
j)	Deputation of Collaborator's experts either at BHEL's manufacturing facilities or project sites to assist BHEL in assimilating technology for CFBC boiler in Thermal Power Plants and other applications.

(SIGNATURE)

Broad technical capabilities of Prospective Collaborator and indicative technical features of
CFBC boiler proposed for TCA

Sl. No.	Description	Prospective Collaborator's response
1.	Indicate whether Prospective Collaborator has the capability to perform the following for CFBC Boilers design	
	a) Capability in preparation of complete arrangement including layout of all equipment	
	b) P&ID of the CFBC boiler	
	c) Design calculations for design and selection of CFBC system- combustor water wall, cyclone, seal pot, super heaters, reheaters, economizers, evaporator, boiler auxiliaries design, efficiency calculation.	
	d) Stress analysis and design of the various components and supports in CFBC Boiler system and also provide basic design and detailed engineering for all components to enable BHEL for in-house manufacturing, even if same is outsourced by Prospective Collaborator	
	e) Design basis and selection of various components of the CFBC Boiler along with valves, piping & instrumentation and their location	
	f) Capability in preparing specification for various Bought out Items which are required for completeness of the CFBC Boiler.	
	g) Selection of analysers, electrical equipment, control & instrumentation system (architecture and control logics) for complete CFBC Boiler	
	h) Capability in preparation of Hazard and Operability (HAZOP) study for complete CFBC boiler	
	i) Manufacturing drawings for the total CFBC Boiler	
	j) Erection procedure for complete CFBC Boiler including erection drawings	
	k) Capability in preparation of complete bill of materials for CFBC Boiler	
	l) Operation and maintenance of CFBC Boiler	
	m) Performance guarantee test procedure	

(SIGNATURE)

Annexure -3

Prospective Collaborator's Experience in the field of CFBC Boilers for Thermal Power
Plants & other applications

Sl. No.	Requirement	Prospective Collaborator's response YES/NO and remarks if any.
1)	For how many years, Prospective Collaborator is in business of CFBC boilers	
2)	Whether Prospective Collaborator has carried out CFBC Boiler system design with water cooled cyclone	
3)	Whether Prospective Collaborator has carried out CFBC Boiler system design with steam cooled cyclone	
4)	Whether Prospective Collaborator has carried out CFBC Boiler system design with mid-wall	
5)	Whether Prospective Collaborator has operating boilers of once through sub-critical type.	
6)	Whether Prospective Collaborator has operating boilers of once through super-critical type.	
7)	Whether Prospective Collaborator's once through super-critical furnace wall design includes rifled tubes or plain tubes.	
8)	Whether Prospective Collaborator has carried out CFBC Boiler system design for reheater control with gas by pass and steam by-pass control	
9)	Whether Prospective Collaborator has carried out CFBC Boiler system design for lignite, coal, peat, refuse derived fuel, petcoke, washery rejects.	
10)	Whether Prospective Collaborator has carried out CFBC Boiler system design for ASME, IBR standards	
11)	Whether the Prospective Collaborator is an original CFBC boiler designer & supplier	
12)	Whether Prospective Collaborator has proven operational Experience of CFBC Boiler, with NOx emission corresponding to 100 mg/nm ³ @6% O ₂ dry & SOx emission 100 mg/nm ³ @ 6% O ₂ dry with sulphur upto 7% in fuel. Please also indicate whether technology for SO ₂ reduction (scrubber or equivalent) downstream of CFBC boiler to reduce SOx to 100 mg/nm ³ with Sulphur up to 8% in fuel, is available with Prospective Collaborator as part of the CFBC Boiler system.	
13)	Whether Prospective Collaborator has supplied any CFBC boiler with mercury emission control/ DeNOx-SCR/SNCR system/ Duct Sorbent Injection system.	
14)	Whether Company background and its product profile along with technical details of CFBC boiler which is being offered to BHEL under this Eoi enclosed.	
15)	Whether product data sheet has been enclosed	
16)	Whether information on market share has been enclosed	
17)	Whether Prospective Collaborator's detailed reference list has been enclosed	



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18)	Whether Prospective Collaborator's annual audited financial reports including auditor's report for last 3 years has been enclosed	
19)	Whether prospective collaborator have positive net worth as per latest audited financial statements	
20)	<p><i>"Prospective collaborator should have at least ten (10) years of experience in designing, engineering, manufacturing, supply, erection and commissioning of CFBC Boilers."</i></p> <p>Whether Prospective Collaborator meets above PQR and requisite supply reference or any other relevant documentary evidence to substantiate the above PQR has been submitted.</p>	
21)	<p><i>"Prospective Collaborator should have designed, engineered, manufactured, supplied, erected and commissioned / supervised commissioning during the last fifteen (15) years at least two (2) number of CFBC Boilers with Steam/Water cooled cyclone design firing Coal/Lignite, of which at least one (1) number of boiler having capacity of 250 MWe and above rating with supercritical parameters and at least one (1) number of sub-critical boiler having capacity of 250 MWe (>810 TPH) or above rating. Both these references i.e. supercritical & subcritical boilers should be in successful operation for a period of not less than one (1) year as on closing date of this EoI."</i></p> <p>Whether Prospective Collaborator meets above PQR and requisite performance certificate issued by the end client/customer as documentary proof to substantiate the above PQR has been submitted.</p>	
22)	<p>Whether above mentioned both references of CFBC Boiler(s) i.e. supercritical & subcritical boilers have achieved an average annual Plant Load Factor of not less than 70% or Availability of not less than 85% during the aforesaid one-year period.</p> <p>If Yes, provide details thereof.</p>	
23)	<p>Whether the Prospective Collaborator owns the Intellectual Property Rights for the technology being proposed for transfer under the Technology Collaboration Agreement (TCA) or have an unencumbered right from the owner of the Intellectual Property Rights to sub-license the technology, if applicable.</p> <p>If yes, whether list of such Intellectual Property Rights enclosed.</p>	
24)	Whether the Prospective Collaborator has any experience in establishing a new manufacturing, testing and assembly facilities, if so please specify.	
25)	Prospective Collaborator shall indicate the following:	
	a) Reference CFBC Boiler firing maximum sulphur content	
	b) Reference CFBC Boiler firing maximum ash content	
	c) Reference CFBC Boiler firing with highest moisture content	
	d) Reference CFBC Boiler firing with lowest calorific value content	
	e) Reference CFBC Boiler firing with maximum desulphurization achieved by lime addition in furnace	



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26)	Whether Prospective Collaborator has confirmed their design & performance of CFBC Boiler as per the indicative fuel analysis and flue gas parameters provided in Annexure-5.	
27)	a) Prospective Collaborator shall confirm Sox emission of 100 mg/nm ³ @ 6% O ₂ dry with sulphur content of 0.6 % and calorific value of 2800 Kcal/kg (HHV) with lime stone addition only in furnace. b) Prospective Collaborator shall indicate Nox emission value in mg/nm ³ @ 6% O ₂ dry corresponding to typical Indian coal parameter (Annexure-5).	
28)	Whether Prospective Collaborator has offered technology license to any other company in the world for supply of CFBC Boilers.	
29)	Whether Prospective Collaborator has supplied supercritical CFBC Boilers of 250 MWe and above rating to the location outside the Prospective Collaborator's country of origin. If Yes, provide details thereof.	
30)	Whether Prospective Collaborator has supplied subcritical CFBC Boilers of 250 MWe and above rating to the location outside the Prospective Collaborator's country of origin. If Yes, provide details thereof.	

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Annexure -4

Reference List: The Prospective Collaborator shall furnish a summary of their product reference as detailed below for major supplies in last 10 years

Sl. No.	Customer / Country	Unit Rating MWe	No of units	Type of CFBC Boiler: Steam cooled cyclone/Water cooled cyclone/Hot cyclone	Type of CFBC Boiler: Natural Circulation/Forced circulation (Once Through)/ SC	Type of fuel	Supply type: New / Retrofit	Date of order	Commissioning Date	Steaming capacity-t/h, pressure-bar, temp°C	Availability	Fuel analysis including sulphur content and calorific value	Guaranteed Emission value in NOx, SOx, Mercury (mg/nm3 at 6% O2 dry)

(SIGNATURE)



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Annexure -5

TYPICAL FUEL ANALYSIS:

Particulars	Imported Coal 1	Imported Coal 2	Indian Coal	Lignite 1	Lignite 2	Petcoke	Washery rejects
Carbon	61.94	39.21	36.2	29.06	21.46	80.80	20.15
Hydrogen	3.75	2.47	1.70	2.35	1.42	5.00	0.57
Oxygen	8.07	9.98	6.00	12.31	7.93	3.00	1.00
Moisture	9.00	44.0	10.0	48.50	44.00	0.30	10.50
Sulphur	0.70	0.19	0.50	0.50	4.00	8.20	0.90
Nitrogen	1.54	0.44	0.60	0.28	0.61	1.70	1.88
Ash	15.0	3.71	45.0	7.00	20.58	1.00	65.00
HHV (kcal/kg)	5950	3400	3200	2800	2125	8000	1800

(SIGNATURE)