

Society for Innovation and Development (SID)
Indian Institute of Science (IISc), Bangalore, INDIA

Open Tender Notice

Tender Notification Ref No.: SID/ICER/ENQ/TNDR/PD-PK/20-21/01 Date: 4th November 2020

The *Society for Innovation and Development (SID)*, Indian Institute of Science Bangalore, invites tenders for “**Detailed Project Report (DPR) for Concentrated Solar Power (CSP) Plant with Supercritical Carbon Dioxide (s-CO₂) Power Cycle**”.

The scope of bid includes **Preparation of Detailed Project Report (DPR) for Supercritical Carbon Dioxide (s-CO₂) based power generation with external heat sources including concentrated solar thermal.**

Details of project overview will be provided by IISc to participating bidders on request.

All the bidders are requested to follow below mentioned **Detailed Scope of Work, requirements, Terms and Conditions** for submission of bids.

1 Scope of work:

1.1 Common scope of work for DPR

| Sl. no | Description |
|---------------|---|
| 1.1.1 | Project cost estimation and project implementation schedule. |
| 1.1.2 | Estimate project cost with reasonable accuracy commensurate with the project definition established at the time of final report submission. |
| 1.1.3 | Present time schedule and execution methodology for implementation of the pilot plant. |
| 1.1.4 | Roadmap for commercialization including cost estimation. |
| 1.1.5 | Identify critical equipment/components that are unique and in developmental phase along with identifying Indian partner(s) who could lead these developmental activities. If no such Indian partner exists, the DPR should list a roadmap for indigenisation, identifying potential Indian partner who has requisite expertise in similar developmental activities. |

Note : *As the subject matter of the proposed the DPR is still under developmental stage, apart from studying the technology development worldwide from the material available on public domain, it would be essential to collect information on the latest developments on the related aspects including indigenization program of critical technology towards import substitution from the Indian equipment manufacturers and other Indian organizations working in these areas.*

The scope of work in the DPR has been divided into 3 parts, the details of each are as mentioned below:

1.2 DPR Part 1: s-CO₂ based power generation using concentrated solar heat

| Sl. no | Work description |
|---------|--|
| 1.2.1 | Study the present status of Concentrating Solar Power (CSP) technology in combination with s-CO ₂ based power cycle worldwide |
| 1.2.1.a | <i>Evaluate central receiver tower technology with s-CO₂ based power cycle.</i> |
| 1.2.1.b | <i>Establish the optimal capacity of the power plant for the Indian market considering present status of commercially established technologies, investment and life cycle cost.</i> |
| 1.2.1.c | <i>Study the progress of CSP technology in combination with s-CO₂ based power cycle in the years ahead based on current research & development as gathered from literature survey and information available in the public domain; and prepare a road map for its adoption on a commercial scale for captive and utility power in India.</i> |
| 1.2.1.d | <i>Identify critical equipment/component , viz., turbine, compressor, power tower receiver, energy storage device, suitability of heat transfer medium/ fluid, and heat exchanger; and prepare a technology road map for its adoption on a commercial scale CSP in India.</i> |
| 1.2.2 | Identify critical equipment/components and their current status of development |
| 1.2.2.a | <i>Present a road map for their adoption into the pilot plant as the technology of individual equipment/component matures.</i> |

1.3 DPR Part 2: s-CO₂ based power generation using waste heat

| Sl. No. | Work Description |
|--|--|
| 1.3.1 | Study the present status of s-CO ₂ based power cycle using waste heat |
| 1.3.1.a | <i>Develop preliminary design and schemes for the s-CO₂ power generation as bottoming cycle for a gas turbine power plant, similar capacity as in DPR Part 1.</i> |
| 1.3.1.b | <i>Listing of major gas turbine models that will support bottoming power cycle of similar capacity as in DPR Part 1.</i> |
| 1.3.1.c | <i>Develop preliminary design and schemes for the s-CO₂ power generation using industrial waste heat from process plants, such as cement, steel, and fertilizer plants. The capacity will be similar to that of DPR Part 1.</i> |
| <p>Note : The capacity of the bottoming cycle for the purpose of the study would be in the MW level. With regard to item 1.3.1.a, this part of the DPR will cover the bottoming cycle part only i.e., starting from gas turbine exhaust waste heat recovery boiler to power generation in bottoming cycle up to power evacuation. The study will not cover the topping cycle part i.e., gas turbine and related power generation/evacuation. With regard to item 1.3.1.c, this part of the DPR will cover only the waste heat recovery heat exchanger and associated to power generation in bottoming cycle up to power evacuation.</p> | |

1.4 DPR Part 3: s-CO₂ based power generation using external heat source

| Sl. no | Work Description |
|---|--|
| 1.4.1 | Study the progress of s-CO ₂ based power cycle in the years ahead based on current research & development, information as gathered from OEMs and R&D organizations. The critical equipment/component, viz., turbine, compressor, suitability of heat transfer medium/ fluid, and heat exchanger; and prepare a technology road map for its adoption on a commercial scale for captive and utility power in India. |
| 1.4.2 | Develop preliminary design and schemes for the s-CO ₂ power cycle with external heat source such as natural gas. |
| Note: The criteria for determining capacity of the s-CO ₂ power cycle will be its scalability for further development towards commercial operation. The capacity will be similar to that of DPR Part 1. | |

2 Division of Responsibility (DOR)

| Sl. no | Activities | Division of Responsibility | |
|--------|---|----------------------------|-------------|
| | | IISc | Consultant |
| 2.1 | Arrangement of data for DPRs | Consult | Responsible |
| 2.2 | Solar energy yield & power cycle heat balance calculations | Consult | Responsible |
| 2.3 | Technology roadmap/ design assessment of power tower receiver, energy storage, HTF, s-CO ₂ heat exchanger, s-CO ₂ turbine, s-CO ₂ compressor | Review / Consult | Responsible |
| 2.4 | s-CO ₂ cycle – design consideration | Responsible | Review |
| 2.5 | Plant configuration | Review | Responsible |
| 2.6 | Environmental and safety consideration | Consult | Responsible |
| 2.7 | Material selection consideration | Consult | Responsible |
| 2.8 | Plant arrangement & layouts | Consult | Responsible |
| 2.9 | Technical specifications & diagrams | Consult | Responsible |
| 2.10 | Project timelines and cost estimate | - | Responsible |
| 2.11 | Techno-economic analysis | - | Responsible |
| 2.12 | Report preparation | Review | Responsible |

3 Report preparation

| Sl. no | Description |
|--------|--|
| 3.1 | The reports will be prepared covering all the aspects mentioned in Section 1. |
| 3.2 | Preparation of 3 parts of the DPR are in the scope of the Consultant, it may be required to combine these parts into one DPR. |
| 3.3 | As required and desired by IISc, Consultant would be required to participate in meetings with IISc in the course of the DPR preparation and also revise the draft DPR till its acceptance by IISc. |
| 3.4 | Consultant may be required to undertake travel for preparation of DPR. For such travels, the cost should be borne by the Consultant. |

4 Methodology of DPR preparation

| Sl. no | Description |
|--------|---|
| 4.1 | The Consultant should describe in detail the approach and methodology to be followed in preparing the DPR and shall submit a typical content sheet of the proposed DPR. |
| 4.2 | <p>The methodology should cover various tasks to be performed in preparing the DPR to meet its stated goal including but not limited to</p> <ul style="list-style-type: none">• Site selection• Project justification• Technology selection• Material selection criteria• Systems & equipment description• Layout preparation• Indigenization of critical technology for equipment/components• Cost/tariff estimation for pilot plant with break up under major cost heads and financial analysis• Roadmap for commercialization including cost and tariff estimation for commercial level plant. |

5 Deliverables

| Sl. no | Description |
|--------|--|
| 5.1 | Detailed Project Report for a scalable MW level Supercritical Carbon Dioxide (s-CO ₂) Power Cycle with Concentrated Solar Power (CSP) as heat source. |
| 5.2 | Detailed Project Report for a scalable MW level Supercritical Carbon Dioxide (s-CO ₂) Power Cycle based plant used as bottoming cycle for combined cycle application, and using industrial waste heat. |
| 5.3 | Detailed Project Report for a scalable MW level Supercritical Carbon Dioxide (s-CO ₂) Power Cycle based plant with gas/oil fired boiler as heat source. |

6 Timelines

| Sl. no | Description |
|--------|--|
| 6.1 | <i>Complete DPR within three months from the date of release of purchase order.</i> |
| 6.2 | <i>The submitted report will be subject to revision by the Consultant, based on review comments given by IISc.</i> |

7 Mandatory requirements:

- a) The bidders must enclose a client list, contact details, relevant brochures and compliance certificate (Annexure I) with the tender.
- b) The bidders should be well established firm preferably leaders in the application stated above and must have a proven track record.
- c) The Consultant should be a registered/incorporated firm in India, with at least 15 years of existence in the field of power sector.
- d) Annual turnover of minimum Rs.500 crore in each of the last three financial years i.e. FY 2016-17, 2017-18, and 2018-19 or FY 2017-18, 2018-19 and 2019-20.
- e) Should not be blacklisted by any Central / State Government / Local Government/ Public Sector Undertaking in India.
- f) The agency/firm should have prepared at least one Feasibility report or Detailed Project report for a megawatt level (1MWe or above) concentrated solar thermal based power plant.
- g) The agency/firm should have engineered at least one Megawatt level concentrated solar thermal based power plant (1MWe or above) which is successfully commissioned prior to submission of this proposal.
- h) The agency/firm should have prepared at least one Feasibility report or Detailed Project report for a megawatt level (1MWe or above) s-CO₂ based power cycle.

OR

The agency/firm should have carried out at least one detail engineering or concept design for a megawatt level (1MWe or above) s-CO₂ based power cycle.

8 Indemnity and Other Terms

The agency/firm selected shall be responsible for its own acts and/or omissions and those of its Officers, employees, and agents during DPR execution. The selected agency/firm shall fully indemnify and hold IISc-SID harmless against all claims arising out of agency/firm work done under this. All Intellectual Property or products that result in whole or in part by the selected partner for the DPR Work will belong to IISc.

9 Technical evaluation

| Sl. No. | Qualification Criteria |
|---------|--|
| 9.1 | Consultant's experience in preparing feasibility report or detailed project report for Megawatt level Concentrated Solar Plant (CSP) based power plant |
| 9.2 | Consultant's experience in engineering megawatt level Concentrated Solar Plant (CSP) based power plant |
| 9.3 | Consultant's experience in preparing feasibility report / detailed project report for Megawatt level s-CO ₂ based power plant. |
| 9.4 | Consultant's experience in carrying out detail engineering/ concept design of Megawatt level s-CO ₂ based power plant. |
| 9.5 | Approach, Methodology and Work Plan for Performing the Assignment |
| 9.6 | Overall design and engineering experience of Consultant in solar and thermal power plants |
| 9.7 | Resume(s) of the team of Executives who shall work on the assignment |

Note: The Bidders shall provide all documentary evidences in respect of the qualifications; and have performed such Consultancy work for the external client(s). Any additional documents that IISc considers required for the evaluation, the same will be intimated by IISc to Bidders for submission.

10 Selection criteria

Evaluation will be based on the technical qualification. Commercial bids of only those technically qualified bidders will be considered.

TERMS AND CONDITIONS FOR SUBMISSION OF BIDS

Both the Technical and Commercial bids should be put in separate sealed envelopes and both the envelopes should be put in another cover subscribing **“Preparation of Detailed Project Reports (DPRs) for a scalable Megawatt level Supercritical Carbon Dioxide (s-CO₂) Power Cycle with Concentrated Solar Power (CSP) as heat source”** and should reach *“The Chief Executive, Society for Innovation and Development (SID) , IISc, Bangalore-560012* on or before **Monday, 24th November 2020**.

1. No sub-contracting is permitted for the tender as a whole. The Consultant shall not bid on behalf of another agency/consultant. The Consultant shall provide an undertaking to this effect, as part of the technical bid.
2. The Technical bid must include all the details of earlier prepared technical DPR, compliance certificate along with commercial terms and conditions, **however, without the price component.**
3. The commercial bid must include the price of the item(s) in INR currency indicating the breakup of
 - a) Detailed price breakup without the tax components. The payment terms should be clearly indicated in the commercial bid. Advance payments will be made to the Consultant against issue of Bank Guarantee for 100 % of the payment requested.
 - b) Only GST of 18% (or tax prevailing at the time of invoicing) will be paid by IISc, Bangalore. The payment will be made in INR only to the Consultant to whom contract is awarded and purchase order is released. No separate payments will be made to any of the subcontractors the agency may hire for part of the work.
 - c) 30% of the DPR charges to the bidding agency will be paid only after satisfactory review by IISc.
4. Conditional tenders shall not be accepted.
5. Bids shall remain valid for minimum of 30 days after the date of bid opening prescribed by the Purchaser.
6. IISc Bangalore reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to award of Contract, without thereby incurring any liability to the affected Bidder or Bidders.

Annexure-I

Note: Compliance Certificate must be enclosed with the technical bid according to the format given below. *This is a mandatory requirement, without which the technical bid will be disqualified.*

1 Scope of work:

1.1 Common scope of work for all DPRs

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|--------|---|--------|------------|-----------|---------|
| 1.1.1 | Project cost estimation and project implementation schedule. | | | | |
| 1.1.2 | Estimate project cost with reasonable accuracy commensurate with the project definition established at the time of final report submission. | | | | |
| 1.1.3 | Present time schedule and execution methodology for implementation of the pilot plant. | | | | |
| 1.1.4 | Roadmap for commercialization including cost estimation. | | | | |
| 1.1.5 | Identify critical equipment/components that are unique and in developmental phase along with identifying Indian partner(s) who could lead these developmental activities. If no such Indian partner exists, the DPR should list a roadmap for indigenisation, identifying potential Indian partner who has requisite expertise in similar developmental activities. | | | | |

1.2 DPR Part 1:

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|---------|--|--------|------------|-----------|---------|
| 1.2.1 | Study the present status of Concentrating Solar Power (CSP) technology in combination with s-CO ₂ based power cycle worldwide | | | | |
| 1.2.1.a | <i>Evaluate central receiver tower technology with s-CO₂ based power cycle.</i> | | | | |
| 1.2.1.b | <i>Establish the optimal capacity of the power plant for the Indian market considering present status of commercially established technologies, investment and life cycle cost.</i> | | | | |
| 1.2.1.c | <i>Study the progress of CSP technology in combination with s-CO₂ based power cycle in the years ahead based on current research & development as gathered from literature survey and information available in the public domain; and prepare a road map for its adoption on a commercial scale for captive and utility power in India.</i> | | | | |
| 1.2.1.d | <i>Identify critical equipment/component , viz., turbine, compressor, power tower receiver, energy storage device,</i> | | | | |

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|---------|---|--|--|--|--|
| | <i>suitability of heat transfer medium/ fluid, and heat exchanger; and prepare a technology road map for its adoption on a commercial scale CSP in India.</i> | | | | |
| 1.2.2 | Identify critical equipment/components and their current status of development | | | | |
| 1.2.2.a | <i>Present a road map for their adoption into the pilot plant as the technology of individual equipment/component matures.</i> | | | | |

1.3 DPR Part 2:

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|---------|--|--------|------------|-----------|---------|
| 1.3.1 | Study the present status of s-CO ₂ based power cycle using waste heat | | | | |
| 1.3.1.a | <i>Develop preliminary design and schemes for the s-CO₂ power generation as bottoming cycle for a gas turbine power plant, similar capacity as in DPR Part 1.</i> | | | | |
| 1.3.1.b | <i>Listing of major gas turbine models that will support bottoming power cycle of similar</i> | | | | |

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| | <i>capacity as in DPR Part 1.</i> | | | | |
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1.4 DPR Part 3:

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|--------|---|--------|------------|-----------|---------|
| 1.4.1 | Study the progress of s-CO ₂ based power cycle in the years ahead based on current research & development, information as gathered from OEMs and R&D organizations. The critical equipment/component , viz., turbine, compressor, suitability of heat transfer medium/ fluid, and heat exchanger; and prepare a technology road map for its adoption on a commercial scale for captive and utility power in India. | | | | |
| 1.4.2 | Develop preliminary design and schemes for the s-CO ₂ power cycle with external heat source such as natural gas. | | | | |

2 Division of Responsibility (DOR)

| Sl. no | Activities | Division of Responsibility | | Comply | Non-Comply | Deviation | Remarks |
|--------|---|----------------------------|-------------|--------|------------|-----------|---------|
| | | IISc | Consultant | | | | |
| 2.1 | Arrangement of data for DPR | Consult | Responsible | | | | |
| 2.2 | Solar energy yield & power cycle heat balance calculations | Consult | Responsible | | | | |
| 2.3 | Technology roadmap/ design assessment of power tower receiver, energy storage, HTF, s-CO ₂ heat exchanger, s-CO ₂ turbine, s-CO ₂ compressor | Review / Consult | Responsible | | | | |
| 2.4 | s-CO ₂ cycle – design consideration | Responsible | Review | | | | |
| 2.5 | Plant configuration | Review | Responsible | | | | |
| 2.6 | Environmental and safety consideration | Consult | Responsible | | | | |
| 2.7 | Material selection consideration | Consult | Responsible | | | | |
| 2.8 | Plant arrangement & layouts | Consult | Responsible | | | | |
| 2.9 | Technical specifications & diagrams | Consult | Responsible | | | | |

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|------|-----------------------|--------|-------------|--|--|--|--|
| 2.10 | Project cost estimate | - | Responsible | | | | |
| 2.11 | Financial analysis | - | Responsible | | | | |
| 2.12 | Report preparation | Review | Responsible | | | | |

3 Report preparation

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|--------|---|--------|------------|-----------|---------|
| 3.1 | The reports will be prepared covering all the aspects mentioned in sections 1 and 2 of this tender document. | | | | |
| 3.2 | Preparation of 3 parts of the DPR are in the scope of Consultant, it may be required to combine these three parts into one DPR. | | | | |
| 3.3 | As required and desired by IISc, Consultant would be required to participate in meetings with IISc and stakeholders within India in the course of DPR preparation and also revision of the submitted DPR till its acceptance by IISc. | | | | |

4 Methodology of DPR preparation

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|--------|---|--------|------------|-----------|---------|
| 4.1 | Consultant should describe in detail the approach and methodology to be | | | | |

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|-----|---|--|--|--|--|
| | followed in preparing the DPR and shall submit a typical content sheet of the proposed DPR. | | | | |
| 4.2 | <p>The methodology should cover various tasks to be performed in preparing the DPR to meet its stated goal including but not limited to</p> <ul style="list-style-type: none"> • Site selection • Project justification • Technology selection • Material selection criteria • Systems & equipment description • Layout preparation • Indigenization of critical technology for equipment/components • Cost/tariff estimation for pilot plant with break up under major cost heads and financial analysis • Roadmap for commercialization including cost and tariff estimation for commercial level plant. | | | | |

5 Deliverables

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|--------|---|--------|------------|-----------|---------|
| 5.1 | Detailed Project Report for a scalable MW level Supercritical Carbon Dioxide (s-CO ₂) Power Cycle with Concentrated Solar Power (CSP) as heat source. | | | | |
| 5.2 | Detailed Project Report for a scalable MW level Supercritical Carbon Dioxide (s-CO ₂) Power Cycle based plant used | | | | |

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|-----|---|--|--|--|--|
| | as bottoming cycle for combined cycle application, and using industrial waste heat. | | | | |
| 5.3 | Detailed Project Report for a scalable MW level Supercritical Carbon Dioxide (s-CO ₂) Power Cycle based plant with gas/oil fired boiler as heat source. | | | | |

6 Timelines

| Sl. no | Description | Comply | Non-Comply | Deviation | Remarks |
|--------|--|--------|------------|-----------|---------|
| 6.1 | <i>Complete DPR within three months from the date of release of purchase order.</i> | | | | |
| 6.2 | <i>The submitted report will be subject to revision by the Consultant, based on review comments given by IISc.</i> | | | | |
| 6.3 | <i>Consultant shall submit a bar chart covering major milestone activities from commencement to the submission of final DPR.</i> | | | | |