



भारत सरकार / Government of India  
अंतरिक्ष विभाग / Department of Space  
यू.आर. राव उपग्रह केंद्र / U.R.RAO SATELLITE CENTRE  
एच.ए.एल. एयरपोर्ट रोड, विमानापुра डाक / HAL Airport Road, Vimanapura Post,  
बेंगलूरु/ BENGALURU – 560 017

संदर्भ सं. /Ref No.: URSC/PUR/EOI-01//SPD/RTEG/2020-21

28.01.2021

अभिकल्प तथा माडलिंग; अनुकरण तथा विश्लेषण; रेडियो आईसोटोप रहित 100W रेडियो  
आइसोटोप तापवैद्युत जनित्र (आर.टी.ई.जी) के परीक्षण तथा अर्हता हेतु इच्छा की अभिव्यक्ति करने के  
लिए आमंत्रण [ई.ओ.आई]

Invitation for Expression of Interest [Eoi]

for design, and modelling; simulation, and analysis; testing, and qualification of  
100W Radio Isotope Thermoelectric Generator (RTEG) without Radio Isotope

यू.आर. राव उपग्रह केंद्र (यू.आर.एस.सी.), (पूर्व इसरो उपग्रह केंद्र) भारतीय उपग्रहों की अभिकल्पना, विकास, संविरचन और परीक्षण के लिए, भारत सरकार के अंतरिक्ष विभाग के तहत भारतीय अंतरिक्ष अनुसंधान संगठन (इसरो) का अग्रणी केंद्र है। इसके अनुक्रम में अंतरिक्षयान की प्राप्ति के अधिदेश में, यह केंद्र उपग्रह निर्माण की गतिविधियों तथा तत्संबंधी अत्याधुनिक तकनीकी के विकास और अंतरिक्षयान के अभिकल्प, विकास, संविरचन और परीक्षण के अवसंरचना की स्थापना में कार्यरत है।

U.R. Rao Satellite Centre [URSC] (Formerly known as ISRO Satellite Centre), of Indian Space Research Organization [ISRO] under Department of Space, Government of India is the lead Centre of ISRO for Design, Development, Fabrication and Testing of all Indian made Satellites. As a sequel to its mandate of spacecraft realisation, the Centre is engaged in the development of cutting-edge technologies of relevance to its Satellite Building Activities and setting up of infrastructure for Design, Development, Fabrication and Testing of Spacecraft.

100W (विद्युत आऊटपुट ऊर्जा) रेडियो आईसोटोप ताप विद्युत जनित्र (आर.टी.ई.जी), के तीन चरण विकास हेतु इच्छा को अभिव्यक्त करने का प्रस्ताव है। **चरण-1** में अभिकल्प, मॉडलिंग, अनुकरण व विश्लेषण, **चरण-2** में विकास तथा संविरचन है, **चरण-3** में रेडियो आईसोटोप ताप विद्युत जनित्र (आर.टी.ई.जी) के परीक्षण तथा अर्हता संबंधी क्रियाकलाप हैं। अनुकरण व विश्लेषण में विद्युत, ऊष्मीय तथा संरचनात्मक विश्लेषण (तक ही नहीं सीमित) होना चाहिए। विकास ऊर्जा जनन तथा ऊष्मीय प्रबंधन हेतु इसे इसरो के गहन अंतरिक्ष में शामिल करने के विचारार्थ आर.टी.ई.जी का विकास किया जाता है।

The proposal is to invite Expression of Interest for Three Phase development of 100W (Electrical output power) Radio Isotope Thermo Electric Generator (RTEG). Phase 1 consists of activities to carryout *Design, Modelling, Simulation & Analysis* in **Phase-1**, Phase 2-*Development* and *fabrication* in **Phase-2**, and Phase-3 consists of *Testing and qualification* of Radio Isotope Thermo Electric Generator (RTEG) in **Phase-3**. The simulation & analysis must include (but not limited to) Electrical, Thermal and Structural analysis. The development of RTEG is taken up as it is envisaged that it will be a part of ISRO's deep space missions for power generation and thermal management.

पर्याप्त ज्ञान, अनुभव/सुविज्ञता तथा मजबूत वित्तीय पृष्ठभूमिवाले ठोस संस्थापनाओं से रेडियो आईसोटॉप के बिना 100W रेडियो आईसोटॉप ताप विद्युत जनित्र (आर.टी.ई.जी) के तीन-चरण विकास के लिए अपनी इच्छा अभिव्यक्त करने हेतु आमंत्रित किया जाता है।

Potential Establishment(s) having sufficient know-how, experience/expertise and sound financial background are invited to express their interest for the three-phase development of 100W Radio Isotope Thermo Electric Generator (RTEG) without Radio Isotope.

ई.ओ.आई दस्तावेजों को हमारे वेबसाइट [www.isro.gov.in](http://www.isro.gov.in) से डाऊनलोड किया जा सकता है।

Eol documents can be downloaded from our website [www.isro.gov.in](http://www.isro.gov.in)

ई.ओ.आई को तकनीकी पैरामीटर के अनुपालन के आधार पर मूल्यांकन किया जाएगा: फार्म A, B व ई.ओ.आई दस्तावेज संख्या के अनुबंध-I, तकनीकी सुविज्ञता, फर्मों की वित्तीय सुदृढता।

The Eol will be evaluated on the basis of Compliance to the Technical Parameters; Compliance towards Form A, B & Annexure-I of Eol document No., Technical Expertise, Financial soundness of the Firm[s].

आवश्यकता पडने पर ई.ओ.आई की प्रक्रिया को रद्द करने / पुनः जारी करने के अधिकार को यू.आर.एस.सी आरक्षित रखता है।

URSC reserves the right to cancel/re-issue the process of Eol if the necessity so arises or to seek further information/details.

कंपनी/फर्म, यदि किसी भ्रष्टाचार या कपटपूर्ण प्रथाओं में भाग लेने के बारे में यदि पाया जाए तो उन्हें निविदा प्रस्तुत करने की प्रक्रिया से बहिष्कृत किया जाएगा और उनके ई.ओ.आई दस्तावेज पर विचार नहीं किया जाएगा।

Companies/Firms, if found to have indulged in any corrupt or fraudulent practices, will be debarred taking part in the Tendering process and their Eol Document will not be taken up for consideration.

#### **पूर्व-ई.ओ.आई. बैठक:**

अपेक्षाओं की सही जानकारी पाने हेतु एक वर्चुअल पूर्व-ई.ओ.आई बैठक का आयोजन करने का प्रस्ताव है। इच्छुक पार्टी जो संपर्क व्यक्ति के साथ ई-मेल पते द्वारा बहुत पहले प्रत्युत्तर करते हैं को पूर्व-ई.ओ.आई के दो दिन पहले बैठक का लिंक दिया जाएगा।

#### **Pre-Eol Meeting:**

It is proposed to conduct a Virtual Pre-Eol meeting for better understanding of the requirement.

A link for the meeting will be shared with interested parties that respond to the focal point with their email addresses well in advance two days before the Pre-Eol Meeting.

इच्छा की अभिव्यक्ति हेतु पूर्व-ई.ओ.आई सम्मेलन/बैठक में भाग नहीं लेनेवाले कंपनी/फर्मों पर विचार नहीं किया जाएगा।

THE COMPANIES/FIRMS WHO DO NOT PARTICIPATE IN THE PRE-Eol CONFERENCE/MEETING FOR EXPRESSION OF INTEREST, SUCH COMPANIES/FIRMS WILL NOT BE CONSIDERED.

इच्छुक विक्रेता(ओं) से एतद्वारा अनुरोध किया जाता है कि नीचे उल्लिखित दिनांक, समय और स्थान पर पूर्व ई.ओ.आई. बैठक में भाग लें: -

The interested Vendor[s] are hereby requested to take part in the Pre-Eol meeting on the Date, Time and Venue mentioned here below: -

पूर्व ई.ओ.आई. बैठक की तारीख Date of Pre-Eol Meeting	:	18.02.2021
समय / Time	:	10:00 AM
स्थान / Venue	:	इंटरनेट द्वारा ऑनलाइन बैठक (दो दिन पहले लिंक को दिया जाएगा।) यू.आर.राव उपग्रह केंद्र, बेंगलूरु -560017 Online Meeting through Internet (Link will be shared two days in advance) URSC, Bangalore-560017
पर्क व्यक्ति Focal Point	:	<p>1. श्री नितीश कुमार यू.आर. राव उपग्रह केंद्र, एच.ए.एल. एयरपोर्ट रोड, विमानपुरा डाक बेंगलूरु- 560 017 संपर्क सं. 080 2508 3724 Shri. Nitishkumar U.R.RAO Satellite Centre HAL Airport Road, Vimanapura Post Bengaluru-560017 Contact No. 080 2508 3724 ई.मेल: <a href="mailto:nitish@ursc.gov.in">nitish@ursc.gov.in</a></p> <p>2. प्रधान, क्रय व भंडार यू.आर. राव उपग्रह केंद्र एच.ए.एल. एयरपोर्ट रोड, विमानपुरा डाक बेंगलूरु- 560 017 संपर्क सं. 080 2508 4002 ई.मेल: <a href="mailto:hpsc@ursc.gov.in">hpsc@ursc.gov.in</a> Head Purchase and Stores U.R.RAO Satellite Centre HAL Airport Road, Vimanapura Post Bengaluru-560017 Contact No. 080 2508 4002 Email : <a href="mailto:hpsc@ursc.gov.in">hpsc@ursc.gov.in</a></p> <p>3. श्री विजेश कुमार वी.एल (क्रय) यू.आर. राव उपग्रह केंद्र एच.ए.एल. एयरपोर्ट रोड, विमानपुरा डाक बेंगलूरु- 560 017 संपर्क सं. 080 2508 4027 Shri. Vijesh Kumar VL (Purchase) U.R.RAO Satellite Centre HAL Airport Road, Vimanapura Post Bengaluru-560017 Contact No. 080 2508 4027 Email: <a href="mailto:vijeshkv@ursc.gov.in">vijeshkv@ursc.gov.in</a></p>

इच्छुक विक्रेता, इच्छा की अभिव्यक्ति हेतु पूर्व ई.ओ.आई सम्मेलन में भाग लेनेवाले अपनी प्रतिनिधि के विवरण को कृपया पहले ही भेजें।

कृपया यह नोट करें कि पूर्व-ई.ओ.आई बैठक के पूर्वन/स्थागन के अनुरोध पर, किसी भी परिस्थिति में विचार नहीं किया जाएगा।

Interested Vendor[s] may please provide the details of their Representative[s] taking part in the Pre-EoI Conference for Expression of Interest well in advance

Please note that request for “preponement/postponement of Pre-EoI meeting” will not be entertained under any circumstances.

“इच्छा की अभिव्यक्ति” के साथ विक्रेताओं को आवश्यक है कि निम्नलिखित सूचना को विस्तृत रूप में उपलब्ध कराएँ:

Along with “Expression of Interest” Suppliers/ Firm[s] should furnish the following information also in detail:

1.कंपनी के पंजीकृत पते के साथ फोन, फैक्स, ई-मेल, वेब विवरण आदि

Registered address of the Companies with Phone, Fax, Email, Web etc

2.कंपनी/संगठन की स्थिति (स्वामित्व/भागीदारी/निजी/लोक लि. आदि) बोर्ड के निदेशक आदि के नाम व पता

Company/Organization Status (Proprietary/Partnership/Private/Public Ltd. etc.) with

Name and Address of Proprietor, Partners, Board of Directors, etc

3.सहयोगी: (क) भारतीय (ख) विदेशी

Associates: (a) Indian (b) Foreign

4.पिछले तीन सालों में प्रमुख उपभोक्ताओं की सूची के साथ पूरा पता और उनके संपर्क व्यक्ति

List of Major Customers during the last 3 Years with full address and their Contact Persons

5.अवसंरचना सुविधा का स्वामित्व / उपलब्धता के ब्यौरे

Details of Infrastructure Facilities owned / available

6.कंपनी के मुख्य शेयरधारी के नाम तथा पता और उनके शेयर पूँजी की प्रतिशत

Names and addresses of the major Shareholders of the Company and the percentage of their share capital

7.नवीनतम वार्षिक रिपोर्ट की प्रति के साथ पिछले तीन सालों की पूँजी और कुलबिक्री

Capital and Turnover for the preceding 3 Financial Years with copy of latest Annual Report

8.उपलब्ध वित्तीय क्षमता/ ऋण सुविधाएँ

Financial Capacity/Credit facilities available

9.विक्रेता के बैंकरों के नाम और पता

Name and Address of Bankers

10.व्यापार संघ जिससे उद्योग संबंध रखते हैं

Trade Association to which Industry/ies belong to

11. स्थापना / जी एस टी पंजीकरण संख्या  
Establishment / GST Registration Number
12. व्यवसाय का प्रकार  
Nature of Business
13. अपने बैंकरों द्वारा जारी की गई फर्म की शोधन क्षमता / वित्तीय योग्यता  
Solvency/Financial capacity of the Firm issued by their Bankers
14. कोई अन्य सूचना जो उद्योग संगत समझें  
Any other information the Industry/ies consider relevant
15. अपने सामर्थ्य और कर्मियों के क्षेत्रों का स्पष्टतः उल्लेख करते हुए कंपनियों के प्रोफाइल  
The Profile of the Company/ies clearly bringing out the areas of Strength and Weaknesses
16. ई.ओ.आई में भाग लेने हेतु स्व-मूल्यांकन, तकनीकी और संगठनात्मक क्षमता  
Self-Assessment of Technical and Organizational Competence to take part in the Eol

**ई.ओ. आई. प्रतिक्रिया का समापन / Completion of the Eol Response:**

क) कंपनी / फर्मों को सलाह दी जाती है कि वे ई.ओ.आई. दस्तावेजों में निहित सभी अनुदेश; नियम व शर्तें; फार्म्स; आवश्यकताएं तथा अन्य सूचनाओं को ध्यानपूर्वक पढ़ें। ऐसा माना जाता है कि ई.ओ.आई की प्रस्तुति को उसके आशय को पूरी तरह समझने के साथ ई.ओ.आई दस्तावेजों के ध्यानपूर्वक अध्ययन तथा परीक्षा के उपरांत ही किया गया है।

The Company/Firms are advised to study all the instructions; Terms and Conditions; Forms; Requirements and other information in the Eol documents carefully. The submission of Eol shall be deemed to have been done after a careful study and examination of the Eol documents with full understanding of its implications.

ख) इस ई.ओ.आई के लिए प्रतिक्रिया, संपूर्ण तथा सभी पहलुओं में परिपूर्ण होना चाहिए। ई.ओ.आई .दस्तावेज द्वारा आवश्यक सूचनाओं को न प्रस्तुत करने या सभी तरह से ई.ओ.आई .दस्तावेजों को पूरी तरह प्रतिक्रियात्मक न होते हुए प्रस्तुत करना कंपनी/फर्मा के जोखिम पर होगा तथा इससे दस्तावेज की अस्वीकृति भी हो सकती है।

The response to this Eol should be full and complete in all respect. Failure to furnish all the information required by the Eol document or submission of proposal not substantially responsive to the Eol documents to every respect will be at the risk of the Company/Firms and may result in rejection of the document.

ग) प्रस्तुत ई.ओ.आई के सभी पृष्ठों को संख्यान्वित करना है तथा प्राधिकृत हस्ताक्षरी द्वारा हस्ताक्षरित होना है।  
All the pages of the Eol submitted must be numbered and signed by the authorized signatory.

घ) ई.ओ.आई के संबंध में प्रचार करना सख्त मना है तथा एजेंसी द्वारा प्रस्तुत ऐसे प्रचारित ई.ओ.आई की अस्वीकृति की जा सकती है।

Canvassing in connection with the Eol be strictly prohibited and such canvassed Eol submitted by the Agency are liable to be rejected.

उपरोक्त सभी सूचना सहित "इच्छा की अभिव्यक्ति" अधोहस्ताक्षरी को उपरोक्त संदर्भ संख्या को उद्धृत करते हुए निर्धारित दिनांक व समय पर पहुँचना चाहिए।

"Expression of Interest" with all the above information shall reach the undersigned, quoting the above Reference Number on or before the due date & time.

ई.ओ.आई प्रस्तुति की अंतिम तिथि

Last date for submission of Eol : 23.03.2021 at 14.00 बजे / Hours IST

ई.ओ.आई. खोलने की तिथि व समय

Eol Opening date and time : 23.03.2021 at 15.00 बजे / Hours IST

उपरोक्त सभी सूचना सहित इच्छा की अभिव्यक्ति, अधोहस्ताक्षरी को उपरोक्त संदर्भ संख्या को उद्धृत करते हुए 23.03.2021 के पहले पहुँचना चाहिए। इस प्रस्ताव को पूर्व- ई.ओ.आई अर्हता के रूप में पहल किया गया है। बिना कारण बताएँ इच्छा की अभिव्यक्ति को स्वीकार या अस्वीकार करने का अधिकार यू.आर.एस.सी. आरक्षित रखता है।

"Expression of Interest" with all the above information shall reach the undersigned, quoting above Reference Number on or before 23/03/2021. This proposal is initiated as a Pre-Eol Qualification. URSC reserves the right to accept or reject all or any such "Expression of Interest" without assigning any reasons what so ever.

Sd/-

**व प्रधान, क्रय व भंडार/SR.HEAD, PURCHASE & STORES**

**Government of India, Department of Space  
UR RAO Satellite Centre [ URSC ]  
Formerly ISRO Satellite Centre [ISAC]  
HAL Airport Road, Vimanapura Post,  
Bengaluru – 560 017**

*No:*

**Invitation for Expression of Interest [EoI] for  
design, and modelling; simulation, and  
analysis; testing, and qualification of 100W  
Radio Isotope Thermoelectric Generator  
(RTEG)**

**2020**



<b>SL. No</b>	<b>CONTENTS</b>	<b>Page No.</b>
<b>1.</b>	<b>MODUS OPERANDI</b>	<b>03</b>
<b>2.</b>	<b>Eol OBJECTIVE</b>	<b>05</b>
<b>3.</b>	<b>INTRODUCTION TO SATELLITE SUBSYSTEMS</b>	<b>05</b>
<b>4.</b>	<b>INTRODUCTION TO RADIOISOTOPE THERMOELECTRIC GENETRATOR (RTG)</b>	<b>05</b>
<b>5.</b>	<b>DESCRIPTION&amp; SCOPE OF WORK</b>	<b>05</b>
<b>6.</b>	<b>PROCEDURE FOR FINALISING CONTRACT</b>	<b>07</b>
<b>7.</b>	<b>TERMS AND CONDITIONS:</b>	<b>07</b>
<b>7. 1</b>	<b>Terms and Conditions: Finance</b>	<b>07</b>
<b>7. 2</b>	<b>Terms &amp; Conditions: Organisation Portfolio</b>	<b>07</b>
<b>7. 3</b>	<b>Terms &amp; Conditions: General</b>	<b>08</b>
<b>8.</b>	<b>Eol RESPONSE FORMAT</b>	<b>09</b>
<b>8. 1</b>	<b>General Details of the Vendor</b>	<b>12</b>
<b>8. 2</b>	<b>Mandatory Supporting Documents</b>	<b>13</b>
<b>8. 3</b>	<b>Form A' Compliance Matrix Table</b>	<b>14</b>
<b>8. 4</b>	<b>Form 'B' Compliance Matrix Table</b>	<b>15</b>
<b>8. 6</b>	<b>Eol Response Format Contents</b>	<b>16</b>
<b>9.</b>	<b>Details of the technical specifications of the 100W Thermo-Electric Generator Annexure-(I)</b>	<b>18</b>

## **1. Modus Operandi:**

The intending Vendor is advised to read the EoI documents, Terms and Conditions and other details carefully for Radioactive thermoelectric generator. The Vendor shall be deemed to have known the nature, scope and magnitude of the work. Vendor should express the interest only if he considers himself eligible and if it is in possession of all documents required as per the EoI. The Vendors are required to study EoI document and express interest after carefully examining all instructions, eligibility criteria, forms, terms, standards and specifications as per the EoI document with full understanding of its implications.

If the Vendor is found ineligible after opening of the EoI, his EoI document shall become invalid *ipso facto*, and costs of the tender document and processing fees, as applicable shall not be refunded. EoI which are not in compliance with our EoI conditions shall be rejected, without assigning any reasons thereof. Failure to furnish all requisite information and/or documents shall result in repudiation of the EoI notwithstanding the fore-going, UR RaoSatellite Centre [URSC], Bengaluru reserves the right to assess the capability of the Vendor to execute the Contract keeping in view the overall interest of URSC. In the event, the Vendor capability and capacity are found to be unsatisfactory; URSC reserves the right to reject the EoI document, without assigning any reasons thereof.

Any neglect or omission or failure on the part of the Vendor in obtaining necessary information as stated above or in any other matter affecting the Vendor, shall not relieve him from any risks or liabilities or the entire responsibility for completion for Radioactive thermoelectric generator in accordance with the EoI documents followed by the Request for Proposal (RFP) documents and clearance by URSC as and when it happens.

The requirements stated herein below are preferable specifications and URSC reserves the right to request for any additional information and also reserves the right to reject the EoI response of any Vendor, if in the opinion of URSC, the qualification or data is incomplete or if the Vendor is found not qualified to satisfactorily execute the Contract. The Vendor shall bear all costs and expenses associated with preparation and submission of EoI document including post EoI clarifications, discussions, technical and other presentations and URSC shall in no case be responsible or liable for such costs, regardless of the outcome of the EoI process. The Vendor shall also not be entitled to claim any costs, charges and expenses incidental to or incurred by him through or in connection with the submission of

the EoI or its consideration by URSC, even though URSC may elect to modify or withdraw the Invitation to EoI or not to accept the EoI.

At any time prior to the deadline for submission of EoI, URSC may for any reason on its own initiative modify the EoI document by an amendment. The amendment shall be notified in writing or by fax or e-mail to the Vendor or uploaded online on the website. URSC shall bear no responsibility or liability arising out of non-receipt of the same in time or otherwise. Notwithstanding the above, URSC may at its discretion extend the deadline for submission of EoI in order to afford reasonable time to Vendor to take into account the amendment in preparing the EoI.

All the EoI must be submitted before the time and date fixed for the receipt of EoI as set forth in the EoI document. URSC shall not be responsible for non-receipt of EoI due to any postal delays/loss of EoI documents in transit and delay due to customs/courier, etc. and it shall be the sole responsibility of the Vendor to ensure delivery of the EoI within the time fixed. URSC reserves the right to accept or reject any of the EoI in full or part without assigning any reason thereof. EoI received after stipulated time and date shall be rejected.

URSC, on successful completion of the EoI process may release an RFP based on the revisions in the specifications and other terms as may be agreed upon/felt necessary during the process of the EoI and EoI evaluation. URSC reserves the right to make necessary modification(s) in the specifications/terms at the time of release of RFP or not to release an RFP as a sequel of this EoI. All other standard commercial and regulatory terms and conditions will be released as part of the RFP, which need to be complied and responded by the vendors in the RFP response.

If the EoI opening date happens to be on an unidentified Holiday due to any reason, including *Force Majeure*, tender(s) shall be opened on the next working day.

Vendor shall submit EoI document only in sealed envelopes, super-scribing the Tender Number and the due date of opening of the Tender. The EoI shall be complete in respect of all technical specifications, instructions, drawings, pamphlets and catalogues, as per the EoI document. Failure to furnish all information as per the requirements of the EoI document and submission of EoI not substantially responsive to the EoI document shall render the EoI/Vendor liable for rejection. Any/all EoI by way of fax/e-mail shall not be accepted.

The Vendor should provide along with his EoI document the Name of his Bankers, if required by UR Rao Satellite Centre [URSC], Bengaluru.

*The Suppliers need to get enrolled in the e-tender portal to access tender and submit their offer online during Request for Proposal (RFP) stage. Vendor need to have Digital Signature Certificate as detailed on ISAC/URSC e-portal and corporate e-mail ID to register on the above portal.*

## **2. EoI Objective:**

URSC is planning for design, and modelling; simulation, and analysis; testing, and qualification of 100We-(electric output) Radio Isotope Thermoelectric Generator (RTEG) through industry participation. The purpose of this EoI is to invite proposals from the potential Vendors for consideration.

## **3. Introduction to Satellite Subsystems:**

UR Rao Satellite Centre [URSC] is one of the lead Centres of the Indian Space Research Organisation [ISRO] responsible for Design, Development, Assembly and Integration of Satellites for various applications.

## **4. INTRODUCTION TO RADIOISOTOPE THERMOELECTRIC GENERATOR (RTG):**

Spacecraft power systems for space missions where solar power is not viable, requires use of RTG for powering the spacecraft. It involves the housing of the radioactive power source, thermoelectric elements, interfaced between the power source and the thermoelectric elements, and an efficient heat rejection system. Industries having sufficient expertise in development and realization of RTG are requested to respond with regard to RTG support.

This document defines the prerequisites of the Vendor for short listing of Vendors for qualification.

## **5. DESCRIPTION AND SCOPE OF WORK:**

RTG as a, spacecraft power system, involves the housing of the radioactive power source, thermoelectric elements and an efficient heat rejection system. The expertise expected from the is as follows

- a) Expertise in design, modeling, and simulation of individual components of the RTG with respect to standard operating conditions, and performance study of the components with regard to the operating conditions, degradation with time, and limiting conditions of performance. The electrical and thermal efficiencies shall be defined in detail.

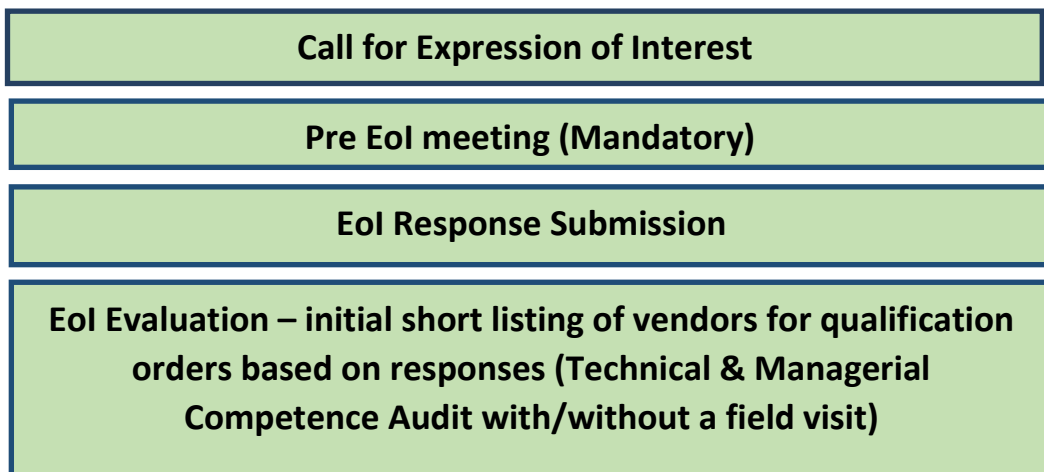
- b) Development and Fabrication of RTG, test and analysis, and Qualification, which must be carried out at component level as well as overall system level as per ISRO standards with clearance from URSC.
- c) It is expected that the Vendor would provide necessary support with regard to the design, modeling, simulation, analysis studies, and testing and qualification as and when required by URSC.
- d) Testing expertise for robust perform both in vacuum and in atmosphere of other planets, capable of operating in vacuum conditions of deep space, dusty, CO<sub>2</sub> rich or corrosive environment and survive indefinitely without damage when stored in earth atmosphere at temperatures as high as 50°C without degradation and corrosion of components.
- e) Vibration shocks withstanding capability during launch and stageseparations, and should be able to bear vibrational loads during launch phase, orbit maneuvers and landing phases.
- f) Vendor to provide the Electrical Power of the heat source assumed (~2000W approx.). The alternate power source used in place of Radioisotope material for ground application shall be described in detail.
- g) The vendor shall provide the handling and assembly procedures of the radioisotope material into RTG assembly.
- h) The design of the heat source capsule, the list of candidate material, its characteristics and properties considered for modeling and its geometry shall be part of deliverables.
- i) The physical and mechanical properties and the geometry of the Heat distribution module shall be part of the deliverables by the vendor. The vendor shall also provide the list of candidate material considered for design.
- j) The vendor should provide a solid model in the “Solid works” format for the design and provide an FEA thermal analysis of the design.
- k) Consolidated list of deliverables
  - (1) Solid model of RTG assembly (.prt format)
  - (2) Electrical equivalent mathematical model

- (3) FEA thermal analysis model (.fem, .sim formats) and details of thermal interfaces
- (4) FEA structural analysis model
- (5) Documentation related to basic studies, selection of materials, design, development, modeling, analysis, testing and qualification.
- (6) RTG assembly
- (7) Testing and handling equipment

For detailed technical specifications refer attached **Annexure-(i)** attached.

## 6. Procedure for Evaluation Purpose:

The entire exercise of selecting viable vendors is for entering in to RC carried out in two stages i.e. Expression of Interest (Eol) and qualification stage and Request for Proposal (RFP) Stage. Following is the flow chart depicting the structure process flow that would be adopted in the vendor evaluation process.



## 7. Terms and Conditions:

### 7.1 Terms and Conditions: Finance

7.1.1 Vendor (or authorized representative) participation in Pre Eol-Conference is mandatory. It is to get more clarity about the work.

## **7.2 Terms & Conditions: Organization Portfolio**

7.2.1 The applicant may be Proprietorship, Registered Partnership Firm, Indian Company/Domestic Company-Private or Public Company-Listed or Unlisted. Vendor shall submit the interest in the given EoI response sheet.

7.2.2 An Indian Company would be deemed to be owned by Indian Citizen and by an Indian Company if more than 51 per cent of equity interest in the company is beneficially owned by Resident Indian Citizens and Indian Companies that are, in turn, ultimately owned and controlled by Resident Indian Citizens.

7.2.3 Control has been defined as the right to appoint the majority of the Directors or to control management and policy decisions, including by virtue of their shareholdings or management rights or shareholders or agreement or voting arrangements.

7.2.4 The applicant must be registered in India as required by law with minimum three years of continuous operation up to the date of publication of this EoI.

7.2.5 The Vendor should also have a valid GST registration. The Vendor should submit Self attested copy(ies) of the Certificates of Incorporation and other certificates that are legally required for carrying out its business activities in India.

7.2.6 The certificates should be valid at the time of EoI submission and should be certified by an authorized signatory. A copy of PAN Card should also be submitted.

7.2.7 Income Tax Returns of the last three assessment years duly certified by a Chartered Accountant has to be submitted.

7.2.8 An undertaking (self-certificate) is to be submitted that, the Organization hasn't been blacklisted by any Central/ State Government Department/ Central Government funded organizations/ State Government funded organizations/ World Bank, or other World Bank organizations and is not under any illegal expression by Government of India.

7.2.9 The applicant, should not have, during the last three years, either failed to perform on any agreement, or been expelled from any project or agreement or have any agreement terminated for breach by the applicant.

7.2.10 Persons who are individually or institutionally, in any manner, involved with the selection/screening process of the EOI, and employees of ISRO are ineligible for applying.

7.2.11 An undertaking (self-attested) is to be submitted that there has been no outstanding bankruptcy, judgment or pending legal action that could impair operating as a going Concern. Also the Vendor must be solvent, in the Legal Court of Law.

### 7.3 Terms & Conditions: General

7.3.1 This Eol is not an offer and is issued with no commitment. URSC reserves the right to withdraw the Eolor change or vary any part thereof at any stage. URSC also reserves the right to disqualify any Vendor/proposal, should it be so necessary at any stage.

7.3.2 Timing and sequence of events resulting from this Eol shall ultimately be determined by URSC.

7.3.3 By submitting a proposal, each vendor shall be deemed to acknowledge that the Vendor has carefully read all chapters of this Eol, and has fully informed himself as to all existing terms and conditions.

7.3.4 The proposal and all correspondence and documents shall be written in English.

7.3.5 Vendor shall compulsorily fill up the Response format and compliance matrix (Part- I & Part- 2) as given in Chapter 8 in the Eol.

7.3.6 **Participation of Vendors for Pre-Eol Meeting:** A Pre-Eol Meeting will be arranged Online through Internet in order to have a better understanding of the Eol document with regard to Technical and Commercial aspects, clarify doubts if any, and other allied details.

#### 7.3.7 GST Registration:

##### **Important Notice to Vendor**

Government of India has implemented Goods and Services Tax [GST] w.e.f 01.07.2017. The Vendor should mandatorily possess a valid GSTIN along with the GST Registration Certificate. Please take note of this aspect.

### 8. Eol Response Format:

Cover Letter

(Company letterhead)

[Date]

To,

**HEAD, PURCHASE & STORES**

**UR Rao Satellite Centre**

**HAL Airport Road, Vimanapura Post**

**Bangalore -560017**

**Karnataka**



Dear Sir,

**Ref: Expression of Interest for design, modelling; simulation, and analysis; testing, and qualification of 100W Radio Isotope Thermoelectric Generator (RTEG)”**

Having examined the Expression of Interest (Eol), the receipt of which is hereby duly acknowledged, we, the undersigned, intend to submit a proposal in response to the Expression of Interest (Eol).

We attach hereto the response as required by the Eol, which constitutes our proposal. Primary and Secondary contacts for our company are:

	<b>Primary Contact</b>	<b>Alternate Contact</b>
<b>Name:</b>		
<b>Title:</b>		
<b>Company Name:</b>		
<b>Address:</b>		
<b>Phone :</b>		
<b>Mobile:</b>		
<b>Fax :</b>		
<b>E – mail :</b>		

We confirm that the information contained in this response or any part thereof, including its exhibits, and other documents and instruments delivered or to be delivered to URSC is true, accurate, verifiable and complete. This response includes all information necessary to

ensure that the statements therein do not in whole or in part mislead URSC in its short-listing process.

We fully understand and agree to comply that on verification, if any of the information provided here is found to be misleading the short listing process, we are liable to be dismissed from the selection process or termination of the contract during the execution of the contract.

We agree for unconditional acceptance of all the terms and conditions set out in the EoI document.

It is hereby confirmed that I/We are entitled to act on behalf of our company/ corporation/ firm / organization and empowered to sign this document as well as such other documents, which may be required in this connection.

Dated this

(Signature) (In the capacity of)

(Name)

Duly authorized to sign the EoIResponse for and on behalf of:

(Name and Address of Company) Seal / Stamp of Vendor

Witness Signature:

Witness Name:

Witness Address:

**CERTIFICATE AS TO AUTHORIZED SIGNATORIES**

I, ....., the Company Secretary of ....., certifythat ..... Who signed the above response to EoI is authorized to do so and bind the company by authority of its board / governing body.

Date:

Signature:

(Company Seal)

## Part-I

### 8.1 General Details of the Vendor

<b>8.1.1</b>	Name of the Vendor	
<b>8.1.2</b>	Year of Establishment	
<b>8.1.3</b>	Core capabilities of the Vendor, Standard products from vendors if any	Type brief profile of the Vendor in Annexure - A(without referring to attachment of any report/s)
<b>8.1.4</b>	Head office location and address with contact number & email id:	
<b>8.1.5</b>	Corporate website URL, if any:	

## 8.2 Mandatory Supporting Documents

Auditor certified statements for the last three years, FY 2017-18, FY 2018-19 & FY 2019-20 in Annexure-B (please provide the profit and loss statement and balance sheet).

	FY 2017-18	FY 2018-19	FY 2019-20
Net Revenue from Operations (in INR Crores)			
EBTD [Earnings Before Tax and Depreciation]			
% of Revenue from Aerospace Segment/Unit			
Net worth			
Share Capital			
% of shareholding by Indian			
% of shareholding by Foreign			

**Part-2**

**8.3: Form A Compliance Matrix to be filled by Vendors**

<b>Refer Chapter No</b>	<b>Description</b>	<b>Understanding and Compliance (Yes/No)</b>	<b>Remark</b>
<b>1</b>	Modus Operandi		
<b>2</b>	Eol Objective		
<b>3</b>	Introduction to Satellite Subsystems		
<b>4</b>	Introduction to Radioisotope thermoelectric generator (RTG)		
<b>5</b>	Description and Scope Of Work		
<b>6</b>	Procedure For Finalizing Contract		
<b>7</b>	Terms & Conditions		
<b>8</b>	Eol Response Format		

**8.4: Form B- Compliance Matrix to be filled by Vendors with respective to Organisation, Experience and Infrastructure**

<b>Sl. No</b>	<b>Description</b>	<b>Compliance /Non-Compliance</b>	<b>Remarks*/ Supporting documents</b>
1.	In-house <i>experience having completed similar nature of work of <b>purchase orders of total worth, preferably Rs.50 Lakhs or more in a year during the last 3 years.</b> (Provide copies of the orders clearly showing the scope of work, magnitude of the work involved, proof of completion and delivery)</i>		Attach as per Annexure -C.
2.	Past experience in for design, and modelling; simulation, and analysis; testing, and qualification of 100W Radio Isotope thermoelectric Generator (RTEG).		Provide the detail about work, and work order value with relevant purchase order copies if any. Attach as Annexure - C.
3.	In-house availability of qualified work force and Management structure(Please provide a table of the available workforce with details of trade, qualification, number, years of total experience, years of employment/experience with the vendor etc.)		
	Certificates held like ISO 9001, AS 9100, NABL Accreditation, or any equivalent is preferred.		
4.	List of Customers within the State/Country/abroad		Provide documentary proof. Attach as Annexure -D.
5.	Specify standard product(s) of the company, if any		

Signature:

Name of the authorized signatory for the company:

Date:

Place:

Note:

- Vendors even meeting partial specifications with respect to infrastructure can participate in this EOI. However, Preference will be given to the responses**

**meeting all OR most of the above specifications and criteria during EOI evaluation.**

2. If required, Provide Documentary Proof as supporting documents, topics where ever it is deemed necessary sheets can be attached.

**\* Remarks:**

1. Provide Documentary Proof as supporting documents to the topics in the above table.
2. Clearly fill the column with the regard to the availability of facilities in-house (OR) outsourcing.
3. In case of outsourcing, mention the full address, details and their expertise shall be mentioned.

Signature:

Name of the authorized signatory for the company:

Date:

Place:

Note:

1. **Vendors even meeting partial specifications with respect to infrastructure can participate in this EOI. However, Preference will be given to the responses meeting all OR most of the above specifications and criteria during EOI evaluation.**
2. If required, necessary sheets can be attached

## 8.6 Eoi Response Format Contents

The proposal should be submitted as an Expression of Interest (Eoi) as a collation of the following table of contents as below, in the enclosed format, clearly providing the details requested below with documentary proof/supporting documents as Annexure.

The vendor has to provide the information as per the formats as prescribed in chapter 8 Response Format. The overall compliance matrix as per section 8.3, 8.4, 8.5 should also be submitted as per the Eoi proposal. All these inputs may be furnished inaneatly typed document in the said formats.

The proposal and all correspondence and documents shall be written in English.

<b>Sl. No</b>	<b>Contents</b>	<b>Page No</b>
1.	Covering Letter	
	<b>Part-I</b>	
2.	General particulars of Vendor	
3.	Mandatory Supporting Documents	
	<b>Part-2</b>	
4.	Form A Compliance Matrix to be filled by Vendor	
5.	Form B Compliance Matrix to be filled by Vendor	
<b>List of Annexure</b>		
	Annexure- A	Brief Profile of the vendor
	Annexure-B	Auditor certified statements
	Annexure-C	Copies of PO/Work order/Contract copy
	Annexure-D	Quality Certification copies ( ISO 9001 : 2008 or equivalent)



## Annexure-(I)

### Details of the technical specifications of the 100W Thermo-Electric Generator:

Mandatory Requirements		
Sl. No.	Description	Specification
1.	General Introduction	<p>The development of RTEG is taken up as it is envisaged that it will be a part of ISRO's deep space missions for power generation and thermal management. RTEG of 100W electrical output power is envisaged for use in these missions. The Expression of Interest (EoI) indent is raised to identify partners/ vendors those are interested in working with ISRO to achieve this final goal. The realization will be divided into three phases.</p> <p>Phase 1</p> <ul style="list-style-type: none"> <li>• Design, Modelling, Simulation &amp; Analysis</li> </ul> <p>Phase 2</p> <ul style="list-style-type: none"> <li>• Development and fabrication</li> </ul> <p>Phase 3</p> <ul style="list-style-type: none"> <li>• Testing and qualification of Radio Isotope Thermo Electric Generator (RTEG)</li> </ul>
2.	Information to Vendor	<p>The vendor is expected to offer technical quotes for Phase 1 alone against this RFP. The commercial contract for phase 1 will be called for after review of the EoI response. Phase 2 &amp; phase 3 activities will be offered after the successful completion of Phase 1 deliverables, review and acceptance.</p>
3.	Objectives of Phase1	<ul style="list-style-type: none"> <li>• Design a RTEG of electrical power output of 100W</li> <li>• Study various options of RTEG design for the specified end-use</li> <li>• Design of thermopile</li> <li>• Study and design of the various options of TEGs like BiTe, PbTe, Ge-Si, TAGS, etc.</li> <li>• Design of the heat rejection system</li> <li>• Present the design to ISRO identified team for approval of design</li> <li>• Provide the deliverable as per the timeline identified/ agreed</li> <li>• Deliver design of a working RTEG that meets the functional requirements specified in this EOI</li> </ul>
4.	<p>The RTEG is expected to be a stand-alone unit meeting the following needs: -</p> <ol style="list-style-type: none"> <li>1. Continuous Radioisotope (fuel) disintegration to be converted into heat.</li> <li>2. Convert the heat to generate electrical power to the space craft</li> <li>3. Reject the extra heat into space/atmosphere</li> <li>4. An interface to transfer nominal heat to the spacecraft for thermal</li> </ol>	

	5. management.	
Functional Requirements:		
5.	Power Output	100 watts at Beginning of Life (BoL) and at least 75W at End of Life (EoL)
6.	Operating Conditions	Capable of operating in vacuum conditions of deep space, dusty, CO <sub>2</sub> rich or corrosive environment  Survive indefinitely without damage when stored in atmosphere at temperatures as high as 50°C without degradation and corrosion of components.
7.	Shock	Should be able to withstand launch shocks of about 2000g
8.	Vibration	Survive 3 axis vibration testing of 50g rms in a sinusoidal sweep from 5Hz to 300Hz
9.	Temperature Range	Thermoelectric material of high efficiency should be selected and should be able to work in wide temperature ranges (200k to 1000 k)
10.	Efficiency of TEG module	5% or better
11.	Weight	20kg or less
12.	Life	20 years or more
Electrical Requirements		
13.	Electrical power output	Should be capable of generating 100W of continuous power in BoL conditions. >75W EoL
14.	Efficiency of the System	5% or better where efficiency means the capability of thermopile to convert the heat from source to electricity.
15.	Operating Voltage	25 – 30V, Extendable upto 41V
16.	Current	< 3 amperes
17.	Degradation	Vendor to provide profile of power output with time in graphical and data form.  The effect of various operating conditions like vacuum of deep space, dusty environment, CO <sub>2</sub> rich environment, Acidic or corrosive environment, solar irradiation, as well as in earth conditions should be clearly brought out in the analysis.
18.	Electrical Performance	The System shall be resilient from thermal loads from sun and have a guaranteed performance of >85W of generation at BoL even when the heat rejection system is facing direct sun load.

19.	Operating Conditions in earth	Survive indefinitely without damage when stored in atmosphere at temperatures as high as 50°C
20.	Operating Conditions in space	Vacuum of deep space, dusty environment, CO <sub>2</sub> rich environment, Acidic or corrosive environment, and with solar irradiation (up to 2 AM0)
Heat Source		
21.	Introduction	Commercially available heat source of appropriate value to be used, to provide the desired electrical output.
22.	Vendor to provide the Electrical Power of the heat source assumed (~2000W approx.)	
23.	The design of the heat source and its characteristics shall be a deliverable.	
24.	Mass and volume of the heat source should be provided by the vendor.	
25.	The heat source should allow flexibility in terms of energy and heat flux characteristics like tuning of power output and temperature.	
Heat source Capsule		
26.	The heat source capsule design shall consider the thermal and mechanical loads experienced by the system due to the high operating temperature.	
27.	The material considered shall also be capable of withstanding the irradiation characteristics of the radio isotope material and the resultant residual gases.	
28.	The design of the heat source capsule, the list of candidate material, its characteristics and properties considered for modelling and its geometry shall be part of deliverables.	
29.	The design of the capsule shall also address the pressure build up / venting of the system due to the residual gas generation.	
30.	The capsule design shall ensure that the radiation emitted outside the capsule should be within permissible limits for humans to work with.	
Heat Distribution Interface (Interface between heat source and TEG Hot side)		
31.	Introduction	The heat distribution interface provides the thermal interface between the capsule and hot side of the TEG.
32.	The physical and mechanical properties and the geometry of the Heat distribution module shall be part of the deliverables. The vendor shall also provide the list of candidate material considered for design.	
33.	The method of bonding or retaining the TEG in physical contact with the structure shall be clearly brought out in the design/ modelling.	
Thermoelectric generator (Thermocouples)		
34.	Efficiency >6% at standard operating temperatures.	
35.	The deliverables shall include the thermal and electrical model of the TEGs considered with the list of properties and its values for the range of temperatures considered.	

36.	Degradation	Should be less than 1% per year to be demonstrated and explained as deliverable. Less than 0.2% degradation in power output with cumulative total of at least 1000 hrs of operation in varying or stable conditions.
Heat Rejection system		
37.		Able to reject up to 2 KW to space and maintain temp on cold side as close optimal value for maximum power output.
38.		Temp should not increase beyond 150°C for cold side of the thermopile in any case.
39.		Should be able to radiate heat in earth conditions as well as within launch vehicle before launch.
40.		Stability during sun (partial or full) and other planetary loads also the model developed should be predictive to ascertain the temp in a situation with known parameters.
41.		The model delivered should also allow to predict the temperature in case of electrical load variations.
42.		Should also be resilient to atmospheric conditions, dust, etc. the effects of these conditions on the performance and temp characteristics should be clearly analysed and outlined.
43.		Effect of change of material (TEG couple and its effect)
44.		Should also allow to act as a source of heat for spacecraft under specified conditions.
Other General Requirements		
45.		Design of the thermopile should include all models heat source, interface material, thermocouple and heat rejection system.
46.		They should be holistically compatible and complimentary to each other to facilitate resilience to environmental conditions
47.		The thermopile design shall meet the outgassing requirements as per ASTM E 595
Safety Requirements		
48.		The unit should have the highest SAFETY STANDARDS possible.
49.		The unit should be safe for human handling in close vicinity under all conditions even with nuclear fuel concealed inside.
50.		The unit should be able to resilient to any pre- launch or post-launch explosion so as to not cause any nuclear contamination in the environment
51.		Any possible hazard attached with the unit or the fuel has to be analyzed addressed, and also informed.
Deliverables		

	<p>ISRO shall be expecting the following details (DELIVERABLES) mandatorily for the design:</p> <p>Thermal mathematical model of the UNIT DESIGN.</p> <p><b>Structural analysis model</b></p> <p><b>Equivalent Electrical mathematical model</b></p> <p>Materials selected and the reason for selection for material (except proprietary)</p> <p>Fuel selection and reasons for it.</p> <p>Procedures followed and their explanation.</p> <p>Boundary conditions of Simulations done and explanations for them.</p> <p>All interfaces and their characteristics.</p> <p>Access of the Fuel in the unit and interface between heat source and thermopile.</p> <p><b>Documentation related to the above points</b></p>
	Provide a solid model in the “Solid works” format for the design
	Provide an FEA thermal analysis of the design
	Development of the Generator should be possible in 3 Phases.