



Ref : Advt No. NCRA/SKA/EoI/2015/2

Request for Expression of Interest (EoI)

from

Government and Public Sector Organisations

regarding work for the second part of the

Pre-construction Phase

of the

Telescope Manager and other Work Packages

of the

Square Kilometre Array (SKA) Telescope

<http://ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest>

13 April 2015

National Centre for Radio Astrophysics
Tata Institute of Fundamental Research
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Referred Documents

- 1 The documents in the Request for Proposals released by the SKA Office in March 2013
Referred to as : RfP documents
Obtained from :
<http://www.skatelescope.org/publications/request-for-proposals/>
 - 2 A Readme file summarising the content of each RfP document
Referred to as : RfP Readme
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>
 - 3 Detailed explanation of the Work Breakdown Structure of all Elements of the SKA
Referred to as : SKA WBS document
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>
 - 4 Detailed explanation of the Work Breakdown Structure of Telescope Manager Element
Referred to as : SKA TM WBS document (Note that MGR is now referred as TM)
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>
 - 5 Documents for the Concept Design Review of Monitoring and Control System
Referred to as : M&C CoDR documents
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>
 - 6 A list of documents submitted by the TM consortium to SKA Office for PDR
Referred to as : TM PDR document list
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>
-

Documents to be submitted (see Sec 3.2 for full list)

- 1 Spreadsheet to be filled out for all SKA Elements at Level 4
Referred to as : SKA WBS spreadsheet
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>
- 2 Spreadsheet to be filled out for Telescope Manager Element at Levels 5 and 6
Referred to as : SKA MGR spreadsheet
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>
- 3 Covering letter for the response to this EoI, with a checklist for submission
Referred to as : Cover letter
Obtained from :
<http://www.ncra.tifr.res.in/ncra/ncra-1/information/ska-expression-of-interest/>

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1. Executive Summary

The Square Kilometer Array (SKA) (see www.skatelescope.org for extensive information) is a next generation radio telescope to be constructed jointly by an international consortium that involves participants from both academia and industry. The SKA will be a revolutionary telescope both in terms of expected science output as well as the engineering challenges in building it. The telescope will be located in radio quiet regions in South Africa and Australia. Construction is expected to start by 2018, at an estimated cost of 650 million Euro for SKA Phase I (to be completed by 2022) and an estimated cost of 1.5 billion Euro for the full SKA (i.e. Phase II, from 2022 to 2027). India, alongwith 10 other nations at present, are members of the SKA Organisation that is overseeing the construction of this global radio telescope.

We are currently in the midst of the pre-construction phase of the SKA, which runs from end of 2013 to the beginning of 2017. This phase involves two stages, Stage I which lasted till the beginning of 2015 and Stage II, which lasts from mid-2015 to the end of 2016. Stage I ended with the Preliminary design Review (PDR). Work that was done during Stage I included (1) deriving the functional and performance requirements, leading up to the Systems Requirements Review (SRR) and (2) elaborating the preliminary design, leading up to the (PDR). The work to be done in Stage II involves developing the Stage I designs into detailed designs and procurement specifications for the construction phase, leading up to the Critical Design Review (CDR) by the beginning of 2017. The total cost for the Phase I work is roughly 90 million Euros. For both the phases of the SKA, the Indian participation is expected to be about 5 %.

The above work is being carried out for each Element of the SKA and periodic reviews are done by independent, international panels of experts. The Elements cover different technical aspects of the SKA, ranging from the receptors (e.g. dishes, dipole arrays) to the signal transport sub-system, the signal processing sub-system, data processing sub-system, infrastructure sub-systems etc. One such element is the Telescope Manager which includes the entire Monitoring and Control sub-system of the SKA telescope, in addition to a number of interfaces and links to other sub-systems. This Telescope Manager Element work-package is being executed by an international consortium that is led by the NCRA for the pre-construction phase. In addition, NCRA is also be involved in a few specific areas in other Elements as well, e.g. in Signal and Data Transport as well as in Central Signal Processing. Much of the initial design work is being carried out in collaboration with industry, with funding that is provided to NCRA from the Government of India.

Stage 2 will start from mid-2015, and the NCRA would like to invite interested PSUs, autonomous bodies and ministries under the central or state government to respond with an Expression of Interest (EoI) for participation in this next stage of work for the Telescope

Manager as well as for the other Elements. A shortlist will be made from the parties which submit an EoI, based on technical evaluation by a committee, following which apportioning of work will be done based on invited tenders.

This EoI is for the design phase alone and does not involve any construction of hardware or software. Following the successful completion of the pre-construction design phase, the construction period will start. Contracts for this latter phase of work will be issued based on a fresh EoI which will be invited at that time.

2. Background Information

2.1 The Square Kilometre Array (SKA)

The Square Kilometer Array (SKA) is a proposed next generation radio telescope to be constructed jointly by an international consortium that involves contributions from both academia and industry. This ambitious facility pushes the envelope in many areas of technology and is an unprecedented engineering challenge. The telescope will be operational with its full capability by 2027, and has an estimated cost 1.5 billion Euros in total, and early science will be possible with SKA phase I from 2021 onwards. The SKA will be built as two telescopes - in South Africa (and some African sites) and in Australia (and New Zealand). Thousands of radio receptors located over 100s of kms will be linked to create a telescope equivalent of a dish of size one square kilometre. The SKA will operate from 70 MHz to 10 GHz (to be extended to 30 GHz), achieved through dipole arrays, phased array tiles and dish antennas. The telescope is expected to answer fundamental questions about the nature of gravity, the role of magnetism, the formation of the first stars and galaxies, and possible extra-terrestrial life.

Over the last 5 years, an international team of astronomers and engineers in 20 countries has worked to develop the concept design for this telescope. This international effort is coordinated by the SKA Organisation, a not-for-profit company located in Manchester, UK. NCRA-TIFR represents India as a member of the SKA organisation, which has 10 other member countries at present and India is in the process of becoming a full member.

2.2 Stage I of the Pre-construction phase of the SKA (2013 to the present)

The SKA project is currently in the pre-construction phase, which started by the end of 2013, involving detailing the requirements specifications and detailed design work.. This work leads to a Systems Requirements Review and a Preliminary Design Review for each of these Elements, which is currently being concluded following review by an international panel. This will be followed by the Critical Design Reviews by end-2016, to be completed by beginning 2017. The purpose of the CDR is to establish that the final detailed designs are sufficiently mature for release of the final deliverables to the manufacturing stage of the programme. It will review the

detailed design and demonstrate that the final design meets the requirements. The end of this phase will be followed by the actual construction and commissioning of the SKA.

Given the mammoth scale of the project, formal systems engineering methodology is being followed strictly. In keeping with this, a number of documents were submitted for the PDR of the Telescope Manager by the consortium led by NCRA, and this list of these deliverables are available on the website. This list should indicate the scope and scale of the work involved.

The full list of Elements, each being designed by an international consortium, are

- Telescope Manager (which is led by NCRA)
- Dish (including phased array feeds)
- Low frequency aperture array
- Science data processor
- Central signal processor
- Signal and data transport (including synchronization)
- Assembly Integration Verification
- Infrastructure (including power)
- Mid frequency Aperture Arrays
- Wideband Single Pixel Feeds

2.3 Stage II of the Pre-construction phase of the SKA (2015-2017)

The next stage of work will be to evolve detailed designs, develop a construction plan and do the necessary prototyping and costing, which can lead up to construction work by 2017. This work will end in a Critical Design Review, which will be done by an international panel of experts. This EoI is specifically aimed at inviting responses for this stage of work. Note that this stage will not involve actual construction.

Though most of NCRA's involvement is in the Telescope Manager work package, NCRA is also a partner in the Signal and Data Transport, as well as the Central Signal Processing packages. Expressions of interest are invited for all of these. In addition, parties can also indicate interest in other Element work packages, though NCRA will probably only play the part of facilitating networking between the interested parties and the relevant consortia.

2.3 NCRA and the SKA

The National Centre for Radio Astrophysics (NCRA), based in Pune, is one of the centres of the Tata Institute of Fundamental Research (TIFR). The NCRA has built and runs the Giant Metrewave Radio Telescope (GMRT), the worlds largest radio telescope at low radio frequencies. The NCRA has been associated with the SKA project since its inception. Since 2009, NCRA scientists and engineers, along with some industry partners, have been working on various aspects of the Monitoring and Control System of the SKA. In January 2011, NCRA was

designated as the lead institution for this activity, charged with delivering “concept design” documents that would be formally reviewed by an international panel of experts. A successful Concept Design Review of the Monitoring and Control system was held in November 2011. The documents submitted at the time of this review (M&C CoDR documents) can be downloaded from [http://www.skatelescope.org/public/2011-11-08%20Monitor and Control CoDR/](http://www.skatelescope.org/public/2011-11-08%20Monitor%20and%20Control%20CoDR/) and the respondents are encouraged to read them as background material on the nature and scope of the Telescope Manager work.

Following this, the Monitoring and Control has been expanded in scope and renamed as the Telescope Manager. NCRA has formed an international consortium under its lead, to work on the Telescope Manager element of the SKA. This consortium bid for the Telescope Manager work for the pre-construction phase and was awarded the bid by the SKA Office.

On being awarded the bid for Telescope Manager, the consortium then contracted out different parts of this work to consortium members and external parties, including private industry identified initially through an EoI. We also participate at a lower level of commitment in several other work packages as was mentioned earlier. The intensity and scope of the involvement in these Elements is likely to increase in successive phases of the project. In order to harness the expertise in various aspects of engineering, we wish to partner with public enterprises and private companies who have the relevant expertise and experience to contribute to the above areas of the project.

2.4 Description of Stage II work

Overall, the entire work package includes generation of the functional and performance requirements, design and analysis including requirements and competitive costing, detailed design of the element, developing a schedule for construction, costing from construction to operation and production of technical documentation for procurement.

2.4.1 Stage II

Stage II of the work involves detailed design and engineering preparing for procurement, detailed optimization, RFI characterisation, detailed construction plan, scheduling, FMECA, validation, consolidating the risk register, evaluating the design to fulfil requirements, establishing a development process and a production plan. This ends with a Critical Design Review by an international panel.

2.4.2 Critical Design Review

The CDR will review the final design in order to confirm requirements specifications and design description, production process, test and verification plans, risk mitigation, final costs and reliability data and integration and test plans. This will be done by an international panel of experts constituted by the SKA Office.

2.5 Statement of Work

The work needed to be done for the Telescope Manager for the entire pre-construction phase is detailed in the RfP documents issued by the SKA Office for all the Elements and all parties responding to this EoI are encouraged to go through them carefully. The documents referred to in this section are to be found at the url mentioned in the 'Referred Documents' section.

In particular, the Work Breakdown Structure for all Elements of the SKA including the Telescope Manager (TM) as well as other Elements are described in the RfP document “SKA Pre-Construction Top Level WBS” upto one level of detail. Respondents are encouraged to read all of it, with special attention to Telescope Manager. As can be seen from the WBS, the Telescope Manager includes aspects of system engineering, interfaces, standardisation, operations support, observatory software etc.

The Statement of Work for all Elements including TM is described in the RfP document “Statement of Work for the Study, Prototyping and Preliminary Design of an SKA Element” including the deliverables for the various review processes. The SKA TM spreadsheet breaks down the level 4 tasks for Telescope Manager into its constituent sub-tasks, and the respondents are expected to indicate their interest in Telescope Manager against this statement of work.

All parties are encouraged to go through all of the documents in the RfP, including “The Square Kilometre Array Intellectual Property Policy” before responding to this EoI.

The Telescope Manager work is being undertaken by the international consortium led by NCRA, and each Element is run by a similar consortium. Parties that are shortlisted after technical qualification, and then enter into an agreement with the NCRA to participate in this work, after due process, will work within these consortia. Some of the work has already been allocated to research partners and some has been outsourced to private parties. All work to be awarded will be parts of entire body of work and NCRA reserves the right to split the work amongst multiple qualified partners. Any new work that is awarded to a new party would have to be carried out in collaboration with these partners. This work can be of two forms, (1) contract for specific deliverables and (2) contract for specific manpower needs. The details of these will be discussed with the shortlisted parties after due process. Note that, when contracts are awarded, NCRA will not bear infrastructure or logistics expenses for deputed manpower. This will have to be borne by the respondent, who will also need to nominate a project manager for the personnel deputed.

Given the international nature of the project and the highly deadline-driven process followed, selected parties would need to demonstrate good track-record in completing similar projects on time. Also, given the collaborative nature of the project, interested parties must be able to attend videoconferences and teleconferences on a regular basis.

Respondants to this EoI will be evaluated by a technical committee. Only organisations that are thus shortlisted will be invited to submit tenders for the specific work. Organisations can specify interest in any number of specific tasks listed in the statement of work (SKA WBS spreadsheet and SKA TM spreadsheet, see referred documents list). In case of conflicts for the same task,

NCRA will use its discretion to resolve them, including awarding contracts to multiple partners to jointly work and create deliverables for the task.

2.6 Work Breakdown for the Telescope Manager

The level 4 tasks for this Element are listed in the RfP documents. For convenience, these are listed below with an indicative list of sub-tasks. The detailed breakdown of tasks at one level lower than this is given in the SKA TM spreadsheet.

- **SKA.TEL.MGR.MGT – Engineering management**

This includes Project management plan, costing, meetings management, communications and Integrated Task Teams.

- **SKA.TEL.MGR.SE – System Engineering**

This includes Systems engineering approach, Verification planning and performance, Modelling, Architecture, Interface Definition, Design Specification, Road mapping and obsolescence analysis, Engineering resource allocation, Operations, Sustaining engineering, Software development environment, FMECA, Hazard analysis, Standardisation activities, Product Assurance, Integrated Task Teams, Change control, Risk management, Configuration control.

- **SKA.TEL.MGR.TELMGR - Telescope management**

This includes Monitoring data acquisition and handling, Control, Data model support, Operator and engineer interfaces, Local M&C interface standardisation, Specific interfaces scoping, Operations Support databases, Operations Support, Monitoring data archive, Fault detection and management, Safety and asset protection, Security, Reliability, availability and integrity, Engineering device simulators, Platform specification.

- **SKA.TEL.MGR.OBSMGT - Observation management**

This includes Proposal submission, Observation preparation, Scheduling, Instrument configuration, Observation execution, Observation management data archive, User interface, Simulation, Platform specification.

- **SKA.TEL.MGR.PROT - Prototypes**

This includes Concept prototypes, Integration prototypes, Design verification, Qualification prototype.

- SKA.TEL.MGR.LMC - local monitoring and control

This includes Systems engineering, Monitor, Control, Diagnostics, Platform specification.

- SKA.TEL.MGR.LINFRA - local infrastructure

This includes Systems engineering, Hardware housing, Cooling, Power, Signal distribution, Timing, Safety.

- In addition, the consortium will also work on the Telescope Manager interface to Dishes, Low Frequency Array, Signal and Data Transport, Central Signal Processor and Science Data Processor.

2.7 Systems other than the Telescope Manager

Though NCRA is planning to lead only the Telescope Manager consortium, close contact will be maintained with the consortia leading the other domain work. NCRA will also be involved directly, though at a lower level of participation, in the international consortia working on these elements, especially in Signal and Data Transport, Central Signal Processing and possibly Science Data Processing. Hence, responses are invited about interests in these other domains as well. The statement of work for these other domains can be found in the Work Breakdown Structure document in the RfP, and the respondents interests can be submitted through the SKA WBS spreadsheet.

3. Submission of Expression of Interest (EoI)

Expressions of Interest are invited from PSUs, autonomous bodies of the Government of India and Ministries with proven technical expertise, track record and experience in the design and development of a control and monitoring system, signal transport, signal processing (hardware and software) etc for large and complex science projects at the international level. Experience in astronomy projects will be useful, but is not mandatory.

EoI should take the form of filled-in documents, viz., the SKA WBS spreadsheet and the SKA TM spreadsheet. Interested parties will have to indicate the specific topics in these spreadsheets they are potentially interested and have the relevant expertise in. These are for level 4 tasks for the entire SKA for all elements, and at the level 5 for the Telescope Manager. When submitting additional documents to substantiate the level of expertise in the area, information specific to the topics selected in these spreadsheets should be given.

Following the response to this request for EoI, eligible parties will be short-listed by an expert committee. The expert committee may seek clarifications on specific aspects from respondents to

the EoI. NCRA will then invite bids for actual contract of work towards the Telescope Manager tasks from this short-list of organisations, along with work for the other SKA Elements. These companies will then be invited to submit technical and price bids which will be evaluated by a committee.

The deadline for submission of the response to this advertisement is **14th May 2015 6 pm**.

3.1 Contact information

For clarifications:

Please contact The Dean, GMRT Observatory (deangmrt@ncra.tifr.res.in), NCRA-TIFR, Pune

Postal Address:

National Centre for Radio Astrophysics (NCRA)
Tata Institute of Fundamental Research
University of Pune Campus,
Post Bag 3, Ganeshkhind,
Pune 411007
Tel - 020 2571 9000/9111
Fax - 020 2569 2149

3.2 Methodology of submission and Qualification

- 1 Sealed Expression of Interest shall be submitted in the format specified in the Cover Letter, enclosing documents listed below and any other documents that would help in the evaluation of the EOI. The deadline for submission is **14th May 2015**, 6 pm IST.
 - a Filled-in cover letter
 - b Filled in spreadsheets (SKA TM Spreadsheet and SKA WBS Spreadsheet)
 - c Technical staff strength in all relevant categories
 - d Details of past experience of the organisation in executing similar work, including work related to large national or international science projects. This should be accompanied by a brief technical description of the work done as well as details of meeting target deadlines in terms of time and cost. This should include details of past experience in either or both of (1) contracts for deliverables and (2) deputing manpower on site.
 - e Appreciation letters from clients as well as their contact information

In addition, soft copies of the two filled-in spreadsheets (SKA TM Spreadsheet and SKA WBS Spreadsheet) should be emailed to dirncra@ncra.tifr.res.in before the submission deadline, with the subject line “SKA EoI <organisationname>” where

<organisationname> is the name of your organisation.

- 2 The EOI should be printed on company stationery and the authorized person who signs the offer is required to indicate his/her e-mail ID, mobile no. and also general e-mail ID for easy and fast communication.
- 3 The envelopes for EOI shall bear the following: “Expression of Interest - Stage 2 of Pre-construction Phase of the SKA Project”, and name and address of the respondent organisation. It shall be addressed to:

THE CENTRE DIRECTOR,
National Centre for Radio Astrophysics
NCRA-TIFR
University of Pune Campus,
Post Bag 3, Ganeshkhind,
Pune 411007

3.3 Eligibility Criteria and Qualification Process

- 1 Any Public Sector Unit (PSUs), and autonomous bodies and ministries under the central or state government can apply to this request for an EOI
- 2 The EOI envelopes shall be opened after the submission deadline.
- 3 The EOI will be evaluated by an Expert Committee. Mere submission of EOI will not entitle a respondent to get selected to the tendering stage. The criteria for qualifying for the tender evaluation stage shall include, but are not limited to the following :
 - The respondent should have been in existence for a period of 5 years prior to the issue of this advertisement.
 - The respondent should have executed at least two projects at a similar scale (supporting documents must be included). This condition can be relaxed for respondents who have been involved in science projects of a similar nature.
 - The respondent should have carried out scientific projects using their own manpower similar to the project described in this document.
 - The respondent must have the necessary infrastructure, trained personnel and in-house expertise for the project infrastructure, in-house facilities and experience for design, manufacture, integration, testing and packaging the product.
 - The respondent must have well defined quality policy and assurance program.
 - The respondent should have a well defined plan for the creation of the product and organizational structure for project planning, monitoring, schedule

- tracking, corrective measures etc.
- The responses provided under Sec 3.2 (1)
- The EOI submitted by the respondent shall be complete in all respects and shall include all details asked for in the previous section.

During the shortlisting process, NCRA-TIFR may ask respondents to clarify certain issues that are not described in the EoI in sufficient detail. All respondents will be informed of the results after the shortlisting process.

- 4 Following the shortlisting based on this EoI, NCRA will announce a limited tender process for the work to be contracted.

3.4 Process Schedule

Date of this announcement	13 th April 2015
Deadline for receiving EoI	14 th May 2015
Intimation of results of qualification of respondents	30 th June 2015
Standard tendering process	To be announced after 30 th June 2015