Report on Validation of the SKA Site Selection Process

Summary

In accordance with its Terms of Reference, the SKA Siting Group (SSG) has conducted a validation of the SKA site selection process that has concluded with a Report and Recommendation for a preferred site of the SKA from the SKA Site Advisory Committee (SSAC).

The SSG attests, without qualification, that the agreed site selection process, as described in the Revised Plan for SKA Site Selection, was followed, thereby validating the SKA site selection process.

The SSG concludes that:

- The SSAC adhered to the Evaluation Plan, dated 2 November 2011, in the conduct of all SSAC business; and
- The SSAC has discharged its responsibilities, as described in the Terms of Reference and Rules of Procedure for the SKA Site Advisory Committee and interpreted and clarified in the Evaluation Plan, in submitting to the SSG a motivated recommendation for a preferred site.

Consequent to the validation of the process, the SSAC Report and Recommendation is to be transmitted to the Board of Directors of the SKA Organisation.

The present report on process validation fulfills the last of the SSG objectives, and therefore denotes the end of SSG oversight of the site selection process.

We invite the Board of Directors of the SKA Organisation to determine when the SSG’s Terms of Reference are concluded and take the action to formally disband the SSG.

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Introduction

The SKA Siting Group

The SKA Siting Group (SSG) was established in October 2010 by the Agencies SKA Group (ASG) and the SKA Science and Engineering Committee (SSEC) to assist in the final site selection process. The initial Objectives, Working Approach, Membership, Conflict of Interest, and Resources of the SSG were defined in the Terms of Reference for the SKA Siting Group (Attachment A) approved by the ASG in agreement with the SSEC and updated in the Revised Plan for SKA Site Selection, approved by the SKA Founding Board (the successor to the ASG) in agreement with the SSEC on 20 May 2011, and adopted by the initial Full Members of the SKA Organisation (the successor to the Founding Board) in December 2011. Following the termination of the SSEC on 31 December 2011, the SSG is solely a working group of the SKA Organisation.

Table 1: SSG Members and Resource Liaisons

<table>
<thead>
<tr>
<th>Vernon Pankonin, Chair</th>
<th>Yervant Terzian</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSF, USA</td>
<td>Cornell U., USA</td>
</tr>
<tr>
<td>Simon Berry</td>
<td>Patricia Vogel</td>
</tr>
<tr>
<td>STFC, UK</td>
<td>NWO, NL</td>
</tr>
<tr>
<td>Russ Taylor</td>
<td>Anton Zensus</td>
</tr>
<tr>
<td>U. Calgary, CA</td>
<td>Max Planck Institute for Radioastronomy, DE</td>
</tr>
<tr>
<td>Adjunct Member:</td>
<td></td>
</tr>
<tr>
<td>Richard Schilizzi</td>
<td></td>
</tr>
<tr>
<td>Director, SKA Program Development Office</td>
<td></td>
</tr>
<tr>
<td>ANZ Resource Liaisons:</td>
<td>RSA Resource Liaisons:</td>
</tr>
<tr>
<td>Michelle Storey</td>
<td>Bernard Fanaroff</td>
</tr>
<tr>
<td>Brian Boyle</td>
<td>Adrian Tiplady</td>
</tr>
</tbody>
</table>

Note: Richard Schilizzi’s participation on SSG ended with his retirement as Director, SPDO, on 31 December 2011.

The objectives of the SSG, as updated by the Revised Plan for SKA Site Selection are to:

- Establish a Roadmap to site selection and manage the implementation of the roadmap up to the issuance of a report and recommendation from the SSAC on the preferred site;
- Establish scientific and technical criteria and non-scientific/technical criteria and selection factors applicable to both sites to be used for identifying a preferred site, and which are in the best interests of the SKA as an international scientific facility;
- Provide oversight of the site selection evaluation, which is to be conducted by the SSAC and defined in the SSAC Evaluation Plan approved by the SKA Founding Board on 16 November 2011; and to
- Validate adherence to the agreed site selection process and transmit the report and recommendation on the preferred site to the Board of Directors of the SKA Organisation.
There are five documents that define and govern the conduct and implementation of the site selection process.

1. **Terms of Reference for the SKA Siting Group (SSG);** approved 27 October 2010 by the ASG and the SSEC. (Attachment A)
2. **A Revised Plan for SKA Site Selection;** approved 20 May 2011 by the SKA Founding Board and agreed by the SSEC. (Attachment B) Some provisions in this Revised Plan supersede elements of the SSG ToR.
3. **Terms of Reference and Rules of Procedure for the SKA Site Advisory Committee (SSAC);** approved 17 July 2011 by the SKA Founding Board and agreed by the SSEC.
4. **SKA Site Advisory Committee (SSAC) Evaluation Plan;** approved 16 November 2011 by the SKA Founding Board and agreed by the SSEC. (Attachment C) The ToR for the SSAC (item 3) is included as appendix 5 of this Evaluation Plan.
5. **Request for Information from the Candidate SKA Sites (RfI).** The SSG circulated a draft of the RfI to the Candidate Sites, with copies to the ASG and the SSEC in early March 2011. After receiving comments on the draft, the SSG issued the Request for Information in final form on 25 June 2011, with clarifying revisions to Annex 1 on 03 September 2011. (Kept in the document archive.)

The end products of the process are the SSG Report on Validation of the Site Selection Process and the Report and Recommendation on a preferred site for the SKA from the SKA Site Advisory Committee (SSAC).
The SKA Site Selection Process

In its Terms of Reference, the SSG was charged with developing a schedule for the site selection process. The timeline and schedule went through a number of iterations with consultations with the Candidate Sites and the ASG/Founding Board. Table 2 displays the activity timeline as agreed in the Revised Plan for SKA Site Selection, with actual dates added:

<table>
<thead>
<tr>
<th>ACTIVITY</th>
<th>Planned Dates</th>
<th>Actual Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition of Data/Information</td>
<td>1 Mar – 15 Sep 2011</td>
<td>1 Mar – 15 Sep 2011</td>
</tr>
<tr>
<td>Analysis of Data/Information by expert panels/consultants</td>
<td>1 Jul – 1 Nov 2011</td>
<td>1 Jul – 30 Nov 2011</td>
</tr>
<tr>
<td>Validation</td>
<td>1 Jan – 15 Jan 2012</td>
<td>1 Feb – 14 Feb 2012</td>
</tr>
<tr>
<td>SKA Governing Board Activities</td>
<td>15 Jan – 29 Feb 2012</td>
<td>16 Feb -- TBD by the SKA Organisation</td>
</tr>
<tr>
<td>SKA Governing Board (Members): Makes site decision.</td>
<td>- 29 Feb 2012</td>
<td>TBD by the SKA Organisation</td>
</tr>
</tbody>
</table>

SSG: Vernon Pankonin, Chair; Simon Berry; Russ Taylor; Yervant Terzian; Patricia Vogel; Anton Zensus.
Review of the Process by Activity (as listed in Table 2)

1.0  SSG: Establish Roadmap

The SSG prepared a Roadmap for SKA Site Selection and submitted it to the ASG and the SSEC for their consideration at meetings in Rome at the end of March 2011. The SSEC approved the document, but the ASG did not. The ASG asked the SSG to rework the timeline to shorten and streamline the process. The schedule of activities presented in the Roadmap was superseded by the Revised Plan for SKA Site Selection in May 2011. The Roadmap document presented to the ASG/Founding Board and the SSEC in March 2011 is maintained in the document archive.

2.0  SSG: Establish Site Selection Factors

An objective of the SSG is to “Establish scientific and technical criteria and non-scientific/technical criteria and selection factors applicable to both sites to be used for identifying a preferred site”. This objective was approached by dividing the SSG into two sub-groups, one to consider the Science and Technical Factors, and the second to consider the Other Factors.

The appropriate Science and Technical Factors had to cover the entire frequency range of the SKA and aimed at maximizing the scientific performance of the instrument. They included the RFI levels at the core sites and remote stations, the long term RFI environment and the protection of the radio quiet zones. In addition, the array configuration was included as a major factor since it defines the scientific performance of the SKA. The ionospheric turbulence was a factor because of its critical importance for the low-frequency observations, and the tropospheric turbulence was a factor because of its importance to the higher-frequency observations. The characteristics of the sites were also important factors in order to maximize the performance of the array. All of these factors were included in the earlier assessment by the International SKA Steering Committee (ISSC) in 2006 when a short list of acceptable sites was selected.

The weights of the Science and Technical Factors were established by the SSG in consultation with the Candidate Site liaisons and the SSEC. The weights, as detailed in the Terms of Reference of the SSAC, were approved by the SSEC at its meeting of 4 July 2011 and by the SKA Founding board at its meeting of 5 July 2011.

The “Other Factors” sub-group convened a workshop in December 2010 which was attended by all SSG members and four experts selected for their experiences with siting of large international projects. The principal intent of the workshop was to brainstorm the overall site selection process with the objective of developing a list of Other Selection Factors.

Thoughts from the workshop were refined further with detailed discussion within the SSG about relative importance of the criteria, within each category of factors, and then between the categories. The SSG then used its conclusions as the basis for a proposed list of criteria for presentation to the ASG and SSEC. In parallel, the proposed criteria were used in the development of the draft Request for Information.

The SSG presented the proposed site selection factors in a report, *Establishment of the SKA Site Selection Factors*, to the Founding Board and SSEC on 25 March 2011. In the resulting discussion, the SSEC approved the Site Selection Factors, but the ASG/Founding Board did not. The report to ASG and SSEC on the *Establishment of the SKA Site Selection Factors* is maintained in the document archive. The material in this report was superseded by the *Revised Plan for SKA Site Selection* in May 2011.

**Revised Plan for SKA Site Selection**

The SSG prepared a *Roadmap for SKA Site Selection* and a *Report on Establishment of SKA Site Selection Factors* and submitted both to the ASG and the SSEC for their consideration at meetings in Rome at the end of March 2011. The documents were approved by the SSEC, but not by the ASG/Founding Board. Based on the reactions received from participants at the ASG/Founding Board meeting, the SSG performed a thorough review of all of its activities and thinking to this point.

Consequent to its review, in a *Revised Plan for SKA Site Selection*, SSG proposed substantive changes to the site selection process, with the goal of addressing three principle concerns:

1. To streamline the process and shorten the timeline proposed in the original Baseline Roadmap – in order to respond to concerns on the overall process schedule;
2. To take account of the likelihood that SKA site selection will eventually enter the political arena; and
3. To ensure that the process retains the integrity of a technical and defensible assessment of the qualities of the candidate sites.

In the *Revised Plan for SKA Site Selection* (Attachment B), an update of the process towards site selection is described, including further detailing of the role of the SSG, the modified role of the SSAC, the SKA Site Selection Timeline, the Science and Technical Selection Factors, Other Selection Factors and Implementation Plans and Costs. A further update of the Timeline (SSAC Schedule) is published in the *SSAC Evaluation Plan* (Attachment C).

The *Revised Plan for SKA Site Selection* included a Reconsideration of the SKA Site Selection Factors and Weights (included as Attachment 2 in the Plan). The Reconsideration of the SKA Site Selection Factors and Weights included the rationale for changes in weights from those originally proposed and for not applying weights to the implementation Plans and Costs category of selection factors. While the SSG views the information contained in the implementation plans and costs as very important to an informed decision on the preferred site, it notes i) that there will be relatively greater uncertainties in the information on plans and costs than for Science &Technical and Other Selection Factors. This makes it inappropriate to apply numerical comparison techniques based on weights to the plans and costs. ii) The costs of the implementation plans to the project are likely to be the subject of negotiations concerning a possible host country premium. The selection factor categories and weights and the individual selection factors and their weights are displayed in Tables 3 and 4, respectively.

<table>
<thead>
<tr>
<th>Table 3 – Weights for the three Selection Factor Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category</strong></td>
</tr>
<tr>
<td>A. Science and Technical Factors</td>
</tr>
<tr>
<td>B. Other Selection Factors</td>
</tr>
<tr>
<td>C. Implementation Plans and Costs</td>
</tr>
</tbody>
</table>

SSG: Vernon Pankonin, Chair; Simon Berry; Russ Taylor; Yervant Terzian; Patricia Vogel; Anton Zensus.
Table 4 – Individual Selection Factors and Weights

<table>
<thead>
<tr>
<th>Factor # (1)</th>
<th>Factor Name</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1 Ionospheric turbulence</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>2 RFI measurement</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>3 Radio Quiet Zone protection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Long term RFI environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5 Array science performance</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>6 Physical characteristics of the sites</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>7 Tropospheric turbulence</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>8 Political, socio-economic and financial</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>9 Customs and Excise</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>10 Legal</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>11 Security</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>12 Employment</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>13 Working and support environment</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>14 Provision and cost of infrastructure components based on the Model of the SKA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>15 Provision and cost of internal and external data transport based on the Model of the SKA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>16 Provision and cost of electrical power based on the Model of the SKA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>17 Consolidated costs of capital and operations expenditures</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Note 1: Category A = Factors 1-7 = 75%.
Category B = Factors 8-13 = 25%.
Category C = Factors 14-17 no weight assigned.

The Revised Plan for SKA Site Selection was presented to the SKA Founding Board in May 2011, and approved by the Founding Board, with the agreement of the SSEC, 20 May 2011. At this point, the Founding Board unanimously reconfirmed the SSG and its mandate.

3.0 Acquisition of Data/Information

Request for Information from the Candidate SKA Sites

The Request for Information from the Candidate SKA Sites (RfI) is the key document in the process that defines the information to be provided by each site for analysis by the expert panels and consultants and for assessment and evaluation by the SSAC. The RfI, the sites’ responses, questions from expert panels, consultants, and the SSAC, and the responses are maintained in the document archive.
The Candidate Sites to host the SKA are:

- Australia, together with New Zealand (ANZ)

The RfI is an SSG document. Therefore, the SSG is accountable for its content and for interpretation and resolution of any issues. The document was prepared under the leadership of the SPDO Director. A draft was circulated to the Candidate Sites, with copies to the ASG and the SSEC for information, in March 2011. Following the receipt of comments from both Candidate Sites, the SSG issued the final version of the RfI to the Candidate Sites on 25 June 2011. A minor revision for clarification was made to one Annex on 3 September 2011. Both Candidate Sites met the due date of 15 September 2011 for their responses to the RfI.

4.0 Analysis of Data/Information

The Revised Plan for SKA Site Selection (in its Attachment 3) outlines the plan to involve expert panels and consultants in analyzing data and information from measurements at the sites and from material submitted by the Candidate Sites in response to the RfI. The terms of reference for the expert panels and their membership, and the charges to the consultants and their identities were provided to the ASG and the SSEC for information, and are maintained in the document archive.

The expert panels and consultants were charged with analyzing data and information; they were not to reach any conclusions on which site was better. The Director and SPDO employees provided technical advice to the expert panels and consultants as needed and requested. During the course of analysis by the expert panels, consultants, and the SSAC, questions on the Candidate Sites responses to the RfI arose. These questions and the Candidate Sites’ responses were transmitted to the appropriate recipient via the SSG. The questions and responses are maintained in the document archive.

The SSG tracked the preparation and submission of the expert panel and consultant reports against the schedule. The tracking document is maintained in the document archive. As noted in the tracking document, there were instances where reports from expert panels or consultants were not submitted by the due date. However, none of the delays impacted the schedule of the SSAC evaluation process.

The SSAC was responsible for assessing the reports from the SPDO, expert panels, and consultants. They note in their report where they disagreed with experts’ reports and where they performed complementary analyses of data.
5.0 Data/Information Evaluation

SKA Site Advisory Committee

The SKA Founding Board (FB), with the agreement of the SSEC, established the SKA Site Advisory Committee (SSAC). The SSAC was tasked with (a) reviewing the data and information obtained on the Candidate Sites; (b) assessing reports by expert panels, consultants and the SKA Program Development Office (SPDO), (c) carrying out an evaluation of the strengths and weaknesses of the sites, and (d) formulating a recommendation on a preferred site for the SKA.

The SSAC operated under the Terms of Reference and Rules of Procedure for the SKA Site Advisory Committee (SSAC) with Appendix 5 updated on 17 July 2011, and Attachment 3 updated on 3 September 2011. The SKA Site Advisory Committee (SSAC) Evaluation Plan describes how the material on, and reports from, the two Candidate Sites, expert panels, and consultants will be evaluated. The SSAC Evaluation Plan was approved by the SKA Founding Board on 16 November 2011, and agreed by the SSEC.

According to the Terms of Reference, in chronological order, the SSAC was to:

1. Prepare a plan by which the data/information and reports from the Candidate Sites, expert panels and consultants will be evaluated. Submit the evaluation plan to the SSG for approval, which will in turn obtain concurrence with the plan from the Founding Board/Governing Board.
2. Assess the available data/information and reports from the Candidate Sites, expert panels and consultants.
3. Evaluate the strengths and weaknesses of the data/information on the selection factors, including the implementation plans and the infrastructure and operations related costs.
4. Based on the evaluation, prepare a report that provides the basis for the recommendation on a preferred site.
5. Recommend a preferred site for SKA.
6. Transmit the report and recommendation to the SSG, which would validate that the agreed process has been followed and transmit the report/recommendation to the SKA Governing Board.

Members of the SSAC were appointed by the SKA Founding Board (FB) with the concurrence of the SKA Science and Engineering Committee (SSEC). The Chair was appointed by the FB with the concurrence of the SSEC. The members were selected to ensure appropriate expert coverage of the site selection factors. The members, with biographies, are listed in Attachment D.

From the SSAC Rules of Procedure, the SSG had an oversight and monitoring role with respect to the functioning of the SSAC. At least one SSG full member would attend all SSAC meetings and telecon/videocons as observer(s).

The SSG’s role was to monitor the work of the SSAC and validate that it adhered to the process and procedures described in the Evaluation Plan. SSG members were observers at SSG meetings to carry out this monitoring role. SSG Observers at meetings, as well as other invitees, including the SPDO Director, also served as resources on process and technical matters as needed.
Before beginning Committee deliberations, each SSAC member signed a statement of *Declarations Regarding Conflicts-of-Interest, Bias, Confidentiality, and Non-Disclosure*. Attachment E is the form the SSAC members signed. The complete file of signed forms is in the document archive.

The SSAC were not isolated from the world during the course of their business. They were aware of media material and lobbying efforts related to the siting of the SKA and sometimes shared such information with other members. The SSG observers at all meetings and telecons noted that all SSAC discussions and deliberations were restricted to material with which they were provided.

At the beginning of their business, SSAC members were advised not to engage with the media on SKA siting, and to refer any media contacts to the SSG Chair. The SSG Chair received a few contacts from media, but they were relatively innocuous, such as whether the SSAC meetings were open to the public (the meetings were not open).

SSAC meetings

The SSAC met three times face-to-face and held four teleconferences during the Committee process as listed below in summaries. There were SSG Observers at each meeting and telecon as noted below. In every case, meetings and discussions were conducted in accordance with the *Evaluation Plan* (see Attachment C). The meeting agendas and full minutes are in the document archive. In addition, subgroups of the Committee held various discussions via email and teleconferences in conducting their assessments of the expert panel and consultant reports on the site selection factors. The sub-group discussions were not minuted.

Meeting Summaries (excerpted from the SSAC Report and Recommendation)

**September 8–9, 2011**      SSAC Meeting, AUI, Washington DC

The SSAC made significant progress on the content of the Evaluation Plan and agreed the processes for conducting the business of the SSAC. In addition, the SSAC was given an overview by the SPDO Director (Richard Schilizzi) of the materials to be provided to the SSAC grouped by selection category – Science and Technical, Other Selection Factors, and Implementation Plans and Costs.

*Present:* Subramaniam Ananthakrishnan; Jaap Baars; Roger Brissenden; Wim Brouw; Ian Corbett; Thomas Garvin; Stefan Michalowski; James Moran; Vernon Pankonin (SSG Observer); Richard Schilizzi (SPDO); Ernest Seaquist; Russ Taylor (SSG Observer); Peter Tindemans; Jacqueline Van Gorkom (by phone);

*Absent:* Jocelyn Bell Burnell, Paul Gilbert

**November 11, 2011**       Telecon: 15–17 UT

The majority of the review material was provided to the SSAC by November 11, 2011 and the in-depth reviews for each Factor were well under way. During the call the SSAC heard a status report from the SPDO Director on the remaining outstanding documentation, and from each of the Factor leads on the
status of their working group’s review, and any preliminary impressions, strengths and weaknesses based on the material received and reviewed to date.

**Present:** Subramaniam Ananthakrishnan, Jaap Baars, Jocelyn Bell Burnell, Simon Berry (SSG Observer), Roger Brissenden; Wim Brouw; Ian Corbett, Jim Crocker, Thomas Garvin, Stefan Michalowski, James Moran, Richard Schilizzi (SPDO; for agenda items 1–4), Ernest Seaquist, Peter Tindemans, Jacqueline Van Gorkom

**November 28, 2011**

Telecon: 15–17 UT

The telecon was held to discuss the progress of the review of the material and finalize the written list of questions for the site teams in advance of the December 6–9 meetings in London. Questions were submitted to SSG for forwarding to the site teams as planned, seven days before the December meetings.

**Present:** Subramaniam Ananthakrishnan, Jaap Baars, Jocelyn Bell Burnell, Roger Brissenden, Wim Brouw, Ian Corbett, Jim Crocker, Thomas Garvin, James Moran, Ernest Seaquist, Yervant Terzian (SSG Observer), Peter Tindemans, Jacqueline Van Gorkom, Patricia Vogel (SSG Observer)

**Absent:** Stefan Michalowski

**December 6–9, 2011**

SSAC Meeting, Institute of Physics, London

The SSAC met to discuss the status of the review of the various Factors and review and formulate any additional questions of clarification for the sites, received site candidate presentations and conducted half-day interviews with both Site Delegations, conducted voting on all Factors in Sections A and B, and determined the strengths and weaknesses of all Section C Factors.

**Present:** Subramaniam Ananthakrishnan, Jaap Baars, Jocelyn Bell Burnell, Simon Berry (SSG Observer; Dec 7–8) Roger Brissenden, Wim Brouw, Ian Corbett, Jim Crocker (via video conference), Thomas Garvin, Stefan Michalowski, James Moran, Vern Pankonin (SSG Observer), Ernest Seaquist, Russell Taylor (SSG Observer), Peter Tindemans, Jacqueline Van Gorkom

**January 11, 2012**

Telecon: 15–18 UT

The SSAC reviewed the additional responses to questions received from the ANZ delegation and final reports on RFI impact at remote site stations for RSA, reviewed all Factors in light of the new material, and discussed the ongoing review of the various Factors, and made plans for report writing.

**Present:** Subramaniam Ananthakrishnan, Jaap Baars, Jocelyn Bell Burnell, Roger Brissenden, Wim Brouw, Ian Corbett, Jim Crocker, Thomas Garvin, Stefan Michalowski, James Moran, Vern Pankonon (SSG Observer), Ernest Seaquist, Russell Taylor (SSG Observer; joined ~16 UT), Peter Tindemans, Jacqueline Van Gorkom.
The SSAC conducted a detailed review of the various Factors in Sections A and B and the Section C Factors, discussed the issues presented and reviewed the first rough draft Report and reached agreement on all outstanding issues and open items. Agreement was reached on the final recommendation and plans set for the final edits and final reviews to the final version of the Report leading to submission of the Final report to the SSG in February 2012.


February 11, 2012 Telecon: 15–17.30 UT

The SSAC reviewed the final draft of the Report and concurred with its submission to the SSG for validation of process.

Present: Subramaniam Ananthakrishnan, Jaap Baars, Jocelyn Bell Burnell, Roger Brissenden, Ian Corbett, Jim Crocker, Thomas Garvin, Stefan Michalowski, James Moran, Vern Pankonin (SSG Observer), Ernest Seaquist, Peter Tindemans, Jacqueline van Gorkom;
Absent: Wim Brouw.

Material for the SSAC

The material to be made available to the SSAC is listed in the Evaluation Plan. Expert panels were formed and consultants identified to analyze data from measurements at the sites and material submitted by the Candidate Sites. The terms of reference for the expert panels and consultants and their reports are included in the document archive. Table 5 shows the information received and reviewed by the SSAC during its deliberations (excerpted from SSAC Report and Recommendation).

<table>
<thead>
<tr>
<th>Information Provided to SSAC</th>
<th># Files</th>
<th># Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>RfI, Terms of Reference (SSG, SSAC) and related documents</td>
<td>20</td>
<td>230</td>
</tr>
<tr>
<td>Australian and New Zealand response to RfI</td>
<td>1</td>
<td>1,134</td>
</tr>
<tr>
<td>South African response to RfI</td>
<td>1,090</td>
<td>21,328</td>
</tr>
<tr>
<td>SPDO and Expert reports and reference material</td>
<td>2,134</td>
<td>6,346</td>
</tr>
<tr>
<td>SKA Siting documentation from 2004 RfP and subsequent proposals</td>
<td>15</td>
<td>867</td>
</tr>
<tr>
<td>Interview presentations and responses to questions from ANZ and RSA</td>
<td>17</td>
<td>496</td>
</tr>
<tr>
<td>Responses to questions posed to the SSG as part of the present work of the committee following the process defined in the SSAC Evaluation Plan</td>
<td>11</td>
<td>27</td>
</tr>
<tr>
<td>Total</td>
<td>3,288</td>
<td>30,428</td>
</tr>
</tbody>
</table>
The SSG had the role of intermediary for all communications between the SSAC and the Candidate Sites, the SKA Program Development Office (SPDO), and the SKA Founding Board. The Candidate Sites’ responses to the Request for Information were submitted to the SSG. The SSG then forwarded the submissions in their entirety to the SSAC. The SSG, via the SPDO, distributed components of the submissions to the Expert Panels and the Consultants as appropriate to their charges. The SSG elected to withhold one document in the South African submission from the consultant because the document was not appropriate to the consultant’s task.

While the SSAC received all submissions from the Candidate Sites, the SSAC, under their own authority, declared one document submitted by RSA and one submitted by ANZ to be out of scope and not to be considered in their evaluation. The sites were informed of this decision, and the decision is noted in the SSAC Report. All materials, including those the SSAC excluded from consideration, are in the document archive.

6.0 Validation

SSG Findings

The SSAC scored selection factors 1-13 according to the procedure described in the Evaluation Plan. The scoring was subjected to a number of tests to validate the robustness of the result. The robustness testing is described in an attachment to the SSAC report. The SSG concludes that the tests demonstrate the scoring to be robust.

In the SSG ToR it is stated: “The SSG will review the report for adherence to the principles of fairness, impartiality, transparency, and freedom from governmental influence, and for compliance with the agreed process in carrying out the site selection analysis;”

The SSAC Evaluation Plan, which established the process for the SSAC in evaluating the material with which it was provided, was submitted to the Founding Board for approval in advance of initiating the evaluation phase. This established a fair and transparent process that was followed.

The SSAC ToR addresses interactions with Candidate Site representatives and government agencies. In observing the process, the SSG saw no evidence that this provision was violated. All interactions between the SSAC and the Candidate Sites were via the SSG, except for the interviews.

The attendance lists of meetings and telecons and SSG observations attest that all SSAC members were engaged in all substantive discussions and all conclusions. The SSG notes the robustness tests applied by the SSAC to the voting patterns as evidence of adherence to principles of fairness, impartiality, and transparency. All SSAC members participated in the meeting at which they arrived at the final conclusions, and a recommendation was reached by consensus.

The procedure followed by the SSAC was governed by a set of given parameters. They were given a set of selection factors on which to base the evaluation of the material provided, and they were given weighting factors to apply to the selection factors. The selection factors and weights were established by the SSG and approved by the SKA Founding Board and the SSEC.

SSG: Vernon Pankonin, Chair; Simon Berry; Russ Taylor; Yervant Terzian; Patricia Vogel; Anton Zensus.
Contained in the SSAC Evaluation Plan is the statement “The SSAC is tasked with reviewing the material obtained on the Candidate Sites, assessing reports by expert panels and consultants, carrying out an evaluation of the strengths and weaknesses of the sites, and formulating a recommendation on a preferred site for the SKA, or if it is not possible, the SSAC may recommend an alternative solution for study.”

From the SSAC Terms of Reference: “The site recommendation from the SSAC must be based on the material with which it is provided on the Science and Technical Selection Factors, the Other Selection Factors, and on the Implementation Plans and Costs. This material is supported by reports of expert panels, consultants, the SKA Program Development Office (SPDO), and a Sub-set of the SSEC.”

Contained in the Terms of Reference for the SSG and included in the SSAC Terms of Reference is the statement: “The analysis and evaluation should be open to a variety of site selection solutions, if the data and information support them.” This statement should be a working premise for the SSAC, but with emphasis on the dictum that however the recommendation is formulated it must be based on the data and information in the material with which the SSAC is provided.

Following the principles expressed in the foregoing four paragraphs, and from observing the process, the SSG finds

• that in arriving at its conclusions, the SSAC confined its evaluations to the material that was provided, as it relates to the Model SKA, and to the Committee members’ own experiences and expertise.

• that the material led to the identification of a single preferred site and did not motivate the SSAC to suggest an alternative solution for study.

• that the SSAC recommendation on a preferred site is based on the material with which it was provided.
SSG Conclusions

The SSG attests, without qualification, that the agreed site selection process, as described in the Revised Plan for SKA Site Selection, was followed, thereby validating the SKA site selection process.

The SSG concludes that:

- The SSAC adhered to the Evaluation Plan, dated 2 November 2011, in the conduct of all SSAC business.
- The SSAC has discharged its responsibilities, as described in the Terms of Reference and Rules of Procedure for the SKA Site Advisory Committee and interpreted and clarified in the SSAC Evaluation Plan, in submitting to the SSG a motivated recommendation for a preferred site.

Consequent to the validation of the process, the SSAC Report and Recommendation is to be transmitted to the Board of Directors of the SKA Organisation.

The present report on process validation fulfills the last of the SSG objectives, and therefore denotes the end of SSG involvement in the site selection process.

We invite the Board of Directors of the SKA Organisation to determine when the SSG’s Terms of Reference are concluded and take the action to formally disband the SSG.

We recommend that the SKA Organisation Company Secretariat maintain the SSG and SSAC wiki sites as the Document Archive for the historical record of the materials associated with this site selection process.

We recommend that the SKA Organisation ensures that these materials remain confidential, outside of the SKA Organisation, until after the site decision is made. Some of the material submitted by the candidate sites in the course of the process is considered corporate confidential and is so labeled by the submitter. This material should remain confidential even if other material is made public.

In recognition of the need for confidentiality, the SSAC Report and Recommendation is to be transmitted directly and solely to the Chair of the Board of Directors of the SKA Organisation under password protection.
Acknowledgements

We appreciate the significant effort the Candidate Site teams devoted to this site selection process. We thank the teams for their cooperation and timely responses to the Request for Information, subsequent questions from the SPDO and the SSAC, and the presentations to the SSAC.

The site selection activities could not have been accomplished without the considerable support of Richard Schilizzi and his team at the SPDO. Until 31 December 2011, Richard served as an Adjunct Member of the SSG, and he played an essential role in setting up the expert panels and the consultants and in distributing the voluminous material to the appropriate recipients.

We commend the SSAC for diligent and conscientious effort in carrying out tasks and meeting responsibilities, and particularly for adhering to schedule under pressure of the time constraints.

Attachments (also in the document archive)

A. Terms of Reference for the SKA Siting Group (SSG)
B. A Revised Plan for SKA Site Selection
C. SKA Site Advisory Committee (SSAC) Evaluation Plan (which includes the SSAC ToR)
D. SSAC members including bios
E. SSAC member Declarations Regarding Conflicts-of-Interest, Bias, Confidentiality, and Non-Disclosure

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For the SKA Siting Group
Simon Berry
Vernon Pankonin, Chair
Russ Taylor
Yervant Terzian
Patricia Vogel
Anton Zensus
Terms of Reference for the SKA Siting Group (SSG)

OBJECTIVES

Through an initial short listing process carried out under the auspices of the International SKA Steering Committee (ISSC), two sites were considered to be scientifically and technically acceptable to host the SKA. These sites are proposed by SKA African Partner Countries, led by South Africa, and Australia/New Zealand, and hereinafter referred to as “candidate host countries”. In order to assist in the final site selection process, the Agencies SKA Group (ASG) and the SKA Science and Engineering Committee (SSEC) hereby jointly establish the SKA Siting Group (SSG). The major objectives for the SSG are to:

1. Establish a roadmap to site selection and manage the implementation of the roadmap up to the issuance of a report and recommendation from the SSEC on the preferred site.

2. Establish scientific and technical criteria and non-scientific/technical criteria and selection factors applicable to both sites to be used for identifying a preferred site, and which are in the best interests of the SKA as an international scientific facility.

3. Provide oversight of the site selection evaluation which is to be managed by the SSEC; concurring with a plan prepared by the SSEC for the site evaluation prior to implementation, and receiving regular progress reports and the final report and recommendation from the SSEC.

4. Validate adherence to the agreed site selection process and transmit the report and recommendation on the preferred site to the SKA governing organization, that is in place at the time, for the site decision.
WORKING APPROACH

General

• The primary interest of the SSG is for the identification of the most suitable site for the SKA as an international scientific facility.
• In carrying out their work, the SSG members will adhere to principles of fairness, impartiality, transparency, and freedom from governmental influence in the site selection process.
• The SSG will be engaged in establishing the roadmap and the scientific and technical criteria and non-scientific/technical criteria and selection factors, and in gathering updated data and information from the candidate host countries.
• The SSG will not itself originate or develop solutions on a preferred site for SKA.
• SSG discussions will, to the extent practicable, be open and will include designated representatives from both candidate host countries.
• Certain SSG discussions will be closed in order to foster open and frank deliberations.
• The SSG Chair has the authority to declare discussions open or closed, in consultation with the SSG members.
• The Secretariat will maintain a record of SSG meetings and discussions.
• There are expected to be no direct communications between the SSG and the candidate host countries, except through the Resource Liaisons. Requests for data and information from both candidate host countries will be made through the SPDO.
• There will be no direct communications on siting matters between individual members of SSG and representatives of the candidate host countries.
• The SSG will regularly inform the ASG and SSEC of progress in the conduct of its business, and when appropriate, will request direction and guidance.

On the Roadmap

a. If a draft roadmap exists when the SSG is established, the SSG will adopt this draft as a basis and will make appropriate modifications before submitting the roadmap to ASG and SSEC for approval; otherwise SSG will start the development of a roadmap.

b. The roadmap should cover the time period from the formation of the SSG to site decision, recognizing that the process after the SSG receives the recommendation from the SSEC is still to be defined.

c. The roadmap will lay out the issues related to site selection that need resolution, milestones for acting in resolving issues and making decisions, the schedules for the process of site selection and for activities on which site selection depends, any deliverables, and the bodies responsible for the deliverables.

d. The roadmap will be approved by the ASG and the SSEC before it is implemented.
e. The roadmap should be in place, as approved, within six months of the establishment of the SSG, at the very latest.
f. The SSG will then manage the implementation of the roadmap.

On the Criteria and Selection Factors
a. The scientific and technical criteria applied in the short list process and those being considered by PrepSKA WP-3 will be reviewed by the SSG and updated as necessary.
b. Appropriate, relevant factors beyond the scientific and technical criteria should be established for consideration in identifying a preferred site. These will be referred to as non-scientific/technical criteria.
c. The scientific and technical criteria and the non-scientific/technical criteria must be defined so as not to exclude a variety of solutions for preferred site or sites for the SKA.
d. The SSG may appoint independent experts and consultants to assist with the establishment of the non-scientific/technical criteria.
e. The scientific and technical criteria and the non-scientific/technical criteria to be used for the broad analytical approach will be approved by the ASG and the SSEC before they are adopted.
f. The scientific and technical criteria and the non-scientific/technical criteria should be in place, as approved, within six months of the establishment of the SSG.

On the Site Evaluation
a. The SSEC will manage the process of evaluation of the data and information on both candidate sites in accord with a plan concurred in by the SSG, and based on the agreed criteria.
b. The SSEC may create a subcommittee or working group of the SSEC to carry out the data and information analysis.
c. SSEC members who are directly involved with the site evaluation shall not also be members of the SSG.
d. Independent experts, consultants, and advisory committees may be appointed to advise and assist the SSEC in carrying out the data and information analysis, including convening an independent advisory committee to analyze information and documentation available.
e. The data and information collected must be in a form such that they allow analysis and evaluation that could, if appropriate, lead to a variety of preferred site solutions.
f. The analysis and evaluation should be open to a variety of site selection solutions, if the data and information support them.
g. Based on the scientific and technical criteria and the non-scientific/technical criteria, the SSEC and duly appointed experts will utilize appropriate methods of Multiple Criteria Decision Making to undertake an analytical comparison of candidate sites.
h. The SSEC will utilize SPDO resources for carrying out the data and information analysis, as appropriate and required, including setting up the analytical comparative analysis.
i. The SSEC, any appointed experts, and advisory committees should base their analyses on:
   1. A review of the original site proposal documentation;
   2. A review of the documentation associated with the process overseen by the International SKA Steering Committee (ISSC) in arriving at a short list of candidate sites;
   3. Analyses performed during the short listing process;
   4. Close interaction with the SPDO which is coordinating PrepSKA activities in gathering and analyzing data on site qualification and characterization;
   5. Updated data and information requested and received from both candidate host countries;
   6. Information received from both candidate host countries as answers to any open questions;
   7. Discussion with authorized representatives of both candidate host countries, and if necessary, visits to both candidate sites.

On the Report and Recommendation,

a. The SSEC will:
   1. Provide a comprehensive report to the SSG summarizing the data and information analysis, which sets out the differences between the two sites based on the agreed criteria, and which provides the basis for a motivated recommendation on the preferred site;
   2. Make a motivated recommendation on a preferred site based on the accompanying comprehensive report.
   3. The report and recommendation of the SSEC should be made available to the SSG by 31 December 2011.

b. The SSG will convene an independent, expert site selection advisory committee to review the report and recommendation from the SSEC on the preferred site to ensure that the recommendation is appropriately motivated by the data and information available. The SSG will appoint the members of the committee, with nominations from the ASG and the SSEC, and giving due consideration to representation over a global geographical distribution.
   1. The Chair of the committee will be named by the SSG.
   2. The members of the committee will be selected for their expertise and experience in selecting sites for international scientific facilities, in particular astronomy facilities, and for their independence from governmental bodies and from candidate site host countries.
   3. The Members of the committee will be acceptable to both of the candidate host countries.
c. The SSG will review the report for adherence to the principles of fairness, impartiality, transparency, and freedom from governmental influence, and for compliance with the agreed process in carrying out the site selection analysis; and the SSG will then transmit the report and recommendation to the governing council of the SKA organization or its predecessor entity; with a goal of 31 January 2012 for transmitting the report and recommendation.

MEMBERSHIP
• There will be six members of the SSG. Three will be appointed by the ASG from the membership of the ASG, and three will be appointed by the SSEC from the membership of the SSEC.
• The SPDO Director will be an Adjunct Member\(^1\) of the SSG.
• The Chair of the SSG will be one of the ASG appointed members, and will be named by the ASG.
• The Members of the SSG will be acceptable to both of the candidate host countries.
• Countries directly involved with the two site proposals will not be Members of the SSG. One representative from Australia and one from South Africa will be designated as a Resource Liaison\(^2\) to the SSG.

CONFLICT OF INTEREST
• Any potential conflict of interest should be declared or identified immediately by candidate SSG Members. Any candidate SSG Member with a conflict of interest may not be an SSG Member. If a serving Member identifies or develops a conflict of interest, that Member will be replaced on the SSG.

RESOURCES
• Support resources, including the Secretariat, will be provided by the Members, as available.
• In the normal course of business, SSG Members will finance their own participation on the SSG.
• The SPDO will maintain a web-based repository for all documents of relevance to the site short listing process.

\(^1\) An Adjunct Member participates in all SSG activities, except some closed discussions at the discretion of the SSG Chair; and provides advice to, and assists, the SSG in its deliberations, but does not have a vote or a say in reaching consensus.

\(^2\) A Resource Liaison participates in open discussions of the SSG and responds to questions and requests for information that pertain to that Liaison’s area of direct knowledge about the candidate SKA site. Resource Liaisons do not participate in any closed discussions of the SSG.
MEMORANDUM

Date: 11 May 2011

To: SKA Founding Board
    SKA Science and Engineering Committee

Subject: A Revised Plan for SKA Site Selection

Summary:

Following events associated with the SKA meetings in Rome, where the SSEC approved the SSG Baseline Roadmap and Site Selection Factors but the ASG/Founding Board did not, the SSG has undertaken a critical examination of all of its foregoing work on defining the process that will lead to the determination of the preferred site for the SKA. In particular, the response of the sites to the SSG’s documents emphasized the need for this review.

Consequent to its review, the SSG recommends substantive changes to the site selection process that was previously proposed. These changes address three principal concerns:

1. To streamline the process and shorten the timeline proposed in our Baseline Roadmap;
2. To take account of the likelihood that SKA site selection will enter the political arena; and
3. Most important to us, the SSG, to ensure that the process retains the integrity of a technical and defensible assessment of the qualities of the candidate sites.

The SSG invites the Founding Board and the SSEC to approve the proposed changes in the process, and to re-affirm the SSG mandate.

Where We Are:

At the Rome meetings, the SSEC approved the plan for site selection presented by the SSG, but the ASG/Founding Board postponed action and requested that the candidate sites be given sufficient time to consider the documents and respond with detailed comments on the documents and the process. The chair of the ASG/FB further asked the SSG to review the selection plan with the aim of “refining the process”, increasing communication bandwidth, shortening the time to decision, and towards “making all parties broadly content” with the process. In comments at the meetings in Rome and in their written response to the SSG documents, some candidate site representatives expressed concern and criticism in several areas, including:

• the scope of the Request for Information (RfI)
• the volume of work needed to prepare the information in response to the RfI
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SKA Siting Group

- the proposed weights to be used in the process of making a decision on the site
- the proposed information-gathering approach relating to costs of delivering infrastructure and other elements, and the requested infrastructure implementation plans

Taken together, the concerns and criticisms highlight a number of areas of differing interpretation by the candidate sites who are required to provide the information on which the site selection process will be based. There is a view that the impact on science has been underemphasized and that the approach to be taken in identifying plans for infrastructure implementation has been structured in a way that will not deliver optimized plans. The SSG is clear in its view that both an assessment of how the candidate sites plan to deliver basic infrastructure (based on a model of how the full SKA might be realized) and cost of delivery are essential to the process. However, the SSG is concerned that the candidate sites in fact may shape their responses towards presenting implementation plans optimized for cost and not for scientific capability, despite the SSG’s intentions otherwise.

After a review of the Baseline Roadmap and Site Selection Factors documents, the SSG concludes that given the required time for adequate responses by the sites to the RfI, the review of the responses, the recommendation on a preferred site, and the final decision on the site by the FB/Governing Body/Council, little time can be saved overall unless significant changes to the process are adopted.

The SSG notes that the decision on the site seems on the cusp already of entering what we have termed the “turbulent phase”. Based on the investigation and benchmarking with other site selection processes, this “turbulent phase” involves high-level political and financial aspects, as well as considerations based on quantifiable technical, scientific, and other factors.

The SSG notes a further concern that has become increasingly apparent over the past few months. The current site selection process was modeled after the earlier site short-listing process in 2006, which involved the members of the International SKA Steering Committee (precursor to the SSEC) in an objective exercise to compare the sites. We are concerned that it may be increasingly difficult for a stakeholder/user-representative group such as the SSEC to be engaged in the type of process we have initially proposed and that the current methodology places a difficult burden on SSEC members in their role of advising on the preferred site. The SSG’s Baseline Roadmap included a step whereby an independent expert body provided analysis of the incoming information and expert panel and consultants’ reports. As a result of the concerns outlined above, the SSG recommends that this SKA Site Advisory Committee (SSAC) be charged with performing the assessment and evaluation of the data and information and with providing the motivated recommendation on a preferred site, rather than the SSEC. This change is reflected in the revised plan that is proposed below.

In its review, the SSG has considered a range of scenarios, including minimal change to the current process, to proceed towards the site selection in a manner that adequately addresses the criticisms and concerns. A merely incremental change of the plan that was previously proposed might apply modest changes to the RfI, and make minor adjustments of the weights (our review
Attachment B

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has identified some options for this kind of amendment). However, in the view of the SSG, the minimal change scenario would not go far enough in addressing the three principal concerns noted at the beginning of this document.

Revised Plan Toward Site Selection

Towards making the selection process as robust as possible and addressing the concerns expressed above, the SSG recommends a substantively modified process. The principal elements of the revised plan are compared with the current plan on a timeline in Attachment 1, and the components of the revised plan are described in the following:

1. The Founding Board (FB) and SSEC remain the authorities to oversee, jointly, the site selection process until the end of 2011. Both bodies should re-confirm the continuation of SSG and its membership or form a new site selection oversight committee, absent conflicted parties as members, to oversee the final process definition and the carrying out of the process, and then at the end to validate that the process was followed. If the SSG is to continue, its Terms of Reference should be revisited and appropriate changes made.
2. The SSG previously laid out a plan for gathering information and using expert panels and consultants to analyze the data and information. These elements of the process should be retained, with changes in the weights and methods of evaluation as described in Attachments 2 and 3. Specifically, in the revised approach, we propose that the consideration of the implementation plans and the cost elements is to be undertaken separately from consideration of the Science and Technical Selection Factors and the Other Selection Factors.
3. The SKA Site Advisory Committee (SSAC), an expert external and independent body, defined in the current SSG Baseline Roadmap, should be given increased responsibilities. It should evaluate the reports of the expert panels and consultants together with the responses from the Candidate Sites, as earlier proposed. In addition, the SSAC should be charged with making the motivated recommendation on the preferred site, rather than the SSEC. The primary reason for this change is that, when appointed, the SSAC will be an independent group with expertise across all of the selection factors proposed by the SSG. The SSAC will give due consideration to the Science and Technical Selection Factors, the Other Selection Factors, and the implementation plans and costs in order to arrive at a conclusion on a preferred site. In our proposal, the SSAC will determine the methodology for evaluating the selection factors and assessing the implementation plans and costs. The proposed SSAC responsibilities and suggested methods of evaluation are described in Attachment 3. In view of the increased responsibility, the membership of the SSAC should be reviewed by SSEC and FB and approved as soon as possible. SPDO should provide the secretariat for the SSAC. In our plan, the schedule impact of this change to the process would be to shorten the overall timeline to site selection by 4-6 weeks.
4. By the end of December 2011, the SSAC should submit its report and recommendation to the SSG (or its successor). The SSG will examine the inventory of documentation, the proceedings and reports of expert panels and consultants, and the proceedings of the SSAC
in order to validate that the process has been appropriately followed. The SSG will then transmit the SSAC’s report and recommendation to the SKA Council.

5. The SKA Council receives the SSAC’s report and recommendation from the SSG, factors in any discussions/negotiations that have taken place with the candidate sites, obtains any additional information required from the candidate sites, and makes a decision on the site for SKA. If the SKA Council were to start discussions/negotiations with the candidate sites in an earlier stage of the process, this could result in significant shortening of the time to decision.

6. Following this sequence of activities, a site decision could be expected no later than the end of February 2012.

Conclusion:

The SSG considers the modified process described above as the best way forward toward a robust site selection and recommends this to the Founding Board and SSEC for approval. If the modified plan is approved, the FB and the SSEC must both act to confirm the continuation of the SSG or to form a new group to oversee the site selection process with terms of reference and membership to be determined. If the SSG is to continue, the current Terms of Reference need to be modified to take into account the agreed changes in the site selection process. Also if the SSG is to continue, the FB and the SSEC need to reaffirm their appointed members or appoint alternatives. Changes in membership may be necessary because some current members may no longer be eligible following organizational changes at the Rome meetings. The SSG, as a group, is committed to its charge to oversee the process towards determination of the preferred SKA site and is willing to continue its work, at the pleasure of the FB and the SSEC.

The SSG
Vernon Pankonin, Chair
Simon Berry
Russ Taylor
Yervant Terzian
Patricia Vogel
Anton Zensus

Attachments: 1. SKA Site Selection Timeline
2. Reconsideration of the SKA Site Selection Factors and Weights
3. Proposed Plan for the Evaluation of the Candidate Sites for the SKA by the SKA Site Advisory Committee (SSAC)
## Attachment B

### Attachment 1

## SKA Site Selection Timeline

<table>
<thead>
<tr>
<th>CURRENT PLAN</th>
<th>PROPOSED REVISED PLAN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>-31 Mar 2011</strong></td>
<td>SSG: Establish Site Selection Factors &amp; Data/Information Needed for Site Selection</td>
</tr>
<tr>
<td><strong>1 Mar - 15 Sep 2011</strong></td>
<td>Acquisition of Data/Information</td>
</tr>
<tr>
<td><strong>1 Jul - 15 Nov 2011</strong></td>
<td>Analysis of Data/Information by expert panels/consultants</td>
</tr>
<tr>
<td><strong>15 Feb – 1 Mar 2012</strong></td>
<td><strong>Validation.</strong> SSG receives report and recommendation from SSEC. SSG validates the process. SSG transmits report and recommendation to SKA Council.</td>
</tr>
<tr>
<td><strong>-15 Jun 2012</strong></td>
<td><strong>SKA Council: Makes site decision.</strong></td>
</tr>
</tbody>
</table>
Reconsideration of the SKA Site Selection Factors and Weights

1. The Request for Information from the Candidate Sites (RfI), reports on the measurement campaigns organised by the SPDO, and other reports generated by the SPDO will provide information on factors affecting the science performance of the SKA, the environment in which the SKA and its staff will operate (political, legal, customs, security etc), and the implementation plans and costs for the basic infrastructure, power provision and data transport. All are important aspects in the site decision. This is a selection between two candidates in terms of site characteristics for the best science, and the capability and cost of supporting a very large infrastructure, taking the political and working environment into account.

2. In its report to the ASG and SSEC in March 2011, the SSG attempted to put very different factors on the same weighting scheme to allow numerical analysis of the relative merits of the Candidate Sites during the final evaluation leading to selection of the site. As noted in the main document, it became clear after the Rome meetings that the selection factors relating to the science are under-emphasized in the previous weighting scheme due to the inclusion of the implementation plans for infrastructure, power provision and data transport in the science and technical factors. Maintaining the same weights as proposed in the March 2011 document, but regrouping them into redefined categories, leads to the three main selection categories having the weights shown in Table 1.

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science and Technical Factors (S&amp;T)</td>
<td>42</td>
</tr>
<tr>
<td>2. Other Selection Factors</td>
<td>20</td>
</tr>
<tr>
<td>3. Implementation Plans and Costs</td>
<td>38</td>
</tr>
</tbody>
</table>

3. We remain convinced that the selection of the site for the SKA must be based, in part, on an assessment of the planning for deployment of the site infrastructure, and along with this, the associated cost. But after careful review we recognise that the original division of selection factors was not appropriate and that these planning-based elements better lie in a separate category of assessment since they are based on the Model of the SKA (Appendix 1, RfI), rather than primarily on measurements and factual information.

4. While the SSG views the information contained in the implementation plans and costs as very important to an informed decision on the preferred site, it notes i) that there will be relatively greater uncertainties in the information on plans and costs than for S&T and
Other selection factors. This makes it inappropriate to apply numerical comparison techniques based on weights to the plans and costs. ii) The costs of the implementation plans to the project are likely to be the subject of negotiations concerning host country premium.

5. The SSG now proposes that the cost and implementation plans be evaluated in a different way to the S&T selection factors and the Other selection factors. The numerical weighting scheme is to be used only for the S&T selection factors and the Other selection factors since they are directly amenable to quantitative comparative analysis when using a scheme like the Analytic Hierarchy Process (AHP, see Attachment 3). The implementation plans and costs will be evaluated by External Consultants primarily in terms of their feasibility, achievability, and risks (see Attachment 3). Table 2 shows the weights proposed for the main selection categories.

Table 2: Revised weights for the three main selection factor categories (see text item 5)

<table>
<thead>
<tr>
<th>Category</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Science and Technical factors</td>
<td>75</td>
</tr>
<tr>
<td>2. Other Selection factors</td>
<td>25</td>
</tr>
<tr>
<td>3. Implementation Plans and Costs</td>
<td>No weight assigned</td>
</tr>
</tbody>
</table>

6. The weights proposed for the individual factors of Science and Technical Factors are shown in Table 3.

Table 3: Proposed weights for the Science and Technical Selection Factors (sum=75%)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Short-term and long-term radio frequency and protection issues</td>
<td>27</td>
</tr>
<tr>
<td>2. Array configuration and science performance</td>
<td>17</td>
</tr>
<tr>
<td>3. Ionospheric scintillation</td>
<td>21</td>
</tr>
<tr>
<td>4. Tropospheric turbulence</td>
<td>5</td>
</tr>
<tr>
<td>5. Physical characteristics</td>
<td>5</td>
</tr>
</tbody>
</table>

The weight for tropospheric turbulence has been reduced and that for array configuration and science performance increased compared to the values in the March 2011 document. The delays in starting the tropospheric phase monitoring campaign mean that there will only be a partial sampling of the phase behaviour as a function of season by the time the evaluation takes place towards the end of the year, with the result that the tropospheric turbulence results will not be as comprehensive as originally planned. The weight for array configuration and science performance (uv gap analysis and the point-spread-function rms, as well as uv plane coverage, imaging performance for a set of standard sources, and the EMI-risk FoM ) has been increased in compensation.
7. The weights proposed for the Other Selection Factors are shown in Table 4. These are unchanged from prior presentations of this category of weights.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Political, socio-economic and financial</td>
<td>2</td>
</tr>
<tr>
<td>2. Customs and Excise</td>
<td>6</td>
</tr>
<tr>
<td>3. Legal</td>
<td>3</td>
</tr>
<tr>
<td>4. Security</td>
<td>3</td>
</tr>
<tr>
<td>5. Employment</td>
<td>6</td>
</tr>
<tr>
<td>6. Working and support environment</td>
<td>5</td>
</tr>
</tbody>
</table>
Attachment B

Proposed Plan for the Evaluation of the Candidate Sites for the SKA by the SKA Site Advisory Committee (SSAC)

According to the SSG’s proposed revised approach, the SSAC will be tasked with reviewing the information on the Candidate Sites, carrying out an evaluation of the strengths and weaknesses of the sites, and formulating a recommendation on the preferred site for the SKA to be submitted to the SSG. The work of the Committee is planned to take place from 7 November to 31 December 2011 in the three stage process outlined below.

1) 7 November – 3 December: Analysis Stage

The SSAC will review the responses by the Candidate Sites to the Request for Information together with the reports by Expert Panels, External Consultants and the SPDO containing the expert analyses of the information for the selection factors and the implementation plans and costs (see list of reports in section 4). The SSAC will use these analyses to evaluate each Candidate Site in terms of its strengths and weaknesses before reaching a conclusion on the site recommendation.

As part of its work in this period, the SSAC will determine whether there are questions of clarification to be posed to the individual Candidate Sites in time for the face to face meeting in Stage 2. A deadline of 1 December has been set for transmission of the questions.

At the end of the analysis stage, in preparation for the formal evaluation process to take place on 7 and 8 December, individual members of the SSAC may, if they choose, carry out an independent pair-wise comparison of the two Candidate Sites for the Science and Technical Selection Factors and Other Selection Factors using a system like the Analytic Hierarchy Process (AHP) described in section 5.

As discussed in Attachment 2, paragraphs 4 and 5, the SSAC evaluation of the implementation plans and costs for the basic infrastructure components, power provision, and data transport will be handled differently from the S&T and Other selection factors. The relatively greater uncertainties in the information on plans and costs compared to S&T and Other selection factors make it inappropriate to apply numerical comparison techniques like AHP based on weights to the plans and costs. In addition, the costs of the implementation plans to the project are likely to be the subject of discussions and negotiations in another forum concerning host country premium. The implementation plans and costs will be analyzed by External Consultants for basic infrastructure and power and an Expert Panel in the case of data transport, following the guidelines described in section 6. These analyses will be primarily in terms of feasibility, achievability, and risk. The SSAC will consider the results of the analysis by the External Consultants and Expert Panel in its evaluation of the plans.
2) 6-8 December 2011: Meeting of the SSAC

A three day face-to-face meeting of the SSAC is planned on 6, 7 and 8 December to interview the site proponents and come to a recommendation on the preferred site. Representatives of the SSG will be in attendance during the meeting, and advice and support will be provided by SPO/SPDO staff.

A five-step procedure is proposed:

6 December
1) Half day interviews with each of the Candidate Sites.
   Each Candidate Site will make a short presentation which will be followed by discussion of the questions of clarification posed earlier to each site by the SSAC.

7-8 December
2) Initial SSAC discussion comprising
   i) An overview by the SPO/SPDO Director of the information package provided to the SSAC grouped by selection category – Science and Technical, Other, and Implementation Plans and Costs
   ii) In the event AHP is utilized, a report by the SSAC Chair or SPO/SPDO Director on the outcome of the pair-wise comparison process for S&T and Other factors undertaken by members. During this discussion, the sensitivity of the result to the weights will be tested. This will ensure the robustness of the result, and the conclusions will be included in the final report.
   iii) Discussion on the merits, strengths and weaknesses of the candidate sites for all three selection categories

3) Comparison of the Candidate Sites against the selection factors and identification of any disabling characteristics.

4) Summarize the strengths and weaknesses for each site in order to provide the motivation for the recommendation on the preferred site.

5) Vote to recommend a preferred site.

3) 9-31 December: Write recommendation on the preferred site and submit to the SSG

Following the 3 day meeting, the SSAC will write a report containing its recommendation on the preferred site and an analysis of the merits of the two candidate sites. The report will also include supporting documents containing the results of a pair-wise comparison analysis, and a summary of the conclusions of the reports by the expert panels and external consultants.

The report will be submitted to the SSG by 31 December 2011.
4) Information to be provided, and due dates

A. Science and Technical Selection Factors

1) Ionospheric turbulence
   Report by the SPDO incorporating reports by external consultants (30 April 2011)

2) RFI measurement
   SPDO reports (30 June, 15 July 2011)
   Review and report by Expert Panel on RFI/EMI (31 August 2011)

3) Radio Quiet Zone protection
   Reports from Candidate Sites (30 June 2011)
   Review and report by Expert Panel on RQZ/Regulatory Affairs (31 August 2011)

4) Long term RFI environment
   Report by external consultant (4 November 2011)

5) Array science performance
   Report by the SPDO on the Figures of Merit for the specific configurations at each candidate site (15 September 2011)

6) Physical characteristics of the sites
   Reports from Candidate Sites (15 September 2011)
   Review and report by SPDO (4 November 2011)

7) Tropospheric turbulence
   Interim Report by the SPDO (15 September 2011)
   Review and report by Troposphere Expert Panel (4 November 2011)
   Final Report by the SPDO (1 December 2012)
   Review and report by Expert Panel on the Troposphere (15 December 2011)

B. Other Selection Factors

8) Political, socio-economic and financial
   Reports by Candidate Sites (15 September 2011)
   Review by SSAC

9) Customs and Excise
   Reports by Candidate Sites (15 September 2011)
   Review and report by external consultant (4 November 2011)

10) Legal
    Reports by Candidate Sites (15 September 2011)
    Review and report by external consultant (4 November 2011)
Attachment B

11) Security
   Reports by Candidate Sites (15 September 2011)
   Review and report by external consultant (4 November 2011)

12) Employment
   Reports by Candidate Sites (15 September 2011)
   Review and report by SSEC (4 November 2011)

13) Working and support environment
   Reports by Candidate Sites (15 September 2011)
   Review and report by SSEC (4 November 2011)

C. Implementation Plans and Costs

14) Provision and cost of infrastructure components based on the Model of the SKA
   Reports from Candidate Sites (15 September 2011)
   Review and report by external consultant (4 November 2011)

15) Provision and cost of internal and external data transport based on the Model of the SKA
   Reports from Candidate Sites (15 September 2011)
   Review and report by external consultant (4 November 2011)

16) Provision and cost of electrical power based on the Model of the SKA
   Reports from Candidate Sites (15 September 2011)
   Review and report by external consultant (4 November 2011)

17) Consolidated costs of capital and operations expenditures
   Report by the SPDO (18 November 2011)
   Review by SSAC

5) Pair-wise Comparison of the Candidate Sites for S&T and Other Selection Factors

The Analytic Hierarchy Process (AHP) is a tool to provide as objective a comparison between the Candidate Sites as possible. It is a multi-criterion decision support tool that allows a group knowledgeable about the subject to convert its well-informed qualitative judgments into a quantitative structure. It is well-suited to a site selection process where many factors are relevant to each site criterion and judgments on complex comparisons need to be quantified.

The AHP technique makes pair-wise comparisons of the Candidate Sites with respect to each of the criteria. The method uses the comparison scale given in Table 1 to quantify the relative strengths of the Candidate Sites for the individual Scientific & Technical Selection Factors, and Other Selection Factors. The relative strength of the comparison for a particular selection factor is normalized to unity for each site, then multiplied by the weight for the factor, and the results for
all factors are summed. Finally, the results of each set of independent pair-wise comparisons by the individual group members are summed and normalized to unity.

Table 1: Relative scoring scale for AHP pair-wise comparison. Reciprocal scores are used for the other site in each comparison.

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal</td>
<td>1</td>
</tr>
<tr>
<td>Somewhat better</td>
<td>3</td>
</tr>
<tr>
<td>Definitely better</td>
<td>5</td>
</tr>
<tr>
<td>Very much better</td>
<td>7</td>
</tr>
<tr>
<td>Overwhelmingly better</td>
<td>9</td>
</tr>
<tr>
<td>Even numbers used when cannot decide between adjacent assessments</td>
<td>2, 4, 6, 8</td>
</tr>
</tbody>
</table>

6) Evaluation of the Implementation Plans and Costs

The analysis of the implementation plans and costs for the provision of power and basic infrastructure components will be undertaken by External Consultants (selected in a competitive process). The analysis of the data transport plan will be carried out by an Expert Panel. These analyses will determine the strengths and weaknesses of the particular implementation plan in relation to the Request for Information (Rfi) and, for each functional subsystem specified in the Rfi, the Consultant/Expert Panel will be required to give their informed opinion on the quality of the response in terms of:

- Feasibility of the solution within the context of the site – is the proposed solution a logically possible proposition?
- Credibility of the solution – has the information presented come from a reliable source with sufficient expertise?
- Costs – are they reasonable / comparable with the consultant’s experience of such implementations in similar environments (percentage over or under estimate, ± %)
- Fit for Purpose – does the proposed implementation deliver the capability that is outlined in the Model of the SKA
- Gaps in the responses to the Rfi (or deviation from specification)
- Sequencing of the implementation – does the plan facilitate a smooth rollout

Risks are to be identified for each of the above areas by the Consultants or Expert Panel using their own judgment and information provided by the Candidate Sites, as well as any additionally identified areas of risk (e.g. assumptions which generate risks, missing factors / considerations, dangers not identified by the site proponents). These risks are to be assessed using a standard five point probability and impact matrix.
The SSAC will consider the conclusions of the analyses by the External Consultants and Expert Panel (for Data Transport) in its evaluation of the strengths and weaknesses, feasibility, and achievability of the plans.
SKA Site Advisory Committee (SSAC) Evaluation Plan

1. INTRODUCTION

The SKA Founding Board (FB), with the agreement of the SKA Science and Engineering Committee (SSEC), has established the SKA Site Advisory Committee (SSAC). The SSAC is tasked with reviewing the material obtained on the Candidate Sites, assessing reports by expert panels and consultants, carrying out an evaluation of the strengths and weaknesses of the sites, and formulating a recommendation on a preferred site for the SKA, or if it is not possible, the SSAC may recommend an alternative solution for study. The Report with recommendation from the SSAC will be submitted to the SKA Siting Group (SSG) for transmission to the FB or its successor, the Governing Board (GB).

The SSAC operates under the SSAC Terms of Reference (ToR) (Appendix 5: dated 17 July 2011, with 3 September 2011 update of Attachment 3) and as interpreted and clarified in Appendix 1.

This Evaluation Plan describes how the material on and reports from the two Candidate Sites, expert panels and consultants will be evaluated.

2. MATERIAL, FACTORS AND WEIGHTS

Material for review consists of RfI responses, expert and SKA Program Development Office (SPDO) or its successor SKA Project Office (SPO) reports, and responses to Candidate Site questions and interviews.

The SSAC will consider material for each of the factors given in Table 1 consistent with the factors provided in Attachment 3 of the SSAC ToR (3 September 2011). The factors fall into the following categories: Science and Technical Factors (A), Other Selection Factors (B), and Implementation Plans and Costs (C).

The Science and Technical factors, and Other Selection factors are by their nature amenable to a quantitative evaluation whereas the Implementation Plans and Cost factors by virtue of the relatively greater uncertainty in the information are better evaluated in terms of a strengths and weaknesses analysis (see Appendix 5, Attachment 4).

The SSAC will adopt the following weights for the factor categories consistent with Table 1, Attachment 5 of the SSAC ToR (17 July 2011):

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Science and Technical Factors</td>
<td>75%</td>
</tr>
<tr>
<td>B</td>
<td>Other Selection Factors</td>
<td>25%</td>
</tr>
<tr>
<td>C</td>
<td>Implementation Plans and Costs</td>
<td>No weight assigned</td>
</tr>
</tbody>
</table>
The weights of each of the individual factors in categories A and B are shown in Table 1 and are consistent with Table 1, Attachment 5 of the SSAC ToR.

<table>
<thead>
<tr>
<th>Factor #</th>
<th>Factor Name</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1  Ionospheric turbulence</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>2  RFI measurement</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>3  Radio Quiet Zone protection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4  Long term RFI environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5  Array science performance</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>6  Physical characteristics of the sites</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>7  Tropospheric turbulence</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>8  Political, socio-economic and financial</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>9  Customs and Excise</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>10 Legal</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>11 Security</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>12 Employment</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>13 Working and support environment</td>
<td>5</td>
</tr>
<tr>
<td>C</td>
<td>14 Provision and cost of infrastructure components based on the Model of the SKA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>15 Provision and cost of internal and external data transport based on the Model of the SKA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>16 Provision and cost of electrical power based on the Model of the SKA</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>17 Consolidated costs of capital and operations expenditures</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 1 – Factors and Weights

3. Evaluation of Data

The process of reviewing the material provided for the 17 factors listed in Table 1 will be as follows:

(a) All members will read all material as practical.
(b) A lead and one or more secondary reviewers will be assigned to each factor.
(c) The lead shall coordinate an in-depth review of their assigned factor and develop a key points synopsis with a suggested score or strength/weakness analysis for discussion within the SSAC. After discussion a written report will be provided for inclusion in the Report.
(d) A scoring system will be used for those factors amenable to quantitative assessment (consisting of the items listed as topics/factors in Sections A and B of Table 1). A strengths and weaknesses approach will be used for the factors and issues set forth in Section C of Table 1.
(e) The SSAC will base its recommendation only on the material provided and will not introduce new material. However, the members of the SSAC may
submit questions to the SSG, using the process outlined in Section 4 for passing questions to the SPDO, one or more experts, consultants and/or one or both of the Candidate Sites, and may use any material that is provided in response. Material from the site interviews and in response to questions posed during the site interviews may also be used. Appendix 1, 6(d) discusses restrictions on material provided by the Candidate Sites in response to SSAC questions. The SSAC will determine the material that is in or out of scope for use in its assessment and evaluation, and will so note in the Report.

4. Scoring and Other Processes

The committee has discussed in detail Decision Making, Communication to SSG and sites, Scoring (i.e., quantitative judgments), Reporting and the nature of the final recommendation in order to achieve an assessment process as clear and transparent as possible. The outcomes, as reported below, need no further explanation, except as regards scoring. The committee felt that the Analytic Hierarchy Process method was well suited to a complex hierarchy of factors applied to a range (>2) of alternatives as was the case in the prior SKA site selection process in 2004-06. With only two candidate sites a straightforward direct comparative scoring system for the factors the factors set forth in Sections A and B of Table 1, is more appropriate.

Decision Making. Decisions will be made using the following process:
(a) A quorum of 50% of the committee plus one must participate in an SSAC meeting in order for it to hold a valid meeting;
(b) To participate a committee member must be physically present, on a video call, or on the telephone;
(c) Decisions are made only by participating committee members;
(d) Every effort will be made to reach consensus. If no consensus is reached a vote will be taken;
(e) All decisions other than the final site recommendation require a simple majority subject to quorum;
(f) Abstentions are permitted and are not considered to be a vote;
(g) In the event of a tied vote it is the responsibility of the chair to steer the committee to a conclusion;
(h) If put to a vote, the final site recommendation requires a positive vote of at least seven committee members;
The Report will document dissenting opinions on the site recommendation.

Communications. 
(a) All questions from SSAC members will be sent to the SSG chair (with copy to the Executive Secretary) who will pass them to the relevant recipient. SSG chair will pass responses to the SSAC members involved (with copy to the Executive Secretary for posting to the SSAC website).
(b) Questions about material on a given factor will only be asked after the SSAC
Attachment C

SSAC	

2 Nov 2011

has received the corresponding assessment report[s].

Scoring. The SSAC proposes to apply a straightforward quantitative comparison method to the factors set forth in Sections A and B of Table 1 using the following procedure:

(a) A scale of 1-19 will be adopted to indicate relative strength of each Candidate Site with 1 being the lowest score.
(b) A total of 20 points will be allocated between the two alternatives. A discussion of the correspondence between the numerical scores and the perceived impact of a particular factor on the effectiveness of the array is provided in Appendix 4.
(c) For each factor, each SSAC voting member will give a score for each site.
(d) Scores will be known by the SSAC committee but individual votes and scores will not be recorded or disclosed. Aggregate scores will be recorded in the Report.
(e) The average and variance will be recorded for each factor.
(f) Scores for each factor will be weighted according to the values provided in Table 1. A summation of weighted scores will be made for each site, resulting in a combined ranking of the two sites for the factors in Sections A and B of Table 1. The SSAC will provide variances for each factor and will discuss qualitatively their importance when formulating the final recommendation.

The SSAC has agreed that factors listed in Section C of Table 1 will be given serious consideration by the SSAC in the final site recommendation, and that the SSAC will review material from the sites, SPDO, consultants and experts, for implementation, feasibility and cost, assess the strengths and weaknesses for each site, and take these factors into account in development of an overall comparison of the two sites.

The following procedure will be used in conducting the strengths and weaknesses assessment:

(a) For each factor listed in Section C of Table 1, a list of strengths and weakness will be developed for each Candidate Site.
(b) Each strength and weakness for both Candidate Sites will be assigned a “low”, “medium” or “high” level of importance based on the judgment of the SSAC. The SSAC will also assess the risk associated with each factor.
(c) Determine based on comparison which site is favored (if any). The SSAC will note any disabling characteristics that may be subject to mitigation.

The quantitative results for Sections A and B of Table 1 will be considered with the results of the strengths and weaknesses assessment for Section C to determine the final result.

Report and Decision

(a) The SSAC will provide a documented report to the SSG on the preferred site.
(b) In order to make an optimal, well-grounded recommendation based on the material provided, the SSAC may possibly need to provide a qualified
recommendation of a site. For example, a qualified recommendation may be made if site A is preferred provided a given factor's shortfall can be mitigated; otherwise site B is preferred.

(c) The SSAC may reach the conclusion that it is not possible to discriminate between the two sites based on the information given.
Appendix 1. SSAC Terms of Reference Assumptions, Interpretations and Clarifications

The following items have been identified by the SSAC in review of the ToR (Appendix 5; July 17, 2011 approved version with September 3, 2011 revision to Attachment 3). The working assumption is that the interpretations below take precedence over the SSAC ToR.

1. **Basis of recommendation.** The SSAC ToR states (bottom of page 1) that “..however the recommendation is formulated it must be based on the data and information in the material with which the SSAC is provided.” We interpret this to mean that the SSAC will base its recommendation on the material provided and will not introduce new material. However, the members of the SSAC may submit questions to the SSG, for passing questions to the SPDO, one or more experts, consultants and/or one or both of the Candidate Sites, and may use any material that is provided in response. Material from the site interviews and in response to questions posed during the site interviews may also be used.

2. **SSG and SPDO Participation in SSAC Meetings.** The SSAC ToR refers (Page 2, “Functioning, item 2; and page 3, “Interactions”, 5th bullet) to “at least one SSG full member” attending full SSAC meetings and participating in SSAC telecons as observer(s). We understand this to mean that no more than two SSG members will attend SSAC meetings, or portions as necessary, and participate in telecons as observers. Further, that SSG members are present as observers and to provide guidance, but not to participate in deliberations. The SPDO Director or designee may also be invited to relevant parts of SSAC meetings by the SSAC Chair to serve as a technical resource, but may not participate in deliberations.

3. **Confidentiality.** In addition to all material provided to the SSAC being confidential (SSAC ToR, page 3, “Interactions”, 6th bullet), the SSAC considers all material produced by the SSAC to be confidential to the SSAC until the SSAC Report is submitted to the SSG which will validate the process then send it onwards to the FB/GB. It is understood that the FB/GB may decide to make some or all of the SSAC material public.

4. **Schedule.** The information provided in Appendix 3 of this Plan updates the information provided in the SSAC ToR on page 3, item 12; page 4, “Timeline”, and Attachment 6.

5. **New Material Delivery Schedule.** The dates for providing the SSAC with new material as listed in Attachment 3 of the SSAC ToR have been revised per Appendix 2 of this plan (table provided by R. Schilizzi). We have based the detailed SSAC schedule given in Appendix 3 of this Plan on these dates and note that further changes may have an impact on the SSAC schedule.
6. **Site Delegations and Communications.**
   a. The primary purpose of the interviews with proponents for each site (SSAC ToR, page 3, Interactions, 2nd bullet) is to provide clarification on material directly related to the 17 factors given in Attachment 3 of the SSAC ToR;
   b. The SSAC expects appropriate site delegations to consist of up to four people able to answer questions about all of the material submitted for that site.
   c. Other communications between the SSAC and the sites will be facilitated by the SSG.
   d. Any questions for the Candidate Sites may be asked via the SSG prior to the interviews. The SSAC may ask questions about the RfI response as well as closely related topics. These questions will be provided via the SSG to the Candidate Sites as far as possible seven days prior to the interviews. Additional questions may be asked of the site delegations during the interviews and, if not answerable during the interview, a due date will be provided for responses. No further questions will be asked of the Candidate Sites after the interview. All material provided in response to SSAC questions should be strictly relevant to the questions asked. Any material deemed not relevant by the SSAC will not be considered.

7. **SSAC Members.** The following revisions are noted to Attachment 2 of the SSAC ToR. (a) Executive Secretary: Roger Brissenden, Harvard-Smithsonian Center for Astrophysics, Cambridge, USA; (b) the withdrawal of Paul Gilbert from the Committee; (c) the addition of Jim Crocker as a replacement member for Paul Gilbert.

8. **Quantitative Assessment Approach.** The committee felt that the Analytic Hierarchy Process method discussed in the SSAC ToR was well suited to a complex hierarchy of factors applied to a range (>2) of alternatives. For example, the method was used effectively in the prior SKA site selection process in 2004-06. In the present case of only two candidate sites and a set of 13 weighted factors in 2 categories (i.e., Sections A and B of Attachment 3 of the SSAC ToR) and the additional unweighted factors listed in Section C of Attachment 3 of the SSAC ToR, a straightforward direct scoring system is more appropriate. The SSAC has agreed to apply a straightforward quantitative comparison method to the factors set forth in Sections A and B in Attachment 3 of the SSAC ToR. The method is described in section 3 of this Plan.

9. **Other Interpretations and Clarifications**
   a. Page 3, item 11 of the SSAC ToR. We interpret “disabling characteristics” to mean a non-fatal characteristic of the site that may be mitigated given sufficient resources and time. Any such characteristic will be documented in the Report.
# Appendix 2. SKA Siting Reports Tracking, 2011.10.22 – v.1.4

The due dates provided in this Appendix for the delivery of material for each factor update the dates given in Attachment 3 of the SSAC ToR.

<table>
<thead>
<tr>
<th>Item</th>
<th>SPDO</th>
<th>Expert Panel</th>
<th>Consultant</th>
<th>SSAC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>In</td>
<td>Out</td>
<td>In</td>
<td>Out</td>
</tr>
<tr>
<td>1 Ionospheric Turbulence</td>
<td>Due</td>
<td>30apr11</td>
<td>16sep11</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td>30apr11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 RFI Measurement</td>
<td>Due</td>
<td>15jul11</td>
<td>15jul11</td>
<td>31aug11</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td>15jul11 - 31aug11</td>
<td>15jul11 - 31aug11</td>
<td>24oct11 expected</td>
</tr>
<tr>
<td>3 Radio Quiet Zone Protection</td>
<td>Due</td>
<td>30jun11</td>
<td>30jun11</td>
<td>30jun11</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td>30jun11</td>
<td>30jun11</td>
<td>30jun11</td>
</tr>
<tr>
<td>4 Long Term RFI Environment</td>
<td>Due</td>
<td></td>
<td></td>
<td>1sep11</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
<td>1sep11 (RQZ E-P report 16oct11; RFI E-P report 24oct11 expected)</td>
</tr>
<tr>
<td>5 Array Science Performance</td>
<td>Due</td>
<td></td>
<td></td>
<td>4nov11</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Physical Characteristics of Site</td>
<td>Due</td>
<td>15sep11</td>
<td>04nov11</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td>15sep11</td>
<td>16sep11</td>
<td></td>
</tr>
<tr>
<td>7 Tropospheric Turbulence</td>
<td>Due</td>
<td>31oct11</td>
<td>1nov11</td>
<td>30nov11</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td>31oct11</td>
<td>30nov11</td>
<td></td>
</tr>
<tr>
<td>8 Political; Socio-Economic; Financial</td>
<td>Due</td>
<td>15sep11</td>
<td>16sep11</td>
<td></td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td>15sep11</td>
<td>16sep11</td>
<td></td>
</tr>
<tr>
<td>9 Customs and Excise</td>
<td>Due</td>
<td>15sep11</td>
<td>16sep11</td>
<td>16sep11</td>
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<tr>
<td>Actual</td>
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<td>16sep11</td>
<td>16sep11</td>
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<td>10 Legal</td>
<td>Due</td>
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<td>16sep11</td>
<td>16sep11</td>
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<tr>
<td>Actual</td>
<td></td>
<td>15sep11</td>
<td>16sep11</td>
<td>16sep11</td>
</tr>
<tr>
<td>11 Security</td>
<td>Due</td>
<td>15sep11</td>
<td>16sep11</td>
<td>16sep11</td>
</tr>
<tr>
<td>Actual</td>
<td></td>
<td>15sep11</td>
<td>16sep11</td>
<td>16sep11</td>
</tr>
<tr>
<td>12 Employment</td>
<td>Due</td>
<td>15sep11</td>
<td>16sep11</td>
<td>16sep11</td>
</tr>
<tr>
<td>Item</td>
<td>SPDO</td>
<td>Expert Panel</td>
<td>Consultant</td>
<td>SSAC</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------</td>
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</tr>
<tr>
<td></td>
<td>In</td>
<td>Out</td>
<td>In</td>
<td>Out</td>
</tr>
<tr>
<td>13 Working &amp; Support Environment</td>
<td>Due 15sep11</td>
<td>16sep11</td>
<td>16sep11</td>
<td>04nov11</td>
</tr>
<tr>
<td></td>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 Provision &amp; cost of infrastructure components based on Model SKA</td>
<td>Due 15sep11</td>
<td>16sep11</td>
<td></td>
<td>16sep11</td>
</tr>
<tr>
<td></td>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 Provision &amp; cost of data transport based on Model SKA</td>
<td>Due 15sep11</td>
<td>16sep11</td>
<td></td>
<td>16sep11</td>
</tr>
<tr>
<td></td>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 Provision &amp; cost of electrical power based on Model SKA</td>
<td>Due 15sep11</td>
<td>16sep11</td>
<td></td>
<td>16sep11</td>
</tr>
<tr>
<td></td>
<td>Actual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17 Consolidated costs of capital &amp; operations expenditures</td>
<td>Due 15sep11</td>
<td>(R1) 18nov11</td>
<td>(consultants)</td>
<td>18nov11</td>
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<tr>
<td></td>
<td>Actual</td>
<td></td>
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</tr>
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</table>
Appendix 3. Detailed SSAC Schedule

The information provided in this Appendix updates the information provided on page 4, “Timeline” and Attachment 6 of the SSAC ToR.

The work of the SSAC is planned to take place from 1 September 2011 to 7 February 2012 as summarized in the table below and discussed in the sections A3.1-A3.5 described below.

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Activity Description</th>
</tr>
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<tbody>
<tr>
<td>8-9 September 2011</td>
<td>SSAC Meeting (face to face; Washington DC)</td>
</tr>
<tr>
<td>8-30 September 2011</td>
<td>Prepare Evaluation Plan</td>
</tr>
<tr>
<td>15 September – 30 November 2011</td>
<td>Receive material to be evaluated</td>
</tr>
<tr>
<td>15 September – 15 December 2011</td>
<td>Assessment and evaluation of material</td>
</tr>
<tr>
<td>11 November 2011 (15-17 UT)</td>
<td>SSAC Meeting (telecon)</td>
</tr>
<tr>
<td>28 November 2011 (15-17 UT)</td>
<td>SSAC Meeting (telecon)</td>
</tr>
<tr>
<td>6-9 December 2011</td>
<td>SSAC Meeting (face-to-face; London)</td>
</tr>
<tr>
<td>26-27 January 2012</td>
<td>SSAC Meeting (face-to-face; Paris)</td>
</tr>
<tr>
<td>7 February 2012</td>
<td>Target for submission of Report to SSG</td>
</tr>
</tbody>
</table>

A3.1 Prepare Evaluation Plan (1-30 Sep. 2011)

The SSAC will prepare its evaluation plan and submit it to the SSG, which will obtain the concurrence of the Founding Board/Governing Board before giving approval to proceed.

A3.2 Receive Material to be Evaluated (15 Sep. – 30 Nov. 2011)

The responses by each Candidate Site to the SSG RFI, and analyses and reports from the Candidate Sites, external consultants, SPDO, and SSEC will be provided to the SSAC.


All SSAC members will evaluate all material as practical. A lead and one or more secondary reviewers have been assigned to each factor so as to prepare and guide discussions of the SSAC as a whole. The lead and secondary reviewers will be responsible for preparing first drafts of the opinions of the SSAC. Preliminary reviews will be at the basis of the interviews with the sites on 7 and 8 December 2011.
A3.4 Meetings

Meeting, September 8-9 (Washington, DC)

The meeting was held as planned. The focus of the meeting was to make significant progress on the content of this Evaluation Plan and to agree to and establish the processes for conducting the business of the SSAC. Both of these items were achieved. In addition, the SSAC was given an overview by the SPDO Director of the materials to be provided to the SSAC grouped by selection category – Science and Technical, Other, and Implementation Plans and Costs.

Telecon, November 11, 2011 (15-17 UT)

The majority of the review material should have been provided to the SSAC by November 11, 2011 and the in-depth reviews for each factor are expected to be underway. The purpose of this call is to hear status from the SPDO Director (Richard Schilizzi) on any outstanding documentation, and from each Lead/seconds team on the status of their review, and any preliminary impressions, strengths and weaknesses based on the material.

Telecon, November 28, 2011 (15-17 UT)

This telecon will be held to discuss the progress of the review of material and finalize questions for the site teams in advance of the December 6-9 meeting. Questions will be submitted to SSG for forwarding to the site teams no later than seven days before the December meeting.

Meeting, December 6-9, 2011 (London)

The meeting format will be as follows:

Dec 6: SSAC meets to discuss the status of the review of the various factors and review and formulate any additional questions of clarification for the sites.

Dec 7: Half-day (morning) interview with the first Candidate Site. The Candidate Site will make a short presentation to be followed by discussion of the questions of clarification submitted by the SSAC. SSAC Discussions (afternoon).

Dec 8: Half-day (morning) interview with the second Candidate Site following the same format as for the first site. SSAC Discussions (afternoon).

Dec 9: The SSAC will:
   a) Compare Candidate Sites against the selection factors and identify any disabling characteristics;
b) Score the quantitative factors and summarize the strengths and weaknesses of the non-quantitative factors for each Candidate Site;

c) Evaluate the scores, strengths and weaknesses for each Candidate Site in order to provide the motivation for the recommendation of the preferred site or other site recommendation;

d) Reach agreement on the outline and content of the Report and make writing assignments.

**Meeting, January 26-27, 2012 (Paris)**

During this meeting the SSAC will conduct a detailed review of the Report and reach agreement on any outstanding issues or open items. If required, the meeting may extend to January 28, 2012. Following the meeting the Report will undergo final edits and proofing prior to submission to the SSG by the target date of 7 February 2012 for validation of process and transmission to the FB or its successor.

**A3.5 Report** (target for submission 7 February 2012)

The SSAC Report will be submitted to the SSG by the target date of 7 February 2012.
Appendix 4. Scoring Interpretation

Table A4.1 offers a guide to the correspondence between the numerical scores and the perceived impact of a particular factor on the effectiveness of the array. The term “effectiveness” is used here in a broad sense to refer not only to array performance but also to the attractiveness of the site to high level scientists and engineers and as conditioned by (for example) legal and security factors. Effectiveness translates ultimately into success in achieving the scientific goals of the SKA, either selectively or more broadly. When used with the relative scores in the table, the term is to be interpreted in a relative sense. Table A4.1 shows six progressively higher ratios with an interpretation in terms of the severity of their impact. Individual committee members will interpolate these scores to cover the discernable range of potential impacts.

<table>
<thead>
<tr>
<th>Ratio</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>10:10</td>
<td>Signifies a minor impact on effectiveness having little or no impact on the achievement in any of the scientific goals.</td>
</tr>
<tr>
<td>13:7</td>
<td>Reflects a more significant but modest effect on effectiveness with potential to have a modest impact on one or more of the science goals.</td>
</tr>
<tr>
<td>15:5</td>
<td>Reflects a serious impact on effectiveness with a measurably reduced capacity for achieving one or more of the scientific goals.</td>
</tr>
<tr>
<td>17:3</td>
<td>Signifies the identification of a very serious impact on effectiveness and potential for failure to achieve several of the SKA scientific goals.</td>
</tr>
<tr>
<td>19:1</td>
<td>Signifies a perception that the loss in effectiveness would lead to a significant and qualitative loss in capacity to achieve many of the scientific goals.</td>
</tr>
</tbody>
</table>

Table A4.1 – Scoring Interpretation
Terms of Reference

The SKA Founding Board (FB), with the agreement of the SKA Science and Engineering Committee (SSEC), has established the SKA Site Advisory Committee (SSAC). The SSAC is tasked with reviewing the data and information obtained on the Candidate Sites, assessing reports by expert panels and consultants, carrying out an evaluation of the strengths and weaknesses of the sites, and formulating a recommendation on a preferred site for the SKA. The report and recommendation from the SSAC will be submitted to the SKA Siting Group (SSG). Following validation of adherence to the agreed process by the SSG, the report and recommendation will be transmitted to the SKA Governing Board which will make the site decision. The timeline to the decision on the SKA site is given in Attachment 1.

In chronological order, the SSAC shall:

1. Prepare a plan by which the data/information and reports from the Candidate Sites, expert panels and consultants will be evaluated. Submit the evaluation plan to the SSG for approval, which will in turn obtain concurrence with the plan from the Founding Board/Governing Board.
2. Assess the available data/information and reports from the Candidate Sites, expert panels and consultants.
3. Evaluate the strengths and weaknesses of the data/information on the selection factors, including the implementation plans and the infrastructure and operations related costs.
4. Based on the evaluation, prepare a report that provides the basis for the recommendation on a preferred site.
5. Recommend a preferred site for SKA.
6. Transmit the report and recommendation to the SSG, which will validate that the agreed process has been followed and transmit the report/recommendation to the SKA Governing Board.

The site recommendation from the SSAC must be based on the material with which it is provided on the Science and Technical Selection Factors, the Other Selection Factors, and on the Implementation Plans and Costs. This material is supported by reports of expert panels, consultants, the SKA Program Development Office (SPDO), and a Sub-set of the SSEC.

Contained in the Terms of Reference for the SSG is the statement: “The analysis and evaluation should be open to a variety of site selection solutions, if the data and information support them.” This statement should be a working premise for the SSAC, but with emphasis on the dictum that however the recommendation is formulated it must be based on the data and information in the material with which the SSAC is provided.
Rules of Procedure

The SKA Founding Board/Governing Board is the final authority over the SSAC. It has delegated to SSG the role of managing and overseeing the SSAC’s assessment and evaluation process to facilitate the work of the SSAC and to ensure compliance with the process that has been agreed by the Founding Board and the SSEC.

Structure and Membership

Members of the SSAC are appointed by the SKA Founding Board (FB) with the concurrence of the SKA Science and Engineering Committee (SSEC). The Chair is appointed by the FB with the concurrence of the SSEC. The members are selected to ensure appropriate expert coverage of the site selection factors. The members are listed in Attachment 2.

Conflicts of Interest

Members are required to sign a conflict-of-interest form prior to serving on the Committee. It is not anticipated that any member of the SSAC holds any financial or other material interest in the decision on a preferred site for SKA. Should evidence of a conflict arise, the member will notify the SSG for resolution.

Functioning

1. The SKA Siting Group (SSG) will have an oversight and monitoring role with respect to the functioning of the SSAC. At least one SSG full member will attend all SSAC meetings and telecon/videocons as observer(s).
2. An Executive Secretary will be available to facilitate the work of the Committee. The Executive Secretary will assist with preparing the evaluation plan, managing documents, preparing meeting agendas, noting and tracking action items, and preparing the report. Meetings may be face-to-face, telecon, and videocon.
3. The Director of the SPDO and other SPDO staff may attend SSAC meetings at the invitation of the Chair.
4. The SPDO will provide the technical secretariat to support the work of the SSAC, and will provide consultation on technical issues and act as the communication channel between the SSAC and the Candidate Sites.
5. SSAC meetings, telecons, and videocons will be minuted, under the charge of the Executive Secretary. Minutes will be considered confidential to the extent practicable.
6. Deliberations of the SSAC will be confidential to the extent practicable.
7. Before beginning the assessment and evaluation phases, the SSAC will prepare a plan for evaluation of the material it is to consider. It will submit the plan to the SSG for approval, and the SSG will in turn obtain the concurrence of the Founding Board. The material that is expected to be provided to the SSAC is listed in Attachment 3.
8. The SSAC will determine the methods and internal organization by which it will evaluate the materials. These methods will be described in the evaluation plan. The SSAC should consider a multiple criterion decision method for evaluating those factors that lend themselves to numerical scoring. Possible evaluation methods with numerical scoring for the various selection factors are described in Attachment 4.
9. The weights that have been assigned by the SSG, and adopted by the Founding Board and SSEC, to the categories of selection factors and to the individual factors in each category are indicators of the absolute importance of that factor in identifying a preferred site. They are given in Attachment 5. These weights should be used by the SSAC in the evaluation, unless the SSAC justifies doing otherwise with SSG concurrence.

10. If the SSAC performs a numerical comparison of selection factors, it must describe in the report what it considers to be a significant difference in the comparison of the candidate sites.

11. The SSAC should identify any disabling characteristics pertaining to the selection factors relative to any particular site and clearly indicate how these factor into the final recommendation.

12. At this time only one face-to-face meeting of the SSAC is scheduled, but at least one additional meeting is being considered. Telecon/videocons will be scheduled as needed. A detailed schedule for the conduct of business is given in Attachment 6.

Materials to be Considered

The SSAC will be provided with information/reports from the Candidate Sites and reports from expert panels, consultants, SPDO, and SSEC. The list of material and the schedule is given in Attachment 3.

Interactions with candidate site proponents, governments/government agencies, and others

- The SSAC reports to the SSG.
- Proponents of each candidate site will be interviewed by the SSAC at a face-to-face meeting. This will be the only direct interaction between the SSAC and the candidate site proponents. The site proponent teams for the interviews are expected to be led by the site Resource Liaisons to the SSG. Other communications with the site proponents will be handled through the SKA Program Development Office (SPDO), with the Director of the SPDO as the point of contact, and with copies to SSG.
- There will be no interactions between the SSAC and representatives of governments and/or government agencies on site-related issues for the SKA.
- The SSAC will route any desired communications with the expert panels, consultants, SPDO, and SSEC via the Executive Secretary through the SPDO, with copies to SSG.
- At least one SSG full member will attend SSAC meetings and participate in SSAC telecons as observer(s).
- All material provided to the SSAC is confidential, unless mutually agreed otherwise.

Resources

- The SPDO will provide general logistical support and the technical secretariat for SSAC meetings, telecons, and videocons.
- An Executive Secretary will be available to facilitate the work of the SSAC.
- The Founding Board/Governing Board will provide travel funds and an honorarium for the SSAC members and the Executive Secretary to attend meetings and carry out the work of the Committee.
- The SSG will oversee and monitor the work of the SSAC, providing guidance and advice when appropriate.
Timeline

The top level timeline for the SSAC to conduct its business shows a begin date on 1 September 2011 and an end date on 31 December 2011 with the following components.

1. 1 – 15 September 2011: Prepare the plan for evaluation.
2. 1 October – 15 November 2011: Receipt of material to be evaluated.
3. 1 October – 30 November 2011: Assessment and Evaluation of the material.
4. 6 – 8 December 2011: Meeting of the SSAC (face-to-face).
5. 9 – 31 December 2011: Write report and recommendation and submit to SSG.

A more detailed schedule for the SSAC is given in Attachment 6.

Attachments: 1. SKA Site Selection Timeline  
              2. SSAC Members  
              3. Material to be Provided to SSAC and Schedule  
              4. Consideration of Methods of Evaluation  
              5. SKA Site Selection Factors and Weights  
              6. Detailed Timeline for SSAC
## SKA SITE SELECTION TIMELINE

### AGREED PLAN

<table>
<thead>
<tr>
<th>Date Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 31 Mar 2011</td>
<td><strong>SSG: Establish Roadmap</strong></td>
</tr>
<tr>
<td>- 31 Mar 2011</td>
<td><strong>SSG: Establish Site Selection Factors</strong> &amp; Data/Information Needed for Site Selection</td>
</tr>
<tr>
<td>1 Mar - 15 Sep 2011</td>
<td><strong>Acquisition of Data/Information</strong></td>
</tr>
<tr>
<td>1 Jul - 1 Nov 2011</td>
<td><strong>Analysis of Data/Information</strong> by expert panels/consultants</td>
</tr>
<tr>
<td>1 Oct – 31 Dec 2011</td>
<td><strong>Data/Information Evaluation</strong>. SSAC carries out assessment and evaluation. SSAC submits report/recommendation to SSG.</td>
</tr>
<tr>
<td>1 Jan – 15 Jan 2012</td>
<td><strong>Validation.</strong> SSG receives report and recommendation from SSAC. SSG validates the process. SSG transmits report/recommendation to SKA Governing Board.</td>
</tr>
<tr>
<td>- 29 Feb 2012</td>
<td><strong>SKA Governing Board:</strong> Makes site decision.</td>
</tr>
</tbody>
</table>

The detailed schedule for the SSAC is given in Attachment 6.
### SSAC Members

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
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<tbody>
<tr>
<td>James Moran; Chair</td>
<td>Thomas Garvin&lt;br&gt;Center for Astrophysics&lt;br&gt;Harvard University&lt;br&gt;USA</td>
</tr>
<tr>
<td>Subramanian Ananthakrishnan</td>
<td>Paul Gilbert&lt;br&gt;Pune University&lt;br&gt;India</td>
</tr>
<tr>
<td>Jaap Baars</td>
<td>Stefan Michalowski&lt;br&gt;Retired, formerly Max-Planck-Institute for&lt;br&gt;Radioastronomy&lt;br&gt;Germany</td>
</tr>
<tr>
<td>Jocelyn Bell Burnell</td>
<td>Ernest Seaquist&lt;br&gt;Open University, Oxford University&lt;br&gt;UK</td>
</tr>
<tr>
<td>Wim Brouw</td>
<td>Peter Tindemans&lt;br&gt;Retired, formerly Groningen University and&lt;br&gt;ASTRON&lt;br&gt;The Netherlands</td>
</tr>
<tr>
<td>Ian Corbett</td>
<td>Jacqueline van Gorkom&lt;br&gt;International Astronomical Union&lt;br&gt;UK</td>
</tr>
<tr>
<td>Executive Secretary: TBD</td>
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</tbody>
</table>
Material to be provided to SSAC prior to September 8-9, 2011 meeting

SSAC Terms of Reference
Approved by FB and SSEC July 2011

SSAC Member CVs

SSG Terms of Reference
Approved by FB and SSEC October 2010

SSG – Revised Plan for SKA Site Selection
Approved by FB and SSEC May 2011

SSG - Request for Information (RfI) from the Candidate Sites
Draft distributed to sites 18 March 2011; Final version to sites 26 June 2011; Rev. 1, 03 September 2011.

Request for Proposals for Siting the SKA (1 Sep 2004)
SKA Siting Evaluation Guidelines (derived from RfP)
Proposal for Siting the SKA in Australia (5 Dec 2005)
South African Bid to Host the SKA
SKA Site Selection Process (5 July 2006)
Pair-wise Comparison Spreadsheet Template
Protocols for Site Selection Short List (8 documents; Jan-Feb 2006)
ISSC Decision on Short List of Acceptable Sites for the SKA (30 Aug 2006)
New material to be provided to SSAC and due dates

A. **Science and Technical Selection Factors**

1) **Ionospheric turbulence**
   Report by the SPDO incorporating reports by external consultants (30 April 2011)
   To SSAC: 1 October 2011

2) **RFI measurement**
   Reports by the SPDO on measurement campaigns (30 June, 15 July 2011)
   Review and report by Expert Panel on RFI/EMI (31 August 2011)
   To SSAC: 15 October 2011

3) **Radio Quiet Zone protection**
   Reports from Candidate Sites (30 June 2011)
   Review and report by Expert Panel on RQZ/Regulatory Affairs (31 August 2011)
   To SSAC: 15 October 2011

4) **Long term RFI environment**
   Report by external consultant (4 November 2011)
   To SSAC: 5 November 2011

5) **Array science performance**
   Report by the SPDO on the Figures of Merit for the specific configurations at each candidate site (15 September 2011)
   To SSAC: 5 November 2011

6) **Physical characteristics of the sites**
   Reports from Candidate Sites (15 September 2011)
   Review and report by SPDO (4 November 2011)
   To SSAC: 5 November 2011

7) **Tropospheric turbulence**
   Interim Report by the SPDO (15 September 2011)
   Review and report by Troposphere Expert Panel (4 November 2011)
   Final Report by the SPDO (1 December 2012)
   Review and report by Expert Panel on the Troposphere (30 November 2011)
   To SSAC: 5 November and 1 December 2011

B. **Other Selection Factors**

8) **Political, socio-economic and financial**
   Reports by Candidate Sites (15 September 2011)
   Review and report by external consultant (4 November 2011)
   To SSAC: 5 November 2011
9) **Customs and Excise**
   Reports by Candidate Sites (15 September 2011)
   Review and report by external consultant (4 November 2011)
   To SSAC: 5 November 2011

10) **Legal**
    Reports by Candidate Sites (15 September 2011)
    Review and report by external consultant (4 November 2011)
    To SSAC: 5 November 2011

11) **Security**
    Reports by Candidate Sites (15 September 2011)
    Review and report by external consultant (4 November 2011)
    To SSAC: 5 November 2011

12) **Employment**
    Reports by Candidate Sites (15 September 2011)
    Review and report by SSEC Sub-set (4 November 2011)
    To SSAC: 5 November 2011

13) **Working and Support Environment**
    Reports by Candidate Sites (15 September 2011)
    Review and report by SSEC Sub-set (4 November 2011)
    To SSAC: 5 November 2011

C. **Implementation Plans and Costs**

14) **Provision and cost of infrastructure components based on the Model SKA**
    Reports from Candidate Sites (15 September 2011)
    Review and report by external consultant (4 November 2011)
    To SSAC: 5 November 2011

15) **Provision and cost of data transport based on the Model SKA**
    Reports from Candidate Sites (15 September 2011)
    Review and report by external consultant (4 November 2011)
    To SSAC: 5 November 2011

16) **Provision and cost of electrical power based on the Model SKA**
    Reports from Candidate Sites (15 September 2011)
    Review and report by external consultant (4 November 2011)
    To SSAC: 5 November 2011

17) **Consolidated costs of capital and operations expenditures**
    Report by the SPDO (18 November 2011)
    Review by SSAC
    To SSAC: 18 November 2011
Expert Panel Members

Radio Quiet Zone / Regulatory Expert Panel
Wim van Driel (Chair), Observatoire de Paris, France
Tom Gergely, NSF, USA
Masatoshi Ohishi, NAO, IUCAF, Japan
Harvey Liszt, NRAO, USA

Radio Frequency Interference/ Electromagnetic Interference (RFI/EMI) Expert Panel
Andrew Clegg (Chair), NSF, USA
Alle-Jan van der Veen, Delft U, Netherlands
Alan Rogers, MIT, USA
Philippe Zarka, Obs Paris, France
Axel Jessner, MPIfR, Bonn
Bo Peng, NAOC, China

Troposphere Expert Panel
Roberto Neri (Chair), IRAM
Larry D’Addario, JPL
Raymond Blundell, CfA
Gunnar Elgered, Chalmers
John Richer, MRAO

Data Transport Expert Panel
Jeremy Sharp, JANET(UK)'s Head of Strategic Technologies
Thomas Brunner, Managing Director, SWITCH
Christian Grimm, DFN
Shigeki Goto, Professor, Department of Computer Science & Engineering, Waseda University, Japan
Bill Johnston, Senior Scientist and advisor to US Dept. of Energy, Energy Sciences Network (ESnet)
Mauro Campanella, INFN, Italy
Pedro Veiga, FCCN and Universidade de Lisboa
Dany Vandromme, RENATER

Employment, Working & Support Environment Expert Panel (Sub-set SSEC)
Ken Kellermann (Chair), NRAO, USA
Considerations of Methods of Evaluation

1) Pair-wise Comparison of the Candidate Sites for S&T and Other Selection Factors

The Analytic Hierarchy Process (AHP) is a tool to provide as objective a comparison between the Candidate Sites as possible. It is a multi-criterion decision support tool that allows a group knowledgeable about the subject to convert its well-informed qualitative judgments into a quantitative structure. It is well-suited to a site selection process where many factors are relevant to each site criterion and judgments on complex comparisons need to be quantified.

The AHP technique makes pair-wise comparisons of the Candidate Sites with respect to each of the criteria. The method uses the comparison scale given in Table 1 to quantify the relative strengths of the Candidate Sites for the individual Scientific & Technical Selection Factors, and Other Selection Factors. The relative strength of the comparison for a particular selection factor is normalized to unity for each site, then multiplied by the weight for the factor, and the results for all factors are summed. Finally, the results of each set of independent pair-wise comparisons by the individual group members are summed and normalized to unity.

The SSAC is encouraged to test the robustness of any analytic comparison by varying the parameters and observing the impact on the result.

<table>
<thead>
<tr>
<th>Comparison</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equal</td>
<td>1</td>
</tr>
<tr>
<td>Somewhat better</td>
<td>3</td>
</tr>
<tr>
<td>Definitely better</td>
<td>5</td>
</tr>
<tr>
<td>Very much better</td>
<td>7</td>
</tr>
<tr>
<td>Overwhelmingly better</td>
<td>9</td>
</tr>
<tr>
<td>Even numbers used when cannot decide between adjacent assessments</td>
<td>2, 4, 6, 8</td>
</tr>
</tbody>
</table>

2) Evaluation of the Implementation Plans and Costs

The relatively greater uncertainties in the information on plans and costs compared to S&T and Other selection factors make it inappropriate to apply numerical comparison techniques like AHP based on weights to the plans and costs. In addition, the costs of the implementation plans to the project are likely to be the subject of discussions and negotiations in another forum concerning host country premium.
The analysis of the implementation plans and costs for the provision of power and basic infrastructure components will be undertaken by External Consultants (selected in a competitive process). The analysis of the data transport plan will be carried out by an Expert Panel. These analyses will determine the strengths and weaknesses of the particular implementation plan in relation to the Request for Information (RfI) and, for each functional subsystem specified in the RfI, the Consultant/Expert Panel will be required to give their informed opinion on the quality of the response in terms of:

- Feasibility of the solution within the context of the site – is the proposed solution a logically possible proposition?
- Credibility of the solution – has the information presented come from a reliable source with sufficient expertise?
- Costs – are they reasonable / comparable with the consultant’s experience of such implementations in similar environments (percentage over or under estimate, ± %)
- Fit for Purpose – does the proposed implementation deliver the capability that is outlined in the Model of the SKA
- Gaps in the responses to the RfI (or deviation from specification)
- Sequencing of the implementation – does the plan facilitate a smooth rollout

Risks are to be identified for each of the above areas by the Consultants or Expert Panel using their own judgment and information provided by the Candidate Sites, as well as any additionally identified areas of risk (e.g. assumptions which generate risks, missing factors / considerations, dangers not identified by the site proponents). These risks are to be assessed using a standard five point probability and impact matrix.

The SSAC will consider the conclusions of the analyses by the External Consultants and Expert Panel (for Data Transport) in its evaluation of the strengths and weaknesses, feasibility, and achievability of the plans.
SKA Site Selection Factors and Weights

1. The Request for Information from the Candidate Sites (RfI), reports on the measurement campaigns organised by the SPDO, and other reports generated by the SPDO will provide information on factors affecting the science performance of the SKA, the environment in which the SKA and its staff will operate (political, legal, customs, security etc), and the implementation plans and costs for the basic infrastructure, power provision and data transport. All are important aspects in the site decision. This is a selection between two candidates in terms of site characteristics for the best science, and the capability and cost of supporting a very large infrastructure, taking the political and working environment into account.

2. As noted in Attachment 4, the Science & Technical and Other Selection Factors lend themselves to analysis by a multiple criterion comparison method based on numerical scoring, whereas the implementation plans and costs, by virtue of the relatively greater uncertainty in the information, are better evaluated in terms of a strengths and weaknesses analysis. Table 2 shows the weights proposed for the main selection categories.

![Table 1: Weights for the three main selection factor categories](image)

3. The weights for the individual factors within *Science and Technical Factors* are shown in Table 2.

![Table 2: Weights for the Science and Technical Selection Factors (sum=75%)](image)
4. The weights for the individual factors within Other Selection Factors are shown in Table 3.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Political, socio-economic and financial</td>
<td>2</td>
</tr>
<tr>
<td>2. Customs and Excise</td>
<td>6</td>
</tr>
<tr>
<td>3. Legal</td>
<td>3</td>
</tr>
<tr>
<td>4. Security</td>
<td>3</td>
</tr>
<tr>
<td>5. Employment</td>
<td>6</td>
</tr>
<tr>
<td>6. Working and support environment</td>
<td>5</td>
</tr>
</tbody>
</table>
The work of the Committee is planned to take place from 1 September to 31 December 2011 in the process outlined below.

1) 1 – 15 September 2011: Prepare Evaluation Plan
The SSAC will prepare its evaluation plan and submit it to the SSG, which will obtain the concurrence of the Founding Board/Governing Board before giving approval to proceed.

2) 1 October – 15 November 2011: Receives material to be evaluated
The analyses and reports from the Candidate Sites, Expert Panels, external consultants, SPDO, and SSEC will be submitted to the SSG, which will in turn transmit them to the SSAC.

3) 1 October – 30 November 2011: Assessment and Evaluation of the material.
The SSAC will review the responses by the Candidate Sites to the Request for Information together with the reports by Expert Panels, External Consultants and the SPDO containing the expert analyses of the information for the selection factors and the implementation plans and costs (see list of reports in Attachment 3). The SSAC will use these analyses to evaluate each Candidate Site in terms of its strengths and weaknesses before reaching a conclusion on the site recommendation.

As part of its work in this period, the SSAC will determine whether there are questions of clarification to be posed to the individual Candidate Sites in time for the face to face meeting. A deadline of 1 December is set for transmission of the questions to the Candidate Sites.

At the end of the analysis stage, in preparation for the formal evaluation process to take place on 7 and 8 December, members of the SSAC may, if they choose, carry out a pair-wise comparison of the two Candidate Sites for the Science and Technical Selection Factors and Other Selection Factors using a system like the Analytic Hierarchy Process (AHP) described in Attachment 5.

As also discussed in Attachments 4 and 5, the SSAC evaluation of the implementation plans and costs for the basic infrastructure components, power provision, and data transport will be handled differently from the S&T and Other selection factors. The implementation plans and costs will be analyzed by External Consultants for basic infrastructure and power and an Expert Panel in the case of data transport, following the guidelines described in Attachment 4. These analyses will be in terms of feasibility, achievability, and risk. The SSAC will consider the results of the analyses by the External Consultants and Expert Panel in its evaluation of the plans.
4) 6-8 December 2011: Meeting of the SSAC (face-to-face)

A three day face-to-face meeting of the SSAC is planned on 6, 7 and 8 December to interview the site proponents, complete the evaluation phase, and come to a recommendation on the preferred site. Representatives of the SSG will be in attendance during the meeting, and support will be provided by SPO/SPDO staff.

A five-step procedure for the meeting is suggested:

6 December

1) Initial SSAC discussion comprising
   i) An overview by the SPDO Director of the materials provided to the SSAC grouped by selection category – Science and Technical, Other, and Implementation Plans and Costs
   ii) In the event AHP is utilized, a report by the SSAC Chair on the outcome of the pair-wise comparison process for S&T and Other factors undertaken by members acting collectively.
   iii) Discussion on the merits, strengths and weaknesses of the candidate sites for all three selection categories

6-7 December

2) Half day interviews with each of the Candidate Sites.
   Each Candidate Site will make a short presentation which will be followed by discussion of the questions of clarification posed earlier to each site by the SSAC.

7-8 December

3) Comparison of the Candidate Sites against the selection factors and identification of any disabling characteristics.

4) Summarize the strengths and weaknesses for each site in order to provide the motivation for the recommendation on the preferred site.

5) Recommend a preferred site.

5) 9-31 December: Write report and recommendation on the preferred site and submit to the SSG

Following the 3 day meeting, the SSAC will write a report containing its recommendation on the preferred site and an analysis of the merits of the two candidate sites. The report will also include supporting documents containing the results of a pair-wise comparison analysis, and a summary of the conclusions of the reports by the expert panels and external consultants.

The report and recommendation will be submitted to the SSG by 31 December 2011.
**SSAC Members**

<table>
<thead>
<tr>
<th>Name</th>
<th>Institution/Organization</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>James Moran; Chair</td>
<td>Center for Astrophysics</td>
<td>Harvard University, USA</td>
</tr>
<tr>
<td>Subramanian Ananthakrishnan</td>
<td>Pune University</td>
<td>India</td>
</tr>
<tr>
<td>Jaap Baars</td>
<td>Retired, formerly Max-Planck-Institute for Radioastronomy</td>
<td>Germany</td>
</tr>
<tr>
<td>Jocelyn Bell Burnell</td>
<td>Open University, Oxford University</td>
<td>UK</td>
</tr>
<tr>
<td>Wim Brouw</td>
<td>Retired, formerly Groningen University and ASTRON</td>
<td>The Netherlands</td>
</tr>
<tr>
<td>Ian Corbett</td>
<td>International Astronomical Union</td>
<td>UK</td>
</tr>
<tr>
<td>Executive Secretary:</td>
<td>Roger Brissenden</td>
<td>Harvard-Smithsonian Center for Astrophysics, USA</td>
</tr>
<tr>
<td>James Crocker</td>
<td>Lockheed Martin Space Systems Company</td>
<td>USA</td>
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<tr>
<td>Thomas Garvin</td>
<td>Thomas Garvin Associates</td>
<td>USA</td>
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<tr>
<td>Stefan Michalowski</td>
<td>OECD Global Science Forum</td>
<td>France</td>
</tr>
<tr>
<td>Ernest Seaquist</td>
<td>Retired, University of Toronto</td>
<td>Canada</td>
</tr>
<tr>
<td>Peter Tindemans</td>
<td>Formerly Netherlands Ministry of Education and Science</td>
<td>The Netherlands</td>
</tr>
<tr>
<td>Jacqueline van Gorkom</td>
<td>Columbia University</td>
<td>USA</td>
</tr>
</tbody>
</table>
SSAC Biographies

Subramaniam Ananthakrishnan, MTech (radio physics and electronics), PhD (physics–radio astronomy), Bombay University, India, 1976. Worked for more than 40 years with the radio astronomy group of the Tata Institute of Fundamental Research (TIFR), which set up the Ooty and GMRT telescopes. He retired as Observatory director (2004) and senior professor (2007). He was also involved in the SKA project in its engineering evaluation and site evaluation committees until 2006. Presently an adjunct professor of electronic science at the University of Pune. His interests include antennas, electromagnetics, and communication systems, and he is involved in many major national projects in India, such as ASTROSAT (X-ray and UV payloads), a 3.6-m optical telescope, a 2-m National Large Solar telescope, and a 21-m gamma-ray telescope. He is currently one of the vice presidents of URSI; he received the International INSA Vainu-Bappu Memorial Award in 2010 for his outstanding contributions in the setting up of the Ooty and GMRT instruments.
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Jacob (Jaap) W.M. Baars obtained the Ir and Dr.Ir degrees in physics at Technical University Delft, the Netherlands in 1963 and 1970, respectively. His career has been devoted to radio astronomy, in particular to the creation of advanced radio telescopes. He participated in the construction and operation of the Westerbork telescope, acting as station manager for several years. In 1975, he joined the Max-Planck-Institute for Radio Astronomy (MPIfR) in Bonn, Germany, to head the Division of Millimeter Technology, where he acted as project manager for the IRAM millimeter telescope in Spain and the submillimeter telescope in Arizona. On leave from the MPIfR, he participated in the early phase of the Mexican–USA Large Millimeter Telescope (LMT) before joining the ALMA group at ESO, where he acted as system engineer and member of the executive management team. In retirement, he is emeritus scientist at MPIfR, member of the LMT Supervisory Committee and the SKA International Engineering Advisory Committee, and consultant to ESO for ALMA.
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Jocelyn Bell Burnell, PhD (radio astronomy), Cambridge, UK (pulsars), followed by gamma-ray, X-ray, IR, and mm-wave astrophysics. Built 81.5-MHz radio telescope, gamma-ray instrumentation, and at Royal Observatory Edinburgh managed early JCMT instrumentation program. Fellow of the Royal Society and Foreign Associate of the (U.S.) National Academy of Sciences. Received the Royal Society Faraday Medal for science communication in 2010. Served as chair of department (Open University) and dean of science (University of Bath). Now officially “retired” and a visiting professor at University of Oxford, Astrophysics.
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Willem N. Brouw obtained his astronomy degrees from Leiden University. After a few years as scientist at Leiden Observatory, he was director of the Netherlands Foundation for Radio Astronomy (forerunner of ASTRON) for many years, then spent 13 years at CSIRO Australia Telescope National Facility before returning to a chair at Groningen University. He is now in active retirement working at Groningen University and ASTRON. His science has concentrated on data processing for interferometry, and he wrote the software for WSRT and Fleurs and was involved in CASA. He has been on council/board for ESO, FAST(ESO), JCMT, ING, EVN, and others; and on review/advisory boards for FAST(CN), ATCA, ALMA, MeerKAT, LOFAR, NOW, and others. He has a longtime connection with the SKA, as a member of the SKA ISSAC from its inception, and its secretary in 2004–2007. He was a member of the first SKA site selection committee.
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Email: icorbett@eso.org
James Crocker is vice president and general manager of Sensing and Explorations Systems at Lockheed Martin Space Systems Company. He has the following degrees: bachelor of electrical engineering (EE), Georgia Institute of Technology; MS EE, University of Alabama, Huntsville. Masters Management, Johns Hopkins University. While head of programs at the European Southern Observatory (ESO), he directed planning and development of the Paranal Observatory. He was the program manager for the development of the Sloan Digital Sky Survey. At the Space Telescope Science Institute, he was the head of the Programs Office, leading the Institute’s efforts to prepare for launch and operations of the Hubble Space Telescope. He has 40 years’ experience in development and management of large complex installations and systems for scientific missions world wide.

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Thomas Garvin, Thomas F. R. Garvin P. C., received his juris doctor degree from the University of California, Hastings College of the Law and has practiced international business law since 1979, initially at a large international law firm in Los Angeles before forming Thomas F.R. Garvin, A Professional Law Corporation, in 1997. He has experience in a variety of international transactions and projects and the interrelationship of the diverse issues that may be involved in a project or transaction (for example, relevant legal issues, financial requirements and restrictions, customs and tax matters, visa and employment law issues, land use and other project entitlement issues, intellectual property and technology law issues, securing governmental and other consents, the provisions for infrastructure and logistics support, regulatory issues, construction and preconstruction issues, etc.). He has since 1979 worked on numerous international transactions, including projects in the following industries: real estate, technology, intellectual property rights, financial services, film and television. He is the past chair of the Intellectual Property and Law Committee of the International Bar Association, past chair of the Taxation Section of the State Bar of California, and past chair of the International Law Section of the Los Angeles County Bar Association.

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Stefan Michalowski is head of the secretariat of the Global Science Forum (GSF) at the Organisation for Economic Cooperation and Development in Paris, an intergovernmental committee that addresses science policy issues (www.oecd.org/sti/gsf). He has an undergraduate degree in astronomy from Carleton College and a PhD in elementary particle physics from Cornell University. As executive secretary of the GSF, Michalowski has provided administrative support and substantive input for the Forum’s activities in the areas of astronomy, nuclear physics, neutron and synchrotron sources, high-energy physics, neutrino physics, astroparticle physics, radio spectrum management, grid computing, industrial mathematics, high-intensity lasers, and many others. He is the author of the recent GSF report, “Establishing Large International Research Infrastructures: Issues and Options” (www.oecd.org/dataoecd/17/22/47027330.pdf). In recent years, he has been a member of site assessment panels for the International Neurininformatics Coordinating Facility, the Global Earthquake Model, and the Scientific Collections consortium, chairing the last two panels.

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James M. Moran is the Donald H. Menzel Professor of Astrophysics, Harvard University, and senior radio astronomer, Smithsonian Astrophysical Observatory. He has been an active radio astronomer for more than 40 years. With A. Richard Thompson and George W. Swenson, he coauthored Interferometry and Synthesis in Radio Astronomy (1st and 2nd eds.). From 1984 to 2005, he was heavily involved in the site selection, design, and construction of the Submillimeter Array on Mauna Kea and was the project director from 1995 to 2005. He was a member of the International SKA Site-selection Advisory Committee in 2006. In 2006–2011, he was chair of the Department of Astronomy, Harvard University. He is a member of the boards of trustees of the Northeast Radio Observatory Corporation (chair, 2009–), Associated Universities Inc. (ALMA oversight committee, 2008–; executive committee, 2010–; NRAO director search committee, 2011–2012), and the Murchison Widefield Array Project (chair, 2009). He is a member of the (U.S.) National Academy of Sciences and the American Academy of Arts and Sciences (AAAS). He was awarded the Rumford Prize of the AAAS in 1971 for his role in the development of very long baseline interferometry.

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**Ernest R. Seaquist** is professor emeritus in the department of astronomy and astrophysics at the University of Toronto. His research career in radio astronomy spans more than 45 years, with specialties in stellar radio emission and starburst galaxies. He served as department chair for 11 years, as president of the Canadian Astronomical Society, and on many national and international committees, including the International SKA Site-selection Advisory Committee in 2006. He served as a panel member for both the current and previous decadal plans for Canadian astronomy and chaired the midterm review of the 2000 decadal survey in 2005. He is currently executive director designate of the Association of Canadian Universities for Research in Astronomy, which promotes the interests of Canadian universities in astronomy.

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**Peter Tindemans**, PhD, theoretical physics, Leiden University, 1975, works largely in science, technology and innovation policy, beginning as program coordinator for the first comprehensive Dutch Innovation Policy in 1979. From 1991 until 1998, he was responsible for overall research and science policy in the Netherlands. He was involved in key European initiatives such as EUREKA (member, High Level Group), COSINE for establishing the first pan-European data networking backbone (chair, Policy Group, 1987–1991) and global efforts such as the OECD Megascience Forum (chair, 1992–1999). Since 1999, he has worked independently with, for example, the World Bank, UNESCO, and (regional) governments in Africa, Latin and Central America, Europe, and Asia on science, technology, and innovation policies. From 2000 to 2010, he was chair of the successive European steering bodies for the European Spallation Source (ESS), a 1.4 billion € neutron facility, and a member of the 2008 Site Review Group for the ESS.

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**Jacqueline van Gorkom** received her PhD from the Kapteyn Institute (Groningen) using the WSRT. She was a member of the scientific staff at the National Radio Astronomy Observatory in Socorro from 1980 to 1988. Since then she has been Professor of Astronomy at Columbia University, where she was department chair for 7 years. Her main scientific interest is in gas and galaxy evolution and she has been active in radio astronomy for more than 35 years. She has served on numerous advisory committees, most recently the ASTRON Board. Currently she is a member of the scientific advisory committees of ASTRON and the EVLA. She was also a member of the SKA site selection committee in 2006.

Email: jvangork@astro.columbia.edu

**Roger Brissenden** earned a BSc (First Class Honors) in physics from the University of Adelaide, Australia (1985), and a PhD in astronomy from the Australian National University (1990). He is deputy director of the Harvard-Smithsonian Center for Astrophysics. He also serves as the manager of the Chandra X-Ray Center and oversees the operation of the Chandra X-Ray Observatory mission. Brissenden’s scientific interests include broadband spectral energy distributions of extragalactic X-ray sources and developing the foundations for the National Virtual Observatory, a “seamless digital sky.” He has been a member and chair of the NRAO visiting committee as well numerous committees for NASA, NSF, and DOE, with a focus on the operations of present and future space- and ground-based astronomy telescopes.

Email: rbrissenden@cfa.harvard.edu
Code of Conduct Regarding Conflicts-of-Interest; Bias; Confidentiality; and Non-Disclosure for Members of the SKA Site Advisory Committee (SSAC)

Preamble

The governing bodies of the SKA project and the candidate sites to host the SKA must have every confidence that the rules of procedure in the site selection process are such that there can be no doubt about the integrity of the process.

The SKA Site Advisory Committee (SSAC) is tasked with reviewing the material obtained on the Candidate Sites, assessing reports by expert panels and consultants, carrying out an evaluation of the strengths and weaknesses of the sites, and formulating a recommendation on preferred site for the SKA, or if it is not possible, the SSAC may recommend an alternative solution for study.

In carrying out its tasks, the SSAC will function free of conflicts of interest and bias and without regard to personal interest of the members. The members of the SSAC will adhere to the highest standards of confidentiality and non-disclosure.

Each member of the SSAC and the Executive Secretary will signify adherence to this code of conduct based on the principles outlined above by signing this document.

1. Declarations

All those involved in SSAC activities should consider whether they are in any way biased in favor or against any of the bidders to host the SKA site, and whether they have any form of involvement with any of the bids or bidders.

Before commencing the formal evaluation of site materials, SSAC members will sign the declarations regarding conflicts-of-interest, bias, confidentiality, and non-disclosure attached to this document. By doing so, they also pledge to observe confidentiality concerning both the content of the site bids and the evaluation process regarding them.

2. Conflicts-of-Interest

It is not anticipated that any member of the SSAC holds any financial or other material interest in the decision on a preferred site for SKA. Should evidence of a conflict arise, the member will notify the SKA Siting Group (SSG) for resolution.

3. Interactions with candidate site proponents, governments/government agencies, and others

As stated in the Terms of Reference and Rules of Procedure for the SKA Site Advisory Committee (SSAC), dated 2011-07-07:
• Proponents of each candidate site will be interviewed by the SSAC at a face-to-face meeting. This will be the only direct interaction between the SSAC and the candidate site proponents on matters of site selection.

• There will be no interactions between the SSAC and representatives of governments and/or government agencies on site-related issues for the SKA, except at the aforementioned interviews.

• All material provided to the SSAC is confidential, unless mutually agreed otherwise.

4. Scope of the Code

The code relates to all activities associated with carrying out the duties and responsibilities of membership on the SKA Site Advisory Committee.
Declarations Regarding Conflicts-of-Interest, Bias, Confidentiality, and Non-Disclosure

Activity: SKA Site Advisory Committee (SSAC)

Name : .................................................................

Organization : ...............................................................  

I declare that I have no conflict of interest regarding the bids of either Candidate Site to host the SKA;  

I declare that I will assess the submitted materials without any prejudice or bias;  

I declare that I will not use any information provided to me during the assessment and evaluation procedure for the benefit of myself or others;  

I declare not to discuss outside the SSAC forum the process of assessment and evaluation, not during the assessment/evaluation procedure and not thereafter;  

I declare not to disclose or discuss any information outside of the SSAC forum about the material submitted with respect to the Candidate Sites for the SKA; 

Date : .................................................................

Signature : .................................................................