# SKA Demonstrators – Initial IEMT Assessment

(DRAFT - ISSC Confidential)

Peter Hall, 17 July 2004

## 1. Introduction

The IEMT has considered the six SKA demonstrator project plans received. Detailed individual demonstrator reviews have been produced by individual Committee members; these reviews were further considered during the recent IEMT retreat (where chairs of IEMT working groups, and other invited individuals, were also present). The individual reviews will be revised and will be available by the end of August. During the retreat, the extended group rated the demonstrator projects quantitatively, according to previously-agreed criteria. (The rating criteria are, in fact, a sub-set of review guidelines given by the Chair for producing the detailed written reports – see Appendix 1).

Participants in the retreat felt it appropriate that the ISSC be advised of the quantitative scoring but, at the same time, recognized the sensitivity associated with the comparison exercise. The group therefore decided to restrict circulation of this part of the demonstrator review to ISSC members, leaving the ISSC to decide if the information should be promulgated further.

## 2. Basis of Scoring

For more background on which major issues the IEMT associates with various SKA concepts refer to the Committee's October 2003 report. The scoring in the table below is based on the ability of the demonstrator project, as defined in the written submission, to reach a critical milestone by 2008. That milestone is taken as the point at which the SKA project might, with good judgement, initiate large-scale technology production, at least on a scale sufficient for a 5-10% SKA demonstrator.

Note that no assessment was made of the Australian NTD project, since details of that project are still to be submitted. It was further assumed that the SKAMP demonstrator project is free to draw on the CSIRO and other technology programs outlined in the Australian submission.

While the October 2003 IEMT report outlined in detail concerns about pivotal technologies, the retreat group noted that, in broad terms, workable focal plane arrays are a significant risk for the demonstrators listed in the first four columns (assuming that the PPD requires an FPA to be an SKA demonstrator). The main risks for the TDP/12 m and SKADS/EMBRACE are economic ones associated with driving down unit costs, although phased array development issues also contribute to the risk in these demonstrators (assuming the TDP/12 m requires a wide FOV feed at low frequencies).

| | **FAST** | **LAR** | **SKAMP** | **PPD** | **TDP/12m** | **SKADS/ EMBRACE** |
|---|---|---|---|---|---|---|
| Frequency range of demonstrator | < 5 GHz | < 1.8 GHz | < 1.4 GHz | < 5 GHz | 0.1 – 25 GHz | < 1.4 GHz |
| Demonstration of pivotal and/or high-risk technology | 3-4 | 3 | 2-3 | 3 [c] | 4[d] | 3 [f] |
| Demonstration of cost reduction strategies | 2 | 2 | 1-2 | 3-4 | 4 | 5 |
| Demonstration of realistic risk management for concept or system | 3 | 1 | 1 | 2 | 4 | 2-3 |
| Likelihood of completion by end of 2008 | 0, 4 [a] | 0, 2-3 [b] | 3 | 3-4 | 0, 4 [e] | 3-4 |
| Likelihood of substantial added knowledge by end of 2006 | 4 | 4 | 4 | 4 | 4 | 4 |
| Realism of project plan (milestones & timescale vs budget and manpower) | 1-2 | 3 | 3 | 4 | 5 | 4 |
| Definition of appropriate milestones (suitable for ISPO monitoring) | 1-2 | 5 | 3 | 4 | 4 | 5 |
| Security of funding for the project as defined | ? | ? | 3-4 | 4 | ? | ? |
| Quality of responses to IEMT Oct 2003 supplementary questions | 1 | 4-5 | NR | NR | 4 | 4-5 |

**Key:**

0 Very poor; or very low
1 Poor; or low
2 Average
3 Good; or high
4 Very good; or very high
5 Outstanding; exceptionally high
? Indicates critical funding outcome still unknown
NR = no response received

**Notes:**

a. Higher score refers 30 m ‘demonstrator of demonstrator’
b. Higher score refers to structure unit ‘demonstrator of demonstrator’
c. Score is for single FOV feed; would be higher with FPA
d. Score is for single FOV feed; would be higher with FPA
e. Higher score refers to single 12 m antenna; would be higher with 2008 interferometry
f. Score is for single polarization EMBRACE; would be higher for substantial area with dual polarization tiles

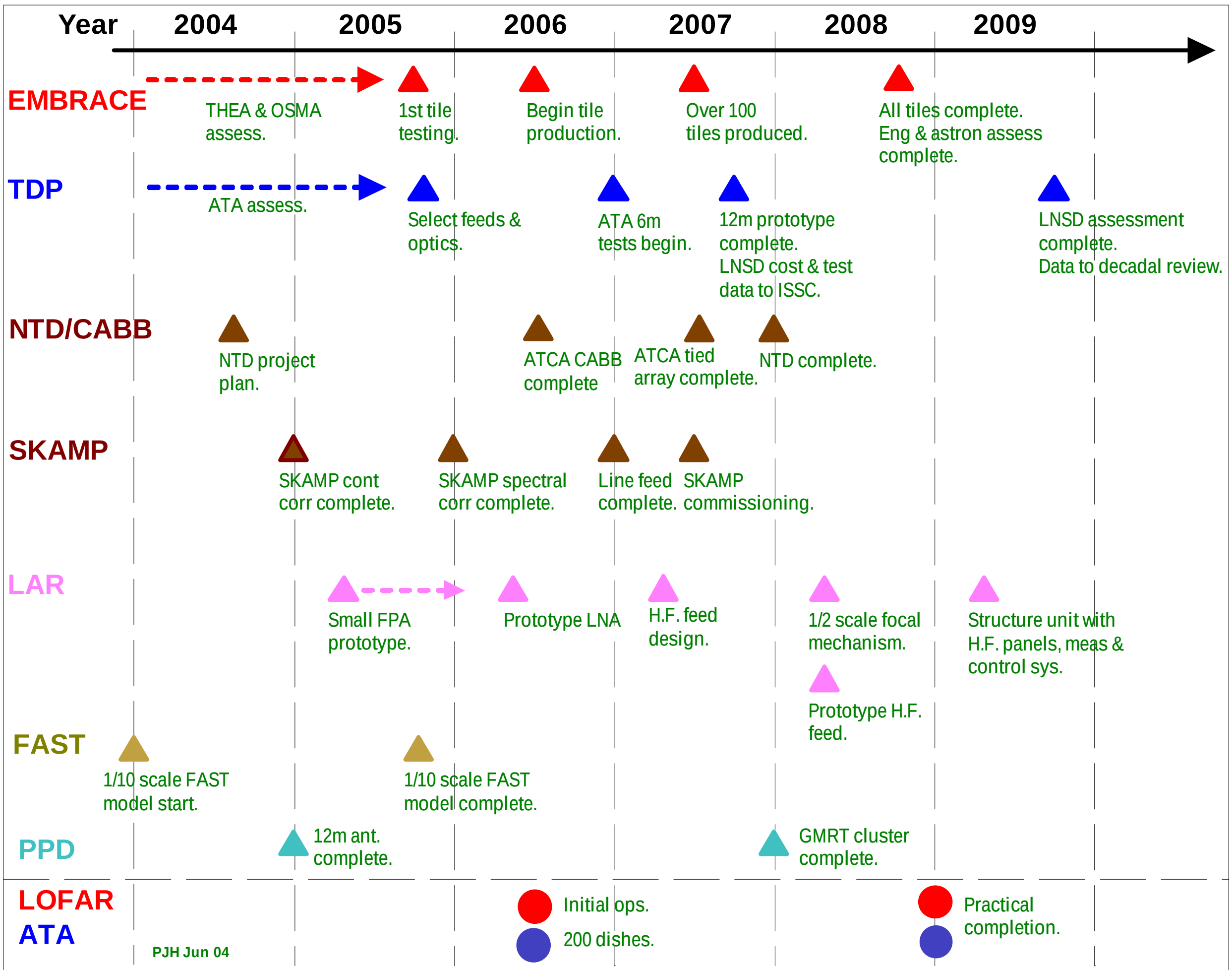
## 3. Concept Risk Assessment

As part of the discussion at the recent engineering retreat participants also rated the risk involved in developing various concepts for SKA application and, in particular, for possible hybrid SKAs. For this early evaluation the assigned risk rating was “high”, “medium” or “low”. The risk was split into two parts: that associated with reaching the cost goals outlined in the whitepapers, and that attached to reaching stated SKA performance goals. The tabular summary from the retreat is shown below.

| Concept | Frequency | Cost Risk | Performance Risk |
|---|---|---|---|
| KARST | < 2 GHz | High | Medium-High(2) |
| LAR | < 22 GHz | High | High (2,3) |
| CR | < 2 GHz | Medium | Medium (2) |
| PPD | < 5 GHz | Low (1) | Medium (2) |
| LNSD | > 1 GHz | Low (1) | Low |
| AA | < 2 GHz | High | Medium |

**Notes:**

1. Technology risk is low but computing cost uncertainty may increase rating to medium
2. Low-frequency FPA unproven
3. Cooled FPA yet to be developed




INTERNATIONAL SKA DEMONSTRATOR MILESTONES

## APPENDIX 1

## SKA Demonstrator Evaluation by the IEMT – Guidelines for Reviewers

**Peter Hall, 23 April 2004**

### 1. Introduction

This document sets out some guidelines for IEMT members reviewing the SKA demonstrator plans due for submission to the Director on 30 April, 2004. Reviewers should feel free to add additional commentary. I anticipate editing and combining the reports in a format similar to the IEMT's 2003 report; the composite document would then be made public via the Director and the ISSC.

The second part of this document contains a pro-forma for scoring demonstrator projects against various criteria. This is an exercise internal to the IEMT although the Committee may, after discussion, choose to make the results available more widely.

### 2. Questions for Reviewers

1. What is the main purpose of the project? SKA technology demonstrator, SKA pathfinder science instrument, or other? Some projects will have several purposes and it would be appropriate to give the reviewer's feeling on primary and secondary motivations.
2. What does the project demonstrate in engineering terms? A whole concept, major subsystem(s), critical component(s), infrastructure, other?
3. What is the approximate scale and duration of the project? Financial and manpower summaries, together with an overall plan, should have been provided by authors.
4. How much of the project is actually funded? If there are outstanding funding applications, when will the results be known?
5. Which institutions are key players?
6. How is the project co-ordinated? Is the management structure straightforward or complex?
7. What are the major milestones? Are the milestones tightly defined? Will it be possible for the IEMT and ISPO to track progress over the coming years?
8. Are the overall goals and milestones plausible given the resources available?
9. Is it likely that the project will add substantial knowledge (e.g. about a concept) prior to the 2006 external review of SKA engineering progress?
10. Is it likely that the project will deliver its major outcomes in time for selection of SKA technologies in 2008?
11. How well does the project address the key technology questions raised by the IEMT in its 2003 report?

12. How well answered are the supplementary questions raised by the IEMT in its 2003 report? Are there major outstanding issues?
13. How well does the demonstrator establish scalability to SKA (including areas such as connectivity and data transfer, in the case of concept demonstrators)? Is there a clear plan in place to demonstrate the cost reductions needed to make SKA feasible?
14. Does the project outline a systematic approach to risk assessment and risk management? What contingency options are discussed and what effect does this have on the concept or system in the SKA context?
15. Is there any software and/or computing component to the project? If so, what are the main issues addressed?
16. Does the plan incorporate activities for further development and review of relevant mechanical engineering and mechatronics?
17. Does the project include activities which demonstrate aspects of SKA infrastructure development? If so, what areas are covered (e.g. remote area construction, passive climate conditioning, remote power provision, wideband data links to remote sites, …..).
18. Will the demonstrator do at least basic astronomical measurements and interferometry (perhaps in conjunction with an existing telescope)? Are there plans to characterize important performance aspects prior to 2008? (Such aspects might include sensitivity, bandwidth, polarization purity, pointing, beamshape stability, …..).
19. Does the project have applicability to other SKA concepts or research efforts?
20. Are there identified links with other international SKA groups, or other major astronomy projects?
21. Are there identified links with industry participants? If so, what is the form of the industry involvement?

**3. Quantitative Scoring**

In the table below, rate the project on the following numerical scale:

0 Very poor; or very low
1 Poor; or low
2 Average
3 Good; or high
4 Very good; or very high
5 Outstanding; exceptionally high

IEMT Evaluation Table for Demonstrator Project

Project:

| **Criterion** | **Rating** |
|---|---|
| | |
| Demonstration of pivotal and/or high-risk technology | |
| Demonstration of cost reduction strategies | |
| Demonstration of realistic risk management for concept or system | |
| Likelihood of completion by end of 2008 | |
| Likelihood of substantial added knowledge by end of 2006 | |
| Realism of project plan (milestones & timescale vs budget and manpower) | |
| Definition of appropriate milestones (suitable for ISPO monitoring) | |
| Security of funding for the project as defined | |
| Quality of responses to IEMT Oct 2003 supplementary questions | |
| | |