Letter to All University Task Managers in
the Antennas and Receiver Sub-Project of the USSKA TDP

October 23, 2003

All,

I am planning the Antennas and Receivers portion of the TDP and have attached drafts of a top-level summary and a WBS spreadsheet showing the participants and a first estimate of the funding. .

If you would like to participate in carrying out the work of this section of the TDP, please send me an e-mail, copy to Cordes, by Oct 31, with the following information:

1) A few sentence statement-of-work (SOW) for the task you are proposing to do for the Antennas and Receivers portion of the TDP.
2) Your estimated total budget by year, including all burdens of your organization, for your SOW.
3) A list of deliverables (reports and hardware) and dates. At a minimum, a brief monthly or quarterly report (as will be specified by NSF) and an annual report will be required.
4) A few sentence statement describing any intellectual property you wish to put on record before receiving TDP funds. You should state who owns this IP and if there is a royalty-free-to-USGov't provision.
5) Your full contact information - telephones, FAX, best e-mail, and mailing address.

A formal proposal submitted by your organization's contracting office will be required at a later date. We will find out next week whether these formal proposals must be submitted with the TDP proposal or after review of the proposal. In either case, do not delay in getting your informal letter proposal to me.

I am accepting the responsibility of managing this sub-project of the TDP and, if you take responsibility for a task, expect your best effort to meet the project needs and to spend funds responsibly. This TDP should not be an avenue for funding other research not needed by the USSKA. I believe that we should review the work on each WBS task annually (including mine) and make changes if progress is low or another approach is better. I want to devote as much as possible of my time to technical matters and hope that most business matters will be handled directly between the task leaders and NAIC.

Sander Weinreb
818-354-4065

2. Antennas and Receivers

Summary

Objective:

- Demonstrate or correct the assertion that the per unit cost of the radio astronomy sensitivity parameter, effective area divided by system noise temperature, A/T, can be decreased by an order of magnitude.
- Demonstrate or correct an initial estimate of approximately $800M for antennas and receivers to meet the SKA specification for A/T with the US LNSD approach.

Overall Approach:

- Demonstrate element A/T with three wideband receivers on a 6m antenna by 2007
- Demonstrate element A/T with a prototype 12m antenna by 2009.
- Provide cost estimates based upon detailed designs of 12m antenna and receivers.

Critical Technologies:

- Decade bandwidth feeds with high efficiency, very low noise, constant impedance, low beam ellipticity, good polarization purity, and fixed phase centers.
- Optics design (F/D, subreflector, and shaping) to mate with the feed design and minimize cost.
- Precise, low-cost, antenna reflector and pedestal manufacture
- Fabrication method for antennas in extended array > 350km from central factory.
- Monolithic-integrated circuit (MMIC) receivers.

Table 2.1 - SKA Sensitivity Specification and USSKA Goals

Frequency Range	Specified A/T	Goal A/T	Antenna Efficiency*	Antenna Temperature**	Receiver Temperature***	System Temperature
0.5 TO 5 GHz	20,000	19,600	67%	10K	7K	17K
0.2 GHz	10,000****	2,714	60%	100K	10K	110K
10 GHz	15,000	14,700	65%	13K	9K	22K
20 GHz	10,000	9.950	60%	17K	13K	30K
30 GHz	5,000	4,980	45%	20K	25K	45K

* Assuming 4400 12m antennas

** At zenith, good weather, and out of galactic plane. Includes spillover. Somewhat higher below 1 GHz.

*** Noise temperature at feed room temperature aperture

**** At 0.2GHz it is not possible to meet the specified A/T because of high sky noise unless A is over 1 km^2.

Work Breakdown Structure, 2.0 Antennas and Receivers

WBS	Task	Person, Organization	Year 1	Year 2	Year 3	Year 4	Year 5	Total
2.1	**Feeds and Optics**							
2.1.1	Wideband feed design A	Kildal, Chalmers	$85	$100				$185
2.1.2.1	Wideband feed design B	Ingersen, Broad Spectrum	$100	$100				$200
2.1.2.2	Wideband feed design B	Imbriale, JPL	$50	$50				$100
2.1.3	Wideband feed design C	Welch, UCB	$100	$100				$200
2.1.4	Feed study continuation	TBD1			$100	$100	$100	$300
2.1.4	Optics study	Cortes, Cornell	$100	$100	$50	$50		$300
2.2	**Reflector**							
2.2.1	Reflector manufacturitng design	Schultz, Schultz Associates	$100	$100	$100	$100	$50	$450
2.2.2	Segmented reflector prototypes	Andersen, Andersen Mfg	$100	$100				$200
2.2.3	12m prototype reflector	Andersen, Andersen Mfg			$500	$1,500	$1,000	$3,000
2.3	**Pedestal**							
2.3.1	Pedestal design	Schultz, Schultz Associates		$50	$50	$50	$50	$200
2.3.2	Pedestal design	Fleming, Minex Inc		$100	$100	$50	$50	$300
2.3.3	Alternate pedestal study	Burke, MIT	$100	$100				$200
2.3.4	12m Prototype pedestal mfg	TBD2				$200		$200
2.4	**Cryogenics**							
2.4.1	Cryocooler study	Photenhauer, UWisc	$50	$50				$100
2.4.2	New technology cryocooler	TBD3	$50	$100	$50	$50	$50	$300
2.5	**Receivers**							
2.5.1	0.13-1.5 GHz receiver development	Weinreb, Caltech	$100	$100	$100	$100	$50	$450
2.5.2	1-11 GHz receiver development	Weinreb, Caltech	$100	$100	$100	$100	$50	$450
2.5.3	11-34 GHz receiver development	Webber, NRAO	$100	$100	$100	$100	$50	$450
2.5.4	Shared MMIC wafer processing	TBD4	$120	$180	$120	$180		$600
2.6	**IF and LO**							
2.6.1	IF/LO development	Webber, NRAO	$50	$50	$50	$50	$50	$250
2.7	**RF System**							
2.7.1	RF system design and management	Weinreb, Caltech	$200	$200	$200	$200	$100	$900
2.7.2	6m System integration and test	TBD5			$200			$200
2.7.3	12m System integration and test	TBD6					$200	$200
2.7.1	Contingency	Weinreb, Caltech	$100	$100	$100	$100	$100	$500
		Totals	**$1,605**	**$1,880**	**$1,920**	**$2,930**	**$1,900**	**$10,235**