32T Test Plan --
Tile / Beam-former Reliability and Weathering (8)

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1 Introduction

The antenna tile / beam-former combination forms the primary collector of the Radio Frequency energy being observed by the overall instrument. As such, the antenna tile and beam-former systems operate entirely in the analogue electronics domain (the first stage digitization is conducted down-stream from the beam-former). This Plan is responsive to requirement #8 contained in the memo "MWA 32-T Objectives and Quality Assurance Evaluation Criteria", dated 4 Sept 2009 (46-03001.99).

2 References

There is a placeholder containing an empty ICD in the MWA knowledge tree, it should be fleshed out!!! – see http://mwa-lfd.haystack.mit.edu/knowledgetree/view.php?fDocumentId=227.

Also there is a very good set of manufacturing and procurement documentation held by Steve Burns of Burns Industries Inc., the expected manufacturer of the tiles and beam formers. The bulk of the manufacturing work will be carried out in China, and as a result much of this documentation is currently in Chinese. It is also likely that Burns Industries representatives will handle the site assembly and installation of the antenna tiles *and beam-formers?*

3 Test Description

The antenna tiles will be "tested by analysis", augmented with some details from field experience of prototype tiles. We plan to identify and analyse fundamental reliability and environmental conditions imposed on the system and the results of this analysis will flow down to requirements on component selection and design. Further we will run such laboratory tests as are practical to validate these component designs.

It is expected that the instrument will have a five-year operating lifetime *(to be confirmed??)*, and this must be the basis on which long term reliability and stability is designed.

The following list represents the identified environmental conditions to which we will address our design. *Items in RED require verification with measured site conditions*.

Condition	Expected Range	Comments
Temperature (ambient, shade)	-10 degrees C to 50 degrees C	Allowance must be made for insolation for items in full / direct sun. Paints/finishes should be as reflective as possible to reduce solar heating. Temperature effects on circuit performance must be gauged and if necessary compensated.
Humidity	Below 20% to 100% RH	Conformal coating on circuit boards is likely to be required to prevent changes to dielectric constants. Specifically LNA and beam-former circuit boards.
Wind	Still to occasional >100kph?	Damage from wind-borne debris?
Varmint	Rodent to Bovine	Damage could range from chewed cables, to impact damage from larger animals, as well as potential damage from pest control activities.
Rainfall/flood	Expected annual rainfall to 200mm, usually concentrated in heavy downpours potentially resulting in local flooding.	Risks include wash-away damage (moved or deluged equipment) as well as fine mud ingress. Foundations and ingress protection need to be considered. Tile movement must be prevented to avoid recalibration of the telescope!
U/V radiation	High UV flux consistent with arid conditions and low cloud-days per year	Plastics must be chosen with high UV tolerance.
High static charge	Consistent with dry atmospheric conditions and poor ground characteristics	Static discharge paths must be considered.
Lighting strike	Estimated near hits per annum?	Lightning discharge design must be considered.
Vibration	Transport to site – g's / time?	Internal and transport packaging to be designed
Vegetation	Thin grasses growing up through the mesh ground-screen after rainfall	While wet, this grass could "short" the lower arms of the dipoles to significantly affect the beam characteristics.

4 Resources Required

4.1 Staffing

Staff required to conduct this analysis would have the following skill requirements:

- Experience in designing equipment for harsh conditions.
- Collect and process regional and on-site weather information.
- Obtain manufacturer's information on components and assess suitability.
- Operate suitable laboratory equipment to test components/sub-systems against expected environmental conditions.

4.2 Hardware

Hardware required for laboratory testing would consist of an environmental chamber suitable for testing a completed dipole, and a completed beam-former (but not necessarily simultaneously). It would be expected that the temperature and relative humidity could be controlled beyond the range expected in the field.

4.3 Software

N/A?

4.4 Execution Time and Constraints

No real idea here. Only constraint I can think of is that the ambient RF noise levels against which we are trying to compete are very hard to measure in typical test environments, so it may not be possible to fully qualify RF components except in the field.

5 Success Criteria

Since this testing is really "design by analysis" there are no direct success criteria, other than the equipment survives in the field for the designated lifetime!

6 Other

I couldn't think of where in the above sections to mention what we have learned about the black versus white RG6 coax cable sheaths in the UV, and the fact that not all black zip-ties are the same, some deteriorate within a short term (eg. 6 mths) in the field, while others seem to be OK after over 24 months.

Revision History

Rev Ltr	Date	Author	Description
01	2009-Sep-28	DJE	Initial draft
02	2010-Jan-04	RFG	Formatting