SPF payload risks and their mitigation

Risk register

- A first draft Risk Register is included in the document WP2-020.050-TD-001D: ‘Concept Description: Single Pixel Feed Payloads’
- Some of the risks will be discussed in this presentation.

High Dynamic Range

- This depends on the performance of the whole system. Failure to achieve the expected high dynamic range will lead to a suboptimal system not able to achieve the science goals.
- Implications for the SPF feed payloads are the need for stable amplitudes and phases, stable and repeatable radiation patterns and stable and repeatable polarization.
- Mitigation strategies include system simulation and testing of key components with particular attention to stability.

Power

- Power consumption is potentially a large risk for the SKA system. Excessive power consumption could limit the size of SKA that can be afforded, and hence reduce the science output.
- SPF payloads are potentially high consumers of power owing to the use of cryogenic cooling.
- Minimization of power must be a high priority in the SPF payload development program.

Design and development gaps

- Currently there is no design for an octave band SKA OMT or dewar or cryogenics sub system. Failure to produce timely designs for use in SKA SPF feed payloads will result in delays to the program.
- Priority must be given to development of these items for the SPF payloads in the PEP phase of the SKA.

Performance

- Failure to meet the expected performance targets per dish would result in the need for more dishes, resulting in much higher system cost, or in worse than expected system performance and lower science output.
- Very high priority must be given to development work that affects system performance, e.g. development work on feed optimization and LNA noise performance.

Cooling performance risk

- Stirling cycle cooling systems are very unlikely to reach the temperatures that are commonly achieved with GM cooling systems.
- Higher operating temperatures for the LNAs and passive components in front of them will result in higher system noise temperatures. Absence of cryo-pumping will make it difficult to maintain a vacuum in the dewar

Cooling performance: risk mitigation

- Work with cryo cooler manufacturers to seek the best possible performance for the SKA.
- Optimise LNA designs for low noise at 50 – 70 K rather than 15 – 20 K.
- Minimise passive losses in front of the LNAs.
- Investigate long life, reliable vacuum pumps that can be operated at any angle.
- Investigate vacuum-free cryogenic systems.

Cost of ownership

- If long lifetimes and low maintenance requirements are not met then the result will be high operating cost. This will almost certainly result in limitation of observations with the SKA.
- Cryogenic cooling systems have moving parts that wear out. LNAs also have a limited lifetime.
- Long lifetime, highly reliable design solutions must be found.

RFI/EMC

- Cryo cooler power supplies and control systems are a potential source of RFI. Oscillating LNAs are another potential RFI hazard that could jeopardize SKA observations.
- It will be important to work with cryo cooler manufacturers to produce designs that do not generate harmful RFI (this may add to the cost).
- LNAs must be designed to be completely stable under all operating conditions and over their operational lifetime.
- It will be essential to carry out very thorough RFI testing on candidate designs.

Component availability (especially low noise devices)

- There is potentially a long period of time over which some or all of the SPF payload LNA designs will be used. Components used in the designs must be available over the full period of time when they will be needed.
- If components cease to be available the result may be the deployment of multiple versions leading to calibration problems and spares holding difficulties.
- It should be SKA policy to use components from established suppliers who have commitments to supply in the long term.
- Where future supply is not certain it will be necessary to advance purchase sufficient components for the lifetime of the SPF feed payload.