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Radio telescope projects open new horizons for high-tech firm

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The design, development, manufacture, and erection of South Africa's world-leading innovative 15-m-diameter experimental demonstrator model (XDM) radio telescope antenna took only 11 months, while software integration, testing and commissioning required only a further two.

The main contractor and systems integrator for the project is IST Dynamics. "The timescales were very compressed – we started last year in June and the XDM is now up and running," says IST Dynamics MD Roelof van Rooyen. "Any first-of-a-kind development is always challenging."

The XDM is the prototype unit for South Africa's MeerKAT radio telescope array, and is the largest radio astronomy dish ever constructed from composite materials (see Engineering News July 6, 2007).

"We did the structure and the control system, and our technology partner, MMS, made the dish – the contract was led by the National Research Foundation (NRF)," he reports. The scientific equipment for the antenna – which turns the dish into a radio telescope – will be provided by the NRF.

"We're integrating the KAT team's scientific software with our control system software and there have been very few hiccups so far," he says. "Coordination between ourselves, MMS, and the KAT team has been excellent – there has been a very strong team approach to the whole project." (KAT stands for Karoo Array Telescope, the conceptual predecessor of MeerKAT.)

"The indications are that the XDM's performance will be very good – it looks as if it will be much better than the specification required," he highlights. "It seems that it will be one of the best performing dishes of its size in the world."

Central to the entire programme was the need to keep costs as low as possible – especially on-site construction and integration costs owing to the vast number of antennas to be commissioned as part of MeerKAT. That is why the dish has been made from composites. Most of the support structure consists of mild steel.

And the number of drives used to precisely steer the dish has been cut in half. "Traditionally, radio telescope dishes have two drives per axis – we have only one per axis," reports Van Rooyen. The traditional arrangement saw the two drives of each axis placed in opposition to each other, one to drive and the other to brake, in order to prevent a phenomenon known as 'backlash' occurring with the gear drives – backlash destroys precision, and precision is a fundamental requirement for radio telescopes.

"To put it simply, we use gravity to act as a brake, so we only need one drive per axis, and we are still getting good precision," he explains.

"The control software wasn't that complex, although it was a concern of the NRF as the dish has to move slowly, through three dimensions, with great precision, so we put our best people on the job," he adds.

The project was executed on a shared-risk basis with the Department of Science and Technology, and this resulted in IST Dynamics investing in the project. "We definitely did not make a profit on this project, but it was of strategic

importance to us," he elucidates. "We have joint ownership of the intellectual property [IP] for this new dish antenna structure, but there is also a lot of background IP in this dish that IST Dynamics and MMS used to successfully execute this project, which obviously belongs to the two companies."

MeerKAT is intended as a precursor to the €1,5-billion Square Kilometre Array (SKA) radio telescope project, which involves the European Union (EU), Australia, Canada, China, India, South Africa, and the US. South Africa and Australia are the two countries shortlisted to host the SKA, which will be the largest radio telescope ever constructed.

All being well, MeerKAT will be composed of a number of XDM-type dishes (60 or more) working together as an array, and will be a major scientific instrument in its own right. The first phase of MeerKAT will be an array of seven dishes, dubbed KAT-7.

"We see the MeerKAT programme and the SKA as a major opportunity not only for our company but for South Africa as a whole," affirms Van Rooyen. "We will tender for KAT-7 – we expect it to again be an open tender, and for it to come out near the end of this year, with the contract to be awarded early next year: KAT-7 is to be commissioned by October 2009, so there is not much time for the process."

Although the company expects both local and international competition for the contract to build the KAT-7 antennas, it is confident of its chances of success, because of its joint ownership of the new antenna structure IP, its ownership (with MMS) of the background IP, and the experience it has gained in the design, development, manufacture, erection, integration, testing, and commissioning of the XDM.

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