



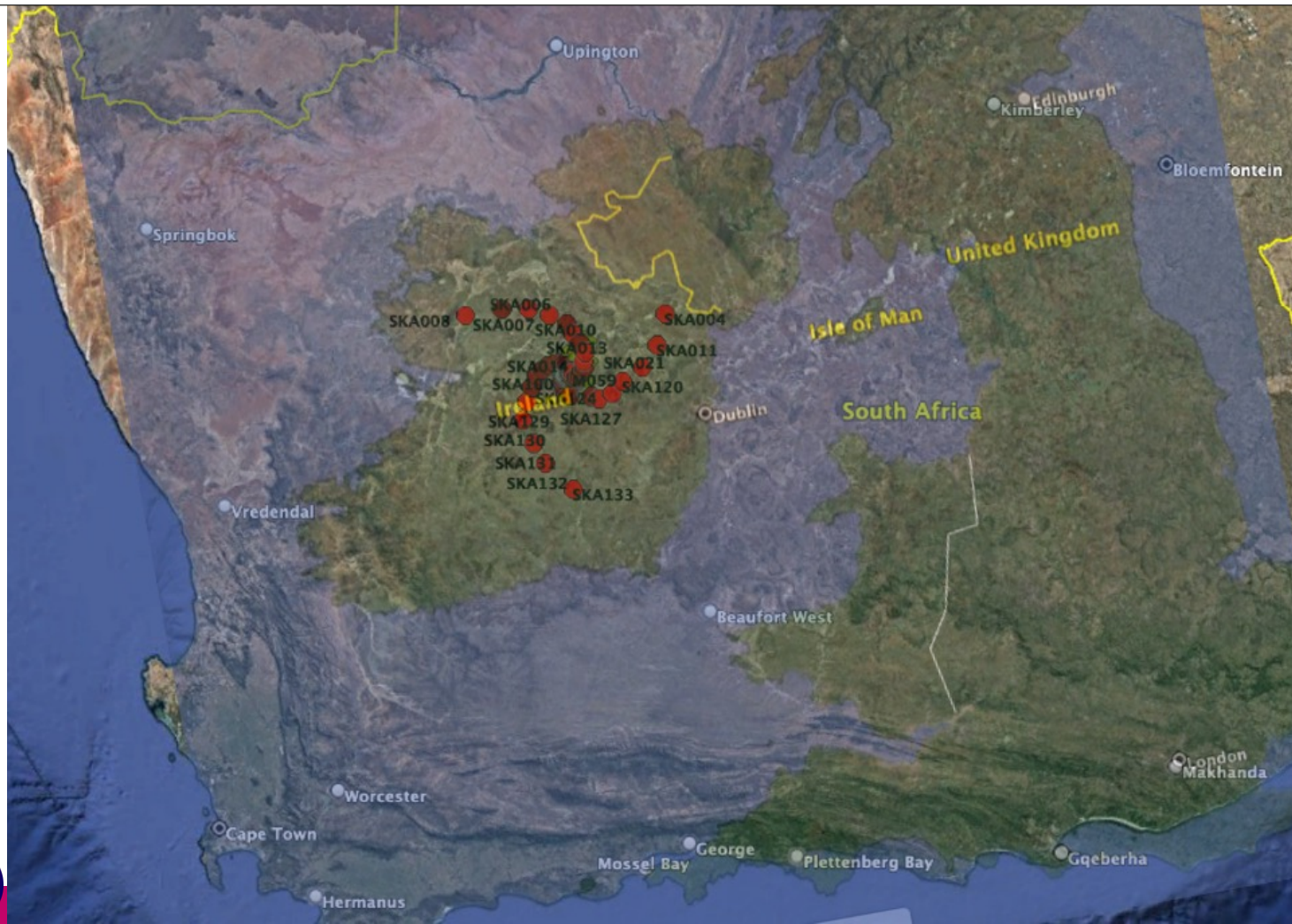
Mid Annual Status Update Meeting (MASUM) 2022

SKA MID INFRASTRUCTURE

Du Bruyn Jonker

11 May 2022

Ireland superimposed on SKA Mid (Wales is too small) 🤔



- Spirals 135-155km each from core (measured dish to dish)

Infrastructure:

- +/- 650km of fibre (underground and overhead)
- Overhead and underground power
- 21 remote PV power stations
- New roads and rehabilitation of existing
- Piled and pad dish foundations
- Security (fencing and guard huts)
- Construction Camp
- Buildings
- Site Monitoring
- Communication

Mid Infrastructure Contracts

- MeerKAT+ infrastructure project; Construction commenced Sept 2021
- MID Infra PSC's
- Mid Infra 4 – Digital Mobile Radio System (DMRS); contract to be finalized this week
- Mid Infra 1 - Power, fibre, roads, dish foundations, security, site monitoring (previously Mid Infra 3)
- Mid Infra 2 – Building ancillaries, BMS, Power Facility (incl DRUPS and fuel facility, transformers)
- Mid Infra 1 & 2 ITT's issued in January 2022
- Virtual tender clarification and site clarification meetings held in February 2022
- Tender Evaluations currently in process with anticipated award in August 2022



Mid Infra PSC's

- 2 x NEC4 PSC's signed in September & October 2021
- SARAQ & Zutari to support the Mid Infrastructure PDT by providing
 - NEC4 Project Managers
 - NEC4 Supervisors
 - Discipline specific specialists to support Design Verification Processes (DVP's)
 - Systems Engineering (including requirements & ICD's through Jama)
 - HSE Support
 - Quality support
 - Configuration Management



Mid Infra 4 – Digital Mobile Radio System (DMRS)

The aim of the project is to establish a Low Band VHF Digital Mobile Radio (DMR) Communications System, as required for emergencies, security and general maintenance in both the core- and expanded SKA telescope area. The intended system will replace the current VHF Midband PMR installation, operated by SRAO. The Scope is divided into two phases, Phase 1 and Phase 2A.

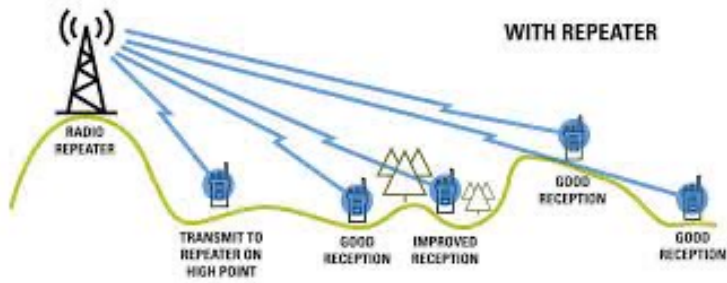
- **Phase 1** comprises a DMR communications system for the SKAO to be used by contractors and the SKAO during construction and operation of the SKA MID Telescope.
- **Phase 2A** will provide the community in the vicinity of and surrounding the SKA MID telescope, with a similar DMR communications system as for Phase 1. The new installation will be used for communications required by emergency services, area security, farming/business operations and general interpersonal communications, to compensate in part for the impact of the SKA project on general communications limitations in the greater surrounding area.

The contract will nominally run for 21 months.



Mid Infra 4 – Current Progress

- Tender closed December 2021
- TSC endorsed the award recommendation 2 weeks ago
- Contract to be finalized this week



Mid Infra 1 - Power, fibre, roads, dish foundations, security, site monitoring

The Contract includes the design (verification and final development of the reference designs provided) and construction of the infrastructure for 109 dishes (antenna) which include:

- Gravel roads and antenna platforms to the selected dish positions
- Electrical reticulation, including overhead lines
- Optic fibre reticulation, including overhead lines and Fibre Repeater Shelters
- Structural reinforced concrete piled and pad dish foundations
- Security fencing
- Infrastructure and equipment related to various monitoring stations
- Contractor's temporary accommodation



Mid Infra 1- DESCRIPTION OF THE WORKS

MID ACCESS

- On-site Access roads
- Antenna (dish) platforms
- Access roads to Site Monitoring and standalone photovoltaic plants in the spiral arms

There is a total of approximately 450km of roadworks required for SKA1_MID. Of the 450km, 180km will be new roads in the spiral arms, 4km will be new roads in the core and 270km in the spiral arms will be existing farm and district roads which will be rehabilitated to improve access.

The core and spiral arms roads will be built to similar specification as the MeerKAT roads (basic farm roads and standard gravel roads). Stormwater Infrastructure will be in a combination of earth channels, concrete channels, culverts, berms and concrete drifts.



Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

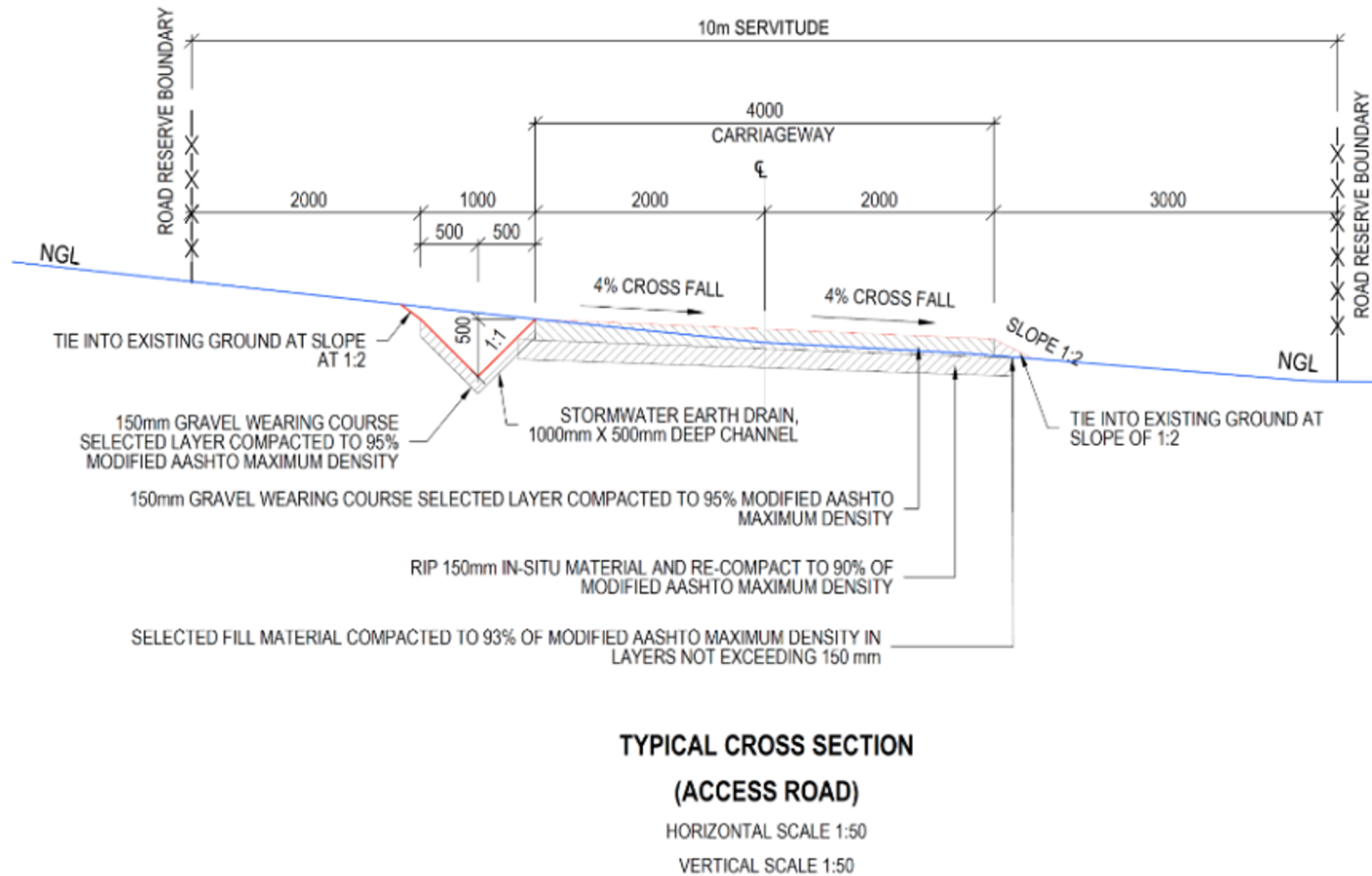


Figure 40: Basic Farm Road Typical Cross-section



Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

MID Power

- 22 kV overhead and underground cable networks supplying mini-substations or transformers, which in turn supplies groups of SKA1 MID dish antennas at 400 V
- Intermediate voltage (3.3kV) cables and networks supplying transformers, which in turn supply a single SKA1 MID dish antenna at 400 V
- Modification / Extensions to the existing electrical networks for new SKA1_MID receptors
- Installation of electrical infrastructure as defined in associated with the PV Power Stations (INFRA #5) that will power the 7 outer most stations of each spiral arm.
- Outage Requirements / INFRA #1 & 2 Coordination and Commissioning Plans
- The electrical reticulation network which forms the bulk of the INFRA 1 electrical scope will interface with the new power facility electrical infrastructure (INFRA 2).



Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

MID Fibre

- An underground fibre network to be implemented in parallel to the existing MeerKAT AFN (Array Fibre Network) to serve the portion of the 109 SKA1_MID Receptors in the core.
- An overhead fibre network with underground linked sections, along the full length of the 3 spiral arms, including repeater facilities
- Underground fibre links between the overhead fibre network on the 3 spiral arms and the dishes, as well as their associated local off-Grid solar PV power plants where applicable



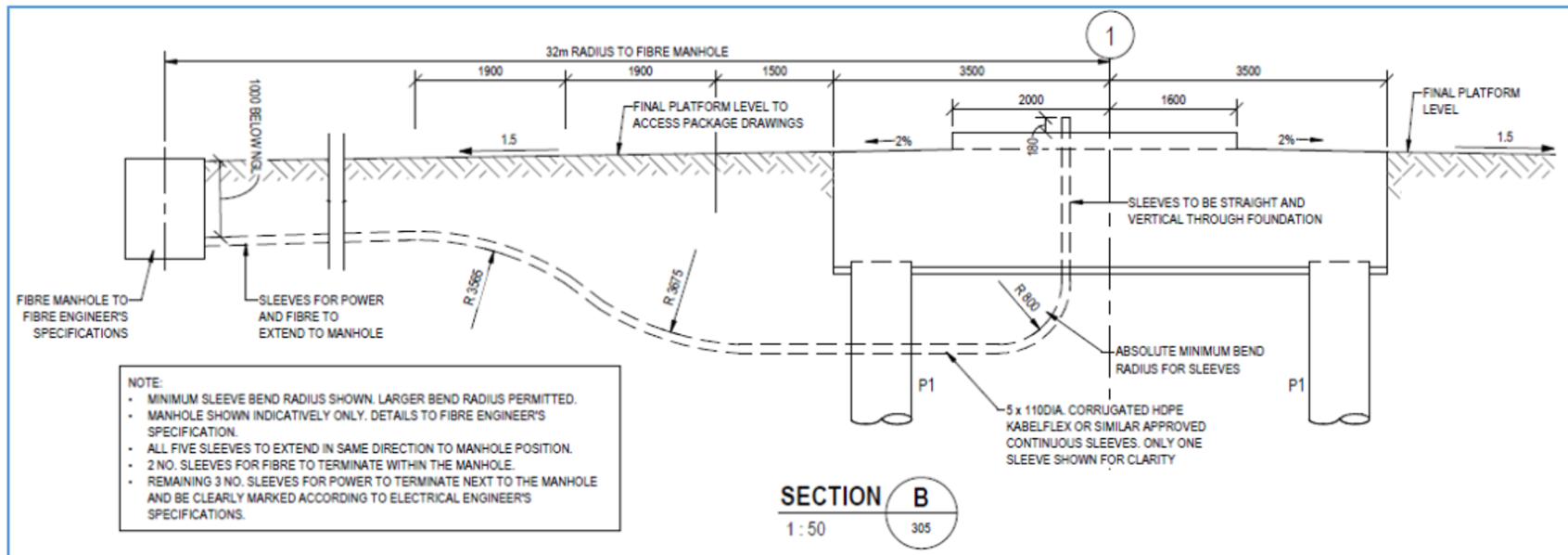


Figure 8: Dish Foundation Fibre Duct with 2-Way Microduct

Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

MID FOUNDATIONS

- Design and construction of 109 Dish foundations
- Both piled and pad foundations will be required for the SKA1_MID antennas
 - ❖ Type 1 piled (87 No): 7m diameter pile cap on 0.75m diameter vertical augered piles
 - Where rock depths range from 4m to less than 11m below ground level (BGL), a piled foundation with a rock socket of 0.75m (1 x pile diameter) into Medium Hard Rock or 1.5m (2 x pile diameter) into Soft Rock or a minimum of 4m (5.3 x pile diameter) into competent very soft rock
 - For rock depths greater than 11m BGL, a pile length of 11.2m BGL (9.7m below base of pile cap) is applied. The residual performance of piles within a deep soil profile is required to be verified with additional pile load testing
 - ❖ Type 3 piled (22 No): 11m diameter cast in-situ reinforced concrete pad foundation



3. DESCRIPTION OF THE WORKS (Cont.)

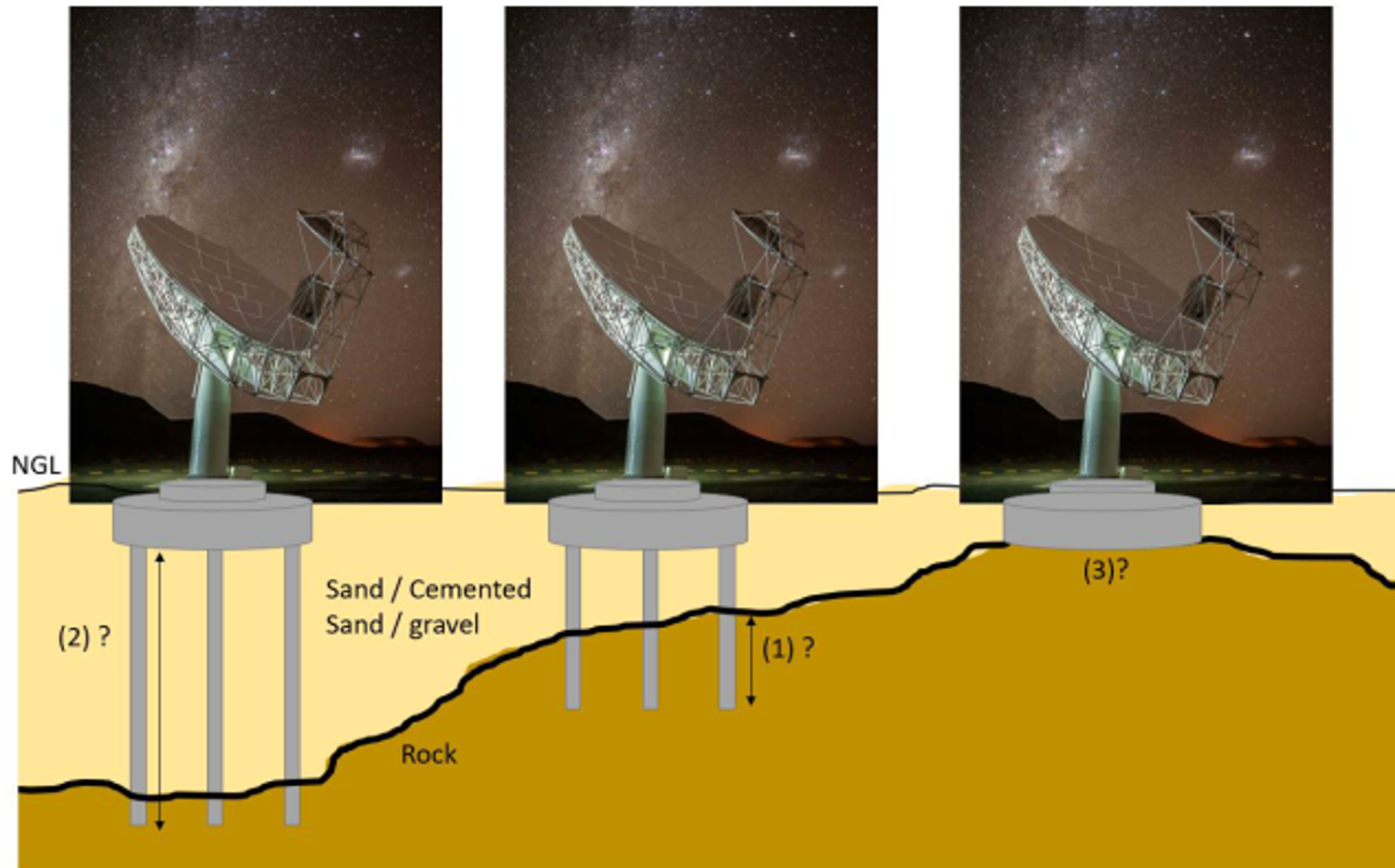


Figure 15: Three key design criteria

Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

TEMPORARY ACCOMMODATION

- The establishment and maintaining of the *Contractor's* own construction Camp. (Basic infrastructure already in place i.e., bulk water supply, bulk power supply and platforms)
- The Contractor will be required to remove the bulk of the infrastructure at the construction camp, as constructed under the MeerKAT+ contract. This activity, referred to as the "reinstatement of the construction camp area" can only be done after the various other Contractors have removed their own site accommodation, fencing and associated services.



Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

Security

- 2.5m high security perimeter fencing for 21 dishes on the 3 spiral arms. These will have 6m wide access gates with two 6m wide removable panels on either side of the gate. The fenced area will be 100m x 100m in plan.
- Security Perimeter fencing at 4 repeater stations situated in the 3 spiral arms. These will each have a 3m wide access gate. The fenced area will be 20m x 20m in plan.
- Security Perimeter fencing at 3 Weather Monitoring Stations situated in the 3 spiral arms. The fenced area will be 10m x 10m in plan.
- Installation of gates where the overhead fibre crosses over a farm boundary or where private roads crosses farm boundaries or internal fences.



Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

Site Monitoring

- Three (No.3) new weather monitoring stations
 - ❖ Power
 - ❖ Fibre
 - ❖ Foundations
 - ❖ Earthing
 - ❖ Mast
- Upgrade of two (No.2) existing weather monitoring stations and three (No.3) new weather monitoring stations
 - ❖ Procure WMS instrumentation, outdoor enclosures and the WMS components
 - ❖ Design and build WMS RFI enclosures
 - ❖ Integrate RFI enclosure hardware and RFI test RFI enclosure sub-assemblies
 - ❖ Build and install functioning WMS populated with instrumentation



Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

Site Monitoring (Cont.)

This work package comprises the following:

- Four (No.4) new Visual monitoring systems
 - ❖ Power
 - ❖ Fibre
 - ❖ Foundations
 - ❖ Earthing
 - ❖ Mast
 - ❖ Procure VMS components and outdoor enclosures
 - ❖ Design and build VMS RFI enclosures
 - ❖ Integrate RFI enclosure hardware and RFI test RFI enclosure sub assembly
 - ❖ Build and install functioning VMS



Mid Infra 1- DESCRIPTION OF THE WORKS (Cont.)

Site Monitoring (Cont.)

- Tropospheric/STI Monitoring Station (TMS), please note that the *Contractor* will provide the infrastructure only, The Tropospheric Monitoring System, a Prodelin 84 cm small aperture system will be provided by another contractor.
 - ❖ Power
 - ❖ Fibre
 - ❖ Foundations (Quantity 3)
 - ❖ Earthing
 - ❖ Mast (Quantity 3)
 - ❖ Fence



Mid Infra 1 Key Dates

1	Accepted design with all documentation issued for Construction	25 weeks after Starting Date
2	Completion of Foundations, Access, Power & Fibre Reticulation Networks and Security for AA1 (Batch 2: SKA046, SKA048, SKA077, SKA081)	31 October 2023
3	Completion of Foundations, Access, Power & Fibre Reticulation Networks and Security for part of AA2 (Batches 3: SKA015, SKA025, SKA009, SKA008)	26 January 2024
4	Completion of Foundations, Access, Power & Fibre Reticulation Networks and Security for next part of AA2 (Batches 4.1 to 4.6: 24 Foundations)	29 March 2024
5	Completion of Foundations, Access, Power & Fibre Reticulation Networks and Security for remainder AA2 (Batches 4.7 to 4.13: 28 Foundations)	28 June 2024
6	Completion of Foundations, Access, Power & Fibre Reticulation Networks and Security for AA3 (Batches 5&6: 49 Foundations)	10 March 2025



AA2 (Batches 3:
SKA015, SKA025,
SKA009, SKA008)

26 January 2024

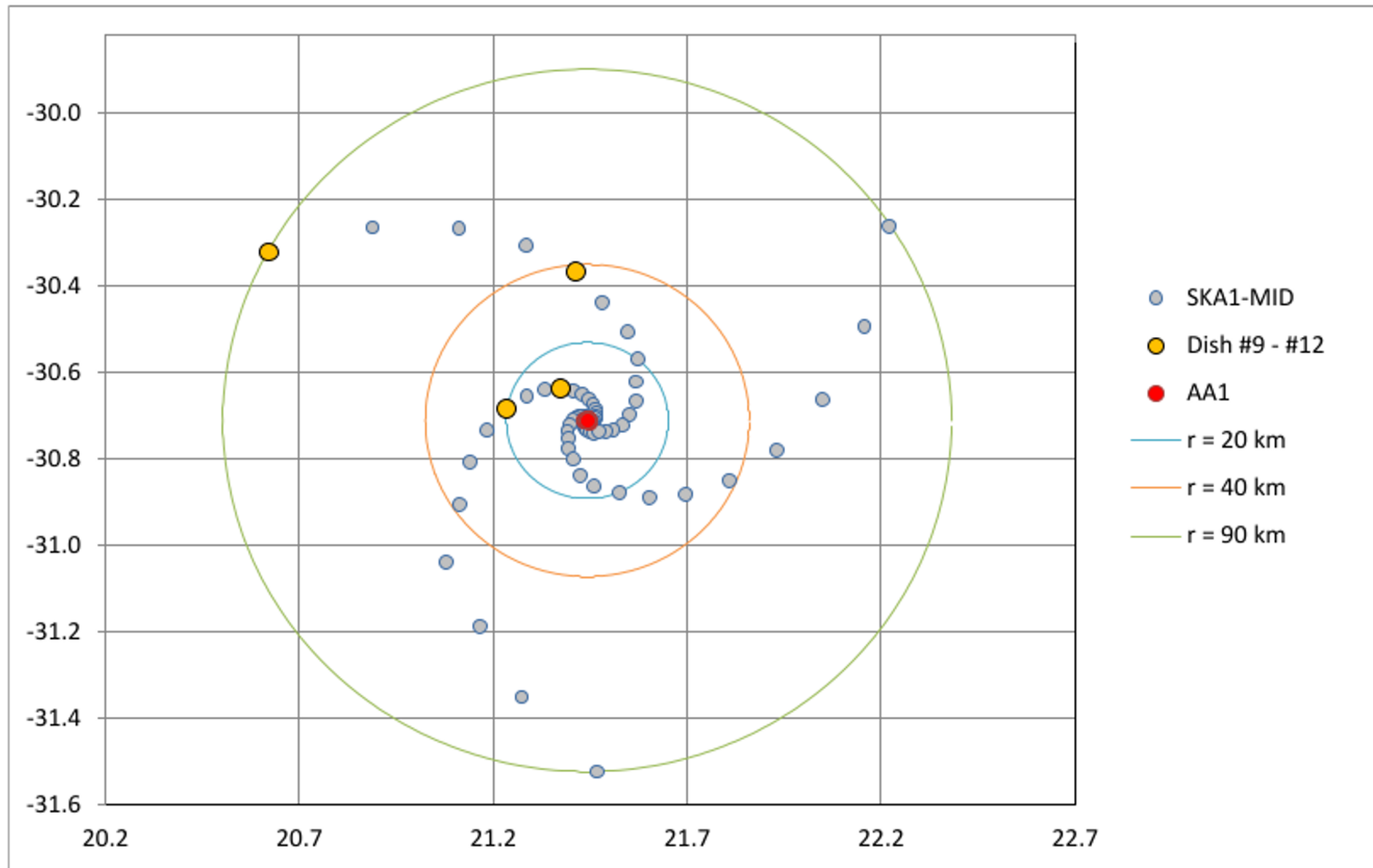


Figure 15: Dishes comprising Batch #3 (yellow dots) in ever-increasing distance from the MID-CPF.

Source:
Roll-Out Plan for SKA1
SKA-TEL-AIV-2410001
[A.AD10]



Mid Infra 2 – KAPB, Power Facilities, BMS

The Contract includes the design (verification and final development of the reference designs provided) and construction of:

- MID Buildings Delivery:
 - Data Rack Power & Fibre
 - Data Rack Cooling (only power meters envisaged)
 - Building Management System (BMS)
 - Building Ancillaries
 - Data Racks (predominantly Row G)
- MID Site Power Facility Delivery:
 - Power Facility (Transformers, switchgear & DRUPS)
 - Diesel fuel tanks expansion (69kl to 186kl)
- Mounting pillars, Power and fibre connectivity, as well as earthing (might be included in Mid Infra 1)



Mid Infra 2 - DESCRIPTION OF THE WORKS

Data Racks, Power & Fibre

1. Distribute power to Radio Frequency Interference (RFI) filters
2. Distribute power from RFI penetrations to Distribution Boards.
3. Heating Ventilation and Air Conditioning (HVAC) Distribution Boards
4. Data Rack Distribution Boards – Row F to G
5. Distribute power & Fibre to DRA Racks – Row F to G
6. Provide power & Fibre to TFR Racks
7. Measurement of power – Power meters that interface with BMS
8. The Protection of power – surge protection
9. Platform above RFI Filters to provide access
10. Data Racks / Cabinets
11. Power Distribution Units (PDU's)



Mid Infra 2 - DESCRIPTION OF THE WORKS (Cont.)

Building Management System (BMS)

1. Monitor Carnarvon POP station
2. Monitor Klerefontein site
3. Monitor CPF
4. Monitor Core Power/Spiral Arm Power
5. Telescope Management interface
6. PV and repeater sites
7. Provide BMS Graphic User Interface (GUI)
8. Provide BMS data - Provide data to subscribers and store and retrieve BMS data.
9. Configure BMS – including future interfaces
10. Hardware and Software upgrades / replacements
11. Extensibility of the BMS – Ensure future modifications are easily implemented



Mid Infra 2 - DESCRIPTION OF THE WORKS (Cont.)

Building Ancillaries

1. Fire Detection and Suppression
2. RFI penetrations
3. Lighting
4. Emergency Lighting
5. Small Power
6. Motion Detection
7. Door Open Sensors
8. Cable trays / Fibre guides
9. Surveillance Cameras
10. Antistatic Test Station
11. GNSS Precision Antenna Mounts



Mid Infra 2 - DESCRIPTION OF THE WORKS (Cont.)

Power Facility

1. Diesel Rotary Uninterrupted Power Supply (DRUPS) Equipment - Upgrade Existing
2. Diesel Rotary UPS (DRUPS) – Install 2 new to match existing
3. Power Transformers – Replace with new
4. 22 kV and 33 kV switchgear in the medium Voltage (MV) Room
5. Mimic Panel - Update
6. Pole 951 /Ring Main Unit (RMU)/ Spare 33 kV cable - Upgrade
7. Low Voltage (LV) Assemblies Upgrade
8. Bulk Fuel Facility - expand
9. Sound attenuation – Install supplementary
10. Remote Monitoring – Integration with BMS
11. Earthing, bonding and lightning protection



Infra 2 - DESCRIPTION OF THE WORKS (Cont.)

Power Facility (cont.)

12. Power and Instrumentation / Control Cabling
13. Dummy Load – relocate, including new container
14. Protection Studies and Implementation and Commissioning Oversight
15. Notices, Labelling, Signage, Operating Instructions
16. Temporary Dummy Loads for on-site testing and temporary standby power
17. Ancillaries and Extras - e.g. RFI L-plate alterations
18. Protection Settings Report and Implementation
19. Network Simulations



Key Dates



General challenges and considerations

- RFI and related permitting process
- Local Participation
- The work will be undertaken on a live / operational telescope facility and that all the prescribed requirements associated with working on a live facility are to be met
- A **shutdown period** will be required (under the MID Infra t 2 contract) to complete the upgrade to the power facility at the CPF. The date for the shutdown period, to be agreed between the *Contractor, Client* and Infra 2 contractor, is anticipated to be during November 2023 for a period of 10 days
- During the shutdown, the telescope will not be operational. As a result, SARA0 policies and procedures relating to maintaining radio protection of the site will not be applicable. The extent of the relaxation of the policies and procedures to be agreed.



Mid Infra 1 & 2 Site Clarification Meetings



Construction underway with MeerKAT+



Fibre & Power trenching



Access Road to SKA063





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15/01/2022 11:40







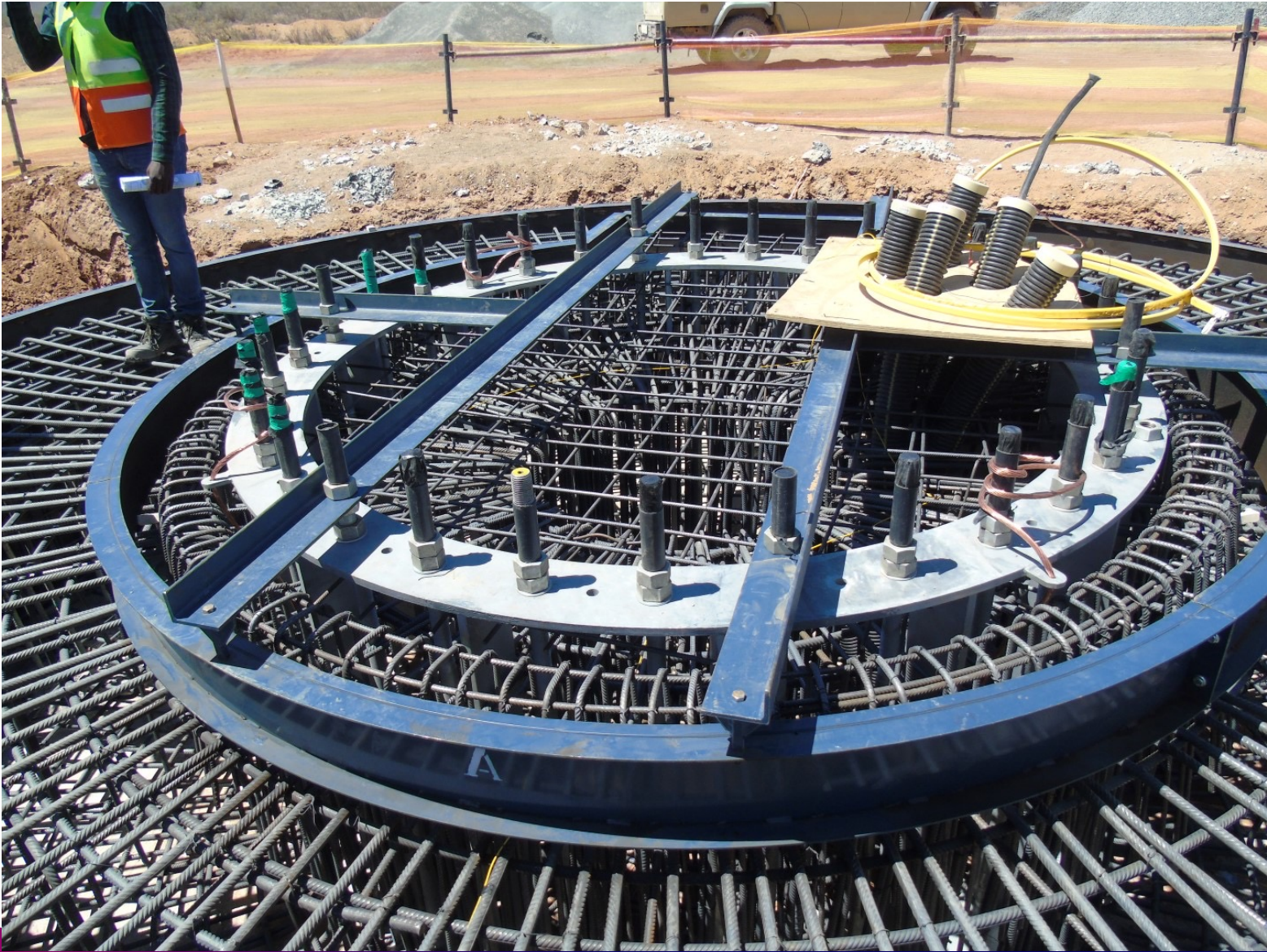






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Thank you

*We recognise and acknowledge the
Indigenous peoples and cultures that have
traditionally lived on the lands on which
our facilities are located.*

SKAO

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