The Australian SKA Pathfinder

Antony Schinckel
ASKAP Director
ATUC 25 October 2011

www.csiro.au

CSIRO

ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

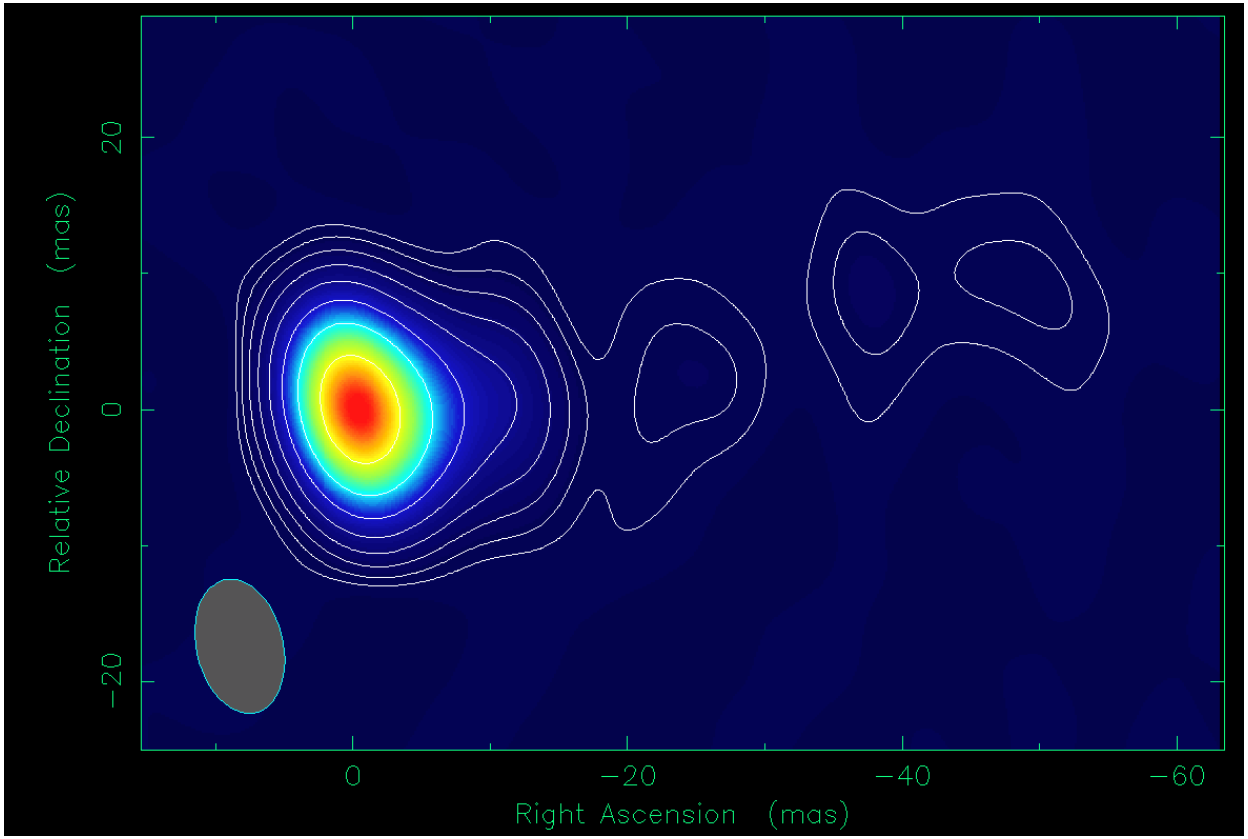
ASKAP – Recent Highlights

- MRO Infrastructure Construction:
  - McConnel Dowell Constructors (Australia) Pty Ltd
  - Construction 65% complete
- Testing on first antennas
  - Used in eVLBI observations
  - Exceed specifications (surface RMS 0.5 mm)
- Pawsey Centre
  - Delivery of 100 Tf machine at Murdoch University (Pawsey 1A)
  - ASKAP an early developer on this machine, now developing larger software
- Promising results with PAF
  - First full-size (188 element) tested at Parkes Testbed Facility (12m)
  - Excellent results
- Digital Systems
  - BETA (6 antennas) digital system components now delivered
  - Integration underway

ASKAP – Recent Highlights

- Fibre link to Geraldton
  - Completed and in use
  - Link from Geraldton to Perth demostrated (eVLBI)
- “X-band” VLBI – first successful tests at higher frequency
- Succesful workshop with Fraunhofer Institute in Berlin on future power renewable power options for ASKAP and SKA

ASKAP – Recent Highlights



PKS 0637-752, observed at 1.4 GHz with the first e-VLBIobservations to use the new ASKAP and Warkworth telescopes, and theNBN/CSIRO/NRN/AARNet fibre connection between the MRO and Perth. PKS0637-752 is thought to harbour a binary supermassive black hole.

Credit: CASS and ICRAR VLBI and ASKAP Teams

ASKAP – Wajarri Naming Ceremony

Photos: courtesy Steve Douglas

ASKAP – Wajarri Naming Ceremony

- **Wilara** - wi-la-ra (Moon)
- **Bundarra** - bun-da-ra (Stars)
- **Biyarli -** bi-yar-li (Galah)
- **Jirdilungu** - jir-di-lu-ngu (Milky Way)
- **Balayi -** ba - la –yi (Lookout)
- **Diggiedumble** - dig gee dum bull (Table top hill)

ASKAP – Wajarri Naming Ceremony

ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP – Antennas

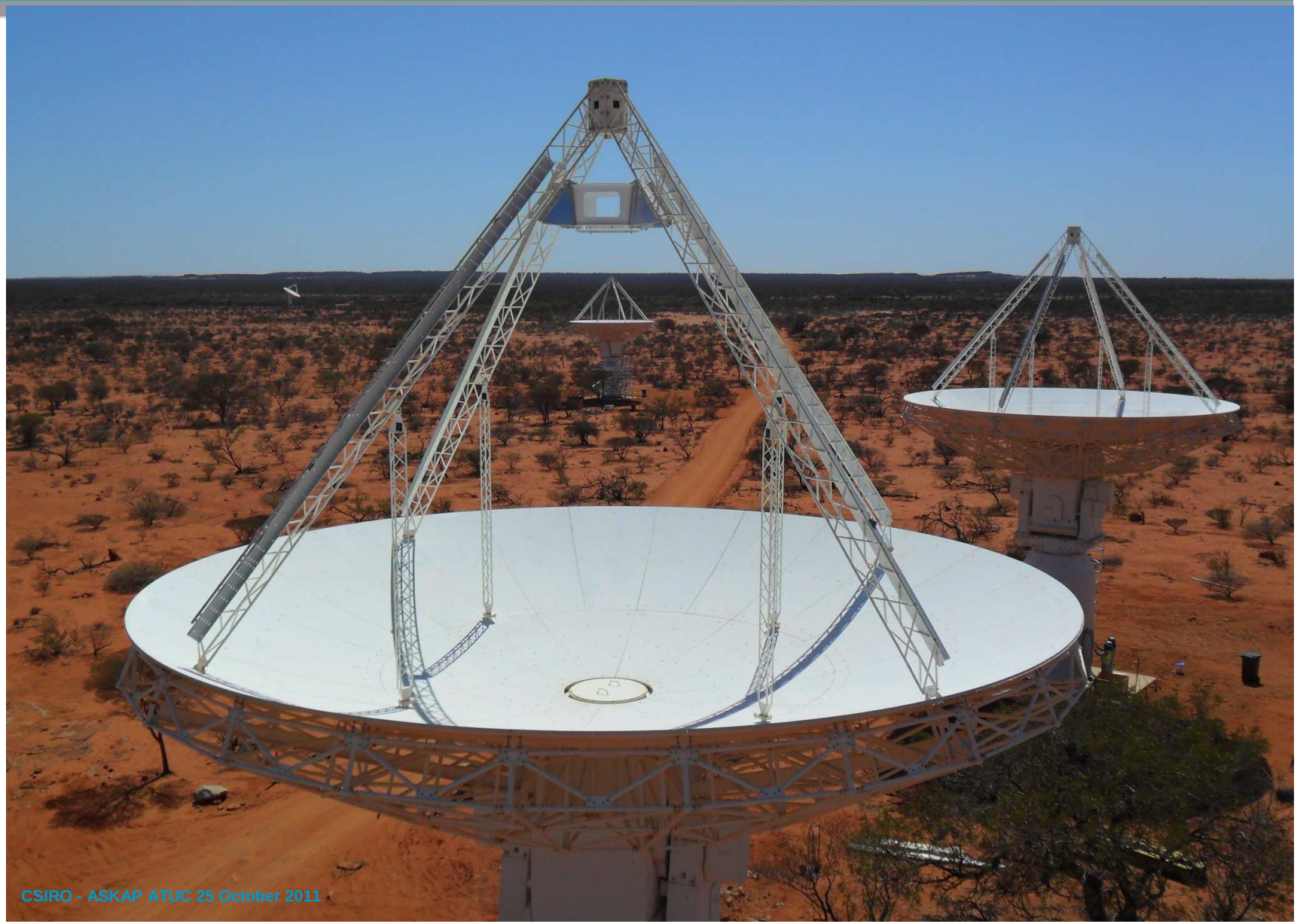
- Ten CETC54 engineers have been on site doing minor completion work on the first antennas along with 3 Boom Logistics and 4 – 6 TME staff from Geraldton involved in antenna assembly
- Nine antennas are completed
- Five more in assembly
- Average time is now 5 days per antenna
- Antennas continue to exceed surface RMS specification –
  - Specification is 1.0mm
  - Delivered RMS averaging 0.52 mm RMS (20 GHz ?)
- Completion of all 36 scheduled Q2 2012

ASKAP - Antennas

ASKAP - Antennas

ASKAP Antennas

ASKAP - Antennas



ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP – PAF at Parkes

- First full size Phased Array Feed completed MATES integration testing and deployed to Parkes on 13 June 2011

- Initial ground based “aperture array” tests very successful
  - sub 50 K temp across much of the band

- Installed on the Parkes 12 metre on 26 July 2011
  - ground AA results confirmed
  - first sky scans very promising

- Second PAF shipped to MRO 10 October 2011
  - will be installed on ASKAP antenna this week

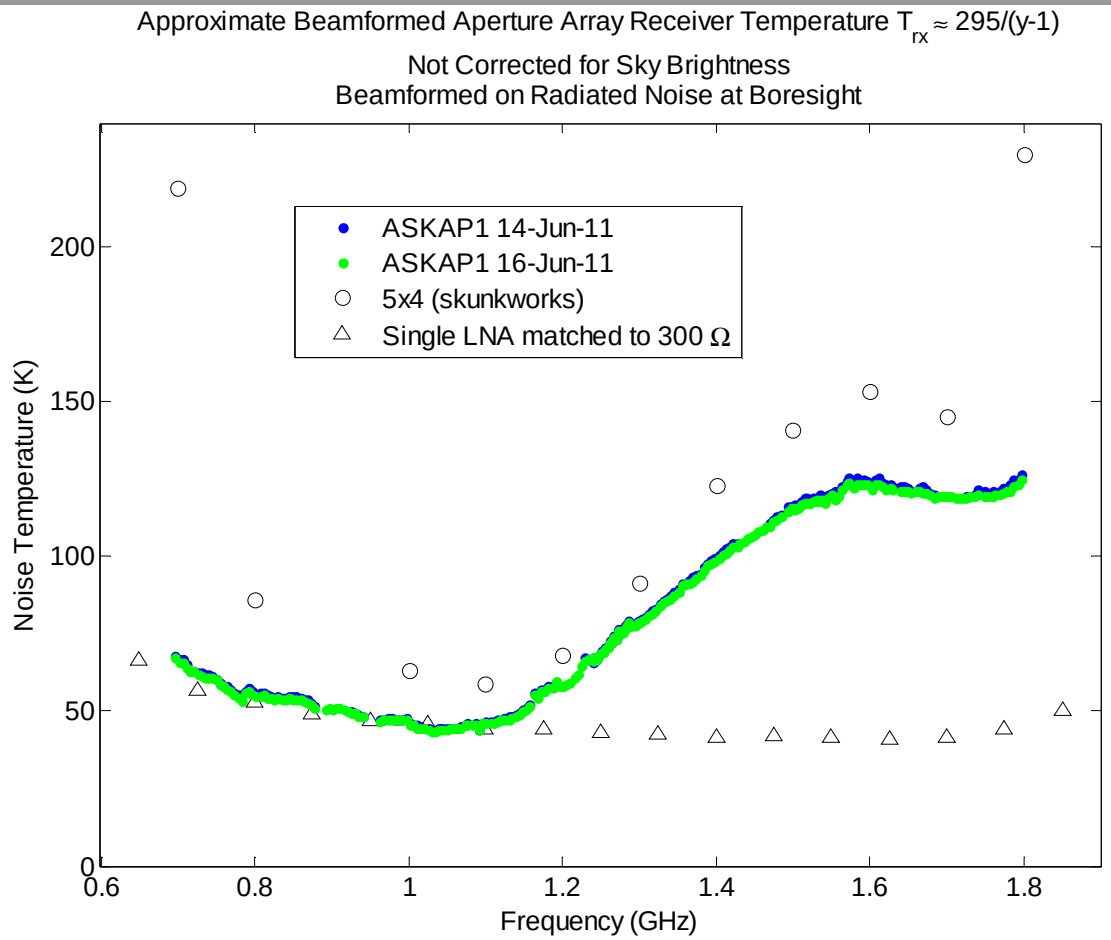
- Remaining 5 Mark I PAFs for BETA in various phases of build


ESD protected area
FOOT PROTECTION MUST BE WORN IN THIS AREA

Analog racks, power supplies, Digitiser and transport (shielded racks) in pedestal 3

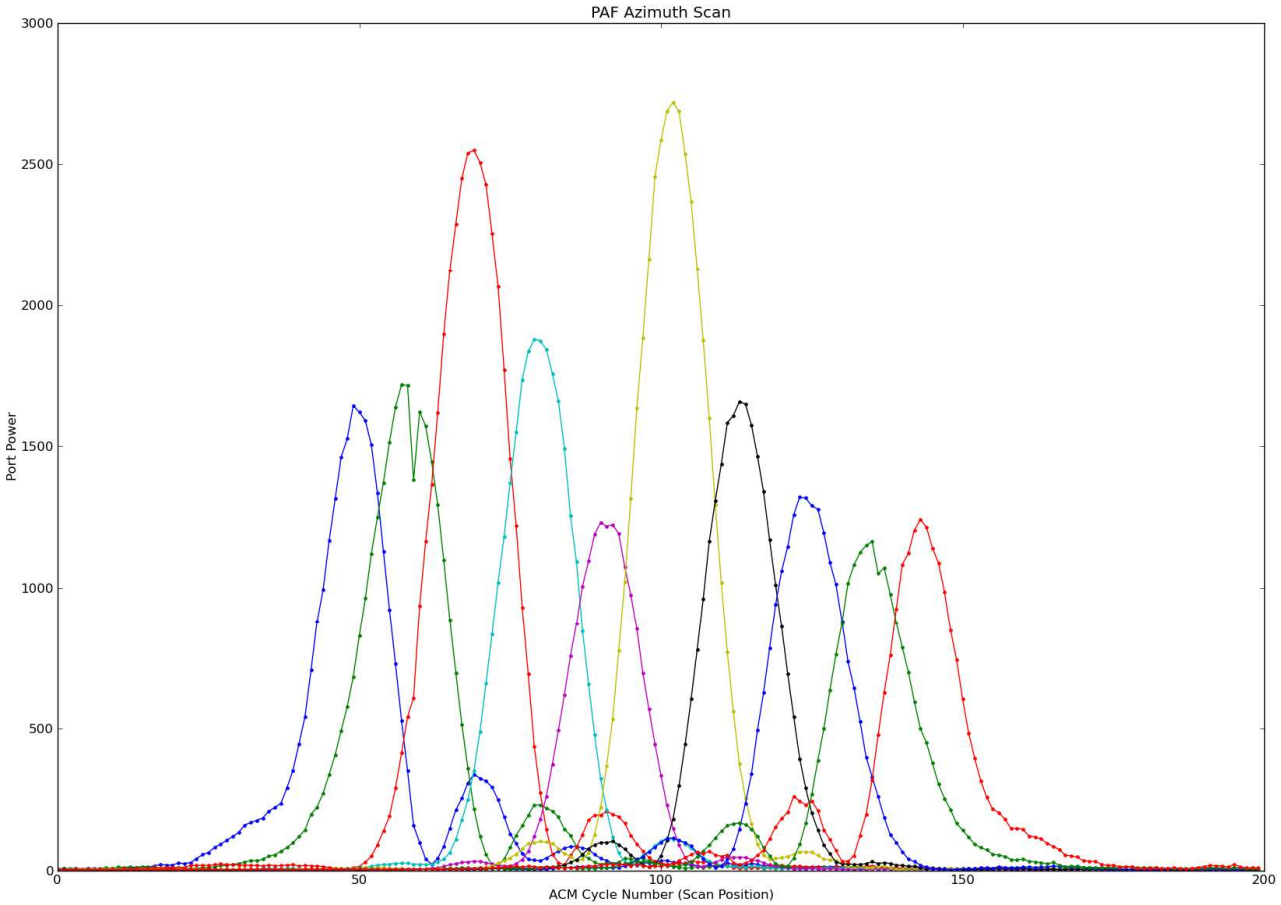
23 October 2011

ASKAP PAF Aperture Beamformed Receiver Temp (Boresight Beam)



Sensitivity matching conditions: Hay, IJMOT 5,6,2010 & ICEAA 2010.
Measurement: unpublished

Drift scan of Virgo across PAF, PTF, 64 MHz Preliminary



Hotan, Chippendale, Reynolds, O'Sullivan, Hay et al, CSIRO Hay, IJMOT 5,6,2010 & ICEAA 2010.

ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP – Digital Systems

- June 2011 – all BETA quantity Redback-2 and DragonFly-2 boards delivered
- 2 Tera-bits/second (2Tbps) communications from the digital receiver to the beamformer operational
- First full ACM (Array Covariance Matrix) in real-time achieved using ASKAP hardware
- Deployment to Parkes of first unit successful
- Deploying to MRO for 1st antenna and BETA

ASKAP – Digital Systems

Integration and test area (Digital)

ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP – Computing

- ASKAP commenced “porting” and develoment on the Pawsey HPC for SKA Computing, phase 1A machine at Murdoch University
- Spectral line imager demonstrated at 1024 cores
- Version 0.4 of the Telescope Operating System released (ToS)
- PAF oriented software installed at Parkes 12 Metre (May)
- ASKAP Computer group in top 10 HPC users in Australia
  - top 3 in terms of s/w developers

ASKAP – Computing

Pawsey 1A machine:

- 10 % of full Petaflop machine

- Hewlett Packard “Computing in a can”

ASKAP – Pawesey Centre – 1A computer Murdoch University

ASKAP – Computing

Pawsey 1A machine (107th most powerful in the world)

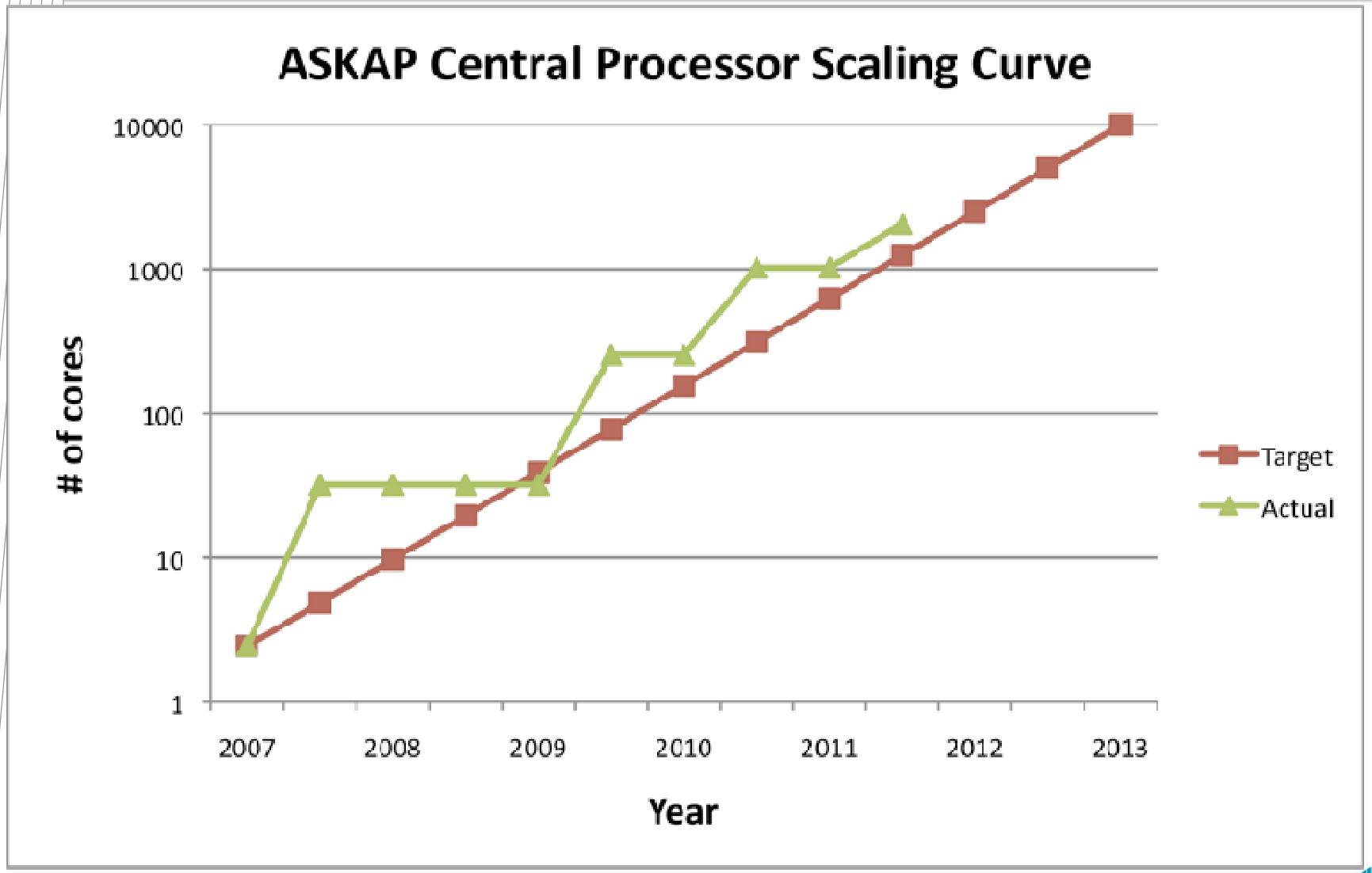
- 10 % of full Petaflop machine
- Hewlett Packard “Computing in a can”
- 800 nodes, each dual hex core Intel Xenon 2.8 GHz processors and 28 GB memory

  = 9600 core machine with 18 TB RAM

- Full Petaflop machine procurement opens 21 November 2013
  - Commission by mid-2013

CSIRO

ASKAP – Pawesey Centre – 1A computer Murdoch University



ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP – Fibre MRO to Geraldton to Perth

- CCTS completed the fibre installation in early June 2011
- Three repeater huts fitted with equipment by CSIRO staff (mid June 2011)
  - two huts solar powered, one hut grid connected
  - economical, low power
- First end-to-end (MRO to Geraldton) light on Sunday 19 June 2011
- First 1 Gb/sec transmission in mid-July 2011, allowing the eVLBI observation
- NBN link Geraldton to Perth completed and tested
- Expect full access MRO – Pawsey HPC for SKA Science at 10 Gb/s in mid-December 2011
  - 40 Gb/sec March 2012
- (Currently ADSL level from Geraldton to outside world)

CSIRO

ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP – MRO Construction

- Good progress this year:
  - roads 90 % completed
  - fibre and power reticulation around site 60 % completed
  - all 36 antenna foundations are completed
  - runway refurbishment completed
  - Central Building foundation completed
  - 4 of 13 central building modules delivered to site
  - drilling for the geothermal cooling system for central building
    - 50 of 130 x 120 metre bores completed
  - Support for other projects (MWA etc) – 50 % installed

ASKAP – Control Building modules arrive at MRO

CSIRO

MRO - Power Generation and Cooling

CSIRO is committed to maximising the use of renewable power sources

MRO Requirements:

- approximately 950+ kW, 24 hours, 365 days (1.4 MW peak)

- “medium” reliability (compared to DoD, communications, medical etc)

- major load is the electronics and processing (50 - 60 %)

- load variations dominantly due to diurnal cooling load

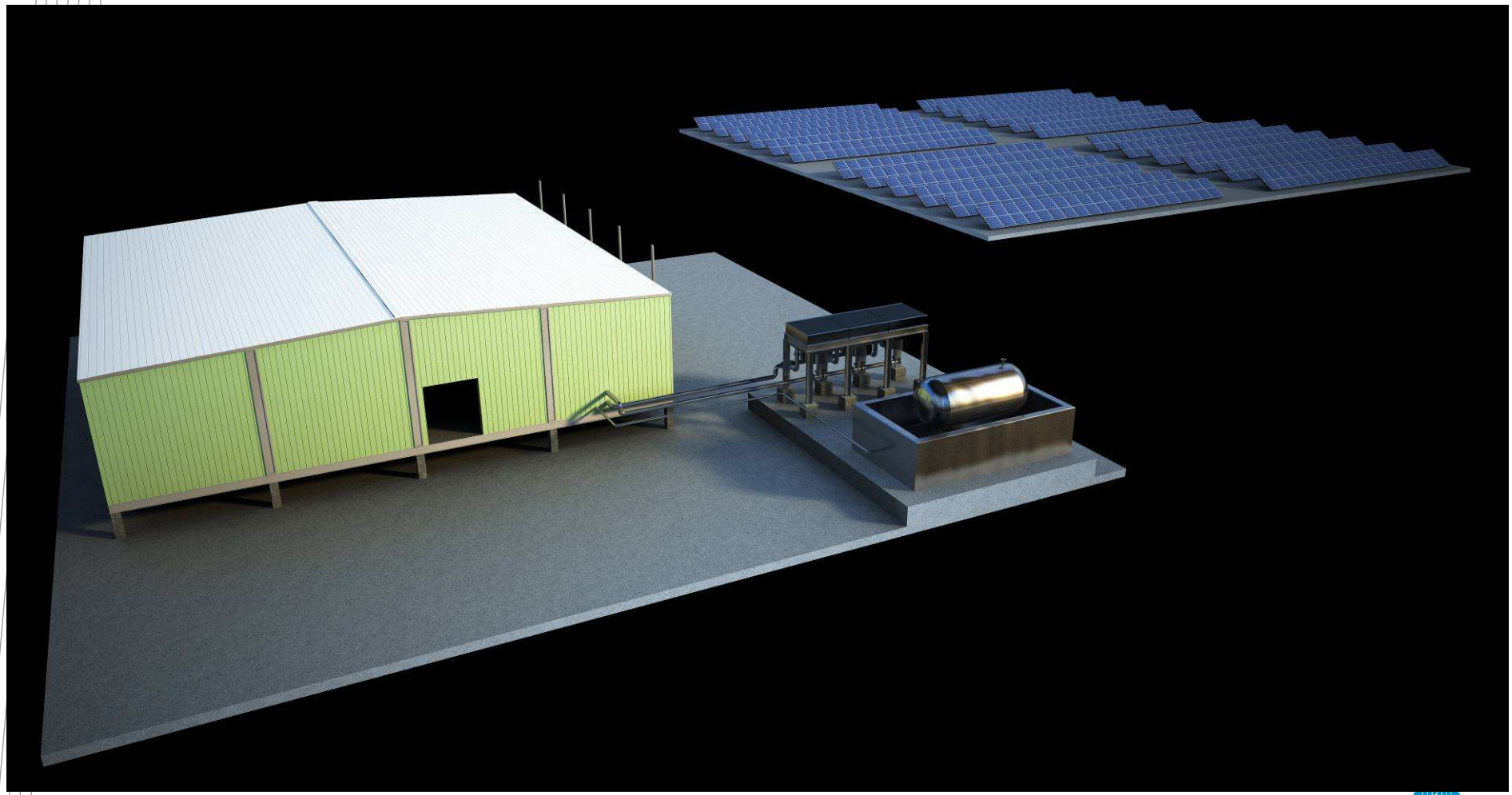
- RFI emission control to maintain pristine radio quiet site standards

“Demand side” management during design and operations planning critical

Working with Horizon Power (WA utility) to develop the design and supply model

Horizon Power – Marble Bar hybrid station

MRO Power Station Site Layout



ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP – MSF at the Geraldton University Centre

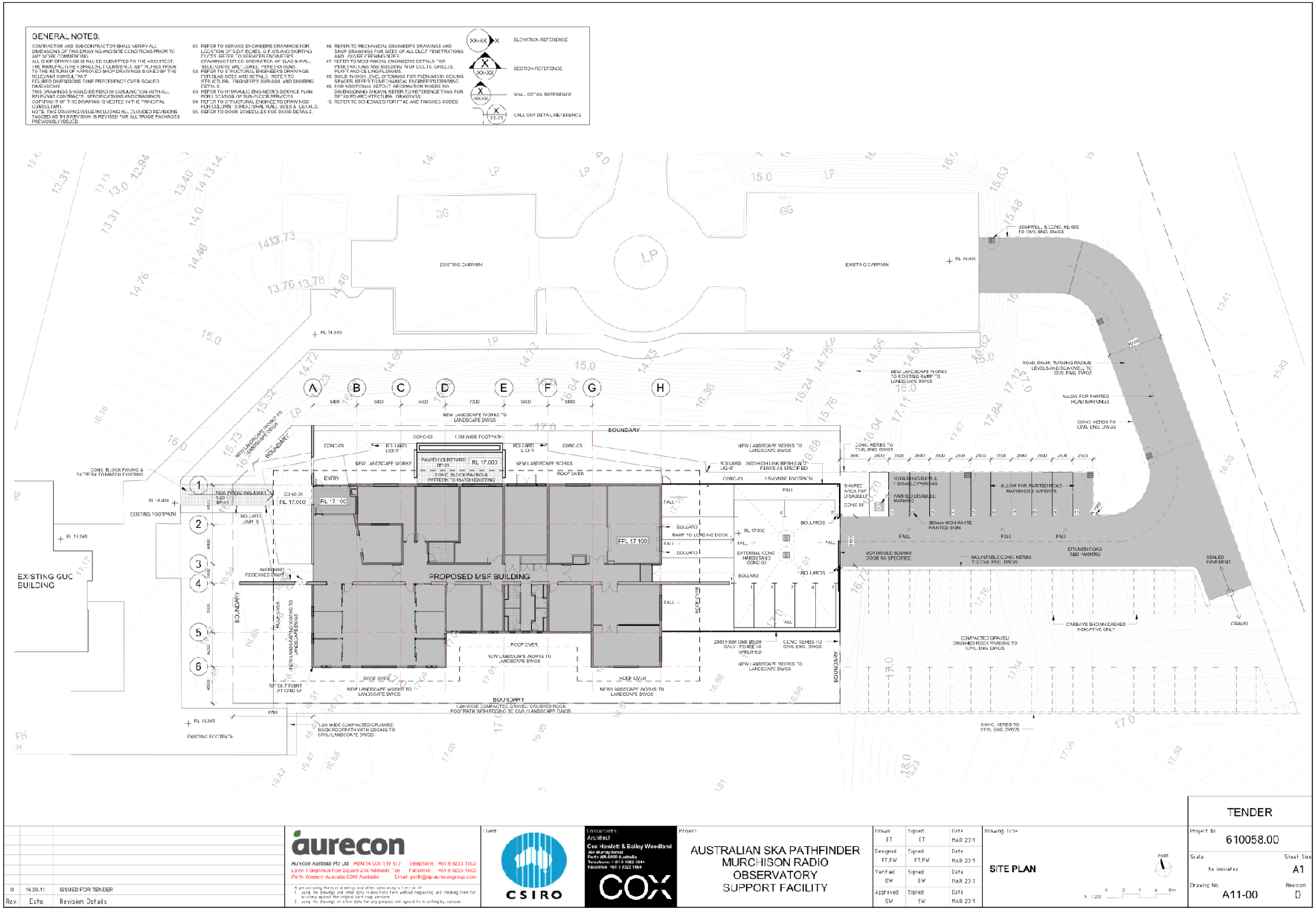
Notice to the industry of of intent to release a tender given in region on 15 June 2011

RFT (Request for Tender) for the construction of the 800 sq m facility was posted on Austender on 27 June

Closed on 5 August 2011

Expect Contract award this week

Occupancy expected September 2012


GENERAL NOTES:
EXISTING CARPARK
EXISTING CARPARK
PROPOSED MSF BUILDING
EXISTING GUC BUILDING
BOUNDARY
TENDER
aurecon
CSIRO
COX
AUSTRALIAN SKA PATHFINDER MURCHISON RADIO OBSERVATORY SUPPORT FACILITY
SITE PLAN
610058.00
A1
A11-00
D
ISSUED FOR TENDER

GENERAL NOTES:

CONTRACTOR AND SUBCONTRACTOR SHALL VERIFY ALL DIMENSIONS OF THIS DRAWING AND SITE CONDITIONS PRIOR TO ANY WORK COMMENCING.
ALL SHOP DRAWINGS SHALL BE SUBMITTED TO THE ARCHITECT. THE MANUFACTURER SHALL NOT COMMENCE ANY WORKS PRIOR TO THE RETURN OF APPROVED SHOP DRAWINGS SIGNED BY THE RELEVANT CONSULTANT.
FIGURED DIMENSIONS TAKE PRECEDENCE OVER SCALED DIMENSIONS.
THIS DRAWINGS SHOULD BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.
COPYRIGHT OF THIS DRAWING IS VESTED IN THE PRINCIPAL CONSULTANT.
NOTE: THIS DRAWING ISSUE INCLUDING ALL CLOUDED REVISIONS TAGGED AS THIS REVISION IS REVISED FOR ALL TRADE PACKAGES PREVIOUSLY ISSUED.

01. REFER TO SERVICE ENGINEER'S DRAWINGS FOR LOCATION OF S.D.F. BOXES, G.P.O'S AND SKIRTING DUCTS. REFER TO SERVICES ENGINEERS DRAWINGS FOR CO-ORDINATION OF SLAB & WALL 'BLOCKOUTS' AND 'CORED' PENETRATIONS.
02. REFER TO STRUCTURAL ENGINEER'S DRAWINGS FOR SLAB SIZES AND DETAILS. REFER TO STRUCTURAL ENGINEER'S SUB-SOIL AND SHORING DETAILS.
03. REFER TO HYDRAULIC ENGINEER'S SERVICE PLAN FOR LOCATION OF SUB-FLOOR SERVICES.
04. REFER TO STRUCTURAL ENGINEER'S DRAWINGS FOR COLUMN / STRUCTURAL WALL SIZES & DETAILS.
05. REFER TO DOOR SCHEDULES FOR DOOR DETAILS.
06. REFER TO MECHANICAL ENGINEER'S DRAWINGS AND SHOP DRAWINGS FOR SIZES OF ALL DUCT PENETRATIONS AND LOUVRE OPENING SIZES.
07. REFER TO MECHANICAL ENGINEER'S DETAILS FOR PENETRATIONS AND BUILDING IN OF DUCTS, GRILLES, PLANT AND CEILING PLENUMS.
08. BUILD IN HIGH LEVEL OPENINGS FOR PLENUMS IN CEILING SPACES. REFER TO MECHANICAL ENGINEER'S DRAWING.
09. FOR ADDITIONAL SETOUT INFORMATION WHERE NO DIMENSIONING SHOWN, REFER TO REFERENCE TAGS FOR DETAILED ARCHITECTURAL DRAWINGS.
10. REFER TO SCHEDULES FOR FP&E AND FINISHES CODES.

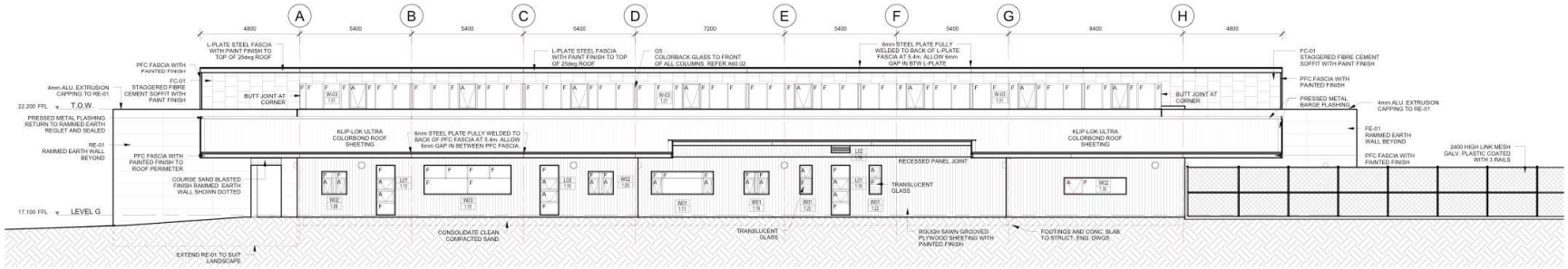
XX-XX X — ELEVATION REFERENCE
X XX-XX — SECTION REFERENCE
X XX-XX — WALL DETAIL REFERENCE
X XX-XX — CALL OUT DETAIL REFERENCE

LEGEND: ELEVATIONS & SECTIONS

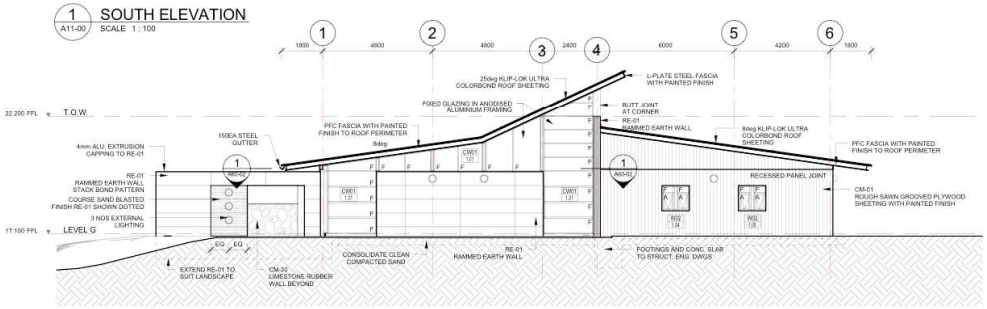
L1 FFL 4.500 — FINISHED FLOOR LEVEL (METERS) ABOVE DATUM
RL 4.500 — SPOT LEVEL - REDUCED LEVEL (METERS) ABOVE DATUM
FCL 4.500 — SPOT LEVEL - FINISHED CEILING LEVEL (METERS) ABOVE DATUM
ROOM NAME 1.001 — ROOM TAG WITH NAME / NUMBER & FLOOR FINISH
D02 2.100 — DOOR NUMBER TAG WITH ROOM NUMBER
W01 0.95 — WINDOW NUMBER TAG WITH ROOM NUMBER

ABBREVIATIONS:
F - FIXED WINDOW
L - GLASS LOUVRE
G - GLASS PANEL
A - AWNING WINDOW
SD - SLIDING DOOR
AL - ALUMINUM PANEL
CJ - CONTROL JOINT

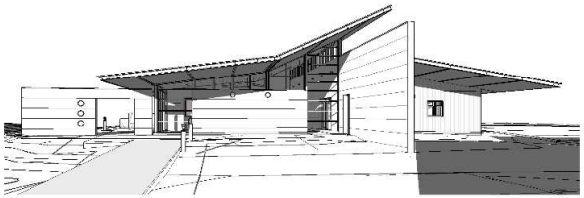
GLASS TYPE LEGEND:
G1 - CLEAR GLASS
G2 - BLUE COLOUR INTERLAY GLASS
G3 - BLUE BODY TINTED GLASS
G4 - WHITE TRANSLUSCENT INTERLAY GLASS
G5 - BLUE COLORBACK GLASS
(ALL GLASS TO COMPLY WITH RELEVANT REGULATIONS AND AS SPECIFIED)



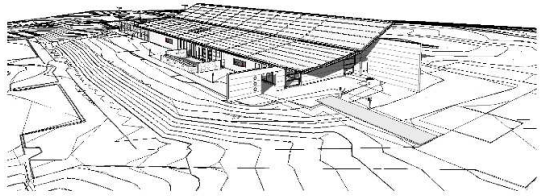
1 SOUTH ELEVATION
A11-00 SCALE 1 : 100



2 WEST ELEVATION
A11-00 SCALE 1 : 100



3 NORTHWEST VIEW
SCALE



4 NORTH-NORTH WEST VIEW
SCALE

TENDER

Rev.	Date	Revision Details
0	16.03.11	ISSUED FOR TENDER

aurecon
Aurecon Australia Pty Ltd ABN 54 005 139 873 Telephone: +61 8 9223 1500
Level 1 Septimus Roe Square 256 Adelaide Tce Facsimile: +61 8 9223 1605
Perth Western Australia 6000 Australia Email: perth@ap.aurecongroup.com

Client: CSIRO

Consultants:
Architect
Cox Howlett & Bailey Woodland
360 Murray Street
Perth WA 6000 Australia
Telephone: + 61 8 9322 3644
Facsimile: +61 8 9322 1864
COX

Project: AUSTRALIAN SKA PATHFINDER MURCHISON RADIO OBSERVATORY SUPPORT FACILITY

Drawn	ET	Signed ET	Date MAR 2011
Designed	ET,BW	Signed ET,BW	Date MAR 2011
Verified	BW	Signed BW	Date MAR 2011
Approved	SW	Signed SW	Date MAR 2011

Drawing Title: ELEVATION SOUTH & WEST

At 1:100 0 1 2 3 4m

Project No. 610058.00
Scale 1 : 100
Sheet Size A1
Drawing No. A30-01
Revision 0

ASKAP Overview

1. ASKAP Recent Highlights

1. ASKAP Status and Progress
    1. Antennas
    2. Phased Array Feeds (PAFs)
    3. Digital Systems
    4. Computing
    5. Network connection to Pawsey HPC Centre for SKA Science
    6. MRO Infrastructure
    7. MRO Support Facility (Geraldton)

1. ASKAP Project Plan update – ADE

2. Current Status

ASKAP Plan Overview

ASKAP:

- rapid development cycles in all areas:
  - PAFs – chequerboars, LNAs etc
  - Data Transport
  - Digital Systems
  - Computing

- New technologies coming on line quickly
  - laser modulation allowing RFoF economically
  - V7 of Xilinx FPGA family
  - Analog to Digital Convertors

ASKAP Plan Overview II

ASKAP Design Enhancements (ADE)

1. Apply “Lessons learnt” from current PAF knowledge, BETA etc. Areas include:
   - mechanical packaging, size, impacts of RFoF, cooling etc

2. Incorporate new technologies
   - RF over Fibre
     - recent rapid price drop of optical components
     - minimise cable loses, stability,
     - continuous fibre from PAF to beamformer in central building
     - removes 95% of equipment from pedestal – cooling, RFI, elec
   - Virtex 7 – newest Xilinx FPGA family – factor of 4++ reductio
   - Direct sampling – deletes entire heterodyning sub-system
   - Mk II systems will be compatible with Mk I (12 PAF observing)

Build and install 6 of these new Mk II designed systems on ASKAP Antennas by March 2013

ASKAP Plan Overview III

Three primary components to the plan:

1. Complete BETA, including:
    1. 6 antennas with Mk I (existing) PAFs and Digital systems
    2. 36 antennas + infrastructure (pads, power and fibre)
    3. MRO infrastructure, fibre link to Geraldton, building, MSF, Power station

2. Commence ASKAP Design Enhancements (ADE)

    Apply learning from ASKAP, including;

    - RFoF ("RF over fibre")
    - PAF – RFoF-ready, high frequency fix, re-packaging
    - Digital systems (Virtex 7, leaner, faster, cheaper)
    - Equip additional 6 antennas with new Mk II PAFs (March2013)

3. Seek additional funding for the completion of 24 more PAF systems for ASKAP (2012 – 2013)

ASKAP Key Milestone Overview

PAF on Parkes Testbed 12m	August 2011
PAF on MRO antenna	October 2011
Six Mk I PAF's on BETA (digital systems included)	October 2011 – Feb 2012
SST Reviews	November 2011
Limited BETA observing – start	December 2011

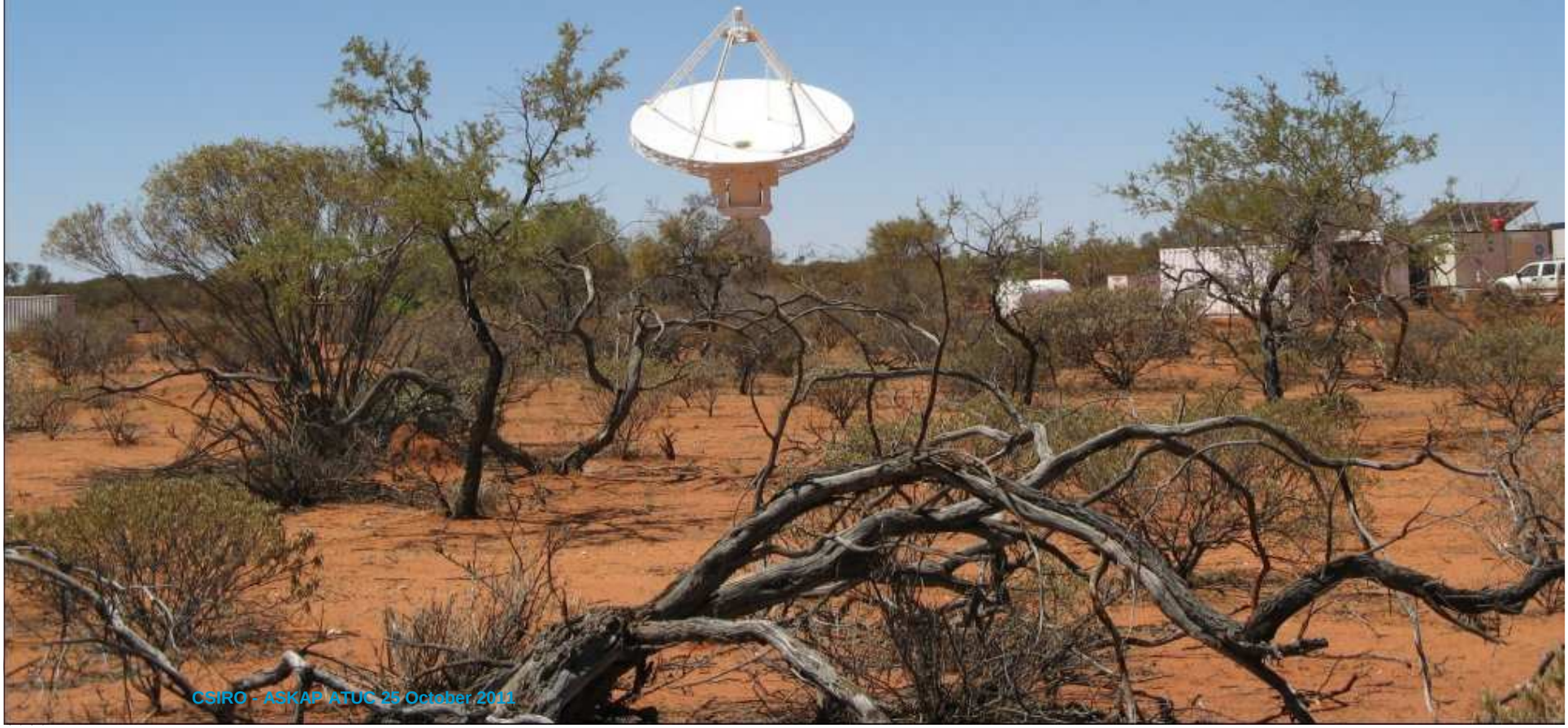
- phase closure
- commissioning focus
- aim is to generate basic data files
- primary BETA capability early 2012
- preliminary BETA data measurement sets Q3 2012

MRO Infrastructure complete – January 2012

Six Mark II PAFs and Digital subsystems – March 2013 (total 12 PAFs)

CSIRO

We acknowledge the Wajarri Yamatji people as the traditional owners of the Observatory site.



More information: www.atnf.csiro.au/projects/askap

Thank you

Antony Schinckel
Phone: 02 9372 4101
Email: antony.schinckel@csiro.au