



# **NRF / SKA SA Dish Concept: Logistics Engineering**

A. Loots *Pr.Eng.* (Associate Director: SKA SA)

D. Liebenberg

**NRF / SKA SA**

14 July 2011

Penticton

# Logistics engineering

KAT-7 & MeerKAT approach

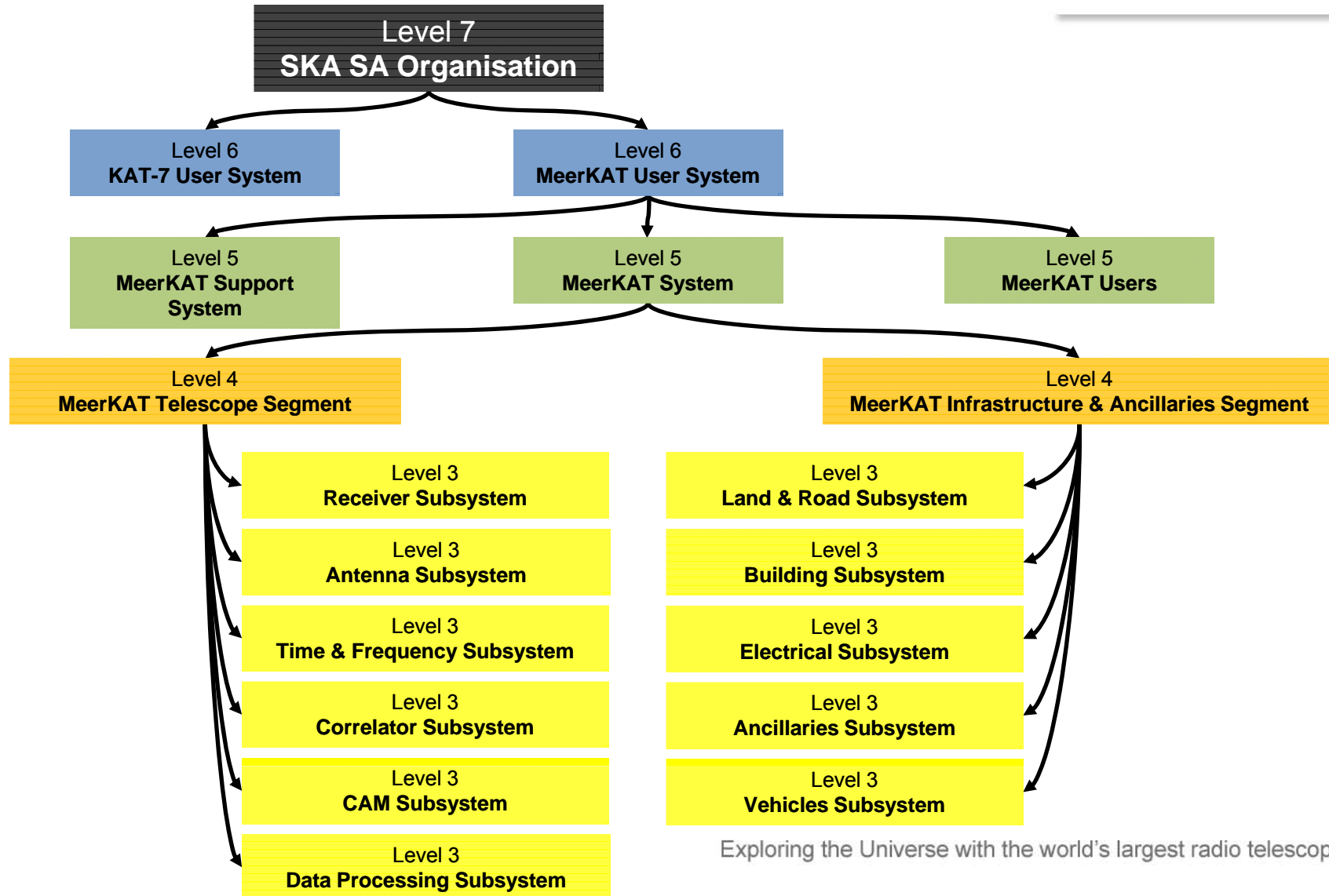


*“Design for Support, Design the Support & Support the Design”*

- We do **NOT** look at components or “level 3” subsystems in isolation in our system engineering or logistic engineering approaches
- This has been our approach from the outset in 2005
- South African developed commercially available & proven software tool (since 1990)
  - **Ramlog Information Management Module** for analyses and generation of manuals
  - **Ramlog Simulation Module** for simulations and optimization
  - **Ramlog** for Maintenance Management
- The next few slides will give a quick snapshot of progress and how our “motto” is implemented in our projects (both KAT-7 and MeerKAT systems)

# MeerKAT Hierarchy

## System levels

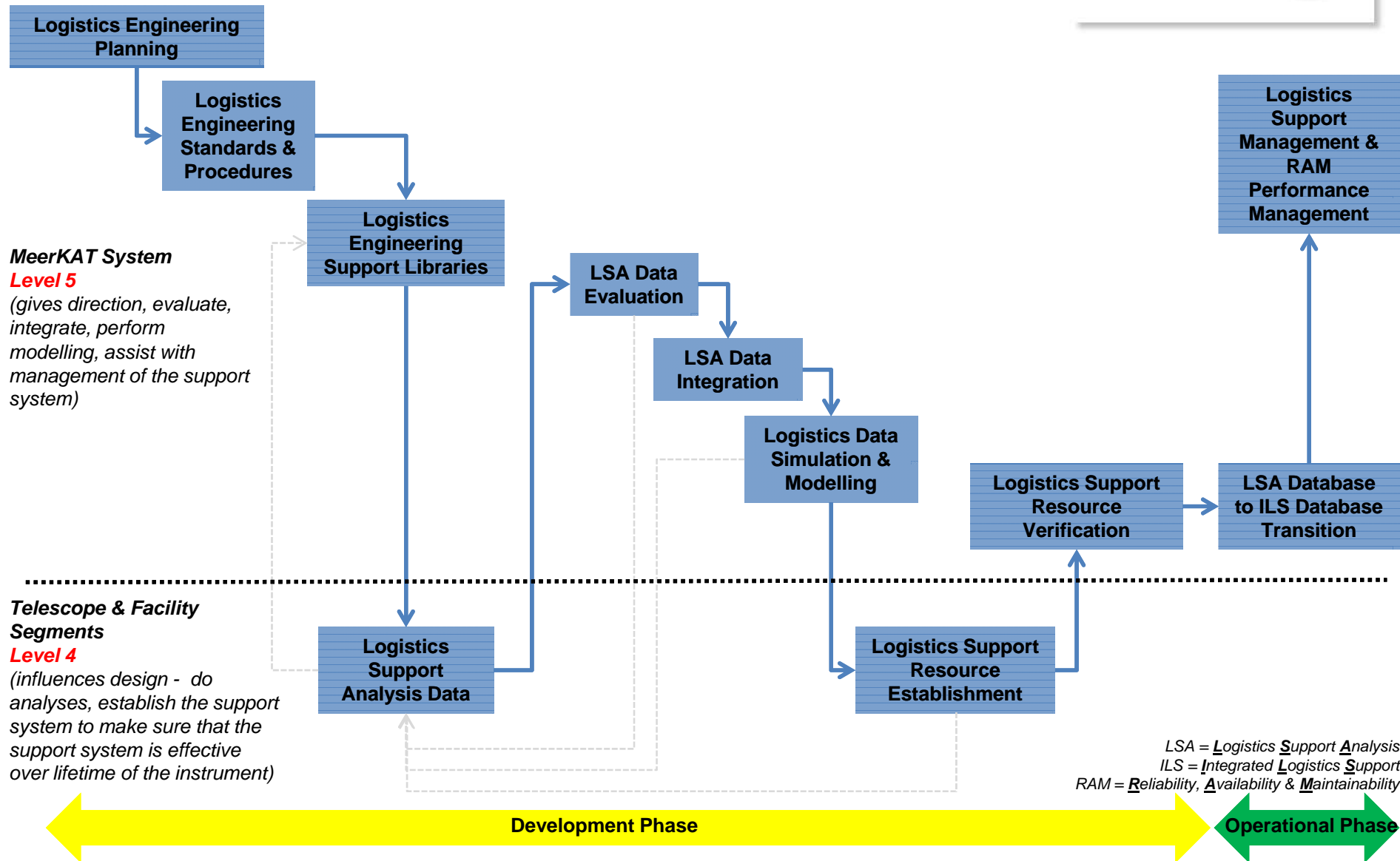


Exploring the Universe with the world's largest radio telescope

# Logistics engineering

KAT-7 & MeerKAT

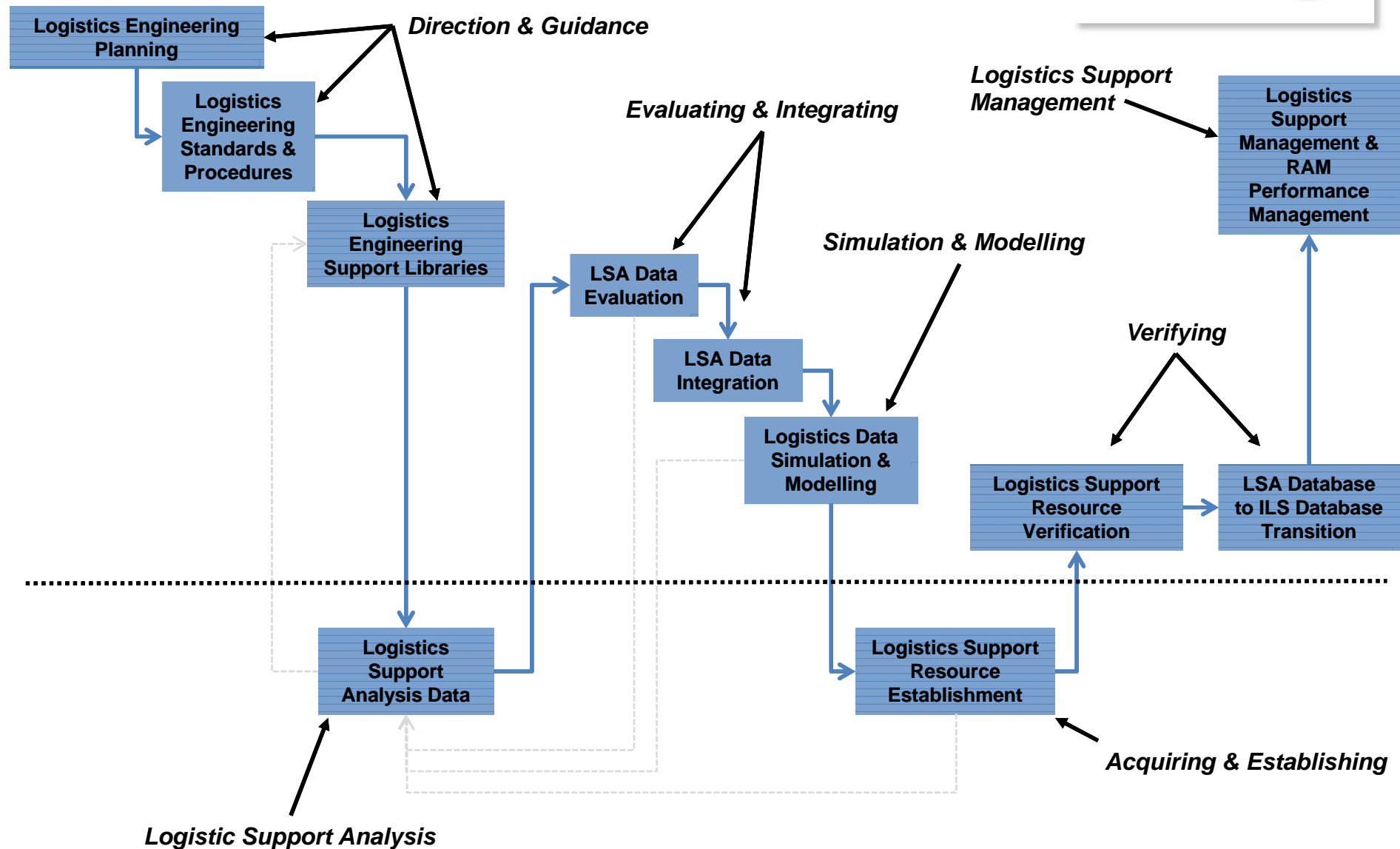
Scope of work



# Logistics engineering

KAT-7 & MeerKAT

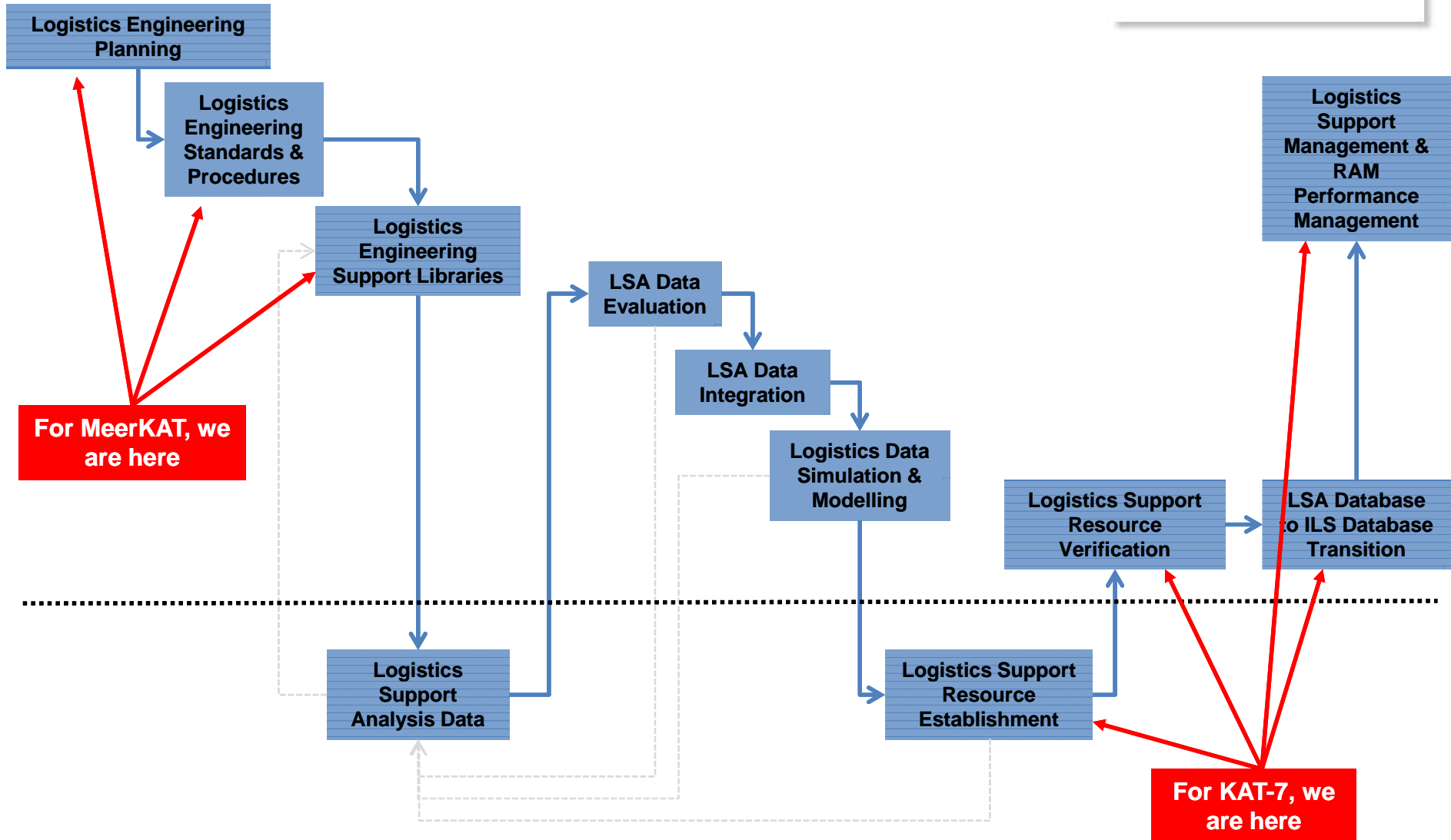
Scope of work (3)



# Logistics engineering

KAT-7 & MeerKAT

Current status / Progress




# Level 5 Direction & Guidance

Actual Approved MeerKAT Documents



## Logistic Engineering Planning



SKA SOUTH AFRICA  
SQUARE KILOMETRE ARRAY


---

Client : NRF (National Research Foundation)  
Project : MeerKAT  
Type : Design Document

---

**MEERKAT SYSTEM SUPPORT CONCEPT**

Document number .....M0000-0000V1-01 DD  
Revision .....1  
Classification.....Commercial in Confidence  
Author .....D Liebenberg  
Date .....24 May 10



SKA SOUTH AFRICA  
SQUARE KILOMETRE ARRAY

---


Client : NRF (National Research Foundation)  
Project : MeerKAT  
Type : Design Document

---

**MEERKAT SYSTEM  
OPERATIONAL PROFILE & RAM ALLOCATION**

Document number .....M0000-0000V1-02 DD  
Revision .....2  
Classification.....Commercial in Confidence  
Author .....D Liebenberg  
Date .....5 Oct 2010

## Logistic Engineering Standards & Procedures



SKA SOUTH AFRICA  
SQUARE KILOMETRE ARRAY

---

Client : NRF (National Research Foundation)  
Project : MeerKAT  
Type : Management Plan

---

**MEERKAT SYSTEM  
LOGISTIC ENGINEERING MANAGEMENT PLAN (LEMP)**

Document number .....M2000-0000V1-02 MP  
Revision .....2  
Classification.....Commercial in Confidence  
Author .....D Liebenberg  
Date .....15 Nov 2010

# Level 5 Direction & Guidance

## Actual KAT-7 Data



RamLog - Information Management Edition

File View Library System Window Help

KAT-7 LSA KAT-7 TELESCOPE MANUAL, PART 9 KAT-7 MANUAL, PART 6 - OLM Prev

**Suppliers**

Cage Code	Cage Name	Restricted
S0001	3M	<input type="checkbox"/>
S0002	AC DC Dynamics	<input type="checkbox"/>
S0182	ACCURIDE	<input type="checkbox"/>
S0107	AEROQUIP	<input type="checkbox"/>
S0151	AFRICAN CAPACITORS PTY LT	<input type="checkbox"/>
S0108	ALCOLIN	<input type="checkbox"/>
S0003	Alltronix	<input type="checkbox"/>

1/182

**Items**

Reference Number	Cage Code	Item Name
DB-ANTENNA-SKA-01	S0169	PEDESTAL PDB ENCLOSURE
40/F150(X)	S0170	CIRCUIT BREAKER 3 PH 3 POLE 40A 400VAC
40/F150(X) AUX	S0170	AUX CONTACT
TBD182	S1000	FUSE 2 A ?X?
SMP1	S1000	PHASE FAILURE & SEQUENCE SENSOR
GC4030M5	S0171	CONTACTOR 40A
TBD183	S0000	RELAY 230VAC ? POLE
	S0000	CIRCUIT BREAKER 1 PH 1 POLE 60A

1/1908

**Support Equipment**

Reference Number	Cage Code	Item Name	Full Name
ZUKVA Oil	S0000	ZUKVA OIL TBD	Engine
20kVA Coolant	S0000	20kVA COOLANT TBD	Engine
449	S0144	CLEEN GREEN SUPER 750ML	CLEEN
K8000-0133V1	S0007	BRAKE HOLDING TORQUE MEASUREMENT KIT	BRAK
134ZA-SUPWHITE	S0168	CARBOTHANE 134 ZA SUPER WHITE	CARB
893ZA	S0168	CARBOGUARD 893ZA	CARB
193ZA	S0168	CARBOGUARD 193ZA	CARB

**Facilities**

Facility Name	Category Code	Type Code	Facility Description	Additional Require
On-Eqpt	101	B	On-Equipment	
ILM Workshop	102	B	Klerfontein Workshop	
OLM Workshop	103	B	Losberg Workshop	
DLM Workshop	104	B	CSE Workshop	
SLM Workshop	105	B	Supplier Workshop	
OLM Store 1				
OLM Store 2				
ILM Store				

**Figures**

Figure Code	Figure Description	Image
35	Gear teeth surface wear	
36	Gear Teeth Cracks	
37	Fatigue failure (pitting) in gear tooth contact surface	
38	Preparation to apply Engineers Blue	

1/163

**Personnel**

Person Identifier	Description	Cost Per Hour
P01	Electronic; RF and Fibre Optic	
P02	Electronic; Process Control	
P03	Electronic; Computing	
P04	Electrical; Low Voltage (<22kVA)	
P05	Electrical; Medium Voltage (>22kVA)	
P06	Mechanical; Antenna Structures	
P07	Mechanical; Generators, Cranes & Veh	
P08	Mechanical; Cooling Systems	
P09	Site; Buildings	
P10	Site; Lands & Roads	

8/10

Preview & Edit

146 x 110

SKASA\_PARTS (DARREL-XP)\SQLEXPRESS RamLog User RamLog User

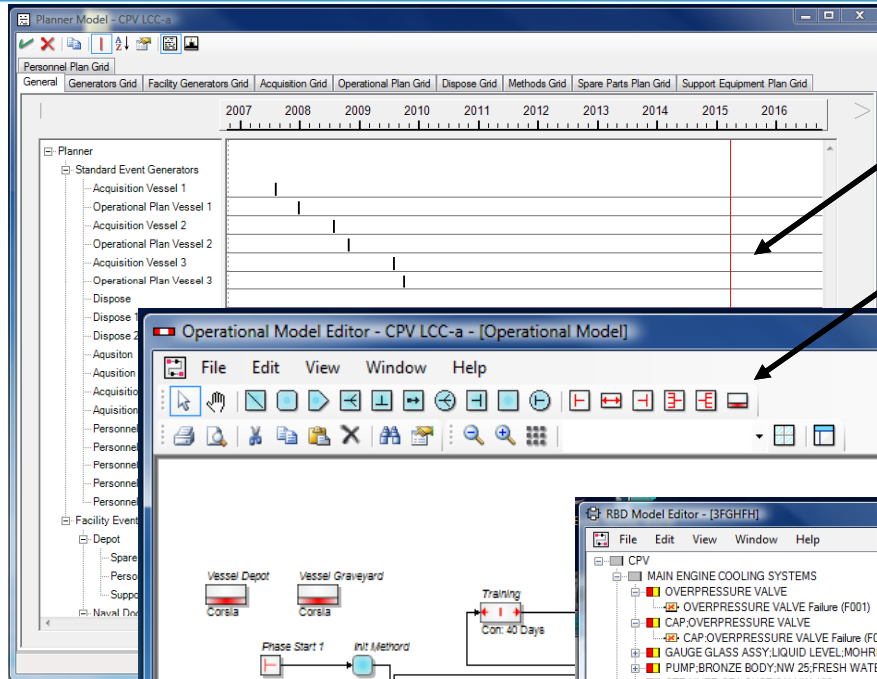
**Logistic  
Engineering  
Support Libraries**

- Suppliers
- Items
- Support Equipment
- Facilities
- Pictures
- Personnel

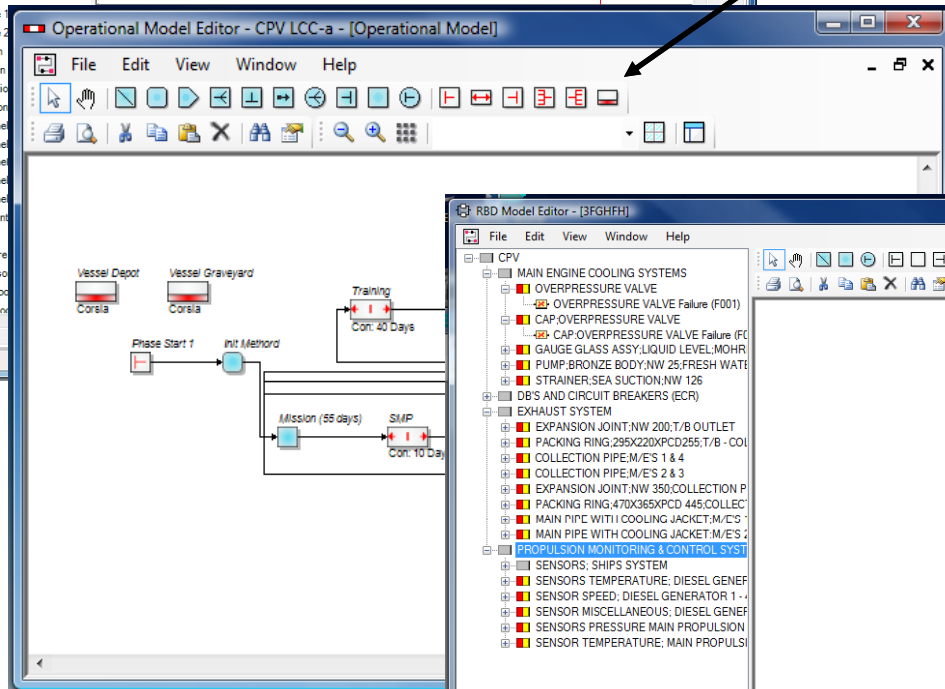
est radio telescope



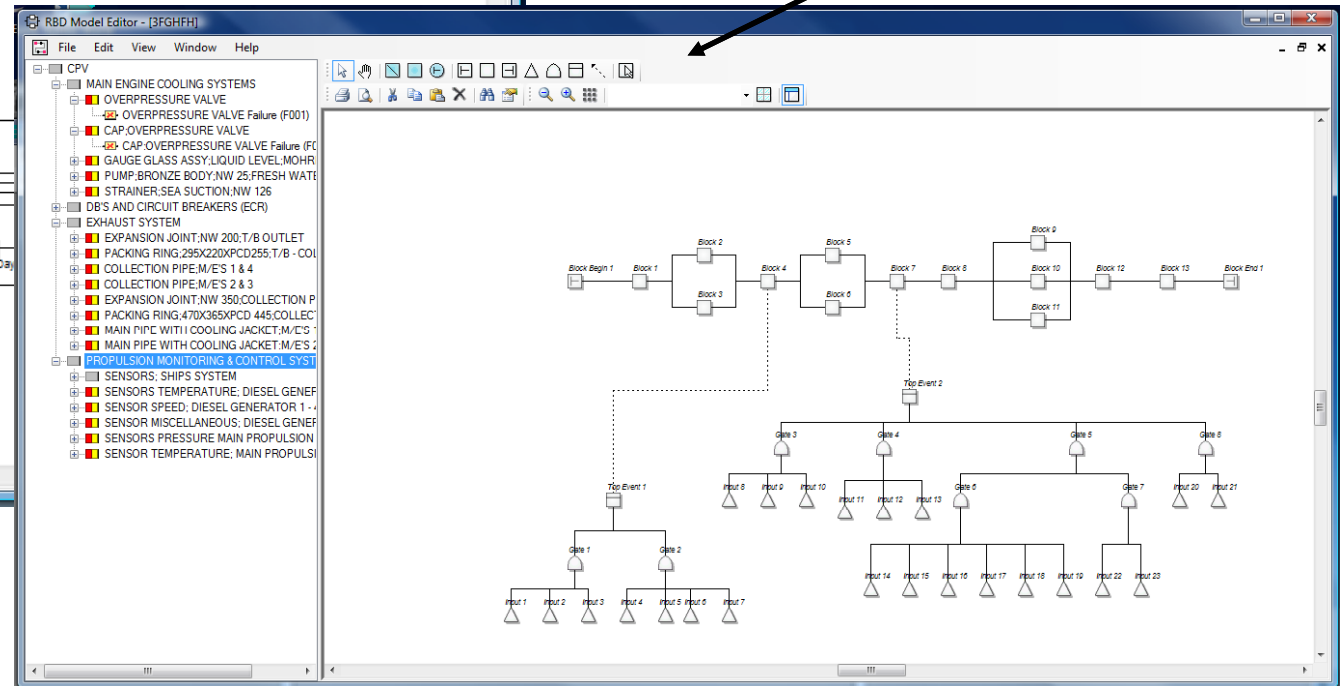
# Level 5 Simulation & Modelling



**Event Planner** to schedule events for simulation purposes (acquisitions, operations, etc)

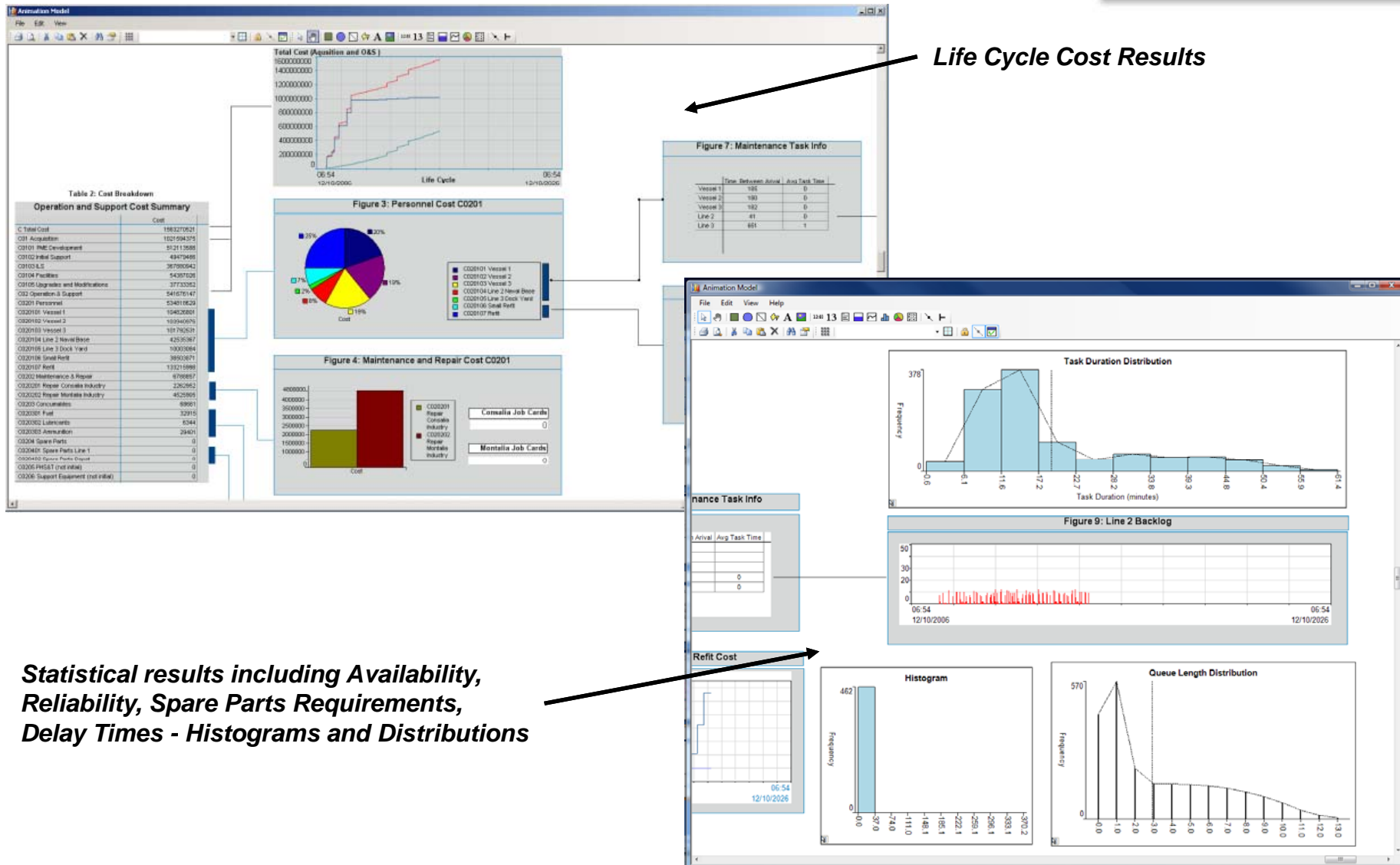


**Operational Model** to simulate the operation, life cycle of the system



**Deploy & Support Model** to simulate the flow of Work

# Level 5 Simulation & Modelling (2)



# Level 5 Support Management



KAT-7 - Windows Internet Explorer  
 http://www.ramlog.net/RLNet/Documents/Uploads/Doc2/index.aspx

**KAT-7**  
 Issue: 0A  
 Issue Date: 17 August 2008

**Figures and Parts**

- 1: MeerKAT SYSTEM
- 2: KAT-7 TELESCOPE SYSTEM
- 3: ANTENNA SUB-SYSTEM
- 4: STEEL PEDESTAL
- 5: AZIMUTH ASSEMBLY
- 6: ELEVATION ASSEMBLY
- 7: DISH ASSEMBLY
- 8: FRONT END ASSEMBLY
- 9: PEDESTAL LIGHTNING PROTECTION AND EARTHING
- 10: PEDESTAL EQUIPMENT
- 11: CABLES AND PIPES ANTENNA TO ASC
- 12: ANTENNA SERVICES CONTAINER
- 13: ASC CONTAINER ASSY
- 14: ASC POWER EQUIPMENT
- 15: ASC BMS EQUIPMENT
- 16: ASC LAN EQUIPMENT
- 17: CABLES FROM KAT-7 ANTENNA TO SITE COMPLEX
- 18: CONTAINER 1 (RFE AND DBE)
- 19: CONTAINER ASSY
- 20: DIGITAL BACK-END STATION
- 21: RF EQUIPMENT
- 22: LAN EQUIPMENT
- 23: BMS EQUIPMENT
- 24: COOLING EQUIPMENT
- 25: CONTAINER 2 (CONTROL AND CSS)
- 26: CONTAINER ASSY
- 27: COMPUTING SUB-SYSTEM STATION
- 28: CONTROL ROOM INSTALLATION EQUIPMENT
- 29: LAN EQUIPMENT
- 30: BMS EQUIPMENT
- 31: COOLING EQUIPMENT
- 32: WEATHER STATION
- 33: MeerKAT TELESCOPE SYSTEM
- 34: ANCILLIARY SYSTEMS
- 35: OPTIC FIBRE NETWORK
- 36: TERRESTRIAL NETWORK BACKBONE (INFRAGO)
- 37: NETWORK CONNECTIVITY (RESEARCH)
- 38: NETWORK CONNECTIVITY (COMMUNITY)
- 39: LAN SUB-SYSTEM
- 40: TRUNKED RADIO NETWORK
- 41: FIXED BASE STATIONS
- 42: MOBILE BASE STATION
- 43: DIESEL GENERATORS
- 44: UPS SYSTEMS
- 45: COOLING SYSTEMS
- 46: FIRE EXTINGUISHER SYSTEMS
- 47: TELEPHONE SYSTEMS
- 48: BUILDING MANAGEMENT SYSTEM
- 49: VEHICLES
- 50: OFFICE EQUIPMENT AND FURNITURE
- 51: MAINTENANCE MANAGEMENT SYSTEM
- 52: MOBILE WORKSHOP
- 53: MEDICAL EQUIPMENT
- 54: OVERHEAD TRANSMISSION LINE POWER
- 55: SITE COMPLEX
- 56: CAPE TOWN SYSTEM
- 57: SUPPORT BASE AT ARC
- 58: CAPE TOWN FACILITY

**Figure 1: MeerKAT SYSTEM**

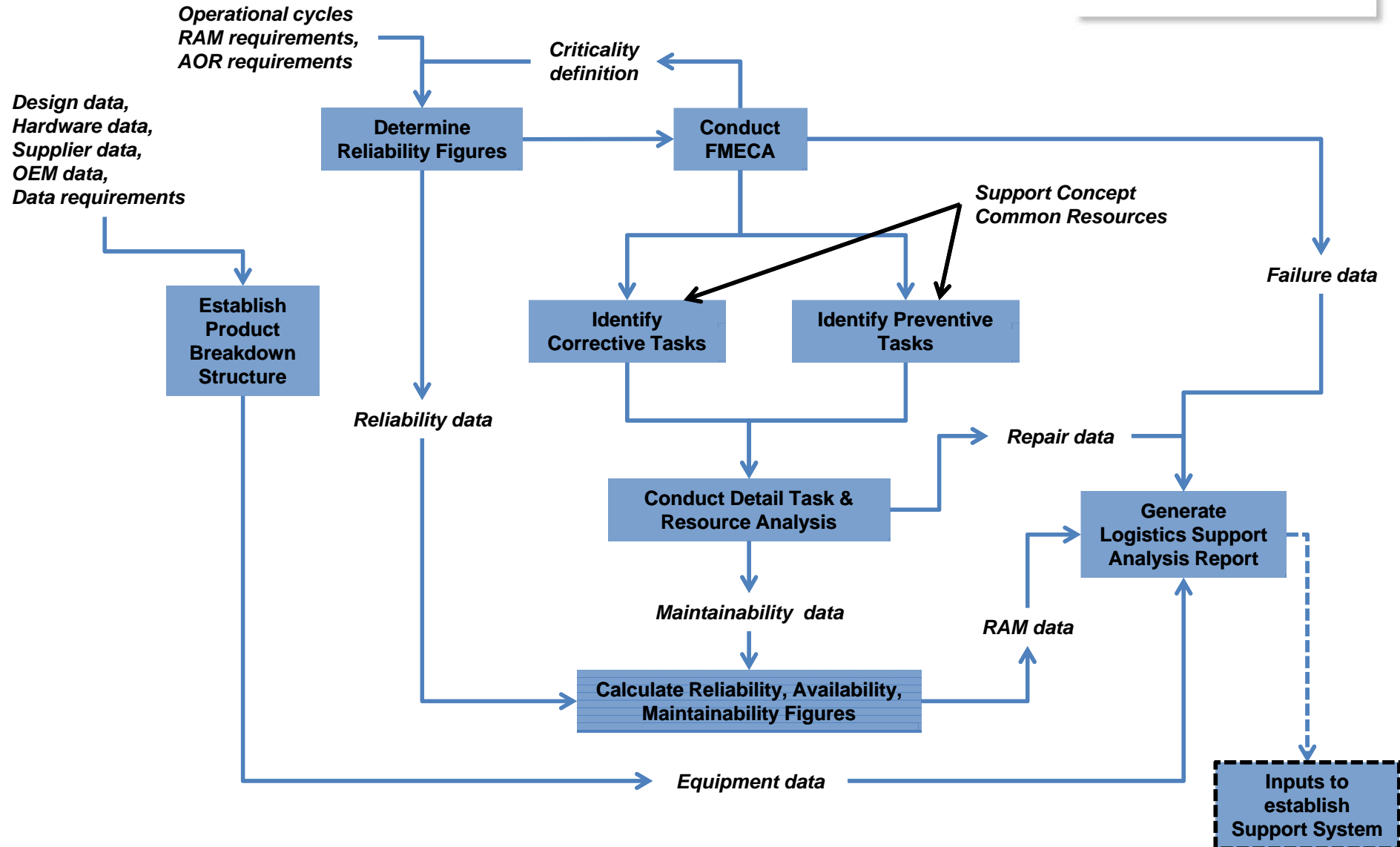
Operating Instructions | Technical Description | Fault Diagnostics | Remove and Replace Instructions | Calibration Instructions | Functional Test Instructions | Scheduled Maintenance Instructions | Special Instructions | COTS Pamphlets and Catalogs | Training Maintenance | Training Support | Training Operational | General Description | Logistic Support Plan (LSP)

No	Part Number	NSN	Name and Description	Qty/NHA	SM&R Code	Remarks
1	REF-001		KAT	1		
2	REF-002		KAT-7 Telescope System	1		
3	REF-136		MeerKAT Telescope System	1		
4	REF-143		Ancillary Systems	1		
5	REF-269		Overhead Transmission Line Power	1		
6	REF-350		Site Complex	1		

Internet | Protected Mode: On | 100%

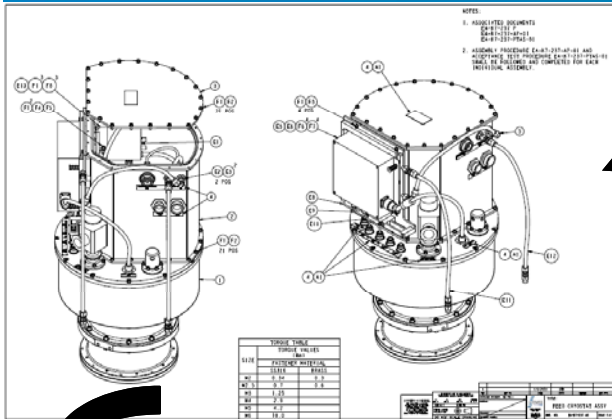
**Support Management System**

# Level 4 Logistic Support Analysis



# Level 4 Logistic Support Analysis

## Product Breakdown Structure



Hardware Data (Original Equipment Manufacturer)

Configuration Management Data (eB)

Logistic Product Breakdown Structure (Ramlog)

**Physical Item: K1000-0040**

Number: K1000-0040  
 Version: 1  
 Configuration Item: FEED CRYOSTAT ASSEMBLY  
 Description: FEED CRYOSTAT ASSEMBLY  
 Units of Measure: EA-Each  
 Build or Buy: Sub Contracted  
 Approval Status: Not Approved  
 Item Status: Current

Number	Revision	Title	Class	Status	Location	Stat.
EA-47-237-203-00	COC	CERTIFICATE OF CONFORMANCE, FEED CRYOSTAT ASSEMBLY, 59003		Current		
EA-47-237-47AS-01	ATR	ACCEPTANCE TEST PROCEDURE (ATP) FOR THE FEED CRYOSTAT ASSEMBLY		Not Approv	Current	
K1000-0040	[1]	M/S	1	FEED CRYOSTAT ASSEMBLY	Maintenance	Not Approv
K1000-0040	[1]	M/S	01	FEED CRYOSTAT ASSEMBLY	eB System	Not Approv

**RamLog - Information Management Edition**

**KAT-7 LSA**

**KAT-7 TELESCOPE MANUAL, PART 9**

**KAT-7 MANUAL, PART 6 - OLM Prev**

**IPIS Grid - KAT-7 LSA : FEED CRYOSTAT ASSEMBLY**

LCN	Alt LCN	LCN Name	LAC	Cage Code
>X1002010301	00	FEED CRYOSTAT ASSEMBLY	<input checked="" type="checkbox"/>	S0018
>X100201030101	00	CRYOSTAT ASSEMBLY	<input checked="" type="checkbox"/>	S0018
>X10020103010101	00	BACKPLATE ASSEMBLY	<input checked="" type="checkbox"/>	S0018
>X1002010301010101	00	BACKPLATE	<input type="checkbox"/>	S0018
>X10020103010102	00	WATER PIPE 01	<input checked="" type="checkbox"/>	S0018

**IPIS Item Details - KAT-7 LSA : FEED CRYOSTAT ASSEMBLY**

Name: FEED CRYOSTAT ASSEMBLY  
 LCN: >X1002010301  
 Level: 5  
 Breakdown Number:   
 Comments: Serialised

Selected Item: FEED CRYOSTAT ASSEMBLY  
 Reference Number: K1000-0040/1  
 Item Name: FEED CRYOSTAT ASSEMBLY  
 Category:   
 Selected Type: Spike Part  
 SMR Code:   
 Qty/NHA: 1 Qty/NHA Comment:   
 LRU  Attaching Part

**(Actual KAT-7 Data)**

OEM = Original Equipment Manufacturer  
 eB = Configuration Management Software used by SKA SA  
 Ramlog = Reliability, Availability and Maintainability Modelling Software used by SKA SA

# Level 4 Logistic Support Analysis

## Reliability & FMECA



RamLog - Information Management Edition [Balancing - KAT-7 LSA (Database)]

Measurement base: Operating Hours 1

MTBF [MCT] Availability

Item	Lock	MTBF	Rate
FEED THROUGH ASSEMBLY		827.7106	0.1223
FEED CRYOSTAT ASSEMBLY		843.8507	0.1081
BACKPLATE ASSEMBLY		863.3613	0.1151
WATER PIPE 01		4.3000	0.0232
WATER PIPE 02		4.3000	0.0232
PRESSURE TRANSDUCER ASSY		26.2000	0.3333
PRESSURE CONTROLLER WITH CABLE		26.2000	0.3333
Cannot provide VDC power to the Press.		26.2000	0.3333
Cannot read the PRESSURE 01. Signal		26.2000	0.3333
Cannot provide PRESSURE 01. Signal		26.2000	0.3333
FRICTION LOCK HOUSING: SK 2.54 YY2C		87600	0.5
CONTACT CRIMPS: TERM 2.54 YY2C			
PRESSURE GAUGE			
PRESSURE GAUGE CLAMP BOTTOM			
PRESSURE GAUGE CLAMP TOP			
SCREW HEX HD M6X30 A4			
WASHER FLAT DIN125 M6 A4			
CRYO CONTROLLER PCB ASSEMBLY		85.7000	0.0134
HEAT EXCHANGER ASSEMBLY		65689.96	0.0134
RELIEVE VALVE BLANK			
VAC VALVE BLANK			
CRYOSTAT TEMPERATURE SENSOR ASSY		175.2000	0.005
S8 FEED THROUGH CLAMP		175.2000	0.005
PT1000 TEMP SENSOR ASSY			
O-RING 56.74X3.53MM		1191.8267	0.7412
CRYOCOOLER SUNPOWER CRYOTEL G1			
PIN CRIMPS UNIVERSAL MATE N-LOC AMP 9			
SEAL VACUUM 16X2MM BLACK		4.3000	0.2017
ION PUMP 2L/S			
O-RING 21.82X3.53MM BROWN			
CABLE TIE 104X2.5MM INSULOK T18R			
CRADLE TY3			
WASHER FLAT DIN125 M4 A4			
WASHER FLAT DIN125 M3 A4			
NUT HEX DIN934 M4 BRASS			
SCREW CAP SKT HD DIN912 M4X12 A4			
SCREW CAP SKT HD DIN912 M4X8 A4			
SCREW CAP SKT HD DIN912 M4X6 A4			
SCREW CAP SKT HD DIN912 M3X12 A4			
SCREW CAP SKT HD DIN912 M3X8 A4			
BASE SHIELD			
MYLAR PEDESTAL SHIM			
G10 PEDESTAL SPACER			
STAGE 1 & OMT ASSEMBLY		4.3000	0.0193

Reliability Data

FMECA Data

RamLog - Information Management Edition

Structure Failure Analysis Task Analysis

KAT-7 LSA

CRYOSTAT ASSEMBLY

BACKPLATE ASSEMBLY

WATER PIPE 01

WATER PIPE 01 FAILURE

WATER PIPE 02

PRESSURE TRANSDUCER ASSY

CRYO CONTROLLER PCB ASSEMBLY

S8 PCB BRACKET

CRYOSTAT PCB

ELECTRONICS CONTROLLER

Cannot control the Cryo Cooler

Cannot power to the Cryo Cooler

SOCKET CRIMPS UNIVERSAL MATE N-LOC AMP 350550-1

STRANDED CABLE 1.5MM RED BLACK

RING CRIMP TERMINAL M5 INSULATED RED

WASHER FLAT DIN125 M3 A4

SCREW PAN HD SLOTTED DIN85 M3X30 A4

SCREW PAN HD SLOTTED DIN85 M3X25 A4

SCREW PAN HD SLOTTED DIN85 M3X16 A4

NUT HEX DIN934 M3 A4

HEAT EXCHANGER ASSEMBLY

RELIEVE VALVE BLANK

VAC VALVE BLANK

CRYOSTAT TEMPERATURE SENSOR ASSY

Cannot Indicate Temperatures on Cryogenic Components

S8 FEED THROUGH CLAMP

PT1000 TEMP SENSOR ASSY

O-RING 56.74X3.53MM

CRYOCOOLER SUNPOWER CRYOTEL G1

PIN CRIMPS UNIVERSAL MATE N-LOC AMP 35047-1

SEAL VACUUM 16X2MM BLACK

ION PUMP 2L/S

O-RING 21.82X3.53MM BROWN

CABLE TIE 104X2.5MM INSULOK T18R

CRADLE TY3

WASHER FLAT DIN125 M4 A4

WASHER FLAT DIN125 M3 A4

NUT HEX DIN934 M4 BRASS

SCREW CAP SKT HD DIN912 M4X12 A4

SCREW CAP SKT HD DIN912 M4X8 A4

SCREW CAP SKT HD DIN912 M4X6 A4

SCREW CAP SKT HD DIN912 M3X12 A4

SCREW CAP SKT HD DIN912 M3X8 A4

BASE SHIELD

MYLAR PEDESTAL SHIM

G10 PEDESTAL SPACER

STAGE 1 & OMT ASSEMBLY

M5 VENTED SCREW

SGETTER BASE 01 ASSEMBLY

Failure Modes - KAT-7 LSA

LCN Name: CRYOSTAT TEMPERATURE SENSOR ASSY LCN: >01020103010109

Mode Description: Cannot Indicate Temperatures on Cryogenic Components

FM Code: F046 Sequence: 1

FMECA FM Task Data CM Task Link FM Task Link

Class Code: T

Local Effect: Cannot Indicate Temperatures on Cryogenic Components

Next Effect: RFE Chain; No Effect

End Effect: Telescope Segment; No Effect

Detection Method: CAM; Health Status - Error on Cryo OMT or Cryo LNA Temp Sensors.

Comp. Provisions: Compare sensor temp values to each sensor nominal temp value. If one is nominal, then th

Design Change:

Cause: Component Failure

Remarks:

Criticality:

4 3 2 1

16 of 234

IKASA\_PARTS (DARREL-VP(S)QLEXPRESS) RamLog User RamLog User

(Actual KAT-7 Data)

# Level 4 Logistic Support Analysis

## Task Analysis



RamLog - Information Management Edition

File View Library System Window Help

KAT-7 LSA KAT-7 TELESCOPE MANUAL, PART 9 KAT-7 MANUAL, PART 6 - OLM Preve

PBS - KAT-7 LSA

Structure Failure Analysis Task Analysis

- KAT-7 TELESCOPE SEGMENT
  - KAT-7 RECEPTOR ASSEMBLY
    - ANTENNA 12 METER
    - FOCUS ASSEMBLY
    - PEDESTAL EQUIPMENT
    - KAT-7 RECEPTOR ASSEMBLY COOLING SYSTEM
      - SERVICE CHILLER ASSEMBLY
        - CHILLER ASSEMBLY
          - PRIME THE CHILLER ASSEMBLY
            - ENCLOSURE ASSEMBLY
            - BASE ASSEMBLY
            - ELECTRICAL PANEL
            - CHILLER-OUT PIPE
            - BALL VALVE FEMALE THREAD 1 INCH NICKEL PLATED BRASS
            - R/R BALL VALVE FEMALE THREAD 1 INCH
            - ELBOW SCREWED FITTING 1 INCH SS316
            - AIR-COOLED WATER HEAT PUMP 5KW
              - REP AIR-COOLED WATER HEAT PUMP 5KW
              - R/R INTERNAL WATER FILTER
              - CONDENSER FAN MOTOR ASSEMBLY
              - NUT SELF LOCKING ISO10512 M10 A2
              - NUT SELF LOCKING ISO10512 M8 A2
              - SCREW HEX HD ISO4017 M10x20 A2
              - WASHER FLAT ISO7089 M10 A2
              - WASHER FLAT ISO7089 M8 A2
              - HYDRAULIC HOSE METAL REINFORCED 1 INCH
              - SWAGE NIPPLE 1 INCH A4
          - COOLING TANK ASSEMBLY
          - FLOW SWITCH BOX
          - FLOW CONTROL MANIFOLD
          - FOCUS COOLING
          - 3-WAY VALVE ASSY
          - T-PIECE ASSY
          - PRESSURE RELIEF VALVE ASSEMBLY
          - BALL VALVE ASSY
          - 3/4 TO 1 INCH TAIL ELBOW
          - BALL VALVE SWAGE ASSY
          - CHECK VALVE ASSY
            - R/R CHECK VALVE ASSY
            - CHECK VALVE 3/4 INCH BRASS
            - SWAGE NIPPLE 3/4 INCH A4
          - U-CHANNEL RUBBER GROMMIT STRIP
          - PUSH IN T-PIECE 16mm
          - HYDRAULIC HOSE METAL REINFORCED 1 INCH
          - PRESSURE REGULATOR/RELIEF
          - PIPE PNEUMATIC 16MM 10BAR BLACK
          - PIPE PNEUMATIC 16MM 10BAR BLUE
          - PIPE PVC 40MM CLASS 6 200MM LONG
          - PIPE 3/4 INCH REINFORCED CLEAR FLEXIBLE
          - LAGGING SPX33 520D x 32ID
        - KAT-7 RECEPTOR ASSEMBLY HARNESSING

Tasks - KAT-7 LSA

LCN Name: KAT-7 RECEPTOR ASSEMBLY COOLING SYSTEM LCN: X0104

Task Code: CEOXA AA Sequence: Description: SERVICE CHILLER ASSEMBLY

Task Detail Subtasks Spare Parts Support Equipment Facilities Documentation Linked Topics

Seq	Description	Time
1	Task Requirement	
2	Advise Stakeholders	2
3	Place Antenna in Maintenance Array	6
4	Place Antenna in Maint Array	2
5	Place Antenna in LOCAL MODE	2
6	Check Antenna Status	0.5
7	Select Emergency Stop	0.5
8	Switch OFF Chiller Assembly	1
9	Prepare to Remove Enclosure	20
10	Remove Enclosure	2
11	Open Chiller Assembly	5
12	Clean Fins	5
13	Remove Fan Louvre	3
14	Remove Fan Blade	3
15	Clean Fan Blade & Motor	5
16	Clean Internal Coolant Filter	5
17	Error Code Reset	
18	Test Pressure Relief Valve	1
19	Heading	
20	Access Cooling Equipment	1
21	Clean Y-Strainer Mesh	5
22	Heading	5
23	Heading	

Subtask Description: Prepare to Remove Enclosure

Subtask Detail Description: Utilising a M13 Wrench, carefully remove the 44 M8 Nylock Nuts and Washers securing the Enclosure Assembly to the Base of the Chiller Assembly. Store the fasteners in a safe place.

Subtask Time (min): 20 Figure: 89

Notes: CAUTION: THE CHILLER BASE IS AN IDEAL PLACE FOR SNAKES TO HIDE AND FOR SPIDERS TO NEST. PRIOR TO WORKING ON THE CHILLER ASSEMBLY ENSURE THAT THERE ARE NO SNAKES

Personnel Requirements:

Personnel	Quantity	Existing Skill	New Sk
P08	1		
*			

of 183

Detail Task Analysis

Task Identification

(Actual KAT-7 Data)

# Level 4 Logistic Support Analysis

## Resource Analysis



LCN Name: ANTENNA 12 METER LCN: >0101  
 Task Code: CE0DA\_AA Sequence: 3  
 Description: ANTENNA ASSEMBLY 3500HRS SERVICE

Task Detail | Subtasks | Spare Parts | Support Equipment | Facilities | Documentation | Linked Topics

Tree View:
 

- SCREW CAP SKT HD DIN913 M8X5A4
- SNAPLOCK 200 PING. 63MM ZINCALUM
- SHEET METAL ROOFING, 5 LDCX ZINCALUM
- SCREW HDX HD SELF DRILLING DIN7504 M5
- WASHER FLAT DIN932 M5x2P
- WASHER FLAT DIN1440 M12x2P
- NUT HD DIN934 M12xGR
- COVER ENCODER WELD ASSY
- COVER ELEV CHAIN WELD ASSY
- DECLINATION STOP ASSY
- DECLINATION ENCODER ASSY
  - SCREW CAP SKT HD DIN913 M3x12 A4
  - ENCODER HEISENBRANCKEN 226 9 AWG 16
  - COUPLING RIGID ALUMINUM 1 PCE 10M
  - SHAFT ENCODER
- ANCHOR PLATE WELD ASSY
- AZIMUTH ENCODER BRACKET TOP ASSY
- AZIMUTH ENCODER BRACKET BOTTOM ASSY
- DRIVE SHAFT AZ ENCODER WELDMENT
- PLATFORM MOTION ASSEMBLY
- COVER ELEV CHAIN WELD ASSY
- BONDING STRAP FEED TO PFA LEG 12H
- BONDING STRAP FEED TO PFA LEG 3H
- BONDING STRAP FEED TO PFA LEG 3H
- BONDING STRAP FEED TO PFA LEG 3H
- BONDING STRAP FEED TO PFA LEG 3H
- PLATE CLAMP
- BRACKET 2
- BRIDGE
- COVER
- COVER
- CABLE WRAP DECLINATION
- LIMIT SWITCH BRACKET BOTTOM
- BRACKET - B LIMIT SWITCH TOP
- BRACKET - A LIMIT SWITCH TOP
- BRACKET - C LIMIT SWITCH TOP
- DECLINATION MOTION ASSY
- COUNTERWEIGHT ASSY
- PFA END WELDMENT
- PFA BEAM PLAIN
- CONDUCTOR LIGHTNING FEED
- CONDUCTOR LIGHTNING DISH

Spare Parts

LCN Name: ANTENNA 12 METER LCN: >0101  
 Task Code: CE0DA\_AA Sequence: 3  
 Description: ANTENNA ASSEMBLY 3500HRS SERVICE

Task Detail | Subtasks | Spare Parts | Support Equipment | Facilities | Documentation | Linked Topics

Facility:
 

- On Equip

Facilities

LCN Name: ANTENNA 12 METER LCN: >0101  
 Task Code: CE0DA\_AA Sequence: 3  
 Description: ANTENNA ASSEMBLY 3500HRS SERVICE

Task Detail | Subtasks | Spare Parts | Support Equipment | Facilities | Documentation | Linked Topics

Full Name	Quantity	Unit Of Measure
ENGINEERS BULL	1	EA
ANTENNA MANUAL PANEL	1	EA
GREASE ALUMINA EPFLD	2	KG
MAGNIFYING GLASS 10X	1	EA
TORQUE WRENCH 12MM to 50MM	1	EA
DIGITAL CAMERA	1	EA
POCKET WEATHER METER	1	EA
ADHESIVE LOCITE THRE-BLOCKING 222	10.02	LT
CHERRY PICKER SMALL CRANE	1	EA
GREASE GUN ALUMINA	1	EA
TAP TOOL MS	1	EA
PLIERS COMBINATION RECLINE 160MM	1	EA
ALLEN KEY BALL DRIVER SET	1	EA
GLOVE LATEX POWDER FREE LARGE (PAIR)	1	EA
FLASHLIGHT MAGNETIC LED 3XCELL D	1	EA
ILLUMINATED INSPECTION MIRROR	1	EA
BROOM VARD STIFF 470MM	1	EA
VACUUM CLEANER KARCHER BSL	1	EA
LADDER INDUSTRIAL 2 PART EXTENSION	1	EA
BRAKE HOLDING TORQUE MEASUREMENT KIT	1	EA
MARKING TAPE 30MMx30M	1	EA
PERSONNEL PROTECTIVE EQUIPMENT	1	EA
ANTENNA KEY MAINTENANCE LOG 3500HR SERV	1	EA
HEX BIT DRIVE SET 1/2 INCH STD	1	EA

Support Equipment

LCN Name: ANTENNA 12 METER LCN: >0101  
 Task Code: CE0DA\_AA Sequence: 3  
 Description: ANTENNA ASSEMBLY 3500HRS SERVICE

Task Detail | Subtasks | Spare Parts | Support Equipment | Facilities | Documentation | Linked Topics

Document:
 

- DP1

Support Publications

(Actual KAT-7 Data)



# Level 4 Logistic Support Analysis

## Support Publications



Client : NRF (National Research Foundation)  
 Project : KAT-7  
 Type : HANDBOOK

### KAT-7 TELESCOPE SEGMENT MANUAL (INTERIM) PART 6 – OLM PREVENTIVE MAINTENANCE

Document number ..... K0000-1000V1-06PM HA  
 Revision ..... F  
 Classification ..... Commercial in Confidence  
 Author ..... D Liebenberg  
 Date ..... 13 Apr 2011

*Maintenance Manual*

### KAT-7 TELESCOPE SEGMENT MANUAL PART 6 – OLM PREVENTIVE MAINTENANCE

K0000-1000V1-06PM HA  
 Revision: F

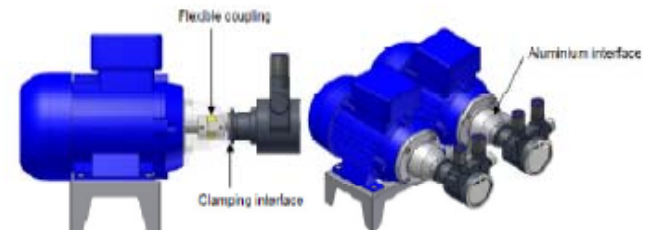


Figure 66 – Clamping Interface on the Pump & Motor Assembly

**CAUTION: TAKE CARE NOT TO DISLODGE OR DAMAGE THE SUPPLY AND RETURN PIPES TO THE ROTARY VANE PUMPS.**

24. Utilising a medium Phillips Screw Driver, unscrew the Clamping Interface securing the Rotary Vane Pump to the Pump Interface.
25. Remove the Rotary Vane Pump from the Aluminium Pump Interface. It may be stuck and may need some force to remove. Utilising a soft faced Hammer, strike the Rotary Vane Pump until it comes off. Half of the Rotex Coupling should come out as it is attached to the Rotary Vane Pump shaft with a M5 Grub Screw. The other half of the Rotex Coupling is attached to the Motor shaft.

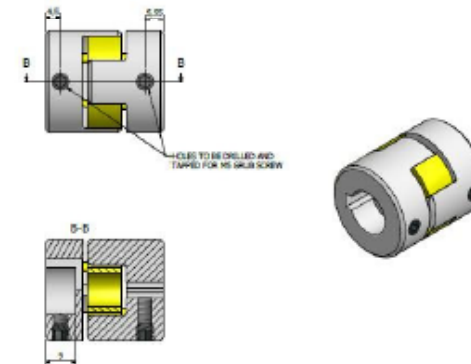


Figure 67 – Rotex Coupling


*(Actual KAT-7 Data)*

# Level 4 Logistic Support Analysis

## Support Publications (2)



### Illustrated Parts Breakdown



SKA SOUTH AFRICA  
SQUARE KILOMETRE ARRAY

---

Client : NRF (National Research Foundation)  
 Project : KAT-7  
 Type: HANDBOOK

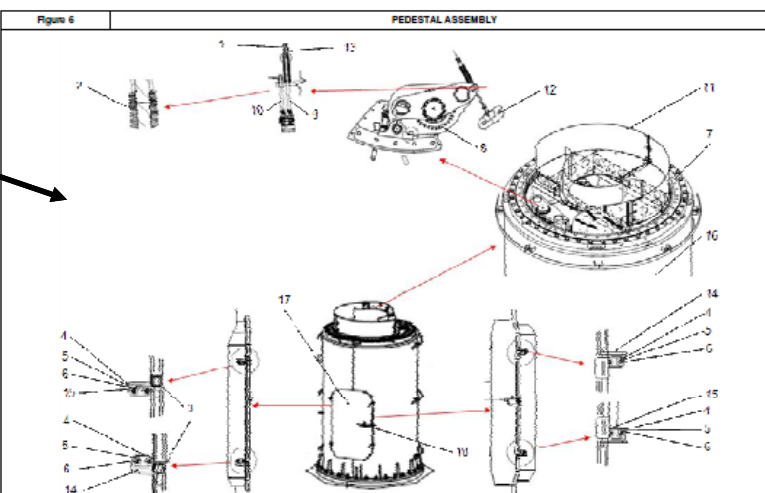
---

**KAT-7 TELESCOPE SEGMENT MANUAL (INTERIM)  
 PART 9 – ILLUSTRATED PARTS BREAKDOWN**

Document number.....K0000-1000V1-09 HA  
 Revision ..... D  
 Classification..... Commercial in Confidence  
 Author ..... D Liebenberg  
 Date ..... 8 Apr 2011

**(Actual KAT-7 Data)**

KAT-7 TELESCOPE SEGMENT MANUAL  
PART 9 – ILLUSTRATED PARTS BREAKDOWN
K0000-1000V1-09 HA  
Revision: D



KAT-7 TELESCOPE SEGMENT MANUAL  
PART 9 – ILLUSTRATED PARTS BREAKDOWN
K0000-1000V1-09 HA  
Revision: D

Fig No	Item No	Item Name	QTY	SM&R Code	Remarks
0	NIFRA14109A0000V1	PEDESTAL ASSY(see Fig 5 for NFA)	1		
1	DIRIND M8X20	NOT HEL DIRIND M8X20(NFA)	2		
2	DIRIND15	SPRING DIRIND M8X15(S2) (NFA)	80	SPZZ	
3	DIRIND15M8X20	WASHER FLAT DIRIND M8X15(WHEL(NFA))	2		
4	DIRIND1 M8X20X2.5A4	WASHER FLAT DIRIND1 M8X20(2.5A4(NFA))	8		
5	DIRIND1 M8X20	NOT HEL LOCKING DIRIND M8X20(NFA)	8		
6	DIRIND1 M8X20A4	SCREW HDZ HDZ DIRIND1 M8X20A4(NFA)	8		
7	NIFRA14109A0000V2	BEARING SLID	1		
8	NIFRA14109A0000V2	AZIMUTH MOTOR DRIVE ASSY(see Fig 7 for detail)	1	REF	
9	NIFRA14109A0000V2	PRE LOAD SHANT ASSY	1		
10	NIFRA14109A0000V1	PRE LOAD SHANT 2 ASSY	1		
11	NIFRA14109A0000V1	AZIMUTH CABLE TRAY, OUTER ASSY	1		
12	NIFRA14109A0000V2	SUPPORT PRE-LOAD	1		
13	NIFRA14109A0000V2	SPACER PRE-LOAD	1		
14	NIFRA14109A0000V2	BRACKET, SINGLE, PRE	1		
15	NIFRA14109A0000V2	BRACKET, SINGLE, LIT	2		
16	NIFRA14109A0000V4	PEDESTAL WELLEMENT ASSY	1		
17	NIFRA14109A0000V2	PEDESTAL DOOR WELLEMENT	1		
18	NIFRA14109A0000V2	LATCHABLE PEDESTAL DOOR	1		

# Maintenance Management



RAMLOG.NET SKA Darrel Liebenberg

Home Maintenance Management Publications My Details Log Out

**KAT-7 Work Orders**

Workshop  
Store  
Maintainer  
System Manager: C Taljaard (SKATest)  
Data Capturer

Work Orders Sent

Work Order	From	To Workshop	Reason	Status	Associated Job Card	Job Card Status
WO-000001	C Taljaard	Telescope	RF Stage 3 Not working. Repare Stage 3 Assembly	Job Card Created	JC-0000001	WIP
WO-000002	C Taljaard	Telescope	PM Task	Job Card Complete	JC-0000002	Complete
WO-000004	C Taljaard	Telescope	Repair a Failure	Job Card Created	JC-0000003	WIP
WO-000005	C Taljaard	Telescope	RELAIR THIS Now !!	Job Card Complete	JC-0000004	Complete

Copyright © 2011 R&M Technologies CC

## KAT-7 Store Items

RAMLOG.NET SKA Darrel Liebenberg

Home Maintenance Management Publications My Details Log Out

**Store Items**

Stores: OEM

Non-Serialised Items  
Serialised Items  
Both

Cage Code	Part Number	Item Name	Serial Number	Quantity
S0102	0.55KW-4P-380V-B3/B145-FS71	MOTOR ELECTRICAL WEG 550W 3PHASE	SNNew49	1
S0007	010807-AR	WIRE, 1.5 X28E ROUND WHT SURFIX		50
S0007	010808-AR	WIRE, 2.5X28E ROUND WHT SURFIX		50
S0007	010809-AR	WIRE, 2.5X48E ROUND WHT SURFIX		50
S0025	05103LM	WIND MONITOR, 4-20mA OUTPUTS	SNNew15	1
S0111	071202-KW-01-05	ELECTRONICS CONTROLLER		50
S0056	08160-001-000-000	CAM CABINET		50
S0056	08160-001-001-000	CAM ENCLOSURE		50
S0056	08160-001-002-000	CAM HEAT EXCHANGER ASSEMBLY		50
S0056	08160-001-002-001	HEAT EXCHANGER BOTTOM PLATE		50
S0056	08160-001-002-002	HEAT EXCHANGER TOP PLATE		50
S0056	08160-001-003-000	CAM SIDE PANEL		50
S0056	08160-001-004-000	CAM DOOR ASSEMBLY		50
S0056	08160-001-005-000	CAM BLOWER ASSEMBLY		50
S0056	08160-001-005-001	BLOWER MOUNT PLATE		50
S0056	08160-001-006-000	CAM POWER INLET		50
S0056	09043-000-000-000-000	KAT-7 RECEPTOR ASSEMBLY COOLING SYSTEM		50
S0056	09043-001-000-000-000	CHILLER ASSEMBLY		50
S0056	09043-001-001-000-000	ENCLOSURE ASSEMBLY		50
S0056	09043-001-002-000-000	BASE ASSEMBLY		50
S0056	09043-001-003-000-000	ELECTRICAL PANEL		50
S0056	09043-001-003-000-001	ELECTRICAL PANEL COVER 1		50
S0056	09043-001-003-000-002	ELECTRICAL PANEL COVER 2		50
S0056	09043-001-003-000-003	FILTER PLATE		50
S0056	09043-001-003-001-000	WELDED ELECTRICAL PANEL		50
S0056	09043-001-004-000-000	CHILLER-OUT PIPE		50
S0056	09043-002-000-000-000	COOLING TANK ASSEMBLY		50
S0056	09043-002-001-000-000	TANK ASSEMBLY		50
S0056	09043-002-001-000-001	LEVEL SWITCH COVER		50
S0056	09043-002-001-001-000	TANK		50

1 2 3 4 5 6 7 8 9 10 ... >>

## KAT-7 Maintainer Inventory

RAMLOG.NET SKA Darrel Liebenberg

Home Maintenance Management Publications My Details Log Out

**Maintainer Items**

Maintainers: C Taljaard (SKATestM)

Cage Code	Part Number	Item Name	Serial Number	Quantity
S0007	K1000-0002V1	ANTENNA ASSEMBLY	SNT-001	0
S0007	NRFKAT4100AD201V2	BEARING SLEW		0
S1000	SWCT6563	DUO M/BLOCK S/S COVER		0
S1000	DIN933 M10X35 A4	SCREW HEX HD DIN933 M10X35 A4		0

Copyright © 2011 R&M Technologies CC

(Actual KAT-7 Data)

Exploring the Universe with the world's largest radio telescope

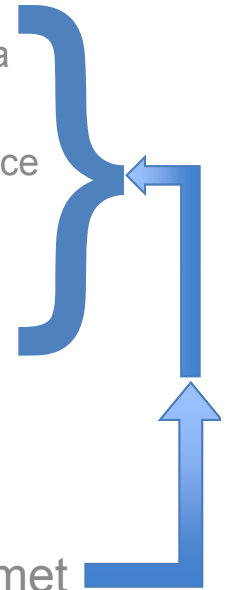
# Logistics engineering

## System reliability analysis



*“Design for Support; Design the Support & Support the Design”*

- System reliability requirements
  - The system shall have critical failures for less than 5% of annual operating time, where a critical failure is defined as a failure which results in the system not being available for science observations OR more than 10% of array elements not being available for science observations
  - The system shall have a mean time between critical failures of  $\geq 684$  hours
  - The system shall have a critical mean time to repair of  $\leq 36$  hours
- FMECA for all sub-systems to identify failure modes
- Allocate MTBF and MTTR for each subsystem based on FMECA
- Calculate system downtime and availability to check if requirements are met



FMECA = Failure Modes, Effects and Criticality Aalysis

MTBF = Mean Time Between Failures

MTTR = Mean Time to Repair. MTTR numbers include logistical system delays.

Exploring the Universe with the world's largest radio telescope

# Logistics engineering

## Comparative reliability allocation for FMECA



Table 1: Comparative reliability allocation for FMECA

		MTBF (months)	MTTR (hours)	Downtime (hours/year)	# of failures/year for system
Receptor	3 receivers + compressor	5	8	–	154
	Digitizer	24	6	–	32
	Antenna positioner	18	12	–	43
Site	Antenna power reticulation	6	8	16	2
	Antenna fibre reticulation	60	48	9.6	0.2
	Power source	60	120	24	0.2
Processor Building	Correlator & Time Frequency Reference	4	8	24	3
	Karoo Array Processor Building	24	48	24	0.5
	Control & Monitoring system	8	8	12	2
	Science processor	8	8	12	2
Remote CAM link		12	24	24	1

MTTR numbers include logistical system delays.

# Logistics engineering

Assumptions for comparative reliability allocation for FMECA



Table 2: Assumptions for comparative reliability allocation for FMECA

		Assumption
<b>Receptor</b>	3 receivers + compressor	Swap-out of hot spares to enable 8-hour repair time
	Digitizer	Swap out failed units
	Antenna positioner	Chiller requirements and concept similar to KAT-7
<b>Site</b>	Antenna power reticulation	
	Antenna fibre reticulation	
	Power source	Built-in redundancy, as per infrastructure concept design
<b>Processor Building</b>	Correlator & TFR	Hot-swappable ROACH units
	Karoo Array Processor Building	Built-in redundancy, as per infrastructure concept design
	Control & Monitoring system	
	Science processor	
Remote CAM link		

# Logistics engineering

## Results: System reliability analysis



- Total number of hours downtime per year = 145, resulting in a critical availability of 98.3%, which meets the requirement of 95%.
- Number of critical failures is approximately 10, resulting in MTBF of approximately 880 hours, which meets the requirement of  $\geq 684$  hours.
- The MTTR of critical failures is 18.5 hours, which meets the requirement of  $\leq 36$  hours.
- Results show that the maintenance cost is driven by the receptors – specifically the receiver sub-system.
- Allocation of comparative reliability (Table 1) implies a MTBF of 2,456 hours for individual receptors. Resulting MTTR for individual receptors is 8.5 hours.
- For the system as a whole, the reliability allocation in Table 1 results in a total number of approx. 240 failures per year.