



DOCUMENT REQUIREMENTS DESCRIPTIONS

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TABLE OF CONTENTS

1	INTRODUCTION.....	5
1.1	Purpose of the document	5
1.2	Scope of the document.....	5
2	REFERENCES	6
2.1	Applicable documents.....	6
2.2	Reference documents.....	6
3	DRDs.....	9
3.1	PROJECT MANAGEMENT PLAN (DRD-01)	9
3.2	PROGRESS REPORT (DRD-02).....	10
3.3	ACTION ITEM LIST (DRD-03).....	10
3.4	CONFIGURATION CONTROL PLAN (DRD-04).....	11
3.5	CONFIGURATION ITEM DATA LIST (DRD-05)	11
3.6	ANALYSIS TREE (DRD - 06).....	12
3.7	CHANGE REQUESTS (DRD-07)	12
3.8	REQUEST FOR WAIVER – RfW (DRD-08)	13
3.9	NON-CONFORMANCE REPORT - NCR (DRD-09).....	13
3.10	DESIGN REVIEW DATA PACKAGE (DRD-10).....	14
3.11	DESIGN REPORT (DRD-11).....	14
3.12	ANALYSIS REPORT (DRD-12).....	15
3.13	DRAWING SETS (DRD-13).....	17
3.14	LOWER LEVEL SPECIFICATIONS (DRD-14)	17
3.15	MANUFACTURING PLAN (DRD-15)	17
3.16	ELEMENT TECHNICAL REQUIREMENTS SPECIFICATION (DRD-16)	18
3.17	SOFTWARE REQUIREMENTS SPECIFICATION (DRD-16)	19
3.18	OPERATIONS MANUAL (DRD-17)	19
3.19	MAINTENANCE MANUAL (DRD-18)	20
3.20	SOFTWARE MANUAL (DRD -19).....	20
3.21	SPARE PARTS LIST (DRD-20)	21
3.22	PRODUCT ASSURANCE & SAFETY (DRD-21)	21
3.22.1	Product Assurance Plan (DRD 21A).....	22
3.22.2	Product Assurance Progress Report (DRD 21B)	23
3.22.3	Safety and reliability analysis (DRD 21C)	23
3.22.4	Reliability and Safety test procedures (DRD 21D).....	26
3.22.5	Other (DRD 21E).....	27
3.23	VERIFICATION PLAN (DRD-22).....	27
3.23.1	Assembly, integration and test plan (AITP) – DRD 22a	27
3.23.2	Test specification (TSPE) – DRD22b	29
3.24	TEST PROCEDURE (DRD-23)	30
3.25	TEST REPORT (DRD-24)	31
3.26	ACCEPTANCE DATA PACKAGE (DRD-25)	32
3.27	DEVELOPMENT PLAN (DRD 26).....	32
3.28	INTERFACE CONTROL DOCUMENT (DRD-27).....	33

LIST OF ABBREVIATIONS

AN	Another
EX.....	Example
SKA	Square Kilometre Array
SKA PO	Office of the SKA Organisation
TBC	To be Confirmed
TBD	To Be Determined
TBS	To Be Supplied

1 Introduction

1.1 Purpose of the document

These Document Requirement Descriptions are provided in order that technical interchange between SKA Element suppliers and the SKA Office is of a uniform quality and of a consistent format.

1.2 Scope of the document

These DRDs apply to the Pre-Construction Phase of SKA1. Applicability to Phase 2 is TBD.

2 References

2.1 Applicable documents

The following documents are applicable to the extent stated herein. In the event of conflict between the contents of the applicable documents and this document, **the applicable documents** shall take precedence.

- [AD1] SKA Project Management Plan - TBS
- [AD2] SKA System Engineering Management Plan - SKA-TEL.SE-SKAO-MP-001
- [AD3] SKA Product Assurance and Safety Plan – SKA-OFF.PAQA-SKO-QP-001
- [AD4] SKA Glossary MGT-040.030.015-LST-002 Rev L
- [AD5] SKA Interface Management Plan SKA-TEL.SE.IFD-SKO-PR-001
- [AD6] Statement of Work for the Study, Prototyping and Design of an SKA Element SKA---TEL.OFF.SOW-SKO-SOW-001
- [AD7] Statement of Work for the Study, Prototyping and Preliminary Design of an SKA Advanced Instrumentation Programme Technology SKA-TEL.OFF.AIP-SKO-SOW-001

2.2 Reference documents

In the event of conflict between the contents of the referenced documents and this document, **this document** shall take precedence.

ECSS documents may be obtained from:

<http://www.ecss.nl/>

- [RD1] ECSS system Glossary of terms ECSS-S-ST-00-01C 1 October 2012

The following documents are useful DRDs either implicit or explicitly referred to in this document, to which further reference can be made.

- [RD2] Configuration management plan - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex A 03-Mar-00
- [RD3] Configuration item list - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex B 03-Mar-00
- [RD4] Configuration item data list - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex C 03-Mar-00
- [RD5] As-built configuration list - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex D 03-Mar-00
- [RD6] Software configuration file (SCF) - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex E 03-Mar-00
- [RD7] Configuration status accounting reports - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex F 03-Mar-00
- [RD8] Change request - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex G 03-Mar-00
- [RD9] Change proposal - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex H 03-Mar-00
- [RD10] Request for deviation - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex I 03-Mar-00

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- [RD11] Request for waiver - ECSS-M-ST-40C Rev.1 Configuration and information management, Annex J 03-Mar-00
 - [RD12] Cost Breakdown Structure - ECSS-M-ST-60C Cost and schedule management, Annex A 31-Jul-08
 - [RD13] Critical-item list - ECSS-Q-ST-10-04C Critical-item control, Annex A 31-Jul-08
 - [RD14] Dependability plan - ECSS-Q-ST-30C Dependability, Annex C 06-Mar-09
 - [RD15] Reliability prediction - ECSS-Q-ST-30C Dependability, Annex E 06-Mar-09
 - [RD16] Failure Detection Identification and Recovery - ECSS-Q-ST-30C Dependability, Annex F 06-Mar-09
 - [RD17] Maintainability analysis - ECSS-Q-ST-30C Dependability, Annex H 06-Mar-09
 - [RD18] Worst Case Analysis - ECSS-Q-ST-30C Dependability, Annex J 06-Mar-09
 - [RD19] FMEA/FMECA report - ECSS-Q-ST-30-02C Failure modes, effects (and criticality) analysis (FMEA/FMECA), Annex A 06-Mar-09
 - [RD20] FMEA worksheet - ECSS-Q-ST-30-02C Failure modes, effects (and criticality) analysis (FMEA/FMECA), Annex B 06-Mar-09
 - [RD21] FMECA worksheet - ECSS-Q-ST-30-02C Failure modes, effects (and criticality) analysis (FMEA/FMECA), Annex C 06-Mar-09
 - [RD22] Customer requirements document (CRD) - ECSS-E-ST-70C Ground systems and operations, Annex A 31-Jul-08
 - [RD23] Nonconformance Report - ECSS-Q-ST-10-09C Nonconformance control system, Annex A 15-Nov-08
 - [RD24] NCR Status List - ECSS-Q-ST-10-09C Nonconformance control system, Annex B 15-Nov-08
 - [RD25] Review procedure - ECSS-M-ST-10-01C Organization and conduct of reviews, Annex A 15-Nov-08
 - [RD26] Review item discrepancy (RID) - ECSS-M-ST-10-01C Organization and conduct of reviews, Annex B 15-Nov-08
 - [RD27] Review team report - ECSS-M-ST-10-01C Organization and conduct of reviews, Annex C 15-Nov-08
 - [RD28] Review authority report - ECSS-M-ST-10-01C Organization and conduct of reviews, Annex D 15-Nov-08
 - [RD29] Product Assurance Plan (PAP) - ECSS-Q-ST-10C Product assurance management, Annex A 15-Nov-08
 - [RD30] Project management plan (PMP) - ECSS-M-ST-10C Rev.1 Project planning and implementation, Annex A 03-Mar-09
 - [RD31] Product tree - ECSS-M-ST-10C Rev.1 Project planning and implementation, Annex B 03-Mar-09
 - [RD32] Work breakdown structure (WBS) - ECSS-M-ST-10C Rev.1 Project planning and implementation, Annex C 03-Mar-09
 - [RD33] Work package (WP) description - ECSS-M-ST-10C Rev.1 Project planning and implementation, Annex D 03-Mar-09
 - [RD34] Progress report - ECSS-M-ST-10C Rev.1 Project planning and implementation, Annex E 03-Mar-09
 - [RD35] QA plan - ECSS-Q-ST-20C Quality assurance, Annex A 15-Nov-08
 - [RD36] End item data package (EIDP) - ECSS-Q-ST-20C Quality assurance, Annex B 15-Nov-08
 - [RD37] Certificate of conformity (CoC) - ECSS-Q-ST-20C Quality assurance, Annex D 15-Nov-08
 - [RD38] Safety analysis report including hazard reports - ECSS-Q-ST-40C Safety, Annex D 06-Mar-09
 - [RD39] Software system specification (SSS) - ECSS-E-ST-40C Software, Annex B 06-Mar-09

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- [RD40] Software interface requirements document (IRD) - ECSS-E-ST-40C Software, Annex C 06-Mar-09
- [RD41] Software requirements specification (SRS) - ECSS-E-ST-40C Software, Annex D 06-Mar-09
- [RD42] Interface Control Document (ICD) - ECSS-E-ST-40C Software, Annex E 06-Mar-09
- [RD43] Software design document (SDD) - ECSS-E-ST-40C Software, Annex F 06-Mar-09
- [RD44] Software release document (SReID) - ECSS-E-ST-40C Software, Annex G 06-Mar-09
- [RD45] Software User Manual (SUM) - ECSS-E-ST-40C Software, Annex H 06-Mar-09
- [RD46] Software verification plan (SVeRP) - ECSS-E-ST-40C Software, Annex I 06-Mar-09
- [RD47] Software validation plan (SVaIP) - ECSS-E-ST-40C Software, Annex J 06-Mar-09
- [RD48] Software [unit/integration] test plan (SUITP) - ECSS-E-ST-40C Software, Annex K 06-Mar-09
- [RD49] Software validation specification (SVS) - ECSS-E-ST-40C Software, Annex L 06-Mar-09
- [RD50] Software verification report (SVR) - ECSS-E-ST-40C Software, Annex M 06-Mar-09
- [RD51] Software reuse file (SRF) - ECSS-E-ST-40C Software, Annex N 06-Mar-09
- [RD52] Software development plan (SDP) - ECSS-E-ST-40C Software, Annex O 06-Mar-09
- [RD53] Software review plan (SRevP) - ECSS-E-ST-40C Software, Annex P 06-Mar-09
- [RD54] Software product assurance plan (SPAP) - ECSS-Q-ST-80C Software product assurance, Annex B 06-Mar-09
- [RD55] Software product assurance milestone report (SPAMR) - ECSS-Q-ST-80C Software product assurance, Annex C 06-Mar-09
- [RD56] System engineering plan (SEP) - ECSS-E-ST-10C System engineering general requirements, Annex D 06-Mar-09
- [RD57] Design definition file (DDF) - ECSS-E-ST-10C System engineering general requirements, Annex G 06-Mar-09
- [RD58] Specification tree - ECSS-E-ST-10C System engineering general requirements, Annex J 06-Mar-09
- [RD59] Design justification file (DJF) - ECSS-E-ST-10C System engineering general requirements, Annex K 06-Mar-09
- [RD60] Interface requirement document (IRD) - ECSS-E-ST-10C System engineering general requirements, Annex M 06-Mar-09
- [RD61] Requirements traceability matrix (RTM) - ECSS-E-ST-10C System engineering general requirements, Annex N 06-Mar-09
- [RD62] Requirements justification file (RJF) - ECSS-E-ST-10C System engineering general requirements, Annex O 06-Mar-09
- [RD63] Product user manual (PUM or UM) - ECSS-E-ST-10C System engineering general requirements, Annex P 06-Mar-09
- [RD64] Analysis report - ECSS-E-ST-10C System engineering general requirements, Annex Q 06-Mar-09
- [RD65] Technical requirements specification (TS) - ECSS-E-ST-10-06C Technical requirements specification, Annex A 06-Mar-09
- [RD66] Assembly, integration and test plan (AITP) - ECSS-E-ST-10-03C Testing, Annex A 01-Jun-12
- [RD67] Verification plan (VP) - ECSS-E-ST-10-02C Verification, Annex A 06-Mar-09
- [RD68] Verification control document (VCD) - ECSS-E-ST-10-02C Verification, Annex B 06-Mar-09

3 DRDs

3.1 PROJECT MANAGEMENT PLAN (DRD-01)

The Project Management Plan (PMP) shall describe, as a minimum, the following aspects:

- The project strategy and approach
- The management approach implemented by the Contractor to manage and control the project.
- The organisational structure and governance of the project
- The roles, responsibilities and the authority of each function in the organisational structure including job descriptions for key functions
- The interrelation among the different functions in the organisation.
- Description of where and how the management and control of the lower tier Contractors is established in the project organisation.

The structure for the Project Management Plan is:

Section 1 Addressing the purpose; structure; validity and applicability of the document.

Section 2 Provide an overview of the project in terms of the project objectives; scope; project strategies; project phases and current status of the project.

Section 3 Provide an overview of the project organisation and governance including how the project is structured in terms of the project levels, project role-players and stakeholders, organisational structures and roles and responsibilities within these structures. In case of a consortium the overview will include a comprehensive description of all these aspects in relation to the members of the consortium.

Section 4 Provide a description of the project management aspects of the project including how the project will be managed in terms of the scope (work), time schedule, cost (resources); progress reporting; decision making; communication and project management tools.

Section 5 Provide a description of the project implementation and execution addressing how the implementation of the project will be managed in terms of engineering, procurement, construction, commissioning and handover to operations.

Section 6 Provide a description on how risk will be managed.

Section 7 Provide a description on how product assurance and quality will be managed.

Section 8 Provide a description on how configuration of the product and change control (including project and technical) will be managed.

Section 9 Provide a description on how information and documentation will be managed.

Section 10 Provide a description on how safety, occupational health and environmental aspects will be managed.

Section 11 Provide a description on how human resources for the project will be managed.

Section 12 Provide a description on how the participation of industry will be managed.

Section 13 Provide a description on how outreach (public relations) will be managed.

Section 14 A list of applicable and reference documents used to compile the PMP.

3.2 PROGRESS REPORT (DRD-02)

The Progress Report summarises the progress of the project on a periodic basis.

It shall summarise the achievements of the period at all levels of the project and show them against the planned date contained in the Project Schedule putting in evidence any deviations description of critical schedule and technical issues utilised in the reporting period and anticipated for the future.

It shall discuss every problem detected at any level of the project during the reporting period and shall address the planned remedial activities.

Progress reports are delivered on a quarterly basis or more often if needed. They shall be provided to SKA PO not later than the 10th of the following month.

Furthermore the progress report shall include:

Schedule reporting and updating which reflects the updated schedule versus baseline planning, reassessment of all start and completion dates for all activities:

- * Action item list
- * Status of critical item list
- * Inspection Planning
- * Supplier selection and qualification
- * Status list and classification of NCRs
- * Status list of requests for waiver.
- * Status list of ECPS
- * Overview of major events in the forthcoming period
- * PA/QA reports of MIPs, test reports, audits
- * Current PA/QA activities
- * Current problems and status of related actions
- * Status of Configuration Item List (CIDL)

3.3 ACTION ITEM LIST (DRD-03)

It shall list all the actions agreed between the Contractor and SKA PO

- * The subject of the action:
- * The originator:
- * The actionee(s);
- * The due date and the closure date:
- * The reference to the document(s) containing the basis for the closure of the action.

This list will be reviewed at each progress meeting

3.4 CONFIGURATION CONTROL PLAN (DRD-04)

The Contractor shall submit for approval a Configuration Control Plan which shall describe the project configuration control organisation, methods, tools and procedures the Contractor intends to implement for the work under Contract. The Configuration Control Plan shall define:

- * The handling of contractual changes:
- * The handling of the interfaces internal to the project;
- * The handling of the interfaces external to the project:
- * The handling of technical changes.

The Configuration Control System to be implemented on the basis of the approved Configuration Control Plan shall ensure that:

- * The manufacturing documentation is in line with the design documentation:
- * The product is in line with the manufacturing documentation;
- * Changes are not implemented without due analysis and approval:
- * Required Configuration Item and/or manufacturing changes are properly documented in Change Requests to be established by the Contractor
- * Requests for Waivers/ Non-Conformance-Reports are properly handled.

The Configuration Control Plan and System shall be imposed on all sub-contractors and third parties participating in the execution of the Contract.

The Configuration Control implies the establishment of a Configuration Item Data List, which includes lists of valid specifications, drawings and in general all documentation items properly dated and numbered for each configuration item.

3.5 CONFIGURATION ITEM DATA LIST (DRD-05)

The CIDL is the list containing all documents which define the SKA. Except for the Interface Control Drawings, drawings shall not be entered individually into the CIDL; only the drawing list. The CIDL plays a crucial role in the verification and acceptance tests and reviews.

The CIDL shall list all valid and released SKA documents from the following categories:

1. Requirements
 - a. Top Level Requirements Documents
 - b. Requirement Specification / Design Specification on item level
 - c. Requirement Specification / Procurement Specification on lower level
 - d. Identification of Deviations
2. Definition of the hardware and software (WBS, Drawing List / Tree, etc.)
3. Analysis Documentation
 - a. Feasibility analyses
 - b. Safety and hazard analyses
4. Design Documentation (design reports, circuit diagrams, technical notes, etc)

5. Interface Control Documentation
 - a. ICDs
 - b. Interface control drawings
 - c. Grounding diagrams
 - d. Others as needed

6. Lists
 - a. Parts, material and component list
 - b. Process list
 - c. Change status list

7. As Built Configuration List
 - a. Manufacturing drawing files list
 - b. NCR status list
 - c. RfW status list
 - d. ECP status list
 - e. List of lower level ADPs (acceptance data packages)

8. Documentation list for assembly, integration, test and calibration, verification
 - a. Procedures and test plans
 - b. Reports
 - c. Verification Matrix
 - d. Log Books
 - e. Cleanliness record

9. Manuals and Handling Procedures
 - a. Project Management Plan
 - b. PA manual
 - c. User manual

10. Open Work

3.6 ANALYSIS TREE (DRD - 06)

The analysis tree describes the hierarchical order and the logic of the various analyses to be performed during the design and development phase.

This shall include evaluation tests of components, bread boarding activities, demonstration models etc.

It shall show in the form of a flow chart all the analysis and assessments foreseen.

3.7 CHANGE REQUESTS (DRD-07)

It describes the initiated change requests. It shall contain:

- * Identification of the Work Package;
- * The description and justification of the change requested;
- * The reasons for the change request;
- * An assessment of the impact of the change on the programmatic, costs, functional and performance requirements of the project at any level.

More details are given in the SKA Change Request Procedure SKA-TEL.SE.CDM-SKO-PR-001

3.8 REQUEST FOR WAIVER – RfW (DRD-08)

A Request for Waiver is usually issued during the manufacturing, test and integration, and is issued by the SKA PO for a single deliverable item.

A Non-Conformance Report shall be the basis of any Waiver.

- a) A relief from the relevant specification, test procedure, integration requirements and/or
- b) To grant acceptance from SKA to use different hardware items or materials due to the inability to procure the specified ones in due time to meet the time schedule.

A granted waiver does not lead to changes of any approved and released document.

The Request for Waiver shall include:

- * Definition of the item affected
- * Identification of documents, software and hardware affected
- * Description of the waiver
- * Description of the need for the waiver including references to the associated NCR(s)
- * Effects on costs and schedule.

It shall be accompanied by all documentation required by SKA PO to judge the acceptability of the waiver.

If any changes in planned costs, schedule or performance are expected, these points shall be clearly addressed.

(Note: It is recalled that SKA PO has no obligation to accept a request for waiver; SKA PO will however provide a reply to this request within 4 weeks).

*If all SKA deliverable items are concerned a Change Request has to be issued.

3.9 NON-CONFORMANCE REPORT - NCR (DRD-09)

It shall report non-conformities which occurred during the manufacture, assembly, testing at all levels of the project and which are authorized by SKA PO. The NCR forms are part of the "as built" drawing set.

The report shall show the following information:

- * Reference number of the non-conformance
- * Staff member who has identified the non-conformance

- * Where has the non-conformance occurred
- * date of the observation
- * description of the non-conformance and the reference to the specification
- * disposition of the Material Review Board (MRB)

Dispositions could be:

- “scrap”
- “Use as is” (waiver - only for “major”)
- “Rework” (original process)
- “Repair” (standard or non-standard methods to be defined)
- “Change / modify the design”: (Change Request)
- “Back to manufacturer/dealer”
- * cause of the non-conformance
- * corrective action proposal

More details are given in SKA product assurance documents.

3.10 DESIGN REVIEW DATA PACKAGE (DRD-10)

3.11 The design review data package is a collection of all documentation which allows scrutinising the compatibility of the design with the specified requirements. The detail of information contained in a specific data package depends on the project phase and thereby on the type of design review for which the data package will be prepared/collected. The contents of the PDR and CDR Design Review Data Packages are defined in [AD6] and [AD7].DESIGN REPORT (DRD-11)

The Design Report summarises all the design features of all contract items subject of this contract. The Design Report shall address every requirement specified in the technical specifications and as applicable to the item subject of the Design Report. In particular the Design Report shall contain the following information:

1. Scope of the design

In this section a general description of the contents of the Design Report shall be given.

2. Applicable documents

In this section all the documents referred to in the Design Report shall be listed.

3. Assumptions

All the assumptions used in the design shall be listed. In particular:

- * design constraints
- * environmental conditions others than specified in technical specifications

- * all analysis & calculation methods (if applicable)
- * maintenance constraints (if applicable)
- * access constraints (if applicable)
- *

(All values used in the assumptions shall be referenced).

4. Materials

All the materials used in the design and their physical and mechanical properties as well as their chemical behaviour shall be given. All applicable treatments and their purposes shall be described.

5. Design description

In this section a complete description of the design shall be given. Every requirement specified in the technical specifications shall be addressed. Figures and sketches shall have a caption and shall be referenced and described in the text. For every design solution supported by calculations reference to section 6 or to an Analysis Report shall be made.

6. Calculations

In this section all the calculations supporting the design, others than those included in the Analyses Report shall be given in detail, including a discussion of the results.

7. Conclusions

In this section a statement concerning the compliance of the design with the requirements shall be given. Non-conformities shall be discussed.

3.12 ANALYSIS REPORT (DRD-12)

The Analysis Report summarizes all the calculations which support the design (e.g. F.E. calculations. etc.).

The Analysis Report shall identify which issue of the specification and which design/manufacturing configuration has been used for the analysis.

An Analysis Report shall be produced every time if a verification by analysis is required in the verification matrix.

The Analysis Report shall contain the following information:

1. Scope of the analysis

In this section the purpose of the analysis shall be given as well as a general description of the contents of the Analysis Report.

2. Applicable documents

In this section all the documents referred to in the Analysis Report shall be listed.

3. Assumptions

In this section all the assumptions used in the analysis shall be listed and discussed. In particular:

- * assumptions used in the definition of the model
- * assumptions used in defining the boundary conditions (if applicable)
- * assumptions used in defining the material properties (if applicable)
- * assumptions used in defining loads and loading cases (if applicable)
- * assumptions used in processing the results, (if applicable)
- * analysis methods

4. Model

In this section the model used in the analysis shall be described in detail.

For example for a structural analysis:

- * the geometry
- * the sectional properties (if applicable)
- * boundary conditions
- * loads topology
- * type of elements used (if applicable)
- * type of component' used (if applicable)
- * correspondence between the model and the actual modelled component

Plots and sketches illustrating the model shall be included and shall be readable in all details. The detail of the description shall allow reproducing the model.

5. Loading cases (for structural analyses)

In this section the loading cases shall be identified.

The loading applied to the model shall be given and illustrated in plots and/or sketches. A list of the loaded nodes shall be given (if applicable).

6. Results

In this section the result" shall be summarized and discussed.

The results coming out from the analysis shall be processed in such a way that they are directly comparable with the verification items verified. A comparison table shall summarize the calculated values with the values of the verification items.

7. Conclusions

In this section a statement concerning the compliance of the results with the performance requirements shall be given. Non-Conformities shall be discussed.

3.13 DRAWING SETS (DRD-13)

They shall define at all levels of the project the as-designed and as-built product.

Drawing sets shall be prepared in accordance with DIN standards or equivalent and approved by SKA PO and shall contain all information necessary to manufacture, assembly, and test the item and the necessary support equipment.

3.14 LOWER LEVEL SPECIFICATIONS (DRD-14)

They are the specifications, at all levels of the project, which define the sub-assemblies and which shall be prepared by the Contractor or/and by the sub-contractors.

The specifications shall contain at a minimum:

Applicable documents

Item description

Interface definitions, requirements

Performance characteristics requirements

Physical characteristics:

RAMS requirements

Environmental conditions including EMC, cleanliness etc.

Design and construction requirements (parts, materials, processes, components, workmanship etc.)

Assembly requirements

Transport requirements

Documentation requirements

Personnel and training

Quality assurance and management

Configuration control and management

Verification requirements:

- Test
- Analyses
- Similarity (verified already in another project with similar conditions)
- Qualification procedure
- Design review
- Audit
- Inspection
- Certificate

3.15 MANUFACTURING PLAN (DRD-15)

The manufacturing plan shall list all actions which are planned for the manufacture, inspection, testing and transport of the units to the destination.

The plan shall include a PERT diagram of all activities with the foreseen duration and shall reference all relevant documents (drawings, procedures, etc.).

Constraints on procurement or deliveries will be identified.

3.16 ELEMENT TECHNICAL REQUIREMENTS SPECIFICATION (DRD-16)

Introduction

The TRS shall contain a description of the purpose, objective, content and the reason prompting its preparation.

Applicable and reference documents

The TRS shall list the applicable and reference documents in support of the generation of the document.

User need presentation

The TRS shall present the main elements that characterize the user's need for developing the product as a background for those requirements that are defined in detail in the dedicated section. The TRS shall put the product into perspective with other related products.

If the product is independent and totally self-contained, i.e. able to match the final user's need, it should be so stated here.

If the TRS defines a product that is a component of a higher tier system, the TRS shall recall the related needs of that larger system and shall describe the identified interfaces between that system and the product.

A non-exhaustive checklist of general questions that should be answered at the early stages of the TRS is:

- What is the product supposed to do? It is fundamental but critically important to make sure that every actor has a complete understanding of what the product has to do.
- Who is going to use this product? It is important to indicate who is going to use the product, why they are going to use it and for what it is going to be used.

Selected concept / product presentation

The technical specification shall describe the concept, the expected product architecture and the functioning principles on which it is based.

Life cycle description

The TRS shall list and describe the different chronological situations of the product's life profile.

An identifier can be associated with each situation in order to be able to link each requirement to at least one situation in which it applies. Such an approach enables sorting and filtering of the requirements per situation.

Environment and constraints description

The TRS shall describe the different environments and constraints for each situation in the life profile that the product is expected to encounter.

An identifier can be associated with each product environment in order to be able to link each requirement to at least the worst environment to which it applies. Such an approach enables sorting and filtering the requirements per environment.

Requirements

The TRS shall list all the technical requirements necessary for the product to satisfy the user's needs.

Interfaces requirements can be rolled-out of the TRS in form an interface requirement document (IRD).

For all TRS and for each requirement, the following characteristics have been selected:

identifiability;
performance and methods used to determine it;
configuration management;
traceability;
tolerance
verification

3.17 SOFTWARE REQUIREMENTS SPECIFICATION (DRD-16)

- * The software requirements specification to be delivered by the Contractor shall be derived from the technical specification and from further discussions with SKA-PO.
- * The software requirements specification should elaborate the functional and performance requirements, the normal and abnormal conditions behavior and should also include test and maintenance requirements.
- * Requirements should be listed for the software, categorized in groups and listed in such a way that they can be traced in the course of the development.

3.18 OPERATIONS MANUAL (DRD-17)

The Operations Manual describes in detail all the procedures needed to operate correctly and safely. It shall at least:

- * Describe the start-up procedures;
- * Describe the shut-down procedures;
- * Describe all the procedures to operate the sub-systems;
- * Describe all the operational error messages for the control computer and the resulting remedial action
- * Describe all the safety procedures to operate the unit:
- * List all the operational limits of the unit;
- * List the emergency cases which can occur during operations;
- * Describe emergency procedures;
- * Make reference to any other procedure needed for safe and correct operation;
- * Trouble-shooting;

3.19 MAINTENANCE MANUAL (DRD-18)

The maintenance manual shall contain the results of a maintainability analyses and detailed maintenance procedures with drawings. It shall contain the maintenance requirements and scheduling for all items included in the supplies of a contract. Beside the description of the maintenance actions, including the necessary procedure and recommendations for an assembly and disassembly. it shall provide a maintenance check-list or matrix including information about:

- * Item to be maintained:
- * Reference to maintenance manuals;
- * Type of maintenance, inspection etc.;
- * Dates (intervals) for maintenance:
- * Duration of maintenance action:
- * Effect on other systems, functions of the Unit;
- * Required parts and consumables and tools:
- * Required major equipment;
- * Required personnel:
- * Estimated man-hours and skill level required for each maintenance task.

A maintenance manual and a computer readable list of maintenance actions shall also be delivered, to be used later for the implementation into a centralized preventive maintenance software for the whole SKA system. The list format will be specified by SKA PO.

The Control software maintenance manual shall cover:

- * The internal organization of the software;
- * The installation procedure including the environment set-up (operating system, etc.);
- * The preventative maintenance operations (file clean-up, etc.).

3.20 SOFTWARE MANUAL (DRD -19)

It describes the software developed or expressly adapted for SKA needs.

It shall:

- Document analysis and design, using the approved analysis and design methodology. as defined in the SKA Software Management Plan;
- Document the programming language. the operating system and development system used;
- Document the procedures to test the conformity to the specifications
- Contain the design documentation
- Describe the detailed procedure to install new releases and to check the installed versions.

Off-The-Shelf Software Manual

In the case of any other "off-the shelf" software, the Contractor shall provide the original documentation (English version only) and a dedicated section of the software manual which:

- * Shall describe the function and the usage of the software

- * Shall describe off-the-shelf embedded software
- * Shall document in a complete way the software
- * Shall define the parameters necessary to customize this software
- * Shall document the detailed procedure to implement upgrades
- * Shall identify the software version

3.21 SPARE PARTS LIST (DRD-20)

This Spare Parts List shall contain all the relevant information concerning the required spare parts such as:

- * Number quantity
- * Make
- * Addresses of manufacturers or representations
- * Name
- * Type designation
- * Dimensions
- * Specifications etc.
- * Delivery times
- * Expected lifetime
- * Storage conditions

In the Spare Part List a subdivision shall be made with the following categories:
Consumables

- * Fragile and/or critical parts
- * Components or parts with very long delivery time or which are custom-made
- * Off-the-shelf / custom-made products

3.22 PRODUCT ASSURANCE & SAFETY (DRD-21)

Summary

The PA Plan shall describe the Contractor's general Product Assurance philosophy (QA, CM, RAMS and SWPA) and define in detail all project-specific PA related tasks, procedures, tools, etc., for system down to at least assembly level, as well as the organizational structure which will be implemented to ensure that all PA- requirements are met throughout the complete project cycle.

The PAP shall cover all aspects of DIN-EN-ISO 9001: 2000 and potentially applicable ECSS – Standards or equivalent regulations and shall contain the following main chapters:

1. Scope of the PAP
2. Applicable Documents (product assurance manual, SOW et al.)
3. General PA Approach i.e. how and when is PA involved in the individual project phase. Who is responsible for the quality of the product, relationship between PA and project management
4. Organization, Responsibilities, Resources

- 5. Applicable existing Procedures. Tools, Facilities
- 6. Task Definitions

- * PA Management
- * QA Engineering
- * RAMS Engineering
- * Configuration Control
- * SWPA

3.22.1 Product Assurance Plan (DRD 21A)

Purpose: Describe the Product Assurance organisation of the contractor and the rules to be applied to verify the implementation of the PA requirements

Approval: By SKA Office

Delivery: In the proposal and for release before contract

Content:

The PA plans shall contain as a minimum:

- 1) Description of the internal industrial organisation and PA organisation relevant to the development programme. Organization charts, including staff and line relationships.
- 2) Methods foreseen to ensure compliance to the SOW, during all the phases of the programme taking into account internal activity and subcontracting.
- 3) Means set-up to meet those objectives (personnel/qualifications, equipment, computing, data bases).
- 4) Definition and description of PA activities to be performed at each phase of the project schedule. For each activity include: identification of inputs, supply of inputs, nature and sequence of tasks, expected outputs. Make at least the following chapters:
 - RAMS,
 - Quality Assurance
 - Configuration Management
 - Software PA
- 5) Training programme if necessary.
- 6) Definition and description of means for quality control.
- 7) Definition and description of methods and tools for traceability during all phases of the programme.
- 8) Definition and description of non-conformance management.
- 9) Supplier evaluation programme.

- 10) Description of interfaces with other plans, especially with overall management plan, configuration management plan, coordination plan for technical activities.
- 11) Detailed list of contractual PA documentation to be included in the offer.
- 12) List of used materials, mechanical parts, electronic components and processes.

3.22.2 Product Assurance Progress Report (DRD 21B)

Purpose: To describe periodically progress of activities and status of items of concern relative to product assurance

Approval: By Contractor's Project Manager and PA/QA Manager

Delivery: Quarterly

Content:

The supplier shall report on the status and progress of the product assurance program implementation.

The PA report shall include at least the following items for the reporting period:

- Progress and accomplishment of each major product assurance task including resolved and new problems, future planning of major activities and events
- Status of PA reviews, Audits and MIPs, Waiver requests, Non conformances (minor and major), Critical items (including mitigation action plan status), Qualification status, EEE component status, Material and processes status, Alerts status.

The PA progress report may be part of the project progress report.

3.22.3 Safety and reliability analysis (DRD 21C)

Purpose Identify and evaluate the risks related to safety and reliability aspects in support to the design, integration, test and operations phases.

Approval: By Contractor's Project Manager

Delivery: At design review and following a Critical Item List (CIL) six monthly review

Content:

This document is constituted of five chapters:

- 1 - Functional Failure Analysis
- 2 - FMECA
- 3 - Fault Tree Analysis Report

- 4 - Design Hazard Analysis Report.
- 5 - Operating Hazard Analysis Report

Summary of content / preparation information:

1 -Functional Failure Analysis

- Function of the item shall be listed, and. for each function shall be described all scenarios which can lead to Major, Serious or Catastrophic impact.

This document shall give the following:

- The list of considered functions, their associated criticality and the failure condition created by the failure of the function.

- For each function, the list of functional failures considered.

- For each functional failure, the description of all scenarios which can lead to Major, Hazardous or Catastrophic impacts.

- For each scenario:

- . Scenario description
- . Operational phase affected
- . Repercussion classification
- . Number of independent event in scenario
- . Concerned failure condition reference
- . Associated parameters: procedure, test, studies...

- For each failure condition associated to functional failure analysis:

- . A detailed description of the impacts
- . A dependence diagram
- . The associated expected occurrence probability
- . The associated Critical Items
- . The associated maintenance tasks and periodicities
- . The associated parameters: tests, studies, procedures, design recommendations,

2 - FMECA

The document shall have the minimum following content:

- 1) Introduction: scope, purpose qualitative and quantitative objectives.
- 2) Related documents: applicable documents, reference documents, relations with other PA documents.
- 3) Identification of elements, subsystems, equipment, software, interfaces, procedures, functions under considerations.
- 4) Identification of phase, sub-phases, scenarios, undesired events, operational mode under consideration.
- 5) Identify applicable block diagrams. The block diagrams used for FMECA shall be consistent with those used for reliability assessment reports.

- 6) Elaborate the FMECA structured using block diagrams. Effects shall be tracked at the topmost level. Effects that can propagate across the interface of combined elements shall be identified. FMECA at the upper level shall be based on lower level FMECAs when available.
- 7) Identify:
 - . safety critical and mission critical single point failure
 - . fault identification, isolation and recovery capability need
 - . failure tolerance requirement non compliance
 - . reconfiguration capabilities need
 - . critical items
 - . safety related functions, constituents or procedures
- 8) Propose corrective actions on design, maintenance, detection or reconfiguration capabilities

FMECA will be conducted in accordance with:

- . MIL STD 1629 A
- . or other normalization document approved by the SKA Office (e.g. ECSS or others)

For each item of the FMECA there will be an associated failure occurrence rate.

3. Fault Tree Analysis Report

Identify combinations of failure modes and impacts to allow the comparison of design alternatives

The document shall have the minimum following content:

- 1) Introduction: scope, purpose, qualitative and quantitative objectives
- 2) Related documents: applicable documents, reference documents
- 3) Identify elements. subsystems, equipment, software, man machine interfaces, procedures, functions concerned; precise considered configuration status.
- 4) Identify phase, sub-phase, scenario, undesired event concerned.
- 5) Show and describe fault trees.
- 6) Analyse fault trees qualitatively and quantitatively
- 7) Summarise and comment output of each fault tree:
 - . identify objectives not met
 - . identify Critical Items
 - . propose corrective actions
 - . identify safety related functions, elements and procedures

4. Design Hazard Analysis Report

Identify hazards related to design and undertake a hazard reduction process.

The document shall have the minimum following content:

- 1) Introduction: scope, purpose, objectives
- 2) Related documents: applicable documents, reference documents, relations with others PA documents
- 3) Identify elements, subsystems, equipment, functions, interfaces under consideration.
- 4) Determine hazardous conditions by checking functions. subsystems, equipment interfaces against applicable hazards.

- 5) Determine how the initiators events may lead, through sequence of effects. To undesired events and safety critical consequences.
- 6) Assess severity of most significant consequence.
- 7) Propose actions for hazard elimination, reduction or control
- 8) Identify critical items. Identify safety related functions, constituents and procedures

5. Operating Hazard Analysis Report

Identify hazards related to operations and undertake hazard reduction process.

The document shall have the minimum following content:

- 1) Introduction: scope, purpose, objectives
- 2) Related documents: applicable documents, reference documents, relations with others PA documents
- 3) Identify phases, subphases and operations of mission and configurations.
- 4) Determine applicable hazards and hazardous conditions by checking hazardous conditions against phases, subphases and operations and taking into account the configuration of the system.
- 5) Determine how the initiators events may lead, through sequence of effects, to undesired events and safety hazardous consequences.
- 6) Assess severity of superior consequence.
- 7) Propose actions for hazard elimination, reduction or control
- 8) Identify critical items. Identify safety related functions, constituents and procedures

3.22.4 Reliability and Safety test procedures (DRD 21D)

Purpose: To describe content of tests associated to reliability and safety analysis and the need of validate the analysis.

Approval: By Contractor's Project Manager

Delivery: At design review

Content:

All reliability and safety test procedures shall contain as a minimum the following chapters

- 1) Introduction: name of test, scope, purpose of test, success criteria
- 2) Necessary tools, installation, personnel
- 3) Preparation of tools, facilities and training of personnel
- 4) Preparation of Test Review and execution
- 5) Items to be tested (identification, configuration, interface)
- 6) Description of test step by step
- 7) Test Review Board organization
- 8) Processing and reporting of output of test. List of addresses
- 9) Schedule

3.22.5 Other (DRD 21E)

Subjects which are not covered in detail by DRDs shall follow the SKA product assurance procedures.

3.23 VERIFICATION PLAN (DRD-22)

It shall list all the verification activities to prove the conformity product with the technical specifications at all levels of the project.

It shall list all the verifications to be performed and give the reference to the requirements of the technical specification and the corresponding test or inspection procedure (if applicable)

Verification methods could be:

- * Test
- * Analyses
- * Similarity (something was verified in another project with similar conditions)
- * Qualification procedure
- * Design review
- * Audit
- * Inspection
- * Certificate

List the closing documents where the results will be documented.

Indicate the milestones where these verifications have to be performed (e.g. prior PDR, CDR, etc.)

3.23.1 Assembly, integration and test plan (AITP) – DRD 22a

Purpose and objective

The assembly integration and test plan is the master plan for the product AIT process. It describes the complete AIT process and demonstrates together with the verification plan how the requirements are verified by inspection and test.

It contains the overall AIT activities and the related verification tools (GSE and facilities), the involved documentation, the AIT management and organization. It also contains the AIT schedule.

It is one of the major inputs to the project schedule and is used to provide the customer a basis for review and evaluation of the effectiveness of the AIT programme and its proposed elements.

An AITP is prepared for the different verification levels covering in detail the AIT activities at that level and outlining the necessary lower level aspects.

The AITP is complementary to the verification plan. It takes into account the test standards defined in the Customer requirements.

The availability of the verification plan is a prerequisite to the preparation of the AITP.

Scope and content

Introduction

- a. The AITP shall contain a description of the purpose, objective, content and the reason prompting its preparation.
- b. Any open issue, assumption and constraint relevant to this document shall be stated and described.

Applicable and reference documents

The AITP shall list the applicable and reference documents in support to the generation of the document.

Definitions and abbreviations

The AITP shall list the applicable dictionary or glossary and the meaning of specific terms or abbreviations utilized in the document.

Product presentation

The AITP shall briefly describe the selected prototypes and their built status with reference to the verification plan.

Assembly, integration and test programme

- a. The AITP shall document the AIT activities and associated planning.
- b. The AITP shall include test matrix(ces) that link the various tests with the test specifications, test procedures, test blocks and hardware model.
- c. Assembly, integration and test programmes including inspections, should be detailed through dedicated activity sheets.
- d. Activity sheets shall include descriptions of the activity including the tools and GSE to be used, the expected duration of the activity, and the relevant safety or operational constraints.
- e. The sequencing of activities should be presented as flow charts.

Support Equipment (SE) and AIT facilities

- a. The AITP shall list and describe the SE, test software and AIT facilities to be used.
- b. The AITP shall describe the logistics and list the major transportations.

AIT documentation

The AITP shall describe the AIT documents to be produced and their content.

Organization and management

- a. The AITP shall describe the responsibility and management tools applicable to the described AIT process.
- b. The AITP shall describe the responsibilities within the project team, the relation to product assurance, quality control and configuration control (tasks with respect to AIT) as well as the responsibility sharing with external partners.
NOTE Tasks with respect to AIT include for example, anomaly handling, change control, safety, and cleanliness.
- c. The planned reviews and the identified responsibilities shall be stated.

AIT schedule

The AITP shall provide the AIT schedule as reference.

3.23.2 Test specification (TSPE) – DRD22b

Purpose and objective

The test specification (TSPE) describes in detail the test requirements applicable to any major test activity. In particular, it defines the purpose of the test, the test approach, the item under test and the set-up, the required SE, test tools, test instrumentation and measurement accuracy, test conditions, test sequence, test facility, pass/fail criteria, required documentation, participants and test schedule.

Since major test activities often cover multiple activity sheets, the structure of the TSPE is adapted accordingly.

The TSPE is used as an input to the test procedures, as a requirements document for booking the environmental test facility and to provide evidence to the customer on certain details of the test activity in advance of the activity itself.

The TSPE is used at each level of the system decomposition (i.e. Element, sub-element, equipment)

The TSPE provides the requirements for the activities identified in the AITP (DRD-22a).

The TSPE is used as a basis for writing the relevant test procedures (DRD-23) and test report (DRD-24).

In writing the test specification potential overlaps with the test procedure is minimized (i.e. the test specification gives emphasis on requirements, the test procedure on operative step by step instructions). For simple tests, merging TSPE and TPRO is acceptable.

Scope and content

Introduction

- a. The TSPE shall contain a description of the purpose, objective, content and the reason prompting its preparation.
- b. Any open issue, assumption and constraint relevant to this document shall be stated and described.

Applicable and reference documents

The TSPE shall list the applicable and reference documents in support to the generation of the document.

Definitions and abbreviations

The TSPE shall list the applicable dictionary or glossary and the meaning of specific terms or abbreviations utilized in the document.

Requirements to be verified

The TSPE shall list the requirements to be verified (extracted from the VCD) in the specific test and provides traceability where in the test the requirement is covered.

Test approach and test requirements

The TSPE shall summarize the approach to the test activity and the associated requirements as well as the prerequisites to start the test.

Test description

The TSPE shall summarize the configuration of the item under test, the test set-up, the necessary GSE, the test tools, the test conditions and the applicable constraints.

Test facility

The TSPE shall describe the applicable test facility requirements together with the instrumentation and measurement accuracy, data acquisition and test space segment equipment to be used.

Test sequence

- a. The TSPE shall describe the test activity flow and the associated requirements.
- b. When constraints are identified on activities sequence, the TSPE shall specify them including necessary timely information between test steps.

Pass/fail criteria

- a. The TSPE shall list the test pass/fail criteria, including their tolerance, in relation to the inputs and output.
- b. In the TSPE, the error budgets and the confidence levels with which the tolerance is to be met shall be specified.

Test documentation

The TSPE shall list the requirements for the involved documentation, including test procedure, test report and PA and QA records.

Test organization

- a. The TSPE shall describe the overall test responsibilities, participants to be involved and the schedule outline.

NOTE Participation list is often limited to organisation and not individual name.

3.24 TEST PROCEDURE (DRD-23)

The Test Procedure describes in detail all the necessary operations to perform verification by test.

A Procedure shall be produced for every verification-by-test required in the verification matrix.

The Test Procedure shall contain the following information:

1, Scope of the test

In this section the scope of the test shall be described and the verification item shall be identified.

2. Applicable documents

In this section all the documents referred to in the Test Procedure shall be listed.

3. Test conditions

In this section all applicable requirements needed to perform correctly the test shall be listed (e.g. special environmental conditions. dedicated tools, test rigs. special requirements on the tested items, etc.), calibration requirement.

4. Test procedure

In this section all the operations required to perform the test shall be described in deep detail.

5, Test results presentation

In this section the procedures to process the raw data for the final presentation of the test results shall be described.

The Test Procedure shall be submitted to the SKA PO at least 4 weeks prior to the test.

3.25 TEST REPORT (DRD-24)

The Test Report shall summarise the findings of the tests. The Test Report shall contain the following information:

1. Scope of the test

In this section the scope of the test and the verification item shall be identified.

2. Applicable documents

In this section all the documents referred to in the Test Report shall be listed.

3. Test Procedure

In this section reference shall be made to the applicable Test Procedure.

4. Test results

In this section the findings of the test shall be given. The results shall be processed in such a way that they are directly comparable with the verification items verified. A comparative table shall summarise the actual findings compared with the verification item.

5. Conclusions

In this section a statement concerning the conformance of the test results with the requirements specified shall be given. Non-conformities and changes shall be discussed as far as applicable.

The test report shall be submitted to the SKA PO not later than 2 weeks after the test.

3.26 ACCEPTANCE DATA PACKAGE (DRD-25)

The Acceptance Data Package is the collection of documentation and drawings which shall be the base for the acceptance of the as-built product at all levels of the project.

It shall include

- * The list of data package documents
- * The drawing set identifying the as-built product configuration
- * All certificates of conformance documenting the proper application of the critical manufacturing, assembly, test, inspection incl. plans and procedures
- * The inspection/test reports:
 - * Safety assessment;
 - * Analysis/design reports
 - * Operation, maintenance manuals
 - * Minutes of meeting acceptance review
- * Configuration Item Data List/As Built Configuration List
- * Design Documents
- * Interface Control Documents
- * RFW status list, Request for waiver copies
- * NCR status list, Non-conformance reports: copies from major NCRs
- * ECP status list (could be part of as built configuration list)
- * Top assembly drawing
- * Drawing family tree
- * Declared Mechanical Parts list
- * EEE Parts list
- * Declared Processes list
- * Declared Materials list
- * Test and Calibration reports including manufacturing inspections,
- * Final Inspection report
- * Cleanliness record
- * Historical records / Logbook (with lists of limited life items, open work, temporary installation records)
 - * Handling/ transport procedure including packing/unpacking/ identification/ storage
- * Qualification status list
- * List of lower level Acceptance Data Packages
- * List of deliverable items
- * Safety assessment - justification of residual hazards
- * RAMS – analyses (FMEA, fault tree, maintainability etc)
- * Verification Matrix
- * Open work
- * Remarks

This data package shall be updated at every Acceptance Review for the respective product.

3.27 DEVELOPMENT PLAN (DRD 26)

The Development Plan shall explain in detail the development programme to go from a pre-existing state or Technology Readiness Level (TRL) of an item, for example system or sub-system, to the target state.

The Development Plan shall, in particular:

- Identify the scope of the development plan, and the items to be developed under the plan
- Establish the starting state or TRL of the item to be developed and the target state or TRL
- Define the rationale and strategy for the programme
- Establish any special constraints or conditions imposed on the development (personnel, budgetary, facilities, etc.)
- Identify any critical system requirements and technologies
- Provide a schedule for the development programme with clear indication of intermediate goals, critical milestones, go/no-go decisions, etc.
- Provide an analysis of the risks (technical, financial, schedule, etc) of the development programme and proposed risk mitigation strategies (trade-offs, parallel activities, etc)
- Provide a plan for the management of the programme key personnel, work breakdown, progress reporting, etc.
- In the case of SKA-managed developments, the required budget together with commitment and spending profiles
- Verification methods to be used to quantify progress and to establish the results attained.

3.28 INTERFACE CONTROL DOCUMENT (DRD-27)

The contents of the Element level ICD are given in [AD5]. This is offered as a model for ICDs below Element level.