

Atacama Large Millimeter Array

# ALMA CRYOSTAT DESIGN DEVELOPMENT AND PRE-PRODUCTION

## **STATEMENT OF WORK**

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## FEND-40.03.00.00-003-B-SOW

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## ALMA CRYOSTAT DESIGN DEVELOPMENT AND PRE-PRODUCTION Statement of Work

## **Change Record**

Version	Date	Affected Paragraphs(s)	Reason/Initiation/Remarks	
A	05-Feb-03	All	First Issue for Phase-2 Contracts	
A	21-Feb-03	3.1.2.2, 3.1.2.3	Preliminary Acceptance in-house added	
		3.1.2.4	Commissioning activities added	
		3.1.2.5	Guarantee period clarified	
		3.2.1.3	Project Procurement rules added	
		3.2.1.4	Project Reporting improved	
В	12-Jun-03	All	Revision including comments from JAO and Contractor	
B	29-Jul-03	Section 1-2	Minor comments	
		Section 2.1	AD table updated	
		Section 2.2	RD table updated	
		Section 2.3	Table of acronyms added	
		Section 3.1.5	Milestones updated	
		Section 3.1.6	ESO/ALMA deliverables added	
		Section 3.1.2.4	Guarantee changed to 1 year	
В	06-Aug-03	Section 3.1.2.4	Specific conditions of the Guarantee Clause have been moved to the Contract	
В	19-Sep-03	Section 2.1	Updated Issue Date and Document ID of [AD01]	
		Section 3.1.2.4	The whole Guarantee Clause is moved to the Contract.	



## Statement of Work

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#### 0 INTRODUCTION

The Atacama Large Millimeter Array (ALMA) is an international collaboration between Europe and the North America to build a synthesis radio telescope that will operate at millimeter and sub-millimeter wavelengths (0.3 to 10 millimeters). It will image the Universe with an unprecedented sensitivity and angular resolution, made possible owing to the design concept that combines the imaging clarity of detail provided by a 64-antenna interferometric array together with the brightness sensitivity of a fully filled aperture.

ALMA will be sited in the Altiplano of northern Chile at an elevation of 5000 meters above sea level. The ALMA site is the highest, permanent, astronomical observing site in the world. On this remote site super-conducting receivers that are cryogenically cooled to less than 4 degrees above absolute zero will operate on each the 64 12-meter diameter ALMA antennas. The signals from these receivers will be digitized and transmitted to a central processing facility where they are combined and processed at a sustained rate greater than  $10^{16}$  operations per second. As an engineering project, ALMA is a collection of 64 precisely tuned mechanical structures each weighing more than 80 tons, super-conducting electronics cryogenically cooled, and optical transmission of terabit data rates - all operating together, continuously, on a site very high in the Andes mountains.

The Phase-1 of the project extended in Europe from 1999 through 2002 with the objective to completely define a joint program to construct and operate ALMA. The Construction Phase, or Phase-2, is planned to begin in 2003 in Europe and to extend until the end of 2011, with the Start of Full Science Operations planned in early 2012.

#### 1 SCOPE

As part of the Phase-2 of ALMA, the present Statement of Work (SOW) is applicable to the:

- **Development of Cryostat Design**, consisting in the detailed design of the ALMA Front-end Cryostats. This activity includes laboratory testing, design modifications, and support of design and manufacturing reviews.
- Fabrication and Testing of Pre-Production Cryostats, consisting of the fabrication, assembly, testing, delivery of eight (8) ALMA Cryostat pre-production units including support during commissioning and acceptance at the NA/EU Front End Integration Centers of the first two (2) units. The pre-production phase is concluded by a Pre-Production Review for which additional support is given.

All requirements of the present SOW shall be applicable to the Contractor as well as to Lower-Tier Sub-Contractors. Hardware & Software items from other suppliers shall be produced according to the relevant technical and quality/safety related requirements.



## **2 DOCUMENTATION**

#### 2.1 Applicable Documents List (ADL)

The following documents of the exact issue shown form a part of this SOW to the extent specified herein. In the event of conflict between the documents referenced herein and the present document, the terms of the Statement of Work shall be considered as superseding requirements.

No	Document Title	Date	Reference
AD 01	Cryostat Technical Specifications	2003-09-20	FEND-40.03.00.00-002-B-SPE
AD 02	ALMA Design Reviews Definitions, Guidelines & Procedure	2002-02-07	ALMA-80.09.00.00-001-A-PLA
AD 03	General Safety Specification for the ALMA Project	2003-06-30 draft	ALMA-10.08.00.00-003-A-SPE
AD 04	ALMA Safety – Risk Assessment Procedures	2003-06-30 DRAFT	ALMA-10.08.00.00-004-A-GEN
AD 05	Product Assurance Requirements	2003-05-21 DRAFT	ALMA-80.11.00.00.001-A-SPE
AD 06	ICD Management Plan	2003-03-12	ALMA-80.07.00.00-001-A-PLA

#### 2.2 Reference Documents List (RDL)

No	Document Title	Date	Reference
RD 01	ALMA Project Book	2002-02-20	Version 5.5 of 2002-Feb-20
RD 02	ALMA Project Plan, Version 1	2003-02-10	Issue of February 10, 2003
RD 03	ALMA Documentation Management Plan	2002-11-25	ALMA-80.02.00.00-001-F-PLA
RD 04	ALMA Document Identification Plan	2002-10-31	ALMA-80.02.00.00-002-E-PLA
RD 05	ALMA Document Approval Procedures	2002-10-31	ALMA-80.02.00.00-005-E-PRO
RD 06	ALMA Change Request Procedures	2002-11-01	ALMA-80.06.00.00-001-F-PRO
RD 07	ALMA Product Tree	2002-11-01	ALMA-80.03.00.00-001-L-LIS
RD 08	ALMA Documentation Standards	2002-10-31	ALMA-80.02.00.00-003-E-STD
RD 09	ALMA Official Acronyms and Abbreviations	2003-04-23 NOT RELEASED	ALMA-80.02.00.00-004-B-LIS
RD 10	ALMA HW Development & Production Process Description	2002-05-23 NOT RELEASED	SYSE-80.11.01.00-001-A-PLA

Note: These documents are provided for reference purposes only and should be referred to where necessary.



#### **Abbreviations and Acronyms** 2.3

A limited set of acronyms is given below.

ALMA AOS ESO IPT JAO NRAO OSF RAL	Atacama Large Millimeter Array Array Operation Center European Southern Observatory ( <u>http://www.eso.org</u> ) Integrated Project Team Joint ALMA Office National Radio Astronomy Observatory ( <u>http://www.nrao.edu</u> ) Operations Support Facility Rutherford Appleton Laboratory
AD	Applicable Document
ADR	Acceptance Discrepancy Reports
CDR	Critical Design Review
CR	Change Request
CIDL	Configured Items Data List
DDP	Detailed Design Phase
DRD	Document Requirement Description
FAS	Final Acceptance on-Site (at the Specified Delivery Location)
FDR	Final Design Review
FDP	Final Design Phase
ICD	Interface Control Document
KO	Kick-Off
PA	Product Assurance
PAI	Preliminary Acceptance In-house (or at the Specified Delivery Location)
PAS	Provisional Acceptance on-Site (at the Specified Delivery Location)
PDR	Preliminary Design Review
PPP	Pre-Production Phase
PPR	Pre-Production Review
RD	Reference Document



## **3 REQUIREMENTS**

## 3.1 **Project Definition**

## 3.1.1 Item Definition

The "ALMA Project Plan" [**RD 02**] provides a description of the ALMA Project Organization and Management Plan for Construction, including an overview of the project Level-1 WBS. The detailed definition of Level-2 and 3 WBS is provided in Annex D of [**RD 02**].

The present Statement of Work is applicable to the following Level-3 Work Element(s):

WBS#	Work Element Name
4.080.0660	Cryostat Design and Development
4.085.0680	Cryostat Construction (limited to 8 pre-production units and including 6 dummy cartridges per unit)
4.085.0690	Cartridge Body Construction (limited to 8 pre-production sets for Bands 3, 6, 7 and 9)
4.085.0700	Cryo-Coolers (for the 8 pre-production cryostats). Total of 7 (seven) units.

#### Table 1 - ALMA Work Elements

The items covered by the present Statement of Work include also:

- All necessary test, maintenance and handling equipment
- All necessary transportation containers and boxes
- The supporting documentation

## 3.1.2 **Project Phase Definition**

A complete glossary for the ALMA Project can be found in reference [**RD09**]. The definition of the following basic terms used in the present document is however useful:

Milestones: A point in the project schedule (Gantt chart) defining an important event. There are 4 levels of milestones defined for the overall ALMA Project. Level-1 and 2 are the top levels milestones defined at the highest ALMA organization level.

Level-1 milestones are not given as such in the present SOW.

Level-2 milestones, directly applicable to the work elements mentioned in Section 3.1.1 are presented in this SOW under Section 3.1.3 and are contractually binding.

Level-3 Milestones, derived from higher level milestones, are applicable to the scope of work defined in the present SOW. They are provided in Section 3.1.3 of the present SOW and, unless stated otherwise, are contractually binding.



The Contractor may define intermediate milestones (Level-4) to monitor the progress of its work. They are not contractually binding.

- *Phase:* The span of time between two major consecutive milestones of the development process,
- *Design Review:* Documented, comprehensive and systematic examinations of a design to evaluate its capability to fulfill the requirements for quality, identify problems, if any, and propose the development of solutions,
- *Tollgate:* Milestone that can be passed only after a successful review and approval by ESO and, if applicable, other interested parties.

The ALMA complete Product Development Model is given for information in the [RD 10].

The *Phases* that are <u>applicable</u> in the scope of the present contract are the following:

#### 3.1.2.1 Detailed Design Phase (DDP)

The generic tasks and objectives of the Detailed Design Phase are described in [AD02].

This phase starts with the detailed design of the pre-production units and, particularly, with the identification of the Long Lead Items (LLI) for which early procurements are required in order to meet the delivery schedule. To achieve this objective, the Contractor shall primarily focus on completing the detailed design of the cryostats. Specifications and interfaces shall be verified and frozen. The Contractor shall present the detailed design and the tendering documentation related to pre-production LLI at the **Manufacturing Readiness Review** (**MRR**), organized under ESO's supervision. Upon approval by ESO, the Contractor shall undertake the procurement of the LLI.

In the course of the detailed Design Phase, the first pre-production unit shall be assembled, integrated and tested, and its performance demonstrated. The results of the tests shall be presented at the Critical Design Review as part of the Design Report.

This phase is concluded by the **Critical Design Review** (CDR). The list of documents to be delivered for this review is presented in Section 3.1.4. A description of the objectives, procedure and documentation applicable for this review can also be found in [**AD 02**].

The final issue of the Production Plan, to be delivered as part of the CDR data package, shall include the tendering documentation. Call for Tenders shall be as much as possible directed to industrial companies, for the procurement of module(s), unit(s) or item(s).

#### 3.1.2.2 **Pre-production Phase (PPP)**

This phase starts after the CDR has been declared successful by ESO. It consists of the implementation of the final Production Plan approved at the CDR for the procurement of nonlong delivery time items, fabrication, assembly, integration, testing, acceptance and delivery of the specified pre-production modules, units or items.

Before delivery, the Contractor shall organize the **Preliminary Acceptance In-house (PAI)** review(s) of all deliverable pre-production unit(s) under its responsibility. The **Preliminary** 



Acceptance In-house (PAI) review of the last deliverable pre-production unit shall be extended with an assessment of the whole pre-production phase. This last PAI is referred to as the **Pre-Production Review (PPR)** and aims at optimizing and approving the final series production phase.

Unless otherwise specified, acceptance reviews shall be conducted at Contractor's premises in accordance with the acceptance procedures approved at the CDR. Once acceptance is granted by ESO, the Contractor shall pack and transport the unit(s) to the specified delivery location. The associated packing, shipping and insurances costs shall be borne by ESO.

#### 3.1.2.3 Commissioning and Acceptance at the Specified Delivery Location

The Contractor shall support set-up, commissioning and acceptance of the first two preproduction units at the specified delivery location, respectively the Front End Integration Centers (FEIC) in North America and in Europe. The associated labor costs are borne by the Contractor as part of the present contract. The operation costs (e.g. travel costs, board and lodging) shall be agreed between ESO and the Contractor after submission of the commissioning plan and acceptance procedures provided by the Contractor as part of the Product Engineering documentation. After review and approval, ESO will support, at its discretion, the operation costs on the basis of the agreed commissioning plan and as an additional cost element to the present contract.

After successful acceptance of the pre-production unit(s), conditional to the closure of the Acceptance Discrepancy Reports (ADR) identified during the acceptance review, ESO will grant the **Provisional Acceptance on Site (PAS)** of the deliverable pre-production units.

#### 3.1.2.4 Guarantee Period

The guarantee period and conditions are defined in the Contract.



## 3.1.3 **Project Milestones**

Milestones	Date	L	leve	<sup>1</sup>
		2	3	Τ
Detailed Design Phase				
Technical Kick-off (KO)	01-Jan-03		x	
Freeze Dewar Design	06-Aug-03	x		
Placement of Orders for the Cryo-cooler and Vacuum Vessel of Unit #1	01-Sep-03		x	
Cartridge Body Design Frozen	01-Sep-03	x		
Manufacturing Readiness Review (MRR)	14-Nov-03		x	
Manufacturing Selection Review	01-Dec-03		x	
Cartridge Bodies for Receiver #1 Delivered	01-Jan-04	x		
Cryostat unit #1 Preliminary Acceptance In-house (PAI)	14-Feb-04		x	
Cryostat unit #1 Delivery at FEIC <sup>2</sup>	29-Feb-04	x		
Cryostat unit #1 Provisional Acceptance on-Site (PAS)	14-Mar-04		x	
Internal Critical Design Review (CDR)	30-Mar-04		x	
Pre-production Phase				
Cartridge Bodies for Receiver #8 Delivered	01-Jul-04	x		
Cryostat unit #2 Preliminary Acceptance In-house (PAI)	01-Jul-04		x	
Cryostat unit #2 Provisional Acceptance on-Site (PAS)	01-Aug-04		x	
Cryostat unit #3 Preliminary Acceptance In-house (PAI)	01-Sep-04		x	
Cryostat unit #4 Preliminary Acceptance In-house (PAI)	02-Nov-04		X	
Cryostat unit #5 Preliminary Acceptance In-house (PAI)	03-Jan-05		x	
Cryostat unit #6 Preliminary Acceptance In-house (PAI)	01-Mar-05		x	
Cryostat unit #7 Preliminary Acceptance In-house (PAI)	02-May-05		x	
Cryostat unit #8 Preliminary Acceptance In-house (PAI)	24-Jun-05		x	
Receiver Dewar #8 Delivered to Integration Centre	01-Jul-05	x		
Cryostat unit #3-8 Provisional Acceptance on-Site (PAS)	01-Aug-05			
Cryostat Pre-Production Review (PPR)	05-Sep-05		x	

*Table 2 – Milestones* 

With the exception of the February delivery date for Cryostat Unit 1, the Level 2 and 3 milestones presented in Table 2 are contractually binding. Any change of such milestone dates shall be handled as described in Sections 3.2.1 and 3.2.2.

<sup>&</sup>lt;sup>1</sup> "T" refers to Tollgate

<sup>&</sup>lt;sup>2</sup> PPARC/RAL will make every effort to meet the critical February delivery date goal for Cryostat Unit 1 and will inform ESO immediately of slippage to the proposed schedule. Should the goal date be missed, RAL will deliver Cryostat Unit 1 no later that the 30<sup>th</sup> March, 2004.



## **3.1.4** Deliverable Documents List (DDL)

During the project phases, the documentation shown in the Table 3 shall be delivered at the specified reviews for each Work Element. This table describes the document name and issue number which eventually evolves with the project phases.

	Document Title		KO Issue	MRR Issue	CDR Issue	PA Issue	PPR Issue
DRD 01	Project Management Plan <sup>3</sup>	В	1	2	3		
DRD 02	Product Assurance Plan <sup>2</sup>	В			1		
DRD 03	Safety Report <sup>2</sup>	В		1	2		
DRD 04	Design Report	В		1	2		
DRD 05	Compliance Matrix	В		1	2		
DRD 06	Development/Production Plans	В		1	2		3
DRD 07	Product Engineering Documentation <sup>4</sup>	C		1	2	3	4
DRD 08	Configured Items Data List (CIDL)	В		1	2	3	4
	Acceptance Reports	C				1	
	Safety Compliance Assessment	C				1	

Table 3 - Deliverable Document List (DDL)
Image: Comparison of the second s

The overall approach to manage the ALMA documentation is given for reference in [**RD 03**]. All documents have been separated into one of three classes:

- A. Project Office documents
- **B.** IPT Documents
- **C.** Operations Documents

Regardless of the class, all the documents to be delivered in the scope of ESO contracts are under the managerial responsibility of ESO and shall be reviewed and/or approved by ESO. ESO will, in due time, transfer the managerial responsibility of Project Level and Operations documents to the JAO and Systems Group, and of IPT level documents to the IPT leaders.

<sup>&</sup>lt;sup>3</sup> If more than one Work Element are under the responsibility of one Contractor,

a single comprehensive document can be delivered for these Work Elements

<sup>&</sup>lt;sup>4</sup> As-Designed at design reviews, As-Built at delivery of the product(s)



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## 3.1.5 **Project Deliverables**

The list of project deliverables, fully integrated and tested as specified in the Technical Specifications [AD 01], is given in Table 4 below:

WBS#	Description	Qty	<b>Delivery Location</b>	Comment
4.080.660 4.085.680	ALMA Pre-production Cryostats	444	NA FEIC EU FEIC	Unit #1 - 8: 4 units delivered to the EU FEIC and 4 units delivered to NA FEIC. Cryostats including dummy cartridges for bands 1, 2, 4, 5, 8, 10.
4.085.690	Pre-production cartridges	8 sets	Cartridge Design Groups	Each set consisting of 4 cartridges for bands 3, 6, 7 and 9.
	Documentation		ESO	As required in the Deliverable Documents List (DDL)
	Spare Parts List		ESO	The establishment of the Spare Parts list is under Contractor's responsibility and shall be approved by ESO.
	Tools and Support Equipment		ESO	These are tools for integration, alignment and maintenance. Only those especially developed for the project are deliverable.
	Test Set-Up and Test Equipment		ESO	The number of equipment is restricted to those especially purchased or developed in the scope of the project.
	Software & Firmware		ESO	Only those especially purchased or developed in the scope of the project are deliverable, including maintainable source code.
	Handling & transportation Equipment		ESO	
	ALMA/ESO Equipment		ESO	All ALMA/ESO property or loaned equipment provided to the Contractor during the course of the project.
	Containers		ESO	Container(s) foreseen for the transportation of all deliverables to specified delivery location under safe conditions.

Table 4 - Project Deliverables



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## 3.1.6 ESO/ALMA Deliverables

The list of ESO/ALMA deliverables is given in Table 5 below:

Date	Description	Qty	Supplier	Delivery Location	Com	ment
1-Jan-04	Signal Input Windows	1 set	ESO	PPARC/RAL	Set consisting of RF windows for ALMA bands 3, 4, 6, 7 and 9	
1-Jan-04	Infrared filters	1 set	ESO	PPARC/RAL	Set consisting of both '15 K' stage as well as '110 K' stage IR filters for all 10 ALMA bands	ESO will supply PPARC/RAL with tested signal input windows and infrared blocking filters consistent with the cryogenic system
1-May-04	Signal Input Windows	7 sets	ESO	PPARC/RAL	Each set consisting of RF windows for ALMA bands 3, 4, 6, 7 and 9	requirements, specifications and safety standards.
1-May-04	Infrared filters	7 sets	ESO	PPARC/RAL	Each set consisting of both '15 K' stage as well as '110 K' stage IR filters for all 10 ALMA bands	

Table 5 – ESO/ALMA Deliverables



3.2

# Tasks Applicable to all Project Phases

This Chapter defines the basic tasks that are common to all project phases.

#### 3.2.1 Project Management & Control

#### 3.2.1.1 **Project Management**

The Contractor shall establish and maintain an effective project management structure to achieve the objectives of the Contract. This management structure, conducted by a **Project Office**, shall be separated from the other projects and operations of the involved parties to the extent needed to guarantee the effective and timely completion of the Contract.

The Project Office shall coordinate and control all technical, commercial and contractual activities, the project resources, and manage all disciplines required for the successful completion of the Contract. To be able to do so, the Project Office shall have effective control and support from appropriate senior management of the Contractor's organization.

The Project Office shall establish project rules which ensure, at all levels of the project, the implementation, enforcement, and control of the methods and procedures covering the schedule control, configuration control and product assurance including safety and reliability.

The **Key Personnel** of the project shall consist of people with experience in the specific technologies and/or domains required by the scope of work. Exchange of key personnel during the execution of the Contract shall be agreed with ESO in due time.

The Contractor shall assign a **Project Manager** with authority over the involved personnel and resources. He shall be given full authority to negotiate with ESO and their Sub-Contractors and/or suppliers all issues related to the Contract and shall be the **Single Point of Contact (SPC)** for all formal matters. In case of administrative, financial and contractual matters, the Project Manager shall address to the assigned ESO Technical Representative with copy to the assigned ESO Contract Officer.

In order to facilitate and speed up the technical communications with ALMA staff (e.g. IPT members), the Contractor staff might contact directly ALMA counterparts by e-mail or telephone but shall always keep the Contractor Project Manager and the assigned ESO Technical Representative informed (e-mail copy or telephone minutes).

If events occur which could impact on the project milestones, e.g. technical problems or changes requests initiated by ESO or by itself, the Contractor shall evaluate every possible solution to avoid or limit the impact on the schedule, including utilization of additional manpower and facilities. In any case, the implementation of the solution shall be agreed with ESO.

#### 3.2.1.2 Project Plan, Costs & Schedule

The Contractor shall submit the *Project Management Plan* [DRD 01] at the start of the Contract. This plan shall comply with the Project Milestones defined in the present S.O.W. and in the Contract. Modifications and updates of the Project Management Plan shall be communicated to ESO. In particular, changes of Level 2-3 milestones shall be approved by ESO. In any case, major schedule, costs or technical modifications shall follow the procedures described in sections 3.2.1.3 and 3.2.2.2 "*Change Request Procedure*".

#### 3.2.1.3 **Procurement Policy**

The Contractor will endeavor to obtain competitive quotes, and be able to provide evidence of such, for industrial products available in the market place, through Call for Tenders for the procurement of module(s), unit(s) or item(s). The Contractor shall involve ESO in major project procurements, particularly in the negotiations with third party equipment vendors. For the procurement exceeding  $\notin$ 150,000, the Contractor has to conform to ESO procurement principles, e.g. advance information to ESO on forthcoming procurements, accept bids from all ESO member states plus Spain, ESO representation on selection boards, etc.

#### 3.2.1.4 **Project Reporting**

a) Progress Report (Monthly)

The Contractor shall provide ESO with Progress Reports, **duly approved and signed by the Project Manager**: 1) at the beginning of every month following the project Kick-off, 2) with any invoice submitted to ESO for payment.

The Progress Report shall clearly summarize the current status of the work in progress, expressed as a percentage of completion of the major tasks/milestones represented on the top-level project schedule (Gantt chart). It shall briefly describe the results **achieved** in this period and **planned** for the next period. It shall also give an account on every problem detected at any level (i.e. technical, programmatic, finance) of the project during the reporting period(s) and identify the corrective actions.

The progress report shall also contain the Action Item List (AIL) and the status of all Action Items which shall also be reviewed at each progress meeting. The Progress Reports shall be sent by e-mail to the ESO Technical Representative no later than three working days after the end of the reporting period. In the course of critical phases, ESO reserves the right to ask the Contractor additional reports.

b) Red Flag Report

Independently of and in addition to the regular Progress Reports, the Contractor shall report any event with significant implications on schedule, design or cost. A Red Flag Report shall be issued by the Contractor within 24 hours after occurrence of a major problem jeopardizing delivery, the achievement of the Contract milestones, or the achievement of technical performance and requiring the immediate attention of ESO. This reporting shall apply to problems at all project levels.

#### 3.2.1.5 Progress Meetings (PM)

Progress Meeting shall be held either at Contractor premises, at ALMA European premises, or by tele or video conference (to be agreed case-by-case) on a bi-monthly basis, in any case the week following the receipt of a monthly Progress Report by the assigned ESO Technical Representative. The **Agenda** and the **List of Participants** shall be communicated to ESO at least three days before the meeting. ESO and the Joint ALMA Office (JAO) reserve the right to call extraordinary Progress Meeting, one week in advance.

The purpose of the PM is to review the progress of the work, to highlight and discuss detected and reported problems or concerns, and to determine corrective measures to be taken.

Progress Meeting between the Contractor organizations and their sub-contractors shall be held prior to the meetings between ESO and the Contractor. Meeting may, at the discretion of the ESO or the JAO, involve other participants upon agreement by the Contractor.

Unless specifically requested otherwise by ESO, the Contractor shall write the **Minutes of Meeting (MOM).** The Minutes shall be signed by all the parties at the end of the Meeting. The signature of such minutes indicates solely that the wording is correct and properly reflects the outcomes. The signature shall however not be construed as a formal, contractual agreement. Any matter having contractual implications shall be handled in accordance with the regulations of the contract. The Minutes shall include a List of Action Items (AI) with appropriate deadlines and responsible, and shall be under configuration control.

#### 3.2.1.6 **Project Reviews (PR)**

The Contractor shall prepare the **Review Data Package**, composed of the documents specified in Section 3.1.4 and described in [AD 02]. ESO shall organize the review in consultation with the Contractor, particularly with regard to the appointment of the **Review Board** members, the Chairman of the Review Board, the agenda, participants and contents of the review. The review Data Package shall be made available to the Board members **4 weeks in advance** of the Review. The complete procedure guiding the organization of the reviews can be found in [AD 02].

As a general rule, a review is declared "successfully passed" by the Chairman of the Board when all action items identified by the Board as per the minutes of the review meeting, have been successfully completed.



#### 3.2.2 Configuration Control & Data Management

#### 3.2.2.1 Configuration Control

The plan for the management of the ALMA documentation is provided for information in **[RD 03]**. The Contractor is invited to adhere to this plan. As part of it, the Contractor shall maintain the Configured Items Data List. The CIDL identifies all the official and valid documentation ("configured items") of the Project. It is a key element of the Configuration Control process and shall include the valid issue of specifications, the list of design reports (e.g. included in Review Data Packages), the list of valid drawings (as-designed, as-manufactured or as-built, the list of valid circuit diagrams, interface drawings and documents (e.g. ICD), test procedures and test reports, the list of parts (e.g. corresponding to the product tree), the list of valid manuals (e.g. user's, operations, maintenance).

#### 3.2.2.2 Change Request Procedure

Both parties, the ESO and the Contractor, may at any time request a change which may affect the Contractual Conditions:

- o Contract
- Technical Specifications
- Statement of work
- o Documentation
- Interfaces
- Schedule

In response to a Change Request initiated by ESO, the Contractor shall return a reasonable and justified Change Proposal within 4 weeks, and, if agreed by ESO, implement the change defined in the requested change. In the case of a Change Request initiated by the Contractor, ESO shall reply to such a request within 4 weeks. ESO and the Contractor have no obligation to accept the proposed change. In any case, the implementation of a Change Request shall not start prior to the written authorization or approval by ESO in accordance with the contractual requirements.

When preparing a Change Request, the Contractor shall investigate the proposed change and provide ESO with all information for a decision, including, but not limited to:

- 1. The reason for the change
- 2. An assessment of the technical feasibility, including an analysis of all the impacts on the products and on the total system (i.e. performance, specifications, interfaces, etc.),
- 3. The necessary modifications of the contractual documents (Technical Specifications, Statement of Work, Interface Control Documents, etc ...) shall be clearly indicated by quoting the OLD and NEW versions of the text and/or the drawing,
- 4. The total schedule impact, i.e. on any contractual milestones,
- 5. The total <u>cost impact</u>, giving differential costs changes on labor, operations and capital, for each affected Work Elements / Work Packages,
- 6. Other related factors such as reliability, safety, integrity, maintenance, etc.
- 7. Any additional documents deemed necessary.



A template of ALMA Change Request is provided on the ALMA document server (EDM). The procedure for the submittal and processing of Change Request is given for information in **[RD 06]**. Each proposed change must be identified by an individual and unique number, which shall be used by all subsequent correspondence as reference. The Contractor shall keep a record with all initiated changes with their status (approved, rejected, pending, closed) and provide an updated status together with the Progress Reports.

#### 3.2.2.3 Document Format and Identification

All ALMA Project Level and Operations documents will be maintained in the ALMA webbased document server (ALMA EDM) and will be accessible to all members of the ALMA Project [**RD 03**]. The Contractor is encouraged to maintain the project documentation, including IPT Level documents, on the ALMA EDM.

The Contractor may, in addition, operate a centralized documentation system to fulfill the information requirements of the project. This system shall be capable of providing up-to-date information on all aspects of the project at all times including sub-contractors. However, the ALMA EDM shall serve as a reference for technical interfaces and specifications, as well as for introducing and executing all project changes (e.g. CR).

The Contractor shall supply ESO with an updated CIDL as part of his progress reports. All written documentation and information issued by ESO will be forwarded to the Contractor Project Office for further distribution within the Contractor organization as necessary.

The project documentation shall comply with the document standards described in [**RD 08**] and the document identification plan described in [**RD 04**].

#### 3.2.3 Product Assurance Plan & Safety Analysis

The Contractor shall implement and maintain, through all project phases:

- A quality system which complies with the <u>ALMA PA Requirements [AD 05]</u>. This approach has to be described in the *Product Assurance Plan* [DRD 02].
- A safety approach compliant with the specified safety requirements and, where not explicitly stated otherwise, with all national safety laws and legislation applicable to the design, development, manufacturing, installation and operation of the deliverable items. This shall be reported in the *Safety Report* [DRD 03]



#### 4 ANNEX 1

#### 4.1 **Document Requirement Description (DRD)**

#### **DRD 01 Project Management Plan**

The Project Management Plan shall contain:

#### **1. Project Organization Chart**

- Present the Project Organization implemented by the Contractor
- Describe the Responsibilities of each function in the Chart
- Describe the lines of authority within the Contractor's organization
- Present the Key Personnel assigned to the project
- Describe the relevant experience of the key personnel

#### 2. Work Breakdown Structure (WBS)

Presentation of the project activities organized according to the division of the work within the Contractor and/or to Product tree. The Contractor shall define a Work Breakdown Structure composed of, typically, 5 to 10 **Work Units (WU)** for each of the Level-3 ALMA Work Elements they are responsible for.

For each Work Unit that they have defined, the Contractor shall provide:

- a reference number
- the title of the Work Unit
- the individual or organization responsible for the Work Unit
- the input(s) necessary to complete the Work Unit activities
- the description of the task(s) to be performed under the Work Unit
- an evaluation of the resources required to be perform the Work Unit
- the output(s) or deliverable(s) of the Work Unit
- the duration of the Work Unit

Additionally, the Project Management Plan shall describe the management approach that the Contractor will implement to fulfill all the requirements laid down in the Contract [**AD02**] and in the present Statement of Work.

#### 3. Planning Chart

This Chart shall contain a detailed Gantt chart of the project tasks and activities, possibly grouped by Work Units. A top-level summary of the Project Schedule (fitted on one A4), including project main tasks, Work Units and Level-3 milestones, shall also be provided. ESO reserves the right to ask for detailed/updated schedule at any time.

#### 4. Costs Breakdown & Analysis

The Contractor shall present the costs breakdown of the project in a table-like format that, for each of the Project Phases, lists the (incurred and planned) costs of the ALMA Work Elements, grouped by Work Units and detailed by nature i.e. labor, operations & capital outlays. Labor costs should be defined in working-days. The operation costs include e.g. service contracts, external manpower, etc. The capital costs are mainly for the hardware and equipments procured and deliverable in the scope of the project. The total project cost-to-completion should be clearly identified. For the (pre-) production phase, the non-recurring costs or proposed investments should be detailed and submitted for approval by the ESO.

#### DRD 02 Product Assurance Plan (Relevant to pre-production units only)

The Product Assurance Plan shall describe how the Contractor will implement and maintain, through all project phases, a quality system that complies with the PA Requirements [AD 05] and should therefore covers the following main points:

#### 1. Project Reporting

#### 2. Documentation Control

- Establishing of the specified documentation system

#### 3. Design Control

- Specifications
- Establishment of Configuration Item Data Lists (CIDL)
- Design verification and acceptance (i.e. Reviews)
- Design changes (i.e. Handling of Change Requests)

#### 4. Procurement Control

- Selection of suppliers
- Establishment of purchase orders
- Procedures for incoming inspection
- Acceptance procedures

#### 5. Material & Processes Control

- Incoming Inspection
- Process Procedures and Control
- Product identification & traceability

#### 6. Manufacturing, Assembly, Integration & Tests Control

- Manufacturing Inspection
- Assembly and Integration Procedures
- Tests Plans & Reports
- Calibration Plan of tools and test equipment

#### 7. Non-conformance Control

- Definition
- Classification (e.g. Waivers)
- Processing and Reporting (e.g. RFW, CR)

#### 8. Cleanliness & Contamination Control



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9. Packing, Handling, Transportation & Storage

**10. Delivery & Acceptance** 

#### **DRD 03 Safety Report**

This document shall be prepared in accordance with the guidelines presented in the *General Safety Requirements for Scientific Instruments* [AD 03] and in the *Requirements for Safety Analyses* [AD 04]. Hazard severity and probability levels shall be identified, as well as safety provisions or alternatives needed to eliminate hazards and reduce their associated risk to a level acceptable to ESO. This safety analysis shall be refined as the project moves to the Critical Design Review. At the provisional acceptance, the Contractor shall produce a Safety Compliance Assessment certifying that the delivered items are in compliance with the appropriate safety requirements (i.e. imposed contractually or by applicable national laws).

#### DRD 04 Design Report

The contents of this document for the Preliminary Design Review and for the Critical Design Review are described in [AD 02], ALMA Design Reviews Definitions, Guidelines and Procedure".

#### **DRD 05 Compliance Matrix**

This Compliance Matrix presents the current status of compliance of the product (i.e. design, prototype or final product) with the specifications listed in the Technical Specifications [AD 01]. It may be structured according to the table of contents of the Technical Specifications and include the "achievement to date", that is the value currently achieved for the corresponding specification, and the "current estimate", consisting of a lower and higher limit expected to be achieved at the end of all subsequent design and production phases. If a value does not meet the specification, the Contractor may request a Change or a Waiver in the case non-conformances are identified. The ESO have no obligation to grant approval of such request(s).

#### **DRD 06 Development/Production Plans**

This Plan shall schematically describe how the Contractor will organize and implement the tasks necessary to fulfill all the contractual requirements. The Plan shall be structured according to project phases and milestones. In particular, it shall identify all critical activities regarding development (e.g. Research & Development, prototyping), procurement (e.g. Long Lead Items), manufacturing, assembly, integration, tests, verification and installation:

- Overall description of the production plans
- Resource estimates (labor, operational, capital costs)
- Production schedule and risk estimates
- Description of facilities, non-recurrent costs
- Production Call for Tenders (if applicable)
- Quotation received from possible suppliers
- Integration Plan



**Statement of Work** 

• Maintenance Plan

#### DRD 07 Product Engineering Documentation

This document should include:

- Product Final Specifications
  - Detailed Subsystem Specifications down to the items level
  - Reliability and Maintainability Analysis

#### • Interface Control Documentation

- Detailed Interface Control Documents (ICD) down to the items level
- Drawings and Diagrams
  - Assembly Drawings
  - Detailed Manufacturing Drawings
  - Circuits Diagrams
  - Parts Drawings

#### • AIT and Commissioning Documentation

- Parts List (EEE and mechanical)
- Assembly Procedures
- Test Plans and Procedures
- Commissioning Plan (On-site)
- Acceptance Procedures (In-house/On-site)
- Test Equipment
- Transportation Equipment
- Maintenance Documentation
  - Manuals
  - Maintenance Equipment
  - Spare Parts

#### DRD 08 Configured Items Data List (CIDL)

The Configuration Item Data List (CIDL) identifies all the official and valid documentation of the Project. Configured items shall include and are not limited to the following documents:

- ALMA applicable documents (AD's and RD's),
- Documents part of Review Data Packages,
- Product Engineering Documents (e.g. specifications, ICD, drawings, procedures),
- Sub-system(s), Unit(s), Item(s) Acceptance Reports or Certificates,
- Sub-system(s), Unit(s), Item(s) Safety Compliance Assessments,
- Minutes of Meeting and Action Items,
- Change Request/Notice, Request for Waivers,
- Project Referenced Correspondence,
- Manuals (e.g. user's, operations, maintenance).



Configured items shall be identified in the lists with their reference, issue or revision number, date of issue, originator and status (e.g. approved by ESO, if applicable).