SST Programme:
Programme Management Plan

SST-PRO-PLA-001

Version 3a

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1 Introduction

1.1 Scope & Purpose

In this document we describe the Program Management Plan (PMP) to deliver the Small-Sized Telescopes (SSTs) required for the southern site of CTA (CTA-South), as an in-kind contribution (IKC). This document is issued in the framework of SST-PO. The current CTA PMP [AD 1] is the main input of preliminary SST PMP from which the In-Kind Contribution Allocations and Management adopted the scheme A. The scope of this document is then:

- To define the deliverables from the SST Partners to CTAO.
- To outline the SST organisation and identify a scheme by which SST Partners will be bound.
- To specify the anticipated SST Partners involved and the anticipated resources available.
- To specify the scope of the work and the phases over which it will be performed.
- To outline the essentials of a management plan.
- To present the steps needed to establish the proposed programme.

In this SST PMP (covering activities prior to the signing of SST IKC agreements) the management approach has been tailored to address the particular aspects of management of institute/industry combined teams and their interfaces with CTAO.

The experience of previous projects together with the lessons learnt during their implementation will be reused for the benefit of SST. To accomplish the SST project management an SST P Office (SST-PRO) is established, consisting of a Project Team, formed by various expertise, managerial, technical and quality, necessary to carry out the relevant tasks and duties to fulfil the SST obligations with CTAO. The PRO will evolve with the project phases.

The SST project management will be exercised through:

- This document that defines the management rules and organization
- The implementation of a uniform management approach to all SST Partners and define common techniques for WBS, risk management and control, program schedule, change management, program reporting, documentation and communication exchange
- The definition of rules and procedures for project change management
- The identification and management of the project risks establishing plan for their control and contingency management through the Risk Management Plan and the Risk Register.
- The definition of the tasks necessary to achieve the SST Programme objectives by a suitable Work Breakdown Structure (WBS) and relevant Work Packages Description (WPD) closely linked to the SST Product Tree (PBS).
- The definition of common configuration control rules
- The build-up of the SST schedule and relevant monitoring, control and reporting system, using a coherent set of schedule techniques, with clear identification of the critical path and contingencies to secure the overall program planning.
- The implementation at each level of a uniform information and reporting system (meetings and reviews, progress reporting, action items control).

1.2 Applicable Documents

[AD1] CTA Project Management Plan, CTA-PLA-MGT-000000-0003_1c, Version 1.2, 25 May 2020
[AD2] Document Numbering System, V1 Rev. c, 12 June 2019 CTA-STD-SEI-000000-0001
[AD3] CTAO Configuration Management Plan Doc. No: CTA-PLA-MGT-000000-0002_1b
[AD4] CTAO Acceptance Process CTA-PRO-MGT-000000-0002
[AD5] High level implementation plan - TBW
[AD6] CTA-SST Engineering Review Panel Report CTA-RER-SST-305000-0001_2aIssue 2, Rev. 0, 2020-09-01
[AD7] SST Engineering Review – DMA Disposition CTA-INS-SST-305000-0001 , 2020-11-02

1.3 Reference Documents

[RD1] ECSS-M-ST-10C Rev.1 (6 March 2009)
[RD2] SST Programme Configuration And Data Management plan SST-PRO-PLA-002 1a, June 2021
[RD3] SST-PRO-PLA-004 Risk Management Plan

1.4 Definition of Terms and Abbreviations

1.4.1 Abbreviations and Acronyms

ACADA	Array Control and Data Acquisition System
AIT	Assembly Integration and Testing
AIV	Assembly Integration and Verification
ASTRI	Astrophysics with Italian Replicating Technology Mirrors
BKO	Bridging phase Kick-Off
CDR	Critical Design Review
CTA	Cherenkov Telescope Array
CTAO	Cherenkov Telescope Array Observatory
FAR	Final Acceptance Review
FRC	France Contribution
DR	Delivery Review
DVER	Design Verification Engineering Review
ERIC	European Research Infrastructure Consortium
ESC	Executive Steering Committee
IKC	In Kind Contribution
INAF	Istituto Nazionale di Astrofisica
INSU	Institut National des Sciences de l'Univers
KO	Kick-Off
MPIK	Max-Planck-Institut für Kernphysik
OP	Observatoire de Paris
PA	Product Assurance
PBS	Product Breakdown Structure
PM	Project Manage
PR	Product Review
PMP	Programme Management Plan
PO	Project Office
PQR	Production Qualification Review
PR	Product Review
PRM	Programme Manager
PSE	Programme System Engineer
QA	Quality Assurance
QM	Quality Manager
RAMS	Reliability, Availability, Maintainability & Safety
SE	System Engineer
SST	Small Size Telescope
TRR	Test Readiness Review
WBS	Work Breakdown Structure
WP	Work Package
WPD	Work Package Description

1.4.2 Glossary

TERM	DEFINITION
"As Built" Configuration	The as-built configuration or applied configuration is defining the as-built status per each serial number of Configuration Item (CI) subject to formal acceptance.
"As Designed" Configuration	The as-designed configuration or Applicable configuration is defining the current design status of a Configuration Item (CI)
AIV	AIV is the Assembly Integration and Verification, which is referred to the integration activities related with the verification of the system or sub-system. In the framework of SST for briefness this term includes also the Assembly Integration and Testing which is related with the integration activities and testing to be performed during the integration at system and subsystem levels
Baseline	Set of information which describes exhaustively a situation at a given instant of time or over a given time interval.
Change	Vehicle for proposing modifications to an approved baselined data or the business agreement.
Configuration	Functional or physical Characteristics of a product defined in configuration definition documents subject to configuration baseline.
Configuration Item	Aggregation of hardware, software, processed materials, services or any of its discrete portions, that is designated for configuration management and treated as a single entity in the configuration management process. **NOTE:** A configuration item can contain other lower level configuration item(s).
Deviation	Written authorization to depart from the originally specified requirements for a product prior to its production.
Firmware	Firmware is software programmed onto an electronic device which is treated like a pure hardware.
Executive Steering Committee	The SST Executive Steering Committee (ESC) is the high-level decision-making body which will manage the strategic direction of the Programme and will be in charge of overseeing progress and facilitating global collaboration among the participating groups.
Institutes	Research Institutes involved in the SST Programme.
Contractor	Industry involved in the SST Programme which has a contract with an institute
SST-PRO	It is the team composed by Institutes and Contractors responsible involved in the production of SST telescopes elements, which coordinate the project level activities.
Hardware	Hardware is a single or an assembly of physical electronic devices which cannot be changed in its user environment.
Item	Any part, component device, sub-unit, unit, equipment or device that can be individually considered.
Model	Physical or abstract representation of relevant aspects of an item or process that is put forward as a basis for calculations, predictions or further assessment useful for the preparation of SST production
Partners	are those entities taking responsibility for IKC delivery by signing IKC agreements with CTAO, plus any organisation identified by these signing entities as playing an essential role in SST delivery. The institutes are the partners of the SST+ and CTA-SST consortium.
Product	A product (hardware, software, service) required in the frame of the program and included as element of the product tree having a unique identifier. A product may be deliverable or not.
Product Breakdown Structure	Hierarchical structure depicting the product orientated breakdown of the project into successive levels of detail down to the configuration items necessary to deliver the required functions. The Product Breakdown Structure (PBS) in general is influenced by Institutes/partners decisions to group certain products or by program history. It identifies products and their interfaces, it serves as the basis for the WBS
Service	Service is the result of at least one activity necessarily performed at the interface between the SST consortium and CTA and is generally intangible.
Software	Set of computer programs, procedures, documentation and their associated data.
SST-E2E	The SST end-to-end telescope, or simply SST, will consist of the SST Structure and the SST Camera (including all mechanics, mirrors, auxiliary devices and required software), integrated and commissioned on-site including all required documents. It ends at (and integrates into CTA via) the system interfaces specified by the CTA PBS.
SST Consortium	The SST Consortium then consists of the Partners and their associated Teams, where a Team is a set of individuals within a single organisation at a single location (such as a University group).
System	An entity of products assembled or working together for a well-defined specified purpose. In SST the term system can be utilised in alternative to Telescope End-to-End.
Sub-System	Like a system but a lower level. In SST the SST system is composed by the subsystem SST-MECH, SST-OPT, SST-TCS and SST-CAM.
Waiver	Written authorization to use or release a product which does not conform to the specified requirements
Work Breakdown Structure	Hierarchical representation of the activities necessary to complete a project.

1.5 Evolution of this Document

This document should be fixed once consolidated in the Bridging Phase and used as applicable document for SST project management documentation and programme configuration.

2 System Overview

When a VHE gamma-ray interacts with the atoms and ions in the upper levels of the atmosphere, it induces a cascade of secondary particles which propagate over many kilometres at nearly the speed of light through the atmosphere. These particles emit Cherenkov light, forward-beamed with an opening angle of about one degree. A Cherenkov light event consists of a time-correlated multi-photon image with a typical timescale of ~10 ns. Cascades originate at an altitude of ~10 km above ground and create a light pool on the ground of ~120 m radius. Telescopes placed on the ground, containing large reflectors, focus the light to an imaging camera. Such Cherenkov cameras must be highly pixelated, cover a large field of view, and be able to detect UV/blue light down to the single photon levels with exposure times of approximately a billionth of a second. To provide a high imaging sensitivity over an extensive energy range, from a few tens of GeV up to a few hundreds of TeV, the Cherenkov Telescope Array Observatory (CTAO, see web page link at https://www.cta-observatory.org) will be made of sub-arrays with three different types of telescopes: large-sized (LST, 23 m diameter), medium-sized (MST, 12 m diameter) and small-sized (SST, 4 m diameter) telescopes. They are distributed in two observing sites, the Northern one in La Palma, the Canary Islands, and the Southern one in the Chilean Andes in the Paranal area. The CTA South "Alpha Configuration" would include LSTs, MSTs and SSTs. In particular, it envisages the construction and installation of 42 SSTs (a number that could increase up to 70 in future upgrades).

The SSTs are developed by an international consortium of institutes that will provide them as an in-kind contribution to CTAO. The SSTs rely on a Schwarzschild-Couder-like dual-mirror polynomial optical design, with a primary mirror of 4 m diameter, and are equipped with a focal plane camera based on SiPM detectors covering a field of view of ~9°. They are sensitive in the band from ~0.5 TeV up to ~300 TeV, providing the Observatory with sensitivity to the highest energies. The current SST concept has been validated by developing the prototype dual-mirror ASTRI-Horn Cherenkov telescope and the CHEC-S Cherenkov camera. Table 2-1 reports main properties of the Small-Sized telescope (SST).

Table 2-1. Small-sized telescope main properties

Small-Sized telescope (SST) main properties:	
Optical Design	modified Schwarzschild-Couder
Primary reflector diameter	4.3 m
Secondary reflector diameter	1.8m
Effective mirror area (including shadowing)	>5 m2
Focal length	2.15 m
Total weight	17.5 t
Field of view	>8.8 deg
Number of pixels in SST Camera	2048
Pixel size (imaging)	0.16 deg
Photodetector type	SiPM
Telescope data rates (before array trigger)	>600 Hz

Telescope data rates (readout of all pixels; before array trigger)	2.6 Gb/s
Positioning time to any point in the sky (>30° elevation)	90s
Pointing Precision	< 7 arcsecs

3 Internal Organisation/ Programme Management

3.1 Participation and Governance

SST Programme participation and Governance framework are detailed in the SST Programme High Level Implementation Plan for the provision of the Small Size Telescopes of the CTAO Array [AD5].

3.2 Programme Phases Timeline

The reference SST-PRO Master Schedule is taking into account the reformulation of SST array population as foreseen on the BGR of Dec 15, 2020 and consolidated on the spring 2021 BGR (up to 37 telescopes). On May 2022 the SST population is increased by an additional batch of 5 SST-STR, provided by INAF in the framework of PNRR (Piano Nazionale di Ripresa e Resilienza).

The master timeline of SST/SST+ as it stands at the time of writing is shown in Figure 3-1 and Figure 3-2.

The production and AIT/V phases are based on incremental learning approach. For the first telescopes, especially the first one, longer durations were considered.

To meet the plan and schedule, it has been considered in the full production phase to produce at least two telescopes and to perform on-site AIT/V of two telescopes every month.

ID	Name	Duration	Start	Finish
1	**Bridging Phase**	494 days	Thu 15/07/21	Tue 06/08/23
7	**SST / SST+ Design Consolidation Phase**	386 days	Wed 07/06/23	Wed 27/11/24
8	**Design Consolidation Phase KO**	1 day	Wed 07/06/23	Wed 07/06/23
9	**SST-MEC**	310 days	Thu 08/06/23	Wed 14/08/24
15	**SST-OPT M1 & M2**	310 days	Thu 08/06/23	Wed 14/08/24
21	**SST-CAM**	327 days	Thu 08/06/23	Fri 15/11/24
29	**SST-TEL CDR Preparation**	105 days	Thu 04/07/24	Wed 27/11/24
30	Detailed Design Assessment	30 days	Thu 04/07/24	Wed 14/08/24
31	AIT/V Assessment	30 days	Thu 04/07/24	Wed 14/08/24
32	Telescope CDR ATP Available for RIK	0 days	Wed 14/08/24	Wed 14/08/24
33	Telescope CDR	0 days	Wed 16/10/24	Wed 16/10/24
34	CDR Assessment	30 days	Thu 17/10/24	Wed 27/11/24
35	**SST / SST+ Production Phase**	283 days	Thu 28/11/24	Mon 29/12/25
36	**SST-OPT M1 & M2 Production & AIT/V**	60 days	Thu 28/11/24	Wed 19/02/25
42	**SST-MEC Production & AIT/V**	156 days	Thu 28/11/24	Thu 03/07/25
43	SST-MEC #1 Production & AIT/V	66 days	Thu 28/11/24	Thu 27/02/25
48	**SST / SST+ On-factory AIT/V SST-TEL**	30 days	Fri 07/03/25	Thu 29/05/25
49	CFRP Unpacking and Inspection	10 days	Fri 07/03/25	Thu 20/03/25
50	SST TEL OF-TRR	0 days	Thu 20/03/25	Thu 20/03/25
51	AIT/V SST-TEL #1	40 days	Fri 21/03/25	Thu 15/05/25
52	SST TEL OF-TRB / OF-PQR	0 days	Thu 15/05/25	Thu 15/05/25
53	SST-TEL revision after SST-1 qualification	20 days	Fri 16/05/25	Thu 12/06/25
54	SST-TEL #1 unmount, packing & shipment	10 days	Fri 13/06/25	Thu 26/06/25
55	SST-MEC #2 Production & AIT/V	45 days	Fri 28/02/25	Thu 01/05/25
56	SST-MEC #3 Production & AIT/V	45 days	Fri 28/02/25	Thu 01/05/25
57	SST-MEC #4 Production & AIT/V	45 days	Fri 02/05/25	Thu 03/07/25
58	SST-MEC #5 Production & AIT/V	45 days	Fri 02/05/25	Thu 03/07/25
59	**SST-CAM Production & AIT/V**	283 days	Thu 28/11/24	Mon 29/12/25
65	SST-MEC Tender #2	161 days	Thu 28/11/24	Thu 10/07/25
66	Tender #2 preparation	60 days	Thu 28/11/24	Wed 19/02/25
67	Tender #2 Finalization	20 days	Fri 13/06/25	Thu 10/07/25
68	**SST / SST+ MEC sets availability for delivery to site**	5 days	Thu 26/06/25	Thu 03/07/25
69	SST-MEC TEL 1 set ready for delivery	0 days	Thu 26/06/25	Thu 26/06/25
70	SST-MEC TEL 2 set ready for delivery	0 days	Thu 26/06/25	Thu 26/06/25
71	SST-MEC TEL 3 set ready for delivery	0 days	Thu 26/06/25	Thu 26/06/25
72	SST-MEC TEL 4 set ready for delivery	0 days	Thu 03/07/25	Thu 03/07/25
73	SST-MEC TEL 5 set ready for delivery	0 days	Thu 03/07/25	Thu 03/07/25
74	End of SST+ Programme	0 days	Fri 04/07/25	Fri 04/07/25

Figure 3-1: The SST/SST+ Programme Master Schedule

ID	Name	Duration	Start	Finish
75	**Production & Integration Phase SST/CTAO**	740 days	Thu 26/02/25	Wed 22/12/27
76	**SST/CTAO Production Phase**	740 days	Thu 26/02/25	Wed 22/12/27
77	**SST -OPT #6-37 productiction**	740 days	Thu 26/02/25	Wed 22/12/27
78	SST-OPT/MT & M2 #6-14 production	220 days	Thu 26/02/25	Wed 24/12/25
79	SST-OPT/MT & M2 #15-25 production	280 days	Thu 25/12/25	Wed 20/01/27
80	SST-OPT/MT & M2 #26-37 production	240 days	Thu 21/01/27	Wed 22/12/27
81	**SST -MEC #6-37 productiction**	485 days	Fri 04/07/25	Thu 13/05/27
82	SST-MEC #6-14 Production	200 days	Fri 04/07/25	Thu 09/04/26
83	SST-MEC #15-25 Production	240 days	Fri 10/04/26	Thu 11/03/27
84	SST-MEC #26-37 Tender 2	480 days	Fri 11/07/25	Thu 13/05/27
85	Production Preparation	80 days	Fri 11/07/25	Thu 30/10/25
86	SST-MEC #26 Production & AIT/V	80 days	Fri 31/10/25	Thu 19/02/26
87	On-factory AIT/V SST-TEL #26	80 days	Fri 20/02/26	Thu 11/06/26
88	SST TEL #26 On Factory Qualification Review	0 days	Thu 11/06/26	Thu 11/06/26
89	SST-MEC #27-37 Production	240 days	Fri 12/06/26	Thu 13/05/27
90	**SST -CAM #6-37 Productiction**	425 days	Tue 30/12/25	Mon 16/08/27
91	SST-CAM #6-14 Production	150 days	Tue 30/12/25	Mon 27/07/26
92	SST-CAM #15-25 Production	130 days	Tue 28/01/26	Mon 25/01/27
93	SST-CAM #26-37 Production	145 days	Tue 26/01/27	Mon 16/08/27
94	**On-site AIT/V Phase**	712 days	Fri 27/06/25	Mon 29/03/28
95	Site set-up for SST-TEL AIT/V	30 days	Fri 27/06/25	Thu 07/08/25
96	Training of CTAO Personnel	30 days	Fri 27/06/25	Thu 07/08/25
97	SST #1 SST-MEC & SST-OPT Shipping	40 days	Fri 27/06/25	Thu 21/08/25
98	SST TEL O-TRR	0 days	Thu 21/08/25	Thu 21/08/25
99	**AIT/V SST #1**	115 days	Fri 22/08/25	Thu 29/01/26
100	SST-STR unpacking & post Delivery inspecti	10 days	Fri 22/08/25	Thu 04/09/25
101	SST-CAM unpacking & post-delivery inspecti	10 days	Fri 22/08/25	Thu 04/09/25
102	SST-STR on-site AIT	30 days	Fri 05/09/25	Thu 16/10/25
103	SST-TEL on-site AIT	30 days	Fri 17/10/25	Thu 27/11/25
104	SST-TEL on-site Verification	30 days	Fri 28/11/25	Thu 08/01/26
105	SST-TEL ACRV	0 days	Thu 29/01/26	Thu 29/01/26
106	SST-TEL revision after SST-1 qualification	20 days	Fri 30/01/26	Thu 26/02/26
107	**AIT/V SST #2**	70 days	Fri 27/02/26	Thu 04/06/26
108	**AIT/V SST #3**	70 days	Fri 27/02/26	Thu 04/06/26
109	**AIT/V SST #4**	56 days	Fri 05/06/26	Fri 21/08/26
110	**AIT/V SST #5**	56 days	Fri 05/06/26	Fri 21/08/26
111	**AIT/V SST #6-14**	140 days	Mon 24/08/26	Fri 05/03/27
112	**AIT/V SST #15-25**	168 days	Mon 08/03/27	Wed 27/10/27
113	**AIT/V SST #26-37**	300 days	Tue 26/01/27	Mon 29/03/28
114	End of SST/CTA Sub-System Production	0 days	Wed 22/12/27	Wed 22/12/27
115	End of SST/CTA AIT/V	0 days	Mon 29/03/28	Mon 29/03/28

Figure 3-2: The SST Programme Master Schedule – Production and AIT/V Phases

The Programme timeline will be divided into four phases:

- Bridging,
- Design Consolidation,
- Production,
- AIV.

The Design consolidation and the production of the first batch of 5 SST-STR (named SST+) from PNRR (Piano Nazionale di Ripresa e Resilienza) shall be available for the delivery to South side (jointly with 5 SST-CAMS) within 2025.

Details of work to be completed in each Phase is specified in the following sub-sections.

In the outline below, all dates are given as relative estimates.

3.2.1 Bridging Phase

The Programme starts with a Kick-Off once the SST Programme Plan is approved by SST-ESC. The Kick-off activates the **Bridging Phase (**Figure 3-3**)**, during which the design of the ASTRI structure, CHEC camera and Optics will be iterated with the support of all involved stakeholders to define a shared SST design, the reference for the IKC agreements. The Bridging Phase goals include (a) the Level B requirements assessment with CTAO as well as the presentation of lower-level requirements from SST Consortium, (b) the identification of interfaces both between SST Projects and to CTAO, (c) closure of actions assigned at DVER in Bridging Phase ([AD6], [AD7]).

The Bridging Phase has been closed by the Product Review, held in February 2023, in which the preliminary design of the SST Telescopes has been presented and approved by a board composed of external experts and endorsed by CTAO.

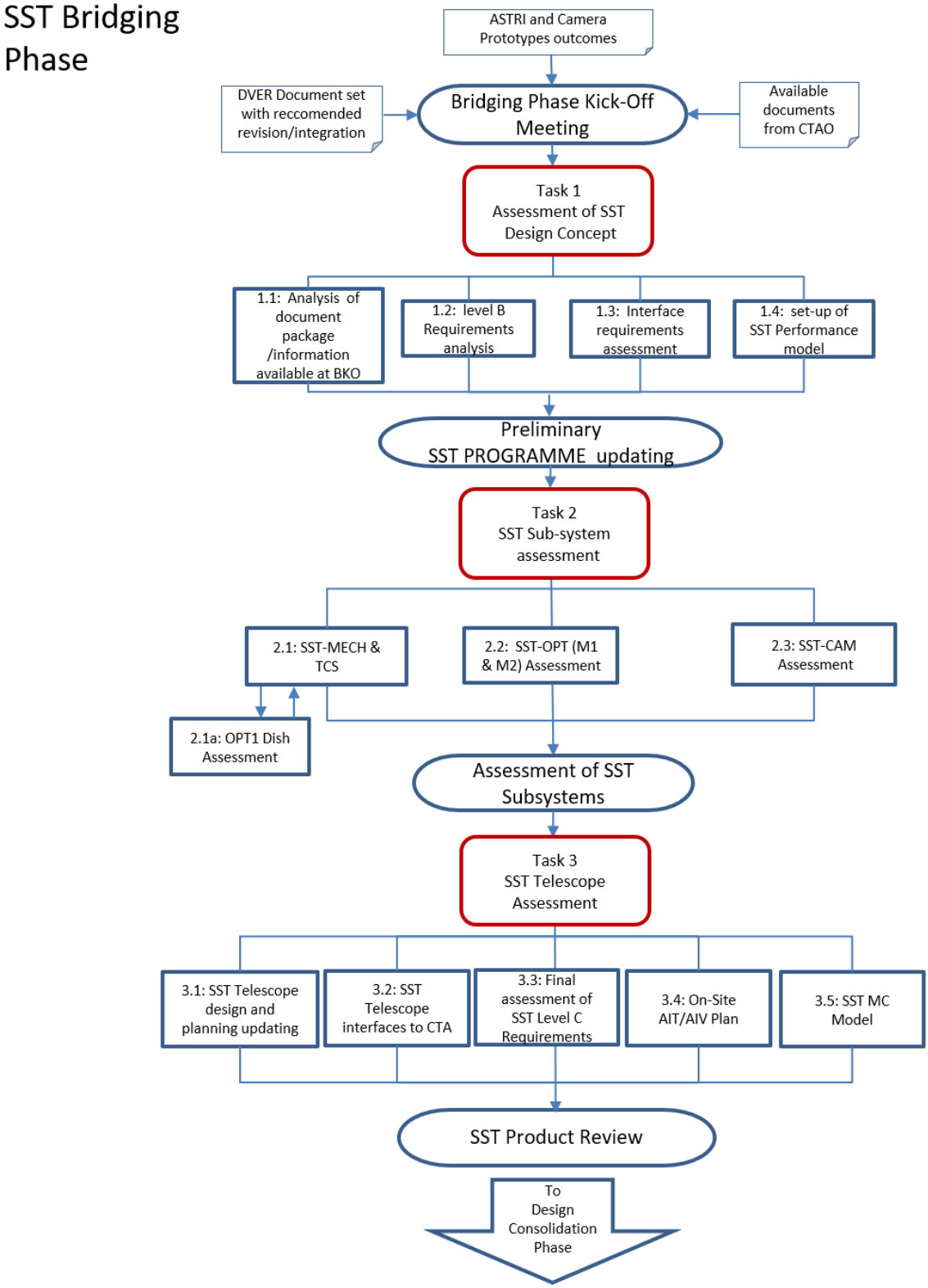

Figure 3-3 ST-PRO Bridging Phase flow-chart

3.2.2 Consolidation Phase

The outcoming of the **Consolidation Phase** is the final SST design, optimised for simplicity, maintainability, and cost. This phase also sees the realisation of the plans and documentation for the Production and AIV Phases. It is expected that the Design Consolidation Phase will take approximately 1.5 years from the start of the Programme and concludes upon passing the CDR.

Starting from the Consolidation Phase KO (occurred on June 7, 2023) and until the Telescope CDR (September 2024) the preliminary design of the Telescope and its subsystem, approved by the Product Review, will be consolidated and finalized. All the analysis and simulations to confirm the chosen design will be carried out. All the HW models needed to confirm the chosen design will be produced and tested.

Figure 3-4 reports the activities that will be carried out during this phase.

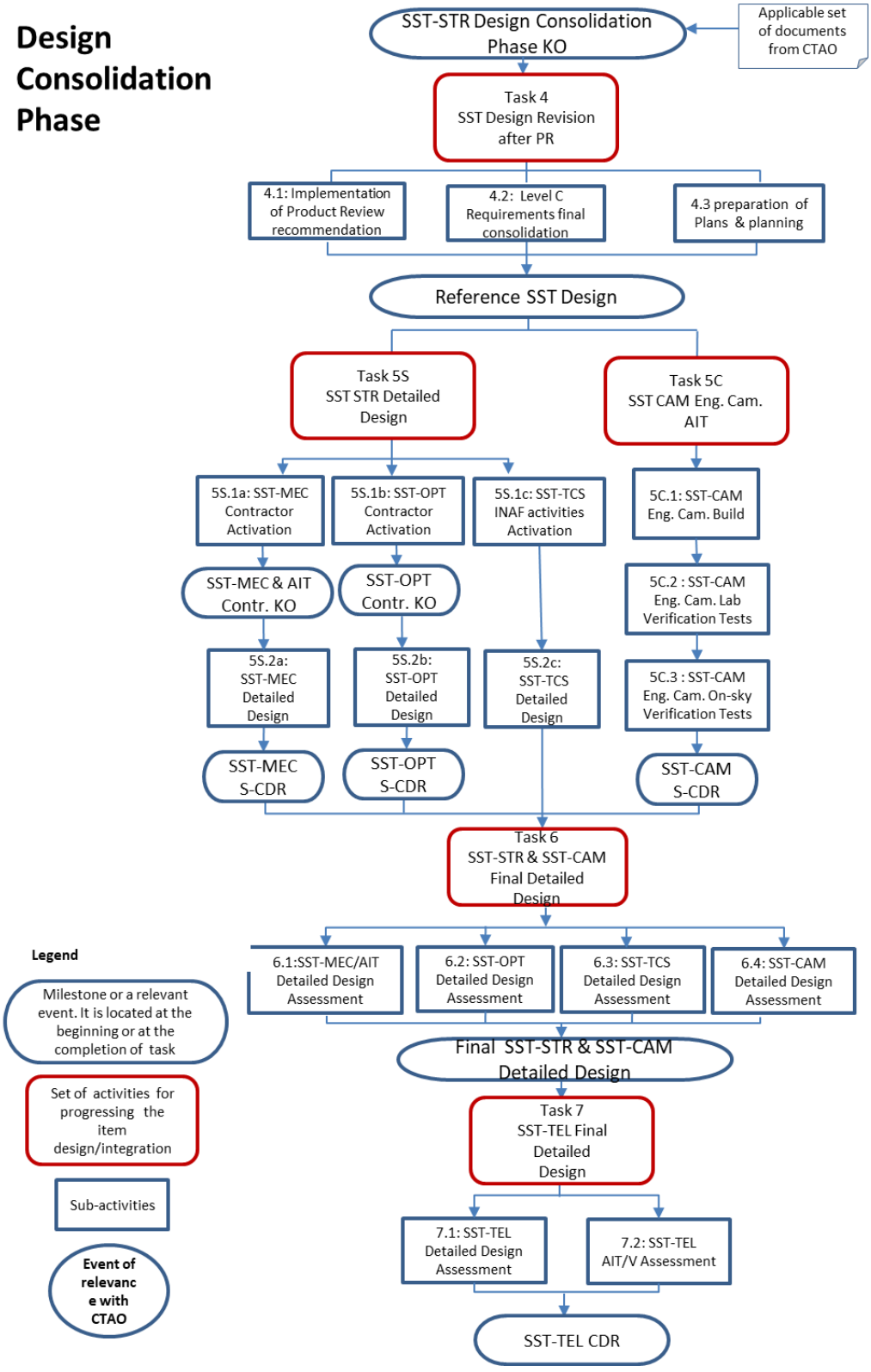

Figure 3-4 SST-PRO Design Consolidation Phase from KO to CDR flow-chart

3.2.3 Production Phase

In the **Production Phase** the SST Structures (including Mechanical Structure and Optics) and Cameras will be produced by the SST Partners and delivered to the CTA southern site over a period lasting approximately 2.5 years following the plans developed and approved in the Design Consolidation Phase. The Production Phase begins in anticipation of the first and second Camera and Structure.

The first model of the Telescope is considered the Qualification Model. It will be completely integrated and tested on factory and then, after a formal process of qualification, it will be shipped on site, where it will be integrated and fully tested again. It will be used on factory to verify interfaces, functions and performance, and to verify the AIT/V process before moving it on site. The Production Phase ends with the delivery of the final components to site.

The first batch of SST Telescopes foreseen the assessment of the telescope qualification with the first produced telescope (SST #1) which is integrated and verified at the premises of the factory responsible for the AIT.

Figure 3-5 and Figure 3-6 report the work logic and activities flow of the first telescope, nominally called the Qualification Model, from the production until the verification onsite. Figure 3-7 report the work logic and activities flow for the telescopes 2-n.

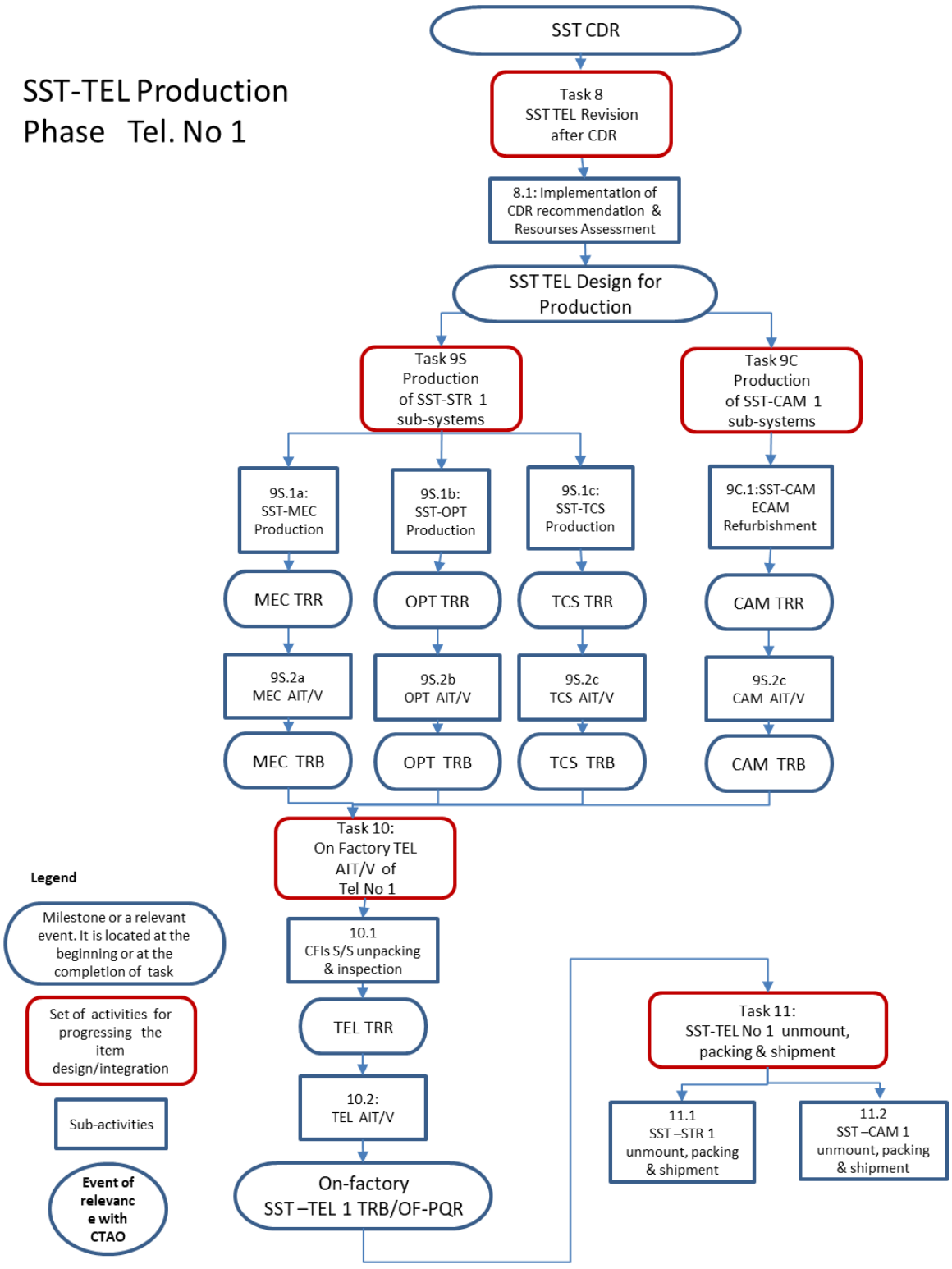

Figure 3-5: SST-PRO TEL 1 Production and on factory AIT/V flow-chart

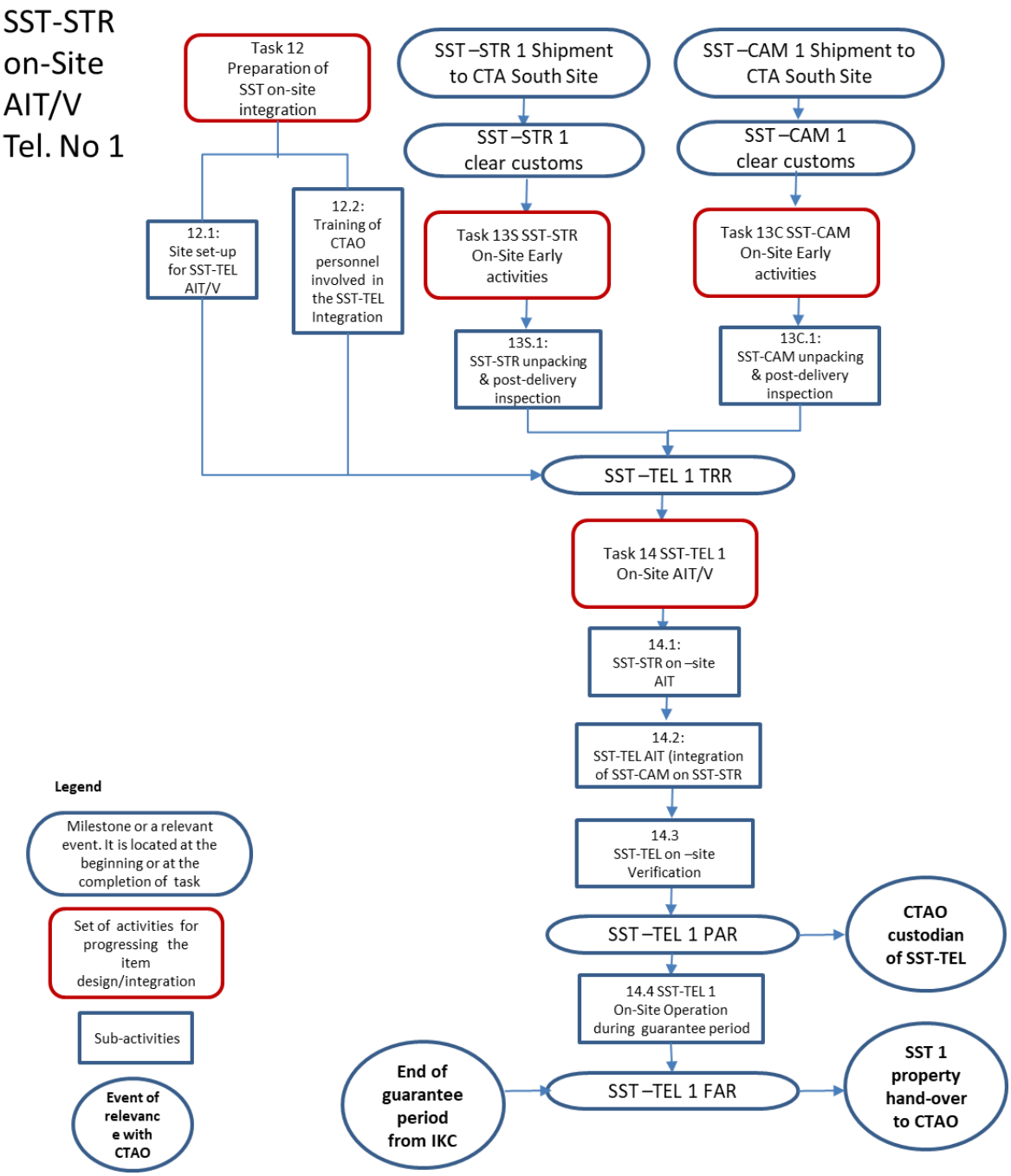

Figure 3-6 : SST-PRO TEL 1 On site AIT/V

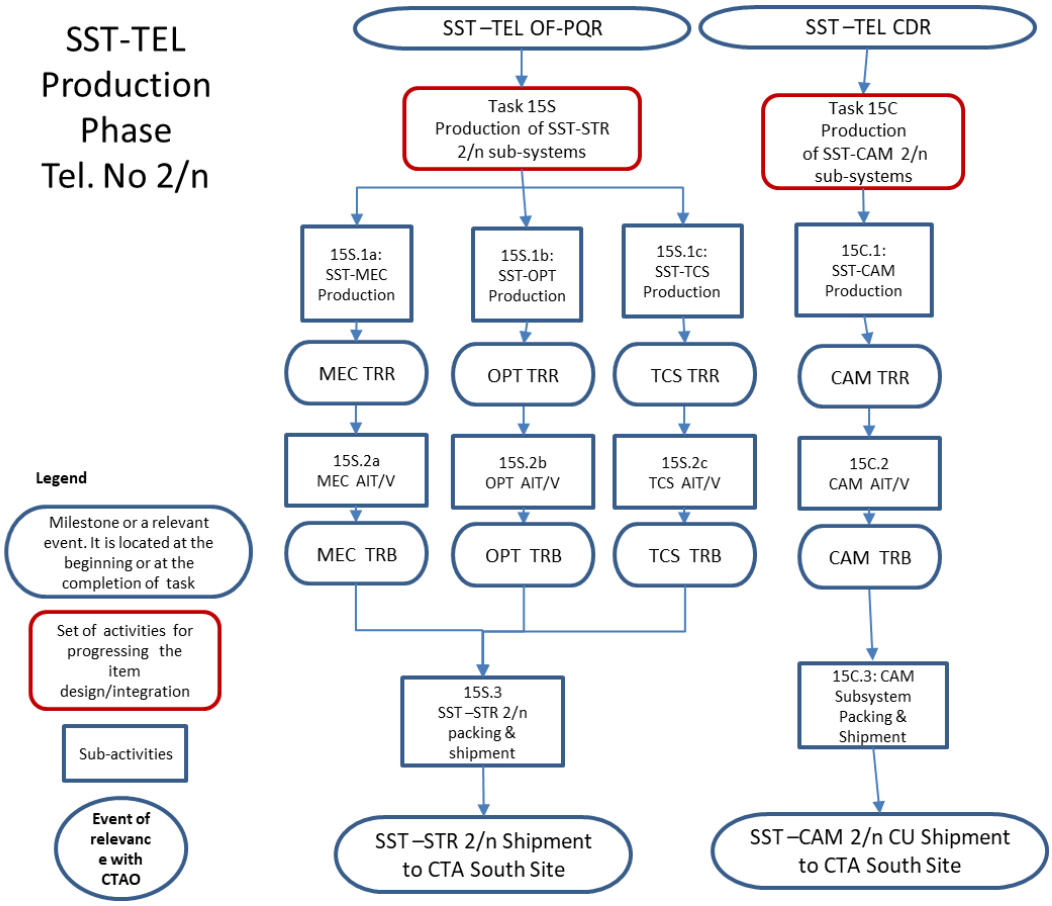

Figure 3-7 : SST-PRO TEL 2 to N Production

3.2.4 AIT/V Phase

The AIT/V Phase will start with the first telescope (Qualification Model) (see 3.2.3).

During the **AIV Phase** of the Programme, Structures and Cameras are received on site, installed, integrated, commissioned and handed over to CTAO following the plans developed and approved in the Design Consolidation Phase. The AIV Phase begins in anticipation of receipt of the first Camera, Optics and Structure with on-site preparation (task 12.1 and task 12.2).

Due to the large number of units, Telescope Production and AIV will run in parallel. AIV phase will end with the acceptance of the final SST by CTAO and the removal of any temporary equipment and personnel on-site.

The Figure 3-8 reports the activities that will be carried out during this phase.

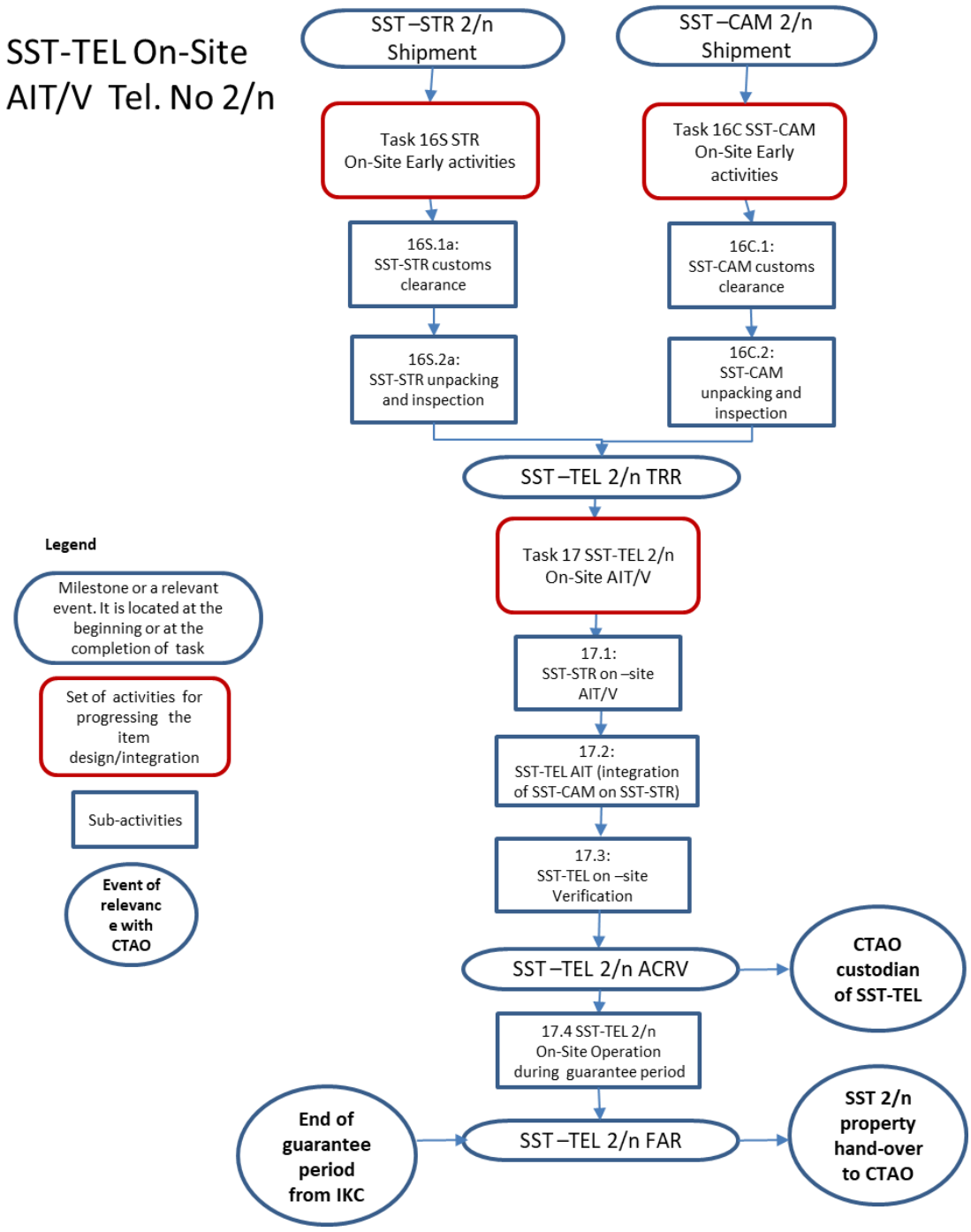

Figure 3-8: SST-PRO TEL 2/n On site AIT/V

3.3 SST Programme main events

In this section the main SST Programme event are presented, consisting of reviews, meetings and decision points that form the boundaries between programme phases. The SST Programme events is summarized in the Figure 3-9 and detailed below.

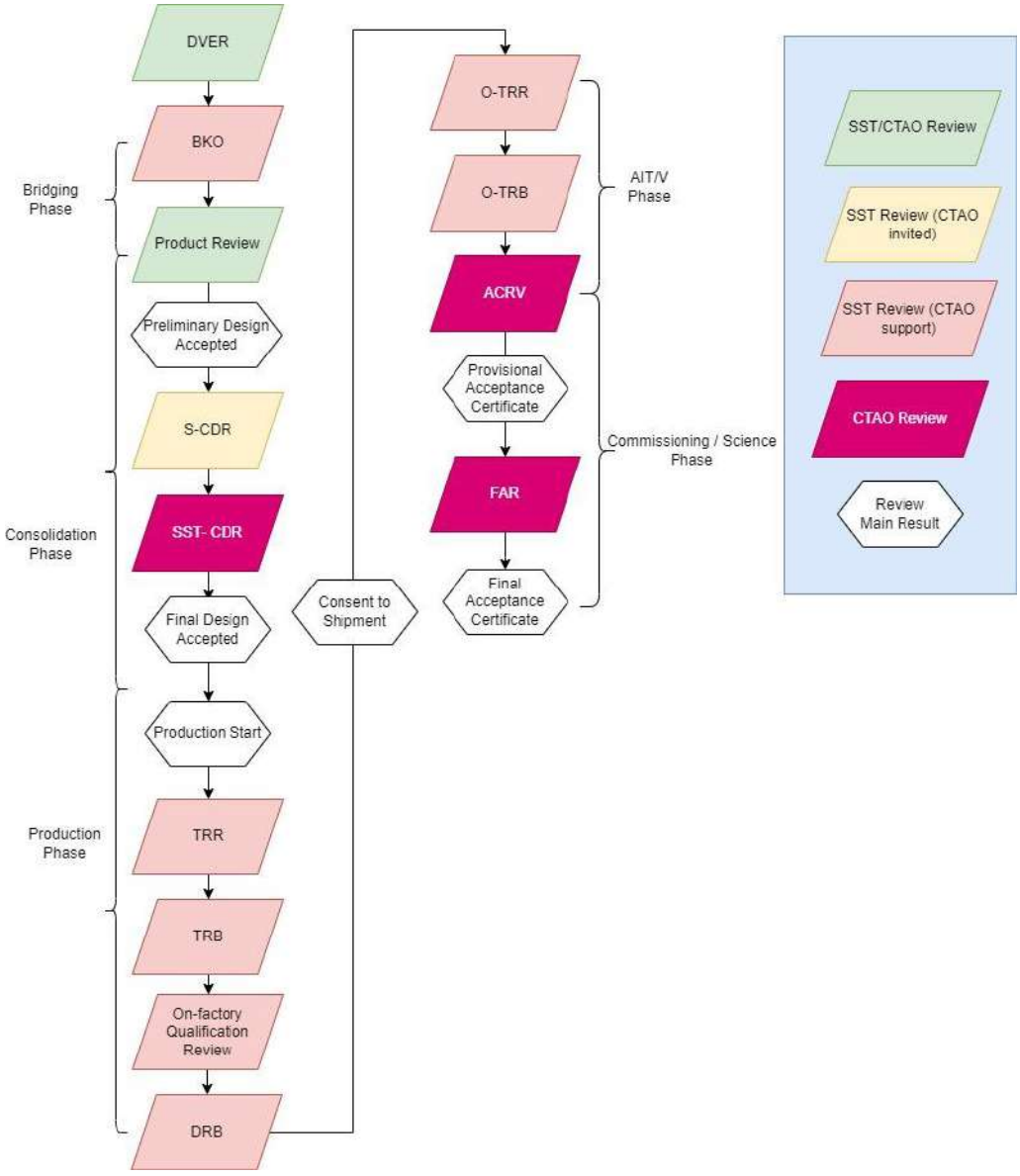

Figure 3-9: SST Events flow-down

Each event is to be accompanied by a documentation / data pack, and a RIX due from previous reviews will be addressed. Reviews are based on those outlined in [AD1] and tailored to the SST. A summary is provided in Table 3-1 at the end of the section.

The SST Programme will take an incremental approach to acceptance as suggest by CTAO in:

- Step 1 Pre-Shipment Provisional Acceptance: Done at the sub-system level prior to shipment to CTAO. Repeated for every unit, or batch of units shipped.

- **Step 2 On-site Provisional Acceptance:** Done for every SST, or batch of SSTs, following onsite AIV.
- **Step 3 On-site Final Acceptance:** Done once the warranty period has expired and when all obligations of the provider have been fulfilled. Can be done once, or in a staged fashion (e.g., per SST or batch, as the warranty expires).

3.3.1 Pre-bridging

3.3.1.1 Design & Value Engineering Review (DVER)

The DVER took place following the SST down-selection and subsequent establishment of the SST Programme. The review was organised by CTAO, and the CTAO PM acted as the decision-making authority. The review covered the existing structure and camera designs, together with preliminary plans for series production and onsite AIV, with the goal to establishing the path to a harmonised SST design. The review resulted in action items and recommendations, categorised by sub-system and with due-dates mapped to the SST BKO and CDR.

3.3.2 Bridging Phase

3.3.2.1 Bridging Phase Kick-Off (BKO)

The BKO meeting indicated the start of the SST Bridging Phase. The event consisted of a remote meeting organised by the SST Programme and attended by representatives of the SST Programme, all SST Projects and CTAO. Several updated documents were presented in accordance with addressing DVER RIX due at the time.

3.3.2.2 Product Review (PR)

The PR was an internal review organised by SST Programme, with active participation from CTAO, in which the design of the subsystems have been presented, along with the status of any and all verification and validation steps. For the PR documents from both the SST team and CTAO were assessed (as a preparatory step towards the CDR). All CTAO Level A and B requirements and their flow down to Level C together with Level D specifications have been assessed to ensure that SST Telescope is adequately specified. All interfaces between the SST Project and CTAO have been specified and presented.

The PR represented an internal SST Programme acceptance of the proposed SST design and has been passed successfully in May 2023.

3.3.3 Consolidation Phase

3.3.3.1 Programme (& Sub-System) Kick-Offs (PKOs)

The PKO event indicates the formal start of the Design Consolidation Phase and was successfully held on June 7, 2023. It was attended by representatives of the SST Programme, all SST Projects and CTAO. The SST team presented the project status, the product review results, the consolidation of the WBS and PBS, the updated schedule and the documents plan.

The SST-STR Kick-Offs (S-PKO) are events internal to the SST-STR Project, formally authorising the start of work by industrial contractors for the optical and mechanical sub-systems of the structure. Each S-

PKO shall be organised by the SST-STR Project with participation from the relevant industrial contractor(s), and taking place after the PKO or (if feasible) combined with the PKO.

3.3.3.2 In-Kind Consortium (IKC) and SST Partnership Agreement Signing

This is a key decision point with two prerequisites. The first is that the PR has been passed and the SST design is regarded as consolidated and accepted. The second one is the establishment of CTAO as an ERIC. Only after these prerequisites are secured the IKC Agreements can then be finalised and signed – thereby establishing exactly the contribution from each SST Partner to the IKC and securing funding for the IKC. At this point the SST Partnership Agreement is iterated, finalised and signed by all parties. The IKC Agreement signing does not need to be completed before progressing to the CDR.

3.3.3.3 SST (& Sub-System) Critical Design Reviews (CDRs)

The SST CDR will be organised jointly by the SST Programme and CTAO. The review is external to the SST Programme, in that CTAO will act as the decision-making authority and appoint the review panel, which will consist of a combination of CTA and non-CTA participants. The CDR will assess if the proposed SST design, and interfaces to CTAO, have been sufficiently verified and are fit-for-purpose for use in the observatory. All design documentation will be submitted, along with preliminary series-production plans. Passing the CDR indicates acceptance of the SST design by CTAO. Following the CDR, the SST design will be under CTAO configuration control.

The SST CDR may be preceded by internal (to the SST Programme) sub-system CDRs (S-CDRs) as appropriate. These internal reviews may take place on the project level (e.g., SST-CAM, SST-STR) or sub-project level (e.g., SST-OPT). Each S-CDR would be organised by the SST Programme Office. S-CDRs would take place on draft documentation to then be revised, as needed, and submitted to the SST CDR. Passing an S-CDR represents approval of the SST sub-system design by the SST Programme.

3.3.4 Production Phase

3.3.4.1 Test Readiness Review (TRR)

A TRR shall be held before the start of the test activity to verify that all conditions allow to proceed with the test. A TRR is an operative review, generally held by a teleconference, with complete focus on pre-shipment test plans and procedures. The objectives of this review is to declare the readiness for the test authorising the start of the test. The TRR(s) may be done singularly for the SST (i.e. for the first integrated telescope on factory), and/or separately for any sub-system (e.g., STR, CAM, OPT, MEC) as appropriate (i.e., depending on timeframe and industrial contracts).

The TRR(s) will be done once, prior to the testing the first produced item under test (i.e. before the AIT/V of the first camera). Following any changes to the test plans / procedures a delta TRR may be needed before further tests are performed.

The TRR will be composed by System Engineers, AIV Managers, Quality Control Responsible and CTAO representatives.

Once the TRR has been successfully completed, it is possible to proceed with the tests.

3.3.4.2 Test Review Board (TRB) – Production Phase

A TRB shall be held to review all results and conclude on the test completeness and achievement of objectives. A TRB is an operative review, generally held by a teleconference, with complete focus on test results and NCRs. In case of NCRs, further testing and a delta-TRB may be needed.

The TRB will be composed by System Engineers, AIV Managers, Quality Control Responsible and CTAO representatives.

Once the TRB has been declared successfully completed, it is possible to proceed with the delivery review board.

3.3.4.3 On-factory Production Qualification Review

The first batch of SST Telescopes foreseen the assessment of telescope qualification by the first produced telescope (SST #1) which is integrated and verified in the premises of the factory responsible for the AIT. After this qualification SST-TEL#1 is dismounted and ready for delivery to South site. The On-factory Production Qualification Review is an internal review organised by SST Programme with the CTAO support.

3.3.4.4 Delivery Review Board (DRB) – Production Phase

Following completion of a successful TRB (or on-factory QR), a given sub-system will undergo the DRB. A DRB will then be organised to assess the test results and authorise a sub-system for shipment to CTAO South Site. The DRB then forms the first step in the CTAO Provisional Acceptance process [AD4]

Unlike the TRR, the DRB will be repeated for each unit (or batch of units) shipped to CTAO south Site. The review is fairly light-weight consisting of remote review of documentation (e.g.: Test Reports, User Manuals, VCDs, etc.). The DRB(s) will be organized by the SST Programme with formal participation of CTAO-PO members and industrial partners (as appropriate).

3.3.5 Onsite AIT/V Phase

3.3.5.1 Onsite Test Readiness Review (O-TRR)

A second test readiness step is needed to accompany the incremental acceptance approach adopted by the SST Programme. The objective of the O-TRR is to ensure that AIT/V plans, procedures and related facilities are fit to assemble and test the first SST, and that all required items have been delivered and are available onsite. The O-TRR is done once, and covers all SST subsystems. If necessary, the O-TRR may be split into two parts: done prior to the build of the first SST, and then iterated prior to the final verification testing of the first SST (this may be needed if, for example, verification test procedures change due to lessons-learnt in commissioning the first SST). If any changes to the AIT/V procedures are made during SST production, a delta-ATRR will be performed. The ATRR will be organized by the SST Programme with formal participation of CTAO-PO members and industrial partners (as appropriate). Authorisation to start on-site AIT/V will come from the the CTAO Director (or be delegated appropriately).

3.3.5.2 Onsite Test Review Board (O-TRB) – Production Phase

The O-TRB shall be held to review all results and conclude on the test completeness and achievement of objectives. A TRB is an operative review with complete focus on test results and NCRs. In case of NCRs, further testing and a delta-TRB may be needed.

Successful completion of the O-TRB leads to the authorization to start on-site AIT/V of all SSTs. The O-TRB will be organized by the SST Programme with formal participation of CTAO-PO members and industrial partners (as appropriate). Authorisation to start on-site AIT/V will come from the CTAO Director (or be delegated appropriately).

Once the TRB has been declared successfully completed, it is possible to proceed with the Provisional Acceptance Review.

3.3.5.3 Provisional Acceptance Review (ACRV)

An ACRV will be performed for every SST, or batch of SSTs, delivered to CTAO. Successful completion of the ACRV for a given SST will result in *Provisional Acceptance* of that deliverable by CTAO. Where *Provisional Acceptance* is the formal recognition by CTAO that the deliverable item subject to the acceptance process is compliant with the relevant requirements and interface specifications, and with safety regulations (if applicable).

The ACRV will therefore examine the deliverable's acceptance documentation package (e.g.: Test Reports, User Manuals, VCDs, etc.), seeking to confirm that all issues and action items from the DRB have been addressed, to verify the as-built status of the element and differences from the Design Baseline, to evaluate test results and inspection results against specification and interface requirements, to check the compliance with safety requirements and regulations (if applicable), and to review the applicable non-conformances and Requests-for-Waiver (RFWs), among other items.

If no major issues have been identified during the ACRV, "Provisional Acceptance" of a deliverable can be granted by the CTAO Director. This implies that equipment, or a software application, can be used, operated and/or integrated into the system at the target site, and responsibilities related to safety (if applicable), operations, and maintenance (except warranty work) are transferred from the supplier to the CTAO, as defined in the corresponding IKC Agreement or contract. A "Provisional Acceptance Certificate" is issued by CTAO, and the warranty period (as established in the corresponding Statement of Work or IKC Agreement) would begin.

If during the Acceptance Review a set of remedial actions is identified that needs further attention, and if the acceptance team considers that none of these issues blocks the safe use of the deliverable, "Provisional Acceptance with Reservations" could be recommended, i.e., provisional acceptance would be conditional on resolving first the pending action items. In this case integration activities and/or use of the deliverable could proceed, but a Provisional Acceptance Certificate should not yet be issued. Once all remedial work is completed the reservations can be removed.

3.3.5.4 Final Acceptance Review (FAR)

Once the warranty period for an SST has expired and when all obligations of the SST IKC have been fulfilled, including the implementation of remedial actions as well as responses to warranty claims made during the warranty period, the FAR can take place and "Final Acceptance" can be granted by the CTAO

Director. A corresponding “Final Acceptance Certificate” is then issued by CTAO and signed. The FAR may be done once for all SSTs, or in stages as the warranty of each delivered batch expires.

Table 3-1 Summary of SST Programme Events

Event		Type	Participants	Frequency	Note
Pre-Bridging					
DVER	Design & Value Engineering Review	Review	CTAO, SST-PRO, SST-STR & CAM	Once	- Completed
Bridging Phase					
BKO	Bridging Phase Kick-Off	Kick-Off	CTAO, SST-PRO, SST-STR & CAM	Once	- Completed
PR	Product Review	Review	CTAO, SST-PRO, SST-STR & CAM	Once	- Completed
Design-Consolidation					
PKO	Programme Kick-Off	Kick-Off	CTAO, SST-PRO, SST-STR & CAM	Once	
S-PKO	Sub-system KO	Kick-Offs	SST-PRO, SST-Subsystem, Industrial Partners *(as applicable)*	Once	T0 Contract (expected in January 2024)
S-CDR	Sub-System Critical Design Reviews	Review	CTAO, SST-PRO, SST-Subsystem Industrial Partners *(as applicable)*	Once	T0+6 months
CDR	Critical Design Review	Review	CTAO, SST-PRO, SST-STR & CAM	Once	T0+9 months
Series-Production Phase					
TRR	Test Readiness Review	Review	CTAO, SST-PRO, SST-STR, SST-CAM	Once (*delta* if procedures change)	T0+14 months
TRB	Test Review board	Review	CTAO, SST-PRO, SST-STR, SST-CAM	Per item tested	T0+17 months
OF-PQR	On Factory Production Qualification review	Review	SST-PRO, SST-STR, SST-CAM, CTAO	Once	T0+17 months
DRB	Delivery Review Board	Review	CTAO, SST-PRO, SST-STR, SST-CAM Industrial Partners *(as applicable)*	Per batch shipped	T0+18 months
On-Site AIV Phase					
O-TRR	Onsite Test Readiness Review	Review	CTAO, SST-PRO, SST-STR, SST-CAM Industrial Partners *(as applicable)*	Once (*delta* if procedures change)	T0+20 months
O-TRB	Onsite Test Review Board	Review	CTAO, SST-PRO, SST-STR, SST-CAM Industrial Partners *(as applicable)*	Per item tested (*delta* if NCRs occur)	T0+23 months
ACRV	Provisional Acceptance Review	Review	CTAO, SST-PRO, SST-STR, SST-CAM Industrial Partners *(as applicable)*	Per batch verified	T0+25 months (First Telescope)
FAR	Final Acceptance Review	Review	CTAO, SST-PRO, SST-STR, SST-CAM	Once (or per batch as warranty expires)	

4 Programme Management / Internal Organisation

The structure for the SST Programme organisation and the relative key-roles are shown in Figure 4-1 and consists of:

- The SST Projects
- The SST Programme Office (SST-PRO)
- The SST-ESC

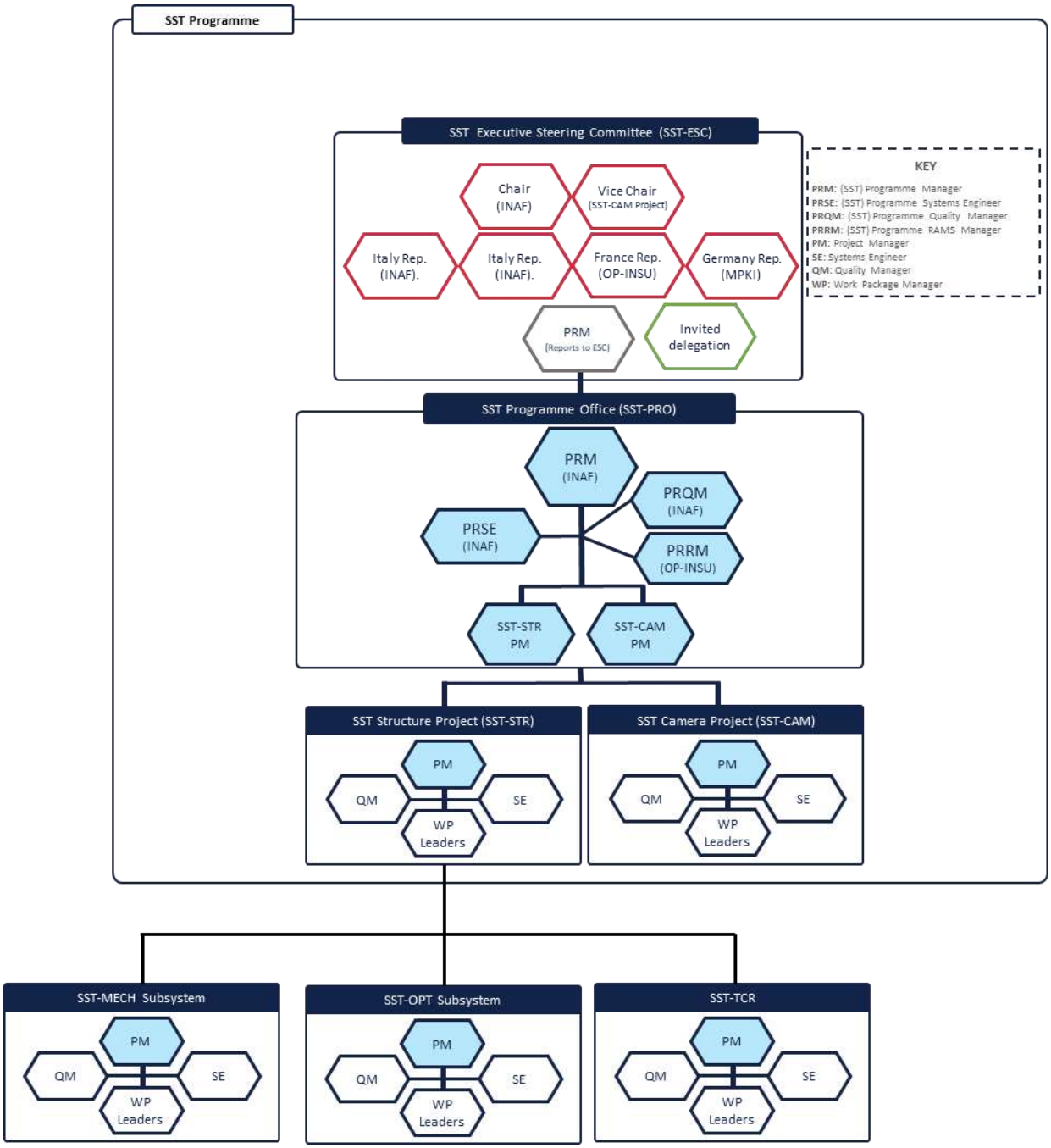

Figure 4-1: The SST Programme organisation and key-roles.

The sections below describe the organization of the SST program / projects. The SST-ESC organization is described in [AD5] .

4.1.1 The SST Projects

The proposed SST Programme contains the following SST Projects:

- SST Structure Project (SST-STR), in which converge the following subsystems:
  - SST Optics (SST-OPT)
  - SST Structure Mechanics (SST-MEC)
  - SST Telescope Control Software (SST-TCS)
- SST Camera Project (SST-CAM)

Any SST Project is defined to provide a specific deliverable or set of deliverables to the SST Programme under the responsibility of a Project Lead Partner with contributions from additional SST Partners. At the time of the document preparation the Project Lead Partner for the Structure is expected to be INAF. The Project Lead Partner for the Camera is expected to be MPIK/MPG.

Each Project is internally organised, but at a minimal level comprises a set of Work Packages under the coordination of a Project Manager. In addition, all Projects will contain a Quality Manager and the Camera and Structure Projects will contain a Systems Engineer. Project roles are appointed by the Project Partners in the manner most appropriate for the specific needs of that SST Project.

4.1.2 SST Programme Office and Project Offices

The day-by-day coordination of the Programme will be delegated to a purposely-configured **Programme Office (SST-PRO)**. The SST-PRO is led by a **Programme Manager (PRM)** and includes a **Programme System Engineer (PSE)**, **Programme Quality Manager (PRQM)**, **Programme RAMS Manager (PRRM)** and **the Project Office Managers** (Structure-**SPM**, Camera-**CPM**). The SST-PRO will meet on weekly basis. The SST-PRO will be hosted by INAF, who will also appoint the PRM and PSE after a proposal to be endorsed by the SST-ESC.

The PRM is an ex-officio member of the SST-ESC to which he/she reports on a monthly basis. Whilst the PRM has coordination responsibility conferred by the SST-ESC he/she has no direct spending authority. The SST PRM responsibilities include:

- Preparation of the detailed Programme management and systems engineering plans.
- Reporting to the SST-ESC
- Liaison with CTAO
- Liaison with CTA+ Programme Manager (only for PNRR early tasks)
- Programme level management, including following and tracking the Programme schedule.
- Risk management
- Programme level coordination across the Projects.
- The day-to-day coordination between the Projects.
- Technical and management coordination with the CTAO PO.
- Programme documentation.
- Interfaces between Projects.
- Internal communications, documentation and configuration management.
- Coordination (and sometimes preparation) of technical documents.

- Coordination between Projects to provide deliverables to CTAO.
- Coordination of logistics.

The PRSE role is to provide technical leadership to the SST-PRO to ensure the successful implementation and execution of the systems engineering process. He/she reports directly to PRM. The PSE responsibilities include:

- Compliancy with SST Telescope requirements (from CTAO) and flow down of requirements at the Programme and Projects levels.
- Systems engineering and coordination across the Projects.
- Definition and maintenance of SST Programme interfaces with CTA.
- Supervisor of the Programme mechanical, thermal, software and electrical design.
- Supervisor of the SST Projects design development and testing activities.
- Compliance between the SST requirements verification and the related telescope production requirements.
- Chairing all the system technical meeting/review.

The PRQM is responsible for the coordination of the Product/Quality Assurance and Safety Assurance activities for SST Programme as well as the Projects. She/He has to establish and control an effective Quality Management Plan covering:

- Quality and Product Assurance plan.
- Approval of no conformity, waiver/deviation from the Projects
- Management of no conformity, waiver and deviation with respect to the CTAO
- SST-PRO Configuration Management.

PRQM is also responsible for the safety in the conduction of SST Programme as well as the Projects. She/He has to establish and control an effective Safety Management Plan and provide the Safety analysis report as well as the Safety assessment report.

The PRRM is responsible for the coordination of the RAMS for SST Programme as well as the Projects. She/He has to establish and control an effective implementation of RAMS requirements and plan from CTAO covering:

- Control of overall SST-PRO reliability.
- Control of overall SST-PRO Maintainability.
- Liaison with PRQM for RAMS analysis coordination.
- Management of critical Item or process for reliability, maintainability, obsolescence, safety.
- Control of the selection of Material, processes, EEE components and mechanical components.
- Coordinate safety design reviews, hazard management and safety risk assessment
- Safety Management Plan
- Provide the Safety analysis report and the Safety assessment report.

Each SST Project shall be organised with a project office structure based on the same key functions of the SST Programme Office. In the following the minimum references key persons of Project Office Manager are identified.

Each Project Manager shall be effective member of the SST-PRO. She/he is the Project authority which approves the Project baseline to be submitted to SST-PRO. Project Manager responsibilities include:

- Preparation of the detailed Project management and engineering plans.
- Project level management, including following and tracking the Project schedule.

- Project risk management
- Technical and management coordination with the PRM.
- Project documentation.
- Interfaces with the other projects.
- Internal communications, documentation and configuration management.
- Technical documents.
- Coordination between PRM to provide deliverables to the SST-Programme.
- Project Coordination of logistics.

The Project System Engineer is the technical leader of the project. Project System Engineer responsibilities include:

- Compliancy with Project specifications and the flow down of requirements at the lower level items.
- Project systems engineering and coordination of project WP leader.
- Definition and maintenance of Project interfaces with SST-PRO.
- Responsible of the Project mechanical, thermal, optical, software and electrical design.
- Responsible of the SST Projects design development and testing activities.
- Compliance between the Project verification and the related project production requirements.

The Project Quality Manager is responsible for the coordination of the Product Assurance/Quality Assurance activities for the Projects. Project QM responsibilities include:

- Project Quality and Product Assurance.
- Identification of project critical Item or process for reliability, maintainability, obsolescence, safety
- Selection in the project framework of Material, processes, EEE components and mechanical components.
- Management of project no conformity
- Project Configuration Management.

Project Safety Manager is responsible for:

- Project Reliability.
- Project Maintainability.
- Safety in the conduction of SST Projects.
- Support Telescope Safety Management.
- Provide the Project Safety analysis report.
- Provide the Safety assessment report.
- Provide project RAMS analysis

WP Leaders:

The following key persons, with the role of WP leader, are nominally identified for the Structure Project:

- Structural Engineer
- Thermal Engineer
- Optical Engineer
- Electronic Engineer
- Software Engineer
- AIV/AIT Manager

In the Camera Project the role of WP leaders is adopted by institute group leaders (or delegated to senior scientists). Each institute takes responsibility for one or several Work Packages, and delegates task to an internal team of engineers and scientists as appropriate.

Structure Project and Camera Project shall identify (considering also the subsystem organization) the Project/Subsystem AIV Manager. The Project/subsystem AIV Manager has the responsibility of the integration activities, verifying the unit acceptance testing, which consists in a series of functional and environmental tests having the purpose of demonstrating that the Subsystem/Project H/W (and, when applicable, S/W) is acceptable and that it performs satisfactorily. The Project AIV/AIT Manager responsibilities include:

- confirmation of the functional characteristics of the Project/subsystem performances;
- AIV/AIT management plan and flow
- AIV/AIT detailed procedures (including verification that the Project is capable of surviving the environmental condition foreseen during the operations);
- Test reporting
- Support Project Office Manager in the definition of SST-PRO Master schedule
- AIT/AIV Manager

4.1.3 SST Programme Operative Organization

A detailed operative organization is defined with the aim to achieve a very effective collaboration between the project offices.

A preliminary SST Programme operative structure is reported in Table 3. In this example the working teams (named SST Working Team – SWT) covers 8 different thematic areas of relevance for the SST Programme activities progress. Each SWT:

- is composed by persons from the Project Offices;
- is referred to a team leader.

Each 2 weeks the status of the SST shall be presented to SST-PRO.

The actions tracking as well as the SWT sessions summary shall be reported in log-book available (to be organised) to SST-ESC.

Table 4-1: SST Working Team.

SST Working Team		SST-PRO		SST-FRC		SST-STR		SST-CAM	
		name	alternate	name	alternate	name	alternate	name	alternate
WT1	Program Coordination and Schedule	Primo Attinà	Alessio Trois	Emma Rebert	TBD	Salvatore Scuderi	TBD	Richard White [1]	TBD
WT2	PA/QA/SA Coordination	Nicola La Palombara	Fatima De-Frontat	Fatima De-Frontat	TBD	Nicola La Palombara	TBD	Chris Bicknell [2]	TBD
WT3	Structural/Thermal Design and interfaces	Carmelo Gargano	TBD	TBD	TBD	Carmelo Gargano	TBD	Duncan Ross [2]	G. Rowelln [3] (Thermal Only)
WT4	Electronic design/development & I/Fs	Gianluca Gianvitto	TBD	TBD	TBD	TBD	TBD	Gianluca Giavitto 4	Davide Depaoli 1
WT5	Software design/development & I/Fs	Gino Tosti	TBD	TBD	TBD	Federico Russo	TBD	Jason Watson [4]	TBD
WT6	IT Coordination & I/F with CTAO's IT	Fulvio Gianotti	Gianluca Gianvitto	TBD	TBD	Fulvio Gianotti	TBD	Gianluca Giavitto [4]	TBD
WT7	Trade-off, optimization & upgraded baseline	Alessio Trois	TBD	Jean-Laurent Dormeaux	TBD	Gino Tosti	TBD	Gianluca Giavitto [4]	TBD
WT8	Full System Analysis, Simulations & Calibration	Francesco Saturni	TBD	TBD	TBD	Giorgia Sironi	TBD	Janson Watson [4]	Sabrina Einecke [2] & Akira Okumura [5] (for optics)

1 MPKI
2 UoLE= University of Leicester
3 UoLE= University of Leicester
4 DESY
5 Nagoya University

4.2 Internal Communications & Documentation

Communication and documentation within the SST Projects will be internally organised. Communication between Team members of different Projects will be facilitated but should initially be via Project Managers. Figure 4-2 indicates the internal communication channels.

The SST-PRO will hold weekly meetings (tag-up meeting) to establish regular communication between the PRM, PSE, Quality Manager, Safety Officer and the Project Managers from each SST Project. The PSE will communicate directly with the Systems Engineers of each Project.

The SST-ESC will hold periodic meetings (once per month) chaired by the SST-ESC Chair to discuss progress, issues, important technical and interface decisions and changes. The PRM will report to the SST-ESC at such meetings. Project Managers from each SST Project may be invited to join such meetings when needed.

The SST-PRO will provide documentation tools and guidelines for the Programme.

4.3 Interactions with CTAO

Figure 4-2 indicates the envisaged interactions with CTAO. The SST-ESC Chair and Vice Chair are responsible for high-level interactions with CTAO, including the formal interaction with the Managing Director (such as meetings involving the lead parties of other IKCs within CTA, such as PIs and Chairs of the other telescope consortia) and high-level review meetings. The SST-ESC Chair, Vice Chair and SST PRM participate in central CTAO organisational meetings (such as the current Project Committee meetings).

The PRM is responsible for day-by-day interactions with the CTAO PO. Such interactions could include: progress meetings with the CTAO Project Manager and System Engineer, updates to the external SST interfaces, requirements flow-down monitoring, and quality assurance processes. Members of the SST-PRO will be in direct contact where appropriate and under the supervision of the PRM with counterparts in the CTAO PO. For example, the PRSE will communicate directly with the CTAO SE team, and the SST-Camera Project Manager will communicate directly with the CTAO Camera Coordinator. In all cases the SST PRM will be aware of such meetings and where possible and appropriate directly involved.

4.4 Decision Making, Issue Resolution & Change Control

The SST-ESC will promote a culture of decision making and issue resolution at the lowest level. Where possible decisions should be made in Work Packages and Projects before elevation to the Programme Office and then the SST-ESC.

Starting from the Design Consolidation Phase change control within a Project that does not affect another project will be internally managed and reported to the SST-PRO. Change control between SST Projects will be discussed at a technical level within the SST-PRO. Any minor changes (as judged by the PRM) will be approved or rejected by the SST-PRO and reported to the ESC and the CTAO PO where relevant. Any major changes, or change requests that result in conflict between Projects, will be escalated to the SST-ESC for discussion and eventual approval or rejection (informing the CTAO PO where needed). Any change requests that require interaction with CTAO will be managed by the SST-

ESC and SST-PRO and flowed down to the SST Project teams. This may also apply to changes coming from CTAO to the SST Programme (for example a change in requirements). During the Production Phase any changes requests will require formal interaction with CTAO following a to-be-defined global CTAO policy. For the Programme such interactions will be managed by the SST-ESC.

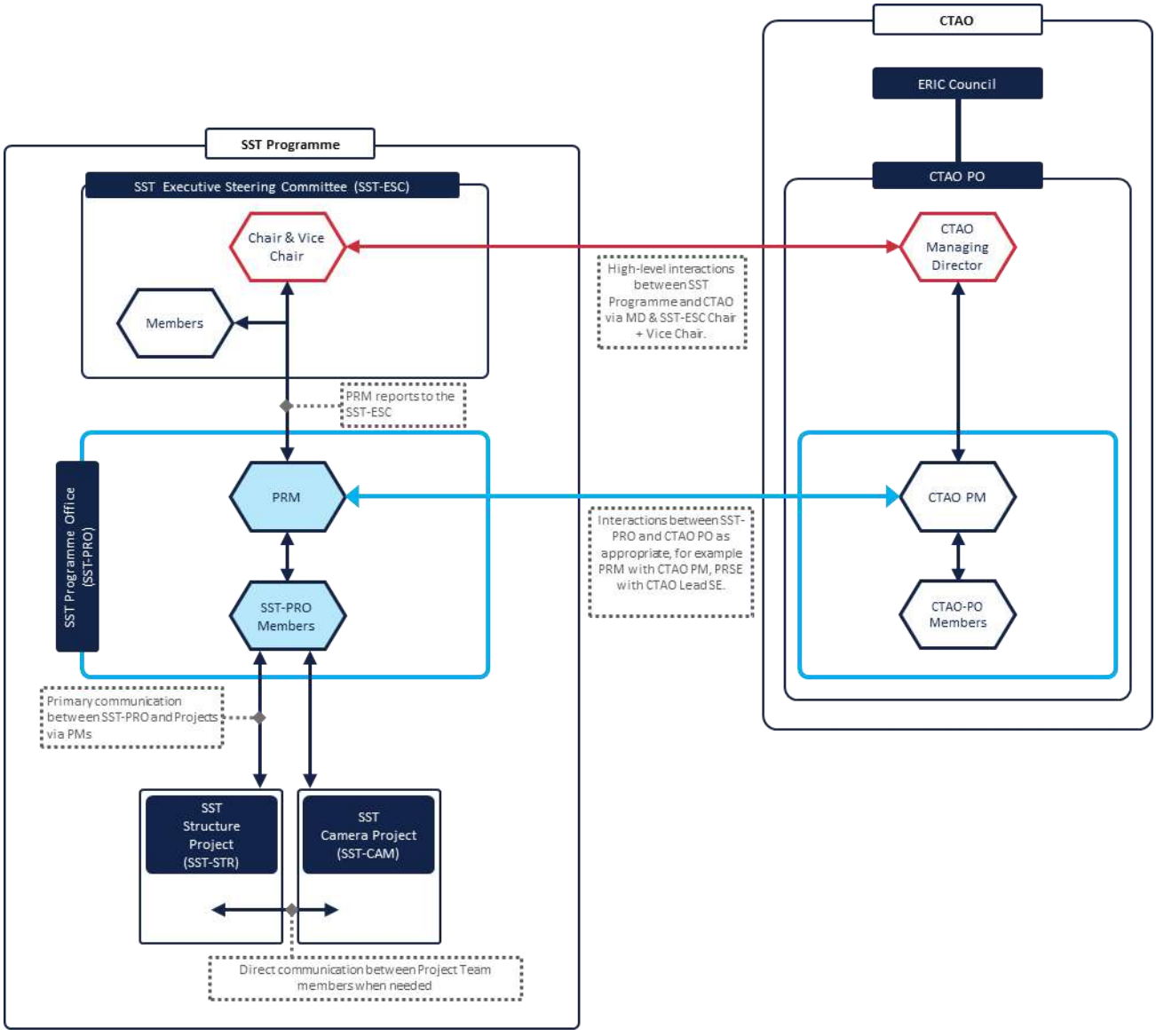

Figure 4-2: Outline of internal Programme communications and SST Programme interactions with CTAO.

5 SST-PRO Organization

The SST-PRO organization is reported in this chapter. This SST-PRO structuring aims to:

- Create a common understanding among the various participants
- Identifying unambiguously the share of responsibilities and the work within the programme/projects organization
- Co-ordinating and optimising the necessary resources for task execution

5.1 Product Breakdown Structure (PBS)

The Product Breakdown Structure (PBS) provides the hierarchical product breakdown of the SST Telescope.

The reference Product Tree will be updated as necessary. It will be maintained up to date under configuration control.

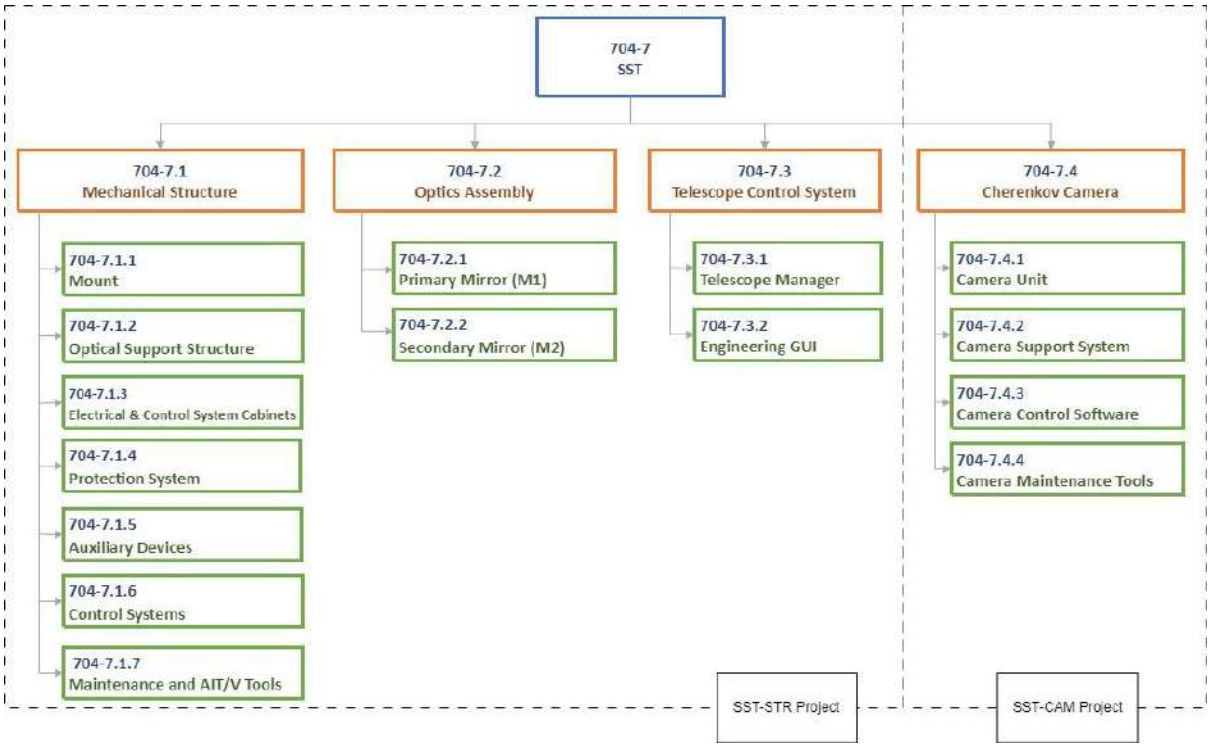

Figure 5-1: SST Telescope Product Breakdown Structure (up to third level)

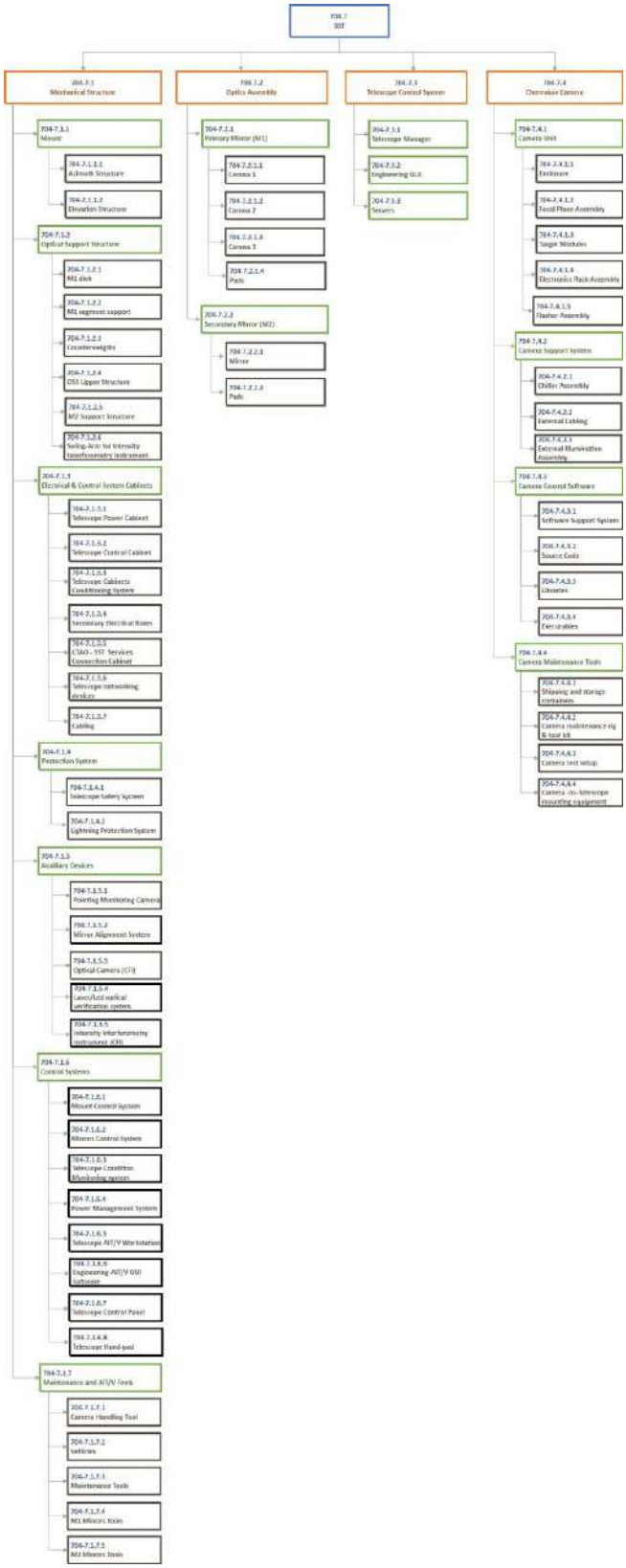

Figure 5-2. SST Structure Product Breakdown Structure (up to fourth level)

The PBS excludes the support functional work, such as Project Management, Engineering and PA, which is covered by the WBS.

The PBS includes as a minimum:

- Items under configuration control
- Items that are subject of technical specification

The Product Breakdown Structure is the source for the selection of configuration items and the basis for the organization of the program Work Breakdown Structure (WBS) of SST-PRO.

Each item of the Product Breakdown Structure will be identified by a unique identification code in accordance with the hierarchical position of the item in the PBS branches. The identification shall remain unchanged during the product lifetime, unless a modification causes discontinuation of interchangeability.

The PBS will be used within the SST-PRO as the reference for the generation of the Deliverable Item List (DIL), where for each item of the PBS the foreseen models and quantity are identified.

The PBS of SST Telescope, reported in Figure 5-2, provides the product decomposition up to third level.

5.2 Work Breakdown Structure (WBS)

The Work Breakdown Structure (WBS) defines the tasks necessary to fulfil the total scope of the SST Telescope design, production and onsite installation, providing a clear, exhaustive and non-redundant description of the tasks necessary to perform the SST Telescope project phases.

It is organized in a hierarchical tree form in order to allow a clear allocation of the tasks to different participants to the project, together with an efficient sharing of the responsibilities.

The WBS is based on the Product Tree, extending the applicable elements to include all appropriate support functions necessary to produce the items.

In accordance with the widely diffuse standard (ESO and ESA), the WBS shows the work related to manufacturing, assembly, integration & test against the models while the Engineering work is identifiable in connection with its related product tree elements. The provisional high level WBS is reported in Figure 5-3. The detailed and applicable WBS shall be presented after the consolidation of SST Telescope consortium as well as industrial teams.

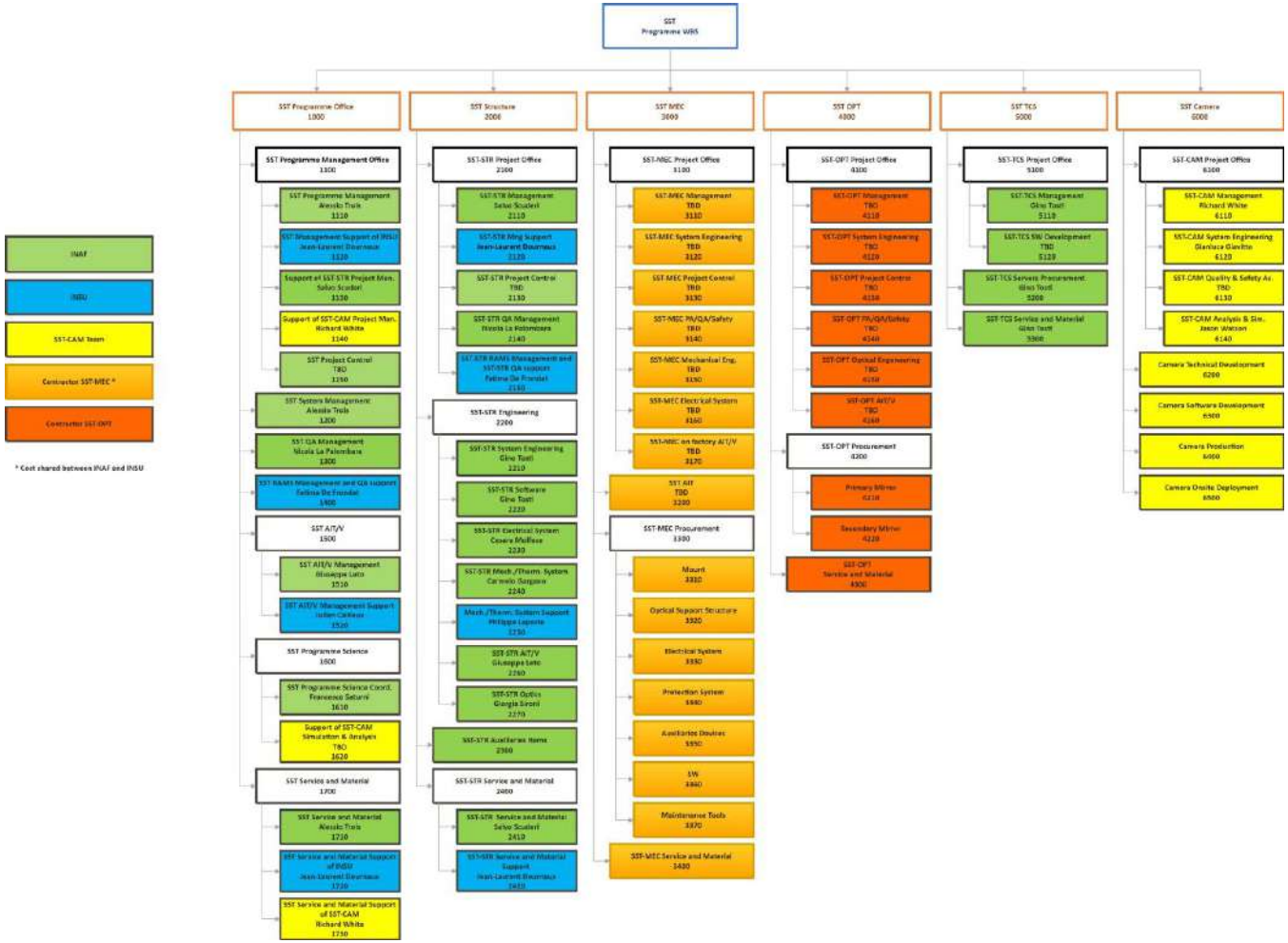

Figure 5-3: SST Telescope High Level WBS

5.3 Work Package Description (WPD)

The Work Breakdown Structure is associated with the relevant Work Package Description (WPD) that univocally defines for each WBS component the task duration, the Work Package Leader, the needed inputs, the performed work and the task output. WPDs shall be presented for the PKO, after the consolidation of SST Telescope consortium and IKC partnership agreement.

5.4 Project Directory

A Project Directory shall be available. This Project Directory shall contain for each member of the SST-PRO consortium the following information:

- function
- address
- telephone numbers
- E-Mail

6 The SST Programme Master Schedule

6.1 Programme Scope & Objectives

The purpose of the SST Programme is to deliver the SST IKC as specified in the IKC agreements. The objectives of the SST Programme are:

- To produce a final SST design accepted by CTAO in a timely and inclusive manner.
- To produce the SSTs with the required quality and on the required timescale.
- To install, integrate and commission the SSTs at CTA-S.
- To transfer SSTs operation and maintenance knowledge to CTAO.

Delivery of the SSTs will be managed through a set of Projects under the umbrella of the SST Programme.

6.2 Programme Deliverables

The SST Programme deliverables are defined as those required to fulfil the SST IKC agreements with CTAO. They are expected to be:

- The SST design including all documentation required by CTAO for acceptance.
- The SSTs.
- Any and all associated software and documentation required by CTAO.
- Spare kits (to be defined)
- Maintenance kits (to be defined)

Input from the SST Programme to CTAO prior to the signing of the IKC agreements, and for which no IKC is anticipated is not regarded as constituting Programme deliverables, for example, material submitted prior to (and for) the acceptance of the SST design. Such non-IKC items will be provided as part of the Design Consolidation Phase and will be identified in the Deliverable Item List (DIL).

6.3 Schedule Technique

INAF will take the responsibility for provision of all Programme-level schedule data.

The SST-PRO master schedule reports, at the current level of content and detail, the main activities and milestones. A coherent set of schedule techniques will be used to allow easy transferring and integration of schedule files in the overall project bar chart and ensure common control, analysis methodology and reporting.

The Precedence Diagram Method (PDM) will be used for all networks.

The project schedule breakdown is organized into hierarchical level:

- Master/summary schedule
- Major constituent schedule (link to PBS/WBS)
- Detailed schedule

Activity numbers will not be reused in the event of deletion or change to the description or nature of an activity.

The same time units will be used for all schedules and the same schedule status date is used for all Detailed Schedules to be integrated into a Master Schedule.

The common set of calendars will be used for all schedules and they will consider all periods where activities cannot take place.

The rules applied to build the project network are:

- Proper logic and sequences of activities
- Coherent set of scheduling techniques at all levels of the SST Consortium
- Coherence between network activities and WBS tasks
- Program key events used as schedule milestones

6.4 Schedule reporting

The project schedule status is reported to SST-ESC and to CTAO-PO on a regular basis.

Updated schedule documentation will be included in the progress report and complemented by the following information:

- Updated Milestones List
- Activity progress status based on the bar charts, showing
  - activities status progress with actual dates of starting and completion and, in case of shifting, new date of completion and recovery actions
  - activities impacted by any other change as change of logic links, change of durations, start and end dates evolution
- Summary list of deliverable items reporting the status (nominal delivery date, new delivery date, final delivery date)

For all the activities that are affected by a schedule change during the reporting period a concise description of their status will be provided, indicating possible impacts and/or other significant implications.

7 Configuration and Documentation Management

7.1 Configuration and Data Management

The SST PRO will establish and maintained a Configuration and Data Management (CADM) plan [RD2] and procedures. The CADM program, applied during the different project phases, includes rules and procedures for:

- Identification revision and control of the Project documentation
- Systematic management of Project data and control of documents distribution and delivery
- Progressive review and release of all drawings and Project documentation in accordance with the Project Requirements and established baseline
- Change control and processing of the change documentation
- Maintenance, throughout the Project life cycle, of the configuration status accounting for each Configuration Item and all configured parts.
- Support for document preparation, identification and control
- Data and document receipt and registration
- Data maintenance, storage, retrieval distribution and exchange.

The CADM includes procedures and standards for:

- Classification of documents
- Document numbering and identification
- Document approval

7.2 Document Management

7.2.1 Document Delivery List

Document delivery list, identifying documentation agreed with each SST partner, is reported in [RD2].

All Controlled Documents (identified in a Configuration Item Data List for a Configuration Item) will be included in the Document Delivery Lists.

Any addition, deletion or revision of the Document Delivery List will be agreed with SST-ESC.

7.2.2 Document Control, Distribution and Retrieval

All controlled documents will be subject to the configuration management requirements.

SST-PRO will protect and distribute documents according to the level of confidentiality of information they contain.

SST-PRO will prepare project documentation to an agreed standard format and structure.

SST-PRO will inform any recipient in a timely manner of the existence of any document needed during project execution.

7.2.3 Document Format

All deliverable documents listed within the Document Delivery Lists for the reviews shall be made available to CTAO in electronic format. All the deliverable document shall be provided to CTAO formal with signatures as pdf file. The source editable documents shall be MS Word file, available to CTAO “on request” only. All the documentation and models of SST Programme shall be available in a document repository accessible to all the SST Consortium members. The current repository environment is organised on Redmine environment of INAF. Instructions for access are provided in [RD2].

8 Inventory and Property Control

Property Control is the instrument for handling, storing, accounting and final disposing of the SST property items. SST-PRO will ensure property control performance of the contract/agreement, including any other third party who acts on his behalf or to whom it entrusts CTA final property.

The inventory control function will provide full accountability of SST owned items during the term of the contract. To serve this purpose, these items will be uniquely identified, marked, segregated and maintained.

Upon completion of the deliveries the SST-PRO partners will dispose of all items acquired in accordance with agreed instructions (To be defined). In order to guarantee the correct implementation of the property control, SST-PRO will define inventory control procedures subject to CTA approval.

8.1 Treatment of Property

All property items subject to inventory control will be uniquely identified and changes to such items affecting their configuration, quality, reliability, performance, value or usefulness to the CTAO, as their physical location will be traced and recorded.

8.2 Recording of Property

SST-PRO will establish a dedicated computerized system capable of recording and reporting Inventory Control Data.

8.3 Marking of property

All hardware and software subject to inventory control must be uniquely labelled to be traceable in the Inventory System.

SST-PRO will ensure that all items under its direct control are provided with labels containing identification and indication of property.

8.4 Disposal of Property

Upon completion of use or at the end of the contract the listed property will be submit to the CTAO a proposal of method of disposal for approval.

8.5 Audit and Physical Inspection

CTA as owner of all items procured under the agreement is entitled to verify any contractor inventory listing and to control the use and state of the inventory items.

Being responsible for the overall coordination of the Inventory Control, INAF, will assure completeness of listings and will support CTA during audit and physical inspection.

9 Risk Management

SST-PRO will implement a Risk Management Process to manage and control risks associated to the series production of SSTs in accordance with the CTA rules.

The objective of the risk management [RD3] is to identify all risks and to keep them within defined and acceptable boundaries. The process will be defined in the Risk Management Plan, identifying the main risks that threaten the successful completion of the production, in particular where it affects the schedule and cost.

The responsibility for the identification and management of risk is taken over by the SST-PRO who supervises the application of the correct methodology and takes in charge the maintenance of the risk register.

Risk Management is a systematic process that will be applied throughout the life-cycle of the project.

The SST-PRO will analyse risks and evaluate, with the other projects, alternative solutions and ensure awareness at all level and elements of the project. It will control risks and establish plans for contingencies, to be managed at designated levels of hierarchy. The risks will be monitored jointly with the other Projects and contingency plans put into action.

The following risk management steps and tasks will be implemented; they are detailed in the proposed Risk Management Plan:

- Definition of risk management implementation rules
- Definition of the risk management policy and the preparation of the risk management plan, for agreement by the Agency
- Identification and assessment of the risk
- Identification of risk scenarios, determination of individual risks magnitude and their ranking using data from all project domains (managerial, programmatic, and technical)
- Decide and act
- Analysis of the risks acceptability or risk reduction option, according to the risk management policy and the determination of the risk reduction strategy
- Monitor, communicate and accept risks
- Periodical assessment and review of the identified risks and as well the identification of changes to the existing risks by performing a new risk analysis
- Definition of the risk trend over the project evolution and its communication to the appropriate level of management is performed with submission of the risks for acceptance by the appropriate level of management.

The risk management policy will be made uniform for all the members of the SST Projects.

10 SST Programme Software and Tools

10.1 Electronic Communication Interface

Communication interfaces and facilities are such to ensure formal secure communication with all project participants over the Internet for technical and programmatic (as described in sec. 4.2).

Mail system, virus screening, videoconference equipment will be put in place as necessary.

The videoconference environment is Google Meet or Zoom.

10.2 Electronic Data Interfaces

Electronic data interfaces, established in a coherent way with the standard adopted by SST Programme, will include:

- Searchable PDF files as the standard file format for delivering read-only documents,
- MS Excel spreadsheets for transferring financial information,
- Microsoft Project for the transferring schedule information,
- MS Word for transferring documents in editable format,
- JPEG as standard file format for photographic pictures,
- MPEG for videos,
- TIFF with LZW or other lossless compression for technical images,
- DWG for Technical/CAD drawings,
- STEP (protocol AP203) for exchange of 3D drawings
- XML for delivering content of specific databases (e.g. Engineering data, Documentation attributes, etc.),
- ECOS (TBC) for the delivery of Financial Proposal and updated WBS price data
- JAMA for management of requirements. This environment is provided by CTAO (TBC)
- EDTS provided by CTAO (TBC) for the management of the reviews and document data base

10.3 Engineering and Management Tools

The preliminary standard engineering tools are reported in Table 10-1 (TBC).

Table 10-1: standard engineering tools

PCB Design	CAD	Circuit Sim.	µ-Controller FW	FPGA FW	Optics	Thermal	FEA
Mentor Graphics	Catia V5	LT Spice	Atmel Studio	Xilinx Vivado	Zemax	SF Pressure Drop	MSC Patran / Nastran
Zuken CADSTAR	Siemens NX	-	-	Xilinx Vivado	ROBAST	-	Ansys
Cadence	SolidWorks	-	-	-	-	-	

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