ISTITUTO NAZIONALE DI FISICA NUCLEARE

CONSIGLIO DIRETTIVO

DELIBERAZIONE N. 14229

Il Consiglio Direttivo dell'Istituto Nazionale di Fisica Nucleare, riunito a Roma in data 29 novembre 2016 alla presenza di n. 33 suoi componenti su un totale di n. 34;

- premesso che con deliberazione del Consiglio Direttivo n. 14055 del 29 aprile 2016 l'Istituto ha approvato l'"In-Kind Contribution Agreement between ESS ERIC and INFN – Construction Phase e annessa SCHEDULE AIK 3.6 Drift Tube Linac (DTL)" volto al riconoscimento dei servizi e dei lavori effettuati dall'INFN come contributo in-kind al progetto ESS in vista dell'inizio della costruzione della facility;

- considerato che l'art. 2.2 del suddetto Accordo prevede la possibilità che ulteriori annessi tecnici resi disponibili da ESS ERIC e dal contraente possano essere successivamente allegati all'Accordo e di esso considerati facenti parte integrante;

- vista la successiva deliberazione del Consiglio Direttivo n. 14108 del 24 giugno 2016 con la quale è stato successivamente approvato l'annesso tecnico "SCHEDULE AIK 3.5 Ion Source & Low Energy Beam Transport (LEBT) to the In-Kind Contribution Agreement signed between European Spallation Source ERIC and INFN";

- considerato che si rende necessario approvare un ulteriore annesso tecnico relativo alla realizzazione, test e consegna delle cavità superconduttive di ESS;

- **preso atto che l'approvazione di tale documento non comporta per l'Istituto oneri finanziari aggiuntivi oltre quelli già precedentemente deliberati con deliberazione del Consiglio Direttivo n. 14055 del 29 aprile 2016**;

- visto lo schema di "SCHEDULE AIK 5.6 Medium-Beta Elliptical Cavity Fabrication and Testing" to the In-Kind Contribution Agreement signed between European Spallation Source ERIC and INFN", allegato alla presente deliberazione e di essa facente parte integrante;

- su proposta della Giunta Esecutiva;

- con n. 33 voti favorevoli;

DELIBERA

1) Di approvare lo schema di "SCHEDULE AIK 5.6 Medium-Beta Elliptical Cavity Fabrication and Testing" to the In-Kind Contribution Agreement signed between European Spallation Source ERIC and INFN", allegato alla presente deliberazione e di essa facente parte integrante.

# SCHEDULE AIK 5.6

# "MEDIUM-BETA ELLIPTICAL CAVITY FABRICATION AND TESTING"

# TO THE IN-KIND CONTRIBUTION AGREEMENT SIGNED BETWEEN ESS AND INFN

# CONTENTS

## 1. SCOPE

This document describes the Scope of Work (SoW) required to complete the Medium-Beta Elliptical Cavity Fabrication and Testing contribution to the ESS programme. It is an integral part of the In-Kind Contribution Agreement and is agreed upon by all undersigning Parties. The SoW contains an appropriate level of detail so all parties clearly understand what work is required, the duration of the work involved, the deliverables and the conditions of acceptance.

## 2. RELATED DOCUMENTS

### 2.1 Applicable Documents

These documents are mandatory for executing the SoW:

**[1]** [REQ] ESS-0041759 Elliptical Cavity Cryomodule Interfaces Requirements, 18 Feb 2016, Rev 1, State Released

**[2]** [REQ] ESS-0041762 Elliptical Cavity Cryomodule Requirements, 18 Feb 2016, Rev 1, State, Released

**[3]** [REQ] ESS-0033356, TUV NORD, "Pre-study of legal QC requirements for pressure equipment (cryo)", 12 Oct 2015, Rev 1, Released.

### 2.2 Reference documents

These documents are provided only as guidance for executing the SoW, unless a specific reference is made elsewhere in this Schedule.

**[4]** [CCP] ESS-0001879 Change Control Process, 9 Oct 2014, Rev. 3 State: Released.

**[5]** [CMP] ESS-0003688 Configuration Management Plan, 14 Oct 2013, Rev. 1 State: Released

**[6]** [DRP] ESS-0008910 Design Review SOP, 27 Oct 2014, Rev. 1 State: Released

**[7]** [RMP] ESS-0000263 ESS Process for Risk Management, 24 Nov 2014, Rev. 4 State: Released

**[8]** [LOG] ESS-0042559 (two documents) Guideline: & Shipping Instruction / Pre Advice – In Kind, Rev. 1, State: Released

**[9]** [PQP] ESS-0037830, ESS template for Project Quality Plan, 22 Sep 2015, Rev. 1, State: Released

**[10]** [ISS] ESS-0017560 TS, AD, NSS and ICS Plan and Implementation Strategy for Hazardous Materials and Sustainability, 08 Feb 2016, Rev. 1

## 3. TERMS AND DEFINTIONS

| | |
|---|---|
| CEA | Le Commissariat à l'énergie atomique et aux énergies alternatives |
| CDR | Critical Design Review |
| CM | Cryomodule |
| ERIC | European Research Infrastructure Consortium |
| ESS | European Spallation Source |
| Facility element | This item corresponds to the product contribution of the Partner. It is an element of the ESS PBS and/or WBS |
| FAT | Factory Acceptance Test |
| INFN-LASA | Istituto Nazionale di Fisica Nucleare – Laboratorio Acceleratori e Superconduttività Applicata |
| PDR | Preliminary Design Review |
| RAMI | Reliability, Availability, Maintainability, Inspectability |
| SAR | System Acceptance Review |
| SAT | Site Acceptance Test |
| SM | Status Meeting |
| SoW | Scope of Work |
| SRF | Superconducting Radio Frequency |
| WBS | Work Breakdown Structure |
| WP | Work Package |
| WU | Work Unit |
| VTF | Vertical Test Facility |
| HPR | High pressure rinse |
| WP | Work Package |
| KO | Kick-off meeting |

## 4. PROJECT DEFINITION

INFN-LASA (Partner) has agreed to procure, fabricate, test and deliver 36 (6-cell) medium beta super-conducting 704.42 MHz dressed cavities according to requirements [1][2]and [3].

The Cavities will be fabricated by the Partner based on CEA/ESS cavity design with the Partner design modifications and fully compatible ("plug compatible") with CEA/ESS boundary conditions. The Partner design modification is relative to the cavity itself. Cavity interfaces such as helium tank geometry, flang-es, tuner connections etc. will be done on the basis of the CEA/ESS design.

As a part of this program of work, the Partner will liaise closely with the various ESS SRF technology development teams, which include CEA Saclay and IPN Orsay who are responsible for the cryomodule integration. The Partner will also liaise closely with STFC, the supplier of the high-beta dressed cavities. In addition, close collaboration will be formulated with a number of commercial partners as selected by the Partner's procurement process, particularly those with demonstrated fabrication experience to achieve the delivery of the cavities by the stipulated timescale.

As part of the delivery of medium-beta dressed cavities the Partner will undertake the procurement of niobium material, the fabrication of SRF dressed cavities and ancillaries through qualified manufacturers.

The Partner responsibility includes the cold vertical characterization tests that will be performed in a qual-ified large European infrastructure. After successful testing (FAT) the cavities will be delivered to CEA Saclay for ESS acceptance (SAT) which is an arrival acceptance inspection. The positive cavity ac-ceptance with SAR(s) by ESS is the formal hand-over from the Partner to ESS that will be then integrated into the cryomodule.

In addition the Partner agree to support ESS regarding any cavity issues at cryomodule integration and testing at CEA Saclay and installation, commissioning and operation start-up at ESS Lund. This support is not covered by the cost in this Technical Annex and will hence be addressed with a change request.

This chapter 4 describes and defines the Scope of Work (SoW) required to complete the medium-beta cavity fabrication, testing, verification and follow-up of the ESS requirements.

### 4.1 Deliverable Item definition

The Partner shall provide its complete contribution in accordance with the following table where deliveries from WBS 11.5.2.3 "Medium Beta Cavity Fabrication" and WBS 11.5.2.4 "Medium Beta Cavity follow-up" are included. Sub deliveries are defined in 4.4.

Start date: [Q1 2015]
End date: [Q1 2019]

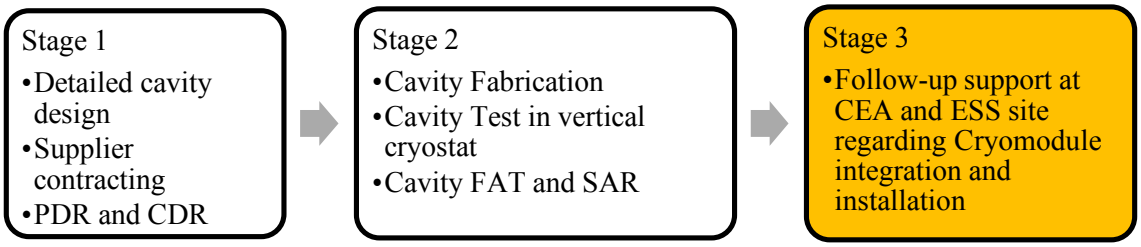
| Task no. | Deliverables | Delivery Deadline / Delivery MS |
|---|---|---|
| WBS 11.5.2.3 | 36 (6-cell) Medium-beta cavities, fully treated (chemical and heat), 2 K qualified cavities including ancillaries (flanges, vacuum valves, antennas, etc.) and helium tank integration, shipped to CEA Saclay. | Q1 2019 |
| WBS 11.5.2.4 | Medium-beta cavity follow-up on niobium material, cavity production, cavity testing in vertical cryostat, cryomodule integration and travel. | Q1 2019 |

This overall contribution is set to the ESS Cost Book value of **11 150 000** Euros.

Each of the delivery milestones is also part of the Earned Value tracking (chapter 5.1).

## 4.2 Project Stages Definition

The project stages including key parameters are depicted in the figure below.




### 4.2.1 Stage 1: Design Stage

#### 4.2.1.1 Preliminary Design

Preliminary design prepares for and precedes detailed design and may involve: design and other analyses and simulations; prototyping; trade-off analyses, and the further development (updating) and documentation of requirements and specifications of the ESS baseline reference design, including definition of interfaces.

Within Stage 1 the preliminary design of the medium beta-cavity and vertical test stand are developed. This includes but is not necessarily limited to:

. Carrying out comprehensive design of the medium beta-cavity and the vertical test stand in relation to the requirements.
. Establish the Risk Register.
. Updates / new baseline for [REQ]

Preliminary design starts upon successful completion of a Kick-Off Meeting, which may include a review of ESS inputs for any baseline reference design including [REQ] and/or [SPEC]. Preliminary design ends with the successful completion of the PDR (Preliminary Design Review).

#### 4.2.1.2 Detailed Design

Detailed design completes Stage 1, prepares for and precedes Stage 2 “Realization and Verification”. Detailed design may involve: analyses and simulations; prototyping; further development and documentation of requirements and specifications including definition of interfaces; and other detailed documentation of the design through reports, 3D models and drawings, which enable realisation through procurement and/or construction / manufacture and assembly.

Within Stage 1 the design is detailed of the medium beta-cavity and vertical test stand and verified by way of analysis and/or test down to the lowest level selected by the Partner and agreed with ESS. This includes but is not necessarily limited to:

. Carrying out detailed design of the medium beta-cavity and the vertical test stand in relation to the requirements.
. Expanding and consolidating the interface requirements and specifications as necessary for the cavities.
. Establish [PQP] and update risk register.
. Contracting with screened cavity-, test facility- and material-suppliers. The contracts shall include options to order additional cavities including material to the same price/unit as for the original 36 cavities till the middle of the production.

- Scheduling and planning of the manufacture, assembly and testing including procedures and cold characterization testing to be performed in a qualified large European infrastructure
- Documenting:
    - logistics needs for the facility element (e.g. test equipment, storage, transportation, handling and packaging, expected preventive and corrective maintenance activities),
    - updates / new baseline for design descriptions of the facility element including written specifications, CAD models, drawings etc.
    - planning for test and verification activities.
    - updates / new baseline for [REQ]
    - Non-conformity tracking using a data management system

The detailed conformity between the proposed design and the requirements shall be developed and demonstrated. The detailed design shall be elaborated such that:

a) A thorough and complete evaluation of the ability of the design to fulfil the requirements is possible and is supported by an appropriate traceability between the requirements and the proposed design features.
b) The development process for hardware is well established including manufacturing methods, processing and tooling requirements.
c) The procurement documentation for the facility element is ready for competitive procurement. This includes technical specifications and statements of work for vendors or manufacturers.

Detailed design starts after the successful completion of the PDR and ends with the successful completion of the Critical Design Review.

#### 4.2.2 Stage 2: Realization and Verification

In stage 2, the cavities are realized, tested and verified. The deliverables of Stage 1, such as design reports, detailed design and prototypes, become tangible hardware products through procurement, manufacturing and assembling. The hardware are then verified, through inspection, demonstration, analysis and most normally through testing in comparison to agreed design, specifications and performance requirements. The activities include but is not necessarily limited to:

- Management of the material delivery and QA/QC at DESY in order to reduce risks and increase the yield of cavities meeting requirements.
    - Niobium sheets must be delivered to DESY in circular disks of maximum 500 mm or diagonal less than 660 mm.
    - DESY will at the expense of ESS inspect the sheets optically and through eddy-current scanning.
    - If a damage, inclusion or similar is discovered, that may impact on the cavity requirement conformity, DESY may perform further analyses also at the expense of ESS.
    - Results from DESY will be reported to the Partner who will be responsible for possible mitigations such as replacement sheets and associated transportation. ESS will however provide the same QA/QC of new sheets as for the original sheets if needed.
    - The transport of approved sheets from DESY to the cavity manufacturer will be managed by the Partner but paid by ESS.
    - ESS will not take responsibility for the conformance of the cavities to applicable requirement, regardless of DESY´s analyses.
    - ESS encourages the Partner to inspect the Nb sheets at the supplier during production and before delivery, in order to ensure that sheets of sufficient quality are delivered to DESY.
- Fabrication, quality management and follow-up on the cavity production and transportation.
- Testing and verification of the medium-beta cavities to applicable requirements.
- If needed, reworking of cavity retreatment.
- Taking over the documentation provided by the suppliers.

- Storing and handling the product in conditions that ensure its integrity,
- Transporting systems (including fixtures) and components (4 cavities/month) to ESS/CEA site and mailing or uploading its corresponding documentation to the ESS WU coordinator.

Stage 2 starts upon successful completion of CDR. Stage 2 ends with the successful completion of SAR(s) (System Acceptance Review).

#### 4.2.3 Stage 3: Integration, Installation, Commissioning and Initial Operations

In stage 3, the cavities are integrated into the Cryomodules at CEA and thereafter installed, commissioned and operation started at ESS in Lund. These activities will be executed by CEA and ESS but support regarding specific issues related to the cavities might need to be provided by the Partner. This includes but is not necessarily limited to:

- Support to CEA regarding the medium beta-cavity Cryomodule integration.
- Support to ESS regarding Cryomodule installation, commissioning and initial operations for issues concerning the medium beta-cavity in specific.

Stage 3 (except brief replies and advice) is not included in the current cost and will be addressed with a change request if needed.

### 4.3 Project Schedule and Key Milestones

| **Ms ID** | **Resp. org.** | **Short description/Milestone definition** | **MS date** | CAS |
|---|---|---|---|---|
| 1. | ESS | Kick-off meeting where after Stage 1 starts. | Tbd | 5% |
| **Stage 1** | | | | |
| 2. | The Partner | PDR | May 2016 | 10% |
| 3. | ESS | CDR including ESS agreement on the Partner cavity production option | Mar 2017 | 10% |
| **Stage 2** | | | | |
| 4. | The Partner | Receiving and arrival inspection reporting of niobium material at the Partner | Q1 2017 | 5% |
| Stage 2 Cavities to CM 1-9 | | | | |
| 5. | The Partner | Receiving and arrival inspection of production subcomponents components for Cavity 1 by the Partner | Q2 2017 | |
| 6. | The Partner | Receiving and arrival inspection of Medium-beta cavities for CM 1 by the Partner | Q3 2017 | |
| 7. | The Partner | FAT and shipping of Medium-beta cavities for CM 1 to CEA | Dec 2017 | |
| 8. | ESS | SAT and SAR of CM 1 cavities | 1 week after delivery | 5% |
| 9. | The Partner | FAT and shipping of Medium-beta cavities for CM 2 to CEA | Jan 2018 | |

| | | | | |
|---|---|---|---|---|
| 10. | ESS | SAT and SAR of CM 2 cavities | 1 week after delivery | 5% |
| 11. | The Partner | FAT and shipping of Medium-beta cavities for CM 3 to CEA | February 2018 | |
| 12. | ESS | SAT and SAR of CM 3 cavities | 1 week after delivery | 5% |
| 13. | The Partner | FAT and shipping of Medium-beta cavities for CM 4 to CEA | March 2018 | |
| 14. | ESS | SAT and SAR of CM 4 cavities | 1 week after delivery | 5% |
| 15. | The Partner | FAT and shipping of Medium-beta cavities for CM 5 to CEA | Apr 2018 | |
| 16. | ESS | SAT and SAR of CM 5 cavities | 1 week after delivery | 5% |
| 17. | The Partner | FAT and shipping of Medium-beta cavities for CM 6 to CEA | May 2018 | |
| 18. | ESS | SAT and SAR of CM 6 cavities | 1 week after delivery | 5% |
| 19. | The Partner | FAT and shipping of Medium-beta cavities for CM 7 to CEA | Jun 2018 | |
| 20. | ESS | SAT and SAR of CM 7 cavities | 1 week after delivery | 5% |
| 21. | The Partner | FAT and shipping of Medium-beta cavities for CM 8 to CEA | Jul 2018 | |
| 22. | ESS | SAT and SAR of CM 8 cavities | 1 week after delivery | 5% |
| | The Partner | FAT and shipping of Medium-beta cavities for CM 9 to CEA | Sep 2018 | |
| 23. | ESS | SAT and SAR of CM 9 cavities | 1 week after delivery | 5% |
| 24. | The Partner | Preparation of final data package | SAR - 5 weeks | |
| 25. | ESS | Final SAR of final data package | Q1 2019 | 25% |

#### 4.3.1 Kick-off meeting

The main objective of the kick-off meeting is to confirm the mutual understanding between ESS and the Partner of the Scope of Work specified herein, including applicable specifications.

- Present and review the project plan, schedule and work breakdown structure (the baseline proposals),
- Introduce the key resources and team members,
- Review key milestones,
- Present management plans as applicable.

The participants shall take the minutes of the meeting and record the action items.

#### 4.3.2 Status meetings

A status meeting shall be held every month during the whole duration of the project. Status meetings may be held at the ESS or Partner's premises or over the telephone/video conferencing facilities available. The purpose with the meeting is to review progress, risks, review/decide on change requests and discuss upcoming activities and potential challenges.

The Partner is responsible for carrying out the SoW in a timely manner, fully in accordance with the time schedule referred to above. The Partner shall provide a written progress Monthly Status Report at least three (3) working days in advance of the meeting.

The Parties shall take the minutes of the meeting and record the action items.

#### 4.3.3 Design Review(s) in Stage 1

##### 4.3.3.1 Preliminary Design Review

Preliminary Design Reviews, reviews preliminary design, sometimes referred to as conceptual design. A PDR assesses preliminary design options and decisions in comparison with ESS input baseline reference design including requirements. A successful PDR demonstrates that design is sufficiently developed, clear and agreed between ESS and the Partner. Preliminary design updates the baseline reference design which was agreed at Kick-off, and a successful PDR establishes a new baseline, described in [CMP] [5] as the 'Allocated Baseline' from which the Partner may proceed to detailed design, including any agreed pre-series prototyping. For planning purposes, a PDR should be limited to no more than one working day.

ESS shall, in cooperation with the Partner develop a 'charge' confirming deliverables for review i.e. the data package, nominating the review committee and containing other coordinating information for the review. As a minimum, the data package shall contain deliverables as specified in 4.4.2.1. The charge including confirming the contents of the PDR data package shall be established as a minimum 3 (three) weeks before the review.

The agenda of the review meeting shall be agreed no less than 1 (one) week before the review meeting. The review meeting may include presentations by the Partner of the work undertaken and explanations of the content of the data package. The Partner should provide drafts for these presentations to ESS as early as possible in advance of the review meeting.

##### 4.3.3.2 Critical Design Review

A Critical Design Review concludes Stage 1. The CDR assesses if the stage 1 activities meet all the requirements with acceptable risk and within the cost and schedule constraints. The CDR demonstrates that the maturity of the preparation is appropriate to support proceeding with full-scale fabrication, assembly, integration, test, and future operation and decommissioning.

The contents of the CDR data package shall be established as a minimum 5 weeks before the review. As a minimum it shall contain all deliverables as specified in 4.4.2.2.

The review board shall review the documentation provided and submit written comments to the ESS and the Partner no less than 3 working weeks before the review meeting. The Partner shall consolidate the comments and provide written answers to the board no less than 1 working week before the review meeting.

The agenda of the review meeting shall be communicated to the Parties no less than 1 week before the review meeting. The review meeting may include in depth presentations by the Partner of the work undertaken and responses to the review findings.

For planning purposes it can be expected that a CDR may last 1 working day.

#### 4.3.4 System Acceptance Review

The System Acceptance Review (SAR) examines the facility element, documentation, inspection, demonstration, test data and analyses that it supports its verification as defined in the Verification Plan and Report. The SAR ensures that all requirements have been satisfied and that the integration activities of the facility element can start as defined in the facility element Integration Plan.

In specific, SARs will include results from Cavity FAT(s) at the Partner and Cavity SATs (arrival inspection) at CEA. In addition a final SAR at the delivery of all cavities will review all remaining documentation as defined in 4.4.5

The SARs shall be organized by ESS. The final SAR will involve programme members of the Partner as well as any other stakeholders at the discretion of the review chairman. The chair of the review board is appointed by ESS. The membership of the board is communicated to the review participants at the earliest possible time.

The content of the final SAR data package shall be established as a minimum 5 weeks before the review. As a minimum it shall contain all deliverables as specified in 4.4.5.

For planning purposes it can be expected that a SAR may last 1 working day.

The review board shall review the documentation provided and submit written comments no less than 3 working weeks before the review meeting. The Partner shall consolidate the comments and provide written answers to the board no less than 1 working week before the review meeting.

The agenda of the review meeting shall be communicated to the review participants no less than 1 week before the review meeting. The review meeting may include in depth presentations by the Partner of the work undertaken and responses to the review findings.

The successful completion of the System Acceptance Review(s) is the prerequisite for transfer of ownership as defined in the In-Kind Contribution Agreement between and for crediting values to the Partner.

### 4.4 **Deliverables**

These chapters define the deliveries to complement 4.1.

#### 4.4.1 Status reports

During the execution of the SoW, the Partner shall submit to the ESS monthly status reports containing (as according to Enclosure 1: Monthly Status Report):

1. The status of the SoW since the preceding report;
2. The progress expected to be made in the next following period and any other pertinent issues related to the Project Results;
3. Updated Milestone Tracking Table
4. Desired changes to existing baseline
5. Risk Management
6. Updated electronic versions of the Partner plans

During the execution of the SoW, the System Status Report related to the facility element will be maintained by the ESS WU Coordinator. The ESS WU Coordinator and the Partner will ensure that the Status Report reflects the current development maturity of the facility element and especially that verification or operating restrictions and limitations due to an uncompleted development are reported.

#### 4.4.2 Stage 1 data packages

The Stage 1 data package shall cover all activities undertaken during Stage 1. The data package shall document as applicable in the SoW, the technical baseline items and the trade-offs that lead to this definition, detailed design including the operation documentation for all the equipment (software and hardware) that are necessary for test, handling, transport, storage, installation, maintenance and operation thereof when applicable. The data package shall demonstrate compliance with the applicable requirements and established verification plans. The data package shall rely on templates provided by ESS. This package shall include the stage 1 work but not be limited to:

##### 4.4.2.1 *PDR data package*

- Requirements, agreed or proposed updates to documents comprising the baseline reference design, such as requirements and specifications etc.
- Design Data, proposed comprehensive design.
- Risk Register, established.

##### 4.4.2.2 *CDR Data package*

- Requirements, any updates.
- Design Data, agreed or proposed updates to documents comprising (detailed design level) including 3D CAD models, drawings etc.
- RAMI Report, a report of the estimation of the probability and consequences of failures in equipment as well as main maintenance tasks and proposed spare parts.
- Safety Report, a brief safety risk assessment report (including identifying hazards and evaluating likelihood of incidents occurring and severity of potential consequences, also list of existing control measures). See 5.5.2.
- Risk Register, established or updated.
- Verification Plan, (including planned FAT and SAT activities).
- [PQP], a full draft for the Project Quality Plan including identification of Standards applied in design, procurement, manufacture and assembly, and planning for compliance verification and inspection.

#### 4.4.3 Stage 2 data package

The Stage 2 data package shall cover all activities undertaken during Stage 2. The data package shall contain the "as-built" documentation and verification records showing the compliance with the facility element requirements. This package shall include the stage 2 work but not be limited to:

- Requirements, any updates.
- Design Data, agreed or proposed updates to documents to conform to 'as-built', 'as-verified' and 'as-delivered' configuration, including 3D CAD models, drawings etc.

. RAMI Report, report update.
. Safety Report, update of the safety risk assessment report
. Data for Operations and Maintenance, operator manuals or instructions, maintenance manuals, lists of tools and test equipment, illustrated parts lists / Bills of Materials, recommended spares lists
. Verification Plan, Specifications and Report(s). This includes:
    - verification plan (or updated plan delivered from a previous data package e.g. at CDR),
    - verification specifications for each planned verification activity (or updated verification spec. delivered from a previous data package e.g. at SAR)
    - verification report(s) showing the summary of each verification activity, the results / outcomes for each verification activity, including from FAT and/or SAT.
. [PQP], any updates to the Project Quality Plan needed to reflect the 'as-built', 'as-verified' and 'as-delivered' configuration baseline, and compliance records and certificates.

#### 4.4.4 Final report

The Partner shall issue a final written report to the ESS within four (4) weeks of the completion of the stages. Such report shall include a comprehensive summary of the contributions made, works and services undertaken and Project Results achieved including identified learning points.

#### 4.4.5 Documentation package for supply

The Partner shall deliver at the completion of the project:

- Stage 1 data package,
- Stage 2 data package,
- Data sheets,
- Certificates for inspections, and qualifying / certifying / regulatory assessments
- All CAD models

## 5. TASKS APPLICABLE TO ALL PROJECT STAGES

### 5.1 Project management and control

ESS is mandated to use Earned Value Management as a tool for managing progress and performance. This translates into a requirement for tracking deliverables from Partners. Below, chapter 5.1.1 – 5.1.6 defines the requirements concerning scheduling and progress reporting in order to comply with this requirement. Templates and instructions for managing the milestone schedule, including the associated earn value basis are found within [ESM].

#### 5.1.1 Use of a Planning Tool

The Partner should use a planning tool (MS Project, Oracle Primavera, Deltek Open Plan or similar). The purpose with this requirement is to enforce a systematic approach to planning, both creating and maintaining the plan. As part of the monthly status report, the current schedule should be made available for ESS (electronic format).

#### 5.1.2 Delivery Milestones

Each distinct delivery should have a milestone with a date. This also includes part or incremental deliveries.

5.1.3 Milestone Definition List

Each Milestone should have a number, name and a definition. The definition should both explain the content and fulfilment of the milestone and delivery.

5.1.4 Interim Milestones

If the duration of the project work producing the deliverable is more than 6 months, the plan should also contain interim milestones. The purpose with interim milestones is to measure progress and to be used for signalling issues in the fulfilment of the delivery (in the interest of both parties).

5.1.5 EV – Weighted MS value

Each milestone, both interim and delivery milestones, should be associated with a weight (percentage between 0-100). The aggregated fulfilment of all milestones should result in 100%.

5.1.6 Monthly Forecasting

In conjunction with the status reporting, the Partner should also provide an updated forecast for the upcoming milestones, as well as the final delivery milestone.

## 5.2 Risk Management

ESS uses Risk Management as one of the Project Management tools to assist the execution of the Programme. The Partner's contribution in this field is vital and shall therefor form a part of ESS Risk Management Process.

The contribution shall be characterized by risk awareness and open communication regarding risks. The common view of risks and uncertainties are utilized as a stepping-stone to the identification and exploitation of opportunities.

5.2.1 ESS Risk Management Process

Risk Management shall be incorporated as a part of the day-to-day work with the contribution. The Partner shall work according to the ESS Risk Management Process [7], including:

- Plan Risk Management
- Identify risk,
- Analyse risk,
- Risk treatment, monitor and control risk.

5.2.2 ESS risk criteria

When analysing risk, ESS risk criteria could be used. Using ESS criteria for likelihood and consequence enables Partner and ESS to analyse risks in a uniformed way.

The ESS acceptance criteria clarifies what risk level that ESS accepts, and when risk treatments are required. All combinations of likelihoods and consequences correspond to a risk level, either being high, medium or low. This is graphically presented in the ESS risk matrix.

Risk treatments are the measures being taken in order to treat the risk to an acceptable level. High-level risks can never be accepted and require treatment. Medium-level risks can be accepted without treatment if the treatment is not proportional to the gained improvements. Low-level risks can be accepted without treatments.

5.2.3 Risk register

The risk register shall contain the gathered knowledge of identified risks, including the assessed risk exposure. The register shall show identified risks in order of priority, including risk treatment plans.

The Partner should preferably use ESS Risk Management software system, used for systematic documentation of risk registers. If not, the Partner risk register format shall be according to ESS' requirements.

5.2.4 Risk status report

Risk status reports shall include summary describing news and relevant changes to the risk exposure, including on-going Risk Management activities. It shall furthermore contain an updated risk register including risk treatment status.

## 5.3 Configuration management

The ESS programme participants shall develop the baseline of the facility elements and is free to redefine the architecture of the facility elements. Full and part delivery milestones should be under change control. This means that both parties need to agree on changes to the milestones. Baselines are described in ESS Configuration Management Plan [5] and change control is described in Change Control Process [4].

The ESS programme participants should follow the principles of configuration management as laid down in the ESS configuration management plan [5], or equivalent best practices. In particular:

1. The ESS programme participants shall identify each document, drawing, subsystem or part, establishing the item configuration and relation to the hardware and software at any time in the project.
2. The ESS programme participants should apply the change control process [4], in agreement with best practices.
3. The ESS programme participants shall ensure that all personnel that use or generate information can easily access the tools implemented to ensure configuration control. ESS shall provide a central repository for all information and that this repository is properly backed up.

## 5.4 Organization

The persons nominated as the Work-Unit Coordinator according to chapter 6 in **Errore. L'origine riferimento non è stata trovata.** are:

For the Partner (local coordinator): Paolo Michelato

For ESS: Christine Darve

## 5.5 Product and quality assurance and safety

5.5.1 Applicable law, legislation and standards

The Partner should ensure that all work and deliverables comply with relevant provisions of the European directives, national regulations and any additional specified standard, regulation or restriction identified in the documents specified in chapter 2.1. The Partner shall specify standards complied with in the PQP and applicable compliance record in the stage 1 or 2 data package.

5.5.2 Safety

The Partner is responsible, in accordance with applicable European directives and national regulations for safety and health at work for the safe conduct of the Scope of Works set out in the Schedules.

ESS is responsible, in accordance with applicable European and Swedish directives and regulations for safety and health at work for the safe conduct of all activities on-site at ESS Lund. The radiological safety at ESS site and facility remains under the exclusive and sole responsibility of ESS.

### 5.5.3 Quality

The Partner shall prepare a consistent and comprehensive [PQP] that shall generally comply with ESS template for Project Quality Plan [9].

If the Partner has an ISO or other certified Quality System, it is recommended that the Partner use the PQP to make reference to procedures, templates etc. from the Partner's Quality System, and to explain how the Quality System to this Project. The PQP deliverable is not a substitute for a Quality System. So where appropriate procedures do not already exist, the Partner may need to develop, document and apply needed procedures and explain the development, documentation and application of Quality procedures in the PQP.

### 5.5.4 Licensing

Licensing refers to the granting of permits to ESS by Swedish Radiation Safety Authority (SSM) to, progressively:

- construct the ESS facility buildings;
- procuring and possessing technical devices and other Components that are designed to produce ionized radiation;
- installing and commissioning these devices in ESS facility buildings and
- operating and maintaining these devices for neutron science users.

Unless otherwise described in the SoW including documents specified in Chapter 2.1, the licensing for systems and components that are either the Partner's deliverables or ESS deliverables is under ESS responsibility.
ESS remains directly responsible to SSM for licensing and it is the responsibility of ESS to identify and describe in this SoW and/or documents specified in Chapter 2.1, any specific requirements for the Partner, any specific deliverables to be provided by the Partner and any specific process(es) to be followed by the Partner which enable ESS to achieve SSM licensing. ESS may at a later stage, request of the Partner additional information required by, or in support of ESS' responsibilities for SSM licensing.

## 6. DOCUMENTATION FORMAT

- All documentation and correspondence shall be in English.
- All office documents shall be in a MS Word and PDF format.
- The electrical drawings shall be in Eplan format.
- All mechanical models and drawings shall be editable and linked and in Catia V6 or provided in a neutral exchangeable CAD format. Drawings shall be also provided in PDF.

## 7. TRANSPORTATION AND DELIVERY

The Medium beta-cavities shall be delivered to CEA, Saclay, France DAP Incoterms. A delivery notice shall be sent from the Partner approximate 1-2 weeks before planned shipping. All deliverables shall be executed in accordance with the [8].

### 7.1 **Acceptance procedure**

The acceptance procedure is based on the deliveries and the fulfillment of relevant requirements agreed in the verification plan, developed by the Partner and approved by ESS..

In support of the System Acceptance Reviews (SARs), the Partner shall compile all needed information and make necessary conclusions of completeness. Based on provided information and performed tests, any conclusions of the acceptance/test are under responsibility of ESS and are formulated during the System Acceptance Reviews.

## 8. EXCLUDED BACKGROUND

Not applicable.

**IN WITNESS WHEREOF**, the Agreement has been executed in two (2) originals, of which the Parties have received one (1) each.

| **ESS** | **Istituto Nazionale di Fisica Nucleare** |
|---|---|
| _____ | _____ |
| *Date* | *Date* |
| _____ | _____ |
| *Signature* | *Signature* |
| _____ | _____ |
| *Name (in block letters)* | *Name (in block letters)* |
| _____ | _____ |
| *Position* | *Position* |