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| **EIC Elliptical Cavity Prototype**  **Project Execution Plan** |

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| **Project:** | EIC Elliptical Cavity Prototype | **Project Coordinator:** | David Savransky |
| **Document Number** | EICELL-PL-001 | **Revision** | 1 |

# Scope, Description, And Cost

SRFOps will fabricate, process, and test a 591 MHz single cell elliptical prototype cavity as part of the ongoing effort for the Electron Ion Collider (EIC) Electron Storage Ring (ESR) first article (FA) cryomodule. This cavity will be used to verify the RF design of the cavity and ensure that it will meet the needs required by the EIC ESR operations.

The projected cost of this R&D cavity will be around $2 Million dollars.

# Milestone Schedule

The Electron Ion Collider (EIC) single cell elliptical prototype cavity has to be delivered before the final design review of the EIC single cell FA CM planned in middle January 2024. The cavity processing and first cold cavity testing should happen before the procurement for the FA cavity is awarded.

# Customer Requirements

The EIC RF group has provided SRFOps with the acceptance criteria for which this cavity should adhere to as well as any qualification tests, both warm and cold, that should be performed on the cavity. The customer also has provided the base RF design for the cavity.

# Risk Plan

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| Risk Subject | External / Internal | Type  (C, S, T) | Potential Impact  (If… then statement) | Mitigations |
| Cavity does not meet the EIC ESR specification | External | C, S,T | If the cavity does not meet the EIC ESR specifications then the project will have to make design changes to the cavity. | Every step of the project is carefully monitored to identify potential problems early. |
| Work center availability | Internal | C, S | If multiple projects require use of work centers or if work centers do not have sufficient staff or tooling for the requested work load to support all SRFOps projects, the EIC project may be delayed due to lack of available resources. | Maintain project representation at scheduling meeting and weekly priorities and planning meetings to coordinate work at all work centers to reasonably meet project milestone dates. |
| Damage of Tooling or of Cavity Sub-Components | Internal | C, S | If damage is found on the tooling needed to fabricate the cavity or the cavity sub-components then the project will be delayed by however long it takes to replace the tool or remake the component | The tooling made will be tested first and will be partnered with a procedure on how to use it safely.  Cavity components will be carefully tracked through all work centers to minimize damage. |

# ES&H Plan

SRFOps will follow the JLab ES&H Policy and all relevant OSPs. SRFOps will be supported by the Accelerator Division Safety Officer.

A thorough review of all the fabrication steps was conducted to ensure that it falls within the scope of the OSP/THA for all the different work centers.

# Fabrication Plan

As part of the customer deliverables, SRFOps has generated a fabrication plan that will cover all the steps that will be performed during the assembly and processing steps.

The key work station tools that are used are:

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| Work Center | Work Station | Tools |
| Fabrication | Tech Shop | 150 Ton and 450 Ton Presses |
| Furnace Room | Brazing furnaces |
| EBW Room | Electron Beam Welder chamber and controls |
| Inspection | CMM Room | CMM system, cavity internal inspection systems (boroscopes) |
| Structures Lab | FARO Arm |
| Test and Measurement | Electronics Shop | Fabrication area with soldering stations and test equipment |
| Cavity Tuning | Tuning Room | RF Vector Network analyzers, dielectric bead pull systems, cavity tuning benches |
| Furnace | Furnace Room | Elnik Vacuum Furnace large enough for metallurgical heat treatment of cavities or parts |
| Chemistry | Chem Room | Horizontal electropolish system, small ultrasonic, chemistry hood and workstation |
| Water Room | Triple rinse sinks, ultrasonic sink, large ultrasonic tank, pressure washer (DI water), and nitrogen drying oven |
| HPR Cabinet | High pressure rinse machine BCP machine inside the cleanroom for cavity cleaning |
| Lapping Room | Room for surface finishing and polishing containing equipment and manual tools |
| Cavity/String Assembly | Cleanroom (WS 1) | Production Cleanroom (ISO 4 classification) for cavity assembly |
| Vertical Test Area | Vertical Test Area | Cryogenic facility using vertical dewars of liquid helium to process, measure, and qualify cavity |

# Inventory And Traceability Plan

All raw materials will be tracked by the project coordinator, including but not limited to: Copper, Aluminum, Niobium, Niobium-Titanium. All fabrication steps and utilization of raw material will be tracked by the Pansophy Traveler system.

An EIC specific storage area will be created to store all tooling and raw materials to allow easy access during fabrication step, this area will be located in the TED highbay. Those items that cannot be stored in the TED highbay shall be stored in either in the Test Lab highbay if the part is needed within a week or shall be stored at Blue Crab if not.

Upon completion of the project, all processing and handling tooling will be repurposed to be used with the FA cavity. The dies and machining fixtures will be stored in long term storage if the need to use them arises in the future for other cavity fabrication steps. As soon as a decision is made that the dies will not be required for any future EIC work, they will be disposed of appropriately.

# Staffing Plan

The SRFOps staffing plan for the EIC Elliptical Cavity Prototype project will be documented in the AWP.

Skills sets external to SRFOps required to support the project include:

* SRF S&T RF simulation experts
* Mechanical Engineering design and simulation support
* EH&S support
* Procurement

# Procurement Plan

All tooling procurements and nondestructive examinations will be carried out by SRFOps following standards set-out by the vendor managements document. For rare material purchases (NbTi, Nb, Cu) either CERN or ASTM specs will be used to ensure the proper material is delivered.

The critical components for the cavity fabrication will be the dies for pressing all the cavity sub-components. Additionally, all the raw materials required for fabrication will be part of the critical components.

# Engineering Design Plan

SRFOps, in cooperation with the Mechanical Engineering Department, will create all the models and drawings for the cavity sub-components as well as the models and drawings for all tooling required for the fabrication and testing process. Any design changes to the cavity RF shape shall be analyzed and verified by the EIC RF group.

# Quality Plan

SRFOps will follow the SRFOps Quality Management System.

# Project Controls Plan

SRF Operations will provide an official monthly update to the EIC RF group project personnel on the status of the fabrication.

# Customer Communication Plan

SRFOps will hold a weekly meeting, to which EIC RF group project personnel shall be invited, to update the status of the production. SRFOps will also participate in any meetings that EIC RF group requests.

# Document and Records Plan

The Project Coordinator will create and maintain an EIC Elliptical Cavity Prototype Document Register to include customer requirements relevant to SRFOps, documents produced by SRFOps to support the project, and other documents deemed critical to quality by SRFOps.

The Project Coordinator will create and maintain an EIC Elliptical Cavity Prototype Work Control Document Register to include the travelers and procedures produced by SRFOps to control work activities.

The Project Coordinator will create and maintain an EIC Elliptical Cavity Prototype Records Register to include the records produced by SRFOps or used by SRFOps to verify work activities and inspection and test results.

All EIC Elliptical Cavity Prototype registers are located in the DocuShare EIC Elliptical Cavity Prototype project folder. All records requested by EIC RF group will be provided as requested.

# Shipping Plan

Following the final cold test of the cavity, SRFOps will release the cavity into the hands of the EIC RF group. The current plan will be to leave the cavity in the structures lab for further studies. If required, SRFOps will ship the cavity and any required handling fixtures to BNL upon request from the EIC RF group.

# Authorization for Release

The Authorization for Release form will be used to ensure all work and documentation is complete after the final cold test of the cavity. The Project Coordinator will be responsible for approving the Authorization for Release Form.

# Customer Deliverables Plan

## Hardware

* A fully welded and processed 591 MHz single cell elliptical prototype cavity as requested by EIC RF group.

## Data

* Full CMM data of the critical components.
* VTA Test Results.
* Tuning force testing results.

# Revision History

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| --- | --- | --- |
| **Revision** | **Description** | **Date:** |
| 1 | Initial Release |  |

# Approvals

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| --- | --- | --- | --- |
| **Approved by:** | **Name:** | **Signature:** | **Date:** |
| Project Coordinator | D. Savransky |  |  |
| Process Owner for Project Execution | T. Ganey |  |  |
| Customer Representative | E. Daly |  |  |
| SRF Department Head | T. Reilly |  |  |