

Activity # 1: 1.3 GHz and 650 MHz SCRF Cavities:

POC RRCAT- A M Puntambekar
POC Fermilab- Chuck Grimm

Deliverables:

S No.	Item	Qty	Due date as on June 2012	Status / due date as on 8 May 2014
1	1.3 GHz 1-cell $\beta=1$	2+2	June 2011	Completed
2	1.3 GHz 5-cell $\beta=1$	1	December 2012	Completed
3(a)	650 MHz 1-cell $\beta=0.9$	1	October 2013	Completed
3(b)	650 MHz 1-cell $\beta=0.92$	1	New Design	December 2014 ¹⁾
4(a)	650 MHz 5-cell $\beta=0.92$	1	October 2014	August 2015 ¹⁾
4(b)	650 MHz 5-cell $\beta=0.92$	4	October 2016	August 2017 ¹⁾ (in phased manner)
Note: 1) Due to change in design to $\beta=0.92$, the dates needs to be refined.				

❖ Inputs required from Fermilab:

Essential inputs :

- Sharing of manufacturing sequence plan, procedure, drawings of forming tooling, machining and welding fixture, traveler documents and inspection reports related to cavity mechanical, optical, RF and vacuum leak testing including details of special measurement test set-up. Hold and check points with cavity vendor and acceptance criteria for different stage.
- Inter-stage (Dumb-bell) RF qualification and tuning procedure, RF measurement procedure including design and drawings of RF measurement fixture and test procedure.
- Invitation to join the review meeting of Fermilab on the progress of 650 MHz cavities .
- Visit of FNAL experts to RRCAT to participate in the 650 MHz 5-cell $\beta=0.92$ multi-cell SCRF cavity development.
- Resuming of regular Web based meeting to exchange development plans and progress on 650 MHz SCRF cavities.

Other desirable inputs :

- Cavity engineering design requirements, design notes, reports, design review procedure and document giving details of acceptance criteria.

Other points during discussion :

- Dr P.D.Gupta requested Dr. Shekhar Mishra for an early processing and testing of 1.3 GHz five-cell SCRF cavity already at Fermilab by June 2014, and for the second round of processing and testing of single-cell 650 MHz SCRF cavity for improving its performance.

Activity #2: Helium Vessel for Beta=0.92, 650 MHz 5-cell SRF cavity

POC RRCAT- Jishnu Dwivedi
POC Fermilab- Chuck Grimm

Deliverables

S No.	Item	Qty	Schedule as per June 2012 meeting	Schedule as of now*
1.1	Helium Vessel for Beta=0.92, 650 MHz 5-cell SRF cavity	4+1	October 2016	October 2017
*Inputs from Fermilab should be received by December 2014.				

❖ Inputs required from Fermilab:

a) Essential inputs:

- Functional requirement specifications and design basis definition,
- Detailed design (including materials, loads, analysis, engineering design, support design and details of standard components like bellow, magnetic shielding etc.),
- Specification for manufacturing,
- Details of interfacing of helium vessel with cavity, tuner and cryomodule including joint design between helium vessel and cryomodule and between two dressed cavities,
- Testing requirements and acceptance criteria including stage inspection for materials and components.

b) Other desirable inputs:

- Details of infrastructure for testing and integration of helium vessel with cavity and tuner, class of clean area for assembly and testing,
- Details for measurement instruments and devices,
- Current status of Dressed Cavity development at Fermilab,
- Progress of SS Helium Vessel development at Fermilab.

Activity # 3: 650 MHz SCRF Cavity Tuner

POC RRCAT- S. C. Joshi/ Vikas Jain

POC Tuner Fermilab- Chuck Grimm

Deliverables:-

May 9, 2014

S No.	Item	Qty	Due Date as on June 2012	Due date as on May 2014
1	Prototype Tuner for $\beta = 0.92$, 650 MHz 5-cell SCRF Cavity	1	-	Dec 2015*
2	Tuner for $\beta = 0.92$, 650 MHz 5-cell SCRF Cavity	4	Oct 2016 (for $\beta=0.9$ cavity)	April 2017**

**To meet the above said delivery schedule, the latest FRS, design and drawings may be supplied to RRCAT by July 2014.*

*** To meet the above said delivery schedule, the approval of prototype mechanism*

❖ Inputs required from FNAL:-

a. Essential inputs :

- Tuner design reports with drawings.
- Tuner test procedure (at room temperature and 2K) and its acceptance criterion
- Specification related to tuner control and its integration with cavity controls
- Specification of fast tuner and Piezo selection criteria

b. Other desirable inputs :

- Sharing of FNAL experience on tuner design, manufacturing and its qualification

Activity # 4: RF Power Supply(DAE to DOE)

POC RRCAT- P.R.Hannurkar

POC Fermilab- R Pasquinelli

Deliverable:

Sr No.	Item	Qty	Exp.Delivery date	Remarks
1	30 kW, 650 MHz RF Power Supply	1	Dec 2015	12 kW unit fabricated and tested

Details of delivery schedule

Sr No.	Item	Exp. Delivery date	Remarks
1	Details of system layout and overall dimensions, vibration & shock test and remote Interfacing	Sept 2014	Request mail to be sent to Ralph, Fermilab
2	Complete design details of 650 MHz RF coupler	Oct 2014	Request mail to be sent to Dr.Shekhar Mishra and Ralph
3	Two prototype 650 MHz RF couplers	March 2015	Request mail to be sent to Dr.Shekhar Mishra and Ralph
4	RF interface and high power RF testing details for HTS	March 2015	To be discussed during visits of RRCAT officials to Fermilab

Essential inputs required from Fermilab :

- In the functional requirement document received from Fermilab, details of vibration and shock test, overall dimensions, system layout and remote Interfacing are not mentioned. Hence it needs to be discussed and finalized.
- Two RF couplers for Indian HTS facility will be required. Possibility for its supply from Fermilab needs to be discussed.
- RF Interface and high power RF testing details for HTS needs to be provided by Fermilab, detailed discussion with RF and control team at Fermi lab to be carried out

Other points during discussion :

Dr. Shekhar Mishra requested RRCAT to also explore the possibility of :

- a) Sending a 12 kW, 650 MHz RF Power Supply unit for integration and testing with SCRF cavity at Fermilab.
- b) Delivering an additional requirement of 60 kW RF power supply unit to Fermilab by Dec 2016 under Annexure - 1.

Activity # 5: Cryomodule for 650MHz SCRF Cavities (Beta=0.61 and 0.9)

POC RRCAT- Prashant Khare

POC Fermilab- Yuri Orlov

SPM- Tom Peterson

May 7 , 2014

Deliverable:

S No.	Item	Qty	Earlier Due Date (As per last meeting in June2012)	Due date (Now possible on best effort basis)
5	Design of Cryomodule for 650MHz SCRF Cavity	1	Oct 2015	Dec-2016

❖ Essential inputs required from Fermilab:

- Technical decisions need to be taken by FNAL experts on different design options. It is a necessary condition to complete the engineering design in time. The functional requirements (FRS) need to be spelled out for major subsystems.
- Technical requirement specification (TRS) for the complete cryomodule is required, after FRS for individual subsystems, is prepared by FNAL
- Cavity support system and cryogen distribution system in the cryomodule, will be the first systems to be taken up by us for engineering design. It will be useful if functional requirements of these are first decided.
- It is requested that cryomodule related webex meetings be restarted at the earliest. These are not being organized since mid 2012. It has been our experience during HTS design process that these meetings help in carrying out the work with speed and precision.
- We are now starting cryomodule instrumentation work and would need discussions to begin on it.

Activity # 6: Horizontal Test Stand for testing two dressed SCRF cavities (HTS-2)

POC RRCAT- P K Kush
POC Fermilab- A Hocker

May 06, 2014

Deliverable:

S No.	Item	Qty	Due date (Meeting: June 2012)	Due date (May 2014)
6a	Design of Horizontal test Stand for testing two dressed SCRF cavities	1	March 2013	Nov 2014
6b	Supply of HTS to Fermi Lab	1	Dec 2014	Sept 2016

Date estimates during meeting June 2012 were based on receiving inputs from FNAL regarding feedbox design and cryogenic piping inputs by August 2012.

The feed box design and other cryogenics related issues were finalised by Dec 2013. The new dates proposed are based on completing the design review with FNAL team by Sept 2014.

❖ Essential inputs required from Fermilab:

- Information on quality assurance documents/ acceptance criteria for HTS-1 cryostat for preparing similar documents for HTS-2 cryostat
- Design conditions/ issues governing the packaging and transportation of cryostat.
- Other checks and hold points during fabrication.
- Joint review of technical design documents with FNAL team to be completed by Sept 2014.

Activity # 7 : Vertical Test Stand Facility

POC RRCAT- S.C. Joshi
POC VTS Fermilab- Ruben Carcagno

May 09, 2014

Deliverable:

S No.	Item	Qty	Due date
1	2 K Cryostat for Vertical Test Stand Facility	1	Commissioned at RRCAT (August 2013 – January 2014)

❖ Essential inputs required from Fermilab:

- Sharing of experience in testing of 650 MHz SCRF cavities (single-cell & five –cell) at Fermilab
- Sharing of information on 650 MHz SCRF cavity processing which includes inspection report of cavity, recipe used for centrifugal barrel polishing & electropolishing, thermal processing etc.
- Sharing of information & details of 650 MHz SCRF cavity thermometry and second sound technique used for identification of quench location in SCRF cavity during vertical test at 2K.
- Supply of one single- cell 650 MHz SCRF cavity tested at 2K in sealed condition for benchmarking VTS facility at RRCAT for testing of 650 MHz SCRF cavities. The cavity may be the one fabricated at RRCAT (presently at Fermilab for testing) or any other tested cavity.
- Sharing of information on 650 MHz SCRF cavity tuning machine which will include functional requirement & technical specification, design of tuning machine – mechanical & control electronics, development of hardware & software required for five-cell 650 MHz SCRF cavity at RRCAT.
- Visit of RF engineer from Fermilab to participate in the 650 MHz SCRF cavity testing at VTS.