TRAVELERS
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SerialNum: 0 **Traveler ID: SNSPPU-VTA-CAV-VTRF** **Rev: R3 Page:0** **Traveler Seq Number: 0**

Traveler Title	**SNS PPU Vertical cavity Testing**			
Traveler Abstract	**Cryogenic RF testing of SNS PPU cavities.**			
Traveler ID	**SNSPPU-VTA-CAV-VTRF**			
Traveler Revision	**R3**			
Traveler Author	**P. Dhakal**			
Traveler Date	**15-Dec-20**			
NCR Informative Emails	**Edaly,Areilly**			
NCR Dispositioners	**Kdavis,dhakal**			
D3 Emails	**kdavis,dhakal,edaly**			
Approval Names	**P.Dhakal**	**K. Davis**	**P. Owen**	**E. Daly**
Approval Date				
Approval Signatures				
Approval Title	**Author**	**Reviewer**	**Reviewer**	**Project Manager**

References	**List and Hyperlink all documents related to this traveler. This includes, but is not limited to: safety (THAs, SOPs, etc), drawings, procedures, and facility related documents.**			
VTA SOP	VTA RF Testing Procedure			
Excel spreadsheet template for VTA RF measurements				

Revision Note	
R1	**Initial release of this Traveler.**
R2	**Fixed some typos and conflits items**
R3	**First Revision, added calibrations field**

The boxes below indicate which acceptance criteria is being met in PPU-202-TA0002 R1 Cavity Vertical Test Acceptance Criteria

Step No.	Instructions	Data Input
1	**Input SNSHB 6-cell cavity serial number.**	**CAVSN** -0-
2	**Record if cavity has Helium vessel.**	**HeliumVessel** ○ **Yes** ○ **No**
3	**Record if cavity is mechanically constrained (i.e. tuner attached, etc.).**	**TunerAttached** ○ **Yes** ○ **No**
4	**Enter the LabView file name, without special characters. (Valid example: HB-046).**	**LabviewFile**
5	**Record Test Date, Dewar No, Top Plate ID and Operator(s).**	**TestDate** NOW **(ex format 18-Jun-2005 16:30)** **Dewar** -0- **VTATSSN** **TestOperator1** -0- **TestOperator2** -0-
6	**Record cavity vacuum pressure, if so instrumented. If during cooling down a pressure of $5x10^{-6}$ mbar or greater at 2.1K is identified:** **- choose option No for Cavity Vacuum OK** **- record pertinent information in the Cavity Vacuum Comment**	**CavityVacuum** **CavVacUnits** -0- **CavityVacuumOK** ○ **Yes** ○ **No**

Criteria #6, combined with CavityVacuumComment

	- abort RF power test - launch NCR	CavityVacuumComment Criteria #6, Combined with CavityVacuum
7	Record Dewar helium bath liquid level, temperature and baratron pressure. Do not continue unless Dewar LHe level is above the end group. Start cavity testing at (31.4+/-0.1) Torr which correspond to about 2.1K.	DewarLHeLevelcm (cm) DewarTempK (K) DewarPressureTorr (Torr)
8	Zero power meters then calibrate cables at cavity fundamental frequency as specified in VTA RF Testing Procedure. If NO option is chosen launch D3 and record pertinent information. Record the serial number of the power meter used during calibration on the network analyzer cart. It is typically MYXXXX with calibration sticker. Verify if calibration of power meter is current Record Power meter head serial number It is typically MYXXXX Note the RF system used for testing cable calibration	PowermetersZeroed ○ Yes ○ No PowermeterSN PowermeterCalibrationCurrent ○ Yes ○ No PowerMeter PowermeterHeadSN RFsystem -0- CableCalibrationOK ○ Yes ○ No CableCalibrationComment

Step No.	Instructions	Data Input
9	Conform: 805 MHz VTA RF Testing Procedure perform low power measurements using a network analyzer (measure the seven cavity mode frequencies). Record the cavity mode frequencies at the right. Example of cavity mode frequencies:	
	6_6Pi =	Freq_6_6Pi (MHz)
	5_6Pi =	Freq_5_6Pi (MHz)
	4_6Pi =	Freq_4_6Pi (MHz)
	3_6Pi =	Freq_3_6Pi (MHz)
	2_6Pi =	Freq_2_6Pi (MHz)
	1_6Pi =	Freq_1_6Pi (MHz)
10	At 2.1 K determine and record Dewar pressure (baratron) and cavity Pi-mode lock frequency precisely with LLR frequency counter - conform: VTA RF Testing Procedure. Lock frequency specifications: Low: 805.35 MHz High: 805.85 MHz If option NO is checked, launch NCR.	LockFrequency Criteria #5 (MHz) DewarPressure_Torr (Torr) LockFreqMeetsSpec ○ Yes ○ No
11	At 2.1 K and cavity field of 4-6MV/m, determine cavity coupling conform: VTA RF Testing Procedure.	CavityCoupling -0-
12	Perform decay measurements and record Eacc, Qo, Qext2, Qext1, %error, radiation, chosen for CW high power tests as specified in: VTA RF Testing Procedure. More information regarding these parameters can be found in CavID raw data.txt or CavID processed data.xlsx. Typical values during decay measurements for:	
	Eacc : (4-6) MV/m	Eacc (MV/m)

	Qo : 1-3 e10	Qo
	Qext1 : 0.6-1 e10	Qextin
	Qext2 : 0.7-2 e12	Qextfp Criteria #4
	%error : 8-13	Qextfperror (%)
	Radiation : 1 e-3 mR/hr	Rad (mR/hr)

Step No.	Instructions	Data Input
13	In Pi mode, test the cavity performance over its full dynamic range at 2.1K observing the administrative limits as specified in VTA RF Testing Procedure. Be sure to capture a clean final-state data set from which to generate the post-processing Qo-vs-Eacc, Rad-vs-Eacc and f-vs-Eacc2 curves.	
14	At 2.1K record:	
	Final Maximum cavity gradient achieved Emax. (22MV/m) Admin	EmaxMVm Criteria #2 (MV/m)
	Final Q_o value at maximum cavity gradient.	QoAtEmax
	Final Q_o at 16 MV/m. Acceptance criteria Q_o >= 8e9.	QoAt16MVm Criteria #3 (MV/m)
	Final value for Radiation at 16 MV/m.	Init_RadAt16MVm (mR/h)
	Initial FEonset: onset of field emission (FE onset, defined to be the first measured gradient where measured radiation is >= 1e-2 mR/hr). If no field emission is detected up to administrative limit (22MV/m) insert a value of 1e-3 MV/m.	Init_FEonsetMVm (MV/m)
	Initial Rmax value for the highest radiation level inside Dewar lid. If Rmax is background up to the administrative limit (22MV/m), insert 1e-3 mR/m for this parameter.	Radmax (mR/h)
15	Record if multipacting (MP) was found during the test, the Eacc at which occurred and if it was successfully processed. The PPU cavities have a MP barrier at 10-14 MV/m.	MultipactingFound ○ Yes ○ No MultipactingGradient (MV/m) MultipactingProcessed ○ Yes ○ No MultipactingComment
16	At 2.1K, was cavity RF processed (conform specifications in VTA RF Testing Procedure) to achieve performances over 18 MV/m? Record pertinent information at the right and launch NCR if cavity RF processing was unsuccessful. If RF processing was done to achieve 18 MV/m, get final full Q(E) data	RFProcessing ○ Yes ○ No RFProcessingComment
17	Record performance limitation at 2.1K. Definition of performance limitation terms: Administrative Limit: 22 MV/m FieldEmission: FE loaded Qo curve (typically > 1 rem/hr) Quench: Cavity quench without field emission or Multipacting Multipacting: Cavity quenching with field emission RF power: Test limited by available RF power Cable: Test aborted due to cable breakdown or broken cable Other: RF Tester defined If cavity PerformanceLimitAt2_1K is selected Other, record pertinent information in the Comment box at the right.	PerformanceLimitAt2_1K -0- PerformanceLimitAt2_1K_Other
18	Final Record Lorentz detuning coefficient (slope of the linear fit frequency vs Eacc2) KLoren.	KLOREN (Hz/MVm2) KLORENComment

19	**Record post-processing data:**	
	Post-procession Radiation at (16+/-0.3) MV/m. PPU specification is <20 mR/hr	**PP_RadAt16MVm** Criteria #1 **(mR/h)**
	Post-procession FEonset: onset of field emission (FE onset, defined to be the first measured gradient where measured radiation is >= 3e-2 mR/hr). If no field emission is detected up to administrative limit (22MV/m)	**PP_FEonsetMVm (MV/m)** **FE_Free (Yes?)** ☐
	Post-procession Rmax value for the highest radiation level inside Dewar lid. If Rmax is background up to the administrative limit (22MV/m), insert 1e-3 mR/m for this parameter.	**PP_Radmax (mR/h)**

Step No.	Instructions	Data Input
20	**At 2.1K, if cavity is quench limited below Eacc 18MV/m, keeping the same Qextfp as used for the Pi mode, attempt to find the related unscaled Quench fields for each member of the fundamental passband. Launch NCR.**	**EaccUnscaledQuench_6_6Pi (MV/m)** **EaccUnscaledQuench_5_6Pi (MV/m)** **EaccUnscaledQuench_4_6Pi (MV/m)** **EaccUnscaledQuench_3_6Pi (MV/m)** **EaccUnscaledQuench_2_6Pi (MV/m)** **EaccUnscaledQuench_1_6Pi (MV/m)** **QuenchStudyComment**
21	**Conform specifications in** VTA RF Testing Procedure **process and upload the VTA RF testing results, using the** Excel file template**.**	
22	**Upload the raw data file with VTA RF testing results using file name: CavID raw data.txt.**	**Must submit traveler before attaching files.**
23	**Upload processed (Excel) data file results using file name: CavID processed data.xlsx**	**Must submit traveler before attaching files.**
24	**Upload processed f-vs-Eacc2 graph (in PDF format) using file name: CavID_FreqvsEacc2.pdf.** **Upload processed Final Qo-and-Rad -vs-Eacc graph (in PDF format) using file name: QoandRadvsEacc.pdf**	**Must submit traveler before attaching files.** **Must submit traveler before attaching files.**
25	**Upload any additional processed data files collected during this test, in the test at the right using file name: CavID_QoandRvsEacc.pdf or any other file name properly describing the CavID and the graph content.**	**Must submit traveler before attaching files.**
26	**Cavity passed all specifications for this traveler: 10, 12, 14, and 19? If NO option is chosen issue an NCR from this traveler.**	**CavityMeetsSpecifications** ○ **Yes** ○ **No**