

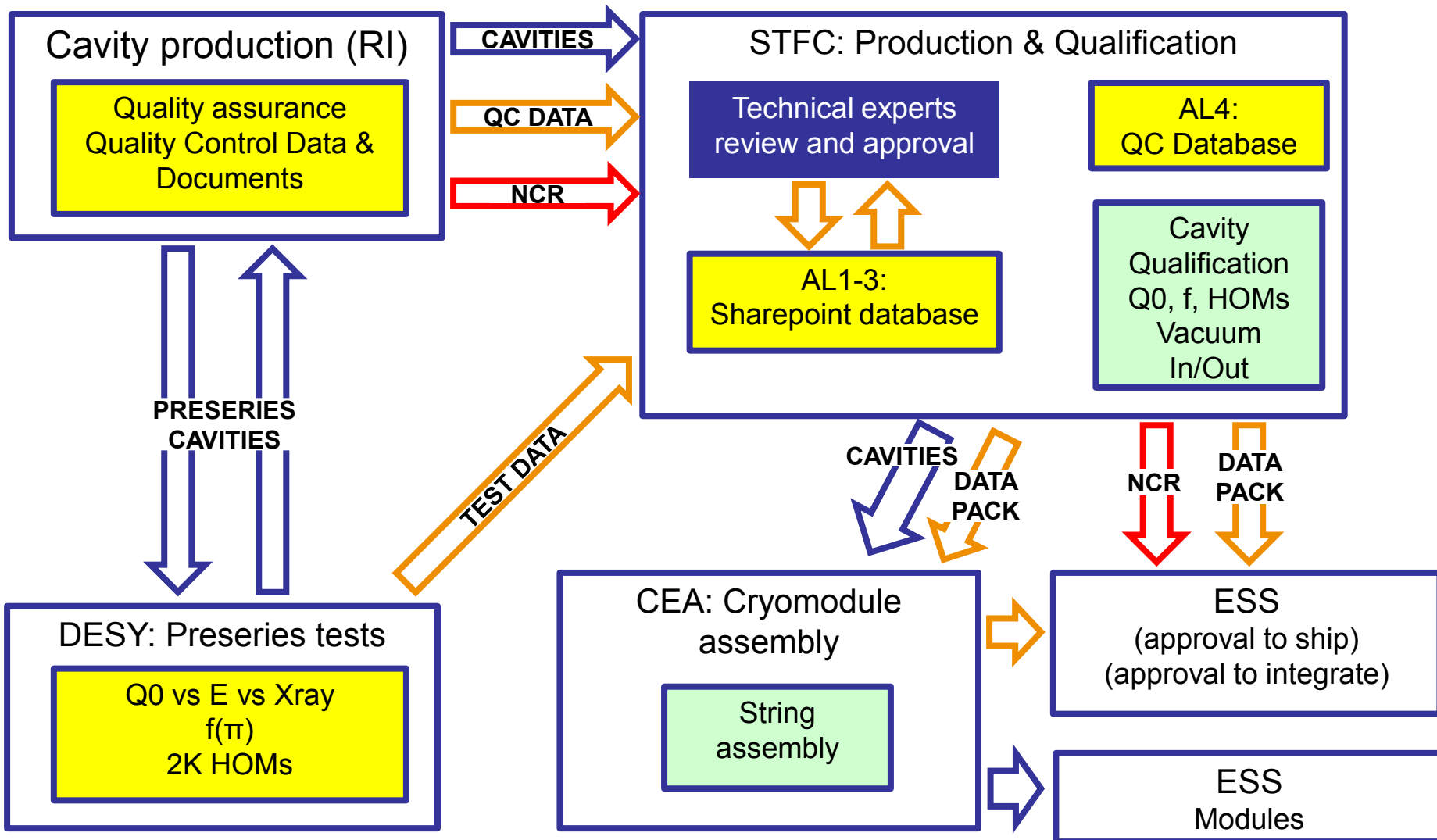
# ESS High Beta Cavities Documentation and NCRs

10<sup>th</sup> ESS SRF Collaboration  
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Thanks to all teams for input including:  
Cavity Manufacturing;  
SuRF Lab;  
QA-QC

# ESS High Beta Cavities Documentation and NCRs

Item	Description
<b>A</b>	<b>Documentation &amp; Data Management</b>
	<ul style="list-style-type: none"><li>• QC measurements – overview</li></ul>
	<ul style="list-style-type: none"><li>• AL1-3 Manufacturing data<ul style="list-style-type: none"><li>• Document overview</li><li>• Document management system</li></ul></li></ul>
	<ul style="list-style-type: none"><li>• AL4 Qualification data<ul style="list-style-type: none"><li>• Document overview</li><li>• Document management system</li></ul></li></ul>
<b>B</b>	<b>NCRs</b>
	<ul style="list-style-type: none"><li>• Process and efficiency</li></ul>
	<ul style="list-style-type: none"><li>• Overview of NCRs to date</li></ul>
	<ul style="list-style-type: none"><li>• Review of key L2/L3 NCRs</li></ul>



# A: Data management (2)

## Overall requirements

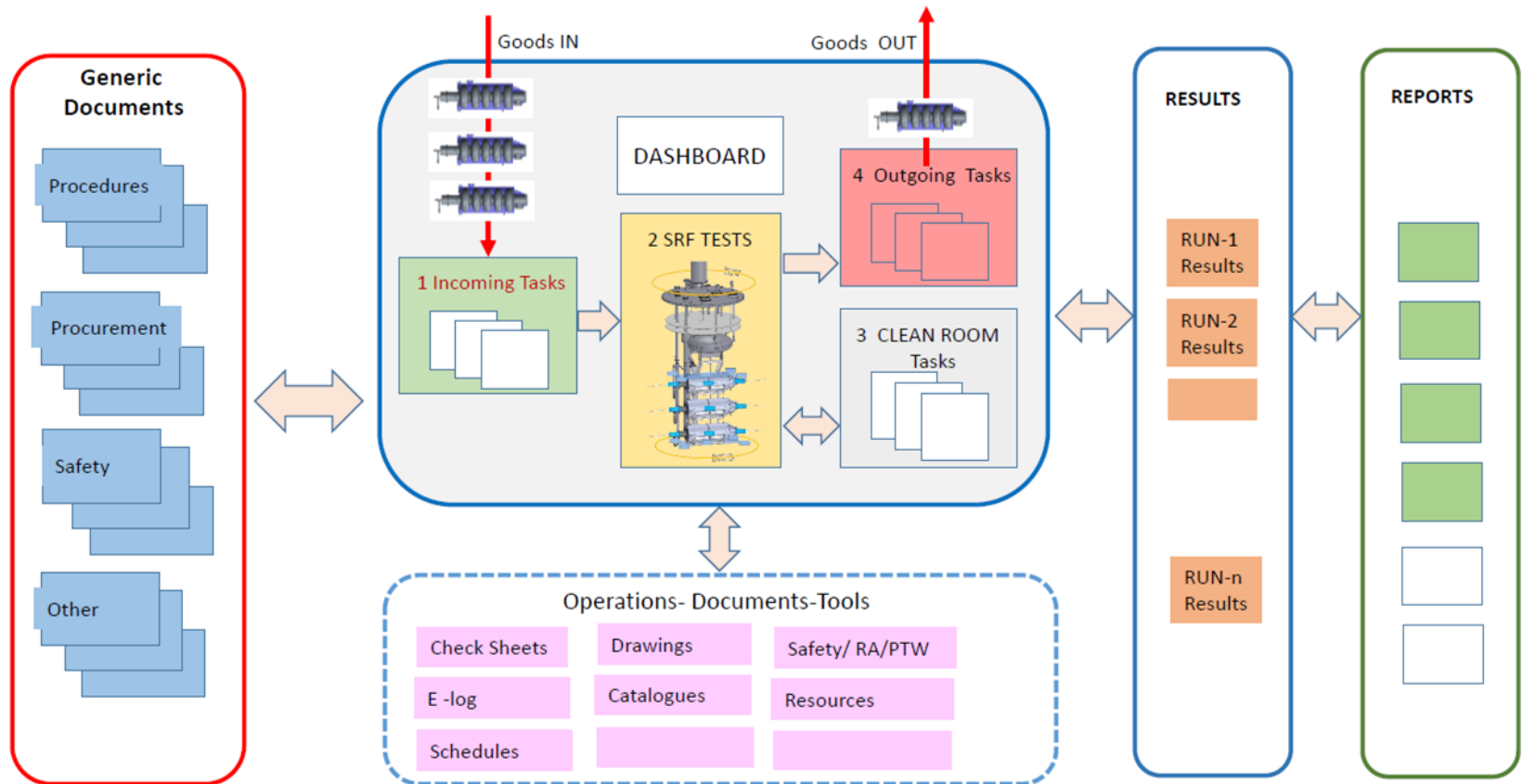
Level	Cavity Status	Types of doc/data	On passing level	Total # of docs, all cavities	# of docs required by ESS
AL1	Welded inner cavity	Subcomponents: Mechanical, RF, visual Cavity: welding, mechanical, RF, visual, vacuum	Cavity proceeds to treatment	c. 1500-6000	~5 – 10 total
AL2	Treated cavity	Mechanical, RF, vacuum, BCP, HPR, annealing	Cavity proceeds to jacket integration	c. 3200	
AL3	Ready for cold test	Mechanical, RF, vacuum, visual inspection, transfer measurements, final vacuum and RF, outgoing visual	Cavity proceeds to cold test	c. 1500	
AL4	Qualified cavity	Incoming inspection, vacuum, cold RF test, outgoing checks	Request approved for shipment; Ship to CEA	c. 2600	~5
AL5	Accepted for string assembly	Incoming inspection at CEA	Final approval	c. 100-300	~2?

- Automated metadata identification – **completed**
  - Tracks:
    - Cavity serial number
    - Test type (RF, Vac, visual, mechanical, 3D CMM, etc)
    - Test type / sequence number
- Automated approval workflows – **completed**
  - Tracks:
    - Which groups needs to approve?
    - Which groups not yet approved?
    - Timing & dates of receipt, approval
    - Comments to link to NCRs / Concessions
- Remaining tasks – **in progress**
  - Tidy up, documentation
  - Final email addresses / users being set up:
    - 1 primary + 2 deputy approvers per area
    - RF, Vac, Mech, QA, WPL etc.
  - Training for users:
    - What / when to approve
    - How to use the system

The top screenshot shows a SharePoint list titled 'RI - Ref. Production Documents'. It contains a table with columns for Name, Manufacturing Stage, Test Code, Test Code Occurrence, Test Code Suffix, Release/Revision No., Component Type, and Component Serial. A pop-up menu is visible over the 'Test Code' column, showing options for 'A to Z', '2 to A', and 'Filter by Manufacturing Stage'.

The middle screenshot shows an Excel Online spreadsheet titled 'Approval Matrix'. It is a large table with columns for Document Name, Test code, Test code occurrence, Component Type, Test type, and Test type. The table lists various documents and their associated test codes and types.

The bottom screenshot shows another Excel Online spreadsheet titled 'Approval Matrix'. It is a table with columns for Area, Name, and Email. It lists approvers for different areas: RF, Vac, Mech, QA, and WPL. The table includes names and email addresses for primary and deputy approvers.



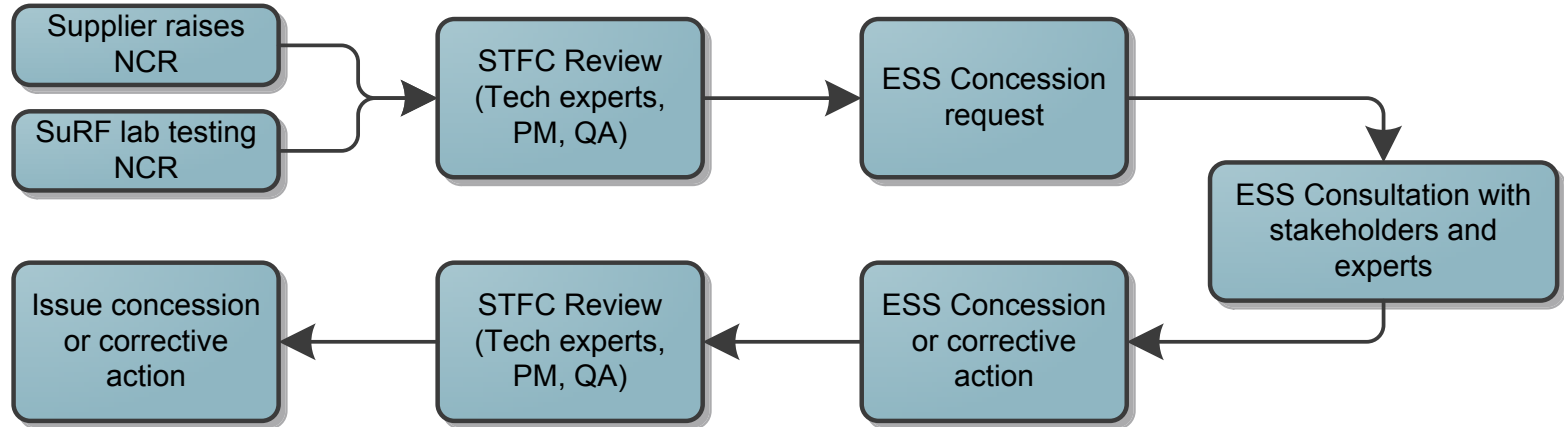
- SuRF lab database under development
  - Storage and tagging of all static documents and data measurements
  - Populate reports automatically from tagged data
- First 'working' iteration expected Sept-Oct

# A: Data management (5)

## AL4: Qualification data - *draft*

AL4 @ STFC	Cavity info / receipt note	Basic cavity / delivery info	STFC QC requirement TBC
	Incoming inspection report	Shock logger visual, tilt and shock indicators	STFC QC requirement TBC
		Box visual inspection	STFC QC requirement TBC
		Cavity visual and mechanical inspection	STFC QC requirement TBC
		Electrical and RF checks out of box	STFC QC requirement TBC
	Incoming inspection - shock log file	Shock log	STFC QC requirement TBC
	Incoming inspection - RF data	RF	ESS requirement
	Storage		STFC QC requirement TBC
	Cold test assembly	CSI mechanical assembly checklist	STFC QC requirement TBC
		CSI/Modular cleanroom particle count data	STFC QC requirement TBC
	Vacuum quality incoming	CSI: RGA & incoming leak check	STFC QC requirement TBC
	Vertical Test Report	Bunker: Recheck RGA/leak	STFC QC requirement TBC
		Cryo: Cooldown temperatures vs time	STFC QC requirement TBC
		RF/Cryo: Rs vs T between 4K and 2K (?)	Additional benefits TBC
		2K RF test report	ESS requirement
		Warm-up temperature vs time (?)	STFC QC requirement TBC
	Vacuum quality outgoing	Final RGA, vacuum and leak data	ESS requirement
		Particle count	STFC QC requirement TBC
	Cold test RF data file(s)	2K RF test data - machine readable file(s)	ESS requirement
	HPR Report	HPR process report	STFC QC requirement TBC
		Mechanical check after re-assembly	STFC QC requirement TBC
		Vac checks after re-assembly	STFC QC requirement TBC
	Storage		STFC QC requirement TBC
	Outgoing preparations	Outgoing RF measurements	ESS requirement
		Diphase trimming mechanical report	ESS requirement
		Box visual inspection	ESS requirement
		Mechanical and visual inspection	ESS requirement
		Shock logger	ESS requirement
	Pressure Certificate	Final PED Declaration of Conformity	ESS requirement
	Cavity history tracability	Cavity "traveller" document	STFC QC requirement TBC

## Process & efficiency



- Many sequential links
- How to accelerate / in parallel
  - Working “ok” for informal guidance during pre-series
  - Far too slow for formal closures (including through STFC)
    - Risk to series production schedule
    - In pre-series, NCRs are not fully stopping production because of relatively minor variances and requirement for schedule to be addressed
    - In Series production, NCRs will need approval from ESS prior to proceeding, will delay cavity production if there is not an efficient system
- How to quickly react to NCRs?
- Are tolerances excessively strict?
  - Minimise bureaucracy and avoid unnecessary NCRs



## List of NCRs & ESS level

- Level 3 NCRs: 4 received:
  - due to mechanical geometry and dimensions
  - H001: c. 0.8mm deviations on tuner mounting holes
  - H002-004: Typically <10um deviation outside specifications
- Level 2 NCRs: 0
- Level 1 NCR: 14
  - 6 due to shape/profile deviations on half cells
    - Collectively cover a large number of HC and DB parts
    - Tolerances too tight -> under revision to avoid recurrence
  - 4 for minor process deviations on 1<sup>st</sup> cavity
    - Mainly added pre-series steps, bypassed to maintain schedule
    - Minor fixes e.g. temporary flanges for rinsing not production intent
  - 1 for run-out of cavity (geometry) before tuning
    - Corrected at tuning stage, may suppress NCRs at this stage in future if fully correctable

## List of NCRs & ESS level

NCR No.	Date Received	Affected S/N	Details	Cavity	ESS level	STFC ESS Ref	ESS #
4121-NCR-11688-0	06/12/2018	First ~40-50 Half-cells	Deviation of 3D shape after deep drawing	For Cavity H001 to H004	1		
4121-NCR-11770-0	15/02/2019	Multiple DB	Deviation of 3D shape of DBs after welding of SR	For Cavity H001	1		
4121-NCR-11782-0	27/02/2019	HN0012	Deviation of 3D shape of EGCS after welding to beam tube	For Cavity H001	1		
4121-NCR-11791-0	15/03/2019	ETTS_001	Dimensional deviation of ETUT Step 2 after machining	For Cavity H001	3	NCR001_H001	ESS-1111693
4121-NCR-11802-0	18/03/2019	HN0001	Deviation of 3D shape of EGTS after welding to beam tube	For Cavity H001	1		
4121-NCR-11861-0	29/04/2019	Multiple DB	Deviation of 3D shape of DBs after welding of SR	For Cavity H002	1		
4121-NCR-11876-0	23/05/2019	H001	First HPR step was skipped after BCP stage 1; cavity was roughly rinsed before next etch step.	H001	1		
4121-NCR-11887-0	02/05/2019	ETCS_002	Dimensional deviation of EGCS after final machining	For Cavity H002	3	NCR004_H002	ESS-1272202
4121-NCR-11895-0	13/05/2019	ETTS_003	Dimensional deviation of ETUT after machining	For Cavity H003	3	HCR002_H003	ESS-1272203
4121-NCR-11896-0	13/05/2019	ETTS_004	Dimensional deviation of ETUT after machining	For Cavity H004	3	NCR003_H004	ESS-1272204
4121-NCR-11902-0	14/05/2019	Multiple DB	Deviation of 3D shape of DBs after welding of SR	For Cavity H003	1		
4121-NCR-11908-0	23/05/2019	H001	Skipped intermediate wall thickness measurement after final BCP. STFC should check this is completed on return of the cavity	H001	1		
4121-NCR-11910-0	23/05/2019	H001	During surface treatment, two intermediate weighing steps and cleaning steps were skipped (link to HPR NCR)	H001	1		
4121-NCR-11911-0	23/05/2019	H001	Intermediate stages show excess runout - corrected at final tuning	H001	1		
4121-NCR-11913-0	27/05/2019	H001	BCP template the field for water filling time is missing	H001	1		
4121-NCR-11914-0	27/05/2019	H001	Flanges not changed for the water rinsing	H001	1		
4121-NCR-11916-0	27/05/2019	H001	Water fill time after BCP for pH-rinsing exceeded	H001	1		

