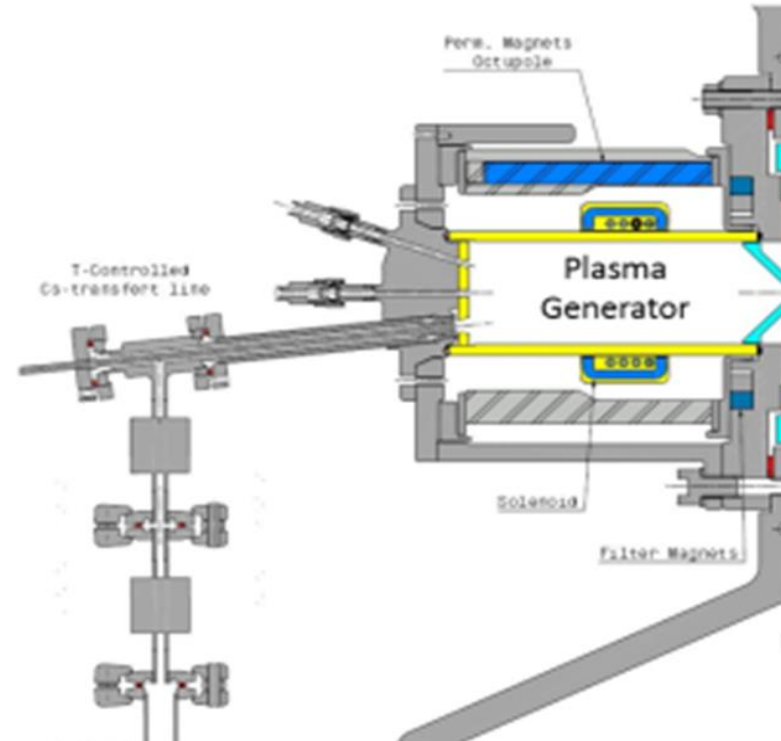


Operational experience of continuous caesiation @ Linac4

Machine Protection Panel meeting – JB. Lallement – M. O’Neil – 17/12/2021

1. How did we “use” cesium.
2. Recap on what is implemented.

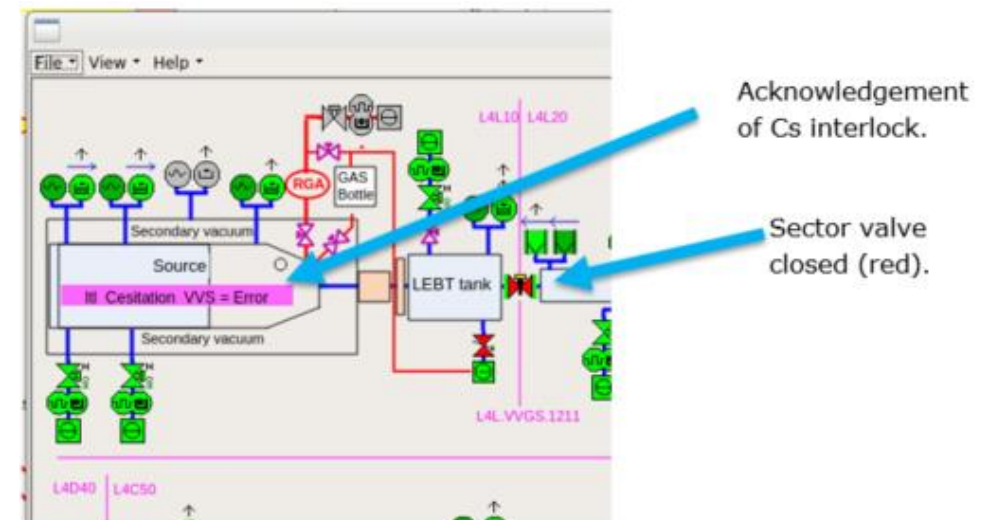


Recap on Cesium Philosophy

- Mode selection via manual switch, in the source cage.
 - Key on vacuum valve interlock chassis.
 - Key needed in place inside source cage to go to Single Shot mode.
- **Mode OFF:**
- **Mode Continuous:**
 - Maximum consignes: 80°C for the reservoir, 100°C for the valve, 10 W for the transfer.
 - Maximum temperature: 83°C, 106°C, 116°C.
- **Mode Single shot:** Never needed with the 2020-2021 source.
 - It implies the LEBT sector valve is closed by interlock.
 - Maximum consignes: 140°C for the reservoir, 170°C for the valve, 15 W for the transfer.
 - Maximum temperature: 143°C, 176°C, 176°C.

Only one interlock event:

Happened with test source on November 25th 2021.
Vacuum stopped while cesium valve open.
Cesium valve closed and heaters went off as expected

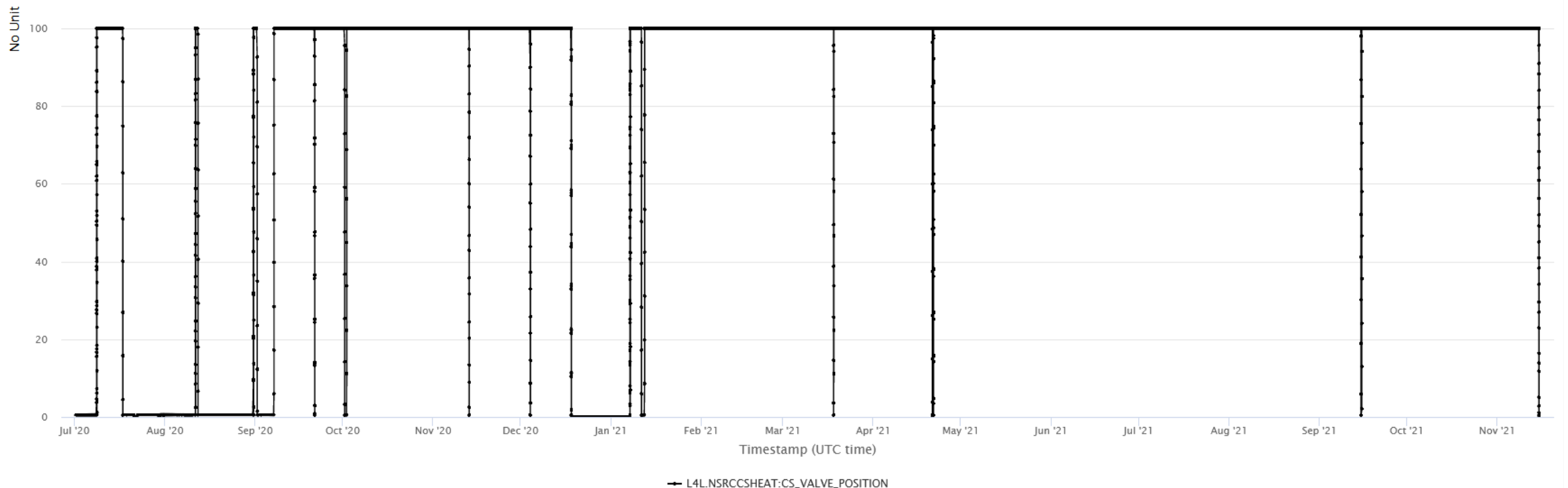


The cesium valve since June 2020

- From Sep. 7th Valve open – Go to continuous cesiation.
- Oct 1st -2nd Water cooling fault.
- Nov. 13th Water cooling intervention.
- Dec. 4th Stop for timing intervention.
- YETS. Followed by a restart and a gas valve replacement.
- Mar. 18th Power network intervention.
- Apr. TS1.
- Sep. TS2.

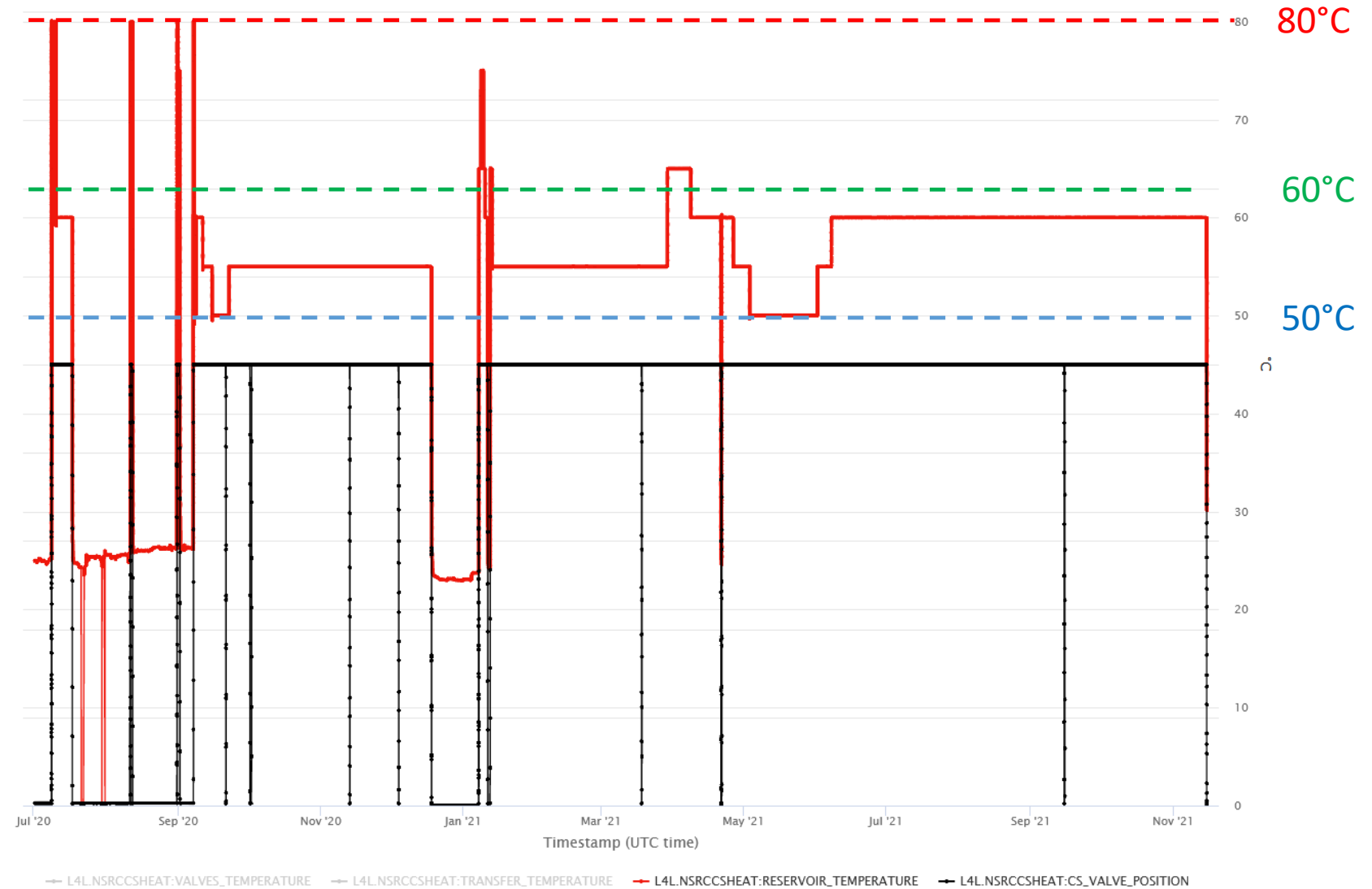
It was decided to close the cesium valve for long source RF stops:

- **Planned interventions.**
- **Faults.**



The reservoir temperature

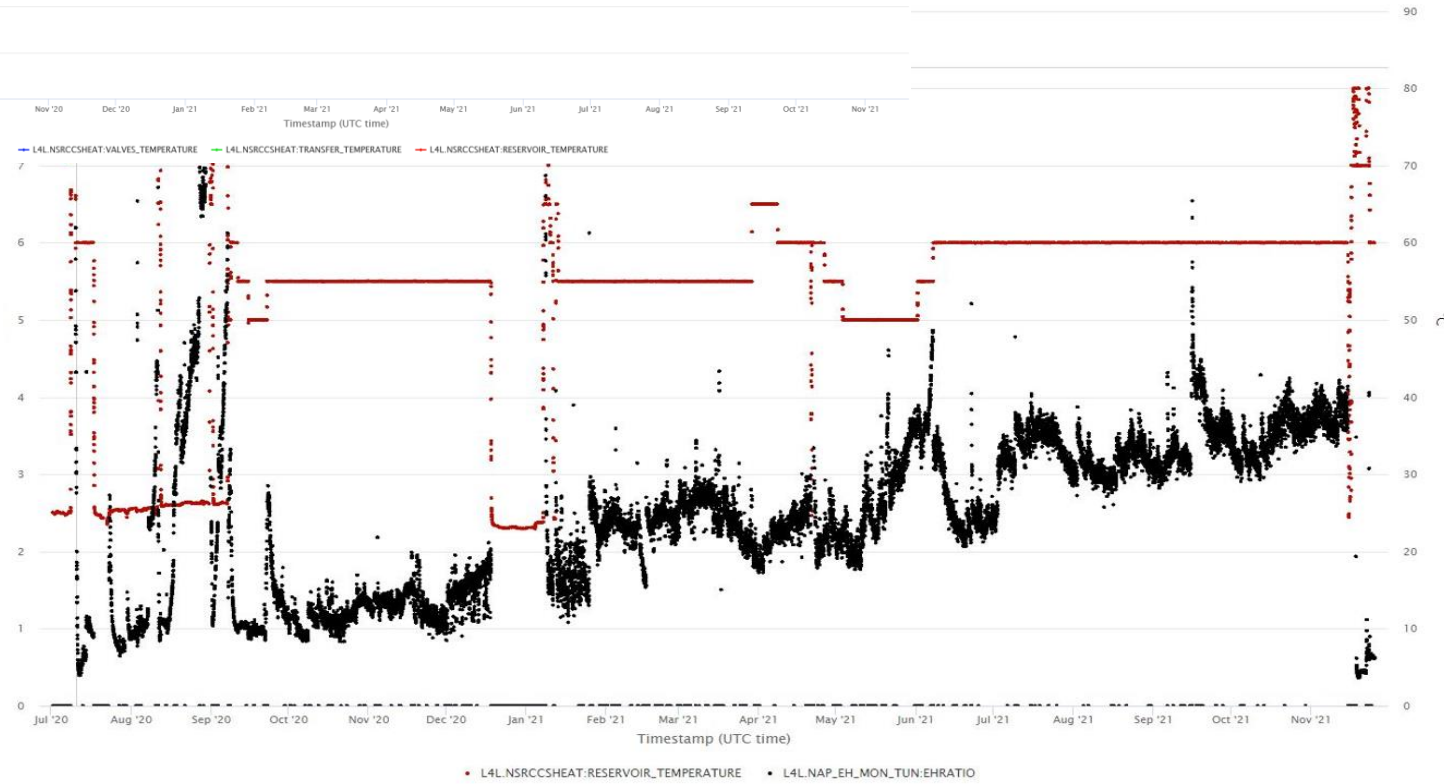
- Generally between 50°C and 60°C.
- Did not go above 80°C.
- Temperature adjustments:
 - Restarts
 - After interventions



The temperatureS: Reservoir, Valve, Transfer-line, & e⁻/H⁻



- Valve kept 20°C above reservoir.
- Transfer line, slightly above the valve.
- Adjustments driven by: e/H.
 - Interventions.
 - Gas stability.
 - Stability.
- TL control via Power not T.



Regular tests of the interlock system

Tested in 2020 and being tested right now (started yesterday) for 2022 run

- **System faults:** CPU stop, crash, power cut, DP chassis power cut, Fiber optic link break:
 - Heater power switched off and cesium valve closes.
- **Sensor faults:** Sensor mismatch (5°C), out of sensible range (0°C to 150°C / 250°C), open/short circuit.
 - Heaters off and cesium valve closes.
- **Process faults:**
 - Meas. Temp exceeds T_{max}: Heaters switched off and valve closes.
 - Reservoir temperature exceeds independent T relay limit: Heaters power lead relay opens.
- **Operator faults:**
 - Temp. above limit: Value remains at last valid value.
 - Switch 'Single' to 'Continuous' with CCV for single: CCV values set to 0.
 - Switch 'Single' to 'Continuous' before temp below threshold for continuous: Heaters off and valve closes.
- **Heater power supply faults:** Exceed safe current:
 - Circuit breaker in output line trips.
- **Installation faults:**
 - Procedure to check the sensor positions, differing connectors for each sensor, power pins different for each heater.
- **Controls:**
 - Emergency stop: Heaters supplies off, output relays open.
 - Sector valve: Switching to continuous mode, valve closes.

Good experience so far – Preparing for 2022

In short:

- System tested at the beginning of each run.
- No system fault observed so far.
- Only ran in continuous mode in 2020-2021.
- Cesium valve was closed manually for interventions and long beam interruptions.
- Found a good equilibrium at 60°C.
- One event at the end of 2021, and system reacted as expected.

- On top of that: Source experts monitoring parameters on a daily basis !!!

- Let' see what we will get in 2022 and so far so good.