1. High power RF facility in FREIA laboratory.

The FREIA laboratory is testing the superconducting spoke cavity series cryomodules (CM) for ESS accelerator. Some tests involve loading the cryomodules with high power RF. For this we use two high power RF (HPRF) stations based on power grid tetrodes (THALES TH595 or TH595A). Operation parameters of each HPRF station shown below:

- Total FWD output power: 400 kW
- Target frequency: 352 MHz
- Pulse with: 3.2 ms
- Repetition rate: 14 Hz
- Total gain: 74 dB and 84.5 dB respective

2. How much power do we really need for tests?

In full power mode the stations work near the it’s maximum ratings. This is increase a probability of breakdowns.

Total CM testing time is 1 month

Total mean time of RF power applying for one cryomodule testing is 135 hours

3. Outgassing analysis

Warm FPC conditioning shows that the major outgassing bands are situated lower than 100 kW.

4. HPRF optimization

Power tubes has an age depended parameter spread. HPRF tuning is a tradeoff between system stability and output power level.

5. What type of problems can be?

- Minor problems and mistakes. MTTR<1h Interlocks, software
- Well known problems. MTTR 4h Fuses, replacing broken and weak components
- Unexpected problems. MTTR 48h Unknown origin, no spare parts, multiple faults
- Fatal problems. MTTR months Broken key components: tubes, anode PS

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**Conclusion:** During Series CM testing most important goal is stable and continuously work of RF power stations.

1. To follow testing plan, we need minimize the malfunctioning time of RF stations.
2. Major outgassing bands of FPC are lower than 100 kW. Upper limit for Cavity condition is near 250 kW. This is a main operation region.
3. Optimization (limitation) of RF station parameters are increase the safety margin.
4. Organization of spare parts storage is one the key activity for minimization of MTTR.