2021 Availability Statistics for LINAC4

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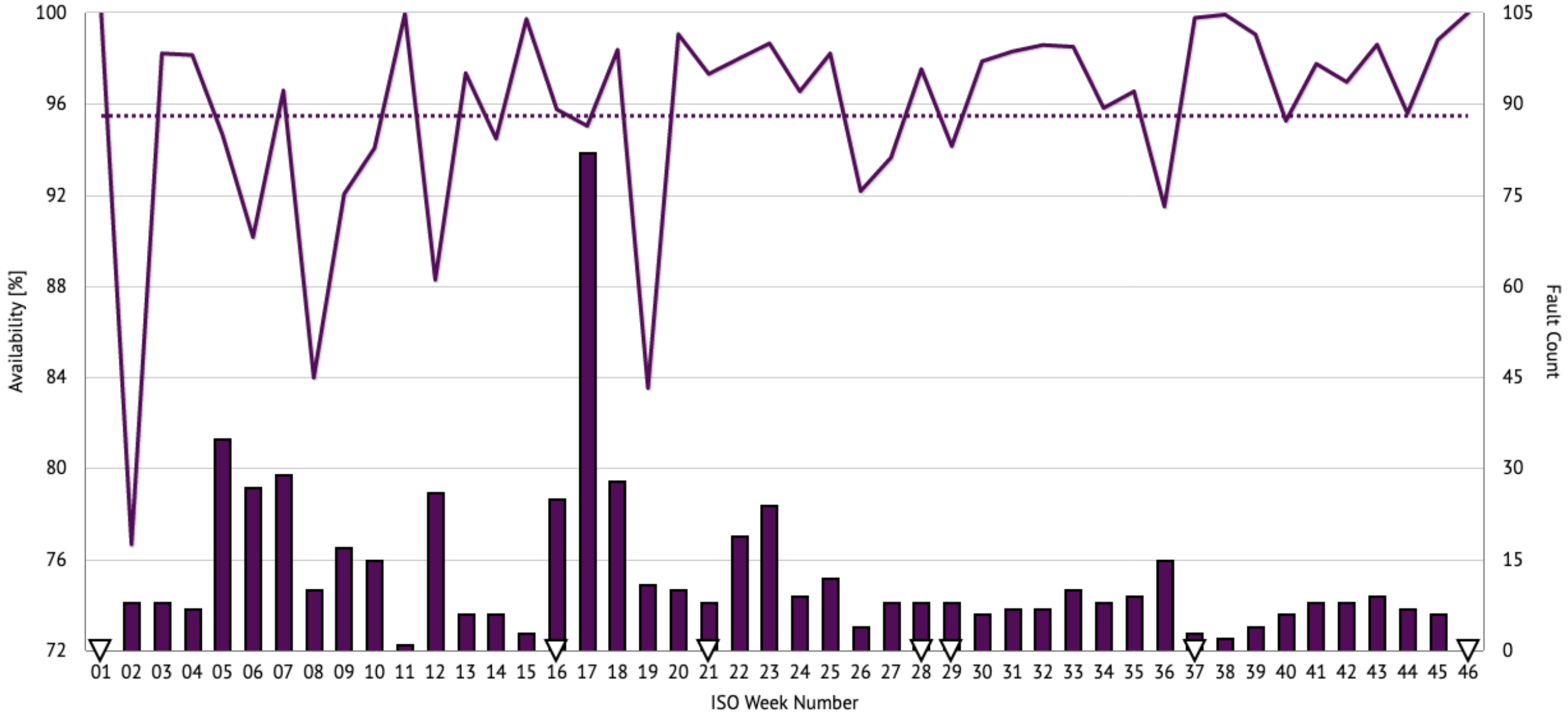
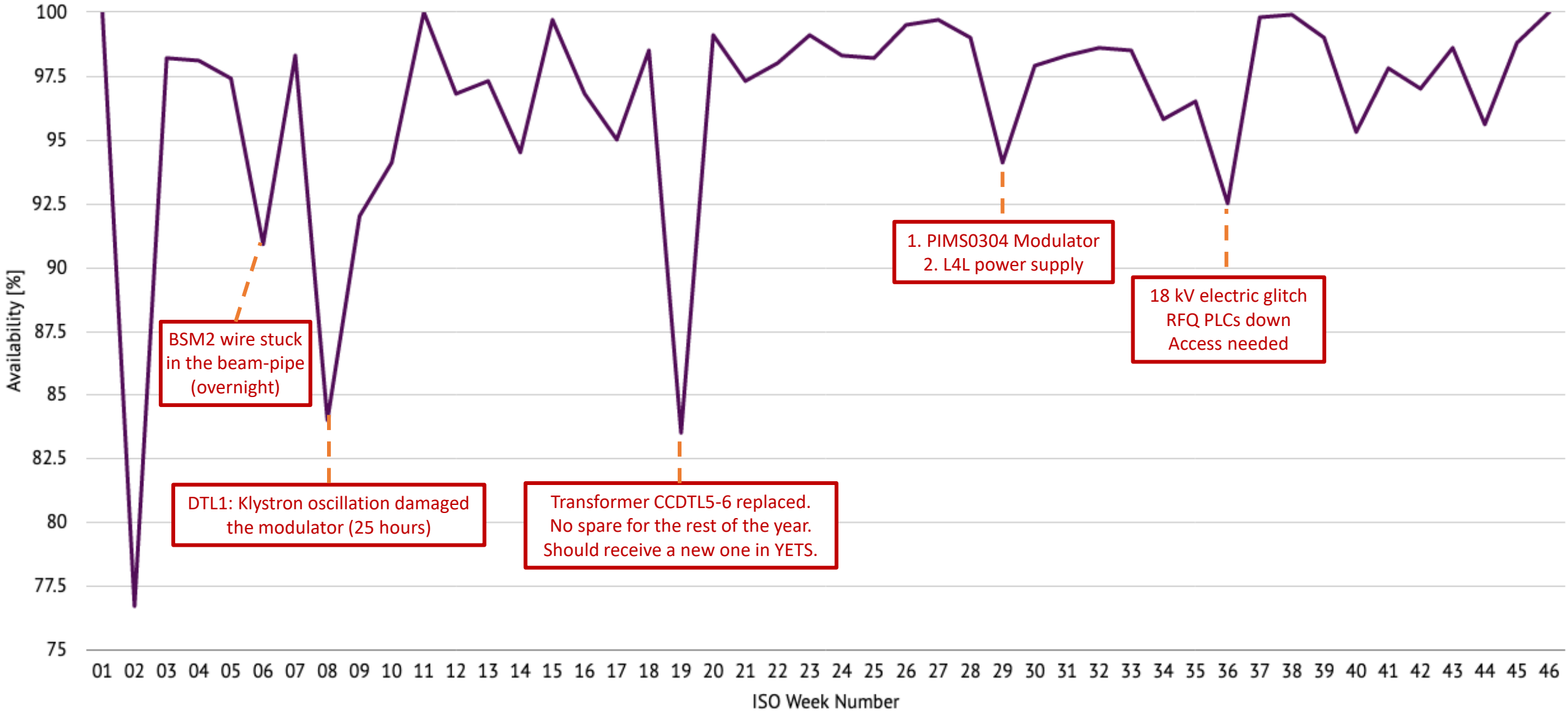
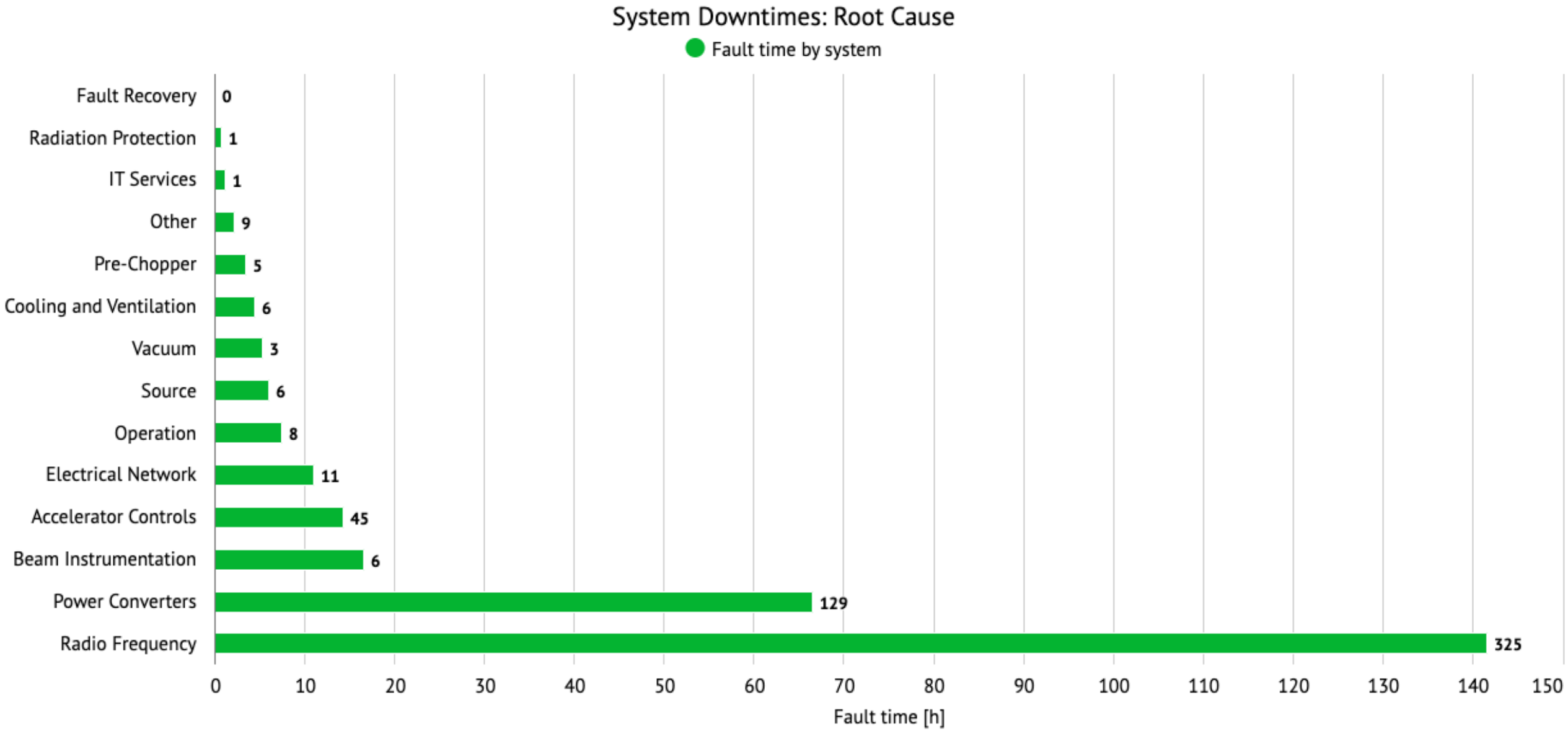
Weekly availability over the full operational period in 2021



Weekly availability over the full operational period in 2021



System Downtimes



Observed top fault contributors and recurring faults

- Classification fully predictable
- Pos. 1 : RF
  - Of course, linacs are all about high power RF → and it is a tricky business
- Pos. 2 : EPC
  - Modulators are in practice the internal part of the RF system
  - RF interlocks stop the modulator → EPC gets the blame
  - When klystron gets unstable then it is the modulator that gets broken
- Pos. 3 : BI & Controls
  - BI high rank is due to BCT Watch Dogs and BSM wire stacked on 1 occasion

RF fault follow ups

- Active mode-anode stabilization of the modulators
  - The biggest contributor : approximately 4h once per month
  - Electronic cards broken when klystron gets unstable
  - DTL1 was equipped with a more robust passive stabilization electronics
  - Tests passed OK → during EYETS all klystrons are equipped with the passive one

- Lengthy PLC restart after electric glitch
  - Access needed to restart PLCs for RFQ LLRF
  - Architecture of the system is being changed during EYETS

- Chopper fixed during the run
  - FESA class improvements
  - Disconnected monitoring scopes leading to "out of range error"

EPC fault follow ups

- Modulator Transformer breakdown
  - Spare is in Bldg 112, where RF uses it for tests and development : time of transport
  - The design spare position is in Bldg 400
  - Topic covered on 286th IEFC
    - "The IEFC recommends the proposal presented by D. Aguglia to request the purchase of a new modulator"

- FGC platform being improved (software)
  - Saving post-mortem logs blocking communication (reset cmnd) for several minutes
    - Additionally it was completely unclear why PC did not want to take reset commands

BI Follow-up

- BCTWD fixed – software design is being improved
  - The issue: Watch Dog obtained its data from BCT via Get command
  - In this particular case the FESA class recompilation made the issue disappear
  - Hot news from Smoooth Update WG: the WD will update to use subscription

Big Sister conditions

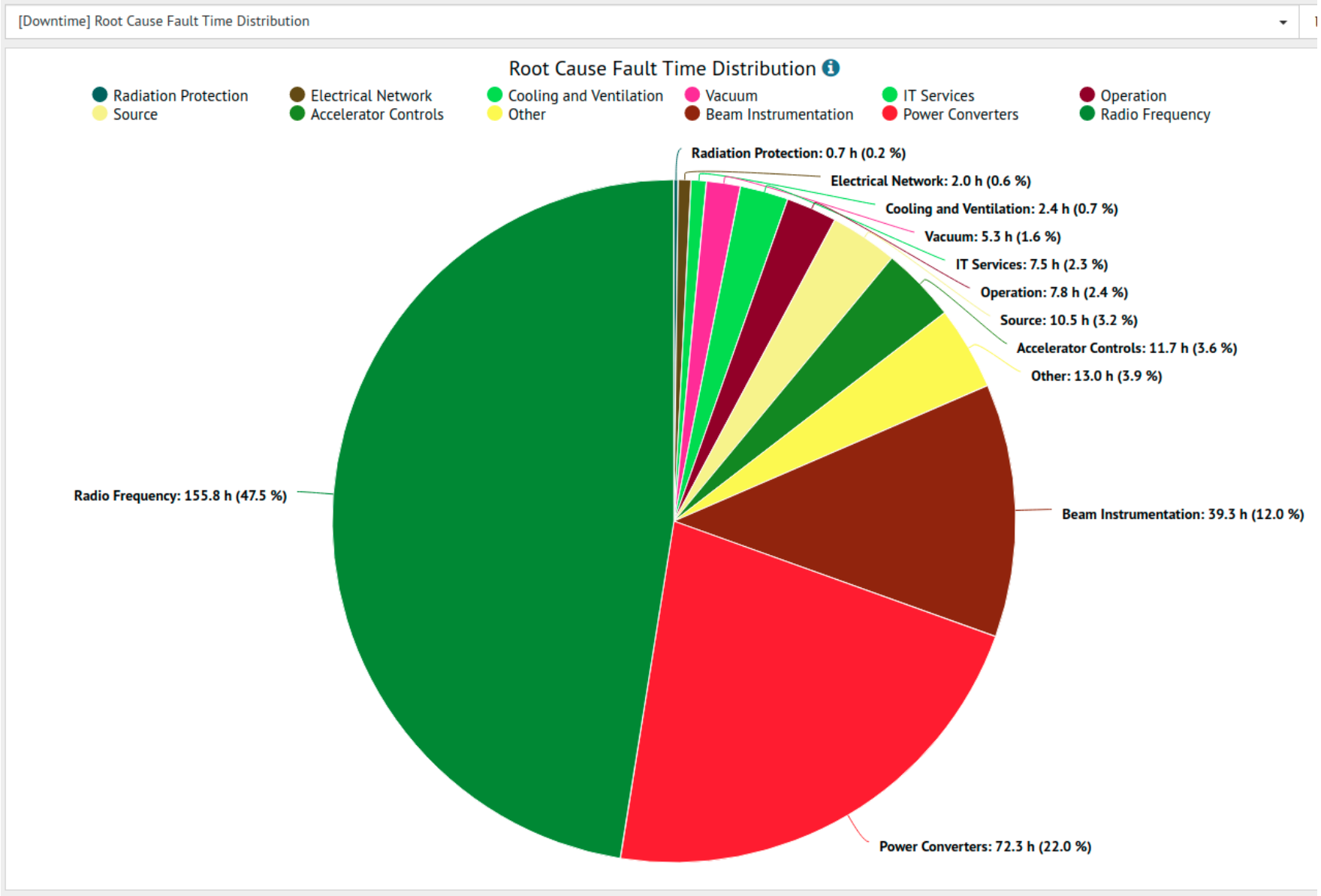
- AFT Faults triggered by
  - BIC-RF or BIC-CH (chopper) in NOT-OK state
    - If it is due to BIC-PSB[1,2,3,4] NOT-OK then it is PSB fault
    - Otherwise LN4 fault
  - Beam stopper in
    - In the first iteration I would not implement this condition
    - It is rarely triggered
      - By operator to perform bigger manipulation like access
      - By RFQ breakdown protection

- AFT Faults finished by 50 consecutive shots with beam (BCT) or being ZERO
  - Time of the 1st shot of the series should be used

Conclusions

- LINAC4 did quite well this year
- All the teams do all they can to oust the biggest fault contributors

And a pie !


[Downtime] Root Cause Fault Time Distribution
Root Cause Fault Time Distribution
Radiation Protection
Source
Electrical Network
Accelerator Controls
Cooling and Ventilation
Other
Vacuum
Beam Instrumentation
IT Services
Power Converters
Operation
Radio Frequency
Radiation Protection: 0.7 h (0.2 %)
Electrical Network: 2.0 h (0.6 %)
Cooling and Ventilation: 2.4 h (0.7 %)
Vacuum: 5.3 h (1.6 %)
IT Services: 7.5 h (2.3 %)
Operation: 7.8 h (2.4 %)
Source: 10.5 h (3.2 %)
Accelerator Controls: 11.7 h (3.6 %)
Other: 13.0 h (3.9 %)
Radio Frequency: 155.8 h (47.5 %)
Beam Instrumentation: 39.3 h (12.0 %)
Power Converters: 72.3 h (22.0 %)