RF Beam Interlocks

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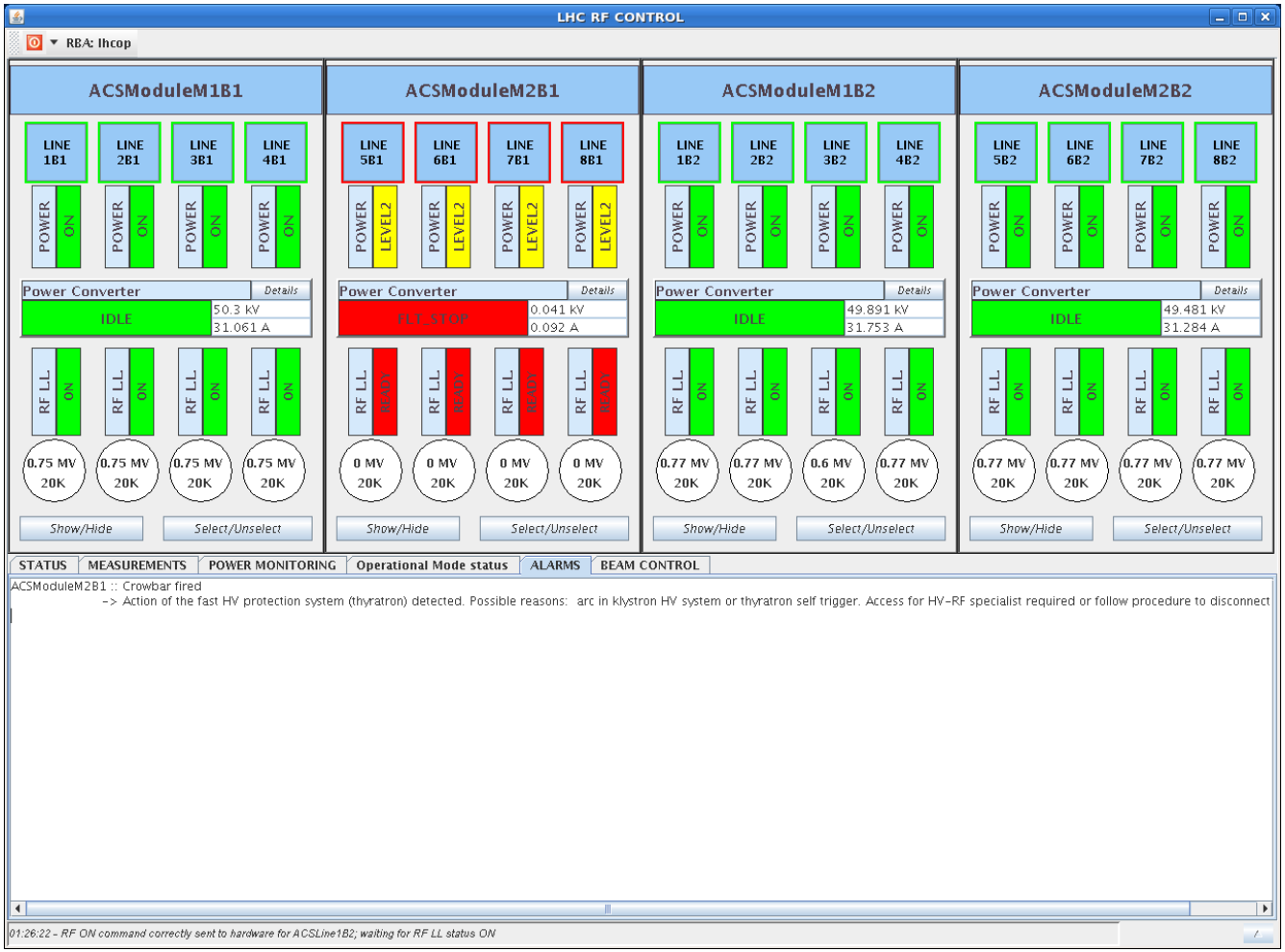
MPP 24.06.2011

Outline

- Outline of RF system interlocks
- What can/should dump the beam
- Proposed changes for technical stop
- Conclusions

RF system topology

- 8 cavities per beam, grouped by cryomodule of 4
- 1 HV power converter per group of 4



3 types of interlock in RF system:

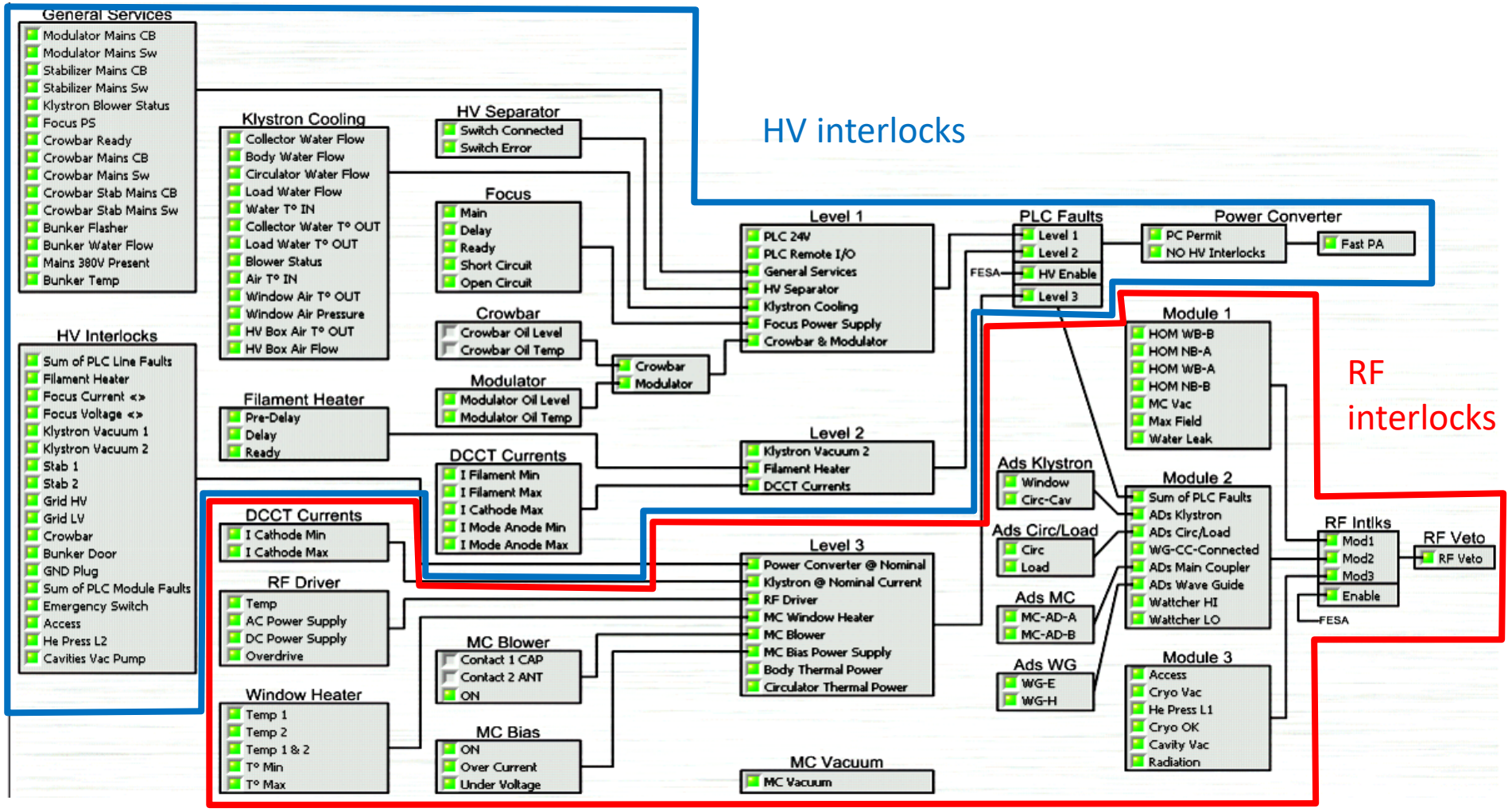
1. RF interlocks: switch off RF drive to 1 klystron (1 cavity)
   - since 17 June these also generate a Beam Interlock

2. HV interlocks: switch off HV power converter (4 cavities)
   - will cause the total voltage (SIS) interlock to dump the beam

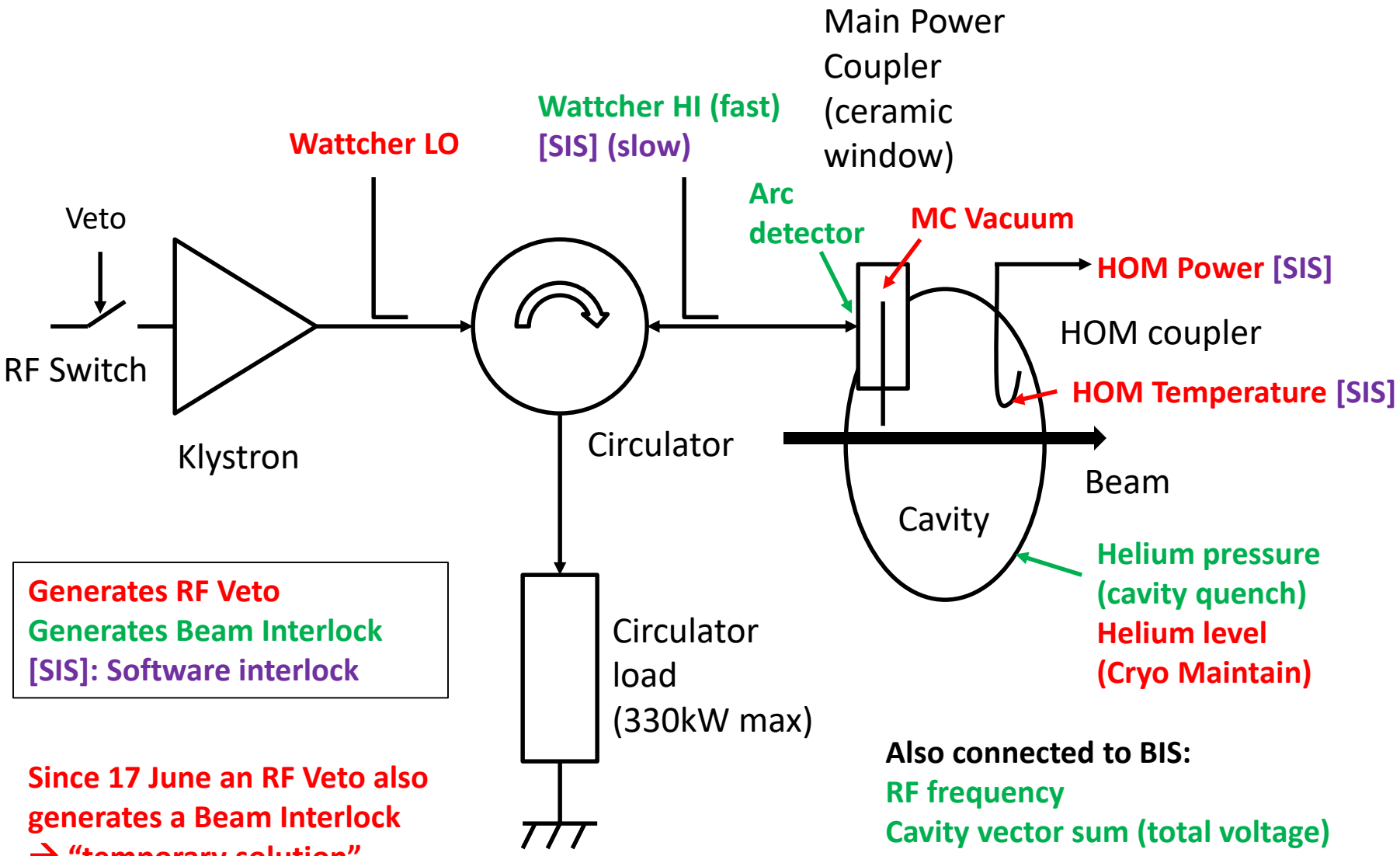
3. Beam interlocks: HW connection to BIC

- Also software interlocks via SIS

RF and HV Interlock chains



RF power distribution & critical interlocks



Generates RF Veto
Generates Beam Interlock
[SIS]: Software interlock

Since 17 June an RF Veto also generates a Beam Interlock
→ "temporary solution"

Also connected to BIS:
RF frequency
Cavity vector sum (total voltage)
Faraday Cage UPS fail

Cavity sum (total voltage) interlock

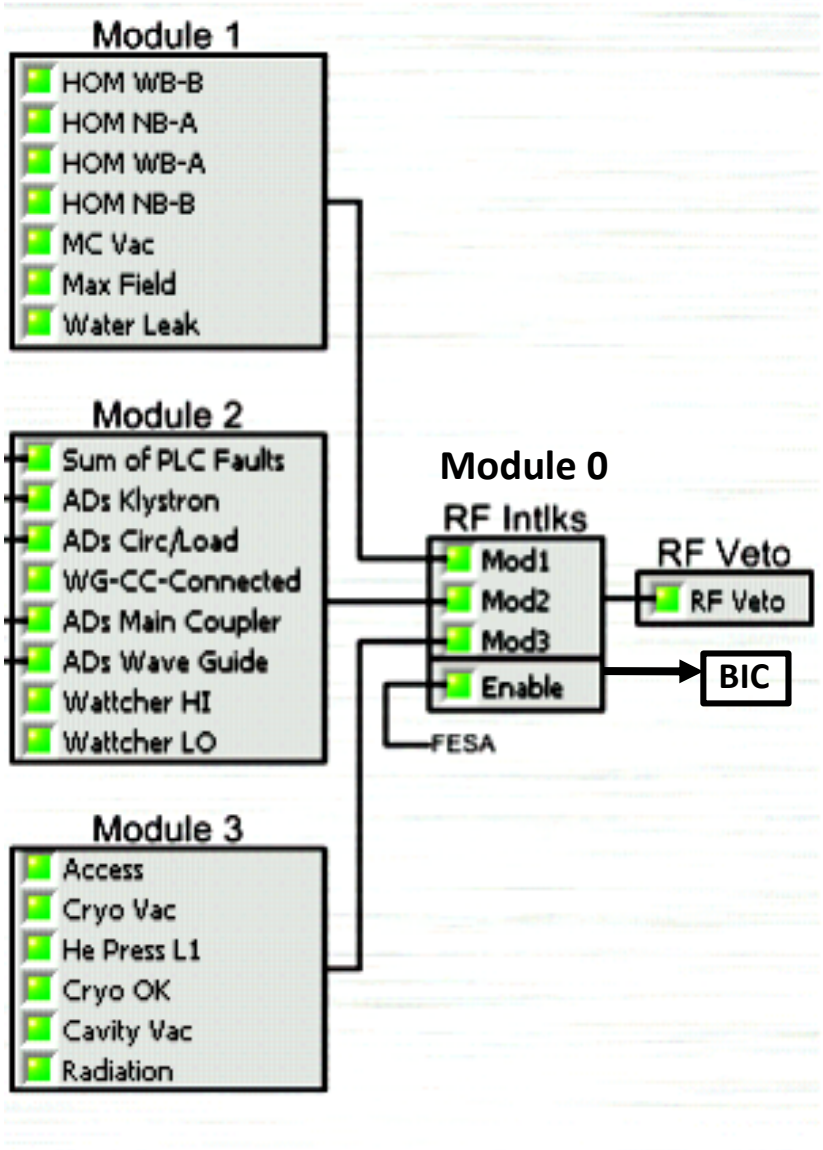
- Cavity Sum acquisition in Beam Phase Measurement module of Beam Control system in SR4
- Currently SIS software interlock on this acquisition (only at 3.5 TeV)
- Hardware interlock foreseen:
  - FGC function for energy-dependent interlock threshold (new firmware to install during TS)
  - HW connection to BIC is prepared and tested

Proposed modification for tech. stop

- Reprogram Module 0 (sum of RF interlocks):
  - all Module 1 interlocks to BIC + RF Veto
  - Module 2 & 3 interlocks to RF Veto only
  - ☺ reduce the probability of false positives
  - ☺ MC Vacuum generates Beam Interlock
  - ☹ Wattcher LO, Cryo OK, Cavity Vacuum no longer generate beam interlock

→ Still under study, no decision taken yet for Technical Stop

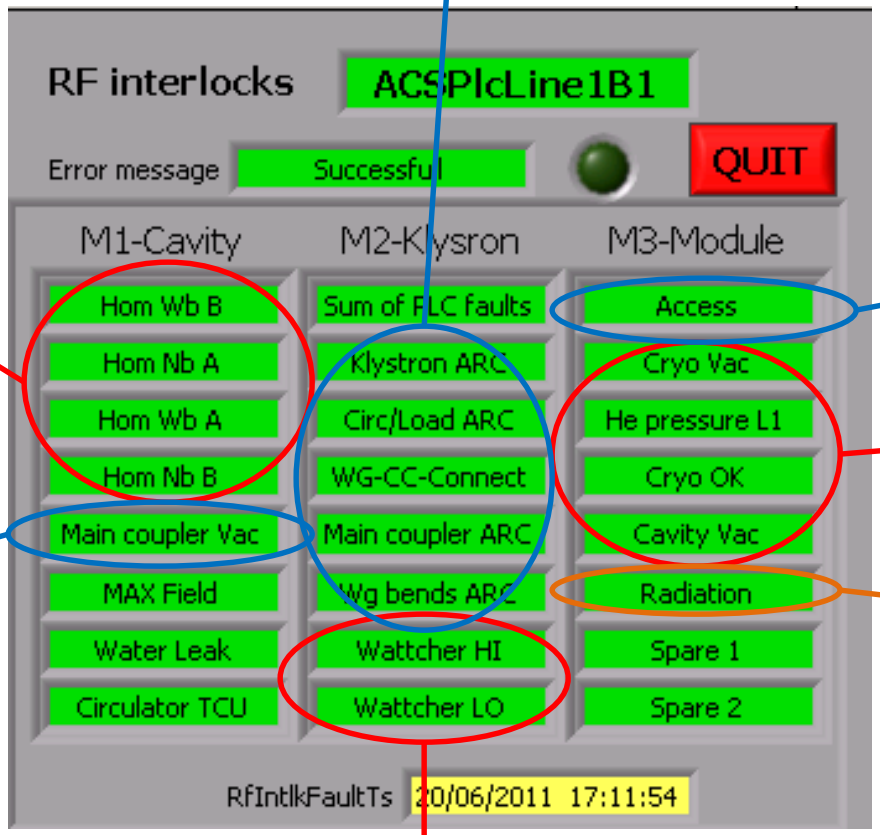
→ Longer term: reorganize interlock inputs to group RF and Beam interlocks by module



Conclusions

- The current situation (all RF interlocks generate a beam dump) is conservative but safe
- So far we have not seen any dumps due to spurious RF trips
- New firmware has been prepared for the interlock modification
- We will decide before the technical stop whether to install it
- In the longer term, reorganization of interlock system under study (for end of year or long shutdown)

RF interlocks



Arc detectors

Higher order mode power

Access system

Cryo + Vacuum

Main coupler vacuum

Radiation

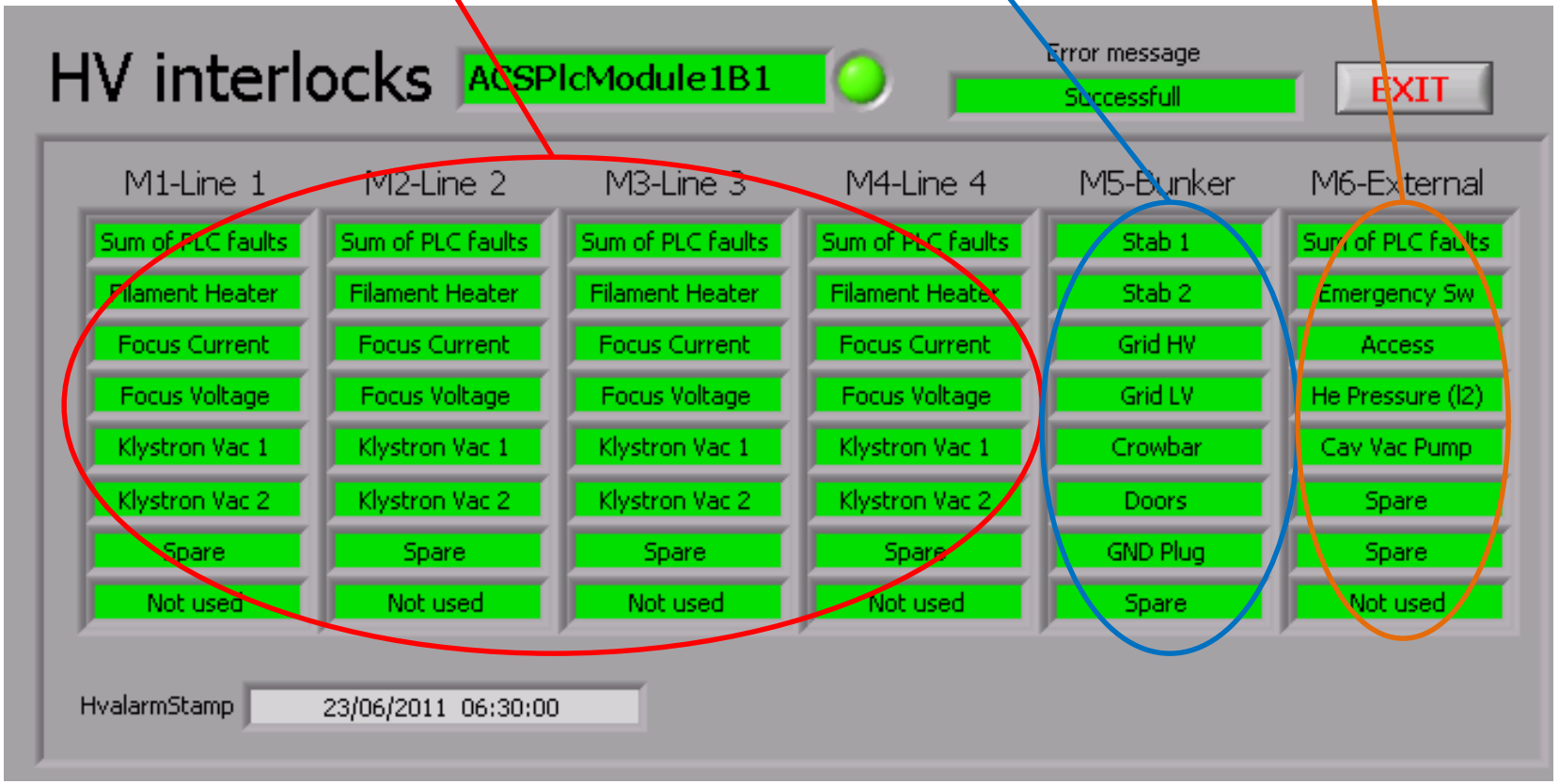
Reflected power

HV interlocks

Klystron faults

HV bunker faults

External faults



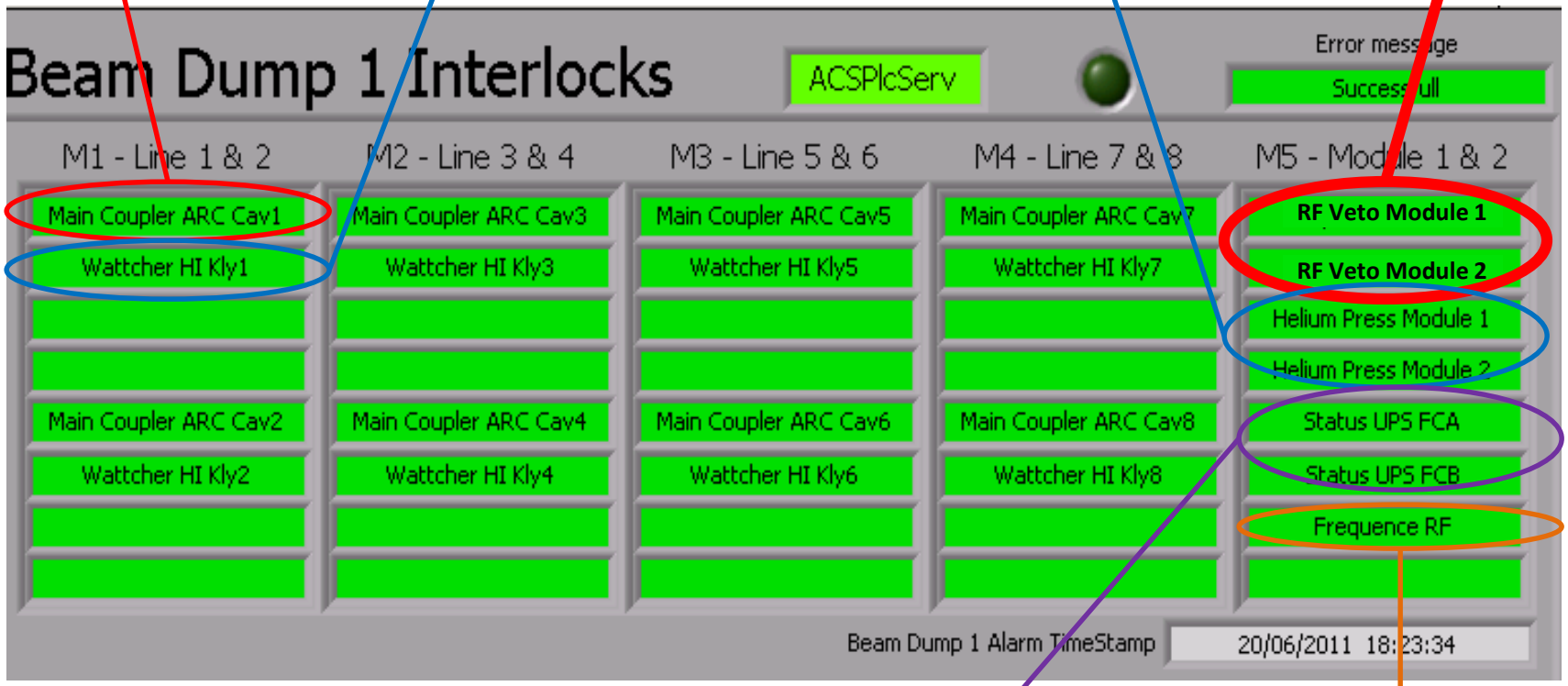
Interlocks connected to BIS (UX45)

Arc detector on Main Coupler

Fast Reflected Power (Wattcher HI)

Sum of RF Veto interlocks (new)

He pressure (cavity quench)



Faraday cage power status

RF frequency interlock