

RF Beam Interlocks

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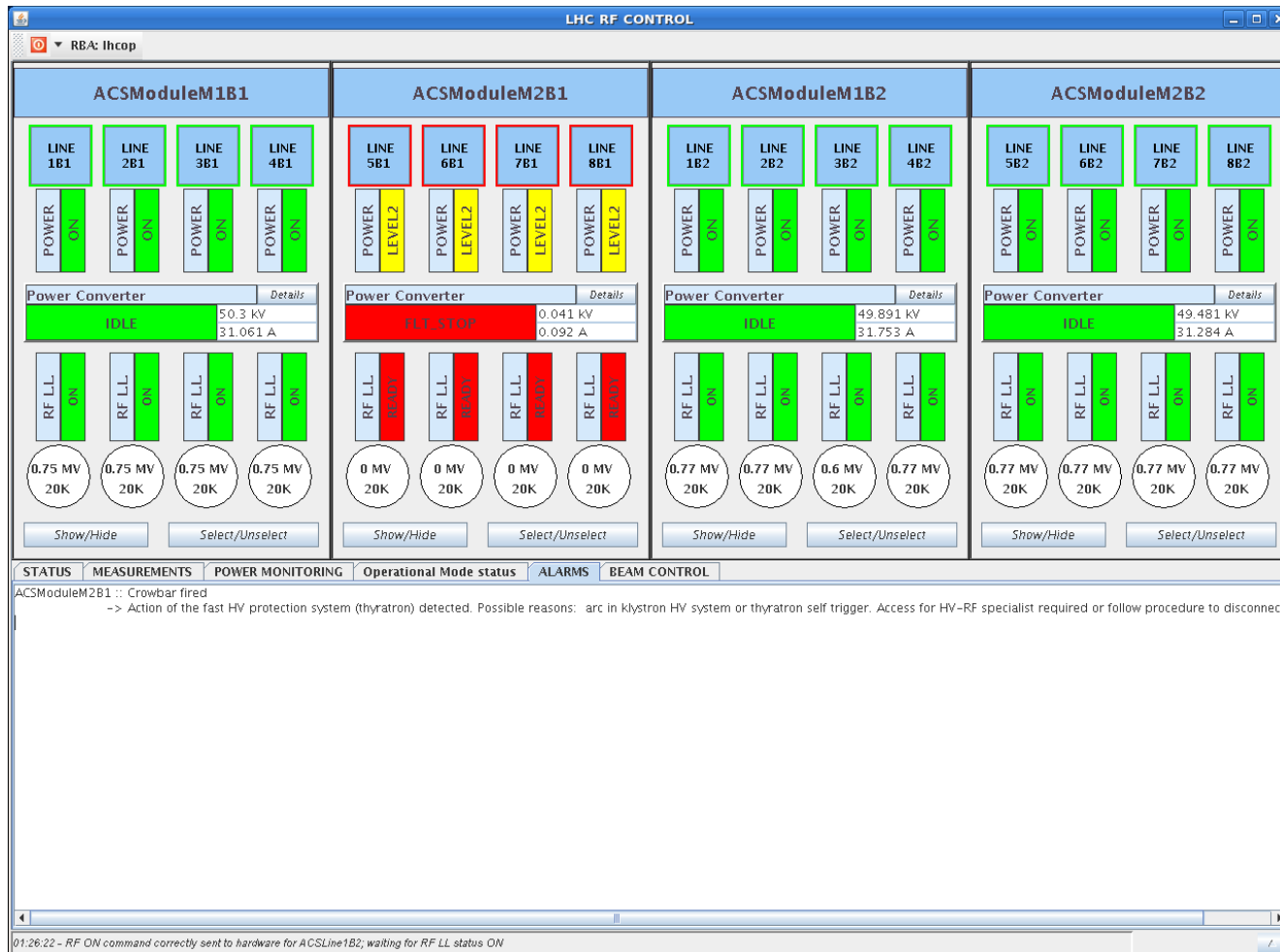
MPP 24.06.2011

Outline

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

RF system topology

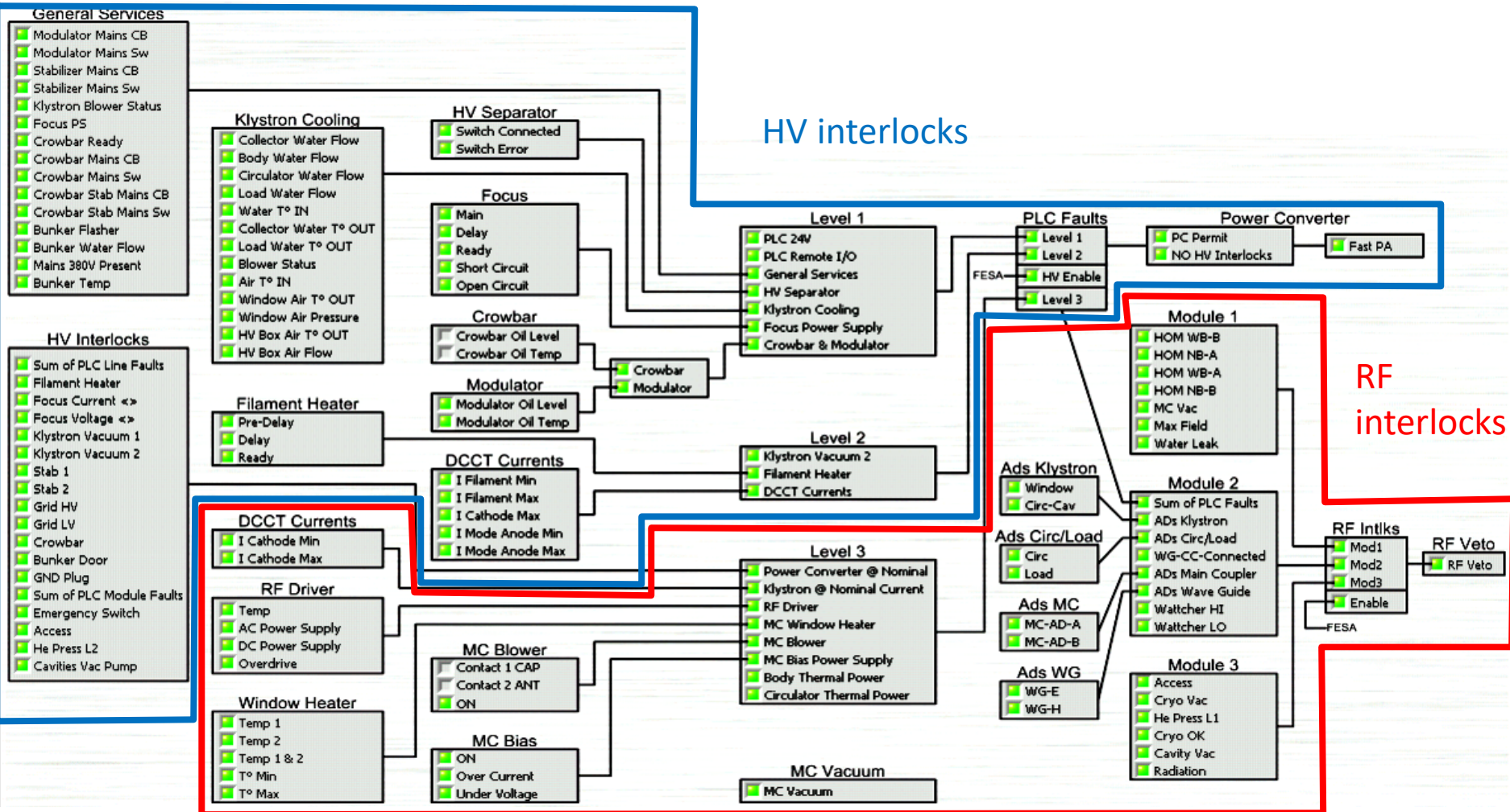
- 8 cavities per beam, grouped by cryomodule of 4
- 1 HV power converter per group of 4



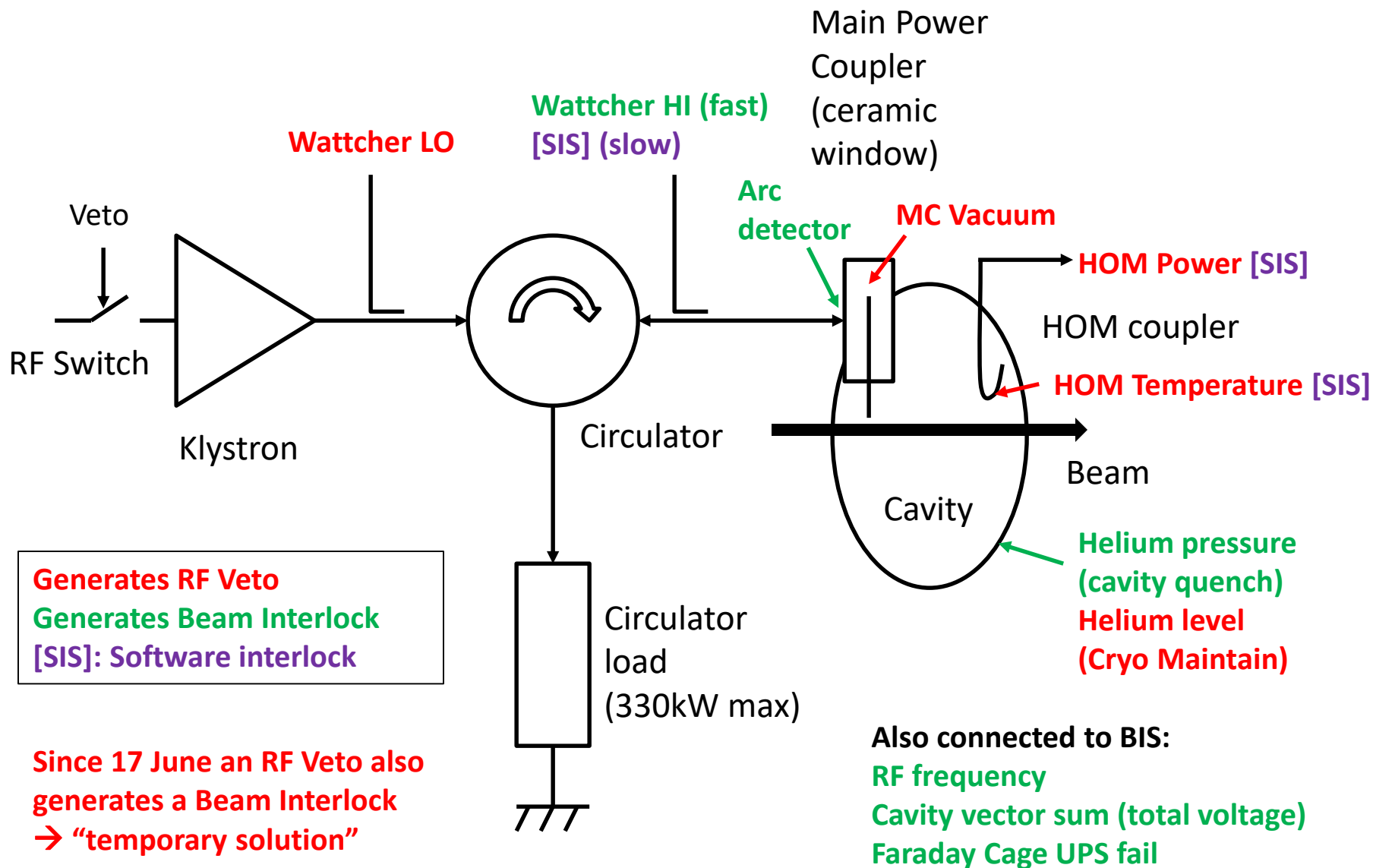
3 types of interlock in RF system:

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

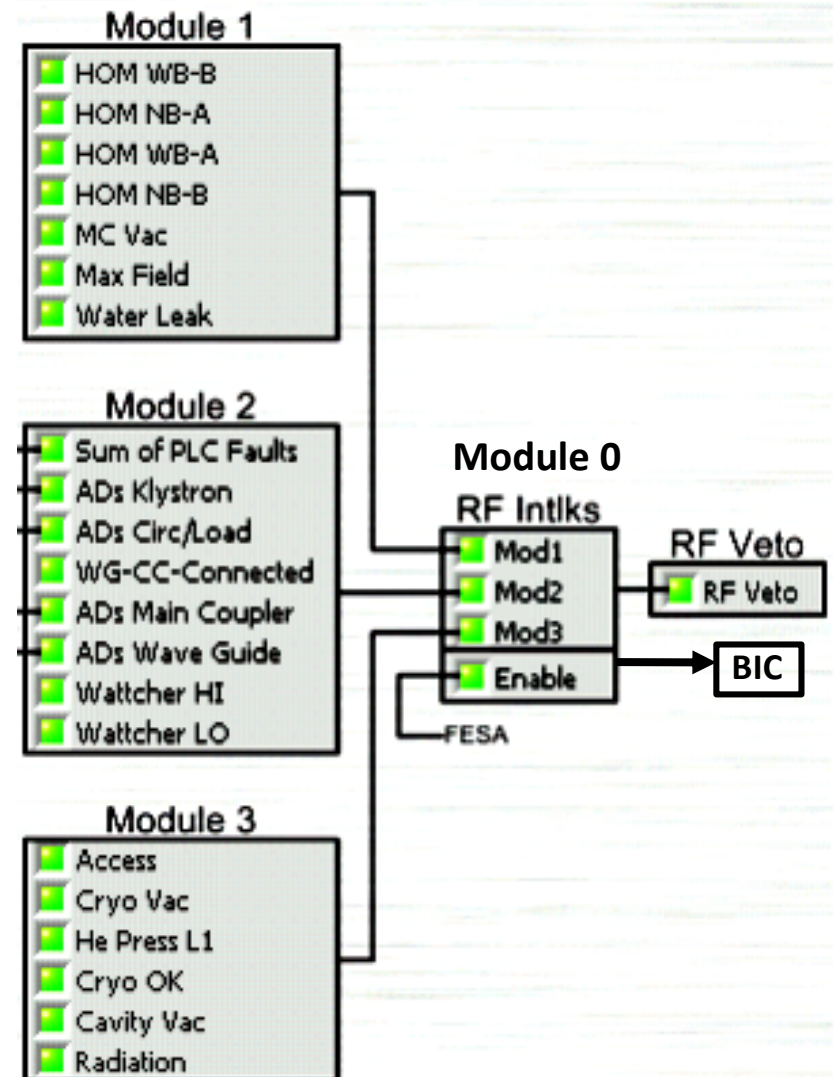
Since 17 June an RF Veto also generates a Beam Interlock → "temporary solution"

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

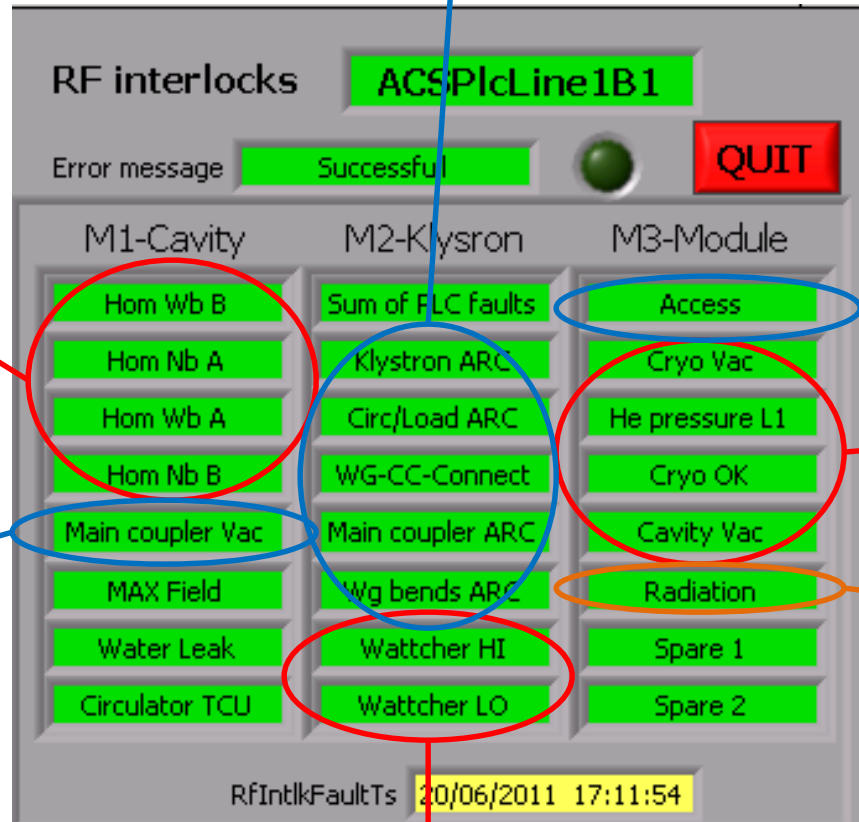
Main coupler vacuum

Access system

Cryo + Vacuum

Radiation

Reflected power



HV interlocks

Klystron faults

HV bunker faults

External faults

The interface displays the following information:

- Module ID:** ACSPICModule1B1
- Status:** Successfull
- EXIT button:** A button labeled EXIT in red text.
- Columns:** M1-Line 1, M2-Line 2, M3-Line 3, M4-Line 4, M5-Bunker, M6-External.
- Rows (Fault Types):** Sum of PLC faults, Filament Heater, Focus Current, Focus Voltage, Klystron Vac 1, Klystron Vac 2, Spare, Not used.

M1-Line 1	M2-Line 2	M3-Line 3	M4-Line 4	M5-Bunker	M6-External
Sum of PLC faults	Sum of PLC faults	Sum of PLC faults	Sum of PLC faults	Stab 1	Sum of PLC faults
Filament Heater	Filament Heater	Filament Heater	Filament Heater	Stab 2	Emergency Sw
Focus Current	Focus Current	Focus Current	Focus Current	Grid HV	Access
Focus Voltage	Focus Voltage	Focus Voltage	Focus Voltage	Grid LV	He Pressure (I2)
Klystron Vac 1	Klystron Vac 1	Klystron Vac 1	Klystron Vac 1	Crowbar	Cav Vac Pump
Klystron Vac 2	Klystron Vac 2	Klystron Vac 2	Klystron Vac 2	Doors	Spare
Spare	Spare	Spare	Spare	GND Plug	Spare
Not used	Not used	Not used	Not used	Spare	Not used

HvalarmStamp 23/06/2011 06:30:00

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)

Beam Dump 1 Interlocks

ACSPlcServ

Error message: Successful

M1 - Line 1 & 2	M2 - Line 3 & 4	M3 - Line 5 & 6	M4 - Line 7 & 8	M5 - Module 1 & 2
Main Coupler ARC Cav1	Main Coupler ARC Cav3	Main Coupler ARC Cav5	Main Coupler ARC Cav7	RF Veto Module 1
Wattcher HI Kly1	Wattcher HI Kly3	Wattcher HI Kly5	Wattcher HI Kly7	RF Veto Module 2
				Helium Press Module 1
				Helium Press Module 2
Main Coupler ARC Cav2	Main Coupler ARC Cav4	Main Coupler ARC Cav6	Main Coupler ARC Cav8	Status UPS FCA
Wattcher HI Kly2	Wattcher HI Kly4	Wattcher HI Kly6	Wattcher HI Kly8	Status UPS FCB
				Frequency RF

Beam Dump 1 Alarm TimeStamp 20/06/2011 18:23:34

Faraday cage power status

RF frequency interlock