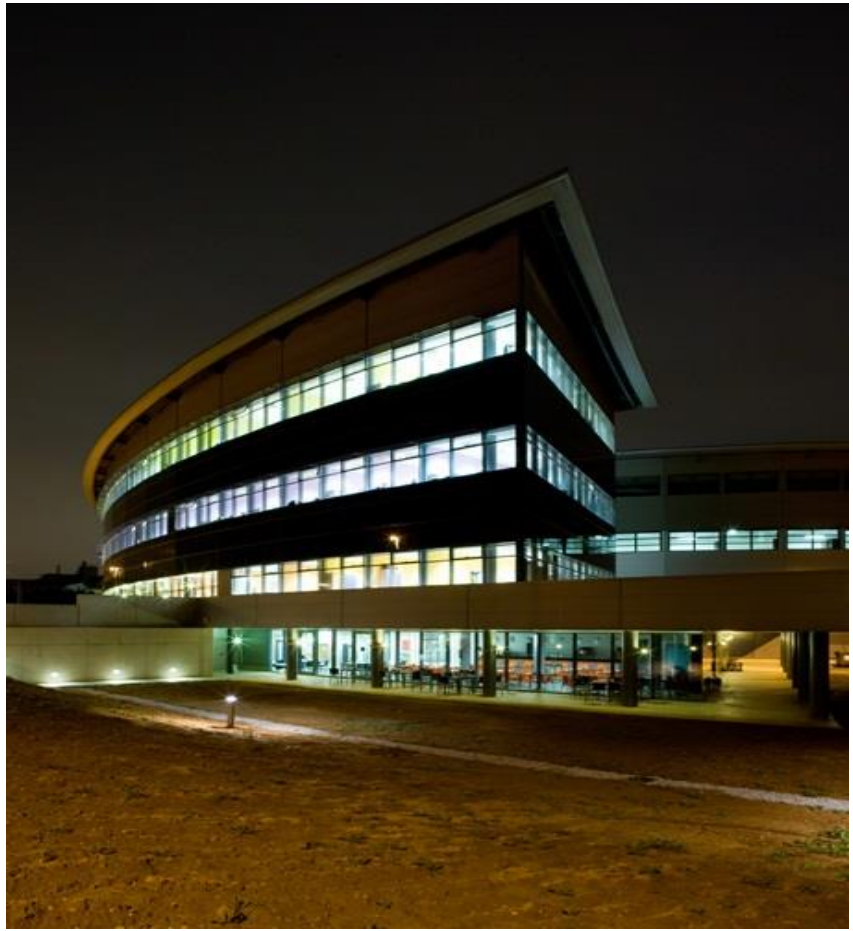
Equipment protection system checks at ALBA



Ferran Fernandez

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Outline

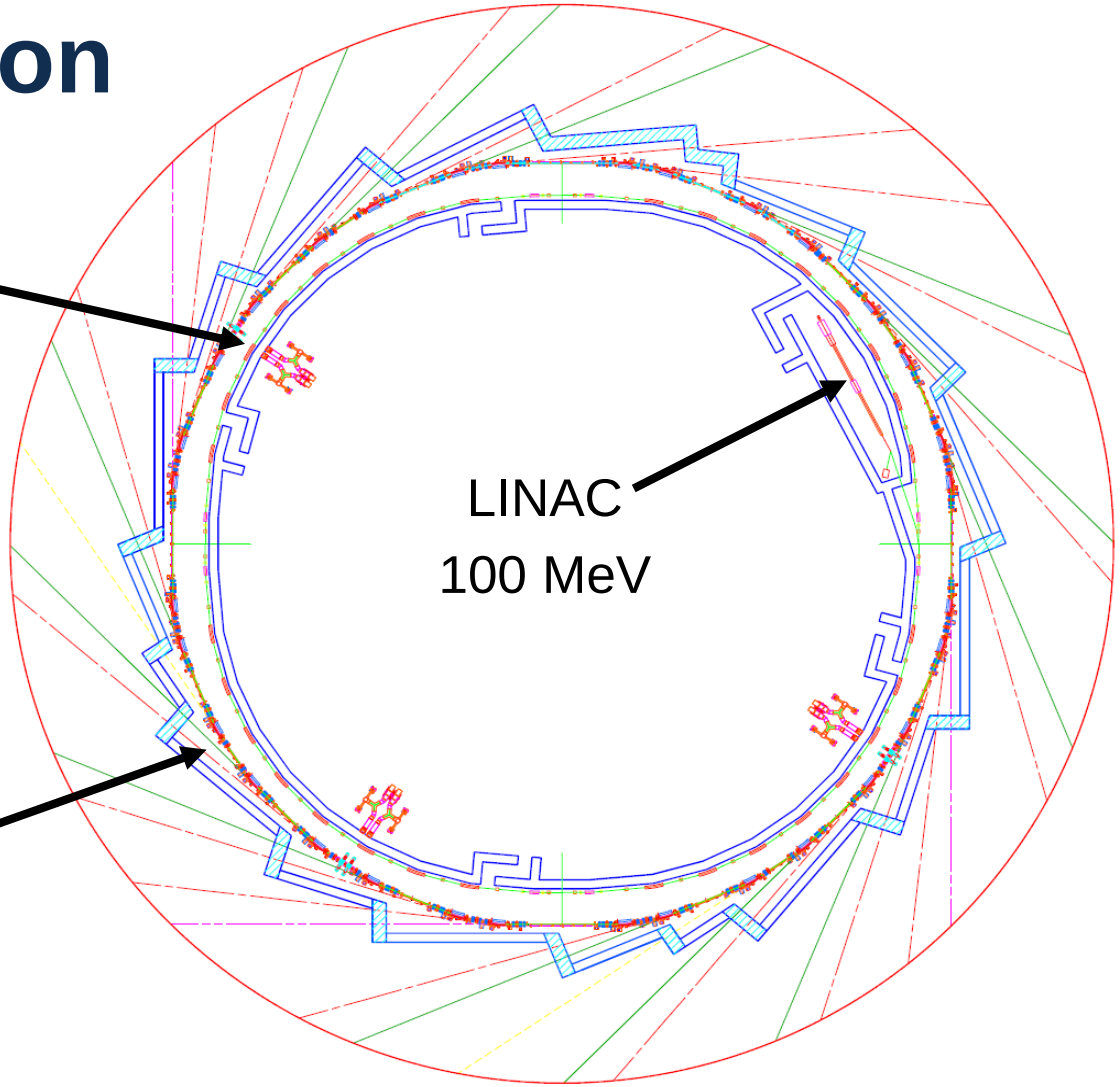
- *Introduction*
- *Equipment Protection Systems (EPS) at ALBA*
  - *Description*
  - *“Protection laws” list*
- *EPS checks*
  - *What to check*
  - *How, how often, simulated vs. real,…*
- *Conclusions*

Introduction

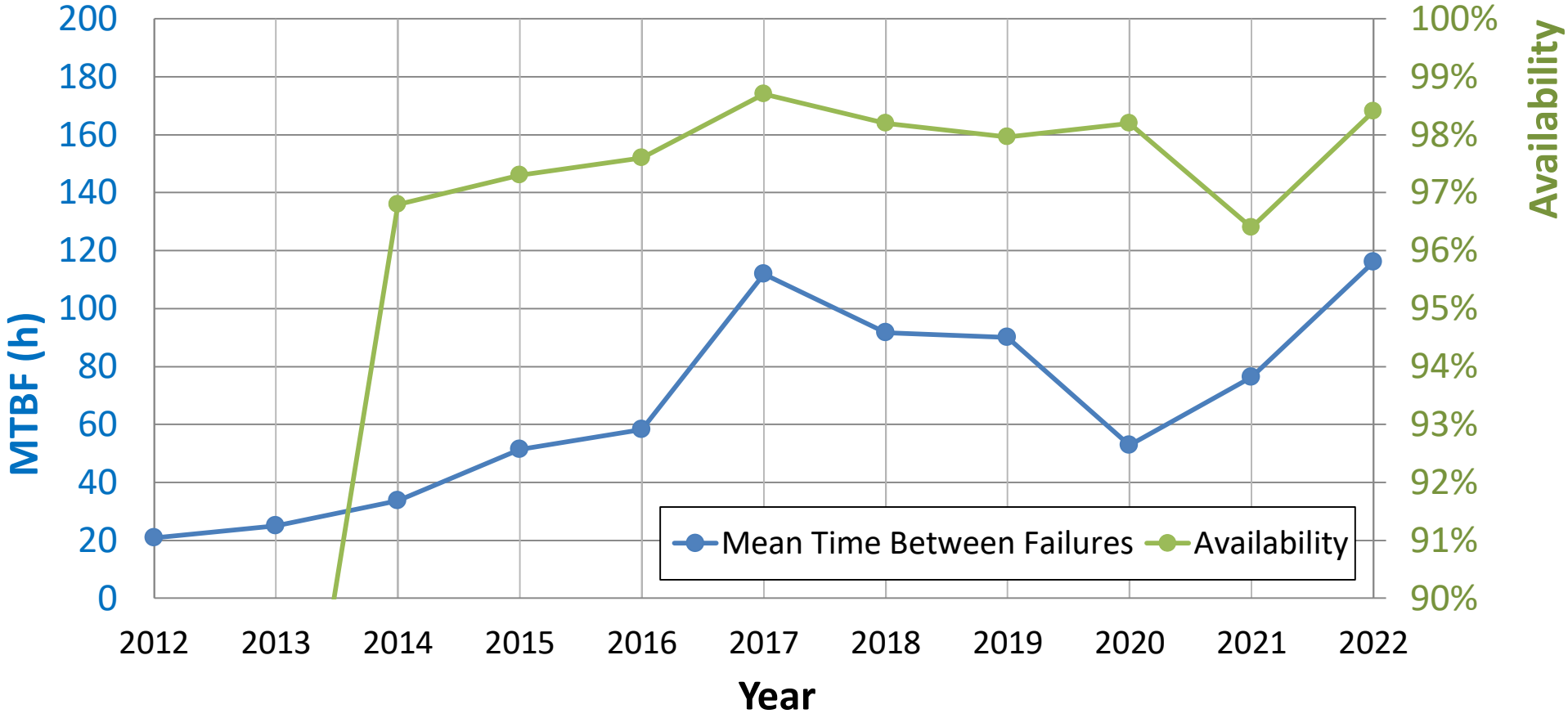
BOOSTER
100 MeV – 3 GeV

+ 11 Beamlines
+ 2 BLs in construction

STORAGE RING
3 GeV



Introduction



ALBA Eq. Protec. Systems

Equipment Protection System (EPS)

- Based on PLCs
- Organized by subsystem: vacuum, magnets, front ends, radiofrequency, insertion devices…
- PLCs share information through powerlink
- “Slow”: time to kill ~80ms

Machine Protection System (MPS)

- Based on timing system
- Signals from Libera BPMs (orbit interlock) and EPS PLCs
- Each event receiver (EVR) can send signal to event generator (EVG) that distributes signal to all EVR
- “Fast”: time to kill ~0.1ms

Critical signals sent to MPS ⟷ BPMs signals sent to EPS

ALBA Eq. Protec. Systems

Equipment Protection System (EPS)

- Each PLC receive signals from :
  - Sensors:
    - Thermocouples, thermal switches
    - Ion pumps (IP), cold cathode gages (CCG)
    - Flow switches, air switches
    - Limit switches (shutters, valves,…)
    - Others: inclinometers…
  - Other PLCs: SR valve closed, kill RF, kill Linac…
  - Orbit interlock from MPS
- Each PLC sends signals to:
  - Relays:
    - Stop power supply
    - Close vacuum valve
    - Stop RF high/driver voltage
    - Stop Linac electron gun/klystrons
    - Stop pulsed high voltage
    - Stop motor controller (ID)
    - …
  - Other PLCs: SR valve closed, kill RF, kill Linac…
  - Critical signals to MPS: kill RF

ALBA Eq. Protec. Systems

Equipment Protection System (EPS)

EPS guarantees the some "laws" are followed

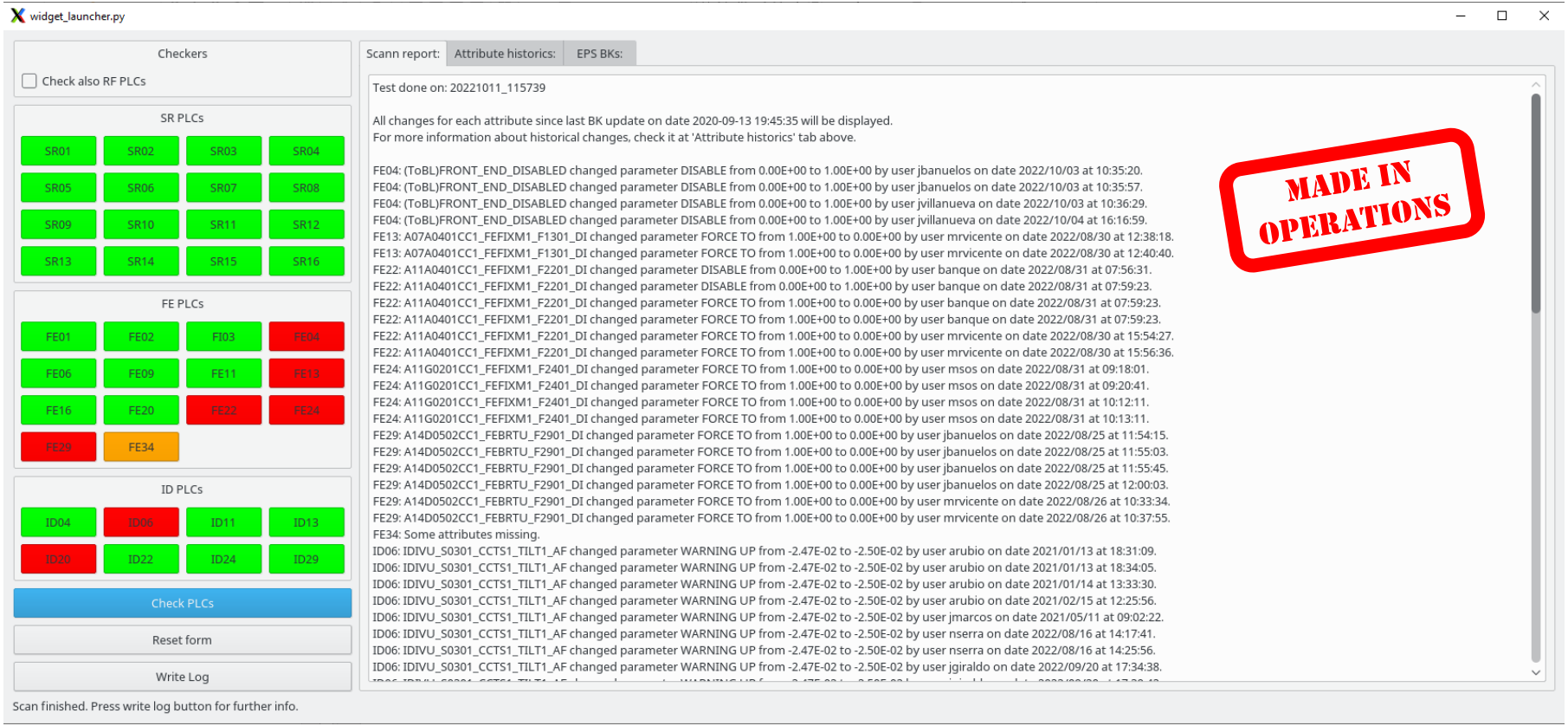
- Storage ring thermocouple warning → Kills Linac
- Storage ring thermocouple alarm → Kills RF
- Vacuum trip (CCG + IP) → Closes sector valves
- SR valve closed → Kills RF and Linac
- Magnet thermal or flow switch → Stops Power Supply
- Insertion device has a tilt → Stops motor
- Front end thermocouple alarm → Closes shutter or kills RF

ALBA EPS checks

WHAT	• **The configuration of the PLCs**: PLCs connected, thermocouples levels, signals enabled/disabled,… • **The hardware**: sensors are working, mechanical switches are not stuck, switches “open”, connections are tight (false alarms)… • **The “chain” is working**: from sensor to switch, including cables, logic, connections…
HOW	• **How often**: weekly, monthly, yearly • **Force/simulate signal vs. real signal** • **Exhaustive vs. random**: test all thermocouples of each PLC vs. pick some of them

ALBA EPS checks

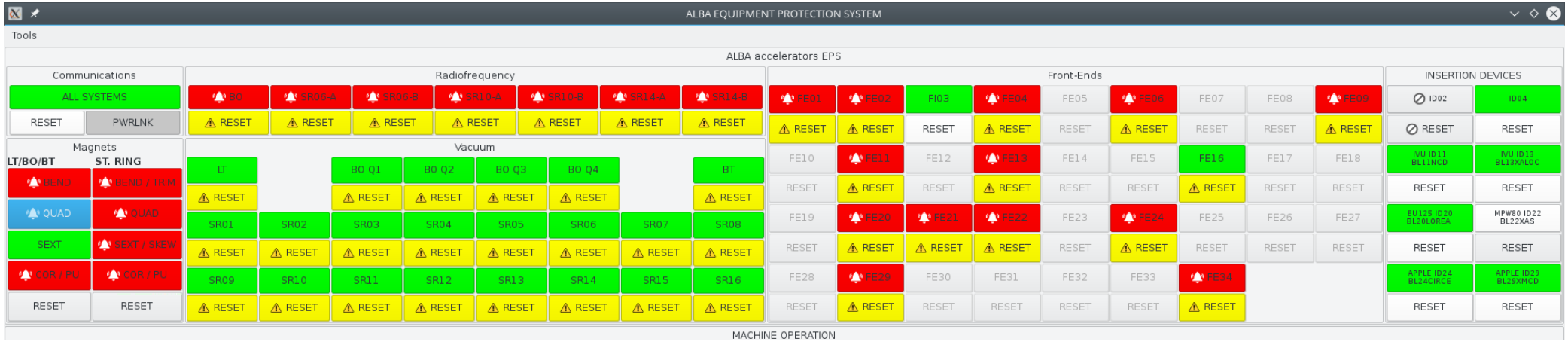
- Every “Monday Startup” we check the EPS configuration parameters



ALBA EPS checks

Some hardware is very easy to test with real signals, exhaustive

- **General water flow cut** (1/year)
  - All flow switches -> OFF
  - All cooled magnets & power supply -> OFF
  - All Front Ends photon shutters -> CLOSE



ALBA EPS checks

Some hardware is very difficult to test

- Magnets maintenance (1/year)
  - Connections are tight (prevent false trips)
  - If thermal switches circuit “open” -> power supplies OFF
  - Coils temperature > 60deg -> power supplies OFF -> Not tested

ALBA EPS checks

Radiation Protection

As **L**ow **A**s **R**easonably **A**chievable

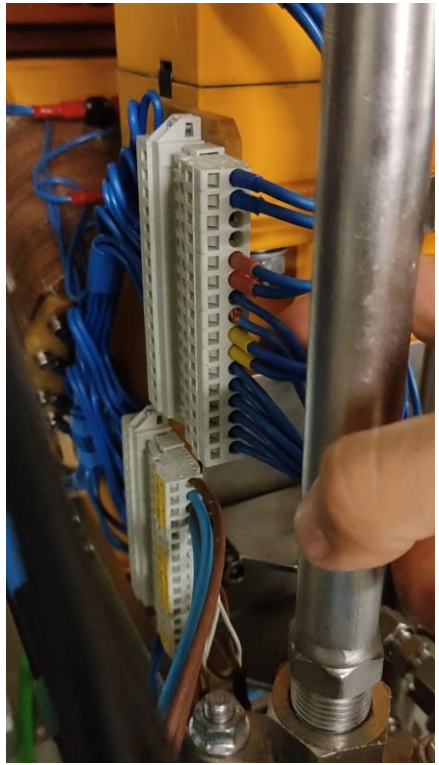
Equipment Protection System checks

As **M**uch **A**s **R**easonably **A**chievable

ALBA EPS checks

A plan of “what / how /how often” EPS checks is decided based on

- Danger
- Redundancy
- Past failures
  - Checks plan must be “alive”
- AMARA



For this, a goog fault tracking, impact on beam hours, is a must

ALBA EPS checks

	SPBX	PLC ITLK (ToBL)FRONT_END_INTERLOCKED	
ANY TC WARN	FEMOVM_F0401_T1_TC_TH	STOP LINAC	
	FEMOVM_F0401_T2_TC_TH	PLC WARN	
	FEMOVM_F0401_T3_TC_TH		
	FEMOVM_F0401_T4_TC_TH		
	FEPSHU_F0401_T1_TC_TH		ok
	FEPSHU_F0401_T2_TC_TH		ok
	FEPSHU_F0401_T3_TC_TH		ok
	FEPSHU_F0401_T4_TC_TH		
	FEXBPM_F0401_TA_TC_TH		
	FEXBPM_F0401_TB_TC_TH		
MOVM TC ITLK	FEMOVM_F0401_T1_TC_TH	FEPSHU_F0401_PSHU	
	FEMOVM_F0401_T2_TC_TH	(ToBL)FRONT-END_INTERLOCKED	
	FEMOVM_F0401_T3_TC_TH	PLC WARN	
	FEMOVM_F0401_T4_TC_TH		
MOVM FLW ITLK	FEMOVM_F0401_FLW_FLW1_DI	FEPSHU_F0401_PSHU	
	FEMOVM_F0401_FLW_FLW2_DI	(ToBL)FRONT-END_INTERLOCKED PLC WARN	
PSHU FLW ITLK	FEPSHU_F0401_FLW_FLW1_DI	Stop SRRF [OUT]	ok
	FEPSHU_F0401_FLW_FLW2_DI	PLC ITLK	ok
		Stop LINAC [OUT]	ok
FIXM FLW ITLK	FEFIXM1_F0401_FLW_FLOWL_DI	(ToBL)FRONT-END_INTERLOCKED	
XBPM TC ITLK	FEXBPM_F0401_TA_TC_TH	DIINTBO_A02D0101_IN4_ITLK_DO	
	FEXBPM_F0401_TB_TC_TH	(ToBL)FRONT-END_DISABLED	

FE01 FE02 FE04 FE06 FE09 FE11 FE13 FE16 FE20 FE21 FE22 FE24 FE25 FE29 FE34

Conclusions

- Due to new devices, maintenance, upgrades,… EPS is changing -> **checks is a MUST**
  - Use **fault tracking** to convince people
- Check **everything**: config., hardware, “chain”,
- Plan an EPS checks (**AMARA + experience**)
- **Operations** is the right team to do it

Thanks to

- Javier Bañuelos, the operator who is doing the EPS checks project
- Marc Sos, the operator who maintains our EPS database and did the EPS config. Checks GUI

Questions?