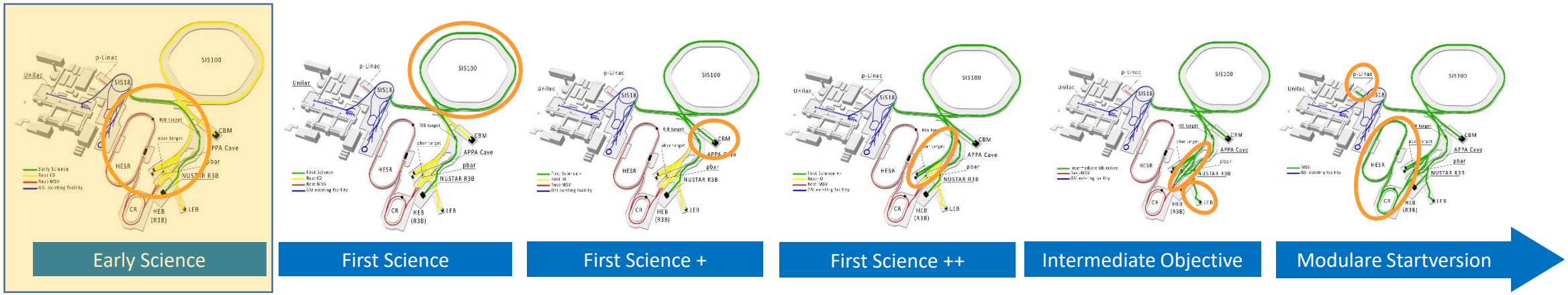
SFRS Commissioning Controls BEA Involvement

A. Reiter (BEA)

11th Nov. 2024

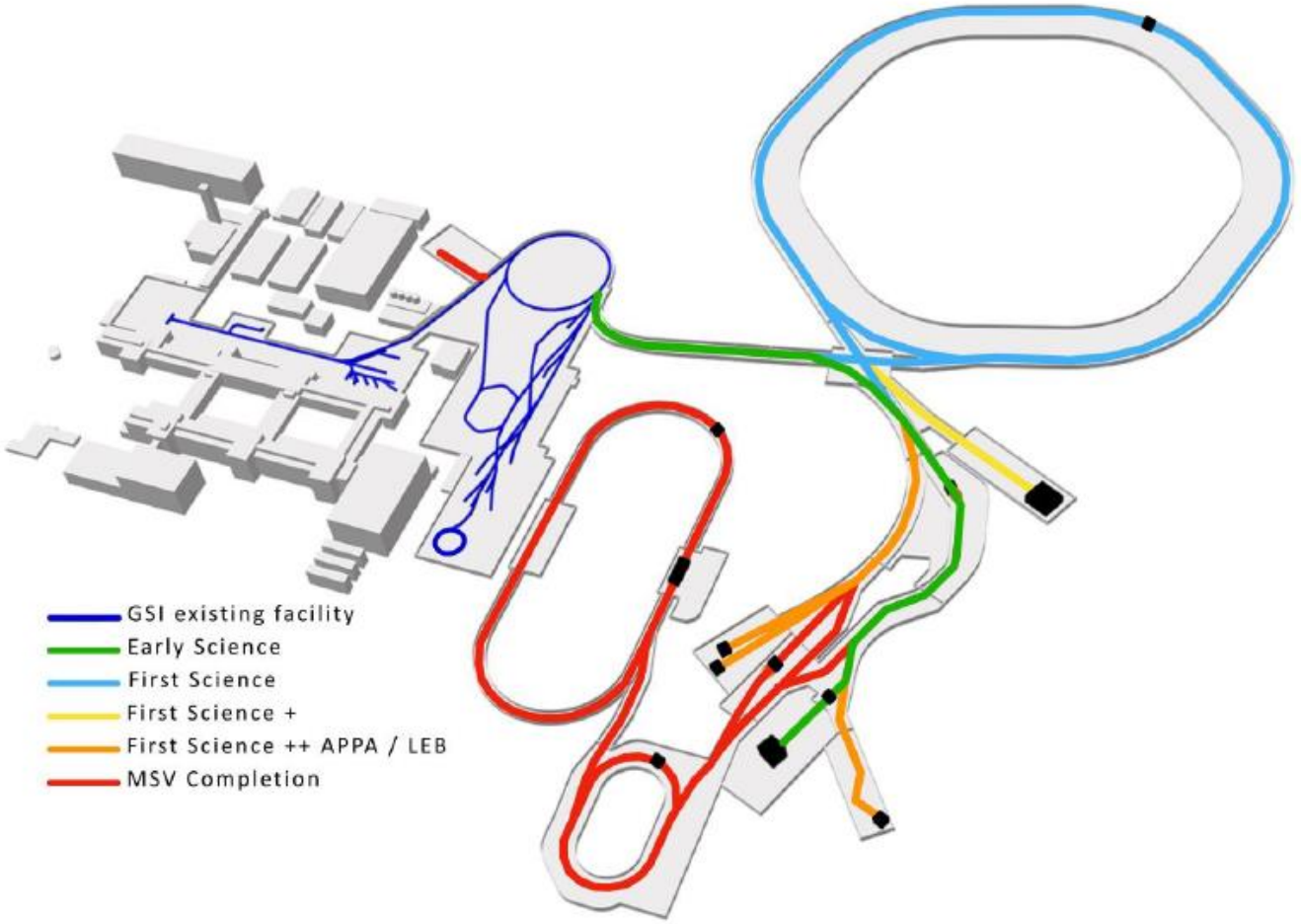
Einordnung in das FAIR Projekt
Early Science



Überblick Baugruppen

- **Strahlführungen “Early Science”:** **T1S1 --- T1S2 --- TSX1 --- TSF1 --- TFF1** **=> Anbindung SIS18 an SFRS**
- **Baugruppen mit Kammern:** 18 (gesamt)
- **Baugruppen mit Steerern:** 4 (von 18): T1S1DK4/DK5/DK8, TSX1DK2
- **Trafos gesamt:** 6 (2x FCT: T1S1DT1FP & TFF1DT1FP)
- **Trafos auf separatem Gestell:** 4
- **Kryo-Stromkomparator CCC:** 2

Detector numbers according to stages



Device type		ES	FS	CBM-FS+	APPA	MSVC
		ES*	FS*	CBM-FS+*	APPA*	MSVC*
Chamber Type						
Total		18	20	7	18	14
Detector type		ES	FS	CBM-FS+	APPA	MSVC
BPM		7	11	0	4	7
BPM (short)*		2	0	0	3	0
MWPC*		12	10	4	8	0
PDC*		6	5	3	3	0
PG 1*		9	15	0	8	3
PG 2*		3	1	0	5	6
RT*		6	8	0	4	6
FCT*		2	4	0	2	3
IPM*		4	5	0	5	1
SCR LT1*		4	1	2	2	0
SCR LT2*		1	3	0	4	5
Detector type		%ES	%FS	%CBM-FS+	%APPA	%MSVC
BPM		0,26	0,32	0,00	0,21	0,21
BPM (short)*						
MWPC*		0,35	0,29	0,12	0,24	0,00
PDC*		0,35	0,29	0,18	0,18	0,00
PG 1*		0,24	0,32	0,00	0,26	0,18
PG 2*						
RT*		0,25	0,33	0,00	0,17	0,25
FCT*		0,18	0,36	0,00	0,18	0,27
IPM*		0,27	0,33	0,00	0,33	0,07
SCR LT1*		0,23	0,18	0,09	0,27	0,23
SCR LT2*						
CCC		0,50	0,50	0,00	0,00	0,00

… finally do not forget the

Data Acquisition and Device Control
Overview FESA Class Software

Information Beam Parameter	Extr. Type	Device	Device type	Software (Front-End & ACS Apps) – Status Oct. 2024				Comment
				Status FESA class	Typical ACS application	ES ready	FS ready	
Total batch charge	Fast	RT	non invasive	Prototype 1 (BEA)	Transmission Setup & optimisation	(y)	(y)	Test with beam in 2022 OK Upgrade HEST in 2025/2026
Beam current & charge (bunch by bunch)	Fast	FCT	Non inv.	Prototype 2 (BEA)	Transmission Setup & optimisation	(y)	(y)	Test with beam in in 2024 OK
Beam current & charge	Slow	CCC	Non inv.	Prototype 2 (BEA)	Transmission Spill structure	(y)	(y)	Test with beam in 2024 OK
Beam intensity (number of particles)	Slow	PDC	Invasive	Lasa (BEA)	Transmission Setup & optimisation	y	y	„Lassie“ Production system at GSI facility
Beam position (batch & bunch by bunch)	Fast	BPM	Non inv.	Prototype 2 (In-kind SLO)	Trajectory monitor Steering app.	(y)	(y)	Test with beam in 2024 OK; further tests in 2025 + 2026
Beam position & profile	(Fast+ Slow) Slow	SEM-Grid MWPC	Invasive	Poland Prototype 2 (BEA)	Setup & optimisation	(y)	(y)	Further development and tests with beam in 2025 + 2026
	Fast Slow	SCR	Invasive	CUPID (BEA)	Setup & optimisation	y	Y	„CUPID“ Production system GSI facility
	Fast Slow	IPM	Non inv.	Not started	To be defined	no	no	DAQ design: „similar“ to CUPID system SFRS IPM with higher priority
Beam loss (relative scale)	(Fast) Slow	BLM	Non inv.	Lasa (BEA)	Transmission Setup & optimisation	y	y	„Lassie“ Production system GSI facility

Current prototype FESA classes should be sufficient for ES commissioning. Maintenance and development along road map of accelerator control system.
Infrastructure: High voltage: operational; Stepper motor: operational; Pneumatic actuators: under development
Outlook: All FESA classes can be expected to be ready for ES and FS commissioning in time.

SFRS: Involvement of Beam Instrumentation Dept. (BEA)

- Detectors: BEA supports for some detector systems like SEETRAM (SEM monitor)
  BLMs (CERN LHC ionisation chamber BLMI)
  IPM at FTF1DK1
  Target wheel monitoring
  Diamond detector readout
  (… and some more topics)

- Infrastructure
  - Stepper Motor Control
  - Pneumatic Actuator Control
  - High Voltage

SFRS: Involvement of Beam Instrumentation Dept. (BEA)

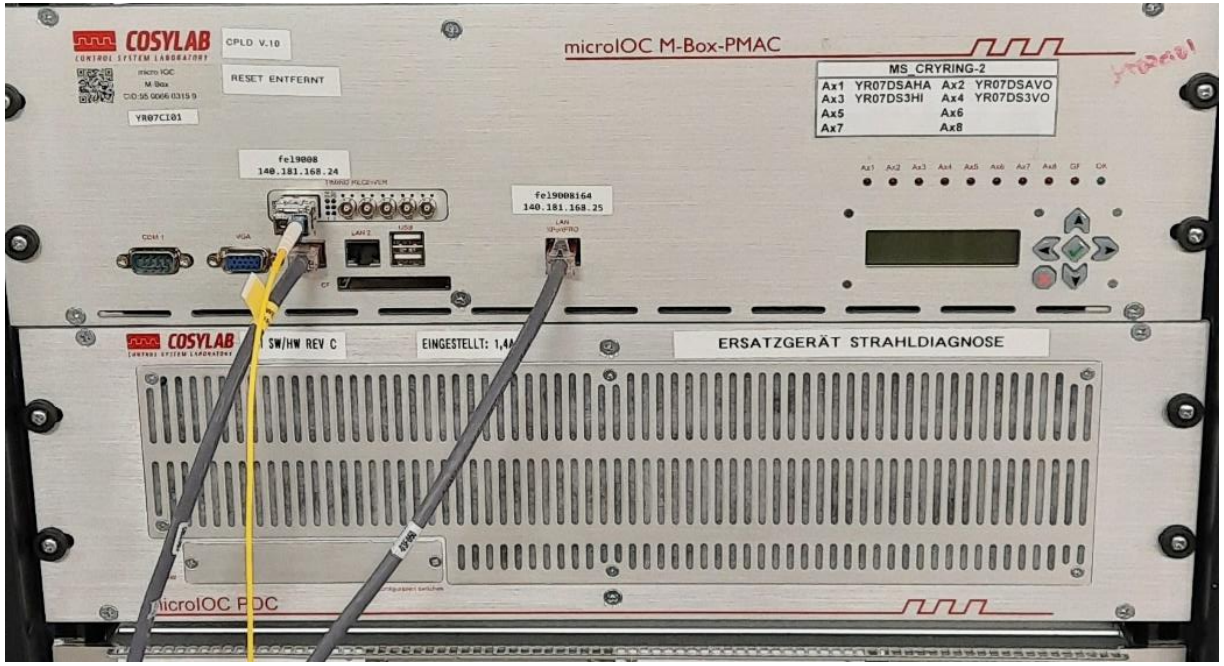
- DAQ systems:
  - BLM: Lasa/Lassie system, µTCA scaler system
  - Detector HV: FESA class for Wiener/Iseg and CAEN
  - IPM: FESA class for readout and control, based on (Poland)/Awags hardware
  - Diamond det. Lasa/Lassie system

Infrastructure
Stepper Motor Control

- **FAIR Stepper Motor system for standard applications**
  - ✓ In-kind Contract SLO: 28 Controller — delivered
  - ✓ Tender and framework contract done
  - ✓ Retrofit: Procurement No. 1 (GSI+FRS): 19 Controller, 40 PDCs — GSI and FRS equipment
  - ✓ FAIR: Procurement No. 2 (FAIR): 23 Controller, 60 PDCs — order: Feb. 2022, delivery: Mai 2023
    all PDCs were SAT tested at GSI
  - ⊘ ~~FAIR: Procurement No. 3 (FAIR): (10–15 PDCs for experiments)~~ — contract terminated due to staging/funding

- ✓ Status Software: FESA class productive (YR, etc.)
  incl. FTRN Timing Integration (2019/2020)
  for triggered applications

- **Bedarf für FS+**
  - ✓ Required hardware covered after procurement No. 2
    for SFRS drives and FAIR machines (11 work packages)
    SFRS: 29 PDCs & 13 Controllers (C. Nociforo)
    some more hardware for experiments (Ch. Karagiannis)

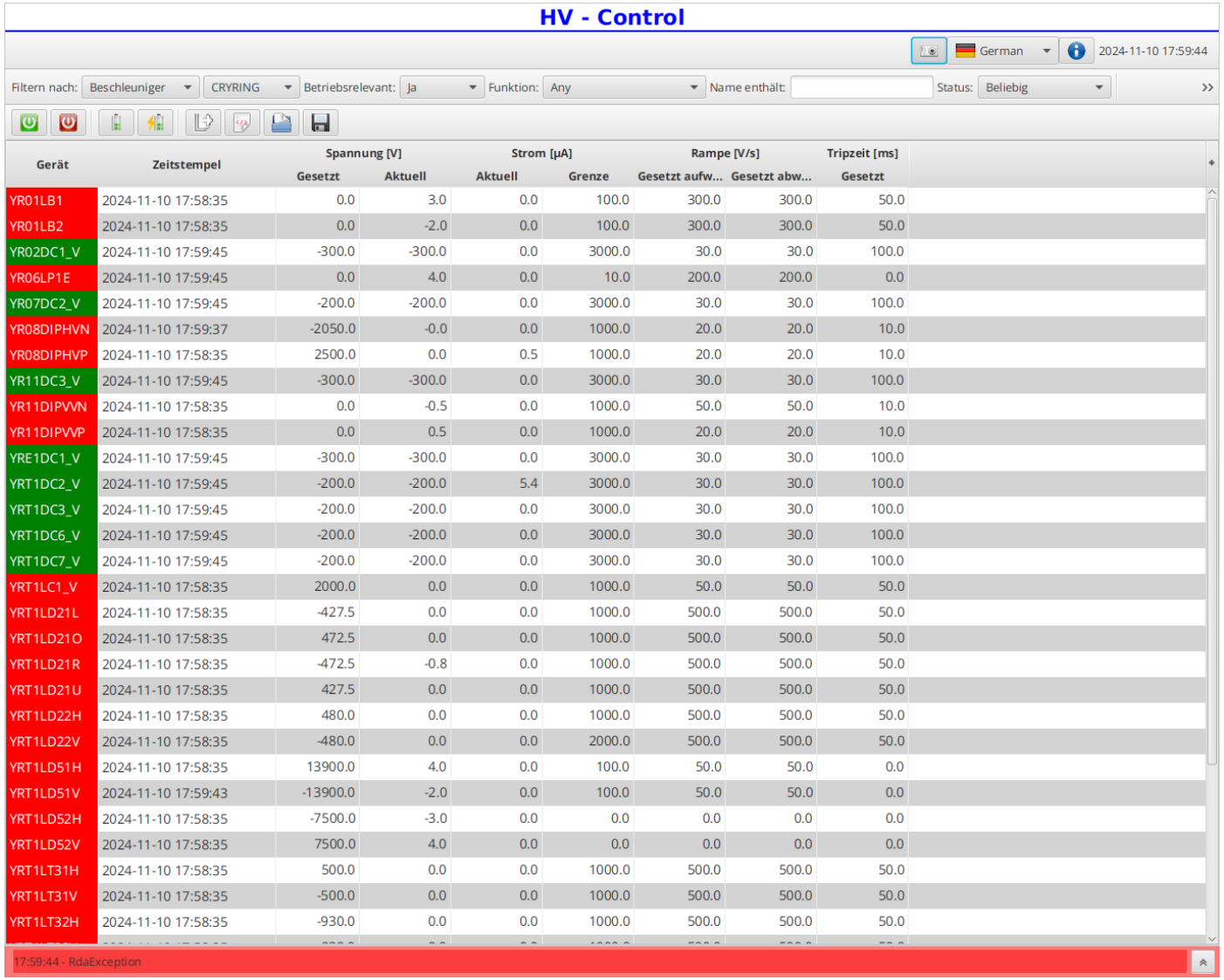


Infrastructure
Detector High Voltage

- **High Voltage Systems**
  - ✓ Updated specification approved
  - ✓ Tender started: published 18th Oct.; 1st deadline: 19th Nov.
  - Stages: SIS100, HEBT and SFRS needs included for some detectors
  - Content: Commercial high voltage modules
  - 🔄 Contract signment: Dez. 2024 / Jan. 2025
  - Delivery: ~ Q4/25 / Q1/26

- SFRS Commissioning
  - ✓ HV system integration done for CAEN and Wiener/Iseg HV systems
  - ✓ Productive FESA software at GSI for several years

Infrastructure
HV Control GUI

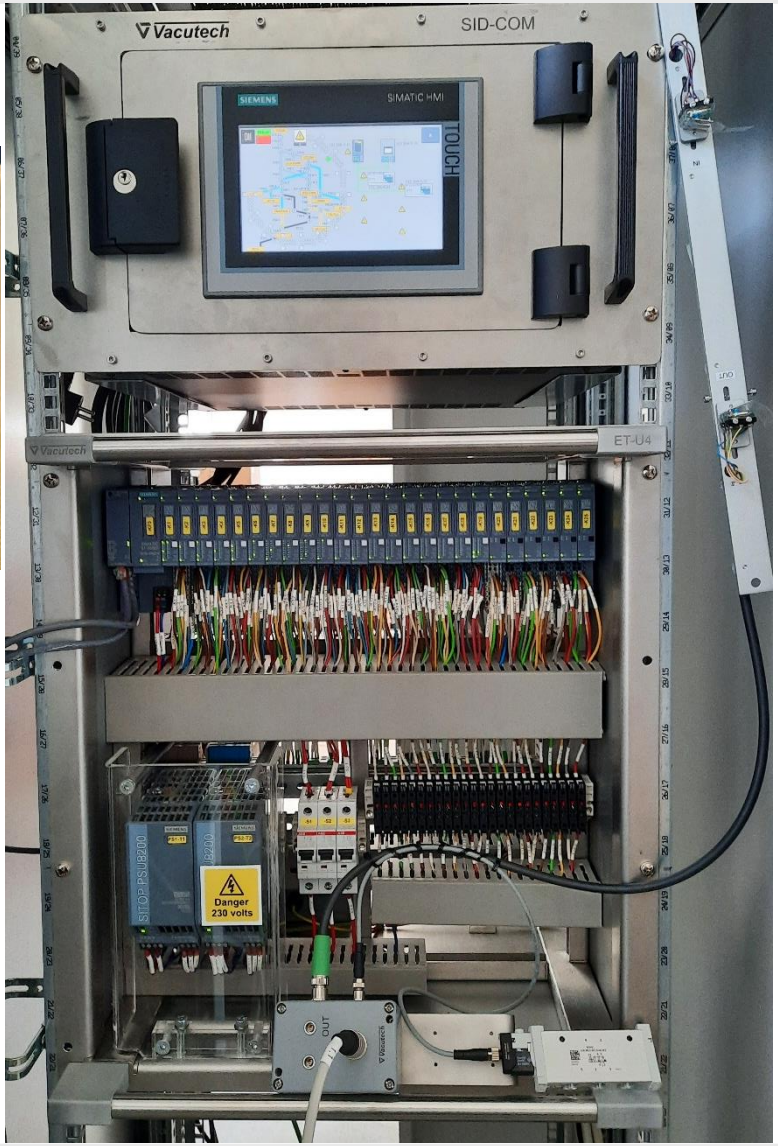


Gerät	Zeitstempel	Spannung [V]		Strom [µA]		Rampe [V/s]		Tripzeit [ms]
		Gesetzt	Aktuell	Aktuell	Grenze	Gesetzt aufw...	Gesetzt abw...	Gesetzt
YR01LB1	2024-11-10 17:58:35	0.0	3.0	0.0	100.0	300.0	300.0	50.0
YR01LB2	2024-11-10 17:58:35	0.0	-2.0	0.0	100.0	300.0	300.0	50.0
YR02DC1_V	2024-11-10 17:59:45	-300.0	-300.0	0.0	3000.0	30.0	30.0	100.0
YR06LP1E	2024-11-10 17:59:45	0.0	4.0	0.0	10.0	200.0	200.0	0.0
YR07DC2_V	2024-11-10 17:59:45	-200.0	-200.0	0.0	3000.0	30.0	30.0	100.0
YR08DIPHVN	2024-11-10 17:59:37	-2050.0	-0.0	0.0	1000.0	20.0	20.0	10.0
YR08DIPHVP	2024-11-10 17:58:35	2500.0	0.0	0.5	1000.0	20.0	20.0	10.0
YR11DC3_V	2024-11-10 17:59:45	-300.0	-300.0	0.0	3000.0	30.0	30.0	100.0
YR11DIPVVN	2024-11-10 17:58:35	0.0	-0.5	0.0	1000.0	50.0	50.0	10.0
YR11DIPVVP	2024-11-10 17:58:35	0.0	0.5	0.0	1000.0	20.0	20.0	10.0
YRE1DC1_V	2024-11-10 17:59:45	-300.0	-300.0	0.0	3000.0	30.0	30.0	100.0
YRT1DC2_V	2024-11-10 17:59:45	-200.0	-200.0	5.4	3000.0	30.0	30.0	100.0
YRT1DC3_V	2024-11-10 17:59:45	-200.0	-200.0	0.0	3000.0	30.0	30.0	100.0
YRT1DC6_V	2024-11-10 17:59:45	-200.0	-200.0	0.0	3000.0	30.0	30.0	100.0
YRT1DC7_V	2024-11-10 17:59:45	-200.0	-200.0	0.0	3000.0	30.0	30.0	100.0
YRT1LC1_V	2024-11-10 17:58:35	2000.0	0.0	0.0	1000.0	50.0	50.0	50.0
YRT1LD21L	2024-11-10 17:58:35	-427.5	0.0	0.0	1000.0	500.0	500.0	50.0
YRT1LD21O	2024-11-10 17:58:35	472.5	0.0	0.0	1000.0	500.0	500.0	50.0
YRT1LD21R	2024-11-10 17:58:35	-472.5	-0.8	0.0	1000.0	500.0	500.0	50.0
YRT1LD21U	2024-11-10 17:58:35	427.5	0.0	0.0	1000.0	500.0	500.0	50.0
YRT1LD22H	2024-11-10 17:58:35	480.0	0.0	0.0	1000.0	500.0	500.0	50.0
YRT1LD22V	2024-11-10 17:58:35	-480.0	0.0	0.0	2000.0	500.0	500.0	50.0
YRT1LD51H	2024-11-10 17:58:35	13900.0	4.0	0.0	100.0	50.0	50.0	0.0
YRT1LD51V	2024-11-10 17:59:43	-13900.0	-2.0	0.0	100.0	50.0	50.0	0.0
YRT1LD52H	2024-11-10 17:58:35	-7500.0	-3.0	0.0	0.0	0.0	0.0	0.0
YRT1LD52V	2024-11-10 17:58:35	7500.0	4.0	0.0	0.0	0.0	0.0	0.0
YRT1LT31H	2024-11-10 17:58:35	500.0	0.0	0.0	1000.0	500.0	500.0	50.0
YRT1LT31V	2024-11-10 17:58:35	-500.0	0.0	0.0	1000.0	500.0	500.0	50.0
YRT1LT32H	2024-11-10 17:58:35	-930.0	0.0	0.0	1000.0	500.0	500.0	50.0

Infrastructure
Pneumatic Drive Control Hardware

- **Pneumatic Drive Control Hardware**
  - ✓ CDR: 14th October 2022, FDRs in Okt./Nov. 2023
  - ✓ Hardware: Development finished, production by Fa. Vacutech, SLO
    - 7x PLC controller (IO Controller)
    - (10+10)x PLC station (IO Device 24/6 Antriebe)
    - ✓ 50x passive distribution box for 6 drives (6-fold node)
    - ✓ 140x terminal box for drives
  - ✓ CE process completed
  - Delivery
    - ✓ Test-Hardware March 2023
    - Series Q4/2024

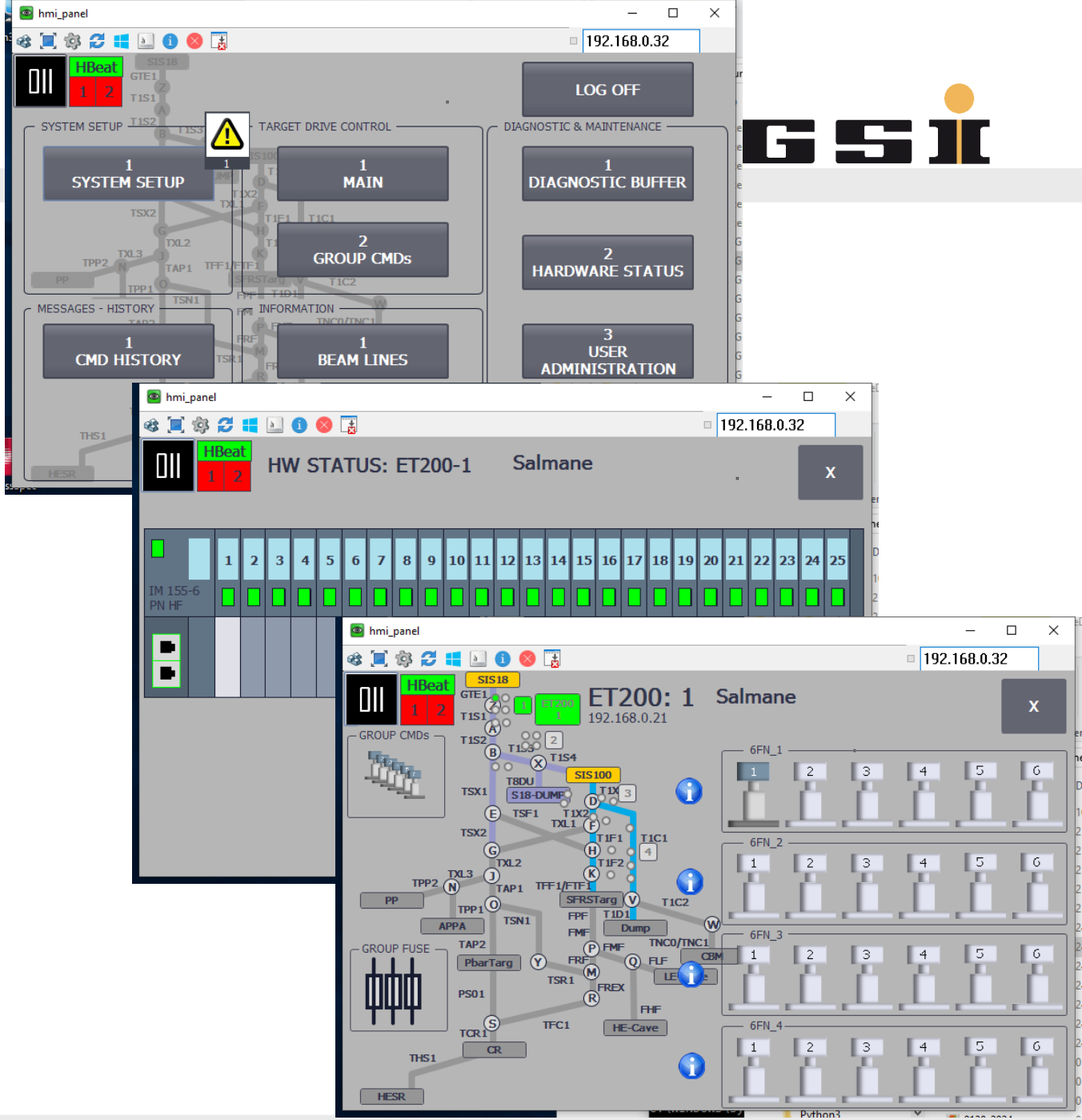
- **Required hardware for FS+**
  - SIS100 and HEBT covered by ongoing production
  - SFRS hardware needs:
    - ✓ Planning completed (BEA & SFRS) on basis of existing cables in CDB
    - **Procurement by SWE in-kind via tender**



Infrastructure
Pneumatic Drive Control Software

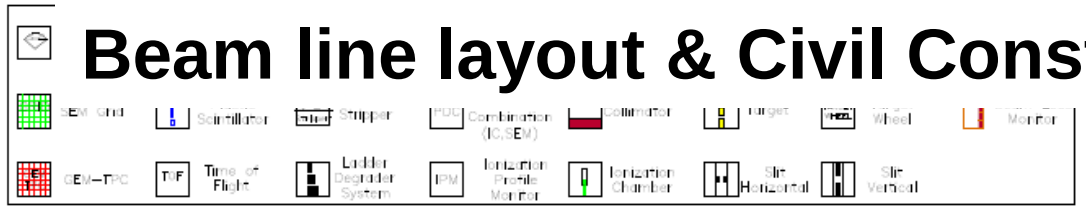
- **Pneumatic Drive Control PLC Software**
  - ✓ SAT in August 2024
  - ↻ Software: SW V7, debugging ongoing
    planned completion (incl. documentation) by end of 2024

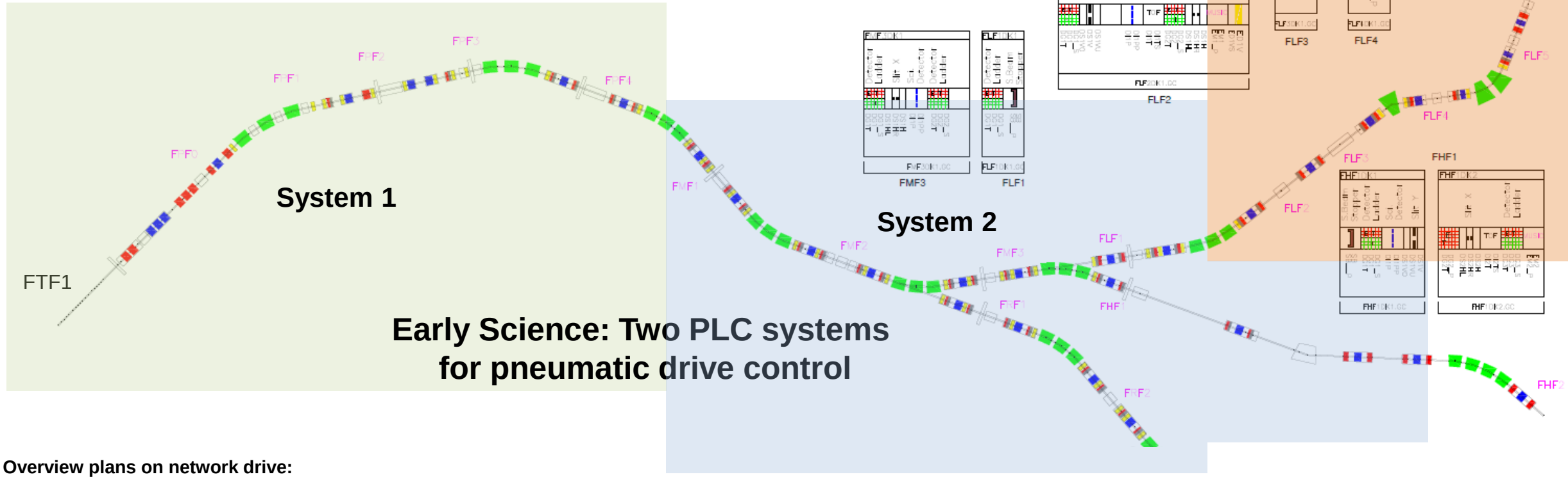
- **Control System Integration (ACC and IND network)**
  - Collaboration BEA – ACO:
    - BEA (S. Hammoumi, R. Haseitl)
    - ACO (C. Betz, P. Pfister)
    - PLC system „lives“ in Industrial network
    - HMI reacheable from ACC network
      for quick access and trouble-shooting
  - BEA:
    - SILECS interface and FESA class to be developed
      (ideally, keep interface to Device Control)



Input Planning Data

Beam line layout & Civil Construction planning





Early Science: Two PLC systems for pneumatic drive control

Overview plans on network drive:

- \\campus\groups\B\1_FAIRGSI$docu\1_Ma\2.4_SFRS\0_Overall_SFRS\Drawings_Plans\Schematics and Layouts\Detectors: S-FRS_Detectors_V.1.43_08.02.2023.pdf
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Final Layout

System Overview – Early Science

Room	Hardware	Type	Comment
System 1 – FTF1, FPF0 – FPF4			
K0410A.E10.020.RACK[BD].301	IO Controller IO Device Switch	SID-COM ET-U4 SCALANCE XC206-2SFP	Use ET-U4 for upgrade option
K0410A.E10.021.RACK[BD].106 K0410A.E10.021.RACK[BD].107	Switch IO Device	SCALANCE XC206-2SFP ET-4	Combine two racks to one and bundle four 6FNs in ET-U4 unit. Use rack 106. **Optical links from E10.020 to E10.021 Rack 106 in CDB**
System 2 – FMF1 – FMF3, FRF1 – FRF3, FHF1, FLF1			
K0410A.E10.020.RACK[BD].501	IO Device Switch	ET-U4 SCALANCE XC206-2SFP	
K0410A.E10.020.RACK[BD].906	Switch IO Controller IO Device	Central Switch SID-COM ET-U4	Bigger switch with more than one LWL port!
K0410A.E10.029.RACK[BD].110	IO Device Switch	ET-U4 SCALANCE XC206-2SFP	Not Early Science! Not counted in estimates!
K0410A.E10.027.RACK[BD].107	IO Device Switch	ET-U4 SCALANCE XC206-2SFP	

Final Layout

System Overview – MSV Completion

Room	Hardware	Type	Comment
System 2 – FMF1 – FMF3, FRF1 – FRF3, FHF1, FLF1			
K0410A.E10.020.RACK[BD].501	IO Device Switch	ET-U4 SCALANCE XC206-2SFP	
K0410A.E10.020.RACK[BD].906	Switch IO Controller IO Device	SCALANCE XC206-2SFP SID-COM ET-U4	
K0410A.E10.029.RACK[BD].110	IO Device Switch	ET-U4 SCALANCE XC206-2SFP	
K0410A.E10.027.RACK[BD].107	IO Device Switch	ET-U4 SCALANCE XC206-2SFP	
System 3 – FLF2 – FLF6			
L0317A.E10.N10.Rack[BD].103	IO Controller IO Device Switch	SID-COM ET-U4 SCALANCE XC206-2SFP	
L0317A.E10.N11.Rack[BD].209	IO Device Switch	ET-U1 SCALANCE XC206-2SFP	

Support for BLM and PDC readout – slides from FDR

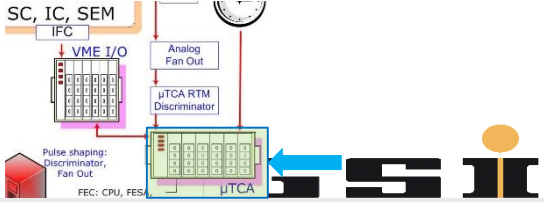
Lasa/Lassie – Main PSP Codes

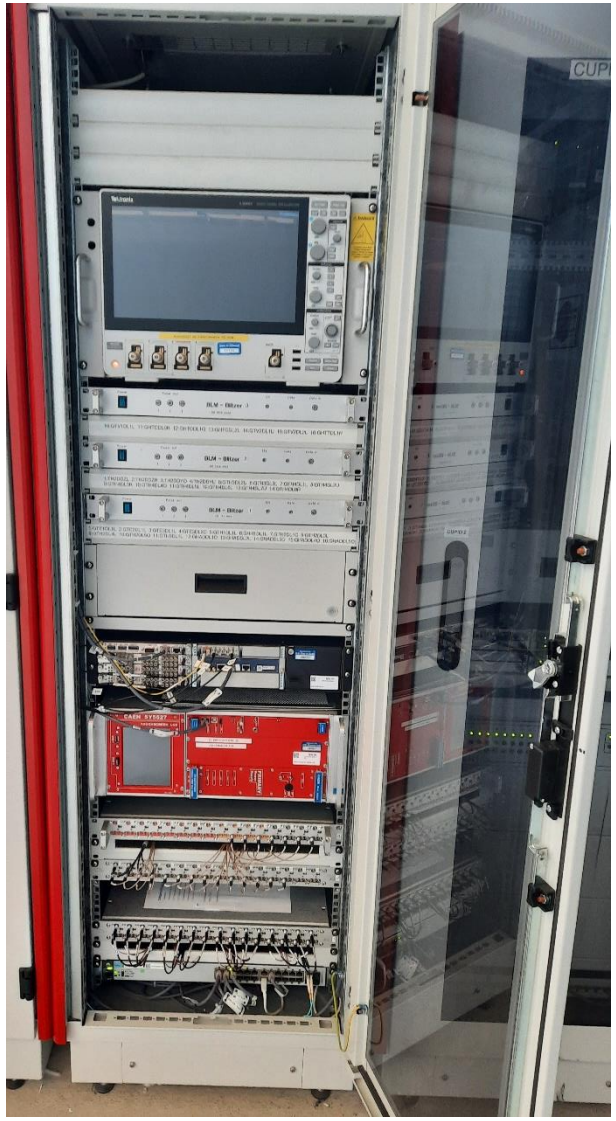
- **Lassie@GSI:**
  - Distributed acquisition systems with several DAQ crates in different installation locations
  - **~220 signals** from various detectors (BLM, PDC = IC + SEM monitors +plastic scintillators), DC transformers, magnets, RF reference signals, hall probes, etc.)
  - SIS18, HEST, ESR, CRYRING, etc.

- **Lassie@FAIR:**
  - **~450 signals**
  - No. of µTCA DAQ systems as given in table
  - No. in brackets indicates further available µTCA DAQ crates (tender 2019)

Machine & PSP code	Description	Detector No.	DAQ No.
SIS100			
2.8.6.5	Beam Loss System	50 (SC) + 196 (IC)	6
2.8.11.1	Cryogenic Charge Collimation system with meas. electronics	~ 60	3
2.8.11.2	Ion-Halo Collimation	~ 10	1 (+2)
HEBT			
2.3.6.6	Beam Loss Monitor	30 + X	2 (+3)
2.3.6.3	Particle Detector Combination	48 = 16 x (SC+IC+SEM)	2 (+3)
~~2.3.11.2~~	~~Halo Collimation Systems~~	~~14~~	
SFRS			
2.4.6.3.1	PDC		2
2.4.*	BLMI ionisation chamber	8 + X	3
Further signals			
2.8.6.1	Current Measurement	1	
…	RF signals		

Example HEST HADES BLM system
Existing µTCA installation – ESR roof / HHT





- New µTCA hardware provides a very compact solution
- Reduced cabling due to availability of RTMs (rear-transition modules)

- SFRS: µTCA DAQ and VME crates for IFC control

Status Quo

- What is the project or work package status?

2.4.6.1.14.1 ➔ Lund in-kind. 2.4.6.1.14.2 ➔ GSI part

Component	#	PSP	Status
Detector (BLMI ~~or LIC~~)	8	2.4.6.1.14.2	Available/SAT check,
HV module	3	2.4.6.1.14.2	Definition stage (discussion BD/BEA)
IFC	8	2.4.6.1.14.1	-on going prod. in Slovenia, proof of prod. (new qualif.), FOS done, check after 40 first batch. Total number for FAIR 300 on top of 40. Could few be used for test of the 40. ➔ 8 in 2026?, after qualification, and money request for the big batch, LUND would join and support for the request where we get from 8 to 10 from there.
IFC V-DIO I/O	3	2.4.6.1.14.1	Delivered/ CID given
uTCA crate	3	2.4.6.1.14.1	Delivered/ CID given/ CID given
VME bridge	3	2.4.6.1.14.1	Delivered/ CID given
Latch clock/Timing Receiver	3	2.4.6.1.14.2	Present (from WR group)
SIS 8800 MTCA scaler	3	2.4.6.1.14.1	Delivered/ CID given
Low cost VME crate	3	2.4.6.1.14.1	Delivered/ CID given
Cables	16	2.4.6.1.14.2	Planned in CDB