

Sirius

The new Brazilian

synchrotron

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Topics

LNLS

Timeline

Considerations

Interlock (Personnel Protection System)

Detectors

Acknowledgment

LNLS

The Brazilian Synchrotron Light Laboratory.

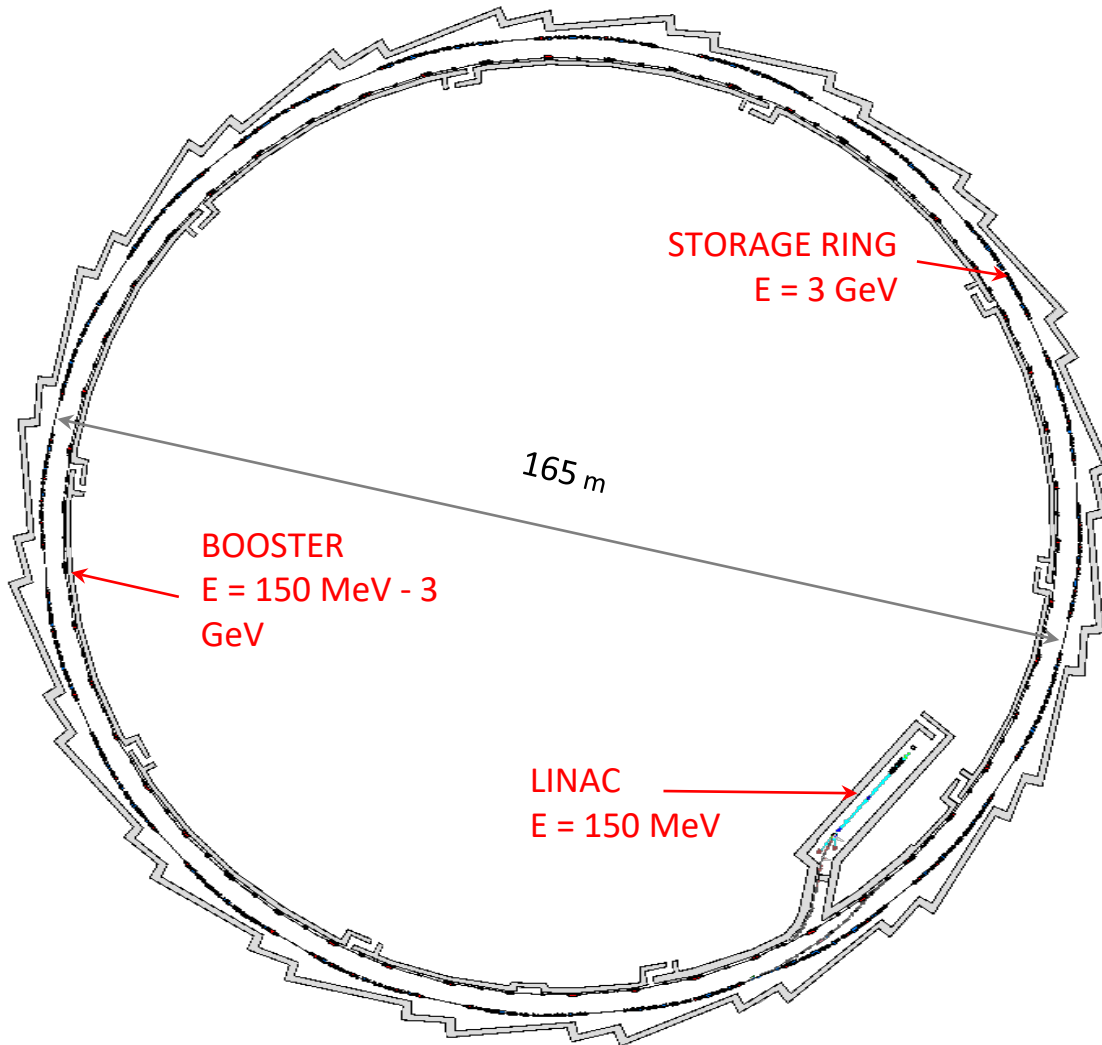
Created in 1984, the LNLS was responsible for the construction and operation of the first synchrotron light source in the Southern Hemisphere. Called **UVX**, operated from 1997 to 2019, benefiting approximately one thousand researchers each year.



- In 2018, Sirius started the commissioning of accelerators.
- In 2020, first beamline in operation.

Upper view of CNPEM

How it works?



Parameter	Value	Unit
Energy	3.0	GeV
Maximum current	500	mA
Nominal Beam Current (top up)	350	mA
Circumference	518.4	m
RF frequency	499.6	MHz
Emittance (without IDs)	0.25	nm.rad
Hor. Emittance (with undulators)	0.15	nm.rad
Number of straight sections	20	
Number of superbends	20	
Bending field (dipoles / "superbends")	0.56 / 3.2	Tesla
Critical energy from "superbends"	19.15	keV
Number of beamlines	40	

Timeline

2014

Preparation
of the ground



Timeline

2016

Structure in
progress



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Timeline

2018

Building conclusion



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Timeline

2018

Building conclusion



Timeline

2018

Building
conclusion

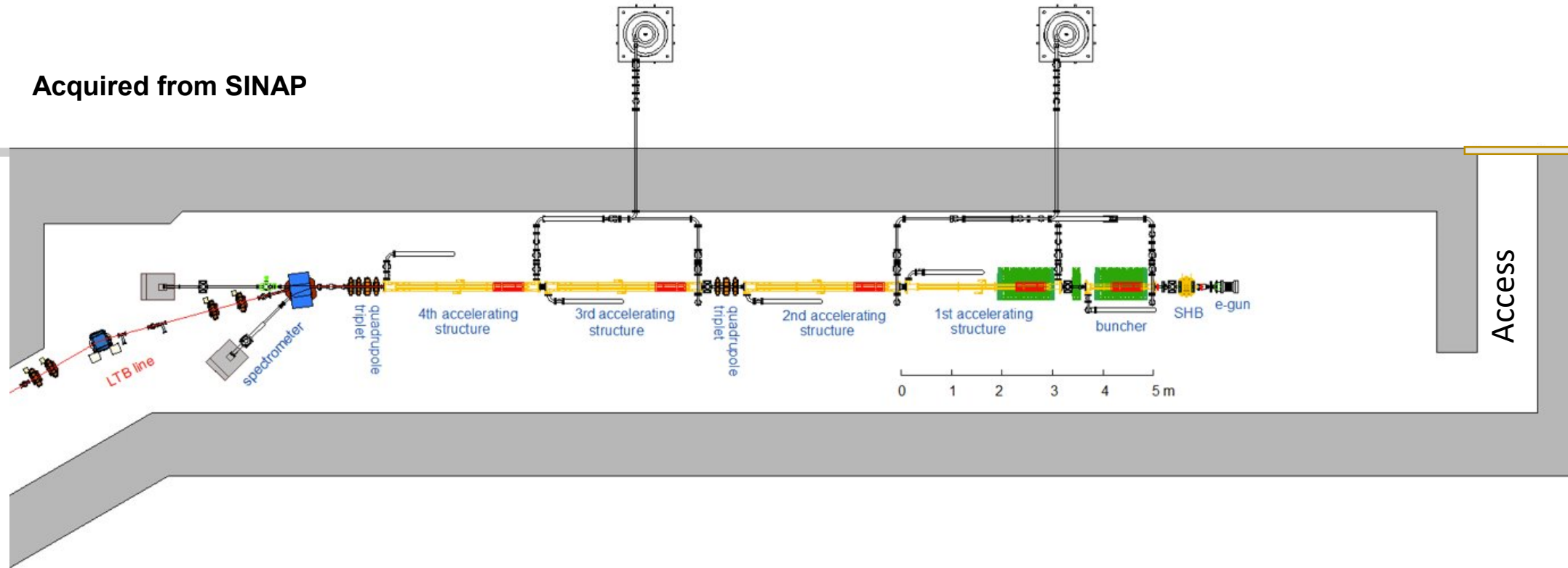


Timeline

2018

Linac
comissioning
May: Electron
beam with 150
MeV

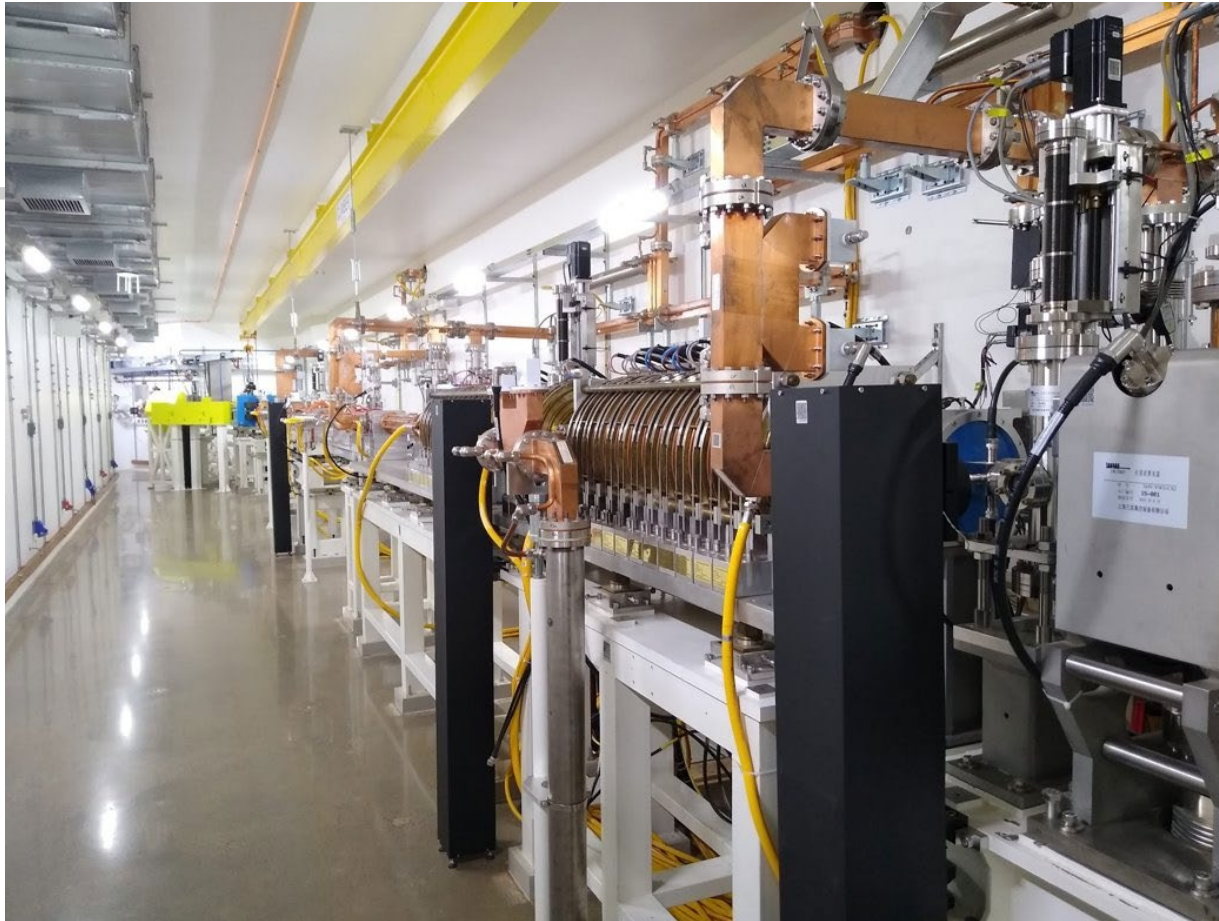
Acquired from SINAP



Timeline

2018

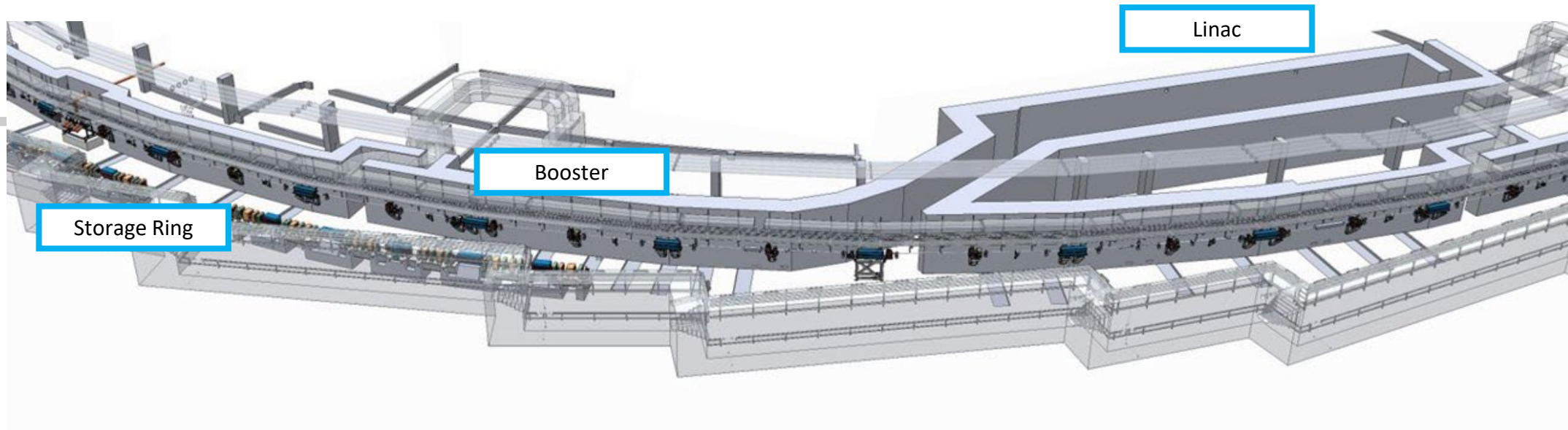
Linac comissioning
May: 1º Electron
beam with 150 MeV



Timeline

2019

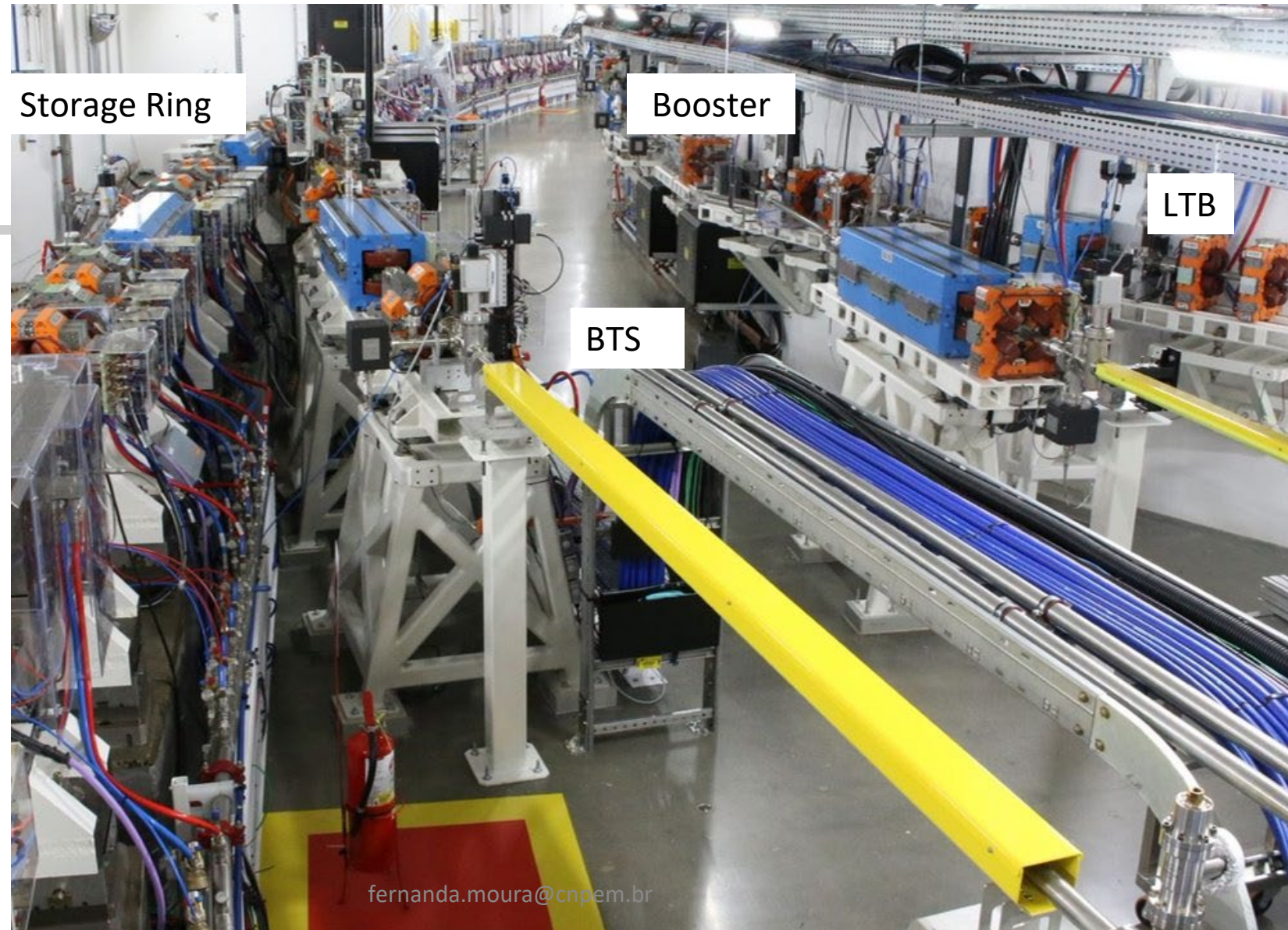
Booster and
Storage Ring
commissioning



Timeline

2019

Booster and Storage
Ring commissioning



Timeline

2020

First beamline in
operation:
MANACÁ



Did you know?

The beamlines at Sirius are named after Brazilian fauna and flora species.

Example: Manacá (MAcromolecular micro and NAnoCrystAllography)



Timeline

2021

EMA (Extreme condition Methods of Analysis)

New beamlines



High brilliance (**high flux of up to 1×10^{14} photons/sec with beamsize down to $0.1 \times 0.1 \mu\text{m}^2$**) is essential, as is the case with the study of materials under extreme thermodynamic (**pressure, temperature and magnetic field**) conditions



Timeline

2022

CARNAÚBA (Coherent X-ray NAnoprobe BeAmline)

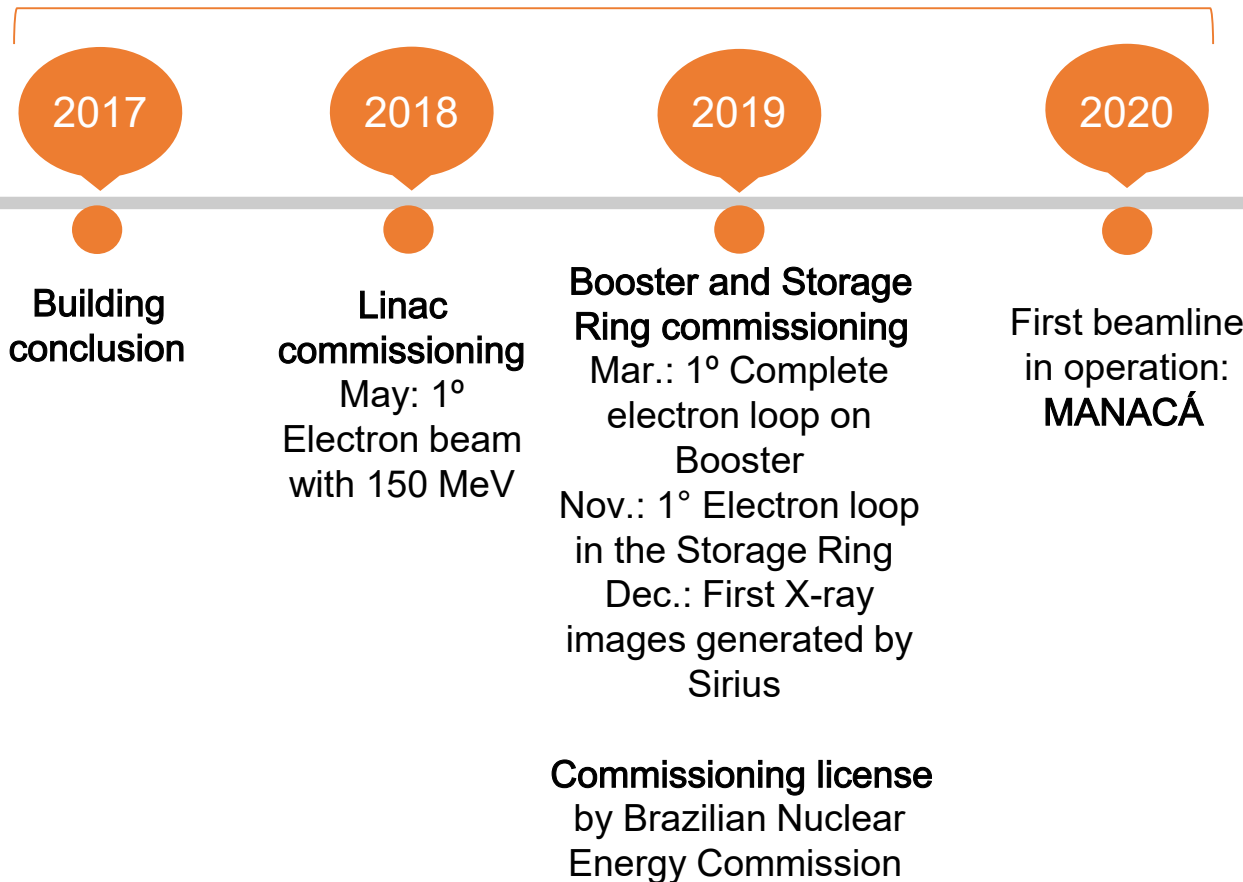
The longest beamline of the Sirius with approximately **145 meters** between the light source and the sample environment, which allows a high optical demagnification and to reach nanometric spatial resolutions. **Energy range from 2.05 to 15 keV, 10^{12} ph/s/100 mA**

New beamlines

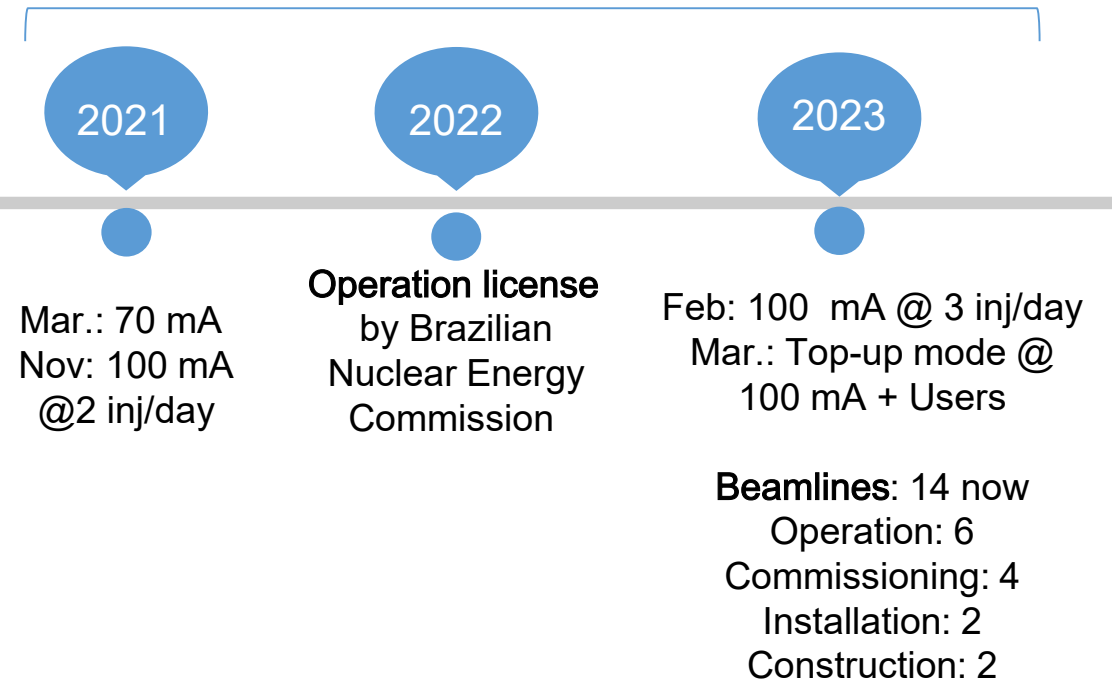


Timeline

Evolution of "Machine"



Evolution of Operation



Topics

LNLS

Timeline

Considerations

Interlock (Personnel Protection System)

Detectors

Acknowledgment

Considerations

Dose annual: 1 mSv for public in all areas of the facility

We have only 2 groups (9 persons) denominated as Occupational Exposure Work.

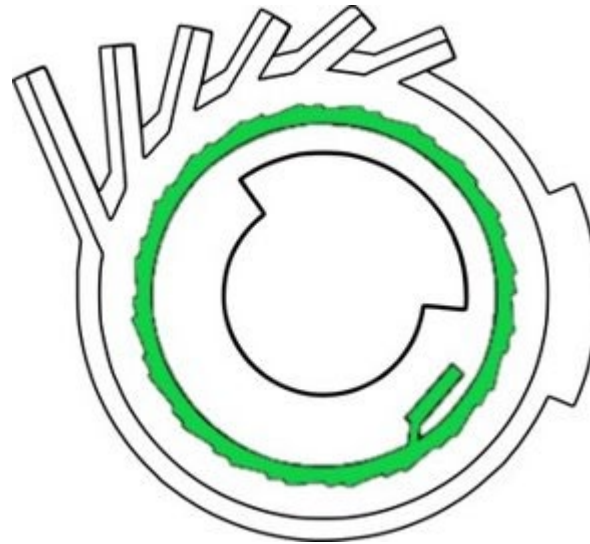


• **In operation** : injection or stored beam
Controlled area and
Forbidden access



End of operation

Wait six hours for
access, or
Radiometric survey
throughout the sector
where access is required



• **Free access area**
Permitted access



Considerations

Dose annual: 1 mSv for public in all areas of the facility

End of operation, permitted access to inside the hutch.



Topics

LNLS

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Interlock

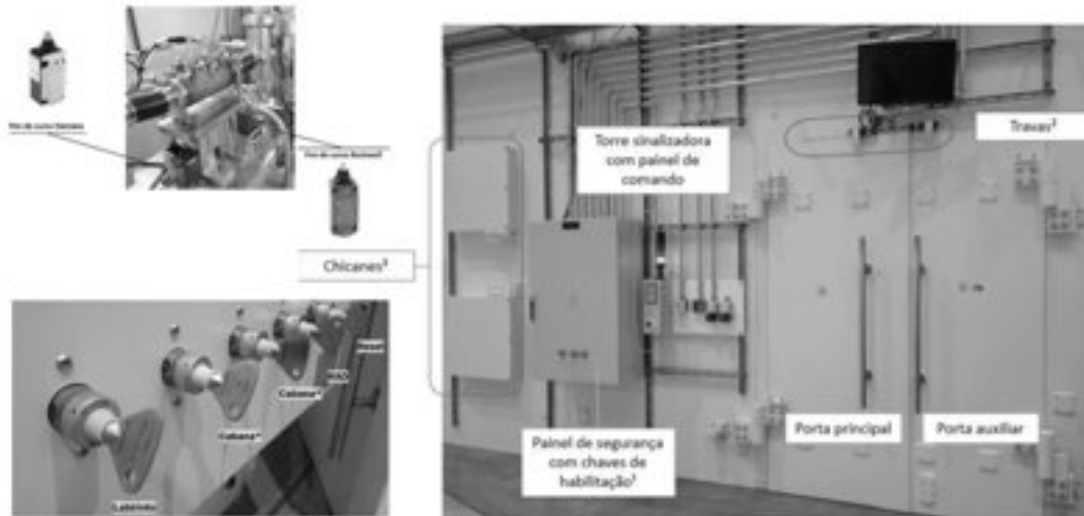
Personnel Protection System (PPS)

- The entire permitted access area must be radiologically safe (**public dose**).
- The system must be robust to ensure a fail-safe condition (**SIL 3**)
- The system must have a change record for each change in the code (security key).
- Application of the traceability principle.

Interlock

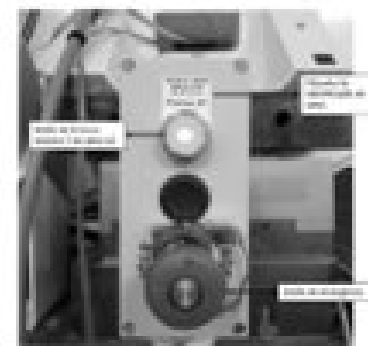
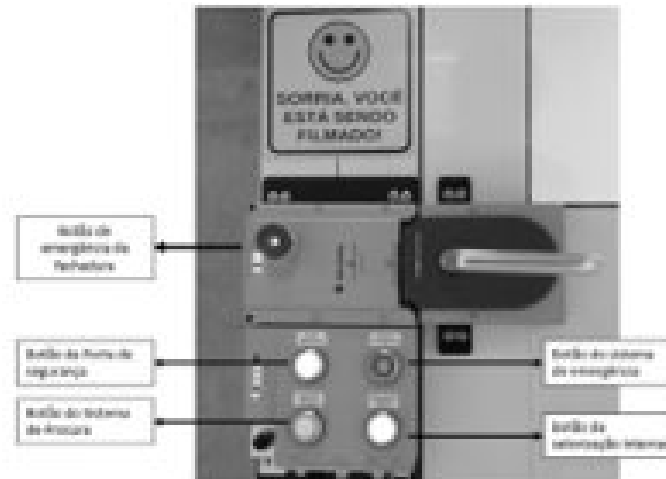
Personnel Protection System (PPS)

Beamline



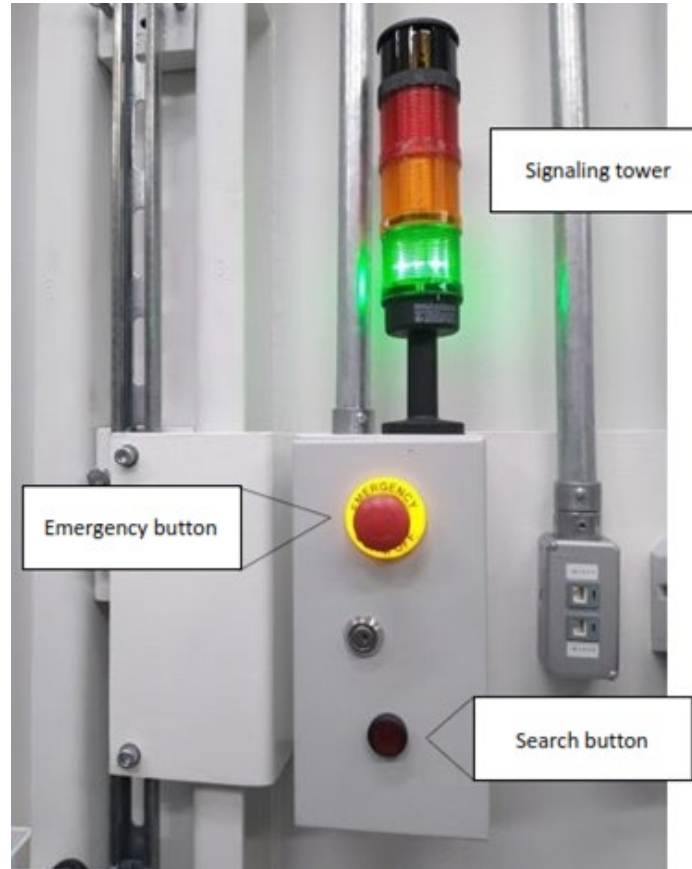
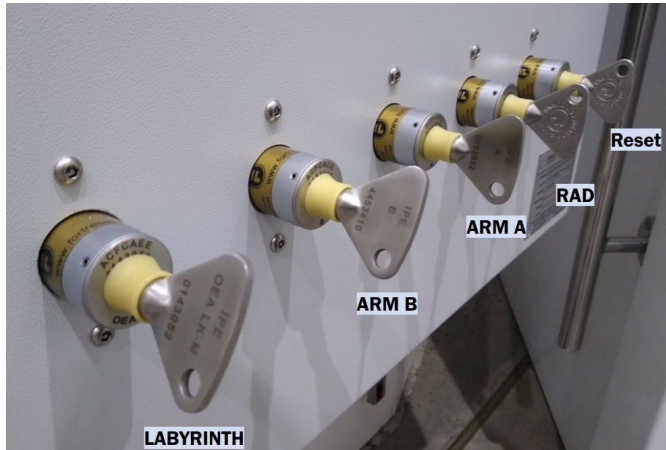
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Machine



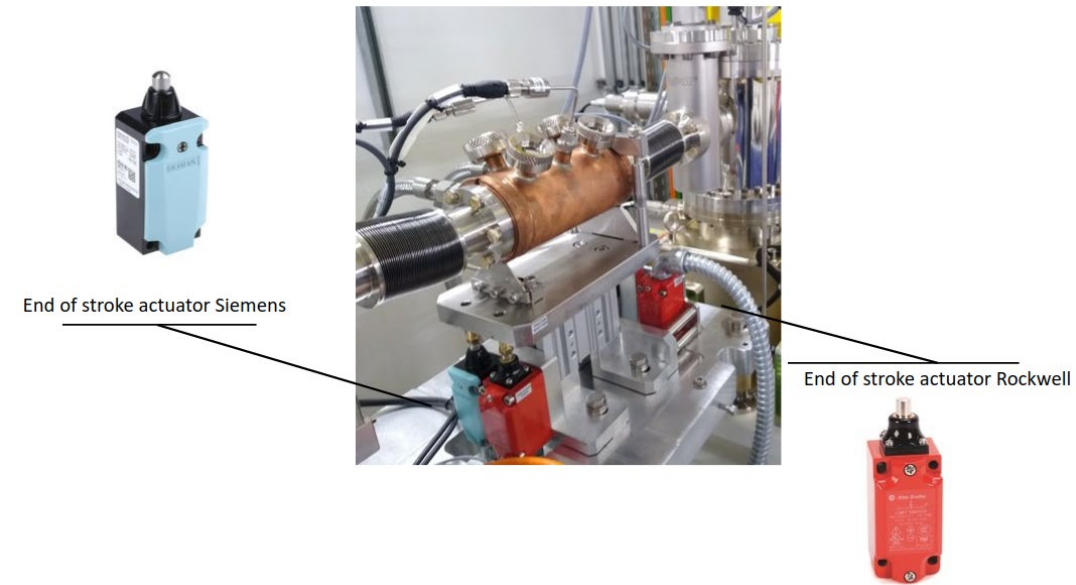
Interlock

Personnel Protection System (PPS)



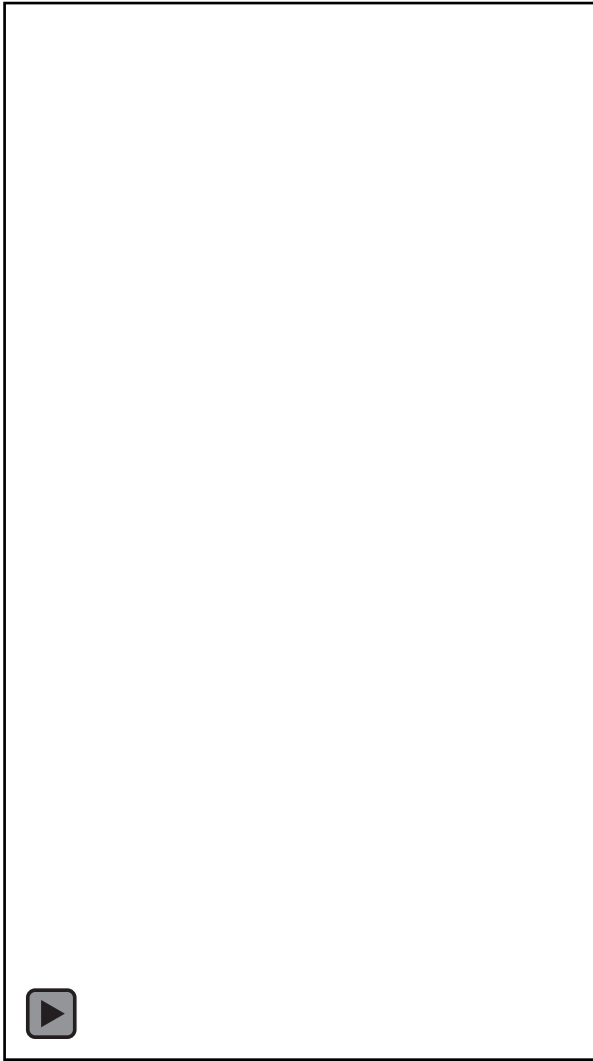
Beamline

Safety Interlock Siemens (PLC)



Interlock

Personnel Protection System (PPS)



Beamline

Safety Interlock Siemens (CLP)

Presentation without sound



Interlock

Personnel Protection System (PPS)

Beamline

Safety Interlock Siemens (PLC)

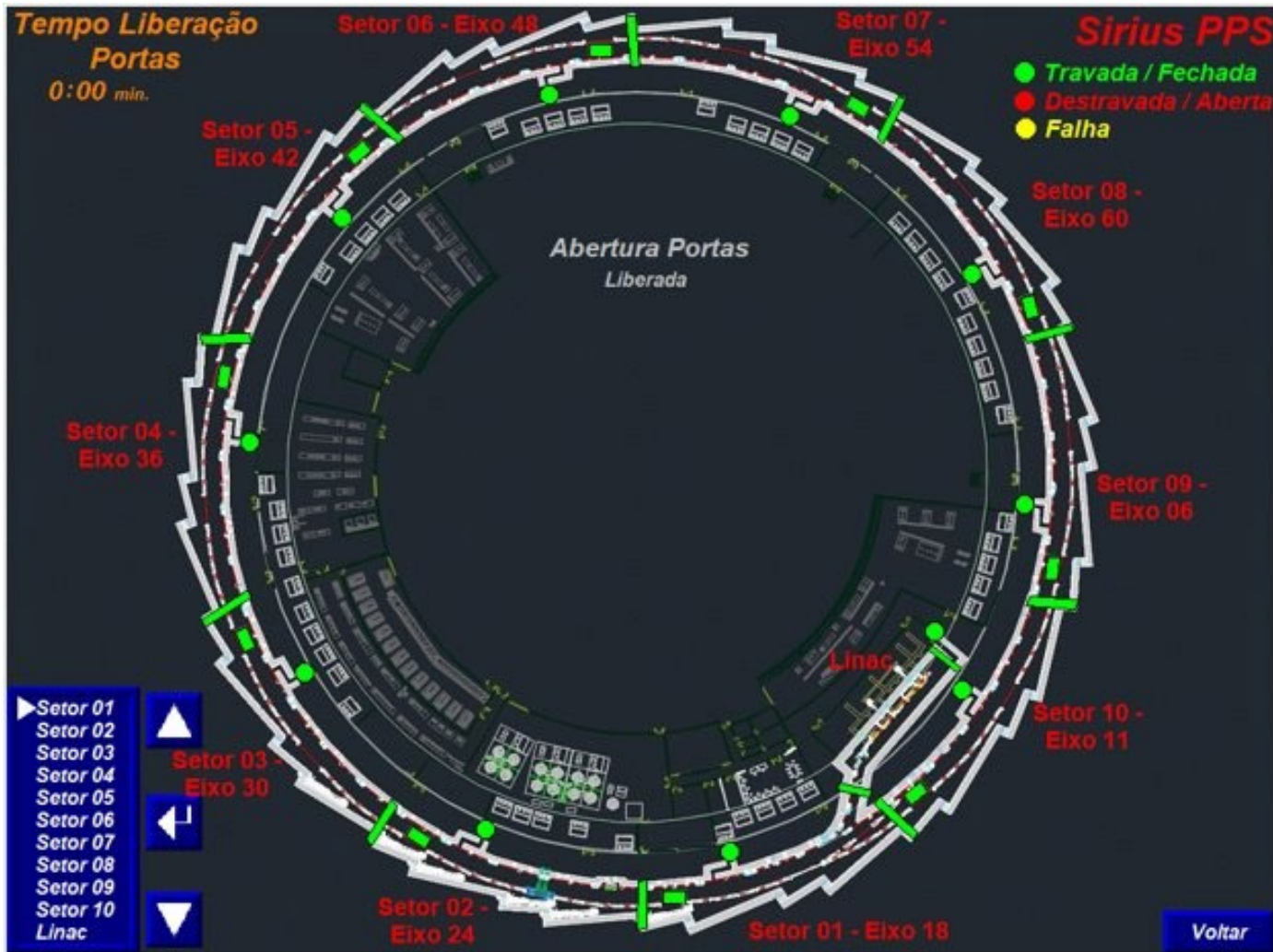
The screenshot displays the PPS ESB control interface. The top bar shows 'MANACA AUTOMATION SYSTEMS' and a timestamp of 9/23/2021 12:58:36 PM. The left sidebar contains navigation options: VIEW OPTIONS, GENERAL, FRONT END, OPTICAL HUTCH, EXPERIMENTAL HUTCH, SUPPORT ROOM, RACKS ROOM, PROGRAMS ALARMS, HARDWARE DIAG, and CONFIGURATIONS. The main area is titled 'PPS ESB' and features an 'INSTALLATION MAP' with three emergency hatches (EM 1, EM 2, EM 3) and an 'OEA PGS' section with 'INTERLOCKED CLOSED' and 'OPEN' buttons. Below the map are three panels: 'MAIN COMMANDS' (RESET, CONDITIONS TO START SEARCH), 'MAIN SIGNALS' (GLOBAL FAILURE, GLOBAL EMERGENCY, HARDWARE SAFETY FAIL, ESB EMERGENCY, EPS OEA PERMISSION), and 'SEARCH STATUS' (SEARCH OK). A 'SYSTEM STATUS' panel shows 'OK'. An 'OXYGEN SENSOR' panel displays '% OXYGEN' at 20.69% and 'OXYGEN ALARM' and 'OXYGEN FAILURE' as 'NO'. A log window on the right shows a list of events with columns for Time, Date, Status, and Text.

Time	Date	Status	Text
7:58:52 AM	9/23/2021	IO	PPS WITHOUT MACHINE PERMISSION
4:10:32 AM	9/22/2021	IO	HVAC OEA OE-09W135 -- Alarme pressostato do fancoil
3:39:03 AM	9/22/2021	IO	HVAC ESB ES-09W335 -- Alarme pressostato do fancoil
7:01:32 PM	9/21/2021	IO	EPS ESB GV2-GV2 - Valve is taking too long to change state GV2
6:36:57 PM	9/21/2021	IO	EPS ESB VAC - Gates after optical hutch shutter not open
6:36:57 PM	9/21/2021	IO	EPS OEA SHUTTER - Optical hutch shutter interlocked
10:29:51 AM	9/17/2021	IO	PPS FAILURE
9:57:03 AM	9/15/2021	IO	PPS EMERGENCY
12:56:03 PM	9/23/2021	IO	HVAC ESB ES-09W340E1-- Alarme disjuntor motor do ventilador do fancoil desarmado
7:54:29 AM	9/23/2021	IO	HVAC ESB ES-09B303 -- Alarme do temperatura alta da serpentina
6:47:58 PM	9/22/2021	I	HVAC OEA OE-09W137 -- Alarme termostato do banco de aquecimento
6:03:48 PM	9/20/2021	I	HVAC OEA OE-09B104 -- Alarme do temperatura alta na entrada de agua gelada
9:50:00 AM	9/20/2021	I	HVAC ESB ES-09B320 -- Alarme do pressao alta filtro grosso
3:58:09 PM	8/31/2021	I	HVAC OEA OE-09B101 -- Alarme do temperatura alta da cabana
11:31:33 AM	6/14/2021	I	HVAC OEA OE-09W136 -- Alarme contador do banco de aquecimento desligado
4:33:18 PM	4/7/2021	IA	HVAC OEA OE-09B120 -- Alarme do pressao alta filtro grosso
9:40:46 AM	4/7/2021	IA	HVAC ESB ES-09B410TT -- Alarme do temperatura alta da cabana

Interlock

Personnel Protection System (PPS)

Machine



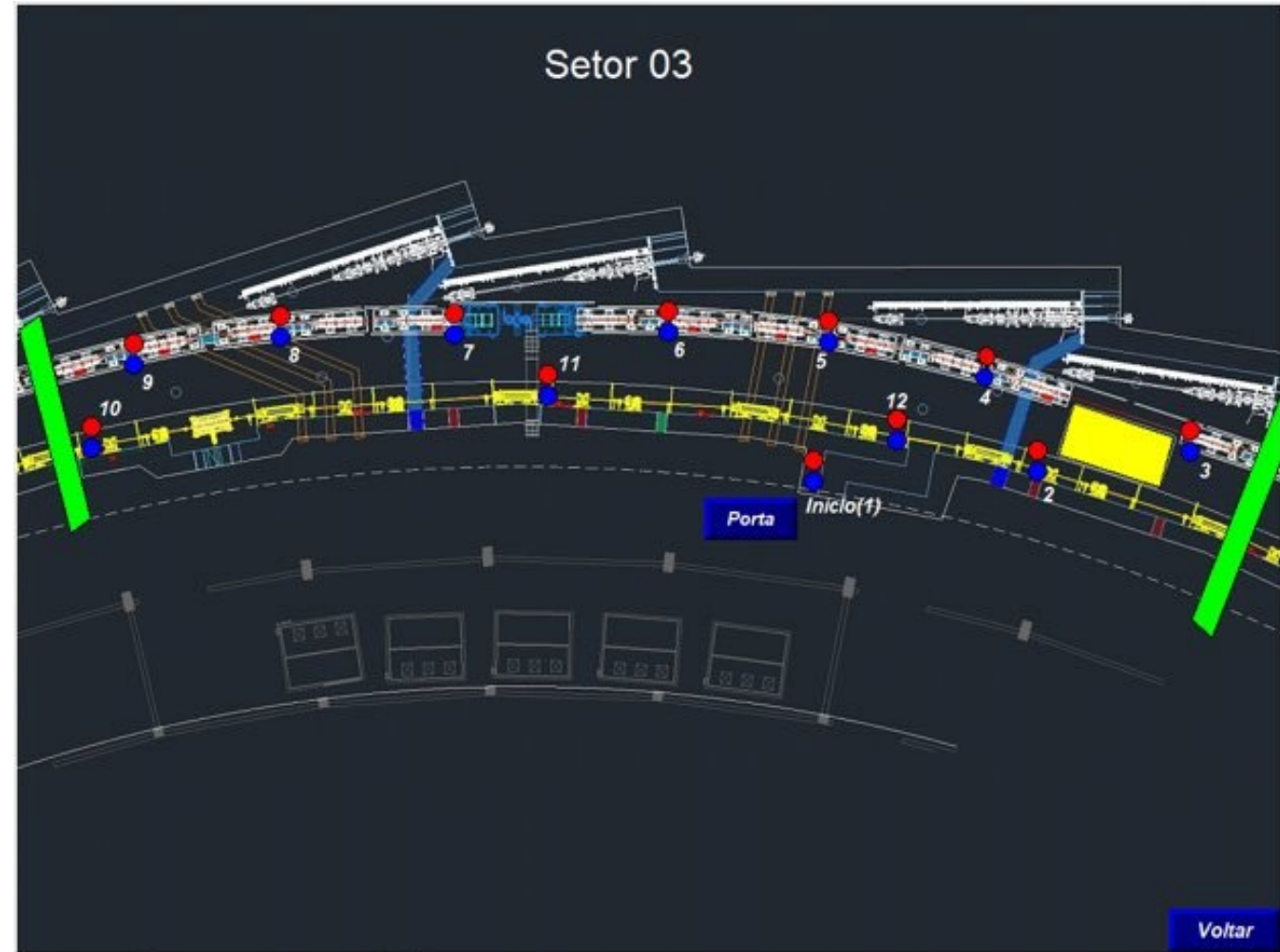
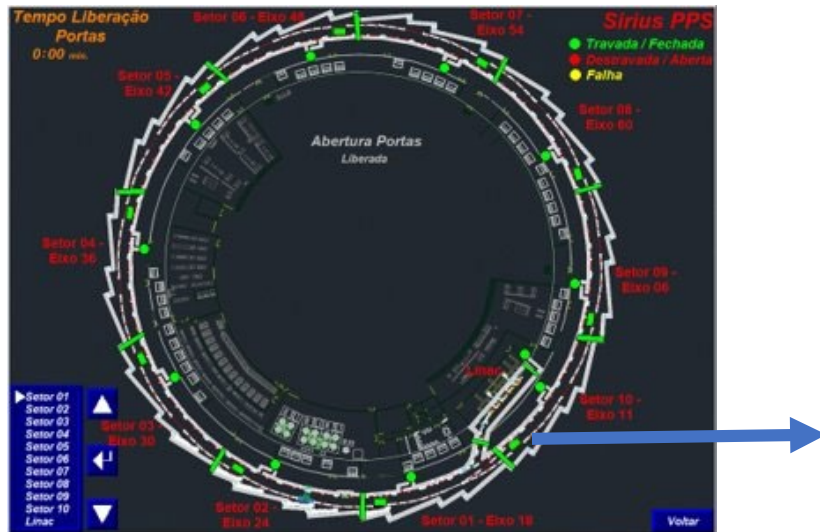
We chose Safety Integrity Level 3 for all components.

Safety interlock Rockwell.

Interlock

Personnel Protection System (PPS)

Machine



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Interlock

Personnel Protection System (PPS)

Machine

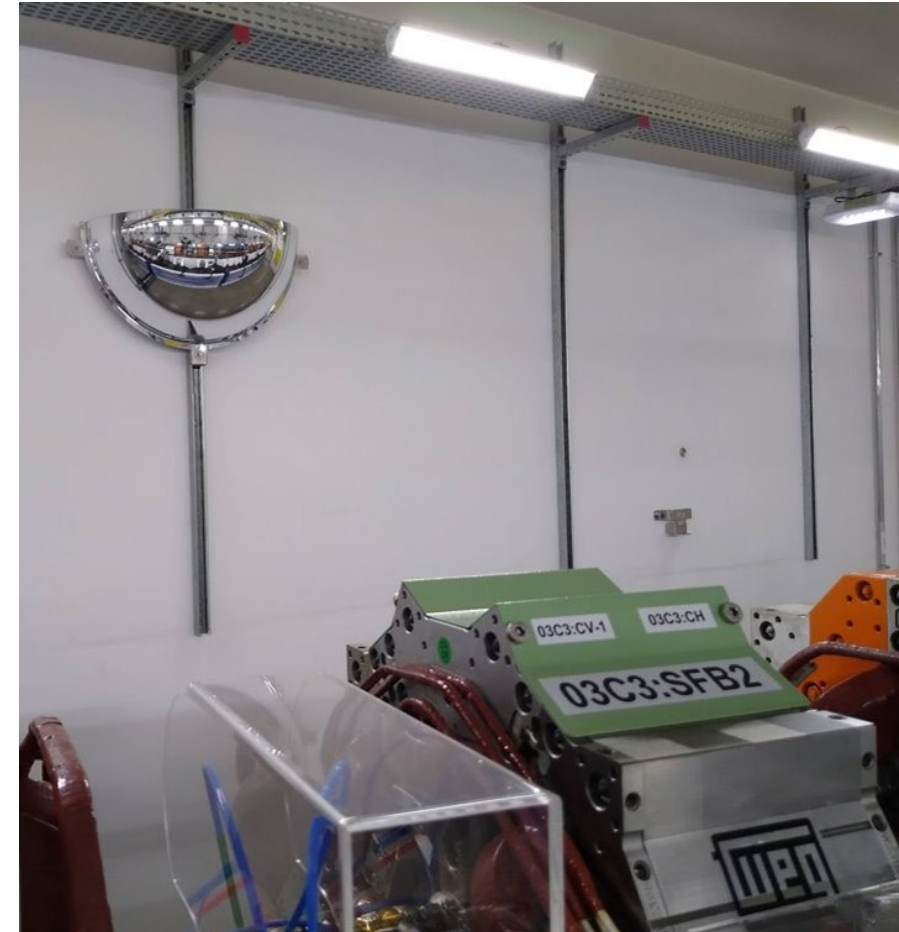


Interlock

Personnel Protection System (PPS)



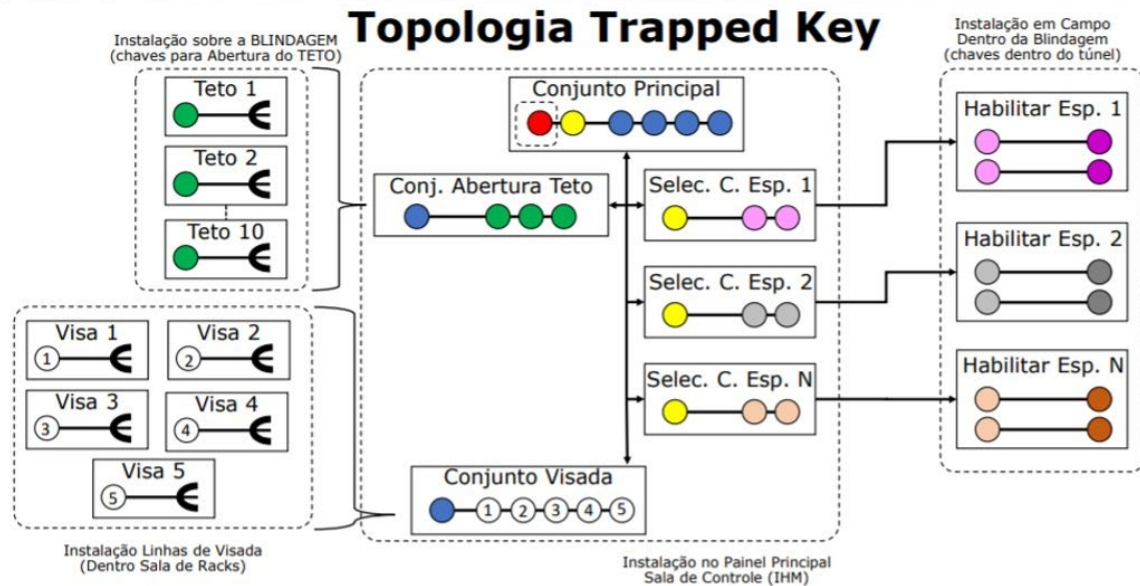
Machine



Interlock

Personnel Protection System (PPS)

Machine



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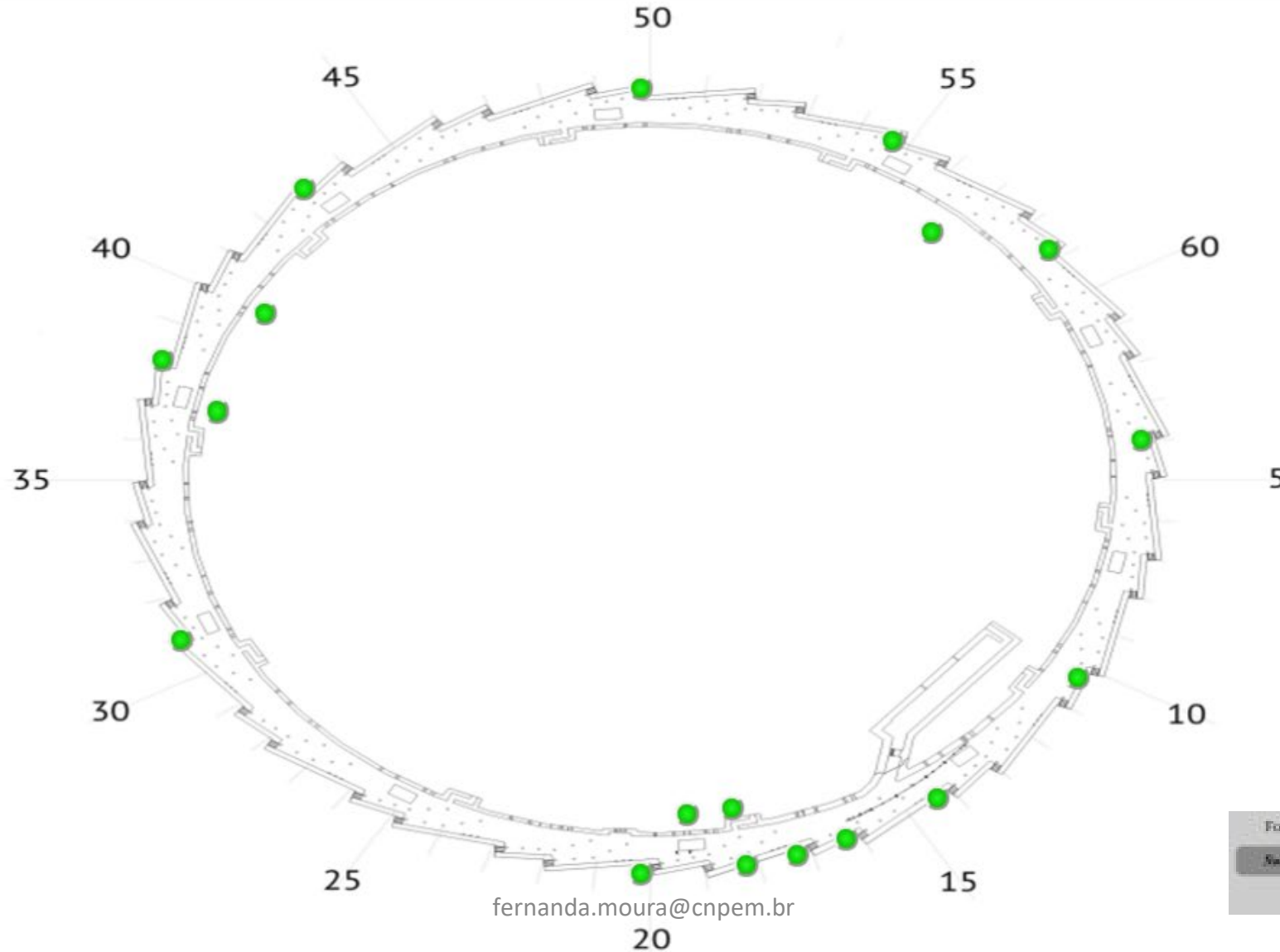
Detectors

Acknowledgment

Detectors

Radiological Monitoring System

5/24/2023, 5:02:14 PM



Legend

- OK (<math><1\mu\text{Sv}</math>)
- Alert ($1-2\mu\text{Sv}$)
- Alarm ($\geq 2\mu\text{Sv}$)
- Failed

NC: PV not connected.

Logarithmic Axis:
Double click on the chart.

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For improvements ideas or further information, contact the groups:

SAC (sac@cnpem.br)

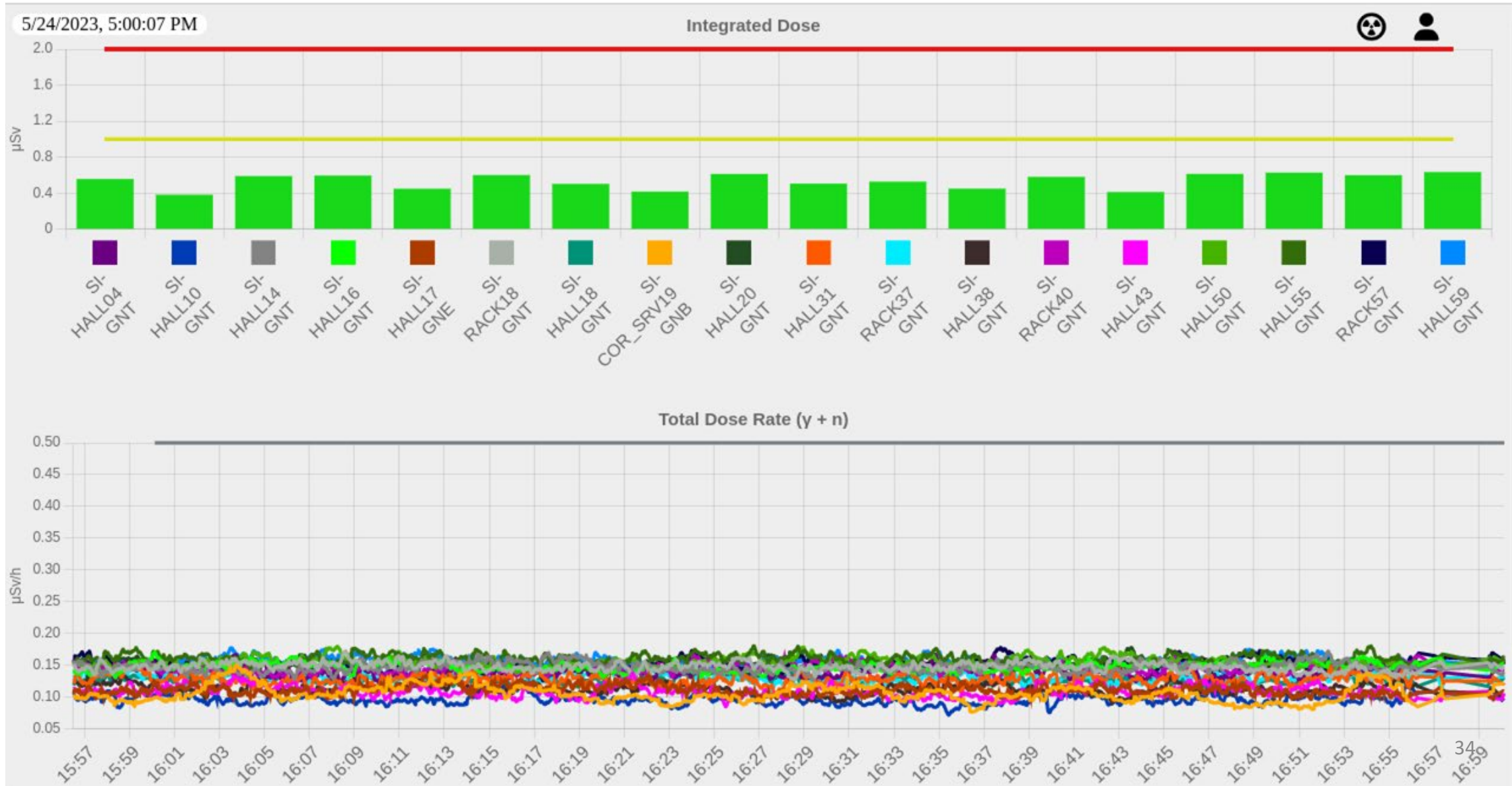
or

RIAD (riad@cnpem.br)

v.i.i.i

Detectors

Radiological Monitoring System



Detectors



Topics

LNLS

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Interlock (Personnel Protection System)

Detectors

Acknowledgment

New challenges

- Validation with 350 mA (2024/2025)
 - Optimization of shielding in the new hutches: New simulations with Fluka.CERN
 - EMA with Actinides research (2024)
 - Biosafety Level 4
 - Non-ionizing Radiation: Risks and procedures.
-
- **Research:**
 - Studies with dosimetric ("Combining Alanine Dosimeters and Monte Carlo Simulations: A method for demagnetization forecast by high dose exposure", 2nd of June)

Thank you

Je vous remercie de votre attention
Obrigada

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CNPem

MINISTRY OF
SCIENCE TECHNOLOGY
AND INNOVATION

BRAZILIAN GOVERNMENT
BRAZIL
UNITING AND REBUILDING

