

NOA - Nuova Officina Assergi Clean Room

The CR NOA Facility @ LNGS

UCLA - Dark Matter2023

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01. A Little Bit of History - 1 - Goal of the Facility

The Clean Room has been discussed and studied **since 2016**.

2017-2019 definition of the space needed, of the Technical Specs and also of the final configuration of the Clean Room

2019 tender and selection of the Company

2020 contract signed: beginning of the activities

The funds have been gathered thanks both to **2 different fundings lines**:

CIPE - Comitato Interministeriale per la Programmazione Economica -
Restart Programme: Abruzzo Region and L'Aquila Municipality

PON - Programma Operativo Nazionale - MUR: Minister of University & Research

The leading idea was to create a **facility @ LNGS** devoted to:

- * **production area** in a dust controlled environment for **innovative SiPM-based photodetectors** for **NEXT-generation experiments** (roughly 350 m²)
- * **big volume assembling area** for the future apparatus (roughly 70 m²);
- * **possible Radon Abatement System** in the future for the whole CR NOA.



These two primary needs arose during the development of DarkSide-20k Project.



UNIONE EUROPEA
Fondo Sociale Europeo
Fondo Europeo di Sviluppo Regionale



Ministero dell'Università
e della Ricerca



01. A Little Bit of History – 2 – Costs

The following machines have been purchased: now are in CR NOA and/or devoted to NOA activities.

Flip-Chip Bonder	AMICRA
Cryo-Probe	FORM-FACTOR
Wire-Bonder	HESSE
Dicer	ADT
Frame Mounter	Ultron
UV Curing	Ultron
Die Expander	Ultron
Pick& Place*	PCB Technology
Reflow Oven*	CIF Circuit Imprimé France + a lot of tools, devices, spare parts.....

* in Electronic Lab or NOA: to be defined

Total Amount CR NOA (approximate): **around 4.0 MEuro**

Total Amount Machines (approximate): **around 3.0 MEuro**

Total Amount of Investment (approximate): **around 7.0 MEuro**

.. without talking of the personnel investment: a lot of money for people staying at LNGS, thanks to all the Institutions and all the Grants.....

02. LNGS Configuration



02. LNGS Configuration

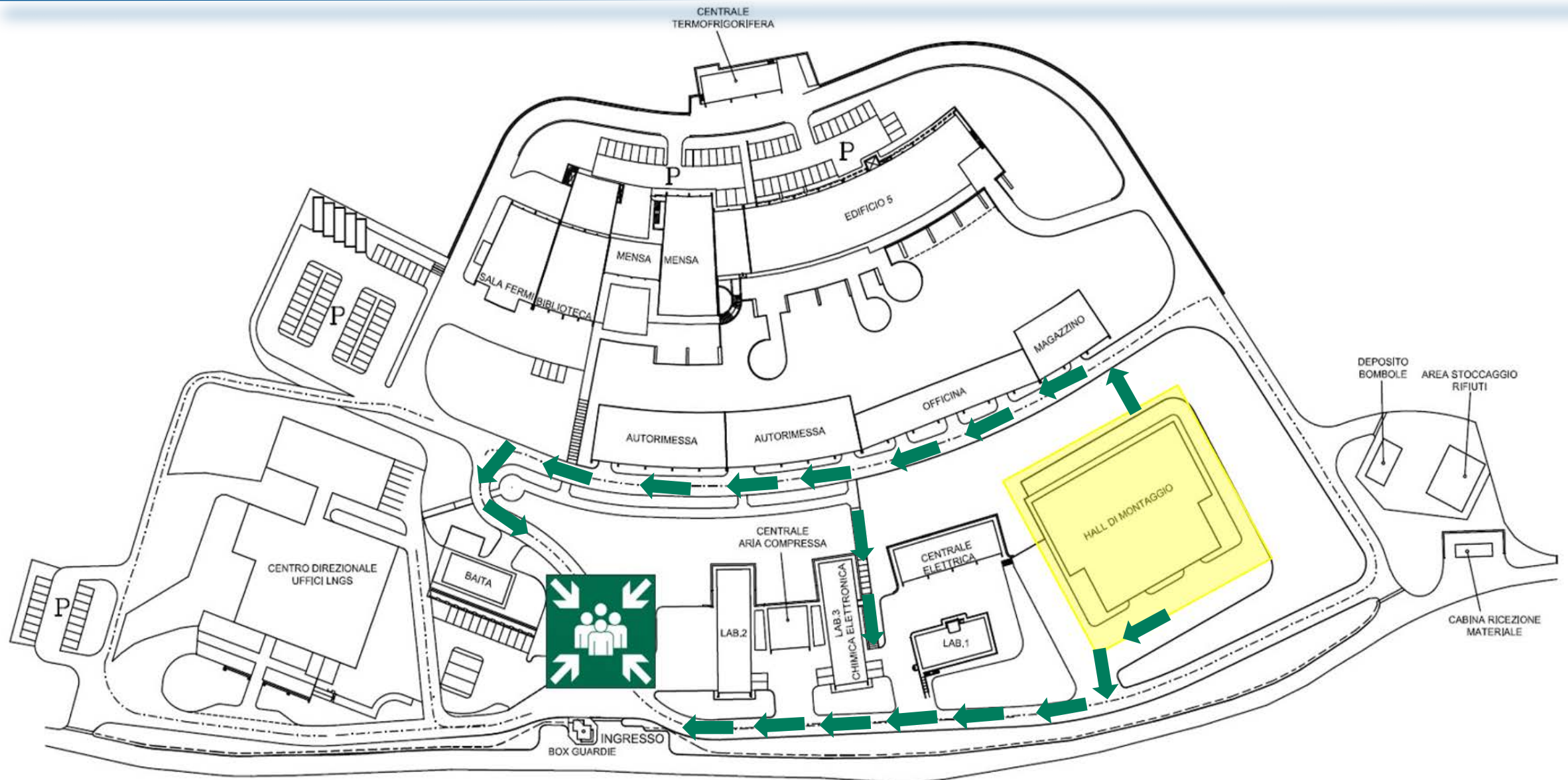


02. LNGS Configuration



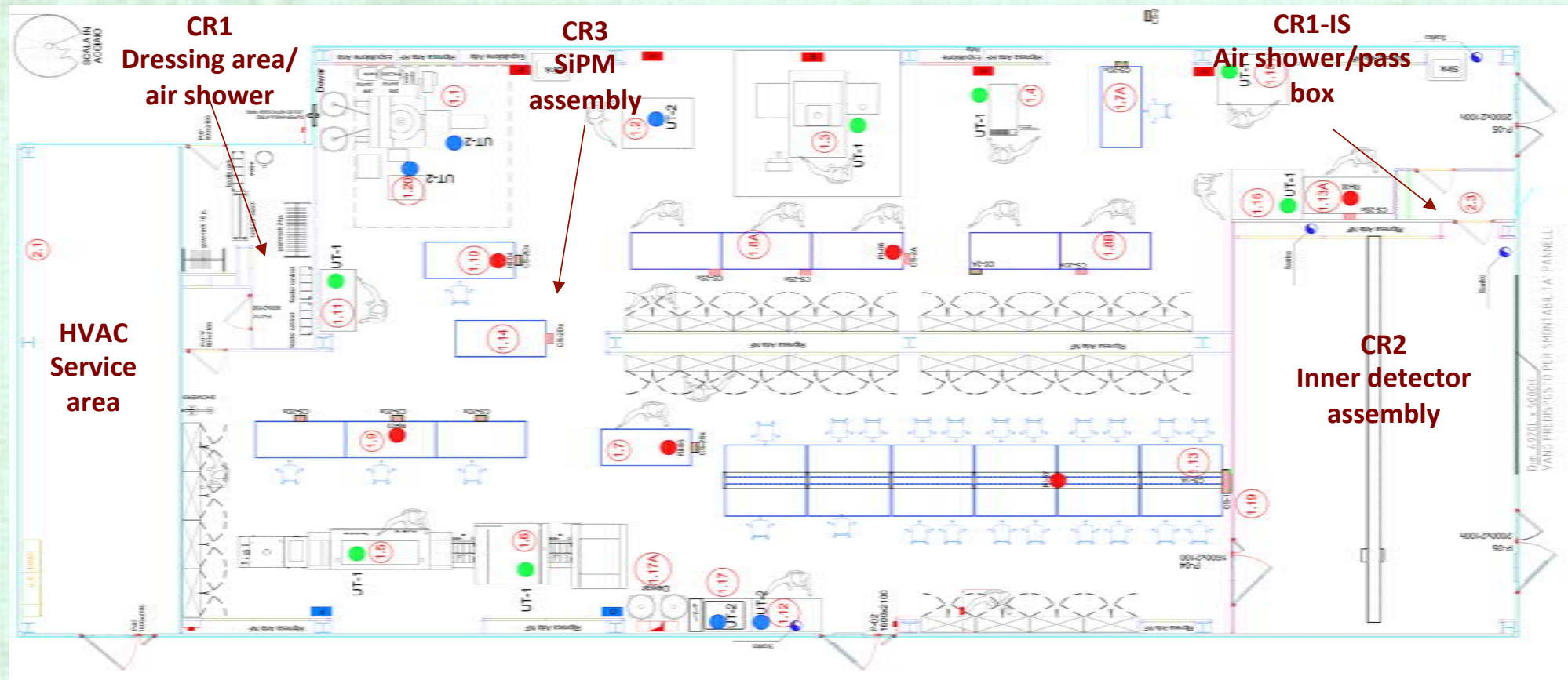
**Hall di
Montaggio
Assembly
Hall**

02. LNGS Configuration



03. NOA Clean Room - Description

The total clean room surface is about 420 m² divided in two different main areas called CR2, CR3 with a respective surface of 353 m² and 68 m² including two dedicated small dressing rooms called CR1-IS and CR2-IS. A third area of about 42 m², is completely dedicated to the air ventilation system and then can be considered as a "service area". CR3 is essentially dedicated to the SiPM assembling and packaging, while inside the CR2 the Inner detector assembly will take place. CR2 + CR3 total volume is about 1400 m³.



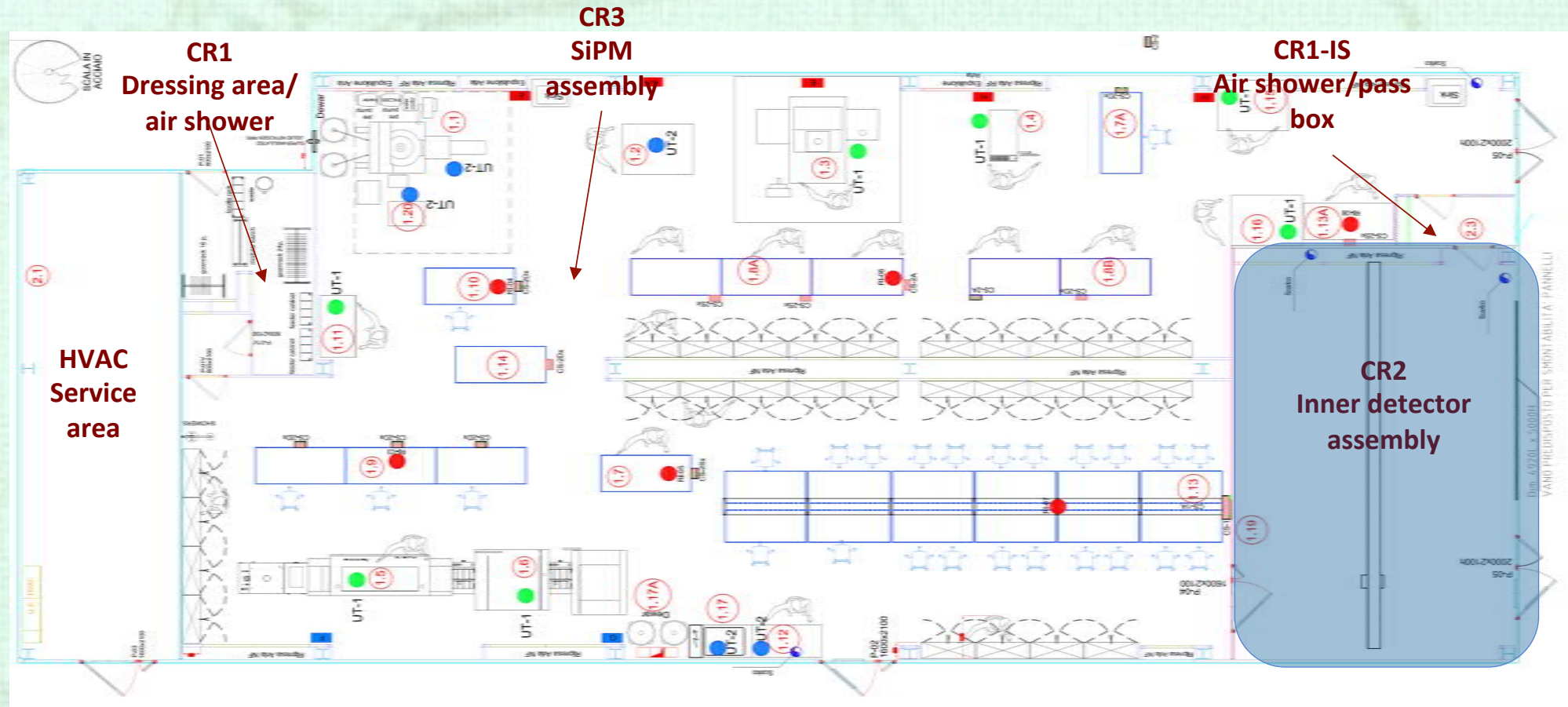
04. NOA Clean Room - layout

* Short Description

CR3 (3.0m high) is essentially dedicated to the SiPM packaging

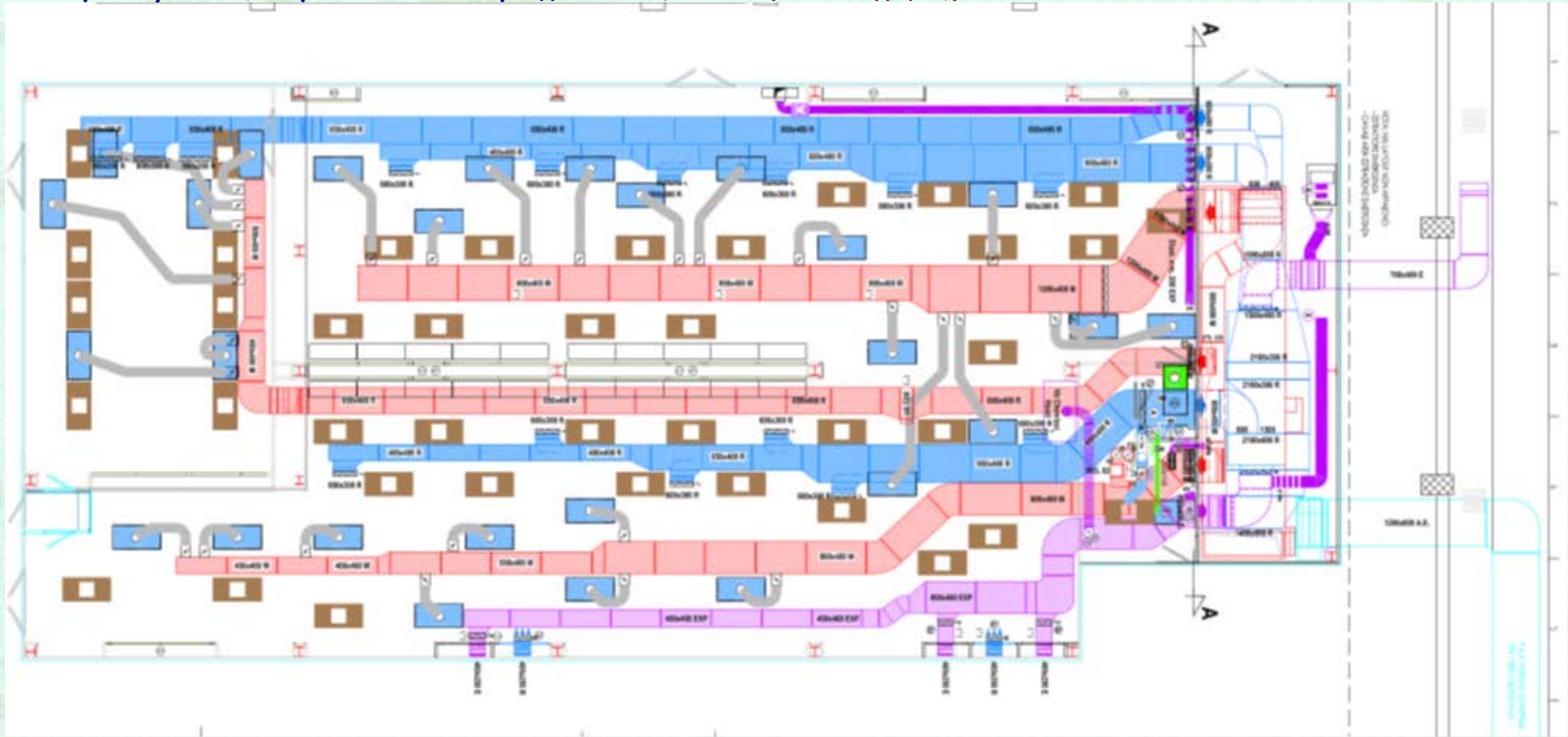
CR2 (5.8m high) devoted to the Inner detector assembly.

CR2 + CR3 total volume is more than 1400 m³.



05. NOA Clean Room – Air Handling System

The NOA air handling system is designed to provide 50 Volume exchanges/hour according to ISO-6 classification standards. This requirement is accomplished by combining the air flux provided by the Unit for the air treatment (UTA), which is about 28.000 m³/h and the air flux coming from the 40 Fan Filter Units (equipped with H14 HEPA filters) placed on the counterceiling which provide the remaining re-circulation flux, with a flow rate of more than 40.000 m³/h.

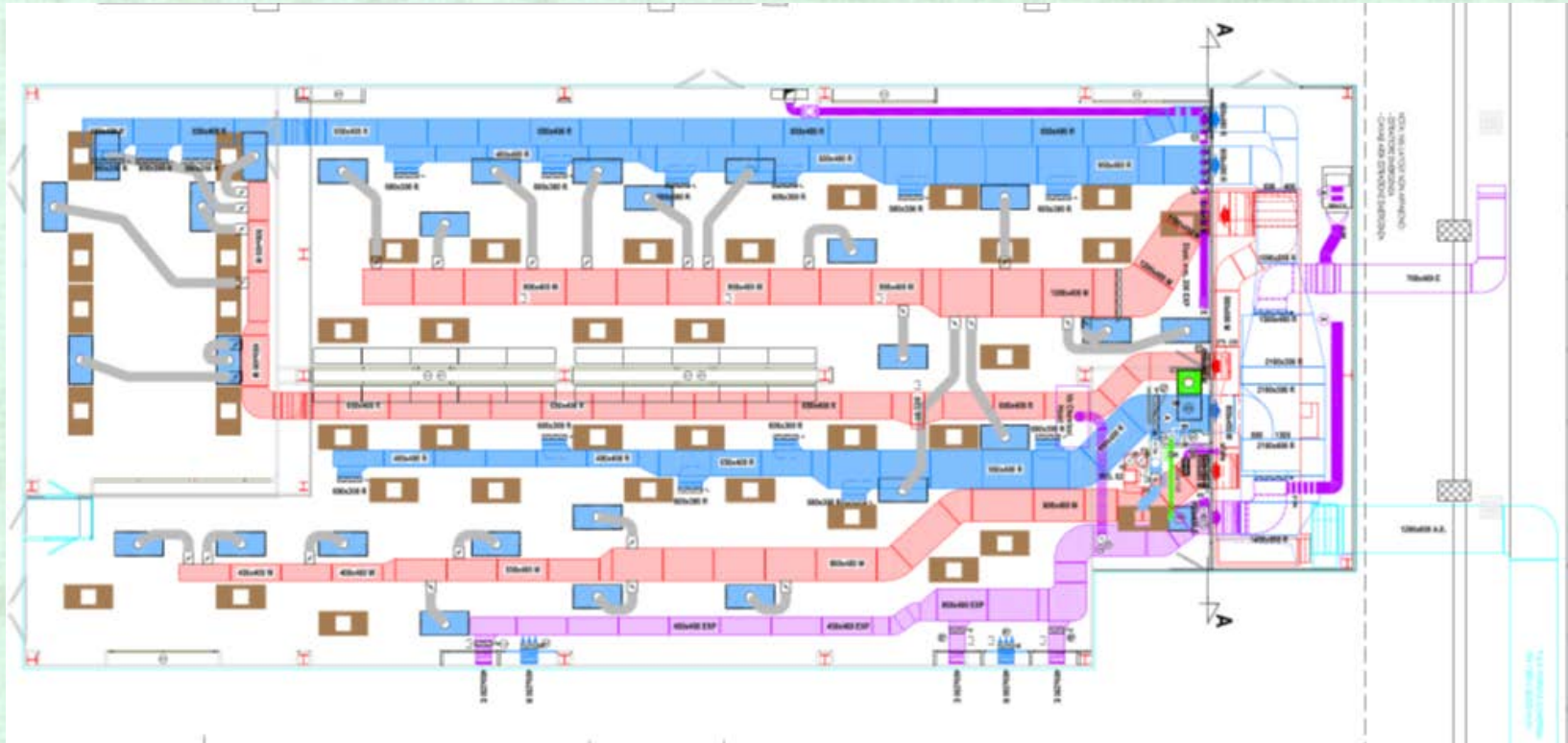


05. NOA Clean Room – Air Handling System - Future

The air handling system will be completely automated providing to run the CR ventilation in different modes:

- Normal mode: 7800 m³/h of make-up air flux
- Full Rn free mode: 1200 m³/h of make-up air (max 24 people contemporary present in the clean room)
- Reduced Rn free mode: 600 m³/h of make-up air (max 12 people contemporary present in the clean room)

Up to now there are some discussion about the Rn Abatement System: realization time is of about 12 months from the order and the cost os of about 1 MEuro (Vat included).



The air handling system allows running CR2 and CR3 separately, both in "normal and in " Rn free" mode. The air configuration system, following the latest design implementations, foresees the following operating modes, (both with or without Rn abatement system active):

- CR2 working, CR3 not working
- CR2 not working, CR3 working

06. NOA Clean Room – Operativity

Inside the CR3, 25 workstations are present: each workstation is equipped with the following services:

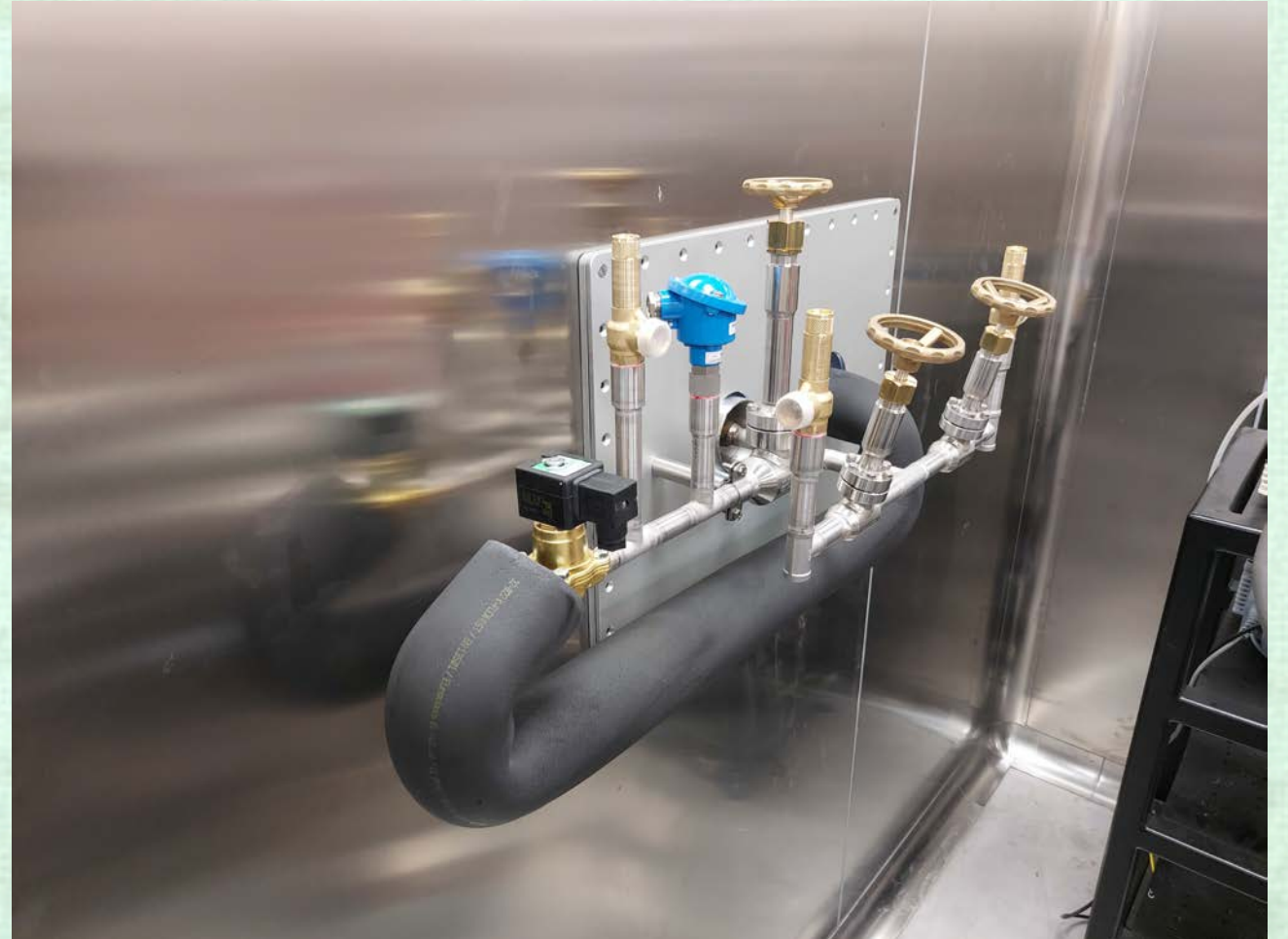
- * Electrical current (220 V, 50Hz) both from normal and UPS power supply
- * Compressed air
- * Low pressure (1,5 bar) Gas nitrogen
- * Vacuum
- * LAN and telephone lines



06. NOA Clean Room – Operativity

Moreover, in the CR3 there are the following systems:

- * a liquid nitrogen charging station is also present for mini-Dewars filling;
- * high pressure (7bar) nitrogen line,
- * industrial water distribution line;
- * chilled water line (Delivery at 7°C)
- * a deionized water line (5 M Ω * cm),
- * two deionized water sinks
- * two chemical hoods.



06. NOA Clean Room – Operativity

Auxiliaries distribution columns are provided for each production machine with a dedicated electrical cabinet for power supply.

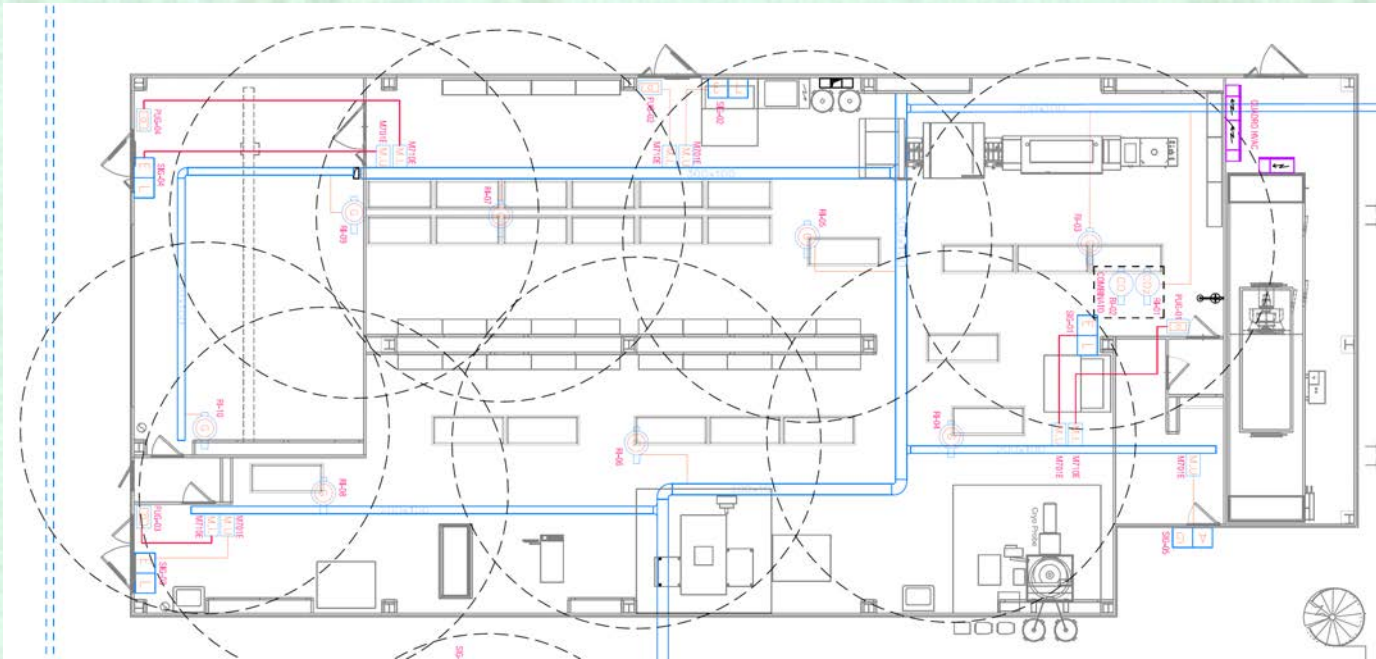


06. NOA Clean Room – Operativity: Safety and Security Systems

Accordingly with the Italian safety standards and together with the LNGS technical service rules, many safety systems have been installed:

- **Oxygen Deficiency Hazard (ODH):** 8 sensors who cover the total area of the CR2 and CR3;
- **Fire detection system** placed both in the main ventilation air ducts and inside the CR2 and CR3 volume.
- **Closed-circuit television (CCTV)** system with cameras placed both inside and outside the Clean Room and also outside the «Hall di Montaggio»
- **Intercom system**
- **Access control system**

All these systems are integrated with the existing LNGS safety and security systems



06. NOA Clean Room – Plants and Systems

For what concern the «internal apparatus» all the mechanical parts, air handling system and auxiliaries plants have been installed and commissioned.

The Clean Room is fully operative since the last Summer.

The systems that are still work in progress are the following ones:

- * external nitrogen tanks + auxiliary accessories - a survey occurred on the 28th of March; installation foreseen by the middle of April

- * connection to the waste tank done; concrete pouring + fence all around the waste tank area to be done.



July 2022

07. NOA Clean Room – Some Pictures

The Dressing Room



07. NOA Clean Room – Some Pictures

Picture of
the external
view



07. NOA Clean Room – Some Pictures

Picture of
the external
view



07. NOA Clean Room – Some Pictures



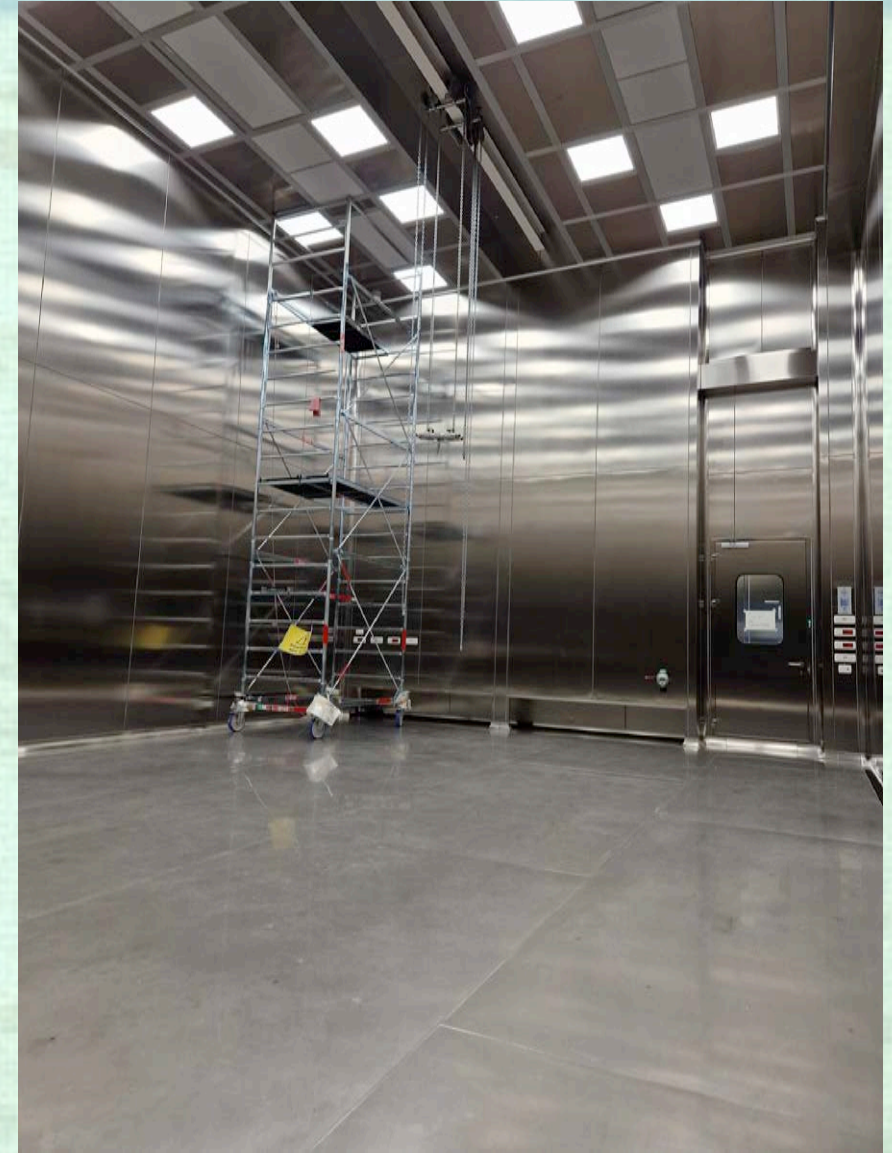
Pictures of CR2,
devoted
to the big components
assembly.

Space: 70 m²

Height: 6m

Floor resistance:
2000 kg/m²

Manual crane:
up to 2 tons



07. NOA Clean Room – Some Pictures

The chillers outside, installed in Winter time



07. NOA Clean Room – Some Pictures

One of the cupboards
storing the wafers



07. NOA Clean Room – Some Pictures

The workstation area



07. NOA Clean Room – Some Pictures

Frame Mounter
and
Die Expander



Auxiliary
tools for manual
packaging

07. NOA Clean Room – Some Pictures

Cryo-Probe



07. NOA Clean Room – Some Pictures

Wire Bonder



07. NOA Clean Room – Some Pictures

Dicer



07. NOA Clean Room – Some Pictures



Flip-Chip
Bonder



07. NOA Clean Room – Some Pictures

The
DarkSide
Team
(part of..)



08. NOA Clean Room - Next Steps

* Request for the next operating steps (agreed with by DarkSide Collaboration):

warehouse - 20÷25 m²

small workshop - 20÷25 m²

in the Assembly Hall

* Optimization of CR operational functions in parallel with DarkSide activities.

* Radon abatement system tender:

estimated cost: 1 MEuro

estimated time: (about 12 months to build from the order)

Right now we have a continuous monitoring of the Radon concentration (n. 3 sample points inside the CR + 1 point outside), thanks to the co-operation with Jagiellonian University - Poland [G. Zuzel]
An average value of the Radon measured is in the range 20 - 30 Bq/m³.

09. NOA Clean Room – Perspectives

Obv., the **first use** of CR NOA will be **reserved for DarkSide**, presumably until..... 2024 (??)

It will be a facility available to be used both by other Experimental Collaboration and by researchers and groups inside LNGS.

In any case, it will be necessary to find a way to advertise and make the facility known in all scientific and/or industrial fields.

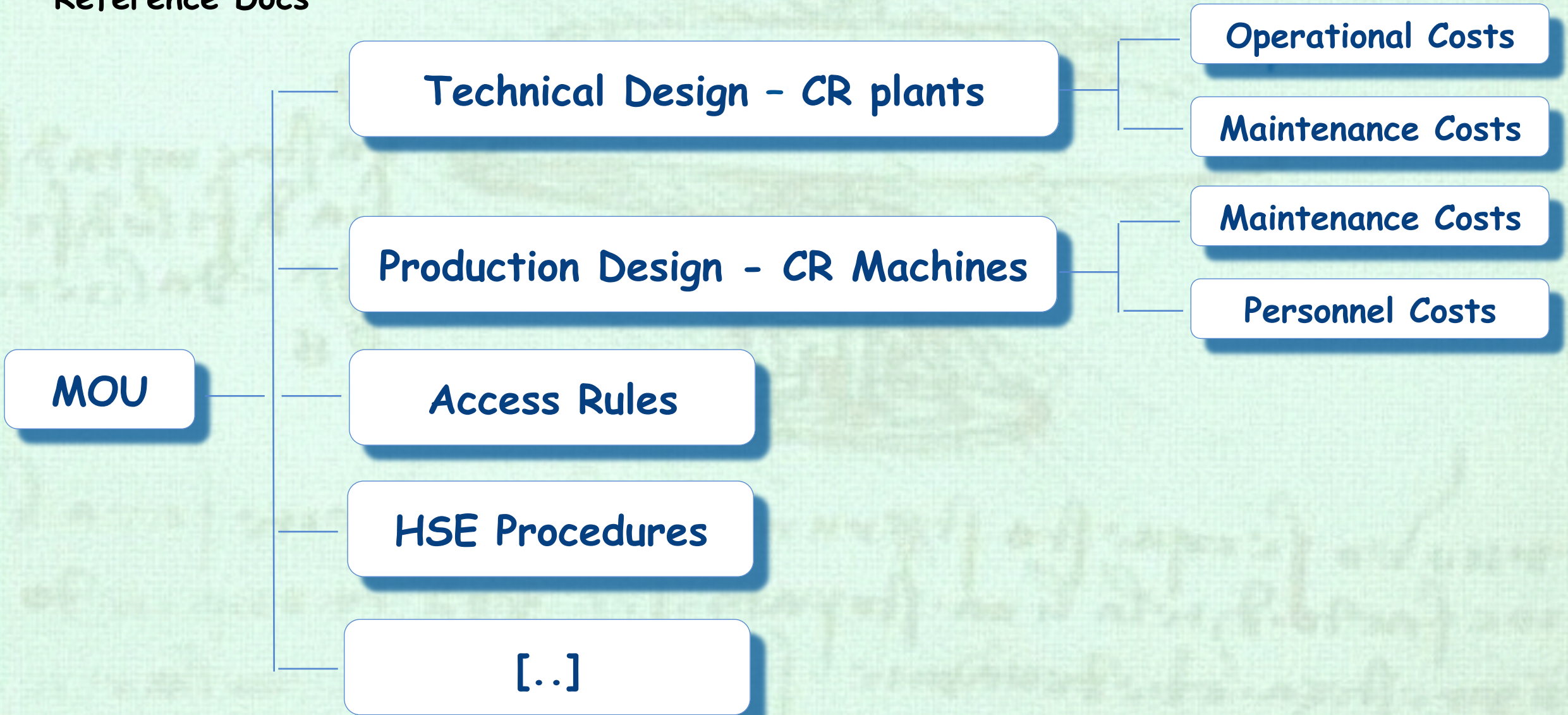
Already today there have been "**expressions of interest**" for the use of the infrastructure by some experimental groups.

Together with the Directorate it was agreed to prepare a **sort of MOU** for the future use of the infrastructure.

This MOU will be based on a guideline that describes the technical and plant characteristics of the CR and the characteristics of the production machines installed and already functioning. In the following slide an example of how the necessary documentation could be structured.

09. NOA Clean Room – Perspectives

Reference Docs



10. NOA Clean Room – Management

Contacts with experimental groups.

- * Definition of requests to be sent to the various experimental groups in order to understand their needs.
- * Send communications to the various groups.
- * Meetings have already been held ; they will be scheduled to continue in the next months (Summer 2023).
- * Advertise infrastructure as soon as completed.
- * Accurate definition of operating costs

Current Personnel

#	Name	March 2023
*	Consiglio Lucia	staff LNGS
*	?????	staff LNGS - Technician; selection in progress
*	Liberatore Lorenzo	Fellowship - up to March 2024
*	Panella Graziano	staff LNGS (<i>retiring - September 2023</i>)
*	Pietrofaccia Lidio	fixed term - new contract (30 months) starting in May 2023
*	Tartaglia Roberto	staff LNGS

##. Conclusions and Thanks

Many thanks to:

- * Maria Teresa Ranalli (CSE)
- * Aldo Ianni (PON P.I.)
- * Lorenzo Liberatore
- * Graziano Panella (DEC & DL)
- * Lidio Pietrofaccia (DO)
- * T.Am.Co. Company

and..

- * Debora Polidoro & Chiara Zarra
- * Giovanni Ambrosi (RUP)
- * Antonio Iannuzzo
- * Paolo Lombardi

[..]

and also to:

- * Lucia Consiglio
- * Kaori Kondo Horikawa
- * Vincenzo Camillo
- * Antonio Flammini
- * Giacomo Gallina
- * George Korga
- * Paolo Organtini
- * Davide Sablone
- * Maria Adriana Sabia
- * Paolo Salomone

[..]

Focus: organizing the work in order to guarantee the complete functionality of CR NOA; the goal is to complete as soon as possible also the external activities. Soon after:

- * establish and schedule a well defined planned shifts to test the DarkSide wafers;
- * prepare the CR NOA Facility for future use in the Research and Scientific Community.

.. and..... thanks a lot for Your attention.....