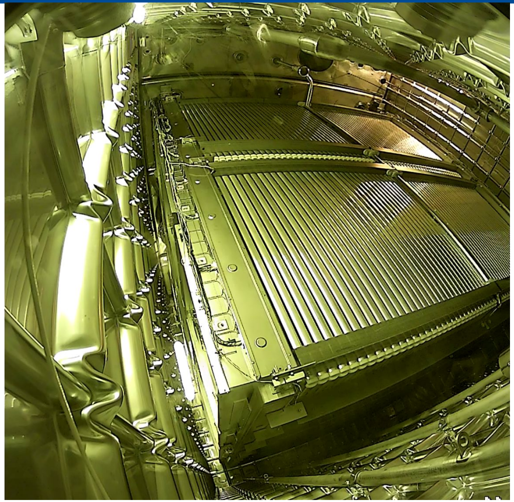



# Operations group and Operations overview

Mônica Nunes

SBND Operations Readiness Review

February 21-22, 2024

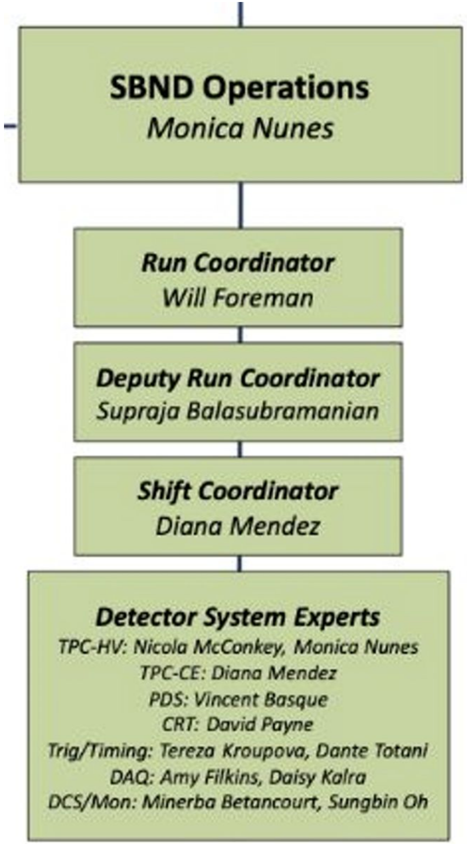
# Charge Questions

For this talk, there are two relevant charge questions that will be covered:

**3.** Is there a well-understood run plan for the remainder of FY24, consistent with the planned accelerator schedule and performance? **Have adequate resources from the laboratory and the collaboration been identified for an efficient and safe running of the experiment and for maintenance of the detector, and have the responsibilities of the collaboration and Fermilab staff been clearly defined?**

**6. Are the ES&H (Environment, Safety, and Health) aspects of all anticipated work properly assessed and managed, with clear roles and responsibilities?**

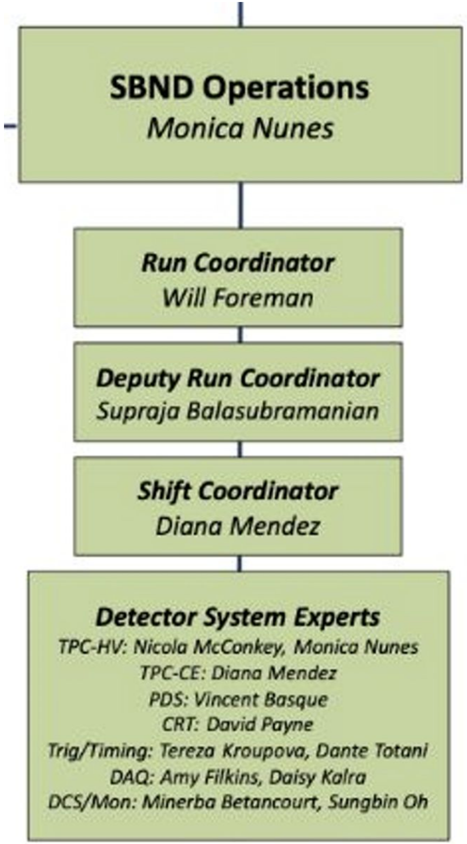
# Operations Team







# Operations Team




Operations group is in charge of ensuring **smooth operations** of the experiment during the entire duration of data collection.

We are working **together with the Commissioning team** to ensure that all our **tools are functional** and to ensure we have a **smooth transition** between Commissioning and Operations.

Collaborators are **already taking shifts** and **testing** all the procedures and tools we have available for monitoring the detector. More about the shifts will be presented in the next talk by Will Foreman.

# Operations Team roles

***Operations Coordinator:*** efficient operation of the detector to meet the physics goals of the experiment:

- Respond quickly to system failures that impact on detector operations
- Schedule of system development and maintenance, in consultation with the spokes.
- Maintain a Detector Experts list.

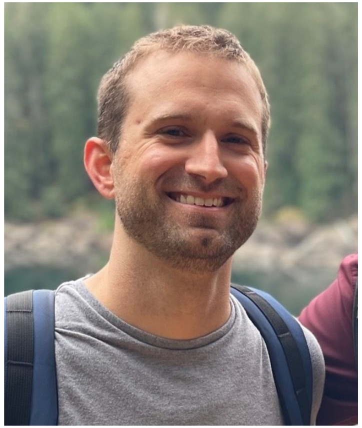
***Run Coordinator /Deputy Run Coordinator***: day-to-day management of de

- Quickly respond to detector system failures that impact efficient detecto
- Responsible for maintenance and updating of shift procedures
- Primary contact between experiment and the Fermilab Main Contro
  operations needs.

***Shift Coordinator:***

- Allocate detector monitoring shifts according to a approved shift assignr
- Maintain records of the assigned and completed shifts

# Operations Team roles



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***Run Coordinator /Deputy Run Coordinator***: day-to-day management of detector data taking

- Quickly respond to detector system failures that impact efficient detector operations
- Responsible for maintenance and updating of shift procedures
- Primary contact between experiment and the Fermilab Main Control Room for daily operations needs.

***Shift Coordinator:***

- Allocate detector monitoring shifts according to a approved shift assignment scheme.
- Maintain records of the assigned and completed shifts

# Operations Team roles

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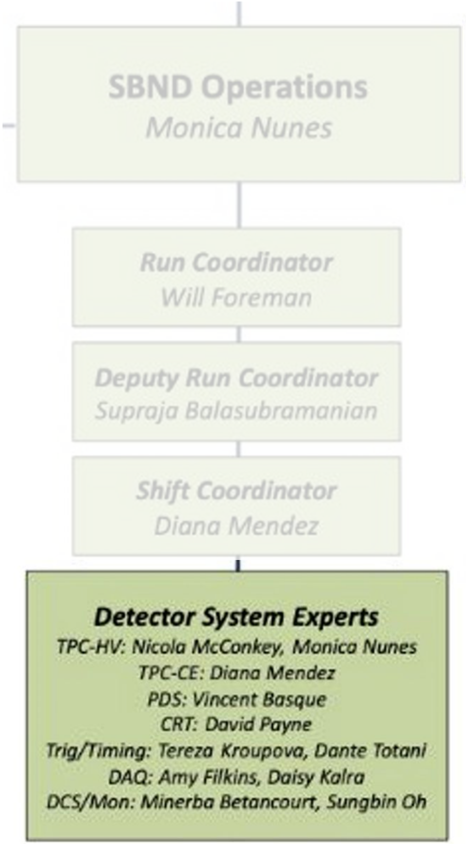
# Operations Team




The various subsystems are coordinated by a **System Operations Leader** which is responsible for:

- **Organize** and **train** new **experts** for each subsystem,
- **Organize** the needs of **maintenance calendar** that will be discussed with the Operations Coordinator,
- Ensure that their subsystem has at least two experts.

We have identified leaders for all subsystems.

The **experts groups** are responsible for:

- **Troubleshoot** each subsystem for smooth operation of the detector,
- Having **on call personnel** that can provide real-time **assistance**

# Experts

During their 1 week shifts, they are **on-call 24/7** to ensure that any problem with each subsystem is fixed as soon as possible.

The experts list now has **over 30 collaborators**, and is growing as more people get trained.

The Operations Team makes sure that there are always enough experts dedicated to each subsystem.

Collaborators can **get trained** to become experts to some subsystem. We encourage them to do so.

The Operations Coordinator is working together with the subsystem leaders to arrange the best time for training so it doesn't interfere with the commissioning activities ongoing.

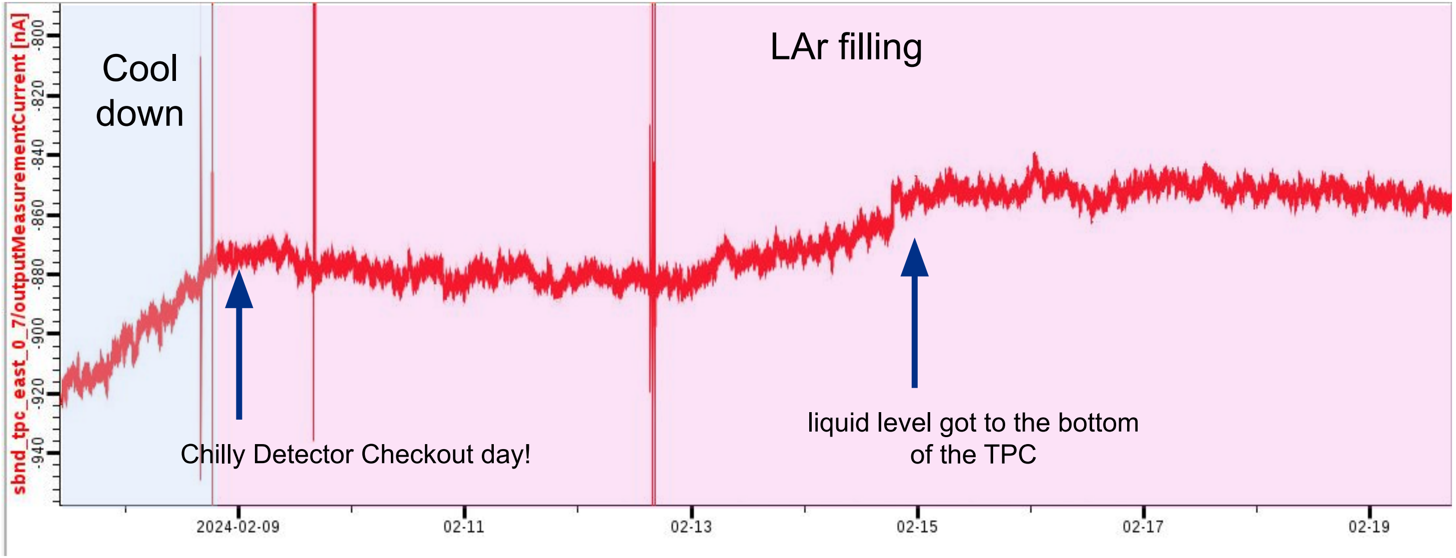
| Detector Subsystem | Institutions with committed experts |
|---|---|
| TPC high voltage | Fermilab, Queen Mary, Chicago |
| TPC cold electronics | BNL, Fermilab, Florida |
| Photon Detectors | Fermilab, Florida, Michigan, Unicamp, CIEMAT,Tufts |
| Cosmic Ray Tagger | Fermilab, Liverpool, Syracuse |
| Trigger/Timing/Beam | Penn, Liverpool, UCSB |
| DAQ | Fermilab, Columbia, Syracuse |
| Slow Controls & Online Mon. | Fermilab, Chicago, UCL |

# Detector cool down

The cryostat is being cooled and to prevent ice formation on the cathode HV connection, we applied -1kV (1% of the target nominal) to the cathode during this period.

This helps us to monitor the cathode and field cage connections during cool down.

The **shifters are monitoring** the applied voltage and the readout current on the power supply.



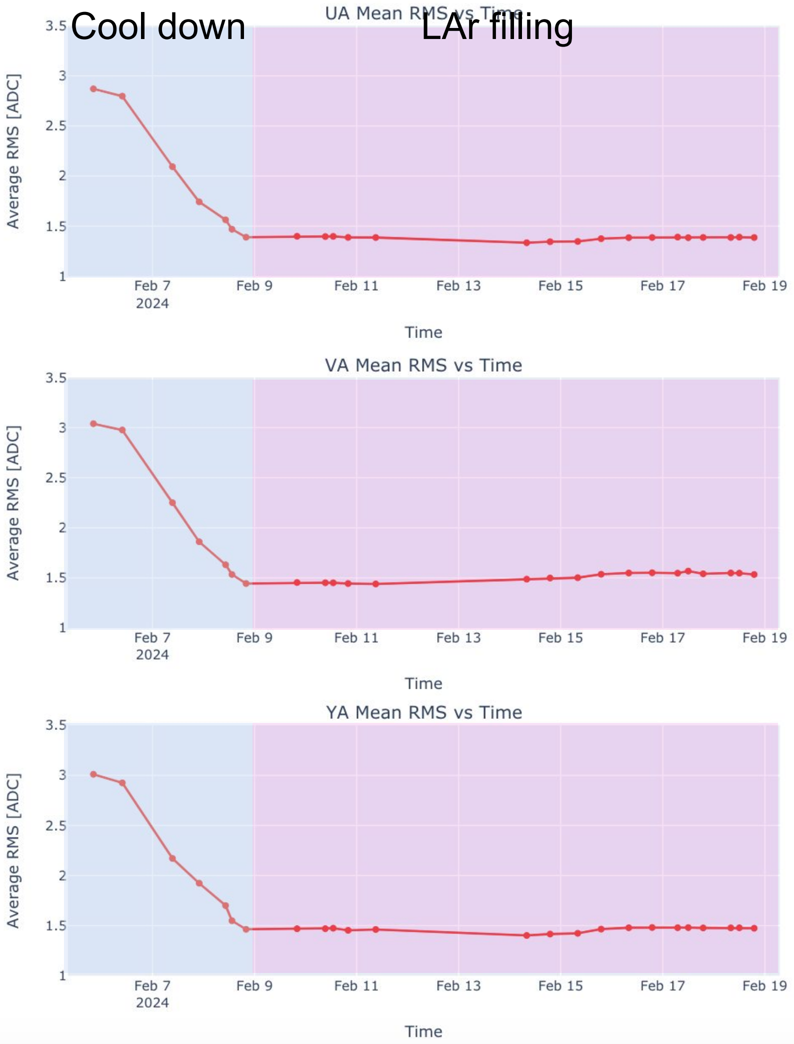
# Noise tests

Since cooldown, we've been **collecting and analysing noise data** to monitor the noise level and see if there are external sources of noise being added.

We will **continue collecting data** during LAr fill and as we ramp up each TPC system.

Since we've been monitoring this data frequently, it will be easier to **identify noise sources** as they are introduced, making it easier for us to fix them as soon as they appear.

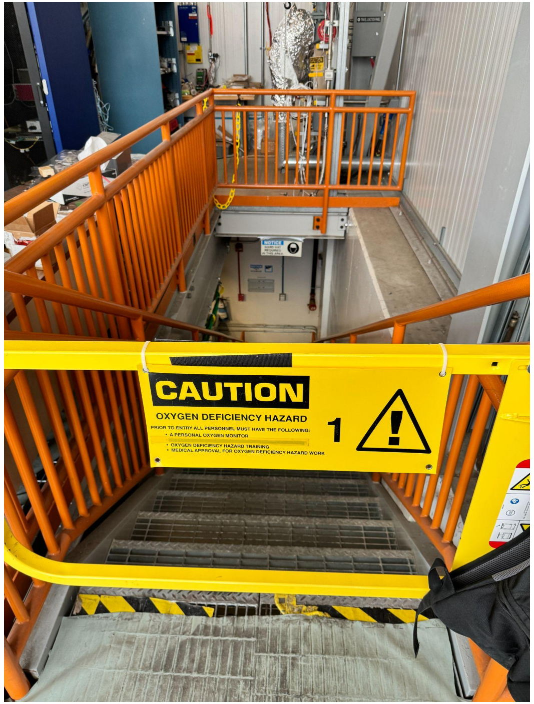
**Shifters are taking noise data** as part of their shift tasks.



# Safety Procedures

Operations Coordinator, together with the Division Safety Officer (DSO), will make sure that **ALL work** on the detector are conducted **according to the Fermilab safety rules**.

- Collaborators accessing the **SBND building** are **required** to take the **SBN Near Detector Hazard Awareness Training**,
- Collaborators accessing the **mezzanine** and the top cap are **required** to have **ODH** training,
- Collaborators accessing the **pit** are required to have the above trainings **and Confined Space trainings**,



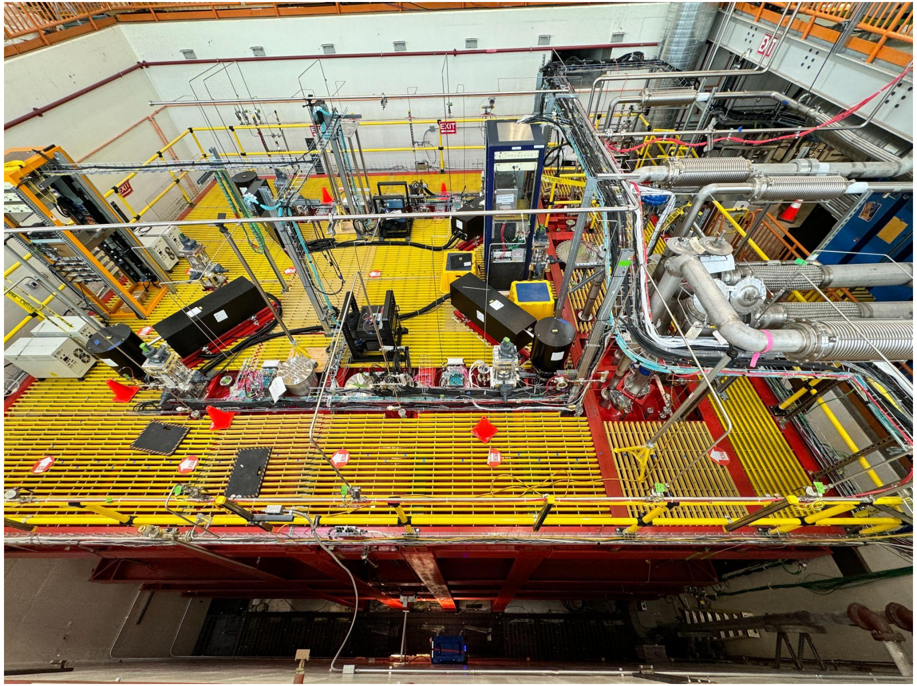
# Safety Procedures

Below grade level:

Access requires that the personnel **carry an oxygen monitor** and **wear a hard hat**.

**Two-person** rule:

- if going to the top cap, one person can remain on the main level if they are able to communicate and be in visual contact.
- If going to SBND pit, the two persons have to be in visual contact at all times.



# Work Planning

All the **work** that needs to happen **at SBND building** is discussed in **toolbox meetings.** They are happening twice a week and we can modify this schedule as needed:

- Discuss progress on the ongoing activities
- Organize the priorities,
- Minimize impact to operations if some activity is needed,
- Revision of procedures.

Work that is considered **high risk** will require a **work plan** and written **Hazard Analysis.**

New equipment or setups will undergo ORCs before being allowed to operate.

# Neutrino Division Technical Support

**ND** is the primary source of **technical assistance** to the SBND collaboration and oversight of experiment operations. ND provides **funds for the operation and maintenance** needs of the SBND detector and the SBN Near Detector (SBN-ND) facility, including cryogenics systems.

- **The Technical Support Department** (TSD) provides key operations support:
  - **Experiment Liaison Officer (ELO)**, currently Carrie McGivern, works with the SBND Operations Coordinator to identify necessary resources to support the experiment and to ensure all work in the SBN-ND facility is coordinated with required work planning, scheduling, and safety procedures.
  - **Operations Support Group (OSG)** provides technical support for online and DAQ systems.
  - **Electrical Group** provides support for electronics infrastructure such as detector AC power distribution, rack protection systems, the ground impedance monitor, and the cryogenics controls system.
  - **Cryogenics group** has primary responsibility for operation of the cryogenics systems. The group provides 24/7 emergency response through on-call expert engineers, performs daily monitoring checks of the cryogenic system performance and arranges for scheduled maintenance.
  - **Electrical and mechanical technician support** on an as-needed basis. The leaders of the groups work with the ELO to identify additional technician resources from other divisions if needed.

# Collaborator Support from Fermilab

We had many collaborators coming to Fermilab over the past years for the assembly and installation of the detector. This contributed immensely to successfully getting the SBND detector ready! This was possible especially because of lab support received.

It's important for operations that the lab **keep supporting collaborators coming to Fermilab** through:

- Lab Access
- Funding

The **success of operations** depends heavily on **on-site personnel** that are able to stay for extended periods of time, especially to serve as **Run Coordinators** and some subsystem **experts**.

# Risks

An Operations Risk Management Plan was created to i**dentify and assess events** that may negatively **impact** the capacity of us **taking good data.**

All **subsystems** have identified possible **operation risks** and have provided **mitigation plans** through the use of a risk assessment form.

The risk rank were scored using a Risk Ranking Matrix, which combines the impact to data taking and the frequency expected for it to occur.

| Risk Frequency ⬇ | Risk Impact ➡ Very Low | Low | Medium | High |
|---|---|---|---|---|
| Very High | Moderate | Major | Severe | Severe |
| High | Minor | Moderate | Major | Severe |
| Medium | Minor | Moderate | Major | Severe |
| Low | Minor | Minor | Moderate | Major |
| Very Low | Minor | Minor | Minor | Moderate |

Description of the risks and mitigations is detailed on SBND's docdb.

# Risks - Wire Bias

**TPC - Bias power supply failure or voltage instabilities:**

**Situation**: wires cannot operate at their nominal voltages.

The cause could be on the power supplies used to bias the wire planes and cover boards.

**Mitigation:** trip limits have been established and applied to the power supplies to protect the circuit. Warnings and alarms are visible to the shifter 24/7. We will have spare power supplies in case we need to change them.

**Response plan:** If power supplies are the problem, they will be replaced. If the problem is in the circuit, the situation will be studied and if needed, we will operate the wire bias at a lower voltage.

| Risk Information |
| --- |
| **Inherent Risk event:**<br>IF – The TPC is not able to operate stably at nominal bias voltages.<br>THEN – the quality of TPC data may be lower if wire transparency condition is not fulfilled, data collection may be impacted due to the modified E-field near the wires. |
| **Root Cause of the risk:**<br>Voltage breakdown or problems with the power supplies for the wire bias and cover board bias voltages, which causes a system trip for the affected channels. |
| **Mitigation Actions already taken:**<br>Trip limits on power supplies are set to safe levels prior to powering on supplies. Slow controls monitoring alarms set to notify shifters before the trip limits are reached. |
| **Assessment of Remaining Risk:**<br>Impacts: Very Low; recovery to nominal within 2 days<br>Frequency: Low, as shown by prior experience in other TPCs<br><br>**Risk Ranking: Minor** |
| **Response Plan:**<br>If voltage breakdown occurs in wire bias or cover board bias systems, the channel(s) with issues will be powered down by the power supply trip.<br>If the power supplies are found to be the source of the problem, these can be replaced by spares. However, instabilities may develop within the TPC which are not caused by any power supply.<br>Following any trip of a wire or cover board bias voltage PS, the "TPC Switch-on Procedures" are followed, which require some hours due to included pauses for monitoring the stability of the channel. If any instabilities are observed during the ramp-up, the bias should be held at the highest stable point for 4 hours, before attempting to ramp up again. The other bias voltages in this TPC should be adjusted to give transparency for the wire plane if necessary.<br>Data taking can continue during this operation, up to ¾ of the detector may be unaffected. |
| **Any Other Information:** |

# Risks - PDS

## PD Readout Failure

**Situation**: Digitizer or other readout hardware fails.

**Mitigation:** Have spare equipment in hand. Alarms and warnings are visible for the shifters that can notify the experts.

This risk is marked as Moderate mostly due to the time to replace some of the equipment, if needed.

**Response plan:** Hardware replacement by trained experts to minimize down time of the system.

| **Risk Information** |
|---|
| **Inherent Risk event:**<br>IF – digitizer devices or other readout hardware fails.<br>THEN – data-taking halts or continues but without a substantial fraction of PD channels. |
| **Root Cause of the risk:**<br>Failure of digitizers, VME crate, digitizer power supplies, or readout cable |
| **Mitigation Actions already taken:**<br>Spare pieces of hardware are on hand and can be swapped as required. Alarms in slow controls and DAQ detect the failed components and the cause of halted data-taking. |
| **Assessment of Remaining Risk:**<br>Impacts: Very Low to Low – some components can be swapped quickly (digitizer) but replacing a VME crate may require more than 2 days, with data quality affected during that time<br>Frequency: Medium - could happen a few times per year<br><br>**Risk Ranking: Medium** |
| **Response Plan:**<br>Hardware replacement by experts using on-hand spares. |
| **Any Other Information:** |

# Risks - SBN ND Building

## Crane incident while cryostat is full

**Situation**: IF the crane loses its load over the cryostat and/or transfer lines once the cryostat is full and before installing the CRT panels.

**Mitigation:** Crane operation over the cryostat or transfer lines will be considered "Special Lift". This requires a written HA to be included and approved through IMPACT. Visual inspection of the rigging equipment will also be performed.

**Response plan:** Assessment of damages, development of an action plan with rigging experts and experts of all the systems involved.

| Risk Information |
|---|
| **Inherent Risk event:**<br>IF - the crane loses its load over the cryostat while the cryostat is full and top CRT layers are not in place<br>THEN - depending on the load weight, size, and position, the load fall could cause significant damages to the cryogenic piping, with resulting release of argon gas in the building, or damages to one of the detector feedthroughs with loss of power or readout to/from sections of the detector. |
| **Root Cause of the risk:**<br>Load not properly secured, mechanical failure of slings or other rigging equipment. |
| **Mitigation Actions already taken:**<br>Once the cryostat is full, any crane activity over the cryostat and cryogenic system will be treated as "Special Lift" per FESHM 10100. A dedicated HA for any crane activity in this condition will be written and approved through IMPACT. Visual inspection of all the rigging equipment utilized will be performed prior to each crane task. |
| **Assessment of Remaining Risk:**<br>Impacts: High Impact. Any serious damage to the cryogenic system may require emptying the detector. Any damage to the detector feedthrough may require several weeks to be fixed, halting data taking or heavily affecting its quality.<br>Frequency: Very Low Frequency, i.e. less than once in 10+ years. In addition, this risk will only be present for a short period of time (few months), until Top CRT modules are not installed.<br><br>**Risk Ranking: Moderate** |
| **Response Plan:**<br>Assessment of damages, development of an action plan with rigging experts and experts from all systems involved. |
| **Any Other Information:** |

# Risks

| Risk Title | Ranking | Impact | Frequency |
|---|---|---|---|
| TPC Drift HV - Excessive HV instability | Minor | VL | M |
| TPC Drift HV - Failure of HV drift hardware (cable, PS) | Minor | M | VL |
| TPC Drift HV - Failure of a Field Cage resistor circuit | Minor | M | VL |
| TPC - Cold Electronics power supply failure | Minor | VL | VL |
| TPC - Wire Bias power supply failure or voltage instabilities | Minor | VL | L |
| Photodetector - cold hardware failure | Minor | L | VL |
| Photodetector - warm hardware failure | Minor | VL | M |
| Photodetector - calibration hardware failure | Minor | L | L |
| Photodetector - Readout Hardware Failure | Moderate | L | M |
| Photodetector - Interlock System Failure | Minor | L | L |
| Failure of White Rabbit timing hardware | Minor | VL | L |
| Failure of MTC/A analog summing inputs for Trigger | Minor | VL | L |
| DCS loses connection to monitored devices | Minor | VL | M |
| DCS archiver software freeze | Minor | VL | H |
| CRT Front-end board failure | Minor | VL | L |
| CRT TIN/TOUT cable failure | Minor | L | VL |
| Loss of CRT PPS or T1 signals distribution | Minor | VL | L |
| CRT data cable failure | Minor | VL | VL |
| CRT Power Supply failure | Minor | L | VL |
| CRT SiPM short | Minor | M | VL |
| CRT electronics noise | Minor | L | L |
| Detector AC Power Transformer Failure | Minor | M | VL |
| Failure of Rack Protection hardware | Minor | L | VL |
| Crane incident while cryostat is full | Moderate | H | VL |
| Crane incident above top CRT layers | Minor | M | VL |
| High temperature in the mezzanine level | Minor | M | VL |
| Water in the building pit | Minor | L | L |
| Failure of cryogenics pumps or similar replaceable hardware | Minor | L | L |

The identified risks have mitigation plans and result in a residual risk of either **Minor or Moderate** ranking: the only two moderate ones were explored in this presentation.

Most identified risks to operations are **caused by hardware failures**, and most **mitigation** plans are **having sufficient spares** on hand so a situation of reduced data quality does not persist for very long.

A more detailed description of the spares identified for SBND can be found on the EOP.

The experiment has identified the spare parts needed for smooth operations, and has already most of them on hand.

# Summary

- The collaboration is well organized to go into Operations!
- We have identified experts leaders to each subsystem that will ensure smooth operations
- Operations Coordinator works with the DSO and ELO to coordinate activities
- We need continue lab support to be able to have more collaborators onsite for crucial roles.
- The Operations Team is already working together with the Commissioning Team

  - The Collaboration is already taking shifts!

- We have an organized plan for performing work at SBND building when needed
- The Operations Team will ensure all work is done on a safe way!
- Risks to operations have been identified and we have mitigation plans in place.