# LBNF Internal Cryogenics Supports Design

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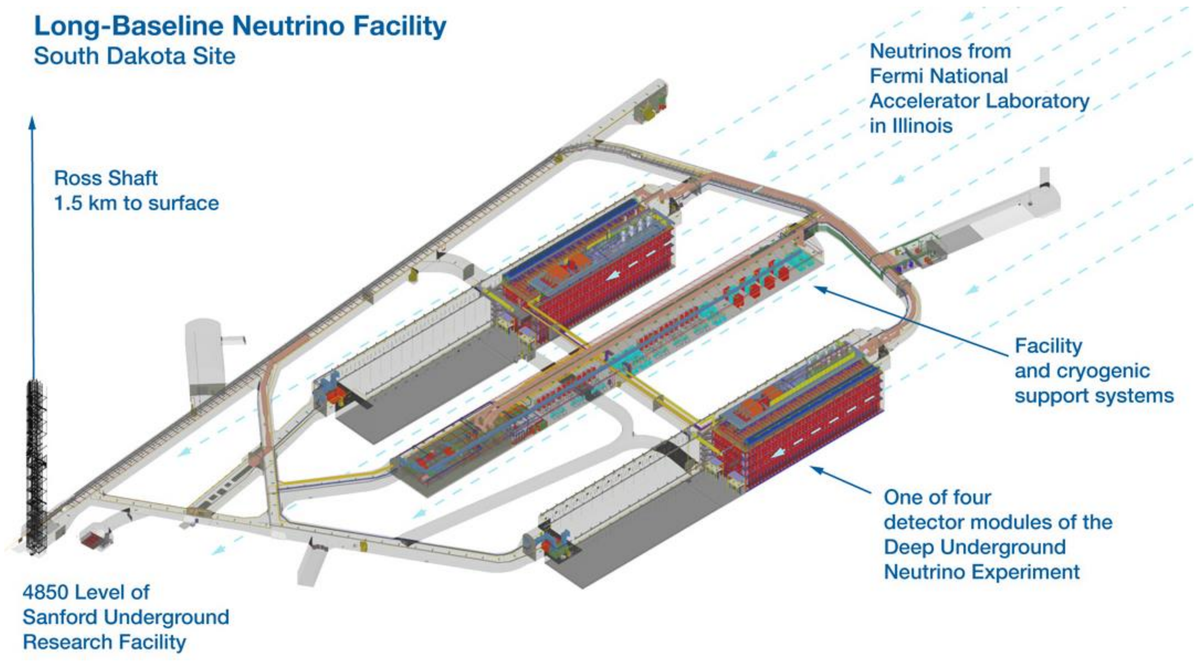
## Introduction

Internal Cryogenics is a part of the LBNF (Long Baseline Neutrino Facility) project. The Internal Cryogenics piping system (IC) is used to transfer liquid and gaseous argon (LAr and GAr, respectively) inside the LBNF Far Detector cryostats to purge them from their original atmosphere, cool them, fill them with LAr and recirculate this LAr from dedicated purification equipment.

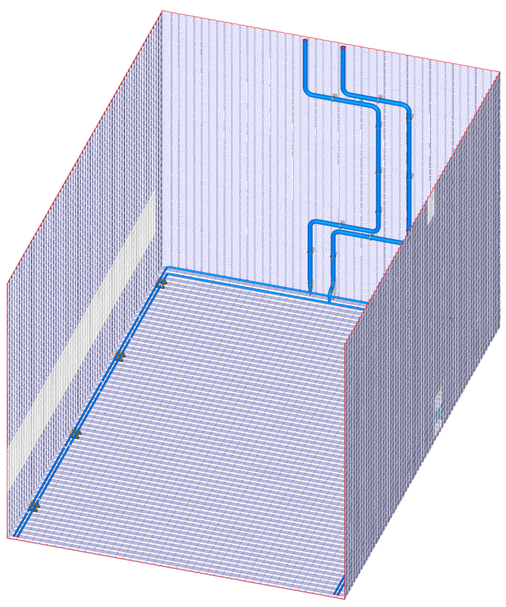



Long-Baseline Neutrino Facility Far Site

## Scope of the Project

The purpose of the project was to develop a conceptual design of the external supports for the Internal Cryogenics. There are numerous restriction on the design, as the supports have to be placed inside of a membrane cryostat. The most prominent ones are:

- No welding is permitted on the sides, ceiling, and floor of the cryostat – only in the top and bottom corners.
- No metal-metal contact is allowed.
- Each support has to be located between membrane corrugations and can never touch them.
- Piping thermal movement has to be compensated.



IC Piping inside of the membrane

## Methodology

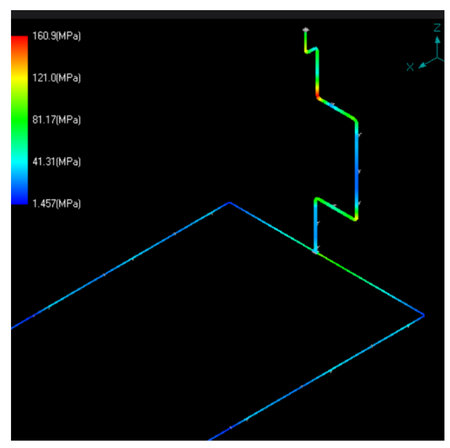
Based on the lessons learned from the ProtoDUNE, the design approach was selected. First, analyses of the forces acting on the piping, and system flexibility were performed. Pressure, temperatures, buoyancy, and gravity were all taken into consideration to inform the future design of the supports.

Following the calculations, few ideas for supports were created. Here, adherence to the specification, simplicity of the design and assembly, and cost were all considered.

## Results and Conclusions

### Forces Analysis

The forces analysis proved effect of the buoyant force is negligible and that the pipes will sink in the Argon. Therefore, the bottom supports will not float.



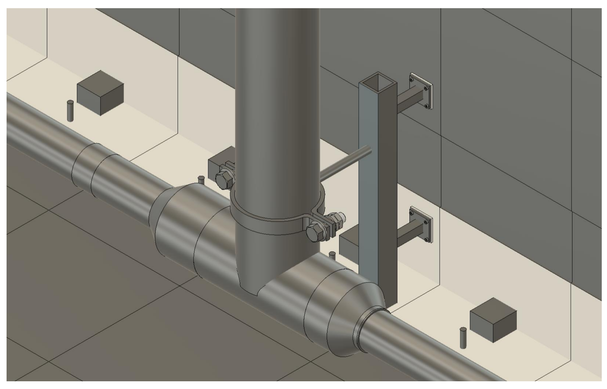

Flexibility analysis: stresses result

### Flexibility analysis

The flexibility analysis showed that it is necessary to have the corner support welded to the corner of the cryostat to serve as an anchor or a guide.

### Conceptual Design

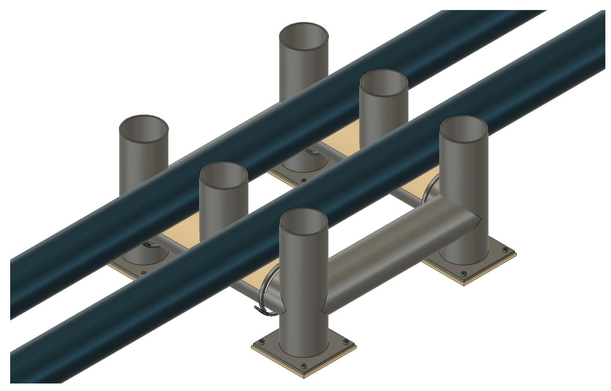
Informed by the calculations, the below designs were prepared:



IC corner support

- Up to two welding points
- Additional stabilizer with PTFE for the membrane contact
- Can serve as either guide or as an anchor

- Simple design
- No added buoyancy
- PTFE pads prevent metal-metal contact
- Height preventing piping shift out of the support



IC bottom support

## Acknowledgements

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