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## Development of cryogenic installations for large liquid argon based neutrino detectors

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A proposal for a very large liquid argon (40 kt) based neutrino detector is being studied. To validate the design principles and detector technology, and to gain experience in the development of the cryostats and the cryogenic systems needed for such large experiments, several smaller scale installations will be developed and implemented, at Fermilab and CERN.

A small-scale prototype (35 t) is already operational at Fermilab, while two larger-scale experiments (500 t each) will be developed, built and tested at CERN. In parallel, two other detectors will be developed, built and installed on a neutrino beam line at Fermilab: a Near Detector (260 t) at about 110 meter and a Far Detector (760 t) at about 600 meter from the target. The final experiment (ELBNF) will receive a neutrino beam from Fermilab and will be installed at the Surf Underground Research Facility in Lead, SD, situated at about 1300 km from Fermilab at about 1.5 km below ground level.

The cryogenic systems for these installations will be developed, constructed, installed and commissioned by an international engineering team. These installations shall bring the required cooling power under specific conditions to the experiments for the initial cool-down and the long term operation, and shall also guarantee the correct distribution of the cooling power within the cryostats to ensure a homogeneous temperature distribution within the cryostat itself. The cryogenic systems shall also include gaseous and liquid phase argon purification devices to be used to reach and maintain the very stringent purity requirements needed for these installations (parts per trillion of oxygen equivalent contamination).

This paper gives an overview of the installations involved in this cryogenic project, describes the functional demands made to these cryogenic systems and presents the initial studies on which these future cryogenic systems will be based.

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