LArTF and MicroBooNE Installation

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Outfitting Concerns for MicroBooNE

- Topics - -
  - Cryo safety and access to pit
  - Getting the tank installed and insulated
  - Service crane to the pit
  - Electrical service to detector elements set in place after the vessel is installed
  - Racks and Cabling for detector readout

Introduction

- The use of Liquid Argon as the basis of large scale neutrino detectors for future neutrino experimentation is under active investigation. A program of increasing scale liquid Argon detector development is scheduled at Fermilab, possibly leading to the use of a very large scale liquid Argon detector at a future site for long baseline neutrino research. A small detector has been installed, successfully operated, and removed in the MINOS Hall of the Fermilab NuMI beamline. *The next upscale of the liquid Argon program at Fermilab is the MicroBooNE experiment*, to be followed by studies of other alternative cryostat designs. It is proposed to operate these devices (serially) in a new facility to be constructed in the Fermilab Booster Neutrino Beam (BNB) just upstream of the existing MiniBooNE Facility, which is still active.

Interfaces to the Experiment - TDR

- The experimenters participating in the MicroBooNE Experiment have had significant input to the definition of the outfitting requirements.
- The principle repository of the requirements has been the MicroBooNE Experiment TDR. Chapter 5 of this document contains a list of the specifications that appear in the discussion presented by Chuck Federowicz.
- These specifications have been discussed and reviewed at numerous Collaboration Meetings of the experiment.

OD-Hazard considerations

- Initial ODH calculations were performed early in 2010, checked and re-done recently
- While various enclosure options were investigated, certain safety features were assumed in all options, based on prior experience with LAr installations
  - Containment area for spills
  - Ventilation to remove heavier-than-air gas
  - Safe areas to escape to (rated “no OD hazard present”, like the outside environment in some above-grade options, or over-pressured areas in buried options)
- ODH calculations
  - Verified that all these are needed to minimize the ODH classification
- The floor area around the MicroBooNE vessel won’t be ODH-0
  - Heavier-then-air argon sinks; expansion from liquid to gas far exceeds the vessel::building volume ratio
  - The nature of this detector requires pumps outside the vessel, located below the liquid level, and other cryo equipment is located nearby to minimize piping
  - Therefore, personnel access below the cryogen level is necessary

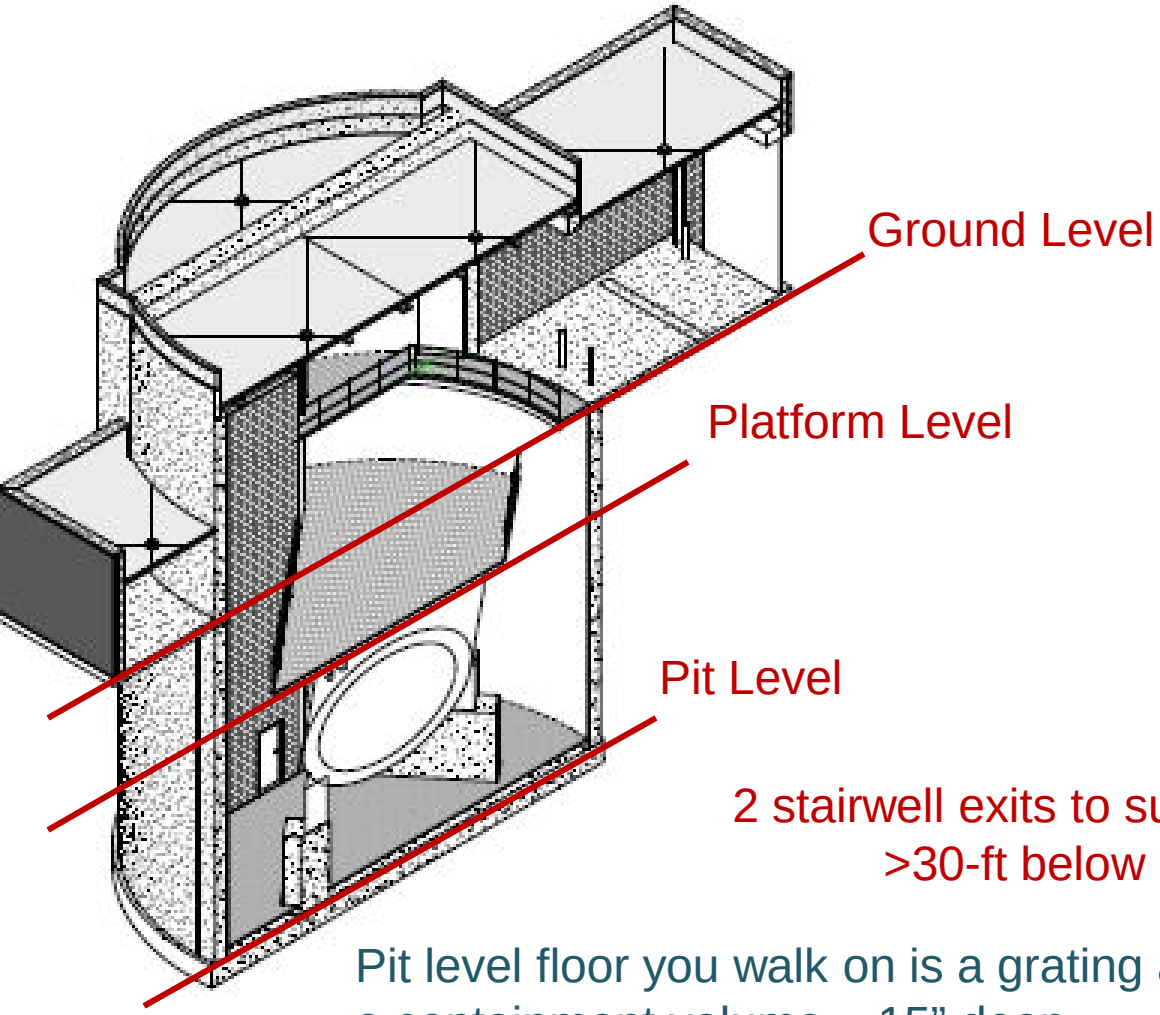
Safe operation in ODH area

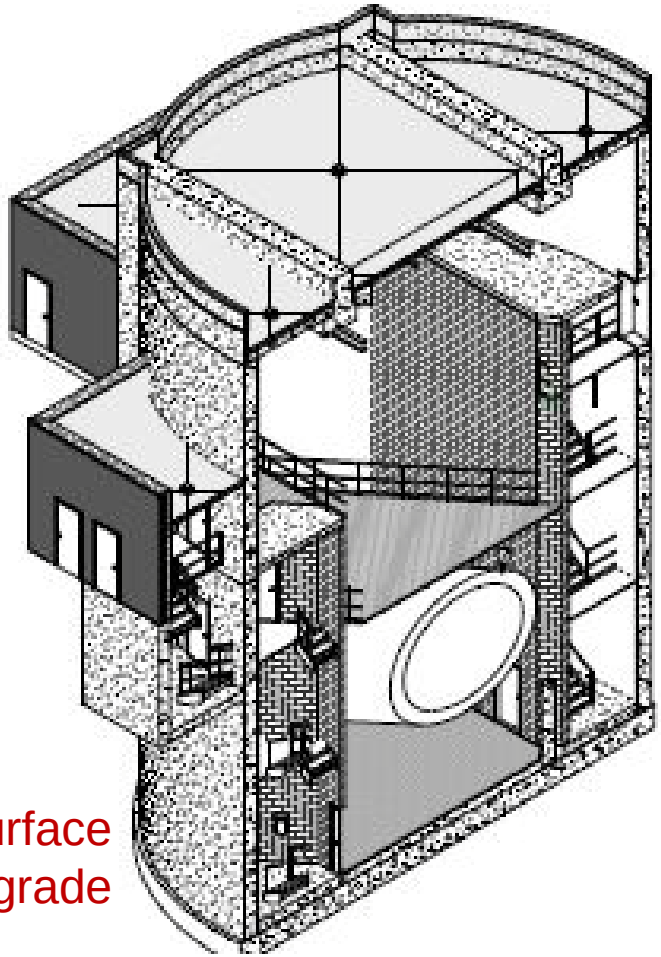
- For this enclosure configuration -
  - Provide a safe area, reachable from all levels of the enclosure, as close as possible to work areas
    - Escape stair – over-pressured to keep argon from seeping in
    - Transit time estimated to be 45-30 seconds, from anywhere on the pit floor to any door in the stairwells
  - Provide a duct, from pit floor to outside, with fans which can remove argon which has leaked and stratifies near the floor. Fans are triggered by oxygen monitors on the floor
    - Grating above the pit floor is what people walk on – covers an insulated containment volume
  - For the worst case spilling/leak (broken pipe), the ODH analysis provides the oxygen concentration versus time. [...can people reach a safe area before being overcome..]
    - Calculations show it takes ~4 minutes to get to a minimum-steady-state level of oxygen at the pit floor, level ~ 12% O2. Falls rapidly, from 21% to below 18%, in the first 60 sec
    - Both longer than it takes to reach the stairwell
  - Backup generator to keep the ventilation systems in stairwells and argon removal, as well as alarms and ODH sensors
    - All of these have failure rates too, all factored in to the final ODH calculations

ODH Interlocks; Access

- An interlock system must be developed that will prevent access if the systems necessary for maintaining ODH-1 conditions in the pit are not functioning.
- Building access will be into the electronics room where a wall surface is reserved for the interlock system.
  - Air quality must be sampled and acceptable.
  - The over-pressurization of the stairs must be operational.
  - The high flow exhaust fans must be capable of operation.
  - The stair doors must not remain open.
- The Fermilab Cryo Safety Committee and Fermilab ES&H Section will review the system.

Geographical Features of LADTF





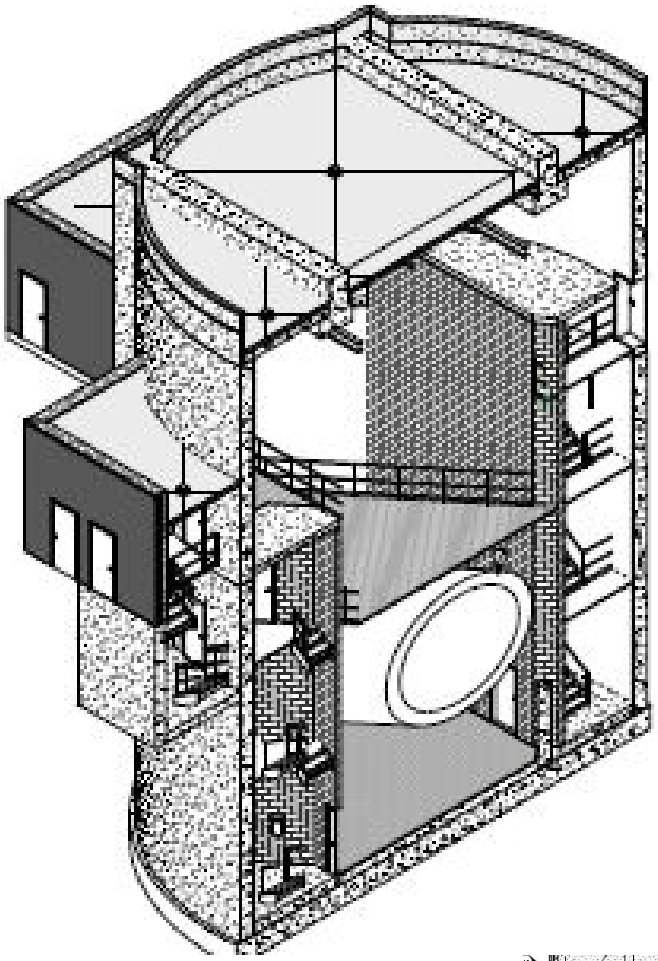
2 stairwell exits to surface
>30-ft below grade

Pit level floor you walk on is a grating above a containment volume – 15” deep

Installing MicroBooNE

- Below-grade structure
  - Sufficient width for the vessel
  - "stacked" arrangement
    - Cryogenics lowest, then vessel, then readout; a separate room for DAQ is on the surface
  - Vessel lowered through the roof
    - Roof is designed in two removable sections which are easily weather-proofed after remove/replace operation
    - Concrete beams bridge above the removable sections, sized to carry additional shielding, if subsequent data-taking indicates a need
    - Use truck crane –
      - Remove beams and roof sections
      - Install vessel supports and vessel
      - Replace roof sections – weatherproof – replace beams

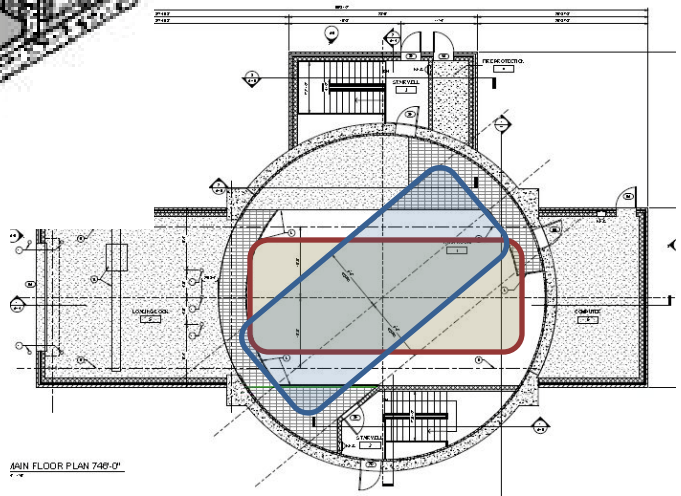
Installing Vessel



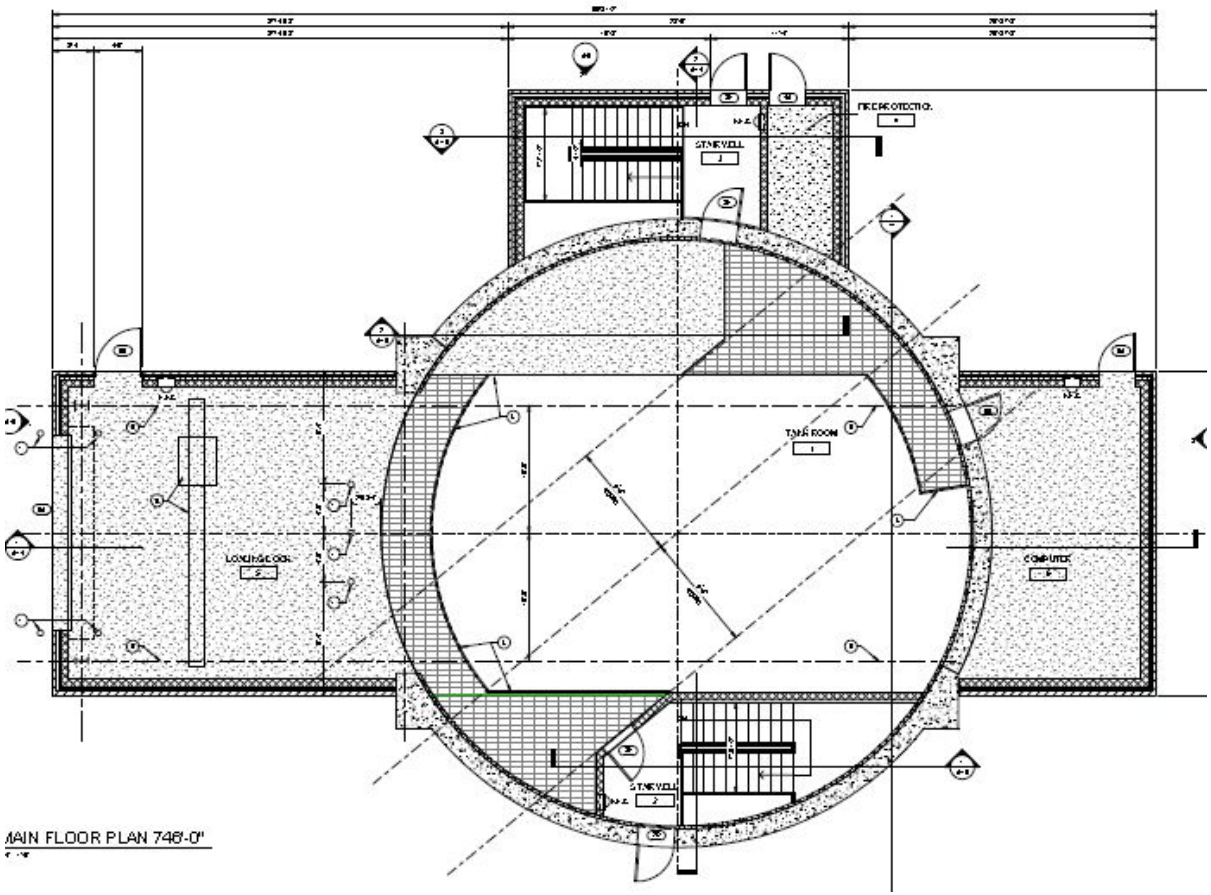
Roof is removable in two sections
The seam between the sections is the only part which gets “re-weather-proofed”

Rectangular removable sections are large enough to accommodate MicroBooNE vessel

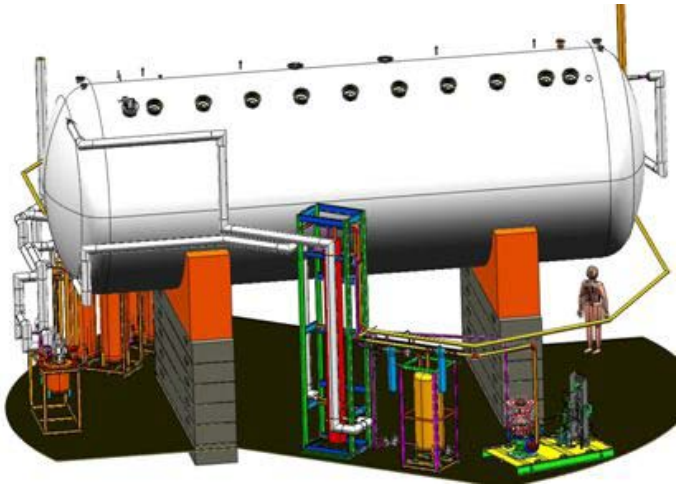
Vessel is rotated from the long axis of the roof opening - - this is done to allow the building crane to reach the pit floor, needed for servicing of cryogenics equipment

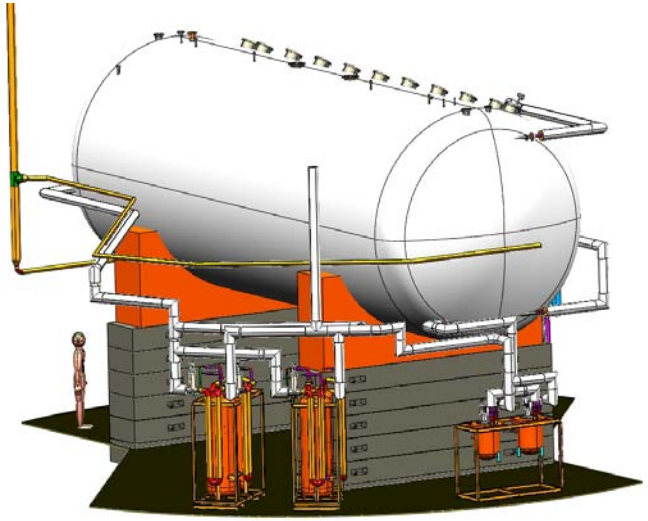


Grond-level view



Cryogenics Installation



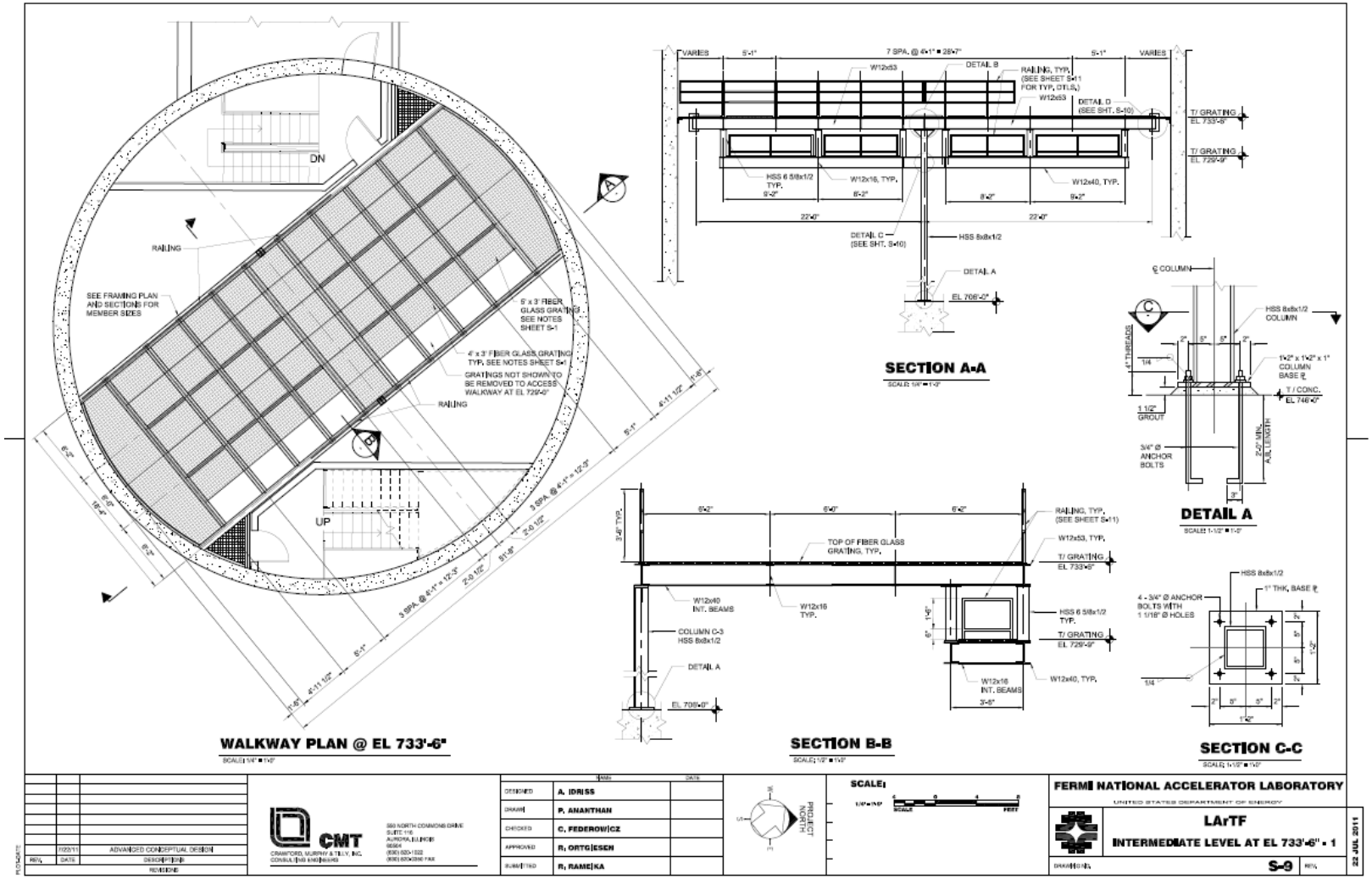


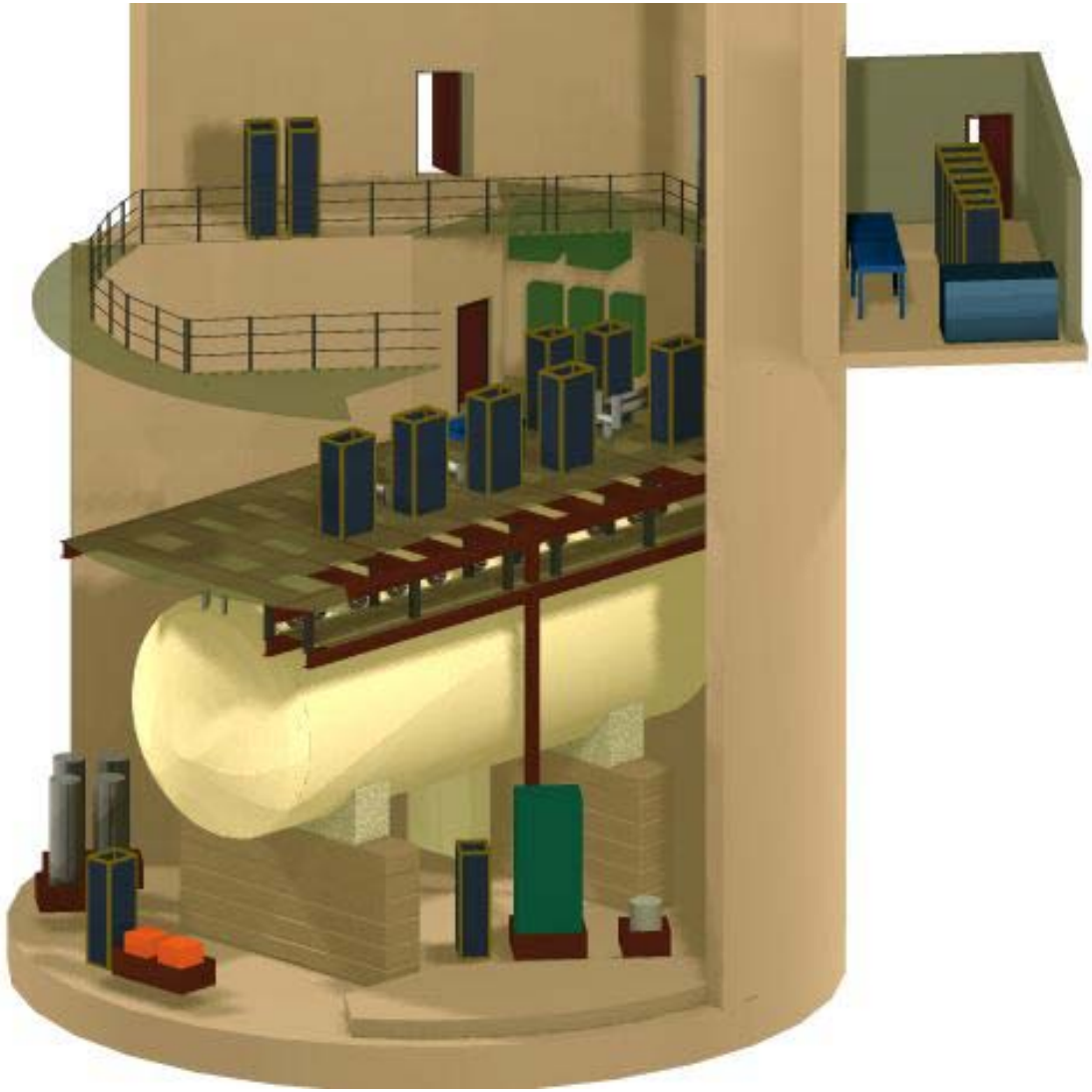
- Pre-assembled units
  - Components on skids
    - Liquid pumps, liquid filters, gas heat exchanger, gas condenser
  - Sections of piping
    - Input lines, vent manifold
- Connections between these made after the vessel is in place
- Use 3-D modeling to help determine the break points; the number of welds performed in the enclosure has a direct link to the determination of the cryogenics installation

Racks and Cabling design

- Platform arrangement above vessel
  - Need access to the detector feed-throughs, during installation and also during operations
  - Platform is part of civil construction contract
  - Removable in two sections – can be handled by the enclosure's 5-ton crane
  - Rack placement and cabling plan worked out in advance
  - These go in place after the vessel and the pre-assembled cryogenics sections are in

The Walkways at El 733’6”





Platform design by civil A&E and fabricated as part of the civil construction

Bi-level platform – lower level located for access to the detector feed-throughs

Platform holds racks serving both the detector readout and cryogenics monitors and controls

Safety relief valves are accessed from the platform, as are the vacuum pump-out ports

Interfaces to the Experiment – Interface sign-off; Schedule; Engineering

- The cryogenics and installation WBS Managers have signed "interface documents" with the enclosure design. These documents state that they have read the enclosure description and specs in the TDR and they agree that the specifications and drawings available are consistent with the requirements of their WBS.
- The schedule developed for construction has been integrated into the MicroBooNE Project schedule. In particular the schedule for the delivery of the cryostat has been coordinated.
- The MicroBooNE Project Electrical Engineer has participated in the definition of the building electrical drawings.