

Chapter 9

Prototyping Strategy

9.1 Overview

This chapter describes the prototyping strategy for the DUNE far and near detectors and the efforts that are underway or being planned. The efforts include:

- The 35-ton prototype at Fermilab
- The single-phase LArTPC prototype at CERN
- The dual-phase LArTPC prototype known as WA105
- The near detector Beamline Measurements prototype (for the detector described in 7.5)

The three far detector prototyping efforts, the 35-ton, the CERN single-phase, and WA105, have evolved from the plans made initially for LBNE (as described in Chapter 7 of Annex 4A: The LBNE Design for a Deep Underground Single-Phase Liquid Argon TPC). At the time the LBNE document was written, the 35-ton cryostat was not yet fabricated; the section below in this chapter provides a summary of the 35-ton past and near future operations. The 1-kton prototype for LBNE has been replaced by the DUNE single-phase LArTPC prototype at CERN; it is summarized below and fully described in its proposal (Annex 4I: CERN Single-phase Prototype Detector Proposal). Following the overall DUNE far detector strategy outlined in Chapter 2 of this volume, the WA105 dual-phase LArTPC prototype will also operate at CERN; this detector is summarized below and described in detail in Annex 4H: WA105 TDR.

Each of these prototypes will provide guidance on procurement strategies, vendors, construction and installation techniques, as well as on refinement of the designs, operations procedures, data handling, and data analysis tools.

9.1.1 Connections to the Short-Baseline Program at Fermilab

The prototyping plans made by LBNE were in turn a part of a larger LArTPC detector development program at Fermilab and elsewhere in the U.S., which are summarized in Chapter 7 of Annex 4A: The LBNE Design for a Deep Underground Single-Phase Liquid Argon TPC and fully described in the *Integrated Plan for LArTPC Neutrino Detectors in the U.S.* This detector development plan has largely been fulfilled, with an endpoint represented by the experiments which comprise the

1 short-baseline program at Fermilab on the Booster Neutrino Beamline : MicroBooNE, the Short-
2 Baseline Near Detector, and ICARUS. Each of these detectors shares some technical elements with
3 each other and/or with the DUNE far detector prototypes. Elements such as :

- 4 • cryogenic system design
- 5 • argon purification techniques
- 6 • cold electronics

7 In other aspects however the detectors are very different – in the design details of the anode wire
8 planes for example. The Short-Baseline Near Detector is most similar to DUNE detectors, having
9 adopted the 35-ton APA-CPA-Field Cage design.

10 The Fermilab LArTPC detector development program also included a calibration detector and
11 reconstruction software development. The planned calibration detector has become the Liquid
12 Argon In A Test Beam program (LArIAT) which has recently begun operations in the Meson
13 Center beamline. The LArSoft software is a set of configurable packages designed to reconstruct
14 the data from any liquid argon detector. It is supported by the Fermilab Scientific Computing
15 Division and has contributors from all of the operating and planned LArTPC experiments at
16 Fermilab.

17 COMMENT FROM REVIEWERS There appeared to be no author assigned to write either an
18 overview or SBN-Connections sections; so the reviewers took a stab at it. Ask forgiveness rather
19 than permission.

20 An earlier version of this overview was entered to the Contributions library on Apr 30; that
21 version received useful feedback. This version is a next attempt – much shorter. Probably needs
22 further work.