

ProtoDUNE Overview and Update on Organization

Eric James
LBNC Meeting
23 March – 25 March 2017

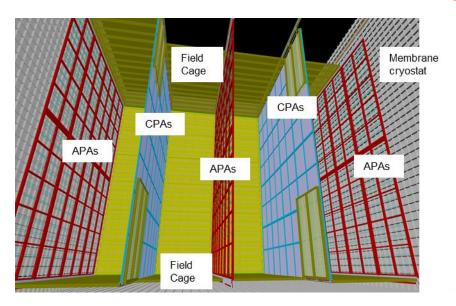


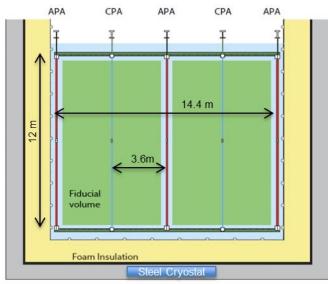
DUNE Project Scope

- Design, construct, and install four 10-kton fiducial mass Liquid Argon detectors for operation within the deep underground area of the Sanford Underground Research Facility (SURF) in South Dakota.
- Design, construct, and install a near neutrino detector underground at Fermilab to provide the necessary inputs for constraining systematic uncertainties on the precision measurements to be extracted from the deep underground detectors.

Note: conventional facilities, beamline, and cryogenics infrastructure are within scope of the LBNF project

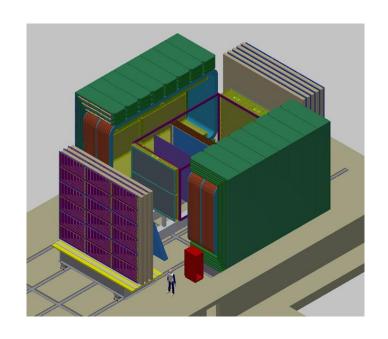
Far Detector Conceptual Design

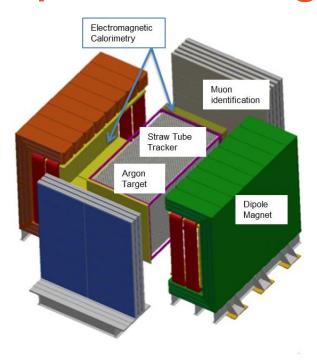




- Detector Parameters (One 10-kton Module)
 - 58 m x 12 m x 14.4 m (~50 times larger than ICARUS)
 - Alternating Anode and Cathode Plane Assemblies resulting in four 3.6 m drift volumes
 - Modular design to facilitate underground transport and installation

Near Detector Conceptual Design





- Detector Parameters
 - 3.5 m x 3.5 m x 7 m Straw Tube Tracker
 - 4π electromagnetic calorimetry and muon ID in dipole B field (0.4T)
 - Pressurized Argon Target

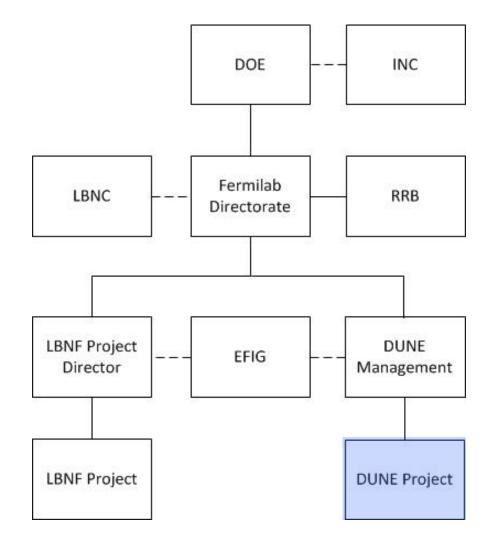


DUNE Project

- DUNE is an international project managed by the DUNE collaboration incorporating some DOE contributions
 - Roughly 25% DOE / 75% non-DOE



Steve Kettell: DUNE Project Coordinator



Detector Requirements

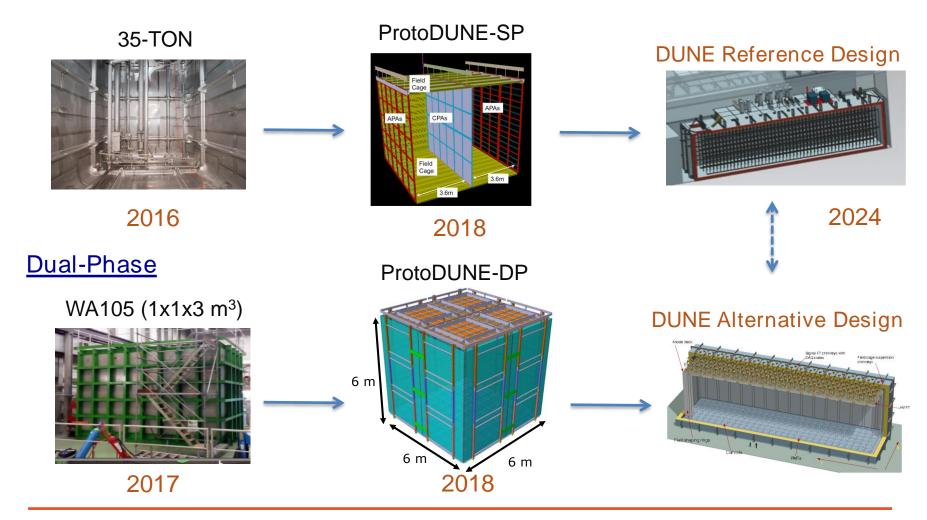
- Requirements on the detectors are derived from the high-level scientific requirements
- A well-developed set of detector requirements was in place at the time of CD-1R.
- Since then, we have reviewed and updated far detector module engineering requirements (focusing on the global requirements with direct tracebacks to the scientific requirements)
- Updated requirements documentation can be accessed directly from the review website (<u>link</u>).

DUNE Collaboration Priorities

- Construction and operation of the ProtoDUNE detectors at CERN
- Preparation of the DUNE Technical Design Reports (TDRs)
 - Needed for at least the first two far detector modules by early 2019
 - Must be accompanied by credible funding model for detector construction
- These are the key activities that get DUNE to the planned installation of the first 10-kton far detector at SURF in the early 2020's and ensure its leadership position within the international landscape for the CP-violation measurements

DUNE Far Detector Prototyping

Single-Phase



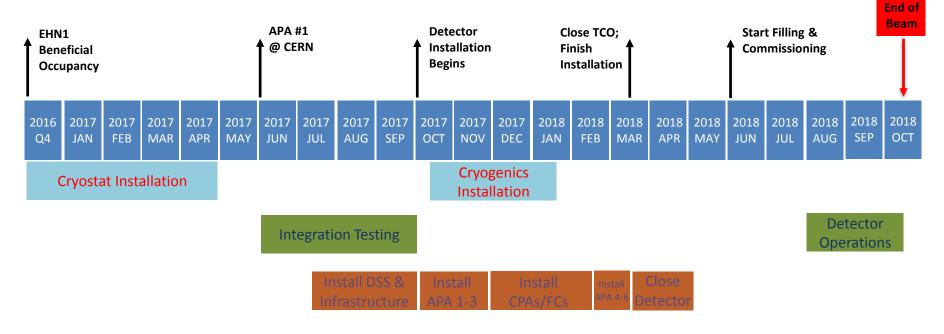
ProtoDUNE Goals

- Mitigation of risks associated with current detector designs
- Prototyping of construction facilities needed for production of detector components
 - ProtoDUNE detectors are assembled from same full-scale components used to construct the far detector modules
- Early detection of potential issues with construction methods and detector performance
- Obtaining required calibration of detector response to particle interactions in test beam

New document summarizing objectives of the ProtoDUNE program in the context of baselining the Far Detectors (DUNE DocDB #2765)



ProtoDUNE-SP Schedule



ProtoDUNE-DP schedule looks similar

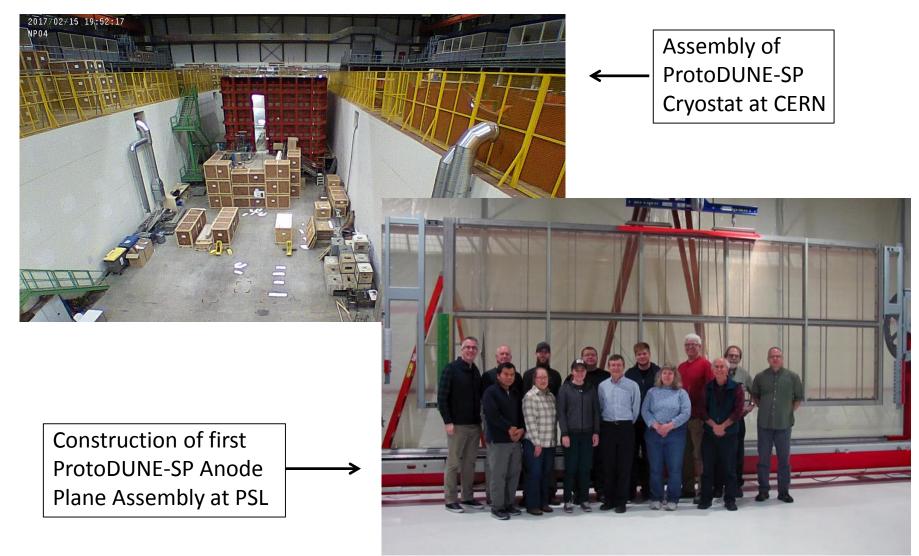


Design Reviews

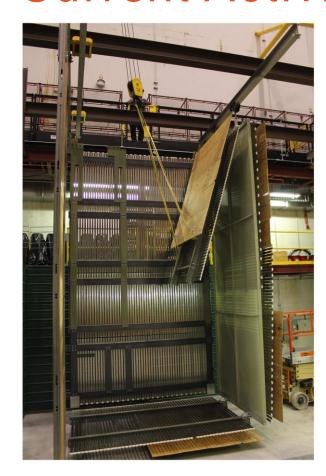
 Over the past year the project has conducted a series of reviews incorporating external reviewers focused on the designs of the different ProtoDUNE subsystems

Subsystem	Design Review
Anode Plane Assemblies (SP)	July 13-14 2016 (PSL)
Cathode Plane Assemblies, Field Cage Assemblies, and HV (SP)	November 9-10 2016 (CERN)
DAQ (SP)	November 3-4 2016 (CERN)
Photon Detector (SP)	August 2-3 2016 (Chicago)
Cold Electronics (SP)	October 12-14 2016 (BNL)
Detector Support Structure (SP)	November 7-8 2016 (CERN)
Dual-Phase Design	April 24-25 2017 (CERN)
Cryo/Beam Instrumentation (SP)	April 26-27 2017 (CERN)

Current Activities I



Current Activities II









ProtoDUNE-SP Integration Tests



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Current Activities III

Operation of DP 1x1x3 m³ Prototype





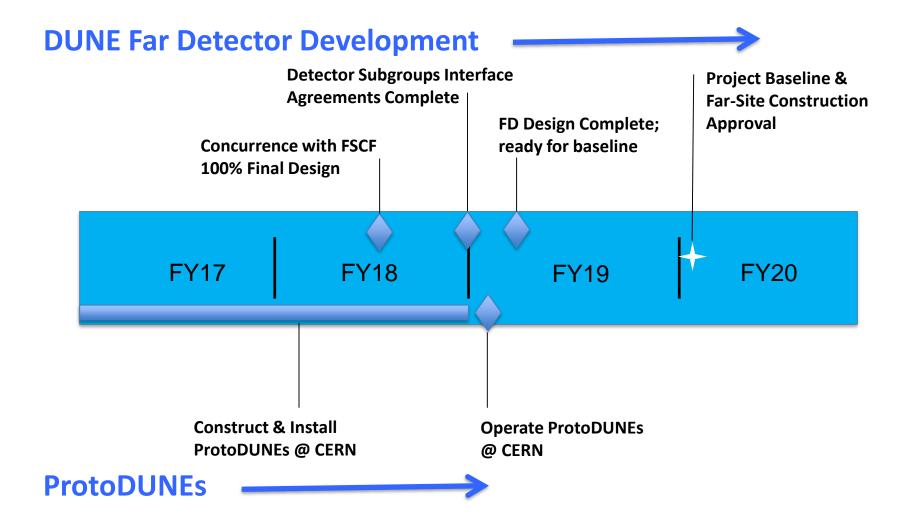


Iceball, which formed on outside of steel support structure during gas cooling, has delayed beginning of operations (more details in subsequent presentations)



03.23.17

Path to Technical Design Reports





ProtoDUNE Construction

- Construction of detector components is now underway and will continue through end of 2017
- Current project focus is on Production Readiness Reviews (PRRs) for each of the major components
 - Main focus of these reviews is formal, written QA/QC plans for the construction activities
 - Chaired by the DUNE QA Manager
 - The first of these reviews took place in late February targeting construction of the ProtoDUNE-SP Cathode Plane Assemblies
 - QA Manager will conduct on order of 20 such reviews between now and the beginning of June

ProtoDUNE Installation

- Completed detector components will be shipped to CERN starting in May 2017
- Large, on-site teams required to install, commission, and operate the ProtoDUNE detectors
 - The organization of the ProtoDUNE-SP team has been a major focus of both the collaboration and project over the past year
 - Project has worked with Fermilab and the DOE to identify operations resources needed to support this large team on the ground at CERN
- The on-site ProtoDUNE-SP team also has responsibility for the detector DAQ system and several auxiliary detector systems as well as data reconstruction and analysis

ProtoDUNE 09 FFB 17 DUNE ProtoDUNE SP Neutrino Platform Coordinators: Coordinator Flavio Cavanna (FNAL) Marzio Nessi (CERN) Christos Touramanis (Liverpool) Regina Rameika (FNAL-Construction) Prompt Reconstruction EHN1 Coordinator: Filippo Resnati (CERN) Engineering Intergration: Jack Fowler (Duke) Maxim Potekhin (BNL) Computing Liason: Ruth Pordes (FNAL) Brett Viren (BNL) Detector Integration, Cosmic Muon Tagging: Cryogenics & Argon Instrumentation Cryostat Testing, and Installation DAO Coordinators: Ed Blucher (Chicago) Coordinator: Roberto Acciarri (FNAL) Stephen Pordes (FNAL) Jonathan Link (Virginia Tech) Coordinators: Data Reconstruction and Analysis Anselmo Cerbera (Valencia) Karol Hennessy (Liverpool) Installation Team Leader: Coordinators: Giovanna Lehmann Miotto (CERN) Internal Cryogenics & Cryomeasurements Josh Klein (Penn) Bill Miller (Minnesota) Ream Configuration and External Instrumentation (Joint SP/DP Working Thomas Kutter (Louisana) Run Control/Systems Monitor Leader Integration/Test Coordinator: Alan Hahn (FNAL) Cryogenics Detector Construction Wesley Ketchum (FNAL) Robert Sulej (FNAL/NCBJ) Andrea Zani (CFRN) Group) Cryogenics Operation PTL Electrical/Cabling Coordinator: Coordinator: Regina Rameika (FNAL) Data Monitoring Leader: Calibration Leader Coordinators: Yannis Karyotakis (LAPP) Jonathan Paley (FNAL) Monitor Leader Flor Blaszczyk (BU) Antonino Sergi (Birmingham) Igor Kreslo (Bern) APA Construction Leader: Xavier Ponas (CERN) Computing Infrastructure Coordinator: Paola Sala (CFRN) Bob Paulos (PSL) Reconstruction Leader: artDAQ Leader: Geoff Savage (FNAL) LAr Vertical Temperature Detector Alan Grant (Daresbury) Dorota Stefan (CERN/NCBJ) Kurt Biery (FNAL) Grounding & Shielding Coordinator: Monitor Leader: Infrastructure Slow Controls Linda Bagby (FNAL) Jelena Maricic (Hawaii) HV/CPA/FC Construction Leader: Photon Detector Readout Leader: Detector Performance (Joint SP/DP Working Victor Gaurino (ANL) Safety Coordinator: Measurements Leader: Group) Martin Haigh (Warwick) LAr Purity Monitor Leaders: Olga Beltramello (CERN) Bruce Baller (FNAL) Jiaming Bian (UC-Irvine) Coordinators: Anslemo Cervera (Valencia) Photon Detector Construction Leader: RCE TPC Readout Leader: Andrew Renshaw (Houston) Leon Mualem (CalTech) Physics Measurements Leader: Yann Rigaut (ETHZ) Giovanna Lehmann (CERN) Mathew Graham (SLAC) APA Commissioning Leaders: GAr Purity Analyzer Leader: Cold Electronics Construction Leader: Andrzei Szelc (Manchester) FFLIX TPC Readout Leader Matt Worcester (BNL) Serhan Tufanli (Yale) Simulation and MC Production Frank Filthaut (NIKHFF) Leaders: Cryogenic Systems and Cryostat Internal Cameras Leader: Leigh Whitehead (CERN) Detector Support Structure Trigger System Leader: HV/CPA/FC Commissioning Leaders: Mike Kordosky (William & Mary) (Joint SP/DP Working Group) Dan Wenman (PSI) Josh Klein (Penn) Anan Mazzacane (FNAL) Francesco Pietropaolo (CERN) Kevin Wood (SBU) Instrumentation Readout Leader: Timing System Leader: Coordinators: Flor Blacszcyk (Boston) Sarah Lockwitz (FNAL) David Newbold (Bristol) Laura Manenti (UCL) David Montanari (FNAL) Stephen Pordes (FNAL) Beam Plug Commissioning Leader: Ash River Trial Assembly Cheng-Ju Lin (LBNL) William Miller (UNM) Photon Detector Commissioning Leader: HV Delivery (Joint SP/DP Working Group) DAB Electronics Ettore Segreto (Campinas) Linda Bagby (FNAL) Photon Electronics Commissioning Leader: Coordinators: Zelimir Djurcic (ANL) Cold Electronics Commissioning Leaders: Carl Bromberg (MSU) Matt Worcester (BNL) Muon Tagging Detector Commissioning Leaders: **Detector Construction** Steve Manly (Rochester)



Camillo Mariani (Virginia Tech)

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Detector Installation/Commissioning



Muon Tagging Detector Commissioning Leaders:

Steve Manly (Rochester) Camillo Mariani (Virginia Tech)

09.FEB.17 DUNE ProtoDUNE SP Neutrino Platform Coordinators: Coordinator: Flavio Cavanna (FNAL) Marzio Nessi (CERN) Christos Touramanis (Liverpool) Regina Rameika (FNAL-Construction) Prompt Reconstruction FHN1 Coordinator: Filippo Resnati (CERN) Coordinators: Maxim Potekhin (BNL) Brett Viren (BNL) Engineering Intergration: Jack Fowler (Duke) Computing Liason: Ruth Pordes (FNAL) Detector Integration. Cosmic Muon Tagging: Cryogenics & Argon Instrumentation Cryostat Testing, and Installation Coordinators: DAO Coordinators: Ed Blucher (Chicago) Jonathan Link (Virginia Tech) Coordinator: Roberto Acciarri (ENAL) Stephen Pordes (FNAL) Data Reconstruction and Analysis Coordinators: Anselmo Cerbera (Valencia) Karol Hennessy (Liverpool) Installation Team Leader: Giovanna Lehmann Miotto (CERN) Coordinators: Internal Cryogenics & Cryomeasurements Bill Miller (Minnesota) Josh Klein (Penn) Beam Configuration and leader: Thomas Kutter (Louisana) Integration/Test Coordinator: Run Control/Systems Monitor Leader Cryogenics Alan Hahn (FNAL) (Joint SP/DP Working Detector Construction Robert Sulej (FNAL/NCBJ) Wesley Ketchum (FNAL) Andrea Zani (CERN) Electrical/Cabling Coordinator: Cryogenics Operation PTL Coordinator: Regina Rameika (FNAL) Calibration Leader: Data Monitoring Leader: Monitor Leader: Yannis Karyotakis (LAPP) Jonathan Paley (FNAL) Flor Blaszczyk (BU) Igor Kreslo (Bern) Antonino Sergi (Birmingham) Xavier Ponas (CERN) APA Construction Leader: Computing Infrastructure Coordinator: Paola Sala (CERN) Bob Paulos (PSL) artDAQ Leader: Reconstruction Leader: Geoff Savage (FNAL) LAr Vertical Temperature Detector Alan Grant (Daresbury) Kurt Biery (FNAL) Dorota Stefan (CERN/NCBJ) Grounding & Shielding Coordinator: Monitor Leader: Infrastructure Jelena Maricic (Hawaii) Linda Bagby (FNAL) HV/CPA/FC Construction Leader: Detector Performance Photon Detector Readout Leader: Victor Gaurino (ANL) Safety Coordinator: Measurements Leader: Martin Haigh (Warwick) Group) LAr Purity Monitor Leaders: Bruce Baller (FNAL) Olga Beltramello (CERN) Jiaming Bian (UC-Irvine) Coordinators Photon Detector Construction Leader: RCF TPC Readout Leader: Anslemo Cervera (Valencia) Yann Rigaut (ETHZ) Giovanna Lehmann (CERN) Andrew Renshaw (Houston) Leon Mualem (CalTech) Physics Measurements Leader: Mathew Graham (SLAC) APA Commissioning Leaders: Andrzej Szelc (Manchester) GAr Purity Analyzer Leader: Cold Electronics Construction Leader: FELIX TPC Readout Leader: Serhan Tufanli (Yale) Simulation and MC Production Matt Worcester (BNL) Frank Filthaut (NIKHEF) Leaders: Cryogenic Systems and Instruementation (Joint SP/DP Working Cryostat Internal Cameras Leader: **Detector Support Structure** Leigh Whitehead (CERN) HV/CPA/FC Commissioning Leaders: Trigger System Leader: Mike Kordosky (William & Mary) Anan Mazzacane (FNAL) Josh Klein (Penn) Francesco Pietropaolo (CERN) Kevin Wood (SBU) Instrumentation Readout Leader: PC4 HV test Timing System Leader: Coordinators: Laura Manenti (UCL) Flor Blacszcvk (Boston) Sarah Lockwitz (FNAL) David Newbold (Bristol) Beam Plug Commissioning Leader: David Montanari (FNAL) Stephen Pordes (FNAL) Ash River Trial Assembly Cheng-Ju Lin (LBNL) William Miller (UNM) Photon Detector Commissioning Leader: HV Delivery (Joint SP/DP Working DAB Electronics Ettore Segreto (Campinas) Linda Bagby (FNAL) Coordinators: Sarah Lockwitz (FNAL) Laura Molina (FNAL) Photon Electronics Commissioning Leader: Zelimir Diurcic (ANL) Cold Electronics Commissioning Leaders: Carl Bromberg (MSU) Matt Worcester (BNL) Muon Tagging Detector Commissioning Leaders: Steve Manly (Rochester) Detector DAQ Camillo Mariani (Virginia Tech)



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Auxiliary Detectors



Commissioning Leaders:

Steve Manly (Rochester) Camillo Mariani (Virginia Tech)

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Far Detector Development

- Concurrent with the construction and installation of the ProtoDUNE detectors, the project needs to remain focused on a number of key activities related to design of the far detector modules
- In particular,
 - The layout of penetrations on top of first far detector cryostat needs to be finalized by this summer to keep design work on schedule
 - Interfaces between the detector and conventional facilities need to be iterated on in conjunction with final design work for far site facilities
 - Further development of detector installation and integration plan needs to occur on the time scale of the TDRs



Milestones

- DUNE Project Office will maintain a milestone-driven schedule covering all detector activities
- An initial version of this schedule focusing on the ProtoDUNE activities (both SP and DP) has been developed over the past year
- ProtoDUNE milestones are updated regularly based on the statusing of this schedule

ProtoDUNE milestone-driven schedule can be found in DUNE DocDB #2202

Risks

- DUNE Project Office will maintain a risk registry for the overall detector construction effort and be responsible for ensuring risk management across the project
- Risk registries are in place for both ProtoDUNE-SP and ProtoDUNE-DP
- Review of ProtoDUNE-SP risks at February 3rd workshop (similar workshop for ProtoDUNE-DP planned for April)

ProtoDUNE-SP and ProtoDUNE-DP risk registries can be found in DUNE DocDB #2320

Review Recommendations

- DUNE Project Office also takes responsibility for acting on and responding to LBNC recommendations that pertain to the detector design and construction efforts
- Similarly, takes responsibility for acting on internal design review recommendations

Summary of tracked LBNC recommendations can be found in DUNE DocDB #2750

ES&H and QA

- ES&H and QA Managers are shared resources of LBNF, DUNE-US, and DUNE Project Offices
- Both are participating in ProtoDUNE design and Production Readiness Reviews
 - Production readiness reviews chaired by QA manager
- ES&H manager working closely with CERN ES&H team to ensure that delivered ProtoDUNE detector components can be installed and operated at CERN
 - Working to establish equivalencies between US & European standards (e.g. for evaluating cables as to whether they meet fire safety requirements)

Summary

- DUNE is focused on its highest priority near-term objectives
 - Operating the ProtoDUNE detectors at CERN in 2018
 - Preparing Technical Design Reports for the first two far detector modules in advance of far detector baselining in 2019
- Collaboration resources are being focused on these two parallel efforts

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