Planning Through to FDR

Recognition that the engineering effort in the previous (CDR era) schedule from PDR->end design is insufficient.

There is a window for us to increase our effort here, requires us to complete a new Project plan and schedule (P6).

Thank you for the information you have provided!

What follows is an attempt to summarize what we have received.

Prototyping Plan - Electronics

Electronics – Two Test Stands

- FEB Electronics Power Distribution to Readout (Pitt – VP + student, Eng support)
- Interface between the module/SiPM to the FEBs (LSU – TK, EE C. Domangue, D. Gomez)

Key focus tasks include:

- check p.e. resolution in ToT mode
  - verify non-linearity of ToT compared to calorimetry mode
- check high rate data acquisition capabilities and impact on dead time
- verify trigger configurations with multiple DT 5202 units daisy chained to DT5215
  - global (beam) trigger
  - self trigger
- check DT5202 compatibility with magnetic field
  - establish performance criteria and compare performance w/o and w/ magnetic field of various strengths (stray field versus in between steel plates)
- investigate slow control options/capabilities
  - check possibility of controlling LED flasher through DT5215

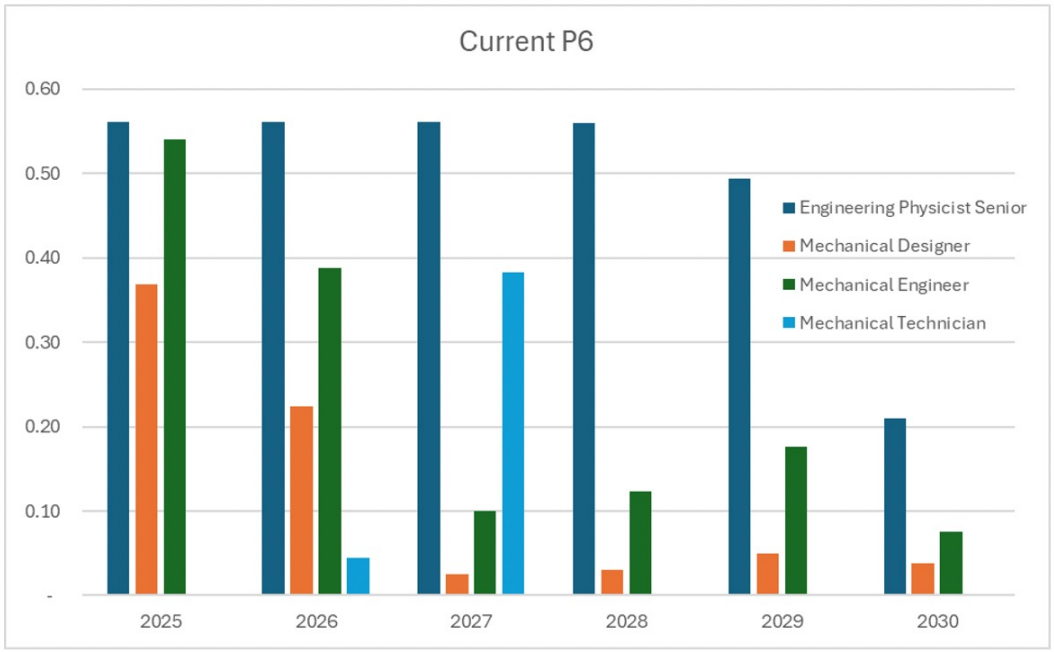
Revised planning

Work Package.WBS (4)	Resource	2025	2026	2027	2028	2029	2030	New Total [FTE]	Old Total [FTE]	New-Old
131.ND.04.01 ND Muon Spectrometer Management	LBN_FNALP_MCH_DS Mechanical Designer - SLAC	-	-	-	-	-	-	-	-	-
	LBN_FNALP_MCH_EN Mechanical Engineer - SLAC	-	-	-	-	-	-	-	-	-
	LBN_FNALP_PHYST Physicist - SLAC (DOE)	-	-	-	-	-	-	-	-	-
	LBN_FNSL_P_ENG_PHYST Engineering Physicist - SLAC	-	-	-	-	-	-	-	-	-
	LBN_FNSL_P_ENG_PHYST_SR Engineering Physicist Senior - SLAC	0.56	0.56	0.56	0.56	0.49	0.21	2.95	2.95	-
	LBN_FNSL_P_MECH_DES Mechanical Designer - SLAC	-	-	-	-	-	-	-	0.21	(0.21)
	LBN_FNSL_P_MECH_ENG Mechanical Engineer - SLAC	0.25	0.25	0.25	0.25	0.25	0.25	1.50	0.75	0.75
131.ND.04.01 ND Muon Spectrometer Management Total		**0.81**	**0.81**	**0.81**	**0.81**	**0.74**	**0.46**	**4.45**	**3.91**	0.54
131.ND.04.02 ND Muon Spectrometer Infrastructure	LBN_FNALP_MCH_DS Mechanical Designer - SLAC		0.25	0.25	-	-	-	0.50	0.13	0.37
	LBN_FNALP_MCH_EN Mechanical Engineer - SLAC	0.35	0.35	0.35	0.20	-	-	1.25	0.17	1.08
	LBN_FNALP_MCH_TE Mechanical Technician - SLAC	-			-	-	-	-	0.07	(0.07)
131.ND.04.02 ND Muon Spectrometer Infrastructure Total		**0.35**	**0.60**	**0.60**	**0.20**	**-**	**-**	**1.75**	**0.37**	1.38
131.ND.04.03 ND Muon Spectrometer Detector Steel	LBN_FNALP_MCH_DS Mechanical Designer - SLAC	-	-	-	-	-	-	-	-	-
	LBN_FNALP_MCH_EN Mechanical Engineer - SLAC	-	-	-	-	-	-	-	-	-
	LBN_FNSL_P_MECH_DES Mechanical Designer - SLAC		0.25	0.25	-	-	-	0.50	0.20	0.30
	LBN_FNSL_P_MECH_ENG Mechanical Engineer - SLAC	0.35	0.35	0.35	0.20	-	-	1.25	0.24	1.01
	LBN_FNSLP_MECH_TECH Mechanical Technician - SLAC	-	-	-	-	-	-	-	0.36	(0.36)
131.ND.04.03 ND Muon Spectrometer Detector Steel Total		**0.35**	**0.60**	**0.60**	**0.20**	**-**	**-**	**1.75**	**0.79**	0.96
131.ND.04.04 ND Muon Spectrometer Magnetic Coil	LBN_FNALP_MCH_DS Mechanical Designer - SLAC	-	-	-	-	-	-	-	-	-
	LBN_FNALP_MCH_EN Mechanical Engineer - SLAC	-	-	-	-	-	-	-	-	-
	LBN_FNSL_P_MECH_DES Mechanical Designer - SLAC		0.25	0.25	-	-	-	0.50	0.19	0.31
	LBN_FNSL_P_MECH_ENG Mechanical Engineer - SLAC	0.35	0.35	0.35	0.20	-	-	1.25	0.24	1.01
	LBN_FNSL_U_GRAD_STDN_EN Grad Student (Engineer) Uncosted - SLAC								0.11	(0.11)
	LBN_FNSLP_MECH_TECH Mechanical Technician - SLAC								0.00	(0.00)
131.ND.04.04 ND Muon Spectrometer Magnetic Coil Total		**0.35**	**0.60**	**0.60**	**0.25**	**-**	**-**	**1.80**	**0.55**	1.45

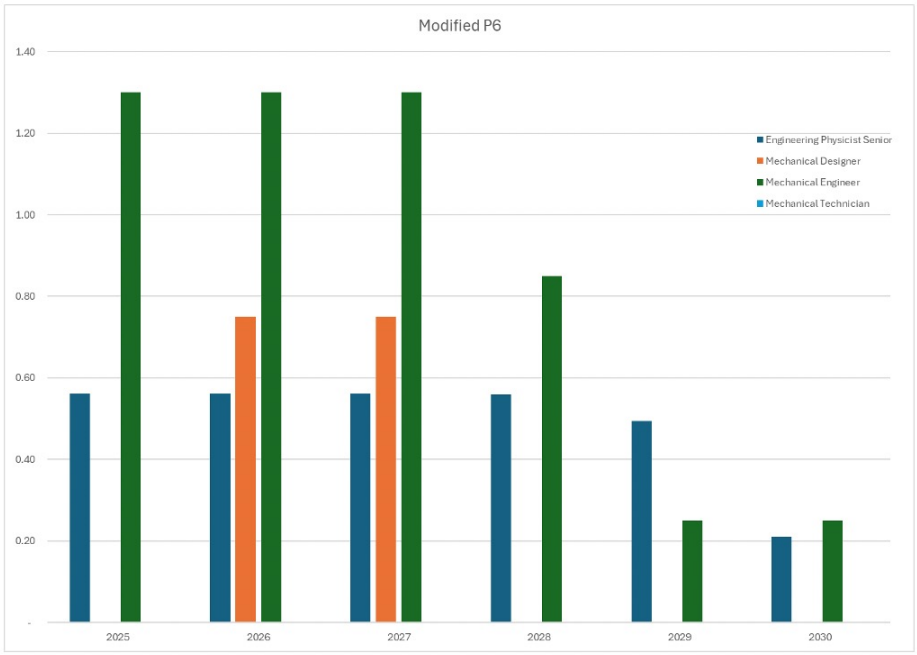
New Total = 9.75

Will we have enough effort for PDR? How to clarify I&I interface.

Management/System Engineering, Coil, Steel, Support Frame (from Marco)



Total = 5.63



New Total = 9.75

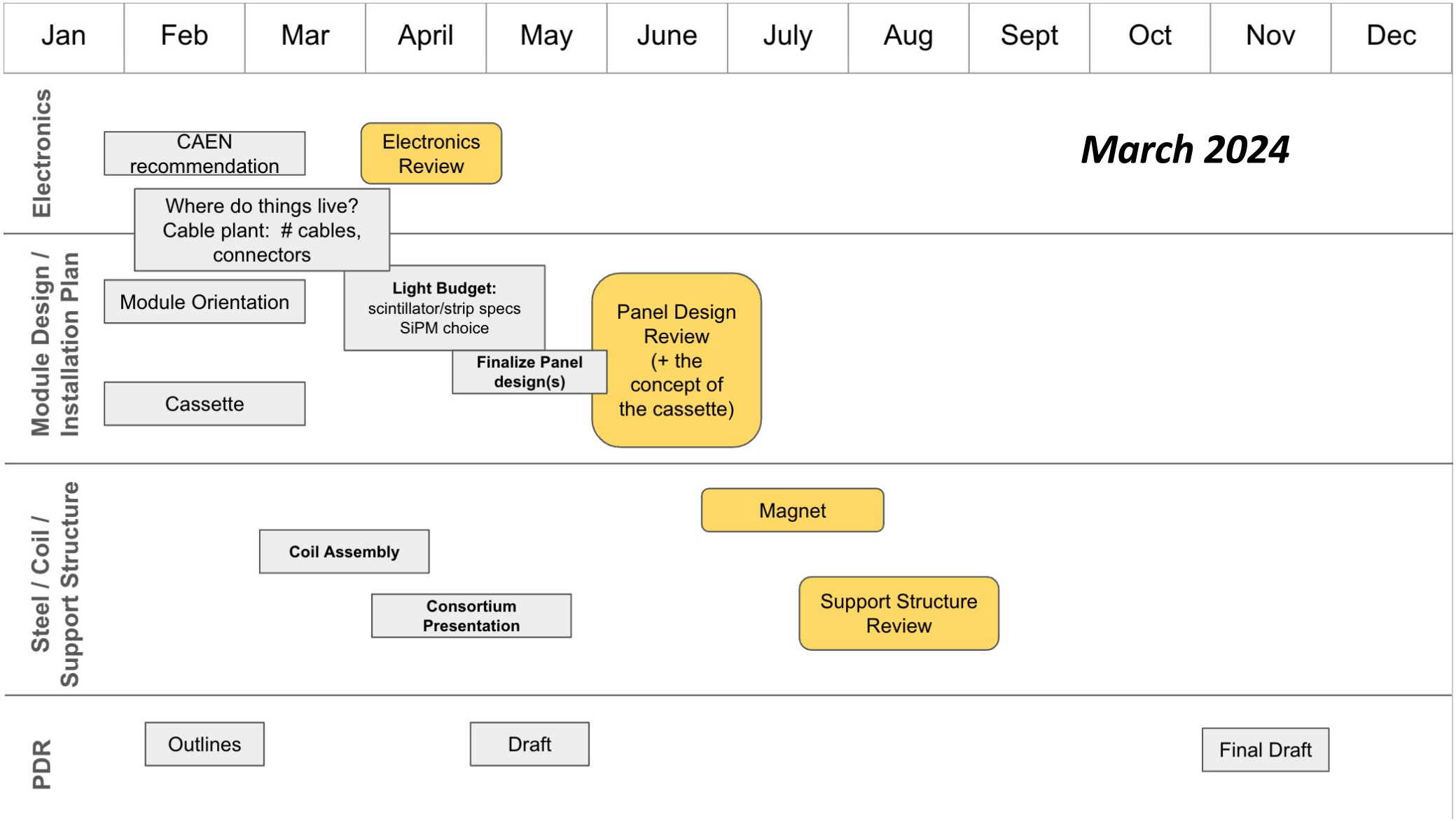
Prototyping Plan – Modules

From T. Chase, 6/28 TMS Meeting

1) mini-module (1/2 width, 1 m long)
   - Test part fit & function
   - Test assembly methods
   - Test light seal quality

2) Prototype full-scale, non-functional cassette (similar shape, different materials)
   - Test structural integrity
   - Test packaging of cables
   - Test rigging & handling strategies

3) Full-sized module
   - Test rigging and handling strategies


Jan
Feb
Mar
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July
Aug
Sept
Oct
Nov
Dec
Electronics
CAEN recommendation
Electronics Review
March 2024
Where do things live? Cable plant: # cables, connectors
Module Design / Installation Plan
Module Orientation
Light Budget: scintillator/strip specs SiPM choice
Finalize Panel design(s)
Panel Design Review (+ the concept of the cassette)
Cassette
Steel / Coil / Support Structure
Magnet
Coil Assembly
Consortium Presentation
Support Structure Review
PDR
Outlines
Draft
Final Draft

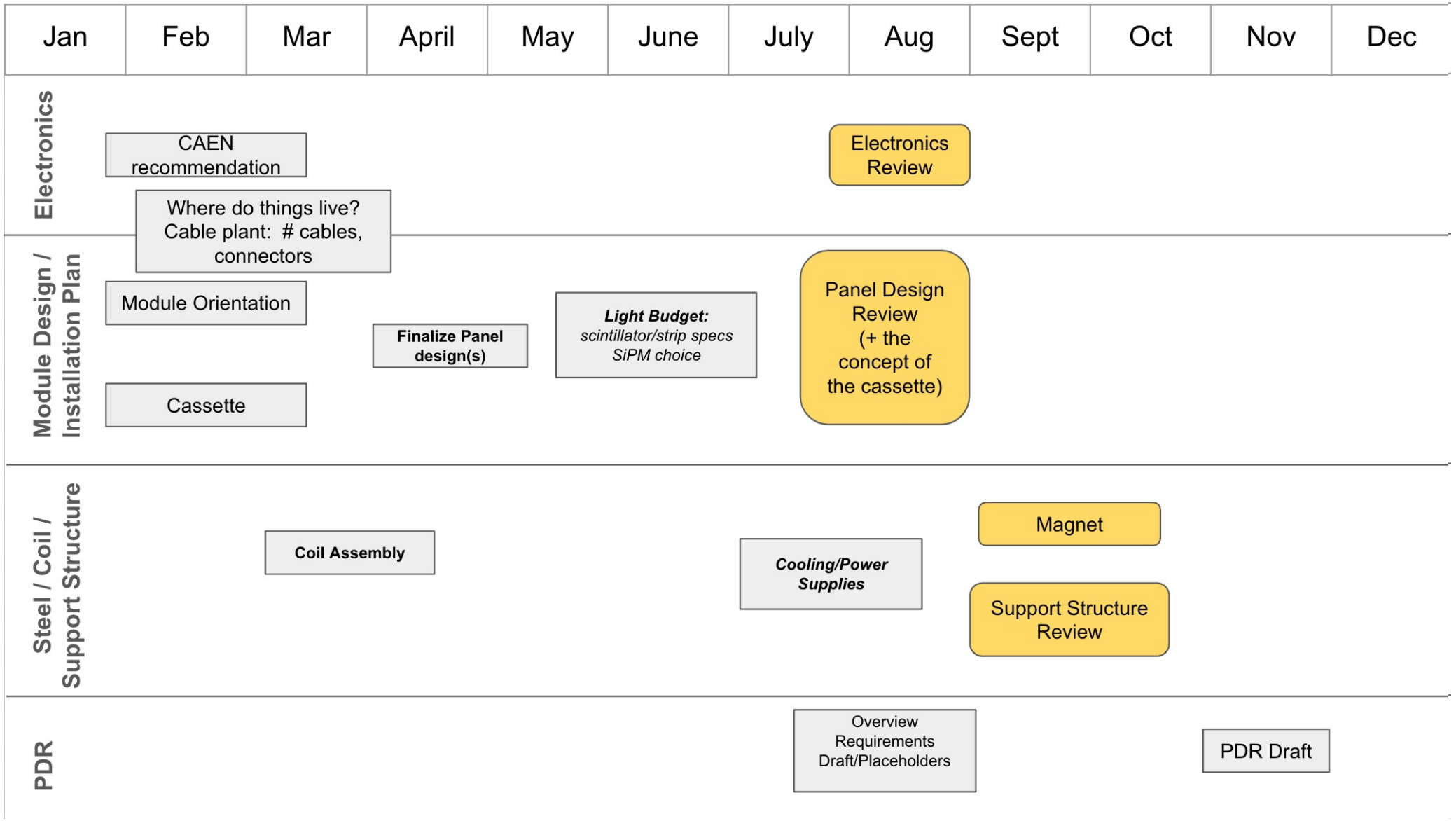
Review the ND-LAR PDR

There has been major progress across all aspects of the design.

Our IMMEDIATE need is to ensure that we have the needed resources and effort to meet the deadline of a PDR draft by end 2024.

Goal is to have the overview and requirements flowdown completed by the end of the summer.

Final plots can come as late as October.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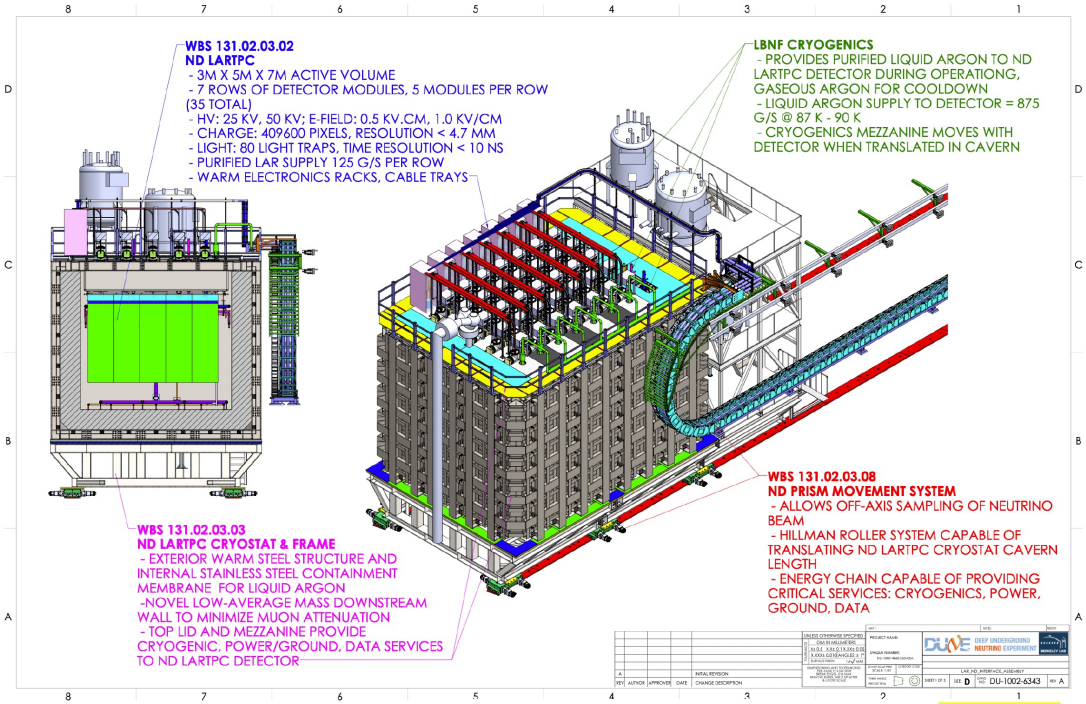
Panel Design Review (+ the concept of the cassette)
Steel / Coil / Support Structure
Coil Assembly
Cooling/Power Supplies
Magnet
Support Structure Review
PDR
Overview Requirements Draft/Placeholders
PDR Draft



+ Clarifying Institutional Responsibilities L3 Managers

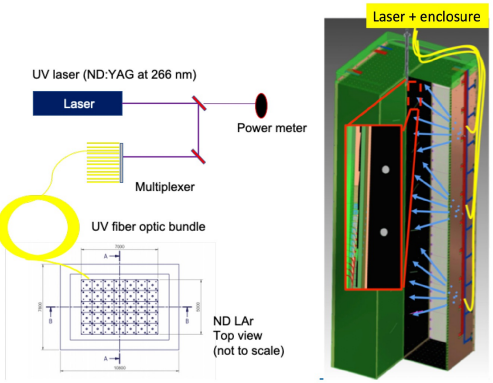


Figure 1.53: An overview of the PE laser calibration system. Nd:YAG laser light injected into optical fibers is guided to each TPC module for calibration.

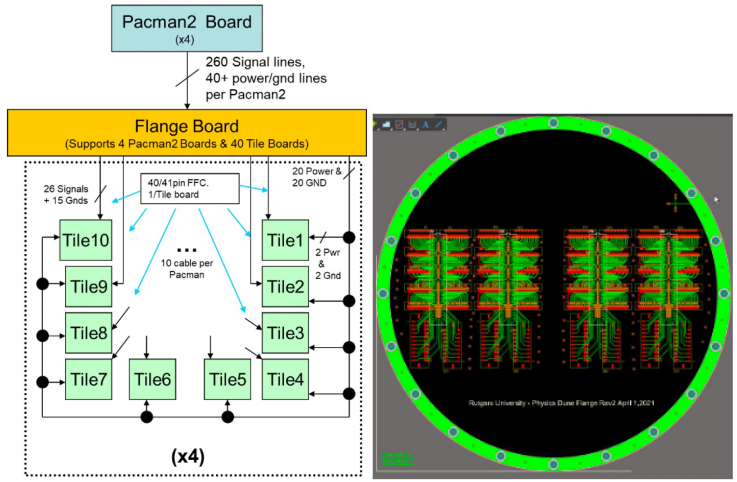


Figure 1.40: Left: Block diagram of connections for a single PACMAN controller at the feedthrough. Right: Flange PCB layout.

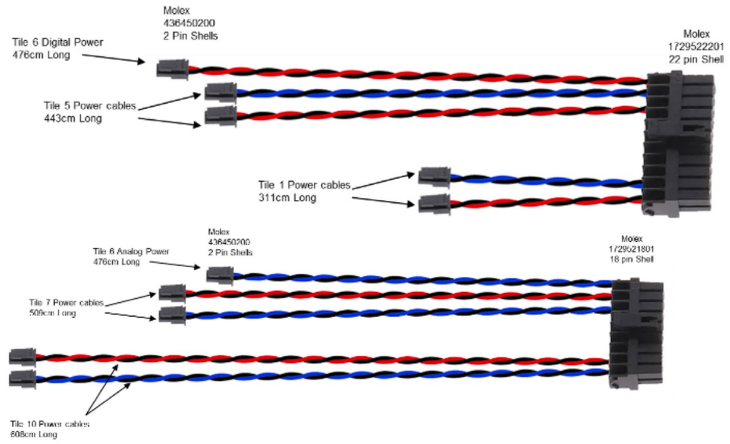


Figure 1.42: Power cable assemblies.

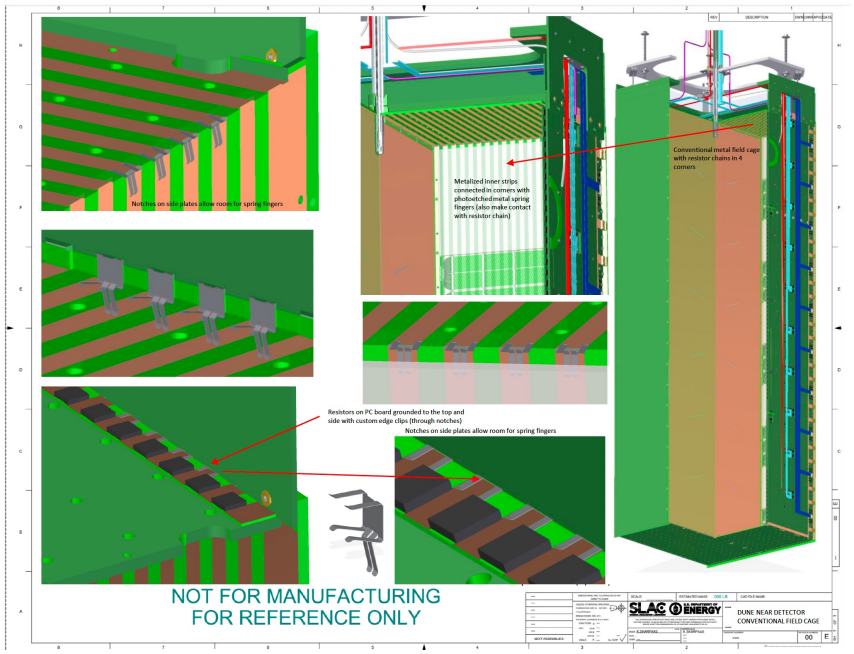


Figure 1.24: An assembly drawing of the module using a multiple resistor chains and metallized strips for field shaping.

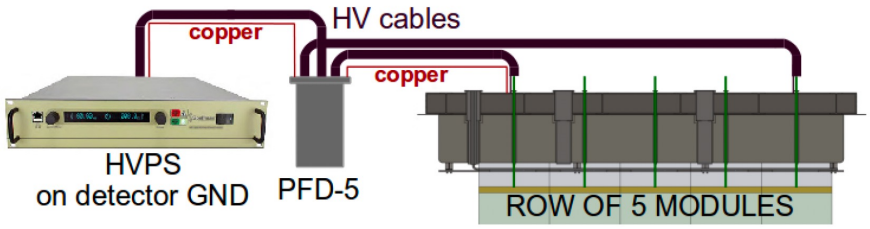


Figure 1.63: Electrical schematics of the HV system with ground path. Safety ground braid is highlighted in red.

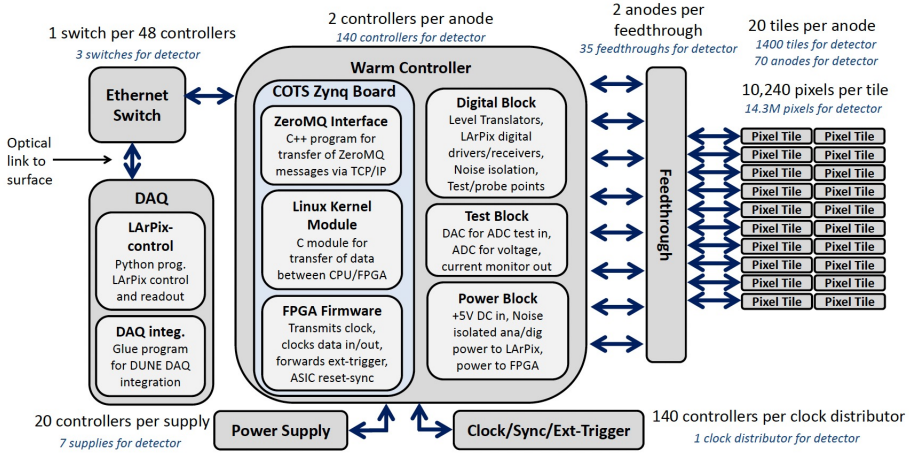
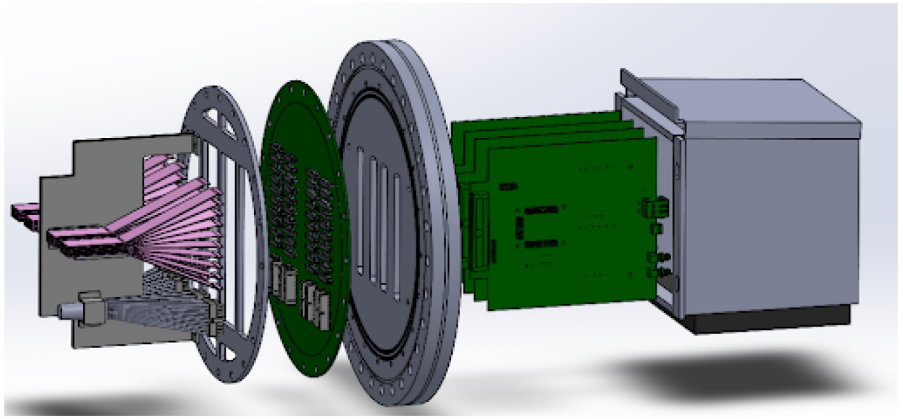


Figure 1.34: The LArPix system architecture for the ND-LAr detector.



1.33: Exploded view of the PACMAN feedthrough assembly composed of four controllers mated to PCB feedthrough.

Category	Document	EDMS	Controlled by	Required for Preliminary Design Review
Design Documents	TDR Chapter		DUNE EB	Sub-system Design Report from TDR. Assumed to include some discussion of value engineering process.
	Design Updates		Consortium	Written description of sub-system design changes made subsequent to the release of the TDR (TDR addendum).
	Grounding & Shielding Plan	xxxxxx	DUNE TB	Short document describing plan for sub-system adherence with detector grounding & shielding requirements.
	Mechanical CAD Model for Sub-system	xxxxxx	Consortium	Updated CAD model for sub-system released in EDMS. As part of the process for releasing the sub-system model, it will be integrated and checked within global CAD model.
	Mechanical Engineering Drawings	xxxxxx	Consortium	Engineering drawings for all sub-system mechanical components. Drawings do not need to be production quaility but should contain all crtical dimensions and tolerances. Drawings should be obtained directly from released sub-system CAD model and be marked "Draft/Not for Production". Drawings should also indicate component fabrication materials and masses consistent with EDMS 2281422. Drawings of any specialized components necessary for transporting or installing detector components should also be provided.
	Mechanical Assembly Drawings and Parts Lists	xxxxxx	Consortium	Assembly drawings and parts lists for all sub-system detector components. Drawings do not need to be production quality but should contain the baseline design and section views. Drawings should be marked "Draft/Not for Production", contain assembly masses consistent with EDMS 2281422, and indicate the center-of-gravity of the assembly (CG marker) . Parts lists should contain full specifications for any custon components.
	Electrical Schematics & Board Layouts	xxxxxx	Consortium	Schematics and board layouts for all sub-system electronics components. Along with the schematic and board layout files for each printed circuit board design, the additional board layout and manufacturing information typically sent to PCB manurfactures (e.g. number and configuration of layers, required drill sizes and tolerances, hole plating requirements, and board trace widths and tolerances) should be provided.
	Specification of Electrical Cabling and Wiring Connections	xxxxxx	Consortium	Specification of all electrical connections between sub-system components. Needs to include complete information on all cables and connectors including maximum voltage and current ratings. Wiring diagrams should be provided as necessary such that all system inter-connections are fully defined.
	Bills of Materials for Electronic Board Components	xxxxxx	Consortium	Bills of materials including parts list with full manufacturer part numbers for each sub-system electronics component. As appropriate, information regarding the cryogenic qualification of specific parts should also be provided.
	Documentation Links for Commercial, Off-the-Shelf Powered Components	xxxxxx	Consortium	Not required for Preliminary Design Review.

Category	Document	EDMS	Controlled by	Required for Preliminary Design Review
Requirements Documents	EB-Held Requirements	2346091	DUNE EB	High-level detector requirements with impact on physics performance.
	TB-Held Requirements	2346092	DUNE TB	Next level detector requirements with potential impacts on multiple subsystems.
	Consortium-held Requirements		Consortium	Spreadsheet with four tabs for Integration, Installation, Fabrication, and Transportation requirements. These requirements should be pulled from Interface documents, Far Detector Installation Plan, QA/QC Plan, and Manufacturing Plan as appropriate.
Installation Documents	Detector Installation Plan	2233449	Integration Office	Chapters detailing sub-system installation plans should be complete and updated.
	ProtoDUNE-II Installation Plan	xxxxxx	Integration Office	Not required for Preliminary Design Review.
Interface Documents	Consortium-Consortium	xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx	DUNE TB	Released version of document detailing interfaces between detector sub-systems (APA, HV, SP-PD, SP-ELEC, DAQ, CALCI, COMP). Six in total for each consortium.
	Consortium-Installation	xxxxxx	Integration Office	Released version of document detailing detector sub-system interfaces with the detector installation plan.
	Consortium-DSS	xxxxxx	Integration Office	Released version of document detailing detector sub-system interfaces with the Detector Support Structure (DSS)
	Consortium-Facilities	xxxxxx	Integration Office	Released version of document detailing detector sub-system interfaces with facility infrastructure. Facility infrastructure includes cryostat penetrations, real estate on top of cryostat, racks on the detector and cryogenic mezzanines, as well as cryogenic systems and piping (both internal and external to the cryostat).
	Interface Drawings		DUNE TB & Integration Office	Required interface drawings (both mechanical and electrical) are specified within each interface document. Interface drawings once completed should be posted as an additional material within the EDMS entry of the corresponding interface document.
Engineering Analysis Documents	Analysis Plan	xxxxxx	Consortium & Compliance Office	Documents the load cases that need to be analyzed for the sub-system and the standards that will be used assess the structural calculations. This document is jointly signed-off on by the consortium and compliance office prior to starting any structural analysis.
	Structural Analysis Note(s)	xxxxxx	Consortium	Engineering notes detailing the structural analyses performed for each of the sub-system load cases defined in the analysis plan and comparison against identified standards.
	Independent Review Report(s)	xxxxxx	Compliance Office	Output from independent review of structural analysis note(s) performed by the Compliance Office. Report(s) should include recommendations for required updates needed prior to Final Design Review.

Category	Document	EDMS	Controlled by	Required for Preliminary Design Review
QA/QC Documents	Preliminary QA/QC Plan	xxxxxx	Consortium	Short document describing consortium QA/QC plan with emphasis on sub-system testing plans covering fabrication, transport, storage, and installation stages. An example QA/QC plan can be found in EDMS 2414898.
	ProtoDUNE Lessons-Learned	xxxxxx	Consortium	Short document detailing sub-system issues uncovered during ProtoDUNE and the steps being taken to address these.
	Preliminary Manufacturing and Procurement Plan	xxxxxx	Consortium	Short document describing consortium plans for the procurement of needed materials, fabrication of detector components, and sub-system assembly. Example Procurement and Manufacturing plans can be found in EDMS 2414899 and EDMS 2414900, respectively.
	Plan for Prototyping Activities	xxxxxx	Consortium	Short document describing consortium plans for prototyping activities moving forward from the Preliminary Design Review including any Ash River activities and ProtoDUNE-II. Description of sub-system specific Ash River activities should be consistent with that in document describing overall plan for Ash River activities (EDMS 2169069)
	Fabrication, Inspection, and Test Procedures	xxxxxx	Consortium	Not required for Preliminary Design Review.
	Fabrication, Inspection, and Test Forms (Travelers, Test Reports, and Inspection Reports)	xxxxxx	Consortium	Not required for Preliminary Design Review.
Cost/Schedule Documents	Cost Estimate		DUNE EB	Consortia sub-system cost estimates are prepared by the DUNE Resource Coordinator working closely with the consortia leadership teams. Effort is currently underway to incorporate cost estimates within P6 to enable production of annual M&S and Labor profiles. Resource Coordinator will determine format for sharing this information with review committee.
	Insitutional Responsibilities		DUNE EB	Not required for Preliminary Design Review.
	Schedule Summary		DUNE TB	Need to define a format to be extracted from P6. Should include a summary of consortium milestones and connections to high-level ProtoDUNE-II and Far Detector milestones.
Tracking Documents	Responses to Past Review Recommendations	xxxxxx	Review Office	Consortia should keep a spreadsheet of recommendations received from each stage of the review process. For each recommendation received, the consortia should provide within the spreadsheet a brief description of how the consortium has addressed the recommendation and an assessment of its current status (e.g. closed or in-progress).
	Review Office Report on Responses to Past Reviews	xxxxxx	Review Office	Not required for Preliminary Design Review.

PROCESS: LBNC REVIEW

	Chapter Draft	Design Review	Ready for LBNC
Intro/Physics	Jun 24	N/A	Jul 24
ND-LAr (final)	Nov 24	Dec 24	Feb 25
TMS	Nov 24	Jan 25	Feb 25
SAND*	Jun 24-Feb 25	Jul 24-Mar 25	Apr 25
ND-LAr Cryostat	Jun 24	Jul 24	Aug 24
NS LAr Cryogenics	Jun 24	N/A	Aug 24
DUNE-PRISM	Nov 24	Dec 24	Jan 25
ND DAQ	Nov 24	Jan 25	Feb 25
ND Slow Control			Feb 25
ND I&I	Nov 24	Dec 24	Jan 24

Propose four phase review

- **Introduction/Physics Chapter**
  - Start July 2024
- **LAr Cryogenics/Cryostat**
  - Start August 2024
- **LArTPC system + DAQ, SC, I&I**
  - ND-LAr+TMS+DUNE-PRISM
  - DAQ, SC, I&I
  - Start Feb 2025
- **SAND**
  - Start Apr 2025

* SAND will divide process into KLOE-2-SAND, Tracker, GRAIN, Integration + LHe cryogenics

Mini-Reviews

We would like to have 3 “mini-reviews” for Electronics, Detector Panels, and Coils/Steel/Support. These reviews would happen during our normal consortium meeting times and would include a few external experts.

- The design has advanced significantly since the CDR. Receiving some external feedback would be valuable.
- It would provide a deadline for finalizing some design choices. Examples would be connectors and cables, strip dimensions, fiber width.
- It would give us the opportunity to present the current full current design (albeit in pieces).

What we told NSG:

Detector elements design decisions completed by Q3, magnet/support structure by Q4.

LBNC Feedback

Met virtually June 5-7:

“LBNC is happy to see progress made on the ND TMS and SAND, despite difficulties related with the current ND cost cap, but would very much welcome more clear and concrete steps towards finalizing the design, prototyping and a tentative timeline for construction.”

We expect that this will be the focus of the next LBNC meeting (October 2-4).

DOE Comparative Reviews

DOE (and DUNE) is trying to understand better the overall support and coordination between Project and Research activities.

- Let us know if you are including TMS-related activities in your proposals.
- Let us know if those requests are successful (or not).

Current cycle should be hearing soon?