DEEP UNDERGROUND SCIENCE AND ENGINEERING LABORATORY (DUSEL) AT HOMESTAKE

INTEGRATED SUITE OF EXPERIMENTS INTERFACE REQUIREMENTS DOCUMENT

ConfiguredDoc-82
Version 1.0

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Lead, South Dakota

Version Control

Responsible Person	Document Control Number	Document Version	Publication Date	CCR #	Description of Change
Bill Kalinowski	ConfiguredDoc-82	1.0	August 25, 2010	CCR 085	Initial Version

Notes for August 2010 Release

Format of Initial Release

This release has 3 major parts as follows below:

1. *Generic, LM and/or OLR Specific Requirements and Tables:* This section includes requirements that are 1) applicable to all types of experiments in the DUSEL Facility (no specific type of experiment noted in the requirement statement) and 2) Requirements applicable to either LM and/or OLR (the requirement text indicates the applicability of the requirement, i.e., the words Lab Module, or OLR) and 3) requirements also applicable to LBNE as indicated in the column titled "Applies to LBNE".
2. *LBNE Specific Requirements and Tables:* This section includes requirements that are applicable to the Water Cherenkov Detector LBNE experiment.
3. *Figures:* This section includes all the figures that are referenced in the 2 parts above.

TBDs/TBRs and Empty Sections

"To Be Determined/Defined" (TBD) and "To Be Refined/Reviewed/Resolved" (TBR) items are tracked for the Non-LBNE specific and LBNE specific Requirement listings. TBX is a term that generically refers to TBRs and TBDs. The TBX listings were numbered in the order in which they were created. The identifier TBX-IRD-ZZZ is given to TBXs in the Non-LBNE Specific requirements listing. TBX-LBN-ZZZ is given to the TBXs in the LBNE Specific requirements listing.

TBR indicates that there exists a value or set of values in a requirement that is expected to change in the future. The TBR value should be used by all groups in the program until it is closed. This ensures a common basis for all users of that value. When the requirement is updated, the program is notified of the change.

TBD indicates that no value or listing of parameters has been defined for a requirement. In cases of TBDs, the requirement serves only as a place holder until a value is determined. Several sections of the IRD contain headings but no requirements. These sections are placeholders for future work beyond that which should be expected at the current phase of the program. These sections should be considered TBD and will be addressed in future releases of this IRD.

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Generic, LM and/or OLR Specific Requirements and Tables

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
1.00		**Purpose and Scope**	
1.01		**Purpose**	
	YES	This document serves as the primary and official repository for the ISE needs that the DUSEL program has agreed will be satisfied by the DUSEL facility design. This document also poses constraints, in the form of requirements, on the ISE.	
1.01.01		**Definition of ISE IRD**	
1.01.02		**Definition of Experiment-Unique ICD**	
1.01.03		**Waivers, Deviations, and Exceedance**	
1.02		**Scope**	
	YES	This document covers all areas of experimental needs throughout the DUSEL Program. These include Surface and Underground needs. At times, key Early Science Parameters are recorded in this document for book keeping only. This document is not the definitive requirement source for Early Science to Facility requirements.	
1.03		**Groundrules, Assumptions, and Limitations**	
	YES	The following groundrules and assumptions apply to this specification:	
1.03.01		**Terms**	
	YES	The term "Facility" with a capital F denotes the DUSEL facility infrastructure, as part of the current scope of the MREFC program. The term "Experiment" with a capital E denotes an experiment that is part of the Integrated Suite of Experiments.	
1.04		**Introduction**	
1.05		**Specification Tree**	
	YES	Figure 1.06-01 shows the Specification Tree for the DUSEL Facility, with this specification highlighted.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		Figure 1.06-01 Specification Tree	
1.06		**Convention and Notation**	
1.07		**Uncertainty Applied to Values**	
	YES	The performance requirements from experiments are calculated from the best estimates of the experiment teams with an additional uncertainty factor. The uncertainty factor for each parameter is listed in Table 1.07-1. The uncertainties specified in the PDR/CD1 column are those that are being currently held by DUSEL.	
2.00		**Documents**	
2.01		**Applicable Documents**	
	YES	The DUSEL facility and all experiments entering the facility shall comply with the Reference Standards and Additional Standards sections of ConfiguredDoc-68, “Environment, Health, and Safety Work Smart Standards Set for DUSEL/Sanford Laboratory.”	
2.02		**Reference Documents**	
2.05		**Order of Precedence**	
	YES	In the event of a conflict in a requirement in this document with a federal, state, or local code, the applicable code will precede the requirement.	
3.00		**INTEGRATED SUITE OF EXPERIMENTS BACKGROUND**	
3.01		**DUSEL SCIENTIFIC OBJECTIVES**	
3.02		**EXPERIMENTAL OPERATIONS DESCRIPTION**	
3.02.01		**Lab Module Experiment Concept of Operations**	
3.02.02		**LBNE Operations**	
3.02.03		**Operations on Other Levels and Ramps**	
		Operations in OLR are different then in the Mid Level and Deep Level Campuses. When personnel move out of the campus areas and into the OLRs, the AOR and life safety expectations change. These are defined in [TBD-IRD-010].	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
4.00		**PHYSICAL AND MECHANICAL INTERFACES**	
4.01		**ACCESSIBLE AREAS**	
4.01.01		**Surface**	
	YES	[Areas on the surface with the functions in Table 4.01.01-1 shall be allocated for Experiment team use.] [TBD-IRD-011].	
		The Surface assembly high bay envelope available for Experiment use shall be at least 32.8 ft (10 m) high.	
4.01.02		**4850L Campus**	
		Areas in the 4850L Campus with the functions in Table 4.01.02-1 shall be allocated for Experiment team use. [TBR-IRD-011]	
	YES	The Facility shall provide spaces with neat lines as defined by the dimensions in Table 4.01.02-2.	
4.01.03		**7400L Campus**	
		[Areas on the 7400L Campus with the functions in Table 4.1.3-1 shall be allocated for Experiment team use.] [TBD-IRD-011]	
		[The Facility shall provide spaces with neat lines as defined by the dimensions in Table 4.01.02-2.] [TBD-IRD-011]	
4.01.04		**Other Levels and Ramps**	
		[The areas defined in Figures 4.1.4-1 through 4.1.4-8 shall be accessible to Experiment team use.] [TBD-IRD-011]	
4.02		**COORDINATE SYSTEM, DIMENSIONS, AND TOLERANCES**	
	YES	[Experiments shall adhere to the policies and recommendations for coordinate systems, dimensions and tolerances in the DUSEL CAD Standard Document]. [TBD-IRD-001]	
4.03		**SHAFT AND WINZE HOIST INTERFACES**	
4.03.01		**Lifting Capacity and Envelopes**	
	YES	Experiment equipment shall be sized and operated within the shaft and winze hoist capabilities described in Table 4.03-1 [TBR-IRD-036]	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
4.03.03		**Suspended Load Envelopes**	
	YES	Suspended Loads under the Hoist cages shall be less than 12 m, assuming a 1-1/2 x 2m cross section.	
4.04		**TRANSPORTATION INTERFACES**	
	YES	The Facility shall provide transportation of Experiment equipment.	
	YES	For the main physics campus, DUSEL transportation can move items of the biggest dimensions of the hoist with consideration of the transportation vehicle (including suspended loads).	
	YES	Specific horizontal transportation interfaces are [TBD-IRD-003].	
4.05		**ACCESS DRIFT INTERFACES**	
	YES	Experiment equipment in the Main Mid-Level Campus shall be sized to be transported in the envelope as defined in the central corridor of Figure 4.05-1. Note that if transportation vehicles are used, the entire envelope will not be available for experiment equipment since some volume will be used by the vehicle.	
	YES	A personnel egress corridor will be available as defined in Figure 4.05-1.	
	YES	Experiment equipment on OLR shall be sized to be transported in the envelopes as agreed to in experiment specific Interface Control Documents.	The size of the drifts in the OLR are variable and this needs to be considered on a case by case basis.
		The Facility shall provide a means to allow the transition of experiment hardware from DUSEL transportation services to Lab Module lifting equipment.	Continuous transportation of experiment equipment is needed from when it is delivered to the site to when it is in place for experiment operation.
4.06		**EXPERIMENT ROOM AND AREA INTERFACES**	
4.06.01		**Access to Experiment Rooms**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		Experiment equipment shall be capable of entering and exiting the Lab Modules through either access drifts.	Operations within a lab module may preclude transport of equipment past an existing experiment. Excavation activities of the Large Cavity may at times preclude use of Excavation number 4850-006 (west main drift).
	YES	Experiments shall allow Facility Emergency Response Teams access to all areas of in experiment in which experiment personnel plan to occupy.	Emergency Response Teams must have safe access experiment operators in an emergency situation.
4.06.02		**Experiment Envelope**	
4.06.02.1		**Physical Envelope**	
		Lab Module 1 shall provide the envelope and the placement of that envelope as defined in [Figure 4.6.2.1-1] [TBD-IRD-004] for the sole occupation of Experiment equipment.	
		Lab Module 2 shall provide the envelope and the placement of that envelope as defined in Figure 4.6.2.1-2 for the sole occupation of Experiment equipment.	
		The Deep Level Laboratory Lab Module shall provide the envelope and the placement of that envelope as defined in [Figure 4.6.2.1-3] [TBD-IRD-005] for the sole occupation of Experiment equipment.	
4.06.03		**Lay down and Assembly Space**	
		Lay down and Assembly Space in the Lab Modules is included in the envelopes defined in Section 4.6.2.1.	No additional lay down space outside the lab modules is required.
4.06.04		**Lifting Interfaces**	
4.06.04.01		**Lifting with Translation**	
		The Facility shall provide lifting with translation of loads within the lab modules as defined in [Figures 4.06.04.01-1 through 4.06.04.01-3] [TBD-IRD-008]. This drawing specifies the envelope in which the lifting device hook can access.	
4.06.04.02		**Lifting Loads**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		The Facility shall meet maximum lifting loads for each area as defined in Table 4.06.04.02-1.	
4.06.04.04		**Mechanical Hook Interfaces**	
4.06.05		**Floor Interfaces**	
4.06.05.01		**Campus Area Floor Surface Properties**	
	YES	This section covers the Floor Properties in the Lab Modules, Large Cavity, and other finished areas that meet the needs of Section 4.01.02 and 4.01.03.	
4.06.05.01.01		**Material**	
4.06.05.01.02		**Flatness**	
4.06.05.01.03		**Slope**	
	YES	The Facility shall limit the floor slope in the Lab Modules and Large Cavity to less than [TBD-IRD-034].	
4.06.05.01.04		**Mechanical Attachment**	
	YES	Experiments shall rest directly on the floor of the experiment areas. Any hard mechanical mounting to the floor must be negotiated with the DUSEL project and documented in an experiment specific Interface Control Document.	
4.06.06		**Wall and Dome Interfaces**	
4.06.06.01.01		**Surface Properties**	
4.06.06.01.02		**Mechanical Attachment**	
4.06.07		**Additional Excavations**	
	YES	Future excavations in DUSEL by experiments shall be conducted and managed by the DUSEL Facility.	Experiments may not excavate without DUSEL involvement since excavation has potential impact to many aspects of the operation and management of the facility. All experiments are included in this requirement, including the BGE Experiments and LBNE.
	YES	Future excavations in DUSEL by experiments shall consider the removal or storage of waste rock.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
5.00		**STRUCTURAL INTERFACES**	
5.01		**LOADS**	
5.01.01		**Floor Loading**	
	YES	The Facility shall provide floors in the Lab Modules that can withstand a distributed floor loading of at least 242 psi (1.67 MPa). Note that this is not a point load.	This is the floor loading of a 15m tall piece of lead, as could be the case for the EXO experiment.
5.01.02		**Wall and Dome Anchor Point Loading**	
5.01.03		**Concurrent Excavation Environment**	
5.01.04		**Hoist Transportation Loads**	
5.02		**STRUCTURAL DESIGN**	
5.03		**ACOUSTICS**	
5.03.01		**Environmental**	
	YES	The Facility shall provide an acoustic environment within the Experiment volume allocations below NC 35. Noise Criterion is defined in Figure 5.03-1 [TBR-IRD-060].	Lab Module environment must be conducive to acceptable levels of noise for construction, science operations, maintenance, and out reach activities.
5.03.02		**Experiment Equipment Generated**	
	YES	Experiment hardware acoustic emissions into the air space of the Lab Module shall be limited to less than or equal to NC 35. Noise Criterion is defined in Figure 5.03-1 [TBR-IRD-060].	Experiments should not create a louder environment than is supplied by the facility since this is a shared space. Integrated acoustic analysis may be necessary to define this requirement.
5.04		**DE-PRESSURIZATION / RE-PRESSURIZATION**	
6.00		**COOLING SYSTEM AND THERMAL INTERFACES**	
6.01		**GENERAL REQUIREMENTS**	
6.01.01		**Active Temperature Control Areas**	
6.01.02		**Heat Loads in Experiment Spaces**	
	YES	The Facility shall remove heat from Experiment spaces using ambient air circulation or chilled water.	
		The Facility shall be capable of removing the heat from the experiment electrical loads specified in Section 6.02.01.	
6.01.03		**Loss of Cooling**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	Experiments shall tolerate a loss of chilled water capacity.	No redundant or secondary chilled water system has been identified in the baseline facility design. This would be an unexpected occurrence, and all scheduled down times would be coordinated with the Experiment teams.
	YES	Experiments shall tolerate a loss of air temperature control in the Lab Modules.	No redundant or secondary chilled water system has been identified in the baseline facility design. This would be an unexpected occurrence, and all scheduled down times would be coordinated with the Experiment teams.
6.02		**CHILLED WATER**	
6.02.01		**Experiment Heat Rejection Allocations**	
		The Facility chilled water system and air handling shall be capable of removing the heat loads defined by area in Table 6.02.01-1.	
6.02.02		**Chilled Water Physical Interfaces**	
6.02.02.01		**Physical Connections**	
		The Facility shall provide chilled water connections in the location and quantity specified in Table 6.02.02.01-1. Each "connection" implies a separate port with an isolation valve or other means such that the system can remain active while making new connections.	
		The Facility shall provide chilled water for Experiment equipment on the 4850L and 7400L.	
6.02.02.02		**Wetted Materials**	
6.02.02.03		**Water Constituents**	
6.02.02.04		**Flow Rate**	
6.02.02.05		**Pressure Drop**	
6.02.02.06		**Supply Temperature**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	The Facility shall provide chilled water no higher than 46°F (7.7°C) [TBR-WTR-25]	
6.02.02.07		**Return Temperature**	
6.02.02.08		**Maximum Pressure**	
	YES	The Facility shall provide chilled water with a Maximum Operating Pressure (MOP) of 150 psi.	
6.02.02.09		**Outages**	
	YES	Experiments shall be designed to tolerate the loss of chilled water upon the loss of normal power.	Some cases exist in which chilled water capability will be required to prevent boil-off of expensive cryogens. These will be dealt with on a one-on-one basis. Details will be worked out in experiment specific Interface Control Documentation.
	YES	[The Facility shall provide a means to continue a decreased capability chilled water supply to a select group of experiments.] [TBD-IRD-029]	Some cases exist in which chilled water capability will be required to prevent boil-off of expensive cryogens. These will be dealt with on a one-on-one basis. Details will be worked out in experiment specific Interface Control Documentation.
7.00		**WATER AND COMPRESSED AIR SYSTEM INTERFACES**	
7.01		**POTABLE WATER**	
7.01.01		**Potable Water Allocations**	
	YES	The Facility shall provide the capacity to deliver specified quantities of water to locations specified in Table 7.01-1.	
		The Facility shall provide potable water connections at the Yates Shaft stations on the OLR.	
7.01.02		**Potable Water Physical Interfaces**	
7.01.02.01		**Physical Connections**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		The Facility shall provide potable water connections in the location and quantity specified in Table 6.02.02.01-1. Each "connection" implies a separate port with an isolation valve or other means such that the system can remain active while making new connections.	
7.01.02.02		**Wetted Materials**	
7.01.02.03		**Water Constituents**	
7.01.02.04		**Flow Rate**	
7.01.02.05		**Supply Temperature**	
7.01.02.06		**Maximum Pressure**	
	YES	The Facility shall provide potable water with a Maximum Operating Pressure (MOP) of 150 psi.	
7.01.02.06		**Outages**	
	YES	Experiments shall tolerate unexpected outages of Potable Water [TBR-IRD-030].	Outages could occur due to system maintenance.
7.02		**PURIFIED WATER**	
7.02.01		**Purified Water Allocations**	
	YES	The DUSEL Facility has purified water production capability on the Surface. The purified water generated on the surface is called Stage 1 Purified Water. Another purification system is present at the 4850L. This second system is fed by Stage 1 water. The water leaving this system is called Stage 2 purified water.	
	YES	The Facility shall provide Stage 1 water with the parameters specified in table 7.01-1 to the specified locations. [TBR-IRD-052]	
	YES	The Facility shall provide Stage 1 water to the 4850L and the 7400L.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
7.02.02		**Purified Water Physical Interfaces**	
7.02.02.01		**Physical Connections**	
	YES	The Facility shall provide Stage 1 water connections in the location and quantity specified in Table 6.02.02.01-1. Each "connection" implies a separate port with an isolation valve or other means such that the system can remain active while making new connections.	
7.02.02.02		**Wetted Materials**	
7.02.02.03		**Water Constituents**	
		Stage 1 water shall have the specific properties as defined in [TBD-IRD-061].	
7.02.02.04		**Flow Rate**	
7.02.02.05		**Pressure Drop**	
7.02.02.06		**Supply Temperature**	
7.02.02.07		**Maximum Pressure**	
	YES	The Facility shall provide potable water with a Maximum Operating Pressure (MOP) of 150 psi.	
7.02.02.07		**Outages**	
	YES	Experiments shall tolerate unexpected outages of Stage 1 Water.	Stage 1 water is not redundantly supplied, and thus scheduled or unscheduled maintenance could cause a temporary outage in the supply. A loss of normal power would result in the loss of the pumps that run the Stage 1 production equipment.
7.03		**WASTE WATER**	
7.03.01		**Waste Water Allocations and General Requirements**	
	YES	Experiments shall have an approved water usage agreement with DUSEL.	All water related activities by the experiments within DUSEL need to be reviewed and approved.

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	Experiments shall be responsible for the treatment of their own discharge water prior to release to the facility for introduction to native water.	This requirement identifies responsibility for treatment of this water. If the responsibility changes to the Facility, more detailed requirements will need to be developed.
	YES	[Experiment discharge water shall be separated from native water until the experiment discharge water has been shown to meet the South Dakota Ground Water Quality Standards SDAR 74:54:01:04 , or, if that standard is not applicable, until the experiment discharge water has been shown to meet the SD Surface South Dakota Surface Water Quality Standards (SDAR 74:51:01:46) and EPA Human Health standards (40 CFR Part 131) .] [TBD-IRD-051]	Rationale from John Sheetz: There is no known requirement from the state (SD) for separation. However, from the DUSEL vantage we will require this separation. This will protect the state's interests and the experimenter's liability should a release occur.
	YES	The Facility shall accept experiment waste water with the parameters specified in Table 7.03.01-1 at the specified locations [TBR-IRD-054].	
7.03.02		**Waste Water Physical Interfaces**	
7.03.02.01		**Physical Connections**	
	YES	The Facility shall provide an inlet for Experiment waste water.	
	YES	Experiments shall provide hardware to move the waste water from the experiments to the Facility waste water inlet.	
7.03.02.02		**Wetted Materials**	
7.03.02.03		**Dispelled Fluids**	
	YES	Additives to experiment water which may be released into the facility shall be on the DUSEL Approved Materials List DCN-xxxx [TBD-IRD-031] or have specific documented approval by DUSEL.	
7.03.02.04		**Flow Rate**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		The Facility shall remove waste water from experiments at the rates specified in Table 7.03.01-1.	
7.03.02.05		**Maximum Pressure**	
		The Facility shall accept experiment waste water at pressures specified in Table 7.03.01-1.	
7.04		**FIRE WATER AND MIST WATER (SEE FLS SECTION)**	
7.05		**COMPRESSED AIR**	
7.05.01		**Compressed Air Allocations**	
		The Facility shall provide compressed air to experiments with the parameters specified in Table 7.05.01-1 to the specified locations.	
7.05.02		**Compressed Air Physical Interfaces**	
7.05.02.01		**Physical Connections**	
		The Facility shall provide the number of connections in spaces as specified in Table 7.05.01-1. Each "connection" implies a separate port with an isolation valve or other means such that the system can remain active while making new connections.	
7.05.02.02		**Maximum Design Pressure**	
7.05.02.03		**Compressed Air Constituents**	
	YES	Experiments shall accept compressed air with [TBD-IRD-033] composition.	
	YES	Experiments shall tolerate unexpected outages of compressed air.	Compressed air is not redundantly supplied, and thus scheduled or unscheduled maintenance could cause a temporary outage in the supply. A loss of normal power could result in the loss of a compressor.
7.06		**INDUSTRIAL WATER**	
7.06.1		**Industrial Water Allocations**	
		The Facility shall provide the capacity to deliver specified quantities of water to locations specified in Table 7.01-1.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		The Facility shall provide industrial water connections at the Ross Shaft stations on OLR.	
7.06.02		**Industrial Water Physical Interfaces**	
7.06.02.01		**Physical Connections**	
		The Facility shall provide industrial water connections in the location and quantity specified in Table 6.02.02.01-1. Each "connection" implies a separate port with an isolation valve or other means such that the system can remain active while making new connections.	
7.06.02.02		**Wetted Materials**	
7.06.02.03		**Water Constituents**	
7.06.02.04		**Flow Rate**	
7.06.02.05		**Supply Temperature**	
7.06.02.06		**Maximum Pressure**	
	YES	The Facility shall provide industrial water with a Maximum Operating Pressure (MOP) of 150 psi.	
7.06.02.07		**Outages**	
	YES	Experiments shall be capable of tolerating a loss of Industrial Water.	Although industrial water is gravity fed, does not rely on power, and enters the lab down both the Yates and Ross shafts, an infrequent event could cause an outage in the system.
7.07		**Storm Water Underground Events**	
	YES	The Facility shall notify experiments on the OLR of pertinent storm water flow pathways near experiment sites.	
8.00		**EXHAUST AIR INTERFACES**	
8.01		**GENERAL REQUIREMENTS**	
8.01.01		**Pressure Relief / Vent Valve Sizing Requirements**	
8.01.02		**Pressurized Gas System Requirements**	
	YES	The experiments shall be not be capable of releasing cryogenic material at a rate above 5,886 CFM [10,000 m^3/h].	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		The Facility shall be sized to accommodate a cryogenic material release rate of 5,886 CFM [10,000 m³/h].	
8.02		**EXPERIMENT ROOM EXHAUST into Lab Module**	
8.02.01		**Temperature Limits**	
	YES	The temperature of experiment air exhausted into the Lab Module Egress Corridor shall be between 32 deg F and 120 deg F [TBR-IRD-020].	
8.02.02		**Contamination**	
		Experiment exhaust shall be vented away from the Lab Module Egress Corridors.	
		Experiment exhaust air into Lab Modules shall be filtered per the MERV 15 ASHRAE 52.2 standard or better when there is the possibility of particulate introduction into the air stream.	
8.03		**DUCTED EXHAUST SYSTEM**	
	YES	The interface requirements in this section pertain to experiment utilization of the facility exhaust air system. Example applications of experiment utlization of the exhaust air system include: - Fume Hoods - Flow from cryogen boil-off - Pressure relief valves or burst disks - Electronics Soldering fumes - Brazing or welding fumes	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	The Facility shall provide capability in the exhaust systems of the following spaces for the removal of vented experiment gasses: - Electroforming Laboratory - Clean and Dirty Machine Shops - Electronics Shops - Large Cavity - Lab Module 1 - Lab Module 2 - Deep Level Lab Module	
	YES	[The Facility shall be capable of accepting radon gas exhaust from experiment radon scrubbing equipment.] [TBD-IRD-062]	Regenerative radon scrubbing equipment needs to either store radon until it decays, or exhaust the radon to the environment. Exhausting the radon into the laboratory exhaust air stream is a better use of underground space.
8.3.1		**Physical Connections**	
	YES	Experiments shall provide all necessary hardware to deliver exhaust gas to the local exhaust air inlet duct.	
8.03.02		**Input Pressure / Flow rate Limit**	
8.03.03		**Input Temperature / Flow rate Limit**	
8.03.04		**Interface Pressure**	
8.03.05		**Pressure System Maximum Design Pressure**	
8.03.06		**Acceptable Effluents and Gasses**	
8.03.07		**Applicable Codes and Standards**	
	YES	The Experiments shall only exhaust substances in accordance with all applicable codes, standards, and approval from DUSEL Environment, Health, and Safety.	
9.00		**ELECTRICAL POWER INTERFACES**	
9.01		**POWER ALLOCATIONS**	
9.01.01		**Normal Power**	
	YES	Normal Power is defined in the glossary.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		The Facility shall provide and distribute normal power for Experiment use as per Table 9.1.1-1. Note that this is the peak power levels that the Experiment will consume. It is not a momentary, transient, or startup/inrush condition. Those conditions will be addressed elsewhere.	
9.01.02		**Stand-by Power**	
	YES	Standby power is defined in the glossary. Where required, the following shall be classified as standby power loads: a. Electric-driven fire pumps b. Mechanical air handling systems c. Smoke control systems for all AORs & exit passages d. Standby lighting required for areas of refuge e. Standby lighting required for smoke control mechanical equipment rooms f. Two-way communications systems g. Critical Science experiment equipment h. Hoists and cages used for emergency egress	
	YES	The Facility shall provide stand-by power only for "Critical Science Experiment Equipment" [TBD-IRD-016].	
		The Facility shall provide and distribute standby power for experiment use as per Table 9.1.1-1. Note that this is the peak power levels that the experiment will consume. It is not a momentary, transient, or startup/inrush condition. Those conditions will be addressed elsewhere.	
9.01.03		**Emergency Power**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	Emergency Power is defined in the glossary. Where required, the following shall be classified as emergency power loads: a. Fire Detection Systems b. Fire Alarm Systems c. Exit Sign Illumination d. Emergency Lighting e. Fire Command Center Lighting Emergency Power is supplied by a local power source such as a battery or UPS.	
	YES	Experiments shall provide emergency power for loads classified as emergency loads.	
		Experiment emergency power loads shall be approved by the Facility.	Definitions for emergency power can be unclear. An approval process forces a discussion between the Experiment team and the Facility.
9.02		**ELECTRICAL POWER LIMITATIONS**	
9.02.01		**Power Loss**	
9.02.01.01		**Reliability and Availability**	
	YES	The Facility shall provide for continuous experiment operation for all experiments except the Large Cavity during planned Facility maintenance (100% availability).	A state of the art, internationally recognized science facility should not have experiment operations impacted by routine facility maintenance. The LBNE experiment has a degraded mode of operation that is acceptable during planned maintenance of one of the power feeds to the 4850L.
	YES	Standby Power to experiments shall be available 100% [TBD-PWR-024] of the time during unscheduled power outages.	In the event of a normal power system fault, power must be available for experiments to safe themselves or shut down.

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	The stand-by power system shall be capable of providing power for a minimum of 4 hours [TBR-PWR-032] for standby power systems.	
		Data Communications during Power Loss	
	YES	The Facility shall provide voice communications between experiments in the Lab Modules and Large Cavity and the surface.	
	YES	Data Communications shall stay fully operational during the loss of normal power. [TBD-IRD-050]	
	YES	Data Communications shall stay fully operational during the loss of stand-by power for [TBD-IRD-050] hours.	
		Water System Availability During Power Loss	
	YES	The sections on the individual types of water address all types of water system outages.	
		Compressed Air During Power Loss	
	YES	Experiments shall be designed to tolerate the of loss of compressed air in the event of a switch to standby power.	The laboratory compressed air system compressor will not run on standby power. Residual compressed air may be available in the pressurized tanks and lines of the
9.02.01.02		**Uninterrupted Power Supply**	
	YES	Experiments shall provide their own UPS if UPS capability is required by the experiment.	
	YES	Experiment UPS systems shall be located within the experiment's volume allocation.	
	YES	Experiment UPS systems shall send health and status data to the DUSEL facility.	Just for critical systems for emergency power.
	YES	Experiment UPS systems shall be commandable by the DUSEL facility.	In an emergency situation, the Fire and Life Safety system may need to turn off power to an experiment.
9.02.01.03		**Unplanned Maintenance**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	Experiments shall tolerate the switch between Normal and Stand-by power.	Unplanned maintenance or a power system fault could cause a switch over to the standby power system.
9.02.01.04		**Automatic Starting after Power Loss**	
	YES	Experiments shall comply with their DUSEL approved Experiment Restart Plan.	Experiment operators will need to coordinate experiment reinitialization with the Facility managers to avoid an over taxing start-up condition on the facility power system.
9.02.01.05		**Emergency Operational Modes**	
9.02.01.05.01		**Power Mode Switching**	
	YES	The Facility shall send a signal to experiments when standby power is initiated.	
	YES	Experiments shall initiate shut down or safing procedures upon receipt of the signal that standby power has been initiated.	
	YES	Experiments shall tolerate the loss of standby power 4 hours after initiated.	
	YES	Experiments shall provide Emergency Power to Experiment Emergency Power loads for no less than 1.5 hours.	
9.02.01.05.02		**Power Mode Switch Time**	
	YES	Experiments shall tolerate a loss of power up to 60 seconds during the transition from Normal to Standby power.	
	YES	Experiment loads powered by emergency power shall tolerate a loss of power for up to 10 seconds during the transition from Normal to Standby Power.	
9.02.01.06		**Experiment Activation/Deactivation and Isolation**	
9.02.02		**Electrical Safety and Hazards**	
9.03		**POWER CHARACTERISTICS**	
9.03.01		**120 V AC Power and Voltage**	
9.03.01.01		**Voltage Levels**	
9.03.01.02		**Inrush Current**	
9.03.01.03		**Power Bus Ripple and Transient Spike Limits**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
9.03.02		**480Y/227V AC Power and Voltage**	
9.03.02.01		**Voltage Levels**	
9.03.02.02		**Inrush Current**	
9.03.02.03		**Power Bus Ripple and Transient Spike Limits**	
9.04		**GROUNDING**	
9.05		**SEPARATION OF POWER BETWEEN EXPERIMENTS**	
9.06		**OVERLOAD PROTECTION**	
10.00		**ELECTROMAGNETIC COMPATIBILITY**	
10.01		**DUSEL-PRODUCED INTERFERENCE ENVIRONMENT**	
10.01.01		**Conducted Interference**	
10.01.02		**Radiated Interference**	
	YES	Experiments shall tolerate emissions from facility transformers, RFID tags, hand held RF radios.	
10.02		**EXPERIMENT-PRODUCED INTERFERENCE ENVIRONMENT**	
	YES	Experiments shall limit conducted emissions to the [TBD-IRD-017] IEEE specification.	
10.30		**ELECTRICAL COMPATIBILITY**	
10.03.01		**Electrical Bonding**	
10.03.02		**Primary and Alternative Power Isolation**	
10.03.03		**Technical Grounds**	
10.03.04		**Ethernet Isolation and Grounding**	
10.03.05		**Fire Control System Isolation and Grounding**	
11.00		**ELECTRICAL WIRING INTERFACES**	
11.01		**ELECTRICAL CONNECTIONS**	
11.01.01		**Connections in Lab Modules**	
		Lab Module experiment electrical connections to the Facility shall be made in the electrical rooms of each lab module.	Only connections made there, there is no space of other equipment.
	YES	Experiment Stand-by power loads shall have a separate connection from the normal power load connection.	
	YES	Electrical cable harnesses between the electrical room and the experiment shall be furnished by the Experiment.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	Electrical cable harnesses shall be routed as specified in the experiment specific Interface Control Document (ICD).	
	YES	All experiment electrical equipment shall reside in the allocated volumes for the experiments, with the exception of power cables that connect the experiment to the facility.	No experiment electrical equipment is to be stored in the Facility electrical rooms.
11.01.02		**Connections in OLR**	
		[Electrical Outlets in the OLR shall be provided by the Facility as per Table 11.01.02-1.] [TBD-IRD-049]	
11.01.03		**Connections in LC Related Areas**	
11.01.04		**Connections in MLL and DLL Campus Drifts**	
11.01.05		**Connections in Surface Facilities**	
11.02		**HARDWARE REQUIREMENTS**	
12.00		**CYBER INFRASTRUCTURE INTERFACES**	
12.01		**GENERAL**	
12.01.01		**Time**	
	YES	The Facility shall provide the means to deliver a time signal with [TBD-IRD-019] microsecond accuracy and resolution.	The Neutrino Pulse of LBNE is on the order of 10 microseconds, therefore the temporal knowledge of the WCD should be at least an order of magnitude better. The SNO experiment ran a 10MHz clock with an external reference so events could be compared globally. A 50MHz fine structure is within the LBNE pulse and R. Kadel suggested we aim for 10ns.
	YES	The Facility shall provide the time signal to the following locations: Lab Module 1 Lab Module 2 Large Cavity Deep Level Lab Module Experiment Surface Control Rooms [TBR-IRD-040].	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
12.01.02		**Data Storage**	
	YES	[Experiments shall be responsible for storing all data generated by the experiments.] [TBD-IRD-038]	
	YES	[The Facility shall be responsible for maintaining experiment data once that data is transmitted to shared DUSEL/Experiment computing resources.] [TBD-IRD-038]	
12.01.03		**Reliability and Availability**	
	YES	The Facility shall provide data networks with [TBD-IRD-012] availability.	
12.01.04		**Security**	
	YES	Experiments shall comply with DUSEL IT security protocols and procedures.	
12.01.05		**Data Exchange**	
	YES	[Experiments shall provide data sharing with DUSEL servers.] [TBD-IRD-037]	
	YES	The Facility shall provide Experiments with laboratory monitoring data. [TBR-IRD-039]	
12.01.06		**Computing**	
	YES	Experiments shall provide computing resources needed for the real time operation of their experiments.	
	YES	The DUSEL Facility along with the Experiments shall jointly develop shared computing capability for data sharing and data analysis.	
12.02		**NETWORK CONNECTIONS**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	The Facility shall provide data communications to areas of the laboratory with data rates as specified in Table 12.02-1. [TBR-IRD-013]	
	YES	The Facility shall provide experiment underground spaces with access to the internet.	
	YES	The Facility shall provide network connections between the underground and above ground experiment computing resources.	
12.03		**COMMUNICATION PROTOCOLS WITH LAB SYSTEMS**	
	YES	Experiments shall utilize [TBD-IRD-056] interface protocol for data exchange and experiment control.	Common standards for interoperability for the DUSEL laboratory could help improve reliability as well as reduce the costs of experiment integration into the laboratory.
12.04		**FIRE AND LIFE SAFETY SYSTEM COMMUNICATIONS**	
	YES	Specific data and communications requirements related to Fire and Life Safety can be found in the Fire and Life Safety section of this document.	
13.00		**ENVIRONMENTAL INTERFACES**	
13.01		**ENVIRONMENTAL CONDITIONS**	
	YES	The Facility shall provide environmental conditions as specified in Table 13.01-1. [TBR-IRD-022]	
13.02		**ATMOSPHERIC REQUIREMENTS**	
13.02.01		**Oxygen Consumption**	
13.02.02		**Chemical Releases**	
13.03		**CLEANLINESS**	
13.03.01		**Air Particulates**	
		The Facility shall provide air in the Lab Modules that is filtered to the MERV 15 ASHRAE 52.2 standard.	
13.03.02		**Experiment Exhaust**	
13.04		**ILLUMINATION**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
13.04.01		**Laboratory Space**	
		The Facility shall provide a minimum lighting level of [TBD-IRD-015] as measured at the floor of the Lab Modules.	
13.04.02		**Supplemental Lighting**	
	YES	Experiments shall provide supplemental lighting when needs exceed that which is provided by the Facility.	
13.50		**RADIATION ENVIRONMENT**	
13.05.01		**Background DUSEL Radiation**	
	YES	The Facility shall provide [TBD-IRD-021] coatings and wall finishes in the Lab Modules to help mitigate gamma radiation and radon gas emissions from rock.	
13.05.01.01		**Radon**	
13.05.01.02		**Gamma Rays**	
13.05.02		**Experiment Emissions**	
13.06		**PARTICLE ACCELERATOR REQUIREMENTS**	
14.00		**HUMAN FACTORS INTERFACE REQUIREMENTS**	
14.01		**OCCUPANCY**	
		The Facility shall use the information in Table 14.01-1 as input from the ISE for occupancy planning. [TBR-IRD-046]	Assumptions must be made to construct an occupancy model that considers all the concurrent activity in DUSEL.
14.02		**EGRESS CORRIDORS**	
14.03		**LABELING**	
14.04		**HOSE/CABLE RESTRAINTS**	
14.05		**WASTE MANAGEMENT**	
14.05.01		**Human Waste**	
14.05.02		**Garbage**	
14.05.03		**Special Disposal**	
15.00		**MATERIALS AND PARTS INTERFACES**	
	YES	Experiment underground cables shall have flame retardant, low smoke, and low halogen properties.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	[Experiment equipment shall contain only materials on the DUSEL Approved Materials List DCN-xxxx or those with documented approval from DUSEL.] [TBD-IRD-031]	
	YES	[All experiments that require tanks to contain liquids (to include water containing potential contaminants as in LC1), reactive solids, gases, or other chemicals, shall maintain separation of the experiment liquids, solids, or gases, from native water sources, or air breathed by personnel in the underground facility.] [TBD-IRD-057]	To prevent contamination of native water sources from experimental waste or leakage. In addition, leakage of gases in the enclosed spaces of the underground facility will displace oxygen needed to breathe, and cannot be cross-contaminated with sources of oxygen needed to breathe. Applicable Codes and Standards: ANSI/ASHRAE 62-2004 - Ventilation for Acceptable Air Quality 40 CRF 280 - Underground Storage Tanks
		The Facility shall be capable of housing 1 experiment with 100T of liquid scintillator in Lab Module 1. [TBR-IRD-055]	DM cryogen detectors (such as LZD and MAX) can contain up to 100T of liquid scintillator.
		The Facility shall be capable of housing 2 experiments with 100T of liquid scintillator in Lab Module 2. [TBR-IRD-055]	DM cryogen detectors (such as LZD and MAX) can contain up to 100T of liquid scintillator.
	YES	[Experiment electrical equipment shall be UL Listed or have specific approval from DUSEL.] [TBR-IRD-058]	
16.00		**FIRE AND LIFE SAFETY INTERFACES**	
	YES	Experiments shall be responsible for experimental hazard containment.	
16.01		**FIRE PREVENTION REQUIREMENTS**	
	YES	This section lists the things the experiment design must do in order to prevent the causes of fires. This includes topics such as material selection, oxygen concentration, and ignition sources. [TBD-IRD-041]	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
16.02		**EXPERIMENT DATA MONITORING**	
	YES	[The experiment shall monitor and transmit to the Facility a limited set of the experiment parameters that will be used for assessing the health and status of the experiment and the identification of conditions that could lead to a hazardous situation.] [TBR-IRD-048] Possible Examples: - Temperatures and pressures of critical systems - Special gas sensors - Electrical system measurements (voltages, currents) - Water level detectors	The Facility central control system should be able to have the data it needs to help prevent a situation that could have a negative impact on the operations or safety of the facility. This type of system is in place at other large research facilities.
	YES	Fire and smoke monitoring systems appropriate to anticipated fire and smoke hazards shall be adaptable to protect each space (lab module or large cavity).	
	YES	All experiment equipment racks and volumes enclosed from the Lab Module or Drift environment shall be equipped with smoke detectors.	
	YES	Experiment smoke detectors shall be capable of communicating with the DUSEL Facility (surface command center).	
	YES	Experiments shall operate hazardous gas detectors in areas where hazardous gasses are used.	
16.03		**FIRE SUPPRESSION SYSTEM INTERFACES**	
16.03.01		**General FLS Hardware and Operational Requirements**	
	YES	Experiments shall include fire suppression capability in all areas that are not included with the Facility fire suppression. [TBR-IRD-014]	
		The Facility shall provide the following fire suppression fluids for experiment enclosures within the Lab Modules and drifts: 1. Water 2. Water Mist	There will exist additional structures within the lab modules and drifts that will require fire suppression fluids.

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	Experiments shall detect hazardous conditions in experiment equipment. [TBD-IRD-047]	
		[Upon detection of hazardous conditions, Experiments shall take action to reduce the hazard.] [TBD-IRD-047]	
	YES	[Experiment hardware shall be capable of being shut down autonomously by the Facility Fire and Life Safety System.] [TBD-IRD-047]	
	YES	[Experiment hardware shut down by the Facility Fire and Life Safety system shall not cause a hazardous condition to occur.] [TBD-IRD-047]	
	YES	Experiments shall be capable of removing power from electrical circuits when a fire is detected in equipment on that circuit.	Removal of power to burning electronics can in some cases stop the fire.
	YES	Experiments shall be capable of removing power to electrical circuits prior to or concurrently to activation of the fire suppression system.	Fire suppression would be less hazardous if electrical power had been removed from equipment.
	YES	The Facility shall provide a fire suppression capability compatible with high voltage low ampere equipment up to 400kV and 100mA.	The DIANA experiment has the high voltage power supply specified in this requirement. Other experiments will have high voltage power supplies and equipment, but the DIANA values are the driving case.
16.03.02		**Water Fire Suppression System Interfaces**	
	YES	The Facility shall provide water fire suppression system connections in the location and quantity specified in Table 6.02.02.01-1. Each "connection" implies a separate port with an isolation valve or other means such that the system can remain active while making new connections.	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
	YES	Experiments shall be compatible with a water fire suppression system in the following areas: Lab Module 1 Lab Module 2 Deep Level Lab Module LC Support Drifts Machine Shops Electrical Shop [TBR-IRD-042]	
	YES	In addition to the floor area of the excavated spaces, the Facility shall provide water fire suppression capability for [TBD-IRD-043] square feet of internal lab space build inside the lab modules.	
	YES	All detailed physical interfaces to the water fire suppression system will be defined in applicable NFPA codes and standards.	
16.03.03		**Mist-Water Fire Suppression System Interfaces**	
	YES	The Facility shall provide Mist-Water fire suppression system connections in the location and quantity specified in Table 6.02.02.01-1. Each "connection" implies a separate port with an isolation valve or other means such that the system can remain active while making new connections.	
	YES	Experiments shall be compatible with a mist fire suppression system in the following areas: [TBR-IRD-044]	
	YES	In addition to the floor area of the excavated spaces, the Facility shall provide water-mist fire suppression capability for [TBD-IRD-045] square feet of internal lab space build inside the lab modules.	
	YES	All detailed physical interfaces to the mist-water fire suppression system will be defined in applicable NFPA codes	
17.00		**OPERATIONAL REQUIREMENTS**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
17.01		**OPERATIONAL LIFETIME**	
17.02		**SURFACE SERVICES**	
17.03		**CONSTRUCTION PROCESS**	
17.03.01		**Experiment Construction Schedule**	
17.04		**TRANSPORT FROM SURFACE TO UNDERGROUND SPACES**	
17.04.01		**Equipment Orientation during Transportation**	
17.04.02		**Hoists and Shafts**	
17.04.02.01		**Availability**	
17.04.03		**Drifts and Ramps**	
17.04.03.01		**Availability**	
		One of the two access drifts to the lab modules shall always be available for experiment equipment ingress or egress.	If there is no way for equipment to enter or leave the lab modules, the operations of an experiment could be negatively impacted.
17.05		**STAFFING**	
17.05.01		**Facility Construction**	
17.05.02		**Experiment Installation and Assembly**	
17.05.03		**Operations**	
17.05.04		**Calibration**	
17.06		**EXPERIMENT MONITORING**	
17.07		**EXPERIMENT DE-COMMISSIONING**	
		Experiments shall be responsible for all activities related to decommissioning experiments and Lab Module reclamation.	
18.00		**EXPECTED WAIVERS / Potential Requirement Growth Item**	

New ID	Applies to LBNE?	Requirement Statements (or Heading, Information, etc.)	Rationale
		EXO has requested chilled water availability while on Standby Power. If EXO selected, other possibilities exist for providing this capability, including: 1. Operating a dedicated EXO chilled water pump off of stand-by power that will re-circulate chilled water to it's first sump. 2. Using industrial water (a low temperature is not needed). Consider LAr and He, too.	
	YES	LBNE and other experiments that require submersion of cables into water do not expect to meet the cabling requirements in Section 15. Fire proofing chemicals contaminate the ultra pure water that is required for the experiments.	
18.00		**GUIDE TO EXPERIMENT INTEGRATION WITH DUSEL**	
18.01		**INTEGRATION PROCESS FOR EXPERIMENT INTEGRATION**	
18.01.01		**Functional Requirements**	
18.01.02		**Experiment Safety Requirements**	
18.01.03		**Applicable Codes and Standards**	
19.00		**VERIFICATION**	
19.01		**TRACEABILITY**	
20.00		**NOTES**	
21.00		**ACRONYMS**	
22.00		**GLOSSARY**	

TBX #	Description	Closure Plan	Assignee	Status
TBD-IRD-001	1) Resolve differences due to the practices for architectural units (feet) and mechanical design units (inches). 2) This needs buy-in and coordination with experiment teams. 3) Get official document number for the DUSEL CAD Standard. 4) Be specific on what parts of the standard are applicable so that the requirement does not unnecessarily drive any program to do things that are not absolutely justified.			Open
TBD-IRD-002	Determine monorail axis offset from the center of the Lab Module.			Open
TBD-IRD-003	Define the physical interfaces between experiment hardware and the tranportation vehicles.			Open
TBD-IRD-004	Create the figure/drawing that shows the experiment envelope in Lab Module 2.			Open
TBD-IRD-005	Create the figure/drawing that shows the experiment envelope in the Deep Level Lab Module.			Open
TBD-IRD-006	Primary and Secondary Equipment and personnel Ingress/Egress from lab spaces.	This requirement was not needed, other requirements were sufficient as both entrances need to be used.		Closed
TBD-IRD-007	Obtain the Standard Drift Envelope. This was apparently the guidance that was sent out to Arup and Golder as guidance for drift design.	Done.		Closed
TBD-IRD-008	Create a drawing showing the required span, Travel, and Hook Height of the lifting equipment in all the lab modules. This drawing also shows the hook envelopes in relation to the experiment envelope.			Open
TBD-IRD-009	Determine the duration allowable for persistent condensation on experiment surfaces.			Open

TBX #	Description	Closure Plan	Assignee	Status
TBD-IRD-010	Define and Document the fire life safety strategy in the OLRs. Address all areas: (Exit travel distance, ventilation, what they must bring with them (breathing, water, food, tools, shelter, self rescuer), what additional training, limitations on how personnel can go down dead-ended drifts.			Open
TBD-IRD-011	Insert detailed dimensions for needed spaces and/or excavation numbers.			Open
TBD-IRD-012	Determine the required data network availability for the experiments.			Open
TBR-IRD-013	Refine the data connection table for outlet types, BGE data requirements, data through put, etc.			Open
TBR-IRD-014	Define the areas that the facility fire suppression system covers versus what the experiment needs to provide.			Open
TBD-IRD-015	Define the facility provided lighting level in the lab modules.			Open
TBD-IRD-016	Define the term "Critical Science Experiment Equipment." Look into using a word other than "Critical" since that word can have a life safety implication.			Open
TBD-IRD-017	Determine the IEEE standard for power quality for conducted emissions.			Open
TBD-IRD-018	Create figures/drawings of the experimental envelope and zones to define subset of areas that needs to be accessible for lifting. Include: Hook Height Span Travel Capacity For both the 20T and 40T capacity	This TBD was absorbed into other requirements and TBXs.		Closed

TBX #	Description	Closure Plan	Assignee	Status
TBD-IRD-019	Determine requirement for the accuracy and resolution of an external time reference.			Open
TBR-IRD-020	Refine the exhaust gas temperature into Lab Module Egress Corridor.			Open
TBD-IRD-021	Coatings and surface finishes meant to mitigate radon levels.			Open
TBD-IRD-022	Refine the Environmental Conditions Table			Open
TBD-IRD-023	Determine the power requirements for the assembly and lay down high bays on the surface.			Open
TBD-IRD-024	Determine the power requirements for the surface computer rooms and control center.			Open
TBR-IRD-025	Double check LUX/Majorana power usage in the Davis Campus. Steve M. to verify this number. May need to reconcile with the values in the Power Table. Ensure that the electroforming lab and other resources are not being double-booked.			Open
TBD-IRD-026	Determine the BGE normal and standby power allocations.			Open
TBD-IRD-027	Deterime the underground level for the Electroforming Lab. This TBD will affect all infrastructure brought to the lab--power, water, exhaust, ventilation, AORs			Open
TBR-IRD-028	Refine the number and location of connections for all water types.			Open
TBD-IRD-029	Define the facility capability for limited stand-by powered chilled water supply pumps or other solution that provides sufficient cooling to prevent cryogen boil-off. The TBD is also to determine whether the experiments need to bring their own standby chiller or this is something that the facility will provide.			Open

TBX #	Description	Closure Plan	Assignee	Status
TBR-IRD-030	Define redundancy capability for potable water system. There may be another system that could come online that would treat industrial water to drinking standards. However, it is unknown whether this would be available for science as this is a capability being driven by AORs.			Open
TBD-IRD-031	Retrieve the name of the official approved materials list.			Open
TBD-IRD-032	Determine the exact Water Standard to which experiment dispelled water must be treated.			Closed
TBD-IRD-033	Determine the gas composition of compressed air supply. Need to determine the level of filtering of that air to produce the required purity.			Open
TBD-IRD-034	Determine the maximum floor slope in the lab modules that is acceptable for the experiments.			Open
TBD-IRD-035	Determine the compressed air requirements from Science.			Open
TBR-IRD-036	Determine the usable envelope inside the cage dimensions of the hoists (the offset from the cage dimensions).			Open
TBD-IRD-037	Define what the real requirements are for data sharing between the experiments servers and the DUSEL E&O servers.			Open
TBD-IRD-038	Develop data storage and computing model for experiment data.			Open
TBR-IRD-039	Define the facility monitoring data that will be provided to the Experiments.			Open
TBR-IRD-040	Refine the locations to which the high accuracy time signal must be sent.			Open
TBD-IRD-041	Determine the specific requirements levied on the experiment design for fire prevention.			Open

TBX #	Description	Closure Plan	Assignee	Status
TBR-IRD-042	Refine the list of experiment spaces that use water fire suppression.			Open
TBD-IRD-043	Determine the amount of additional capacity needed in the water fire suppression system to cover the floor space of the structures built inside the lab module.			Open
TBR-IRD-044	Refine the list of experiment spaces that use mist water fire suppression.			Open
TBD-IRD-045	Determine the amount of additional capacity needed in the water-mist fire suppression system to cover the floor space of the structures built inside the lab module.			Open
TBR-IRD-046	Refine the BGE occupancy model.			Open
TBD-IRD-047	Develop the requirements for experiment automated response to hazardous conditions.			Open
TBD-IRD-048	Refine this requirement to a clear set of actionable requirements around which a system can be designed.			Open
TBD-IRD-049	Determine the electrical outlet separation in the OLR.			Open
TBD-IRD-050	Define requirements for data communications in an off nominal power condition.			Open
TBD-IRD-051	Obtain a better understanding of the limitations on discharging certain types of water into the mine water, as it may be ok, for example, to release RO water underground. From 8/18/10 Peer review, additional concerns: Ware the operational implications for an experiment underground? What is the method of accomplishment to clean the water via contractor? At LBNL, there is a single point contact within the lab for expert handling of spills & contamination.			Open

TBX #	Description	Closure Plan	Assignee	Status
TBR-IRD-052	This requirement may be refined based on the sequencing of the Stage 1 water plant, since water may not be available unless the LBNE schedule gets synchronized with the schedules of the experiments in the lab modules.			Open
TBD-IRD-053	Define the pressure range at the different levels. The ventilation system can change the pressure by up to 20 inches of water.			Open
TBR-IRD-054	Refine/Determine the waste water rates for the various areas.			Open
TBR-IRD-055	Determine the type of liquid scintillators that could be used in DUSEL.			Open
TBD-IRD-056	Develop requirements for common data interface standards between experiments and DUSEL.			Open
TBD-IRD-057	Coordinate with EHS to determine the best way to re-write this entire requirement. Also, understand the implications of this reqirement to LBNE - 40 CRF 280 - Underground Storage Tanks			Open
TBD-IRD-058	Refine the language for this requirement to align with that of other National Laboratories for how they controlled the types of equipment brought into the facility.			Open
TBR-IRD-059	Finalize wall and floor finishes for the experiment used spaces. This TBR is also TBR-EXC-006 and TBR-EXC-007.			Open
TBD-IRD-060	Get official reference for Noise Criterion.			Open
TBD-IRD-061	Get the precise reference document for the LBNE water quality document.			Open
TBD-IRD-062	Review and vet the ability of the facility exhaust system and codes and standards to allow vented radon gas into the laboratory exhaust system.			Open

Table 1.07-1 Uncertainty margin placed on experiment best estimates

	CoDR	PDR	CrDR	Build	Operations
Item / MREFC Phase	CD0	CD1	CD2	CD3	CD4
Peak Lab Module Power		33%			
Peak WCD Power		20%			
Peak Infrastructure Power		25%			
Lab Module Standby Power		33%			
Foot Print		0%			
Monorail Lifting Height		0%			
Bridge Crane Lifting Height		0%			
Lab Module Lifting Loads		0%			
Cooling Water Heat Removal (Lab Modules)		50%			
Cooling Water Heat Removal (WCD)		20%			
Occupancy		0%			
Ventilation Flow Rate					
Emergency Ventilation Flow Rate					
Ventilation Heat Removal		*			
Data Bandwidth					
Potable Water					
Industrial Water					
Waste Water					

* Uncertainty for heat removal from air is based on the uncertainties of peak power and chilled water.

Uncertainty Notes:
For Peak Power, Emergency Power, these margins are applied to best estimates by experiments.
This margin schedule represents design uncertainties only. Future growth allowances are not included.
Occupancy model is best estimate with no allowance for uncertainty. Program can add margin with rolled-up numbers.

Table 3.02.03-1 BGE Experiments on OLR

Level	Site	Experiment
300	1	CO_2 Sequestration
	2	EcoHydrology
	2	Transparent Earth (HPPP, MicroGravity, SQUID)
800	3	CO_2 Sequestration
	1, 4	EcoHydrology
	2	Transparent Earth (HPPP, MicroGravity, SQUID)
2000	1, 3, 5	EcoHydrology
	3	Fractured Processes
	Distributed	GEOX™
	1, 2, 5	Transparent Earth (Broadband Seismic Array)
	1, 2, 5	Transparent Earth (Earth Passive EEM1)
	Distributed	Transparent Earth (Earth Electrical Array)
	2, 4	Transparent Earth (HPPP, MicroGravity, SQUID)
4100	2, 4, 6	EcoHydrology
	Distributed	GEOX™
	1, 3, 4, 6	Transparent Earth (Broadband Seismic Array)
	1, 3, 4, 6	Transparent Earth (Earth Passive EEM1)
	3	Transparent Earth (Earth Passive EEM2)
	Distributed	Transparent Earth (Earth Electrical Array)
	1, 3, 6	Transparent Earth (Active Seismic Monitoring)
	1, 3, 4, 5, 6	Transparent Earth (HPPP, MicroGravity, SQUID)
4550	1	Transparent Earth (Broadband Seismic Array)
	1	Transparent Earth (Earth Passive EEM1)
	1	Transparent Earth (Active Seismic Monitoring)
	1	Transparent Earth (USGS Calbibration Site)
	1	Cavern Design
	1	Cavern Monitoring
	3	Coupled Processes
	2, 6	EcoHydrology
	3	Fractured Processes
	Distributed	GEOX™
	5, 6	Transparent Earth (Broadband Seismic Array)

Level	Site	Experiment
	5, 6	Transparent Earth (Earth Passive EEM1)
	5, 6	Transparent Earth (Active Seismic Monitoring)
	4	Transparent Earth (Earth Passive EEM2)
	4	Transparent Earth (Active Seismic Stress)
	Distributed	Transparent Earth (Earth Electrical Array)
4850	4	Transparent Earth (HPPP, MicroGravity, SQUID)
	Distributed	GEOX™
6800	1	Transparent Earth (HPPP, MicroGravity, SQUID)
	2	EcoHydrology
	2	Fractured Processes
	Distributed	GEOX™
	3	Transparent Earth (Broadband Seismic Array)
7400	1	Transparent Earth (HPPP, MicroGravity, SQUID)

Table 4.1.1-1 Surface Areas

Function	Minimum footprint	Excavation / Building/Room Number	
Long Term Equipment Storage (>TBD Days)			
Short Term Equipment Storage (< TBD Days)			
High Bay Surface Assembly Areas			
Shaft Hoist Staging Areas			
Experiment Control Rooms			
Experiment Computer Rooms			
Private Office Space			
Shared Meeting Rooms			
Shared Machine Shop			
Shared Electronics Shop			
Shared Break Room Facilities			
Lavatory (based on occupancy, shared with facility)			

Table 4.1.2-1 4850L Spaces

Function	Minimum footprint	Excavation / Building/Room Number	Comments
Long Term Equipment Storage (> TBD Days)		4850-005	Used for Excavation equipment assembly and maint. during excavation sequence. Post excavation, no clear allocation. Could be used for Science.
		4850-028	2ndary escape for LM1 utility room. Undesignated Storage Area.
Short Term Equipment Storage (< TBD Days)		4850-005	Used for Excavation equipment assembly and maint. during excavation sequence. Post excavation, no clear allocation. Could be used for Science.
		4850-028	2ndary escape for LM1 utility room. Undesignated Storage Area.
Shaft Hoist Staging Areas		None	Only the Drift Space is available. No staging areas available.

Function	Minimum footprint	Excavation / Building/Room Number	Comments
Transportation Corridors for Equipment and Personnel Ingress/Egress		4850-087 4850-006 4850-088 4850-033 4850-039 4850-029 4850-035 4850-036 4850-001 4850-004	Drift near Yates Shaft West Main Drift East Main Drift LM 1 East Access Drift LM 2 East Access Drift LM1 West Access Drift LM 2 West Access Drift LM 2 West Access Drift Main Drift to Ross Shaft Main Drift to #6 Winze
Experiment Assembly and Operation Space		4850-032 4850-038	Lab Module 1 Lab Module 2
Clean Machine Shop (60m^2)			
General Machine Shop (60m^2)		4850-113 -- This disappeared in latest Golder Table	Experiments and Facility share this machine shop.
Electronics Shop			
Copper Electroforming Laboratory		Majorana Transition Room	
Break Room Facilities		4850-062	AOR #4 (Near Yates Shaft)
		4850-098 4850-132	AOR #9 (Near Ross Shaft)
Lavatory (based on occupancy, shared with facility)		4850-062	AOR #4 (Near Yates Shaft)
		4850-098 4850-132	AOR #9 (Near Ross Shaft)
LBNE Needed Functions (TODO: merge)			

Table 4.1.3-1 7400L Spaces

Function	Minimum footprint	Excavation / Building/Room Number	
Long Term Equipment Storage (> TBD Days)			
Short Term Equipment Storage (< TBD Days)			
Winze Hoist Staging Areas			
Transportation Corridors			
Experiment Assembly and Operation Space			
Break Room Facilities			

Function	Minimum footprint	Excavation / Building/Room Number	Comments
Lavatory (based on occupancy, shared with facility)			

Table 4.01.02-02 Excavation Dimensions and Finishes for Rooms Used by Science (Common and Lab Module Spaces Only)

Excavation Number	DUSEL MREFC Scope Excavation Name	Width (ft)	Height (ft)	Length (ft)	Springline (ft)	Wall Finish Type [TBR-IRD-057]	Floor Finish Type [TBR-IRD-057]
4850-001	Ross Shaft to Main Access Drift	19.68	19.68	595.56	14.76	A	A
Numberless	Access Drift to #6 Winze						
4850-005	Construction Maintenance/Assembly Shop	42.64	27.06	65.60	16.40	A	A
4850-006	West Lab Access Drift	19.68	19.68	2,503.60	14.76	A	A
4850-028	Laydown Area #1	19.68	16.40	83.89	11.48	A	A
4850-029	Lab Module #1 West Access Ramp with transition (6x6 to 6x18.15)	19.68	39.61	145.27	34.69	A	A
4850-032	Lab Module #1	65.60	78.72	164.00	62.32	A	A
4850-033	Lab Module #1 East Main Access Drift	19.68	19.68	27.88	14.76	B	B
4850-034	Lab Module #1 Utility Room	42.64	22.96	137.00	12.30	A	A
4850-035	Lab Module #2 West Access Drift	19.68	16.40	24.25	11.48	A	A
4850-036	Lab Module #2 West Access Ramp (transition from 6x6 to 6x19.66)	19.68	42.08	202.39	37.16	A	A
4850-038	Lab Module #2	65.60	78.72	202.38	62.32	A	A
4850-039	Lab Module #2 East Main Access Drift	19.68	19.68	17.72	14.76	B	B
4850-087	Slashed drift at Yates Shaft	19.68	19.68	71.10	14.76	A	A
4850-088	East Lab Access Drift	19.68	19.68	853.25	14.76	B	B
4850-098	Area of Refuge 9 - East half	-	9.84	-	9.84	A	A

Table 4.03-1 Shaft and Winze Hoist Capability

Normal Speed Specification	Yates Service Hoist "Supercage"	Yates Auxilliary Hoist "Personnel Hoist"	Ross Service Hoist	Ross Production Hoist	No. 6 Winze Service Hoist
Hoist Type	**Conical DD**	**Blair**	**Conical DD**	**Conical DD**	**Koepe**
Payload Mass (tons)	20	5	6	11	6
Payload Personnel	103	24	60	N/A	60
Number of Decks	**1.00**	**2.00**	**2.00**	**1.00**	
Cage Inside Dimensions per Deck (height in ft)*	11'-6"	7'-0"	7'-0"	N/A	7'-0"
Cage Inside Dimensions per Deck (width in ft)*	11'-8 1/2"	4'-7"	4'-8"	N/A	4'-9"
Cage Inside Dimensions per Deck (length in ft)*	12'-6"	5'-8"	12'-4 1/2"	N/A	12'-4"
Cage Travel Time (one-way in minutes)	4.500	2.920	4.580	N/A	2.530
Cage Load/Unload Time (minutes)	5.000	1.500	7.000	N/A	7.000
Cage Total Time (one-way in minutes)	9.500	4.420	11.580	N/A	9.530
Total Availability (hours/day)	N/A	N/A	N/A	18	N/A
Upgrade for Slow Speed, High Capacity Slinging	**Yates Service Hoist**	**Yates Auxilliary Hoist**	**Ross Service Hoist**	**Ross Production Hoist**	**No. 6 Winze**
Hoist Type	**Conical DD**	**Blair**	**Conical DD**	**Conical DD**	**Koepe**
Max Slinging Conveyance Speed (ft/min)	150.000	N/A	150.000	N/A	150.000
Max Slinging Payload Mass (tons)	22.000	N/A	16.500	N/A	Conveyance 16.500 Counter 6.875

* Usable cage envelope for Experiments is rectangular

Table 4.06.04.02-1 Maximum Lifting Loads

Area	Maximum Load (single axis translation)	Maximum Load (dual axis translation)
Lab Module 1	40 T	20 T
Lab Module 2	40 T	20 T
Deep Level Lab Module 1	40 T	20 T

Table 6.02.01-1 Required cooling capacity for Lab Module chilled water and air handling system

	Chilled Water [kW]	Justification / Rationale	Waste heat to air [kW]	Justification / Rationale	Peak Power (REFERENCE ONLY!) [kW]
LM1	1800	DIANA Experiment + 50%	1400	Take the maximum power (with uncertainty) and subtract the lowest possible amount of water cooling: (Peak Power : 2.0MW) - [(Cooling Power:1463kW)/1.5*0.5]	2,000
LM2	840	EXO + GEODM + FAARM + 50%	820	Take the maximum power (with uncertainty) and subtract the lowest possible amount of water cooling: (Peak Power : 1.10MW) - [(Cooling Power:840kW)/1.50*0.50]	1,100
LMD	650	EXO + GEODM + 50% = 690. Value reduced to match the Peak Power since chilling capacity should never need to exceed power.	420	Take the maximum power (with uncertainty) and subtract the lowest possible amount of water cooling: (Peak Power : 650kW) - [(Cooling Power: 690kW)/1.50*0.50]	650
WCD					

Table 6.02.02.01-1 Number of Water Connections per area per water type [TBR-IRD-028]

	Number of Connections to Experiment Equipment					
Location	**Chilled Water**	**Potable Water**	**Industrial Water**	**Stage 1 Purified Water**	**Fire Water**	**Fire Water Mist**
LM1 Entrance	2	2	2	2	2	2
LM2 Entrance	4	4	4	4	4	4
LMD Entrance	3	3	3	3	3	3
Large Cavity WCD Campus		2				
BGE Experiments in the Mid Level Campus	None	None	None	None	None	None
Other 4850L Campus Facilities				None		
Davis Campus						
Ge Crystal Lab @ TBD Level						
Other Levels and Ramps (OLR) @ 300	Not available			0	Not Available	Not Available
Other Levels and Ramps (OLR) @ 800	Not available			0	Not Available	Not Available
Other Levels and Ramps (OLR) @ 2000	Not available			0	Not Available	Not Available
Other Levels and Ramps (OLR) @ 4100	Not available			0		
Other Levels and Ramps (OLR) @ 4550	Not available			0		
Other Levels and Ramps (OLR) @ 4850	Not available					
Other Levels and Ramps (OLR) @ 6800	Not available					
Other Levels and Ramps (OLR) @ 7400	Not available					
Ultra Deep Biological Observatory (Drill Room)						
Surface to CO2 Sequestration Facility						
Surface Machine Shops						
Surface Large Assembly Staging Areas						
Surface Office Space and Control Rooms						

Table 7.01-1 Amount of Water to be supplied to each location

	Potable Water				Industrial Water				Purified Water				
Location	**Volume [gal]**	**Frequency [times per month]**	**Flow Rate [gpm]**	**Minimum Supply Pressure [psi]**	**Volume [gal]**	**Frequency [times per month]**	**Flow Rate [gpm]**	**Minimum Supply Pressure [psi]**	**Volume [gal]**	**Frequency [times per month]**	**Flow Rate [gpm]**	**Minimum Supply Pressure [psi]**	**Notes**
LM1									1,083,106	Initial Water Shield Fill, then only upon anomalies	107		Assume water tank 19m high, 17m dia.; inner volume 9m high, 5m dia. Fill in 7 Days
LM2									2,641,721		107		Assume 2 water tanks 19m high, 17m dia. with inner volume 9m high, 5m dia. + FAARM. Fill each in 7 days.
Deep Level Lab Module (LMD)									581,179		58		Assume 2 water tanks 11m high, 12m dia. with inner volume 5m high, 6m dia. Fill in 7 days.
Large Cavity WCD Campus													
BGE Experiments in the Mid Level Campus													
Other 4850L Campus Facilities													
Davis Campus													
Ge Crystal Lab @ TBD Level													
Other Levels and Ramps (OLR) @ 300													
Other Levels and Ramps (OLR) @ 800													
Other Levels and Ramps (OLR) @ 2000													
Other Levels and Ramps (OLR) @ 4100													
Other Levels and Ramps (OLR) @ 4550													
Other Levels and Ramps (OLR) @ 4850													
Other Levels and Ramps (OLR) @ 6800													
Other Levels and Ramps (OLR) @ 7400													
Ultra Deep Biological Observatory (Drill Room)													
Surface to CO2 Sequestration Facility													
Surface Machine Shops													
Surface Large Assembly Staging Areas													
Surface Office Space and Control Rooms													

Table 7.05.01-1 Compressed Air [TBD-IRD-035]

Location	Flow Rate [cfm]	Maximum Pressure [psi]	Minimum Pressure [psi]	Number of Connections	Notes
LM1	100 @100psi 24 @175psi	>100			MAX made this request; other needs exist such as Radon Scrubbers
LM2	100 @100psi 24 @175psi	>100			MAX made this request; other needs exist such as Radon Scrubbers
LMD	100 @100psi 24 @175psi	>100			MAX made this request; other needs exist such as Radon Scrubbers
Large Cavity WCD Campus					
BGE Experiments in the Mid Level Campus					
Other 4850L Campus Facilities					
Davis Campus					
Ge Crystal Lab @ TBD Level					
Other Levels and Ramps (OLR) @ 300					
Other Levels and Ramps (OLR) @ 800					
Other Levels and Ramps (OLR) @ 2000					
Other Levels and Ramps (OLR) @ 4100					
Other Levels and Ramps (OLR) @ 4550					
Other Levels and Ramps (OLR) @ 4850					
Other Levels and Ramps (OLR) @ 6800					
Other Levels and Ramps (OLR) @ 7400					
Ultra Deep Biological Observatory (Drill Room)					
Surface to CO2 Sequestration Facility					
Surface Machine Shops					
Surface Large Assembly Staging Areas					
Surface Office Space and Control Rooms					

Table 7.03.01-1 Amount of Water to be removed from each location

	Waste Water					
Location	**Volume [gal]**	**Frequency [times per month]**	**Flow Rate [gpm]**	**Purity of Rejected Water**	**Maximum Release Pressure**	**Notes**
LM1	1,083,106	seldom	376 TBR		19m water head	Drain Water Shield half way in 1 day. Water in = water out
LM2	2,641,721	seldom	376 TBR		19m water head	Drain Water Shield half way in 1 day. Water in = water out
LMD	581,179	seldom	203 TBR		11m water head	Drain Water Shield half way in 1 day. Water in = water out
Large Cavity WCD Campus						
BGE Experiments in the Mid Level Campus						
Other 4850L Campus Facilities						
Davis Campus						
Ge Crystal Lab @ TBD Level						
Other Levels and Ramps (OLR) @ 300						
Other Levels and Ramps (OLR) @ 800						
Other Levels and Ramps (OLR) @ 2000						
Other Levels and Ramps (OLR) @ 4100						
Other Levels and Ramps (OLR) @ 4550						
Other Levels and Ramps (OLR) @ 4850						
Other Levels and Ramps (OLR) @ 6800						
Other Levels and Ramps (OLR) @ 7400						
Ultra Deep Biological Observatory (Drill Room)						
Surface to CO2 Sequestration Facility						
Surface Machine Shops						
Surface Large Assembly Staging Areas						
Surface Office Space and Control Rooms						

Table 9.01.01-1 ISE Power Requirements by Location

Location	Normal Power (W)	Rationale	Standby Power (W)	Rationale
Lab Module #1	2,000,000	DIANA 1.5MW load + 33% margin	100,000	
Lab Module #2	1,100,000	EXO + GEODM + FAARM + 33%	160,000	
7400L Lab Module (LMD)	650,000	EXO + GEODM + 33%	100,000	
Large Cavity WCD	See LBNE IRD		See LBNE IRD	
Science on OLR at 4850L		BGE Experiments TBR-IRD-026 The value here is currently contained in the OLR numbers	0	
Science Support Facilities at 4850L	436,000	Science Machine Shops, Electroforming Lab	0	
Davis Campus	700,000	TBR-IRD-025. Includes experiments and electroforming (current and future), misc support lab.	160,000	
Ge Crystal Lab (Assuming at 4850L)	375,000	Level for this lab space is still being determined. TBD-IRD-027	0	
Other Levels and Ramps (OLR) @ 300	20,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Other Levels and Ramps (OLR) @ 800	20,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Other Levels and Ramps (OLR) @ 2000	210,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Other Levels and Ramps (OLR) @ 4100	320,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Other Levels and Ramps (OLR) @ 4550	20,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Other Levels and Ramps (OLR) @ 4850	710,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Other Levels and Ramps (OLR) @ 6800	130,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Other Levels and Ramps (OLR) @ 7400	470,000	BGE Experiments TBR-IRD-026	0	BGE Experiments TBR-IRD-026
Ultra Deep Biological Observatory (Drill Room)	258,000	This was in the Power Subsystem Specification. This line item is for EcoHydrology. Unclear whether this number is already incorporated in the 7400L OLR.	0	
Surface power to CO2 Sequestration	320,000	CO2 group + 33% margin. Note that power for all levels of this experiment are supplied through the CO2 Sequestration Surface Facility by the Experiment.	0	BGE Experiments TBR-IRD-025
Surface Machine Shops	120,000	Same estimate as for underground--60kW for Clean and General Machine Shop	0	
Surface Large Assembly Staging Areas	0	TBD-IRD-023 -- No experiment operations here, just assembly	0	
Surface Office Space and Control Rooms		TBD-IRD-024 -- Perhaps budget for 4 workstations, a printer, fax, supplemental lighting…typical office space electrical sizing should be sufficient.	0	TBD-IRD-024 -- There should be some continued load in the control room
Total ISE Power	**7,859,000**		**520,000**	

Table 11.01.02-1 Electrical Outlet Location on OLR

OLR Level	Location(s)	Type of Power	Outlet Type	Spacing [feet]
300				
800				
2000				
4100				
4550				
4850				
6800				

Table 12.02-1 Experiment Data Connections

Location	Data Rate [Gb/s]	Outlet Type	Number of Connections in Location	Capacity of Each Connection [Gb/s]	Daily Through-put	Spacing	Notes
Surface							
Lab Module 1	10	TBD	4 TBR	1 TBR			
Lab Module 2	10	TBD	8 TBR	1 TBR			
Deep Level Lab Module	10	TBD	4 TBR	1 TBR			
WCD	See LBNE IRD	ee LBNE IR	See LBNE IRD	See LBNE IRD	See LBNE IRD	See LBNE IRD	See LBNE IRD
300L BGE	1	TBD	TBD	TBD			
800L BGE	1	TBD	TBD	TBD			
2000L BGE	1	TBD	TBD	TBD			
4100L BGE	1	TBD	TBD	TBD			
4550L BGE	1	TBD	TBD	TBD			
4850L BGE	1	TBD	TBD	TBD			
6800L BGE	1	TBD	TBD	TBD			

Table 13.01-1 Environmental Conditions

	Surface Facilities	Lab Module 1	Lab Module 2	Deep Level Lab Module	Large Cavity	4850L Drifts	OLR
Pressure* **	5300' elevation 834 mb [TBR-IRD-053]	450' elevation 997 mb [TBR-IRD-053]	450' elevation 997 mb [TBR-IRD-053]	-2100' elevation 1093 mb [TBR-IRD-053]	450' elevation 997 mb [TBR-IRD-053]	450' elevation 997 mb [TBR-IRD-053]	
Temperature		68 to 77 deg F (20 to 25 deg C)	68 to 77 deg F (20 to 25 deg C)	68 to 77 deg F (20 to 25 deg C)			
Relative Humidity		20 to 45 %	20 to 50 %	20 to 50 %			
Oxygen, Nitrogen, CO2, Argon	Standard Atmosphere	Surface Conditions, Standard Atmosphere	Surface Conditions, Standard Atmosphere	Surface Conditions, Standard Atmosphere	Surface Conditions, Standard Atmosphere	Surface Conditions, Standard Atmosphere	Surface Conditions, Standard Atmosphere
Radon	Meets OSHA Requirements	Meets OSHA Requirements	Meets OSHA Requirements	Meets OSHA Requirements	Meets OSHA Requirements	Meets OSHA Requirements	Meets OSHA Requirements

* Values taken from the 1976 US Standard Atmosphere for the elevations listed. Actual pressure is expected to vary based on surface atmospheric conditior

** Under emergency conditions, the pressure in the Lab Modules will be maintained at a negative pressure with respect to the neighboring drift areas.

Table 14.01-1 Lab Rooms and OLR Occupancy Model

Note: This is an estimation model only and does not imply any true or planned start dates for any individual experiment.

SS = Steady State operation

Assumptions:

Assume 3 yrs to install LBNE, 2 yrs per LM experiment.
Assume LBNE LC detectors installed in series.
Assume typical experiment operates for five years, followed by a new experiment installation.
Numbers below only include occupancy directly related to experiment installation and operation. Does not include any other personnel.
20 people needed per experiment to install equipment for LM Experiments
6 people needed to operate each LM Experiment
50 people needed to install LBNE Experiment
2 Large Cavities
Assumes only one experiment in Lab Module 1 at a time.
Assumes experiment assembly of 2 experiments at the same time in Lab Module 2
Experiment calibrations every several months and lasting a week involve a staffing of 10-12 people. This activity is factored into the Operation occupancy counts.
BGE Experiments staggered start on 4850L OLR.

OCCUPANCY MODEL

4850 L

	Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Davis Campus											
Experiment Room	LUX operation	6									
	Installation		20	20					20	20	
	Operation				6	6	6	6			6
Electroforming and Machining	Operation	10	10	10	10	10	10	10	10	10	
LM1											
Experiment 1 (DIANA or other Physics)	Installation	20	20						20	20	
	Operation			6	6	6	6	6			6
Experiment 2 (R&D Space)	Installation	5									
	Operation		3	3	3	3	3	3	3	3	3
LM1 Total		**25**	**23**	**9**	**9**	**9**	**9**	**9**	**23**	**23**	**9**
LM2											
Experiment 1	Installation	20	20						20	20	
	Operation			6	6	6	6	6			6
Experiment 2	Installation		20	20						20	20
	Operation				6	6	6	6	6		

	Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Experiment 3	Installation			20	20						20
	Operation					6	6	6	6	6	
LM2 Total		20	40	46	32	18	18	18	32	46	46
Long Baseline Experiments											
Large Cavity 1	Installation				50	50	50				
	Operations							20	20	20	
Total - 4850 L Main Campus		**61**	**93**	**85**	**107**	**93**	**93**	**63**	**105**	**119**	**61**
Other Levels and Ramps BGE Experiments [TBR-IRD-046]											
See "OLR BGE Tables" tab for nomadic BGE experiments											
THMCB	Construction	10									
	Installation		4								
	Operations			2	2	2	2	2	2	2	2
Ecohydrology	Construction		5								
	Installation			2							
	Operations				1	1	1	1	1	1	1
Fracture Processes	Construction			10							
	Installation				4						
	Operations					2	2	2	2	2	2
4850L OLR BGE Subtotal		10	9	14	7	5	5	5	5	5	5
7400L BGE Experiments											
Ecohydrology	Construction	10	-	-	-	-	-	-	-	-	-
	Installation	-	4	-	-	-	-	-	-	-	-
	Operations	-	-	2	2	2	2	2	2	2	2
7400L OLR BGE Subtotal Total		10	4	2	2	2	2	2	2	2	2
Total BGE OLR		20	13	16	9	7	7	7	7	7	7
7400 L											

LM1	Activity	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Experiment 1	Installation	20	20						20	20	
	Operation			6	6	6	6	6			6
Experiment 2	Installation		20	20						20	20
	Operation				6	6	6	6	6		
Total - 7400 L		**20**	**40**	**26**	**12**	**12**	**12**	**12**	**26**	**40**	**26**
Total - 4850 L + 7400 L	-	**81**	**133**	**111**	**119**	**105**	**105**	**75**	**131**	**159**	**87**
Total - 4850 L + 7400 L + OLR	-	**101**	**146**	**127**	**128**	**112**	**112**	**82**	**138**	**166**	**94**

Verification Methods

Method	Criteria
Test	
Analysis	
Inspection	
Demonstration	

Glossary

Term	Description
Alternate Power	Any power that is not Normal Power (Emergency Power and Standby Power).
Buffer Size	Allowance in meters, either radially or axially, for the PMT's, their support, and a fiducial volume cut. It is measured as the thickness of water layer from the extreme perimeter of the water to the boundary of the fiducial volume.
Chilled Water (Return)	Formerly chilled water that has been through heat exchangers, piped through return lines to a chiller.
Chilled Water (Supply)	Water chilled by the cooling towers on the surface. Additional chillers may be located below grade as well. Chilled water utilizes untreated or industrial water.
Connected Load (Electrical)	Max load connected to the normal or standby power systems, whether the load is normally active, off, or in standby mode.
Deck	Structure above the water to allow occupancy of the excavation volume above the water with people, equipment, or other apparatus.
Emergency Power	Power reserved exclusively for fire/life safety systems
Fiducial Volume	Volume of water available for physics analysis, after removing the volume occupied by the PMTs, their support, and a fiducial volume cut.
Fiducial Volume Cut	Allowance in meters, either radially or axially, between the maximum extent of photocathode and the volume of water used for physics analysis.
Freeboard	Distance between the top of the water level (LC1) and the next higher element in the cavity that the water should not touch
Free Diameter	Unobstructed diameter of the stable, excavated cavern - diameter equivalent of 'neat line' boundary

Term	Description
Free Height	Distance from a [possibly virtual] flat surface at the bottom of the cavity or drift that represents the free, unobstructed height to the 'neat line' at the top of the crown.
Gobfill	Empty spaces in mine filled up with mine waste
Industrial Water	Untreated water provided by Lead Municipal Water facility. This water is drinkable quality, but no chlorine or fluoride has been added (similar to well water).
Invert	Lowest level of excavation space. See Figure 3.03.02-01.
Mine Water	Also known as Native water - water that naturally collects in the mine from underground seepage or springs. This water is extremely high in iron and is rust red in appearance.
MLL 4850L RO Water Purification System	Reverse Osmosis System located in or near the LC1 cavity
Muck	Waste Rock
Native Water	Also known as Mine water - water that naturally collects in the mine from underground seepage or springs.
Neat Line	Unobstructed volume of excavation. No outcropping or uneven excavation wall will intrude into the 'neat line'. See Figure 3.03.02-01.
Nominal Load (Electrical)	Nominal load expected during normal operations.
Normal Power (Electrical)	Power used for normal or nominal operations for facility and experiments
Peak Load (Electrical)	Peak expected load with all loads that can be active at once activated.
Plant Room	
Potable Water	Treated water provided by Lead Municipal Water facility. This water is untreated water, to which chlorine and fluoride has been added. No additional treatment is done.
Process Water	

Term	Description
Return Air	Fresh or recirculated air pulled into the AHUs for conditioning.
Stage 1 Purified Water	Water that exits the surface water purification plant. This describes the water flow between the point of production and point of usage.
Standby Power	Power generated on site for maintaining minimal operations during loss of normal power.
Springline	Highest level of excavation space, prior to the beginning of the upper arch of the excavation. See Figure 3.03.02-01.
Sump	Line below the level (i.e. 4850L) to allow for drainage, cryo leakage, etc. See Figure 3.03.02-01.
Supply Air	Air supplied by the AHUs to the underground spaces.
Surface RO Water Production System	Reverse Osmosis System located in the Yates Hoist Room
Ventilation Air	Fresh air pulled into the surface via the Ross and Yates shaft, and returned to the surface via the Oro Hondo shaft.

LBNE Specific Requirements and Tables

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
4.00	**PHYSICAL AND MECHANICAL INTERFACES**	
4.01	**ACCESSIBLE AREAS**	
4.1.1	**Surface**	
	Surface space shall be allocated to LBNE as specified in [Table 4.1.1-1][TBR-LBN-1].	Space allocation available from DUSEL may be insufficient for LBNE assembly and data handling requirements.
4.1.2	**4850L Campus**	
	Underground space at the 4850 level shall be allocated to LBNE as specified in [Table 4.1.4-1][TBR-LBN-2].	Access to LBNE underground water purification system will be in 4850-024. Excavation to be sufficient in size for installation of 1200 gpm water recirculation loop + headroom sufficient to allow for recharging of chemicals to water system. Size of excavation for drifts -024 -is TBR.
	The intended function of each of the underground spaces allocated to LBNE are as stated in Table 4.1.4-1.	Secondary access via stairway to 5060. Electric power routed via borehole to keep DC current source out of LC1.
	The underground spaces allocated to LBNE shall be oriented with respect to each other as shown in [Figure 4.1.2 1][TBR-LBN-3].	There is tentative agreement on sizes of excavations in Golder 60% design documents pending incorporation of: monorail support points; updated electrical / mechanical rooms (resizing for DUSEL Design Guidance) Excavation size to be sufficient to allow for Clean, Control, Electrical, Mechanical, and WCD gas blanket rooms, 3m line-of-sight survey alcove to drift 24, piping, ventilation ducting, and cables / conduits-Size of excavation for drifts -023 -is TBR.

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
	Excavation 4850-014 (LC1) shall have the dimensions shown in [Figure 4.1.2-2]	Diameter of 55m to neat line allows for integration of LBNE design features for vessel and Fiducial Volume Cut. 1m radial allocated to vessel and 2.5 m radial allocated to PMT + fiducial volume cut. Net fiducial volume is 48m diametrically. Refer to LBNE Figures 1 & 2.
	Excavation 4850-014 (LC1)features shall have the elevations shown in [Figure 4.1.2-2][TBR-LBN-5]	
4.1.3	**7400L Campus**	
4.1.4	**Other Levels and Ramps**	
	Underground space at the 5060 levels shall be allocated to LBNE as specified in [Table 4.1.4-1][TBR-LBN-6].	Listed leakage of 100 liters / minute scaled from existing experiment at Super-K (Japan). Sump design to be consistent with segregation of vessel water from native water as required for TBD Vessel water additives.
	The facility shall be responsible for providing a 76,000 gallon sump for the LBNE containment water in excavation 5060-019.	Based on 2-days of vessel leakage at a rate of 100 liters/minute (38,000 gallons per day)
4.20	**COORDINATE SYSTEM, DIMENSIONS, AND TOLERANCES**	
4.30	**SHAFT AND WINZE HOIST INTERFACES**	
4.3.1	**Lifting Capacity**	
4.3.2	**Cage Envelopes**	
4.3.3	**Suspended Load Envelopes**	
4.40	**TRANSPORTATION INTERFACES**	
4.50	**ACCESS DRIFT INTERFACES**	
4.60	**EXPERIMENT ROOM AND AREA INTERFACES**	
	The facility provided concrete floor of excavation 4850-023 shall be at the same level as the LBNE LC#1 deck shown in [Figure 4.6-1][TBD-LBN-7].	
4.6.1	**Access to Experiment Rooms**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
4.6.2	**Experiment Envelope**	
	The LBNE envelope of usable space per allocated space shall be as shown in [Figure 4.6.2-1][TBD-LBN-8].	
4.6.2.1	**Physical Envelope**	
4.6.3	**Laydown and Assembly Space**	
4.6.4	**Lifting Interfaces**	
4.6.4.1	**Maximum Uni-axial Lifting Load**	
4.6.4.2	**Maximum Bi-axial Lifting Load**	
4.6.4.3	**Travel, Span, and Hook Height**	
4.6.4.4	**Mechanical Hook Interfaces**	
4.6.5	**Floor Interfaces**	
4.6.5.1	**Floor Surface Properties**	
4.6.5.1.1	**Material**	
4.6.5.1.2	**Flatness**	
4.6.5.1.3	**Slope**	
4.6.5.1.4	**Mechanical Attachment**	
4.6.6	**Wall and Dome Interfaces**	
4.6.6.1.1	**Surface Properties**	
4.6.6.1.2	**Mechanical Attachment**	
5.00	**STRUCTURAL INTERFACES**	
5.10	**LOADS**	
5.1.1	**Floor Loading**	
	The Facility shall provide an invert (floor) in the Large Cavity that can withstand a distributed floor loading of at least 242 psi (1.67 MPa) [TBR-LBN-041]. Note that this is not a point load.	Hydrostatic pressure for the WCD.
5.1.2	**Wall and Dome Loading**	
	The LBNE vessel shall be designed to withstand a hydrostatic pressure of [TBD-LBN-9].	Suspended loads previously discussed. Limited geotechnical investigative data available to date.
	The Facility shall provide wall and or dome support to accommodate [TBD-LBE-043] loads that support the LBNE deck in the Large Cavity.	
5.1.3	**Concurrent Excavation Environment**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
	The LBNE experiment shall be able to utilize excavation 4850-023 for experiment laydown [TBR-LBN-10].	Underground assembly space is required. Utilization of drift -023 is only way to avoid addition of another large excavation.
5.1.4	**Hoist Transportation Loads**	
5.20	**STRUCTURAL DESIGN**	
	Experiment structures shall meet the [TBD-LBN-38] codes and standards.	Drawings for structural components within Sanford Lab are expected to require PE stamp for use in SD. Reciprocity between states for applicability of out-of-state PE license has not been investigated.
5.30	**ACOUSTICS**	
5.3.1	**Environmental**	
5.3.2	**Experiment Equipment Generated**	
5.40	**DE-PRESSURIZATION / RE-PRESSURIZATION**	
6.00	**COOLING SYSTEM AND THERMAL INTERFACES**	
6.10	**GENERAL REQUIREMENTS**	
6.1.1	**Active Temperature Control Areas**	
	The facility shall provide active temperature control in excavation 4850-014 (LC#1 dome) above the deck.	Dome area to be temperature / humidity controlled to: minimize heat flow into WCD water; protect electronics from both mold (high humidity) and arcing (low humidity).
	[The LBNE experiment shall be responsible for the active temperature controls in the experiment rooms located in excavation 4850-023][TBR-LBN-12].	Control room and clean rooms will be occupied spaces. Calibration storage to contain articles of TBD sensitivity to temperature / humidity.
6.1.2	**Heat Loads in Experiment Spaces**	
	The heat loads generated by LBNE shall be no greater than the values specified in [Tables 6.1.2-1 & 2][TBR-LBN-13].	Assessment of supporting equipment.
6.1.4	**Condensation Prevention**	
	The design of the LBNE experiment shall preclude personnel hazards due to condensation.	Allowed relative humidity will cause dew point to be higher than water temperature.
6.20	**CHILLED WATER**	
6.2.1	**Chilled Water Allocations**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
	The facility shall provide adequate chilled water to LBNE to remove the heat load specified in [Table 6.2.1-1][TBR-LBN-14].	Experiment-furnished chiller may be required for temperature control of WCD water. Facility-furnished chiller has better location for drift temperature control.
6.2.2	**Chilled Water Physical Interfaces**	
	[The facility shall provide LBNE 570 kW electrical power to the LBNE surface water purification plant.][TBR-LBN-16]	
	LBNE shall provide a heat exchanger to reject heat from the underground purified water (stage 2 RO) to the facility chilled water.	LBNE requirements carrying underground chiller - discussion between ARUP and LBNE indicates that heat exchanger may be used to replace underground chiller for system efficiency and less heat rejection to underground space. - cost equivalence to be verified.
6.2.2.1	**Physical Connections**	
6.2.2.2	**Wetted Materials**	
6.2.2.3	**Working Fluid**	
6.2.2.4	**Flow Rate**	
6.2.2.5	**Pressure Drop**	
6.2.2.6	**Supply Temperature**	
	The facility shall provide chilled water to LBNE 46F (7.7o C) +/- [TBD-LBN-17]	
6.2.2.7	**Return Temperature**	
6.2.2.8	**Maximum Pressure**	No special requirements beyond Arup 60% design.
7.00	**WATER AND COMPRESSED AIR SYSTEM INTERFACES**	
7.10	**POTABLE WATER**	
7.1.1	**Potable Water Allocations**	
7.1.2	**Potable Water Physical Interfaces**	
7.1.2.1	**Physical Connections**	
	INDUSTRIAL WATER	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
	The facility shall provide LBNE a maximum of 600 gpm [TBR-LBN-15] gpm of industrial water to support the LBNE surface water purification plant.	
7.1.2.2	**Wetted Materials**	
7.1.2.3	**Working Fluid**	
7.1.2.4	**Flow Rate**	
7.1.2.5	**Supply Temperature**	
7.1.2.6	**Maximum Pressure**	
7.20	**PURIFIED WATER**	
7.2.1	**Purified Water Allocations**	
	LBNE shall provide [TBD-LBN-18] gpm of surface purified (stage 1 RO) water to the facility [intermittently][TBR-LBN-19].	
7.2.2	**Purified Water Physical Interfaces**	Purified water system being included in Water Cherenkov Conceptual Design
	Facility shall provide space in the Yates shaft for a [8 inch] [TBR-LBN-20] supply pipe.	Design / scope of supply pipe is LBNE workscope.
	[Facility shall provide [TBD-LBN-21] space in the Yates shaft for pressure relief stations.] [TBR-LBN-38]	Purified water system being included in Water Cherenkov Conceptual Design. Design / construct scope of supply pipe is LBNE workscope.
	[The facility shall provide a [TBD-LCV-003] sump for draining the LC tank.] [TBD-LBN-044]	
7.2.2.1	**Physical Connections**	
	[The purified water supply line from the surface to the underground shall have a tap close to the lab modules per Figure] [TBD-LBN-045]	There needs to be a tie-in point between the facility and the LBNE supply line in order to supply water to the lab modules.
7.2.2.2	**Wetted Materials**	
7.2.2.3	**Working Fluid**	
	The surface purified water provided by LBNE to the facility, as measured at the exit of the water plant, shall meet the ASTM D1193-91 Type 1 Standard.	Water purity established via experiment-furnished water purification system. This should provide 18MOhm water at 25degC.
7.2.2.4	**Flow Rate**	
7.2.2.5	**Pressure Drop**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
7.2.2.6	**Supply Temperature**	
	The surface purified water provided by LBNE to the facility, measured at the exit of the water plant, at a nominal temperature of [TBD-LBN-22].	
7.2.2.7	**Maximum Pressure**	
	The pressure of the surface purified water (stage 1 RO water) provided by LBNE to the facility shall be [TBD-LBN-23] psi.	BD - design from surface to 4850 has not yet been determined. Possible maximum pressure of 2100-2500 psi. Ongoing design trade for LBNE Experiment Conceptual Design
7.30	**WASTE WATER**	
7.3.1	**Waste Water Allocations and General Requirements**	
	The facility shall be capable of accepting up to 50 gpm of surface purified (stage 1 RO) waste water with a worst case concentrations of total dissolved solids of 1.4E-2 lb/gal (1,636 mg/liter) and .37 lb/gal (45 gm/liter) salt [TBR-LBN-24].	Waste stream carries away concentrated materials removed from supply water stream.
	The facility shall be capable of accepting up to 300 gpm of surface purified (stage 1 RO) waste water with total suspended solids [TBD-LBN-25] water quality with a maximum expected water volume per day of 1800 gal.	Daily cleaning of surface water purification plant during filling operations.
	The facility shall be capable of accepting up to 50 gpm [of underground purified (stage 2 RO) waste water with [TBR-LBN-26] water quality.] [TBR-LBN-27]	Waste stream carries away concentrated materials removed from supply water stream.
	The surface purified (stage 1 RO) and underground purified (stage 2 RO) water shall be shown to meet the water quality standards of DUSEL Facility Requirements ConfigDoc-83, Para. 3.03.01.05 prior to discharge into the facility waste stream.	
	Experiment provided sump pumps shall be functionally redundant.	
7.3.2	**Waste Water Physical Interfaces**	
7.3.2.1	**Physical Connections**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
7.3.2.2	**Wetted Materials**	
7.3.2.3	**Dispelled Fluids**	NaCl added in water softener charge. No other chemicals added.
7.3.2.4	**Flow Rate**	
7.3.2.5	**Maximum Pressure**	
7.40	**FIRE WATER AND MIST WATER (SEE FLS SECTION)**	
7.50	**COMPRESSED AIR**	
7.5.1	**Compressed Air Allocations**	
	The facility shall provide up to 380 cfm (650 m3/hr) of compressed air to the LBNE underground facility. [TBD-LBN-28]	Preliminary assessment of equipment needed for radon removal (either radon scrubber or nitrogen generator)
7.5.2	**Compressed Air Physical Interfaces**	
7.5.2.1	**Physical Connections**	
	The interface(s) to the underground compressed air shall be as shown in [Figure7.5.2.1-1.][TBD-LBN-29]	
7.5.2.2	**Flow Rate**	
	See 7.5.1.	Preliminary assessment of equipment needed for radon removal (either radon scrubber or nitrogen generator)
7.5.2.3	**Interface Pressure**	
	The compressed air provided to LBNE shall be at 125 psi (0.1 Mpa) nominal. [TBD-LBN-30]	Preliminary assessment of equipment needed for radon removal (either radon scrubber or nitrogen generator)
7.5.2.4	**Pressure Drop**	
7.5.2.5	Maximum Design Pressure	
7.5.2.6	**Interface Temperature**	
7.5.2.7	**Working Fluid**	
8.00	**EXHAUST AIR INTERFACES**	
8.10	**GENERAL REQUIREMENTS**	
8.1.1	**Pressure Relief / Vent Valve Sizing**	
8.1.2	**Pressurized Gas Systems**	
8.20	**EXPERIMENT ROOM EXHAUST**	
8.2.1	**Temperature Limits**	
8.2.2	**Contamination**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
	LBNE shall be capable of using [TBD-LBN-32] diesel machinery during experiment assembly.	Diesel is utilization factor for sizing ventilation
8.30	**DUCTED EXHAUST SYSTEM**	
8.3.1	**Physical Connections**	
8.3.2	**Input Pressure / Flowrate Limit**	
8.3.3	**Input Temperature / Flowrate Limit**	
8.3.4	**Interface Pressure**	
8.3.5	**Pressure System Maximum Design Pressure**	
8.3.6	**Acceptable Effluents and Gasses**	
8.3.7	**Applicable Codes and Standards**	
9.00	**ELECTRICAL POWER INTERFACES**	
9.10	**POWER ALLOCATIONS**	
9.1.1	**Normal Power**	
	The facility shall provide electrical power to the areas listed as specified in [Table 9.1.1-1][TBR-LBN-35].	Preliminary assessment of equipment needed for WCD
9.1.2	**Alternative Power**	
9.20	**ELECTRICAL POWER LIMITATIONS**	
9.2.1	**Power Loss**	
9.2.1.1	**Reliability and Availability**	
	Electric power shall be available at all times (during planned maintenance) per [Table 9.2.1.1-1][TBR-LBN-36].	Preliminary assessment of WCD systems that cannot shutdown for planned maintenance. During planned maintenance, LBNE will operate in a degraded power mode that allows sensors and data systems to continue operation.
9.2.1.2	**Uninterrupted Power Supply**	
9.2.1.3	**Unplanned ~~Maintenance~~ Outage**	
	The facility shall provide standby power to LBNE per [Table 9.2.1.3-1][TBR-LBN-37].	Sumps to remain active during unplanned outage due to limited sump size.
9.2.1.4	**Automatic Starting after Power Loss**	
9.2.1.5	**Emergency Operational Modes**	
9.2.1.6	**Experiment Activation/Deactivation and Isolation**	
9.2.2	**Electrical Safety and Hazards**	
9.30	**POWER CHARACTERISTICS**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
9.3.1	**120 V AC Power and Voltage**	
9.3.1.1	**Voltage Levels**	
9.3.1.2	**Inrush Current**	
9.3.1.3	**Power Bus Ripple and Transient Spike Limits**	
9.3.2	**480Y/227V AC Power and Voltage**	
9.3.2.1	**Voltage Levels**	
9.3.2.2	**Inrush Current**	
	The power factor of LBNE equipment connected to the facility Power subsystem shall be > 0.85.	Power factor to be controlled to limit peak currents.
9.3.2.3	**Power Bus Ripple and Transient Spike Limits**	
9.3.3	**12kV AC Power and Voltage**	
9.3.3.1	**Voltage Levels**	
9.3.3.2	**Inrush Current**	
9.3.3.3	**Power Bus Ripple and Transient Spike Limits**	
9.40	**GROUNDING**	
9.50	**SEPARATION OF POWER BETWEEN EXPERIMENTS**	
9.60	**OVERLOAD PROTECTION**	
10.00	**ELECTROMAGNETIC COMPATIBILITY**	
10.10	**DUSEL-PRODUCED INTERFERENCE ENVIRONMENT**	
10.1.1	Conducted Interference	
	There shall be no facility generated DC currents in excavation 4850-014 (LC#1) dome.	DC currents will bias earth field correction coils.
10.1.2	**Radiated Interference**	
10.20	**ELECTROMAGNETIC COMPATIBILITY**	
10.30	**ELECTRICAL COMPATIBILITY**	
10.3.1	**Electrical Bonding**	
10.3.2	**Primary and Alternative Power Isolation**	
10.3.3	**Technical Grounds**	
10.3.4	**Ethernet Isolation and Grounding**	
10.3.5	**Fire Control System Isolation and Grounding**	
11.00	**ELECTRICAL WIRING INTERFACES**	
11.10	**ELECTRICAL CONNECTION LOCATIONS**	
11.20	**HARDWARE REQUIREMENTS**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
12.00	**CYBER INFRASTRUCTURE INTERFACES**	
12.10	**GENERAL**	
12.1.1	**Time**	
12.1.2	**Data Storage**	
12.1.3	**Reliability and Availability**	
12.1.5	**Data Exchange**	
	The facility shall provide the LC1 native water influx rate and hydrostatic pressure to LBNE over the life of the experiment.	
	The facility shall monitor electrical subsystem parameters of power in the LBNE underground experiment space.	
12.20	**NETWORKS**	
12.30	**ETHERNET COMMUNICATIONS WITH LAB SYSTEMS**	
	The facility shall provide [TBD-LBN-33] channels of 1 Mbyte/s throughput.	
12.40	**FIRE AND LIFE SAFETY SYSTEM COMMUNICATIONS**	
13.00	**ENVIRONMENTAL INTERFACES**	
	LBNE shall be located at the 4850L.	Cosmogenically produced long-lived neutral K produced in the rock and decaying into a K+ in the detector.
13.10	**ENVIRONMENTAL CONDITIONS**	
	[The temperature in the dome of excavation 4850-014 (LC) shall be 65-77F with a humidity range of 30 to 50% relative humidity.][TBR-LBN-34]	Control heat into WCD water.

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
	The facility shall provide a correlation between blasting and ground motion to LBNE. This information shall include data from 3 axis accelerometers; FFT of spectrums; and transfer functions that correlate distance from charge to weight of explosives.	
	The facility shall provide rock creep prediction of the excavation 4850-014 (LC#1).	
13.20	**ATMOSPHERIC REQUIREMENTS**	
13.2.1	**Oxygen Consumption**	
13.2.2	**Chemical Releases**	
13.30	**CLEANLINESS**	
13.3.1	**Air Particulates**	
13.3.2	**Experiment Exhaust**	
13.40	**ILLUMINATION**	
	The facility shall provide lighting in the excavations listed in Table 4.1.4-1 [except for excavation 4850-14] [TBD-LBN-042].	
13.4.1	**Laboratory Space**	
13.4.2	**Supplemental Lighting**	
13.50	**RADIATION ENVIRONMENT**	
13.5.1	**Background DUSEL Radiation**	
13.5.1.1	**Radon**	
13.5.1.2	**Gamma Rays**	
13.5.2	**Experiment Emissions**	
13.60	**PARTICLE ACCELERATOR REQUIREMENTS**	
14.00	**HUMAN FACTORS INTERFACE REQUIREMENTS**	
14.10	**OCCUPANCY**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
14.20	**EGRESS CORRIDORS**	
14.30	**LABELING**	
14.40	**HOSE/CABLE RESTRAINTS**	
14.50	**WASTE MANAGEMENT**	
14.5.1	**Human Waste**	
14.5.2	**Garbage**	
14.5.3	**Special Disposal**	
15.00	**MATERIALS AND PARTS INTERFACES**	
16.00	**FIRE AND LIFE SAFETY INTERFACES**	
16.10	**FIRE PREVENTION REQUIREMENTS**	
16.20	**EXPERIMENT DATA MONITORING**	
16.30	**FIRE SUPPRESSION SYSTEM INTERFACES**	
16.3.1	**Liquid Fire Suppression System Interfaces**	
	The facility shall provide fire sprinklers in the excavations listed in Table 4.1.4-1 except for excavation 4850-14.	
	The facility shall provide a fire sprinkler water supply pipe at the interface between excavation 4850-014 and excavation 4850-136 and 4850-023.	
	LBNE shall provide the fire suppression system in excavation 4850-014.	
16.3.2	**Mist-Water Fire Suppression System Interfaces**	
	The facility shall provide a mist-water supply pipe at the interface between excavation 4850-014 and excavation 4850-136 and 4850-023.	
17.00	**OPERATIONAL REQUIREMENTS**	
17.10	**OPERATIONAL LIFETIME**	
	The Large Cavity shall have an operational lifetime of 30 years.	
17.20	**SURFACE SERVICES**	
17.30	**CONSTRUCTION PROCESS**	
17.3.1	**Experiment Construction Schedule**	

New ID	Requirement Statements (or Heading, Information, etc.)	Rationale
17.40	TRANSPORT FROM SURFACE TO UNDERGROUND SPACES	
17.4.1	Equipment Orientation during Transportation	
17.4.2	Hoists and Shafts	
17.4.2.1	Availability	
17.4.3	Drifts and Ramps	
17.4.3.1	Availability	
17.50	STAFFING	
17.5.1	Facility Construction	
17.5.2	Experiment Installation and Assembly	
17.5.3	Operations	
17.5.4	Calibration	
17.60	EXPERIMENT MONITORING	
17.70	EXPERIMENT DE-COMMISSIONING	
18.00	VARIANCES	
18.10	Combustible materials	
19.00	GUIDE TO EXPERIMENT INTEGRATION WITH DUSEL	
19.10	INTEGRATION PROCESS FOR EXPERIMENT INTEGRATION	
19.1.1	Functional Requirements	
19.1.2	Experiment Safety Requirements	
19.1.3	Applicable Codes and Standards	
20.00	VERIFICATION	
20.10	TRACEABILITY	
21.00	NOTES	
22.00	ACRONYMS	
23.00	GLOSSARY	

TBX #	Description	Closure Plan	Assignee	Status
TBR-LBN-1	Surface space shall be allocated to LBNE as specified in [Table 4.1.1-1].			Open
TBR-LBN-2	Underground space at the 4850 level shall be allocated to LBNE as specified in [Table 4.1.2-1].			Open
TBR-LBN-3	The underground spaces allocated to LBNE shall be oriented with respect to each other as shown in [Figure			Open
TBD-LBN-4	Excavation 4850-014 (LC1) shall have the dimensions shown in [Figure 4.1.2-2]	Figure to be drawn		Open
TBD-LBN-5	Excavation 4850-014 (LC1)features shall have the elevations shown in [Figure 4.1.2-2]	Figure to be drawn		Open
TBR-LBN-6	Underground space at the 5060 level shall be allocated to LBNE as specified in [Table 4.1.2-1].			Open
TBD-LBN-7	The facility provided concrete floor of excavation 4850-023 shall be at the same level as the LBNE LC#1 deck shown in [Figure 4.6-1][TBD-LBN-7].	Figure to be drawn		Open
TBD-LBN-8	The LBNE envelope of usable space per allocated space shall be as shown in [Figure 4.6.2-1]			Open
TBD-LBN-9	The LBNE vessel shall be designed to withstand a hydrostatic pressure of [TBD-LBN-9].			Open
TBR-LBN-10	The LBNE experiment shall be able to utilize excavation 4850-023 for experiment laydown [TBR-LBN-10].			Open
TBD-LBN-11	Experiment structures shall meet the [TBD-LBN-11] codes and standards.			Open
TBR-LBN-12	[The LBNE experiment shall be responsible for the active temperature controls in the experiment rooms located in excavation 4850-023].			Open
TBR-LBN-13	The heat loads generated by LBNE shall be no greater than the values specified in [Tables 6.1.2-1 & 2].			Open
TBR-LBN-14	The facility shall provide adequate chilled water to LBNE to remove the heat load specified in [Table 6.2.1-1].			Open
TBR-LBN-15	The facility shall provide LBNE a maximum of 600 gpm [TBR-LBN-15] gpm of industrial water to support the LBNE surface water purification plant.			Open

TBX #	Description	Closure Plan	Assignee	Status
TBR-LBN-16	[The facility shall provide LBNE 570 kW electrical power to the LBNE surface water purification plant.][TBR-LBN-16]			Open
TBD-LBN-17	The facility shall provide chilled water to LBNE 46F (7.7o C) +/- [TBD-LBN-17]			Open
TBD-LBN-18	LBNE shall provide [TBD-LBN-18] gpm of surface purified (stage 1 RO) water to the facility [intermittently][TBR-LBN-19].			Open
TBD-LBN-19	LBNE shall provide [TBD-LBN-18] gpm of surface purified (stage 1 RO) water to the facility [intermittently][TBR-LBN-19].			Open
TBR-LBN-20	[The facility shall provide space to run an 8-inch supply line from the LBNE surface purified water plant to the LBNE underground purified water plant at 4850 level of WCD via the Yates shaft.] [TBR-LBN-20]			Open
TBR-LBN-21	[The facility shall provide [TBD-LBN-21] intermediate pressure reduction devices for the 8-inch purified water supply line from the surface to underground .][TBR-LBN-39]			Open
TBR-LBN-23	The surface purified water provided by LBNE to the facility, measured at the exit of the water plant, at a nominal temperature of [TBD-LBN-22].			Open
TBR-LBN-24	The facility shall be capable of accepting up to 300 gpm of surface purified (stage 1 RO) waste water with [TBD-LBN-25] water quality with a maximum expected water volume per day of 1800 gal.			Open
TBD-LBN-25	The facility shall be capable of accepting up to 50 gpm of surface purified (stage 1 RO) waste water with [TBD-LBN-25] water quality.			Open
TBR-LBN-26	The facility shall be capable of accepting up to 300 gpm of surface purified (stage 1 RO) waste water with [TBR-LBN-26] water quality with a maximum expected water volume per day of 1800 gal.			Open
TBR-LBN-27	The facility shall be capable of accepting up to 50 gpm [of underground purified (stage 2 RO) waste water with [TBR-LBN-26] water quality.] [TBR-LBN-27]			Open

TBX #	Description	Closure Plan	Assignee	Status
TBR-LBN-28	The facility shall provide up to 380 cfm (650 m3/hr) of compressed air to the LBNE underground facility. [TBD-LBN-28]			Open
TBR-LBN-29	The interface(s) to the underground compressed air shall be as shown in [Figure7.5.2.1-1.][TBD-LBN-29]	Figure to be drawn		Open
TBR-LBN-30	The compressed air provided to LBNE shall be at 125 psi (0.1 Mpa) nominal. [TBD-LBN-30]			Open
TBR-LBN-31	LBNE shall be capable of discharging [TBD-LBN-31] radon to the facility vented air.		Requirement moved to ISE IRD	Closed
TBR-LBN-32	LBNE shall be capable of using [TBD-LBN-32] diesel machinery during experiment assembly.			Open
TBR-LBN-33	The facility shall provide [TBD-LBN-33] channels of 1 Mbyte/s throughput.			Open
TBR-LBN-34	[The temperature in the dome of excavation 4850-014 (LC) shall be 65-77F with a humidity range of 30 to 50% relative humidity.][TBR-LBN-34]			Open
TBR-LBN-35	The facility shall electrical power to the areas listed as specified in [Table 9.1.1-1][TBR-LBN-35].			Open
TBR-LBN-36	Electric power available at all times (during planned maintenance) per [Table 9.2.1.1-1][TBR-LBN-36].			Open
TBR-LBN-37	The facility shall provide standby power to LBNE per [Table 9.2.1.3-1][TBR-LBN-37].			Open
TBD-LBN-38	Experiment structures shall meet the [TBD-LBN-38] codes and standards.			Open
TBR-LBN-39	[The facility shall provide [TBD-LBN-21] intermediate pressure reduction devices for the 8-inch purified water supply line from the surface to underground .][TBR-LBN-39]			Open
TBR-LBN-40	[The surface purified water provided by LBNE to the facility, measured at the exit of the water plant, shall meet][TBR-LBN-40]			Closed
TBD-LBN-041	Refine the value for the floor/invert loading in the LC.			Open

TBX #	Description	Closure Plan	Assignee	Status
TBD-LBN-042	Determine the specifics of providing light for LBNE experiment in the LC following construction. Answer questions such as Could the Construction lighting be used for experiment assembly?			Open
TBD-LBN-043	Determine the value of the loads imparted by the LBNE Deck on the LC walls and dome.			Open
TBD-LBN-044	Determine the integrated design for draining. This entire requirement is TBD.			Open
TBD-LBN-045	Create a Figure following a working group discussion to define how the facility ties into the purified water line.			Open

Table 4.1.1-1 Water Cherenkov Detector Surface Space Requirements

	Length (ft)	Width (ft)	Length (m)	Width (m)	Location	
Control Room	39.36	39.36	12.00	12.00	TBD	TBD
Water Fill System (Produces Stage 1 Water)	91.84	32.00	28.00	9.76	Yates Generator Room	TBR
Gadolinium Removal	45.92	32.80	14.00	10.00	TBD	TBD
Office Space	39.36	39.36	12.00	12.00	TBD	TBD
Operations Parts Storage and Installation Warehouse	328.00	65.60	100.00	20.00	TBD	TBD

All Values are TBR- only space allocated to LBNE as of 7/22/2010 is Water Fill System in Yates Motor Generator Room

Table 4.1.4-1: Excavation Dimensions and Finishes for Rooms Used by Science (LBNE Only Spaces)

Excavation Number	DUSEL MREFC Scope Excavation Name	Width (ft)	Height (ft)	Length (ft)	Springline (ft)	Wall Finish Type [TBR-IRD-057]	Floor Finish Type [TBR-IRD-057]
4850-014	Large Cavity #1 (Including Dome)	180.40	272.24	-	209.92	A	A
4850-018	Large Cavity #1 Calibration Drift	13.12	13.12	66.10	9.84	A	A
4850-019	Large Cavity #1 Calibration Drift Access	9.84	9.84	32.45	7.38	A	A
4850-020	Large Cavity #1 Calibration Room (Including Access Portal)	26.24	16.40	32.96	9.84	A	A
4850-023	Large Cavity #1 Access and Utility Drift	32.80	26.24	48.27	18.04	A	A
4850-024	Large Cavity #1 Access Drift, Water Purification System	32.80	26.24	261.14	18.04	B	B
4850-131	LC1 Utility borehole	0.98	-	107.44	-	B	B
4850-136	Large Cavity #1 Access and Utility Drift - Enlarged section	42.64	28.70	199.80	18.04	A	A
5060-007	Clean Water Sump	19.68	13.12	138.01	8.20	A	A
5060-008	Dirty Water Sump	19.68	13.12	118.01	8.20	A	A
5060-019	Native Water Collection Sump	-	-	-	-	C	C
5060-020	Vessel Water Collection Sump	-	-	-	-	B	B

Table 6.1.2-1 LBNE Generated Heat to be Removed by Facility Ventilation by Space

LC Dome		
Calibration drift 20	**65 kW**	**220,968 BTU/hr**
LC-Balcony, 4850-014	**282 kW**	**961,620 BTU/hr**
LC-Deck, 4850-014	**121 kW**	**411,246 BTU/hr**
Subtotal	**467 kW**	**1,593,834 BTU/hr**
4850 Utility drifts		
Utilities, Drifts 4850-023, -024, -136	**45 kW**	**155,046 BTU/hr**
Water Sys, Drift 4850-136	**113 kW**	**384,034 BTU/hr**
Subtotal	**158 kW**	**539,080 BTU/hr**
5060 Level		
5060-020 Sump	**65 kW**	**222,196 BTU/hr**
Total	**691 kW**	**2,355,110 BTU/hr**
Note that totals include 20% uncertainty factor		

Table 6.1.2-2 LBNE Heat to be Removed by Facility Chilled Water by Space

LC Dome		
Calibration drift 20	**570 kW**	**1,943,700 BTU/hr**
LC-Balcony, 4850-014	**0 kW**	**0 BTU/hr**
LC-Deck, 4850-014	**3 kW**	**10,230 BTU/hr**
Subtotal	**573 kW**	**1,953,930 BTU/hr**
4850 Utility drifts		
Utilities, Drifts 4850-023, -024, -136	**7 kW**	**23,775 BTU/hr**
Water Sys, Drift 4850-136	**0 kW**	**0 BTU/hr**
Subtotal	**7 kW**	**23,775 BTU/hr**
Heat Removal from LC Water		
LC Water	**831 kW**	**2,834,324 BTU/hr**
Total	**1,411 kW**	**4,812,028 BTU/hr**
Note that totals include 20% uncertainty factor		

Table 9.1.1-1 Electrical Power Requirements

LC Dome	
Calibration drift 20	**635 kW**
LC Water	**18 kW**
LC-Deck, 4850-014	**124 kW**
LC-Balcony, 4850-014	**282 kW**
Subtotal	**1058 kW**
4850 Utilities	
Utilities, Drifts 4850-023, -024, -136	**52 kW**
Water Sys, Drift 4850-136	**703 kW**
Subtotal	**756 kW**
5060 Level	
5060-020 Sump	**434 kW**
Total	**2,248 kW**
Note that totals include 20% uncertainty factor	
kW reported, kVA should be estimated	

Table 9.2.1.1-1 Electrical Power Available During Planned Maintenance

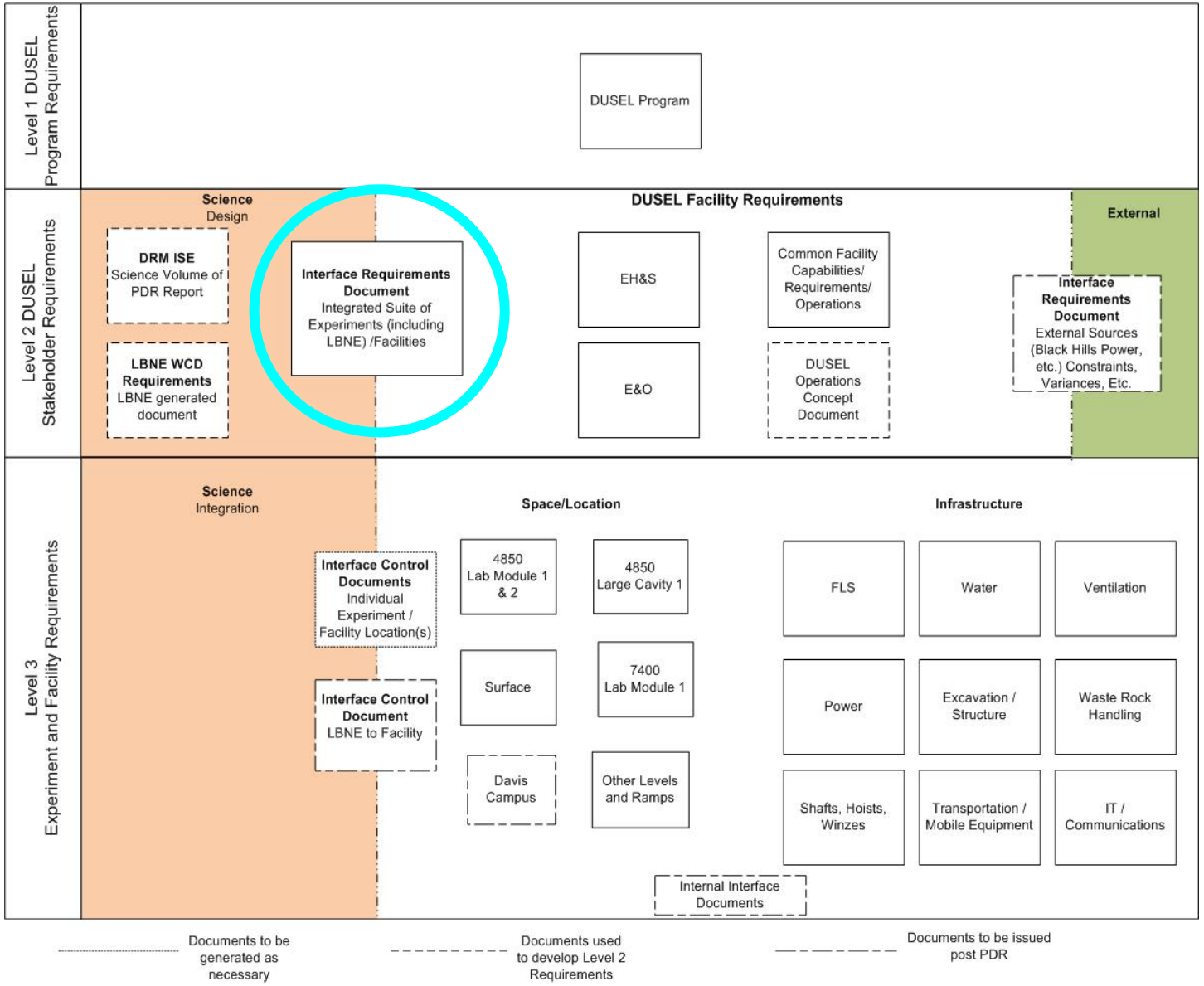
LC Dome	
Calibration drift 20	**0 kW**
LC Water	**18 kW**
LC-Deck, 4850-014	**90 kW**
LC-Balcony, 4850-014	**282 kW**
Subtotal	**390 kW**
4850 Utility drifts	
Utilities, Drifts 4850-023, -024, -136	**40 kW**
Water Sys, Drift 4850-136	**4 kW**
Subtotal	**44 kW**
5060 Level	
5060-020 Sump	**254 kW**
Total	**688 kW**
Note that totals include 20% uncertainty factor	
kW reported, kVA should be estimated	

Table 9.2.1.3-1Electrical Power Available During Unplanned Maintenance (forced outage)

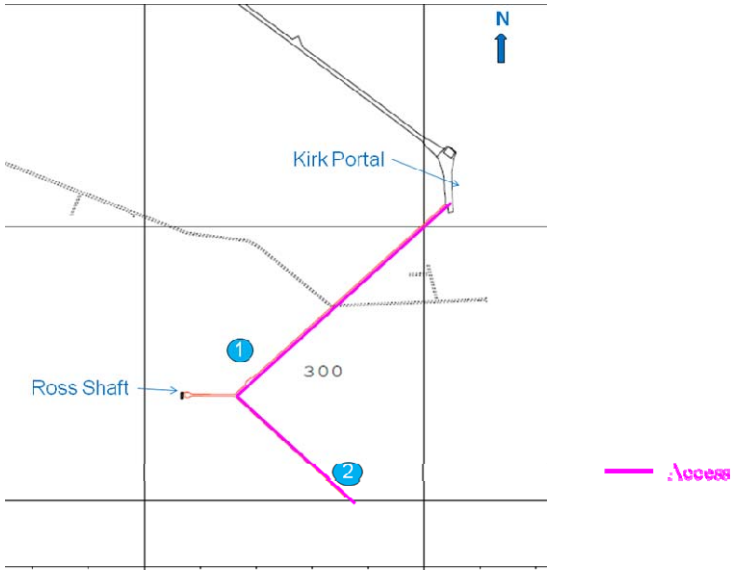
5060 Level	
5060-020 Sump	**110 kW**

Figures Associated with Generic, Lab Module, and/or OLR Specific Requirements

Figure 1.05-1


Level 1 DUSEL Program Requirements
DUSEL Program
Level 2 DUSEL Stakeholder Requirements
Science Design
DUSEL Facility Requirements
External
DRM ISE Science Volume of PDR Report
LBNE WCD Requirements LBNE generated document
Interface Requirements Document Integrated Suite of Experiments (including LBNE) /Facilities
EH&S
E&O
Common Facility Capabilities/ Requirements/ Operations
DUSEL Operations Concept Document
Interface Requirements Document External Sources (Black Hills Power, etc.) Constraints, Variances, Etc.
Level 3 Experiment and Facility Requirements
Science Integration
Space/Location
Infrastructure
Interface Control Documents Individual Experiment / Facility Location(s)
Interface Control Document LBNE to Facility
4850 Lab Module 1 & 2
4850 Large Cavity 1
Surface
7400 Lab Module 1
Davis Campus
Other Levels and Ramps
FLS
Water
Ventilation
Power
Excavation / Structure
Waste Rock Handling
Shafts, Hoists, Winzes
Transportation / Mobile Equipment
IT / Communications
Internal Interface Documents
Documents to be generated as necessary
Documents used to develop Level 2 Requirements
Documents to be issued post PDR

4.1.4-1



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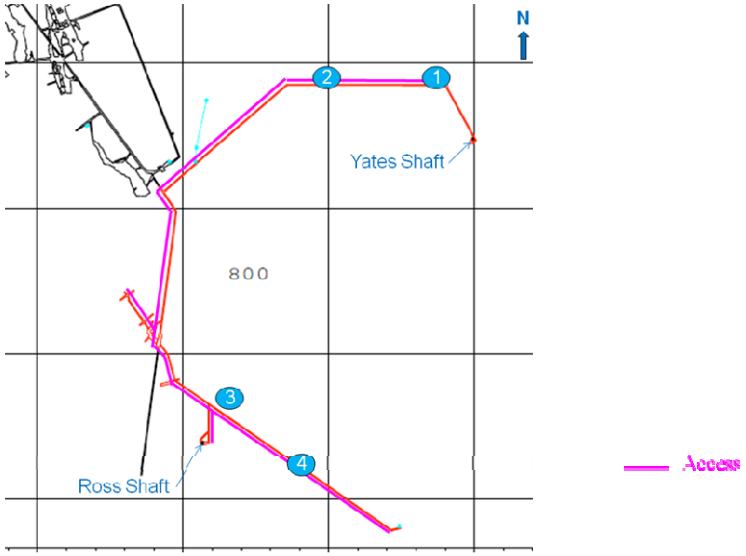

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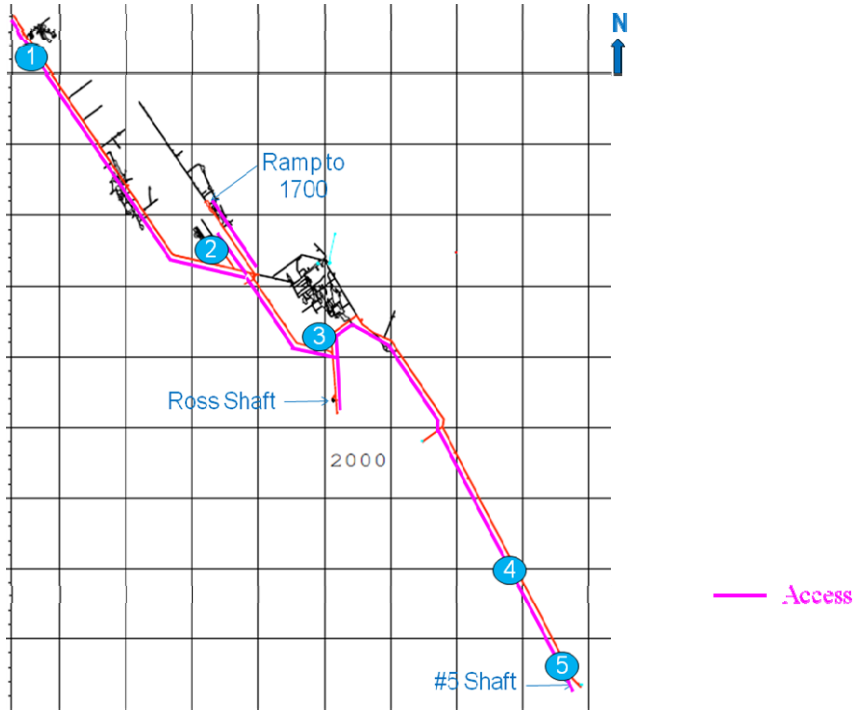

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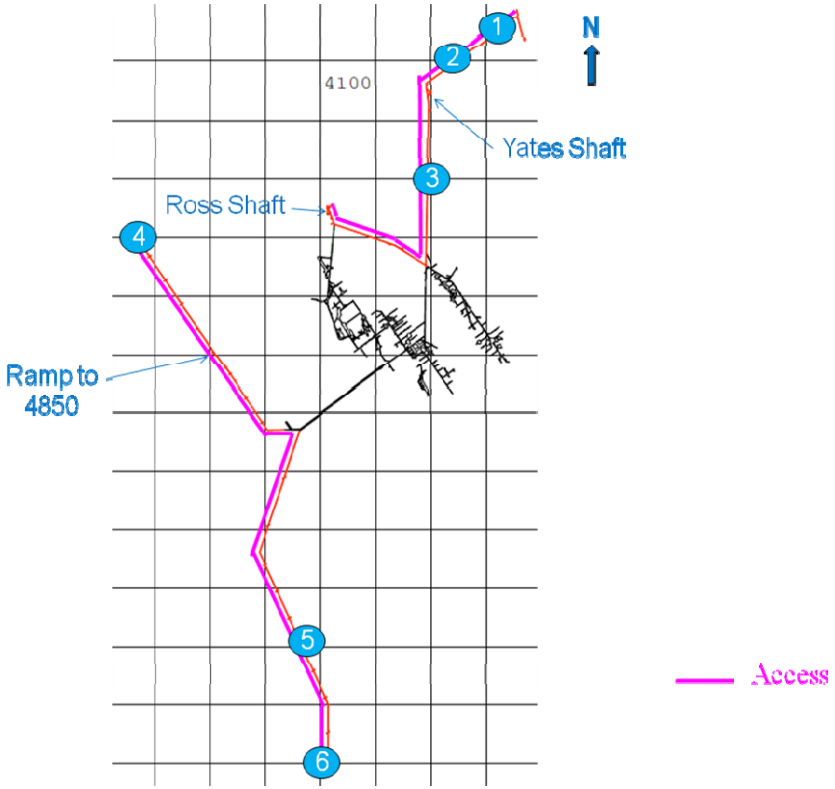

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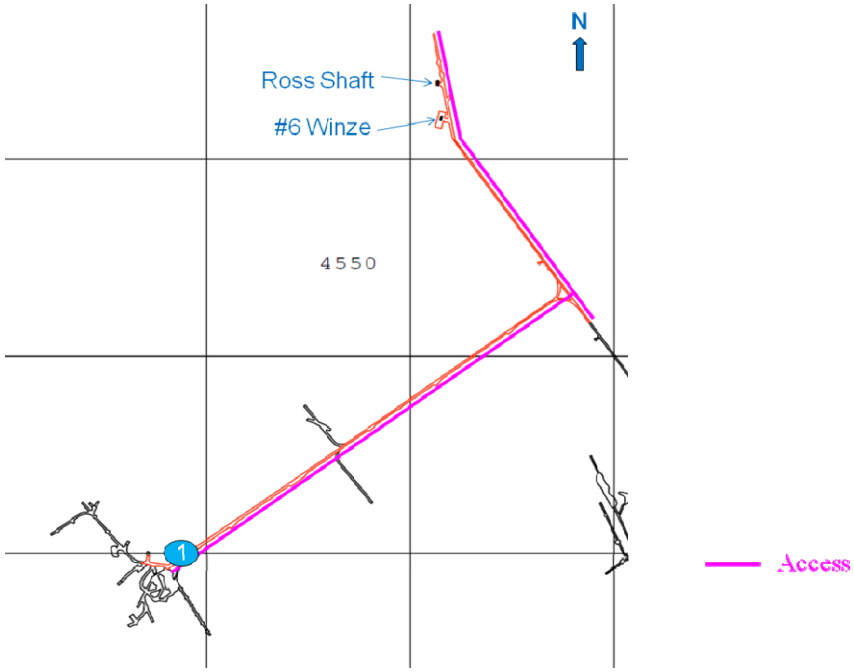

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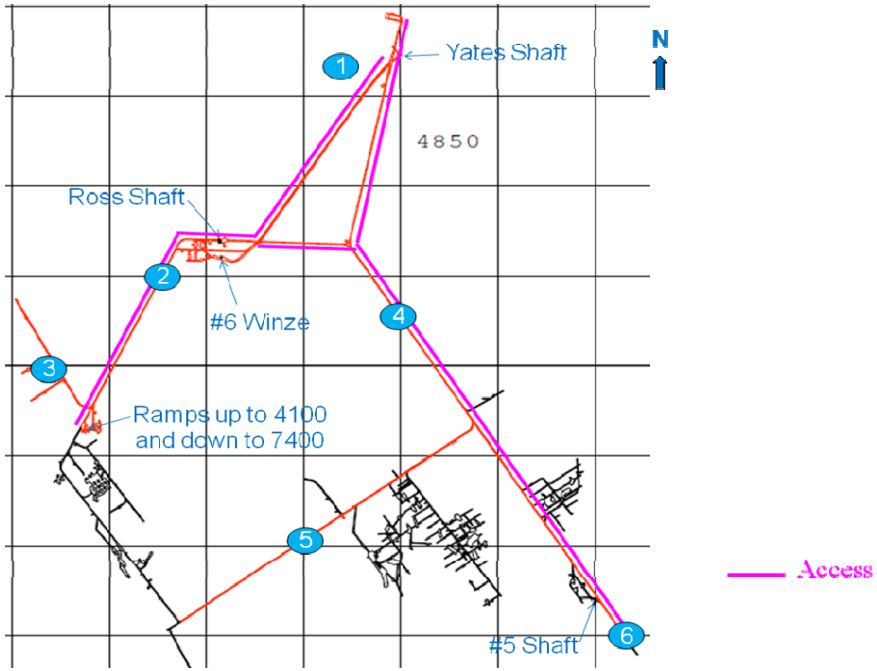
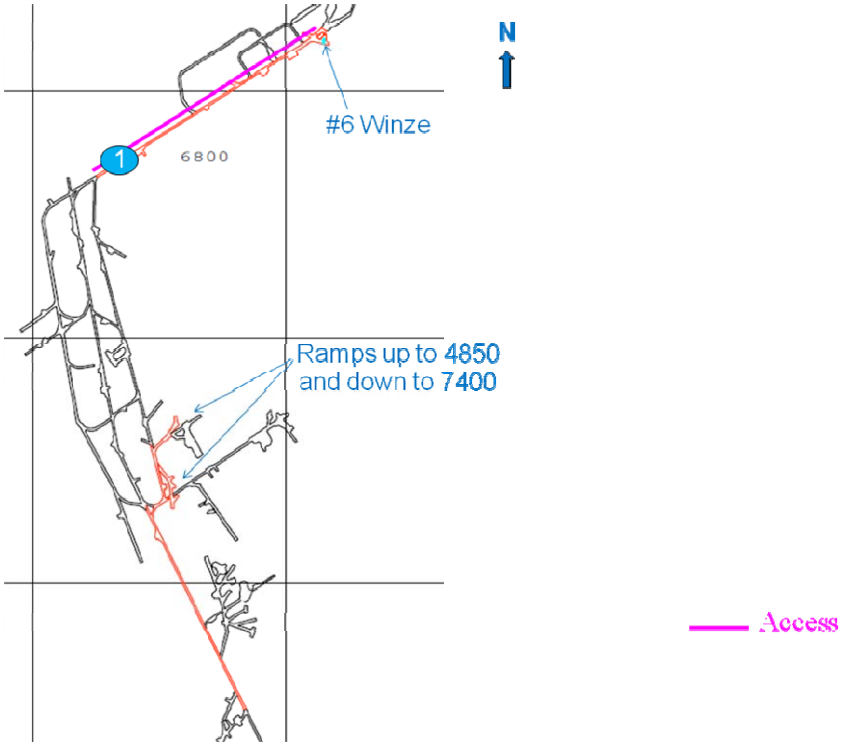

Yates Shaft
N
4850
Ross Shaft
#6 Winze
Ramps up to 4100
and down to 7400
#5 Shaft
1
2
3
4
5
6
Access

4.1.4-7



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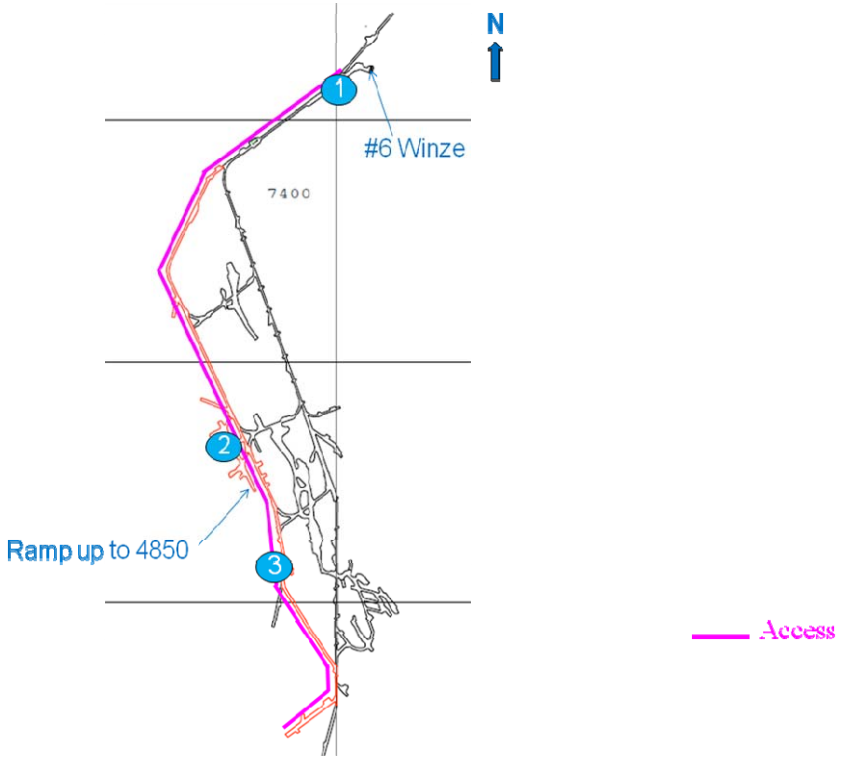

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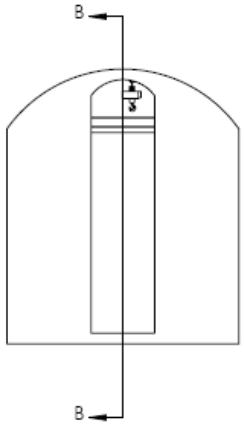

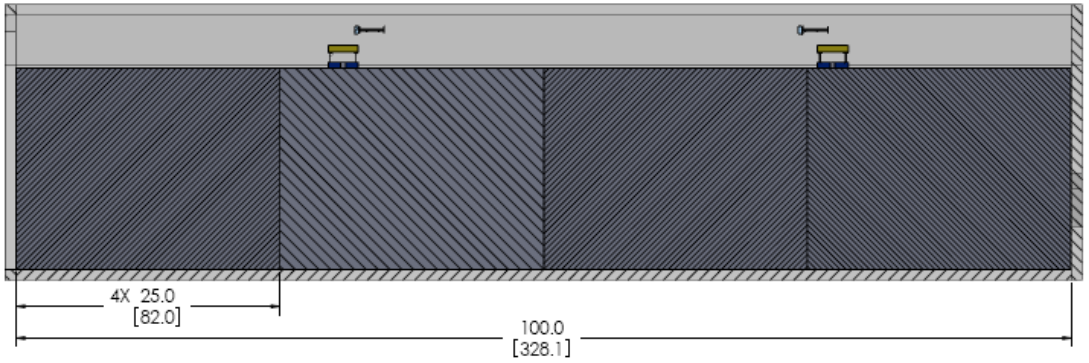

SECTION B-B
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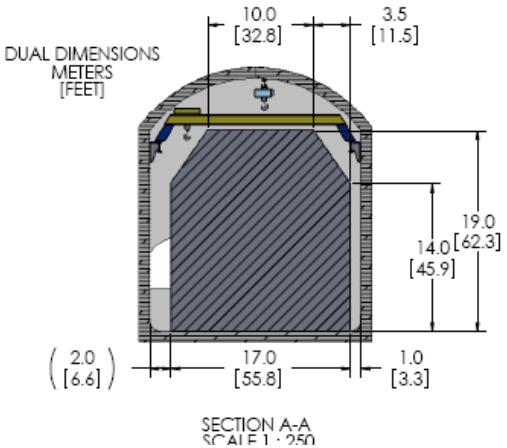
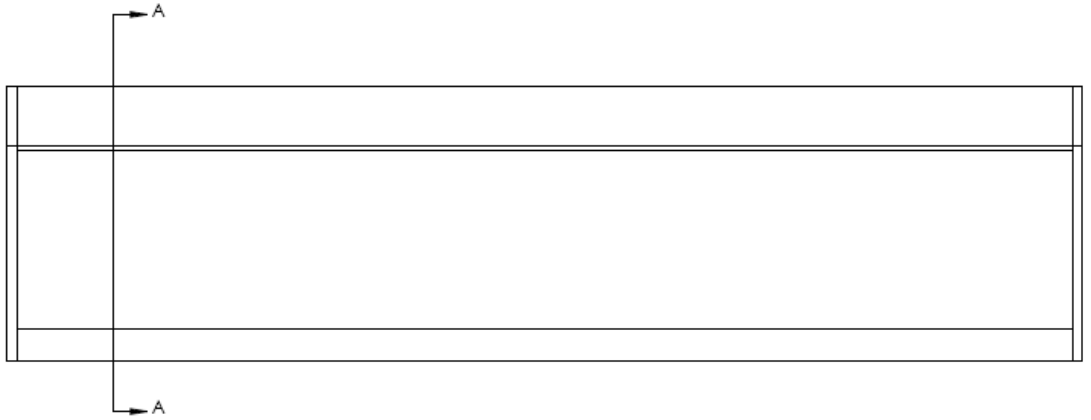


SECTION A-A
SCALE 1 : 250



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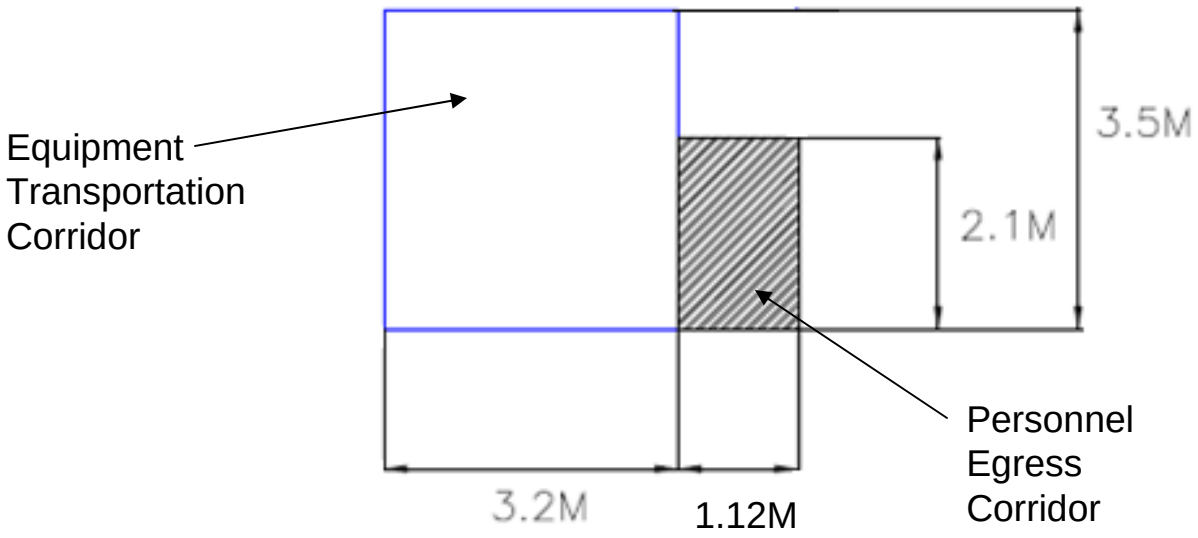
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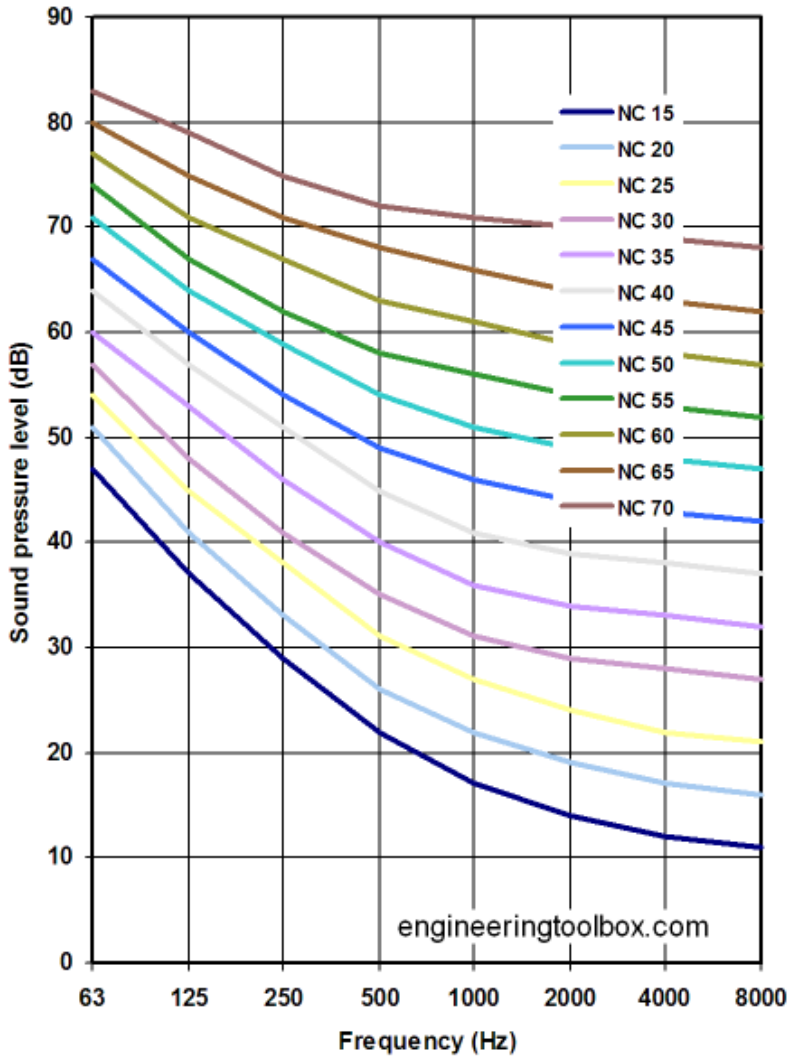
Corridor
3.5M
2.1M
Personnel
Egress
Corridor
3.2M
1.12M

5.03-1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70
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50
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30
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10
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Sound pressure level (dB)
63
125
250
500
1000
2000
4000
8000
Frequency (Hz)
NC 15
NC 20
NC 25
NC 30
NC 35
NC 40
NC 45
NC 50
NC 55
NC 60
NC 65
NC 70
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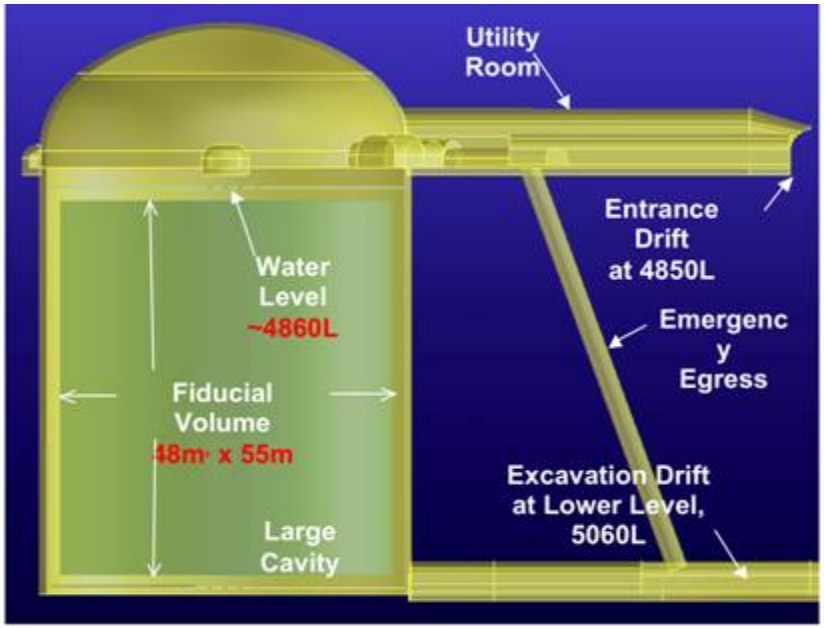
Figures Associated with LBNE-Specific Requirements

LBNE Figure 1

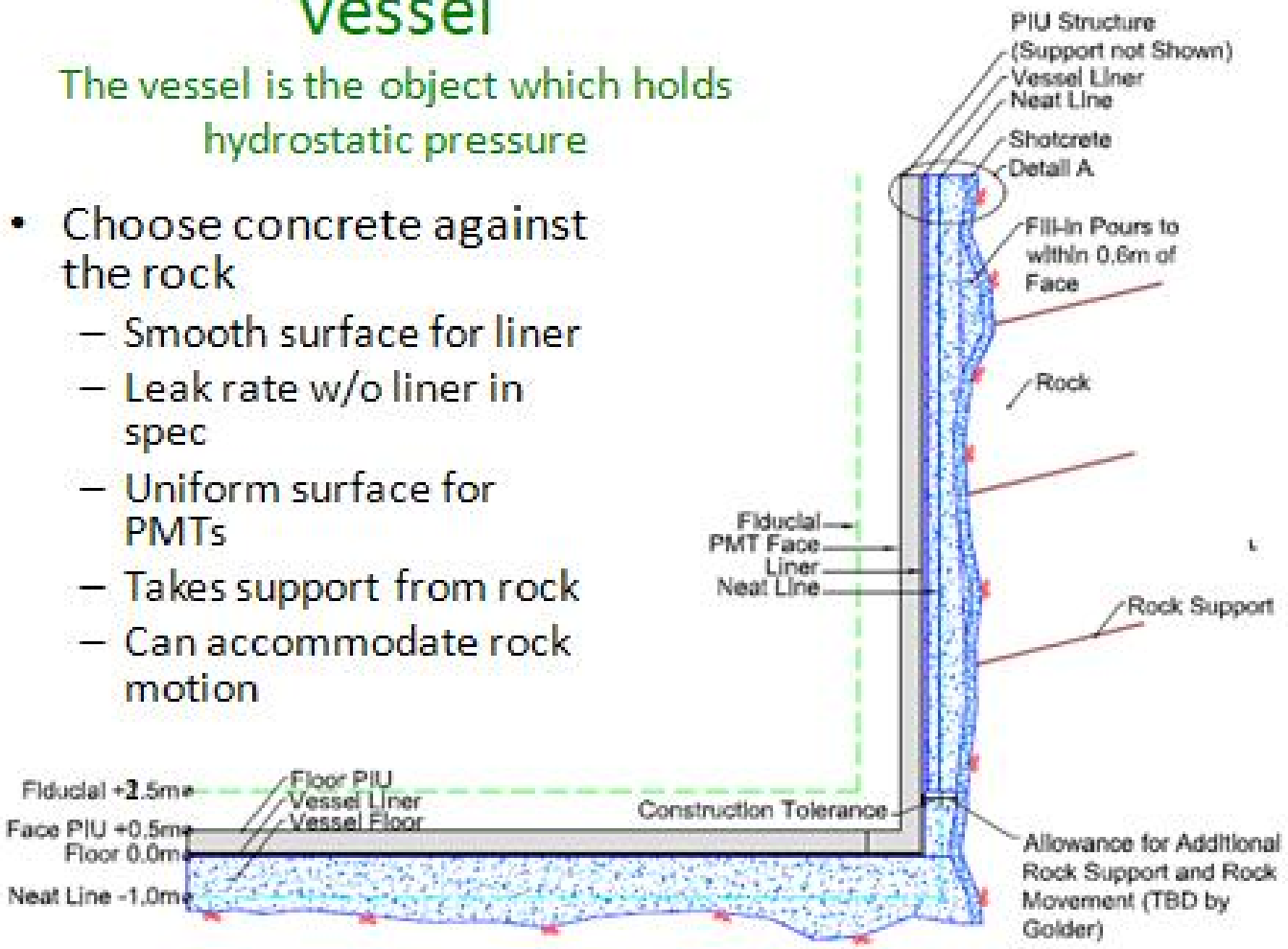


LBNE Figure 2

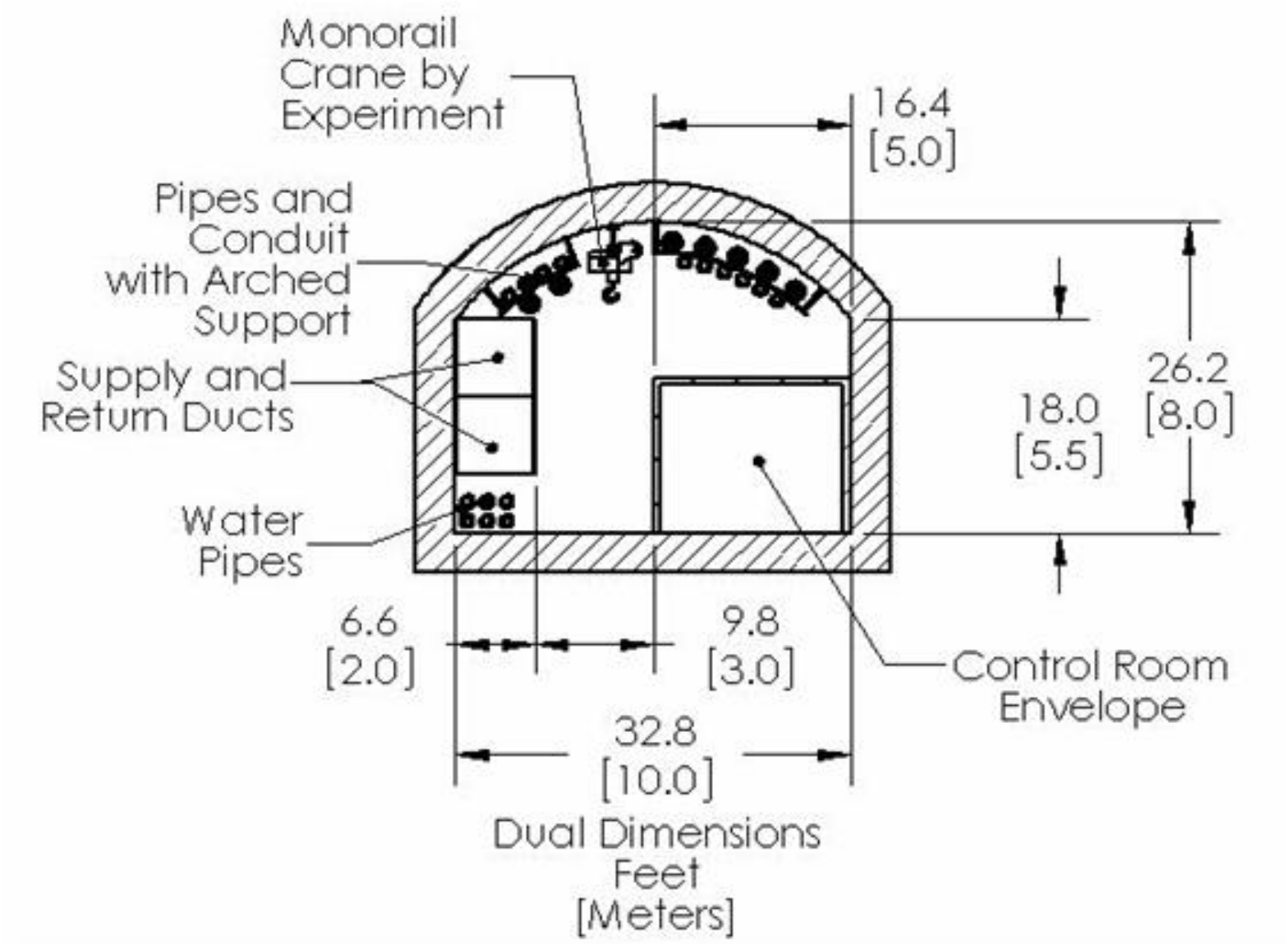
Vessel

The vessel is the object which holds hydrostatic pressure

- Choose concrete against the rock
  - Smooth surface for liner
  - Leak rate w/o liner in spec
  - Uniform surface for PMTs
  - Takes support from rock
  - Can accommodate rock motion



LBNE Figure 3



LBNE Figure 4

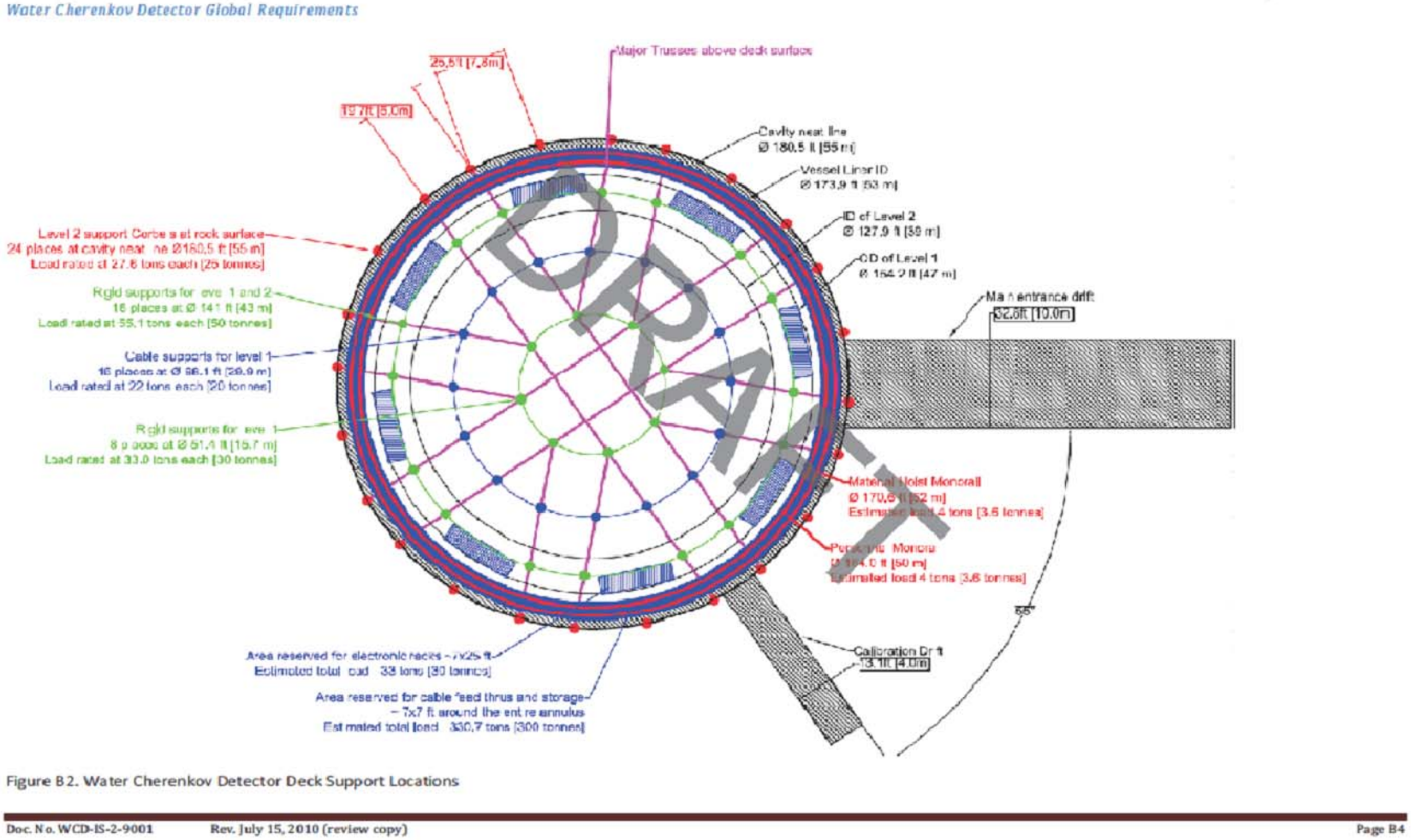


Figure B2. Water Cherenkov Detector Deck Support Locations

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Systems Engineer
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J. Souza Date
Lead Systems Engineer
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23 Aug 2010

D. Taylor Date
LBNE Science Liaison
Organization

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M. Headley Date
Facility Project Manager
DUSEL

Approved By:

23 Aug 2010

K. Robinson Date
Deputy Project Director for Facility Construction
Organization

Reviewed By:

W. Griffing Date
EH&S Director
DUSEL

Jean Souza

From: Murdock Gilchriese [mggilchriese@lbl.gov]
Sent: Thursday, August 19, 2010 8:47 PM
To: Steve Marks
Cc: Jean Souza; Bill Kalinowski
Subject: Authorizaton to sign

Steve, I will not be back to Bancroft until Aug. 31 or possibly mid-September. I hereby give authorization to sign the ISE IRD. Gil

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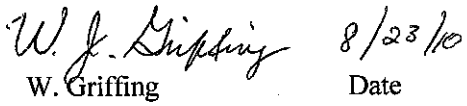
Deputy Project Director for Facility Construction
Organization



W. Griffing Date
EH&S Director
DUSEL

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23 Aug 10

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