Integration of detector and cryogenic safety systems into FSCF BMS system
Detector plans and interface

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LBNF/DUNE Interface meeting

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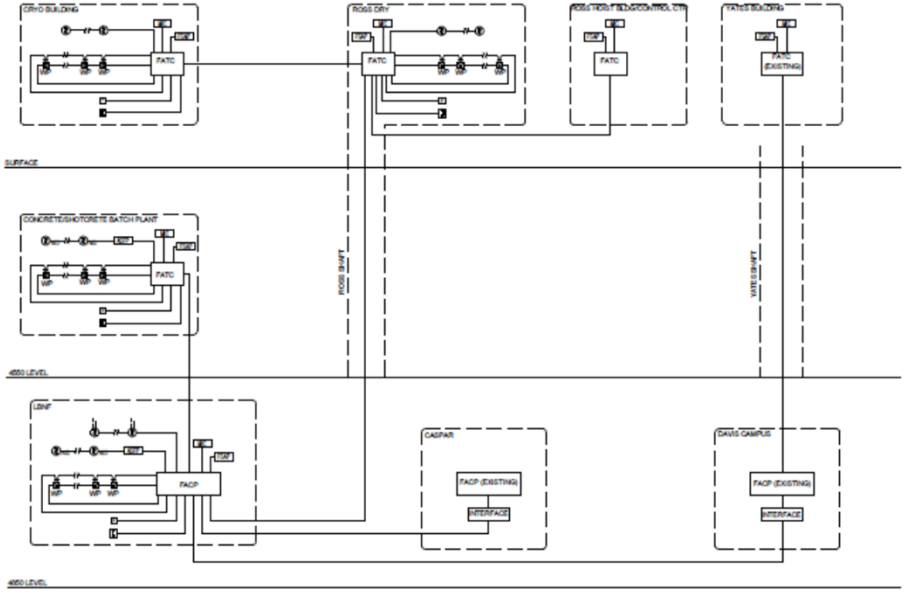
Introduction

- The Dune Detector Safety System has the requirement to protect both life and equipment.
- Any life safety issues must be identified and tie into the Life Safety and Fire Protection System which will be available at the Sanford Underground Research Laboratory.
- References to this system can be found in Dune DocDB 1754, which contains the “South Dakota Science and Technology A/E Services for Infrastructure Design in Support of the LBNF Far Site Conventional BSI – Life Safety and Fire Protection.”
- The above document states that there will be “One overall interconnected fire detection and alarm system monitoring the 4850L including smoke detection, gas detection, suppression systems and all other fire safety related systems tied into the at-grade monitoring facility i.e. Command and Control Center at the surface near the hoist operator.”
- The 30% BSI drawing package for the LBNF underground contains the Fire Alarm One Line Diagram in Drawing No: 15-1-6K U1-FD-E-307.

FIRE ALARM CAUSE AND EFFECT MATRIX

ACTION TAKEN

INITIATING DEVICES	NOTIFY SURFACE LEVEL COMMAND STATION AND ACTIVATE EXISTING ANNUNCIATOR SYSTEM	DISPLAY SPECIFIC CHANGE OF STATUS AT FIRE ALARM CONTROL PANEL	ACTIVATE EMERGENCY VOICE EVACUATION SYSTEM AND ANNUNCIATE ALARM SIGNAL	CAUSE EGRESS DOOR TO UNLATCH AND ANNUNCIATE ALARM SIGNAL	ACTIVATE COMMON SUPERVISORY SIGNAL INDICATOR	ACTIVATE AUDIBLE SUPERVISORY SIGNAL	ACTIVATE COMMON TROUBLE SIGNAL INDICATOR	ACTIVATE AUDIBLE COMMON TROUBLE SIGNAL	TRANSMIT SIGNAL TO SECURITY TO LOCK DOORS AND ENABLE EGRESS	RELEASE MAGNETICALLY HELD OPEN DOORS	TRANSMIT SIGNAL TO FMD	TRANSMIT SIGNAL TO PREACTION SPRINKLER SYSTEM	TRANSMIT SIGNAL TO OPEN MAKE-UP AIR LOUVERS	TRANSMIT SIGNAL TO OPEN SMOKE EXHAUST DAMPERS	TRANSMIT SIGNAL TO START SMOKE EXHAUST	TRANSMIT SIGNAL TO SHUT DOWN ASSOCIATED AHUS	CLOSE FIRE SMOKE DAMPERS IN RATED WALLS	SHUT APPLICABLE FIRE SHUTTER	ACTIVATE AIR LOCK DISCHARGE ALARM	ACTIVATE SMOKE CONTROL SYSTEM	RELEASE FIRE DOOR HOLD-OPEN DEVICES
FIRE ALARM INITIATING DEVICES																						
MANUAL FIRE ALARM STATION	X	X	X	X																		
AREA SMOKE DETECTOR	X	X	X	X					X	X									X	X		
AIR SAMPLING DETECTOR SYSTEM IN DRIFTS	X	X	X	X					X	X						X		X	X	X		
AIR SAMPLING DETECTOR SYSTEM IN DETECTORS AND UTILITY CAVERN	X	X	X	X					X	X						X		X	X	X	X	
DUCT SMOKE DETECTOR	X	X	X	X					X	X	X					X				X		
SPRINKLER WATER FLOW SWITCH	X	X	X	X					X	X								X	X			
PREACTION HEAT DETECTOR												X										
TROUBLE AND SUPERVISORY ALARM DEVICES																						
SPRINKLER TAMPER SWITCH	X	X				X	X															
FIRE ALARM AC POWER FAILURE	X	X						X	X													
FIRE ALARM SYSTEM LOW BATTERY	X	X						X	X													
OPEN CIRCUIT	X	X						X	X													
GROUND FAULT	X	X						X	X													
NOTIFICATION APPLIANCE CIRCUIT SHORT	X	X						X	X													
OXYGEN GAS MONITOR MODULES											X											



FIRE ALARM ONE LINE DIAGRAM 1

SCALE: NTS

NOTES:

1) ALL FIRE ALARM WIRING TO BE 2 HOUR FIRE RATED CIRCUIT INTEGRITY CABLE.

REV.	DATE	DESCRIPTION
REVISIONS		

ARUP

Davis Brody Bond
Architects and Planners

SCALE: 30 0 30 60 SCALE FEET

Fermilab
Long-Baseline Neutrino Facility

DESIGNED	Designer	ARUP
DRAWN	Author	ARUP
CHECKED	Checker	ARUP

LBNF-FSCF-BSI
UNDERGROUND, ELECTRICAL
LEVEL 4850 FIRE ALARM RISE
PHASE 2

DRAWING NO. **15-1-6 L** **U2-FD-E-307** REV.

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DUNE Required Hardware Interlocks

- LAr Level Sensor to Drift HV
  - A defined drop in the level of liquid argon must trigger the shutdown of the drift high voltage
- Rack Smoke Detectors to Local Rack Power
  - Detection of smoke within a rack must trigger a local shutdown of power to that rack. This condition needs to be monitored and logged. *What are requirements for reporting to the overall Fire Protection system?*
- Fiber Optic Cable Bundle Cut to Optical Driver Power
  - Eye hazard exists if a large number of fibers cut. A special “interlock” fiber is required to be included in bundle which runs between systems. This is planned for the clock system and CE electronics; need to consider network and PD fibers.
- Water Leaks to Local Power
  - Water cooling likely limited to CUC Data Processing Room Racks.

DUNE General Hazards/Conditions requiring monitoring and alarms

- Cryo Vessel Pressure
  - Open exhaust valves in controlled manner; Life Safety
- ODH
  - Increase airflow; Close Protega valve; Life Safety
- Monitor Oxygen and nitrogen levels in LAr
  - Shutdown LAr recirculation
- Radiation Sources used for Calibration
  - Follow prescribed rules for handling sources; identify any possible hazards
- Laser Sources used for Calibration
  - Follow prescribed rules for laser operations; identify any possible hazards
- Camera Based/Visual Monitoring
  - Plan for numerous cameras monitoring exterior of steel structure? How is information processed?
- Monitor Safety Ground for Open
  - Shutdown detector power if open (hardware interlock?)
- Crane Operations
  - Follow standard protocol

Temporary during Installation

- Smoke or Temperature Alarm inside cryostat
  - Ventilation and evacuation; Life Safety
- Oxygen Deficiency inside of cryostat
  - Ventilation and evacuation; Life Safety

Single Phase Experiment Operational Interlocks Detector Control Systems/Slow Control

Hardware Interlocks need to be implemented when possible!

- Cold Electronics
  - Warm Interface Crate (WIC) cooling fans must be on before power is applied
  - RTD readout and heater control to prevent condensation at feedthrough
  - Source of optical power; have to detect cut fibers
  - Any Wire Bias turn on conditions?
- Photon Detector Electronics
  - Light sources off before SiPM bias applied
  - Purity Monitor off before SiPM bias applied
- HV
  - Interlocked to LAr level Turn on enables required from PD or CE? From CISC?
  - Loss of power to UPS backup?

Implementation

- Need to select hardware platform to be used
- Interfaces to
  - Slow Controls,
  - Detector Subsystems,
  - SURF

SP Infrastructure BOE – estimate (J. Stewart)

First guess as to a possible cost for a detector equipment safety system

M&S

Item #	Part Description	Manufacturer	Part #	Quantity	Quantity Units	Unit Cost	Total	Contingency	Total with Contingency
	Rack	custom		1	ea.	[illegible]	4000	0.2	4800
	PLC controller			1	ea.	[illegible]	75000	0.5	112500
	Misc. Electrical						10000	0.5	15000
	Total						**89000**		**132300**
	Labor Estimate								
	Activity	**Duration**	**Resource Type**	**Productive Hours**	**Efficiency Factor**	**Total Hours**	**Contingency**	**Hours with contingency**	
	Procure components	6 mo.		200	0.9	222	0.3	289	
	Draft PLC logic	6 mo.	EE	880	0.9	978	0.3	1271	
	Assemble PLC	2 mo.	EE	300	0.9	333	0.3	433	
	Test PLC remote	3 mo.	EE	150	0.9	167	0.3	217	
	Install PLC at SURF	1 mo.	ET	150	0.7	214	0.3	279	
			EE	80	0.7	114	0.3	149	
	Cable PLC	4 mo.	ET	300	0.7	429	0.3	557	
			EE	100	0.7	143	0.3	186	
	Commission PLC in pla	1 mo.	EE	80	0.7	114	0.3	149	
					Total EE	**2071**		**2693**	
					Total ET	**643**		**836**	

Initial Estimate