

DUNE Power and UPS Requirements

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11/11/2020

Some Background info – SURF Electrical Service

- DUNE Docdb 1218 is a presentation by Josh Willhite about reliability of services at SURF.

Some Reliability info – email from 3/11/2019

- Looking back through emails with Black Hills Energy (there were four reported disturbances since 2016 through March 2019):
 - 3/23/2016 – BHE had a momentary voltage dip on their 230 kV transmission system at ~ 12:05 a.m. This was due to a weather related issue on a PacifiCorp 230 kV transmission line going west out of Wyodak, near Gillette, Wyoming. The LUX and MJD experiments reported two power blips, one 4 seconds in duration and one 5 seconds in duration, but the timestamp of these blips in their data logs did not correspond to the BHE disturbance.
 - 4/28/2016 - BHE's 69 kV line between the Yellow Creek Sub and Lookout Sub in Spearfish tripped at 9:56 a.m. The cause appeared to be related to heavy snow/tree issues, although the line patrols did not find anything. This 69 kV circuit was open at the Kirk switch so it had no effect on SURF.
 - 9/14/2016 – A capacitor bank at SURF's Ross substation tripped off at 7:45 PM. There was no connection between BHE and the event, but BHE noticed that it happened before SURF did because of the sudden change in our power factor.
 - 10/11/2018 – SURF experienced a power “blip” at 6:38 PM that lasted approx. 15 seconds. BHE reported that there was a distribution system problem that occurred around 6:30 and probably caused our issues. They de-energized the South side of City of Lead at ~7:25 to make emergency repairs. The Yates hoists shut down and the circuit breaker for service to the Yates Surface Lab tripped off. Power to the Davis Campus was off long enough that the Building Management System (BMS) shutdown. The BMS automatically restarted using default setpoint values that prevented the air handling systems from restarting and functioning properly. This was due to the BMS vendor not properly saving program changes. BHE was surprised that the problem affected SURF because it is not fed from the same substation or 69 kV lines. They were going to analyze the event further and we discussed the need for power quality metering at the Kirk switch.

Conversation (Reliability) Notes from 3/7/2019

- SURF power is very good. Their connection to the utility main is about 1.5 miles and there are multiple feeds to SURF. Estimates power has been down for a total of about 4 hours in the nine years that he has been there. This represents brief interruptions about 10 times during that period.
- The power to the detector goes through a large transformer (12.5 KV) dedicated to LBNF/DUNE and then through a 1000 KVA transformer for each cavern and then to our 4 112.5 KVA double-shielded transformers for each detector. The transformers are all new. Transformers and power cables rarely fail. If one did fail, an investigation (ES&H) would need to take place as to why it failed before it could be switched out.
- The 12.5KV surface transformer would require yearly maintenance. It was stated WORST case would be one 8 hour shift every 6 months. Involves checking oil, inner gas pressure, connections... There is an old 12KV transformer nearby and if we did have a hard failure of the LBNF/DUNE transformer, there is a possibility to switch over to it. It would take time to do this, it is not instantaneous.

Conversation (Reliability) Notes from 3/7/2019

- Since we have two underground 1000KVA transformers for detector power (these do not require maintenance as above), one could argue we have some redundancy with different transformers feeding each cavern. Once power enters the cavern, we will have four small transformers dedicated to each detector.
- There has been discussion in the past on redundant power feeds from both Ross and Yates like what we are doing with the fibers. Conclusion has been that it is expensive. Power cable in the shaft could be damaged if something dropped, but it is believed the new shaft mitigates most of this danger.
- For the Underground DAQ, we have the surface 12.5KV transformer (same issues as above) and a single 750KVA transformer which is unlikely to fail, but if it did, we lose DAQ.
- The surface DAQ room is also a point of failure. A new 112.5KVA transformer will be fed from an existing panel in the building. This transformer will be used to provide the 50KVA requested by DAQ. Strong suggestion that this power have UPS and a backup generator. They do this for their own computer room in Yates Admin.

Current level of UPS planning

- Currently planning on supplying some UPS power for DAQ, Networking and Cryosystem.
- Request has been made to LBNF/Systems Engineering to supply a generator backup for networking racks in CUC; this already must exist for life safety systems.
- DAQ Consortia has identified a need for UPS power to protect computers; allows for computers to go through a controlled shutdown (~10 minutes). All this is on Facility Power.
- No plan currently exists for any UPS supplied “Detector power” with exception of small standalone units some groups might want to use.
- Goal for today is to try to identify any possible additional UPS needs! Consider detector equipment safety.

EDMS 2169065

Layout 2

CUC Electrical Room

DAQ Room
UPS w/ MB

PHP
480/277VAC
360A

400kW/kVA

300kW/kVA

(Proposed)

(Proposed)

~ 200m Conduit run
\$50,275
(4) 4/0 AWG in 2" C

\$18,204

\$35000 (PDU)

DAQ Huts in Det. Cavern
\$20,000

SWGR15-4850-B
15kV, 1200A

TX-48-DAQ
750kVA

12.47kV- 480/277V

DHP
480/277VAC
900A

900A

1200A

450A

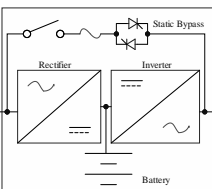
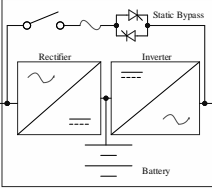
450A

UPS Service Disconnect

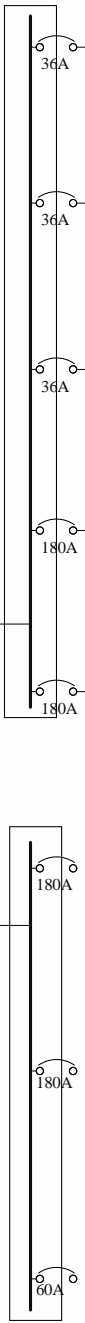
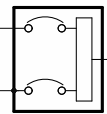
UPS Service Disconnect

Maintenance Bypass Disconnect

Maintenance Bypass Disconnect



Maintenance Bypass Cabinet



36A

36A

36A

36A

180A

180A

180A

180A

180A

60A

30kVA

30kVA

30kVA

30kVA

150kVA

150kVA

150kVA

150kVA

150kVA

150kVA

150kVA

150kVA

k13

k13

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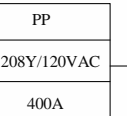
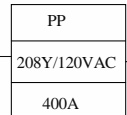
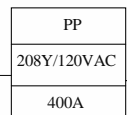
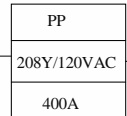
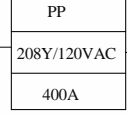
k13

k13

k13

k13

k13



CUC DAQ room power

Cryo and miscellaneous
Detector 1

Cryo and miscellaneous
Detector 2

DAQ barrack 1
+ Slow Controls

DAQ barrack 2
+ Slow Controls

Total cost w/o UPS: \$192,284

DUNE DAQ Room Power
Drawn by: Arnab Ghosh
176993 07/31/2019

EDMS 216905

SWGR15-4850-B 15kV, 1200A

(3) #2 AWG + (1) #6 GIN 1" C

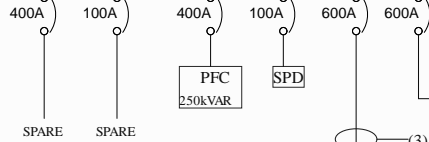
TX-48CC-E/F CUC Electrical Room

1000kVA
12.47kV-480/272V

(2) for two caverns

1600A

SWBD4-48CC-F 1600A, 480/277V
Located in CUC Electrical Room



Provided by ARUP (CUC Electrical Room)

Provided by Fermilab

CHAMBER 1

600A DSW

Located in cavern mucking drift

CHAMBER 2

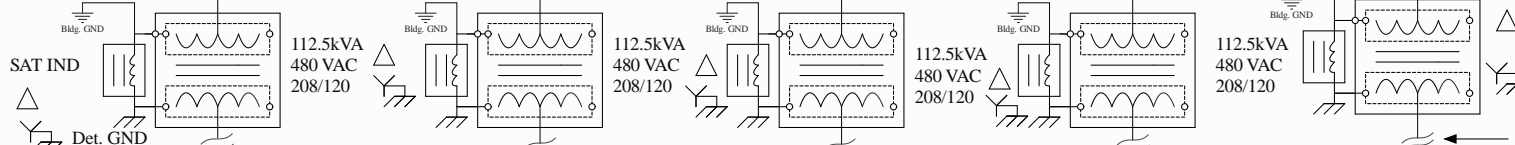
To PHP for the second chamber

Square-D I-Line PHP 480V 600A BUS 32x48x8.25"



(3) 1/0AWG + (1)#6G in 1.5"EMT
40m

Located in cryo mezzanine
(5) 29x17.13x8.25"

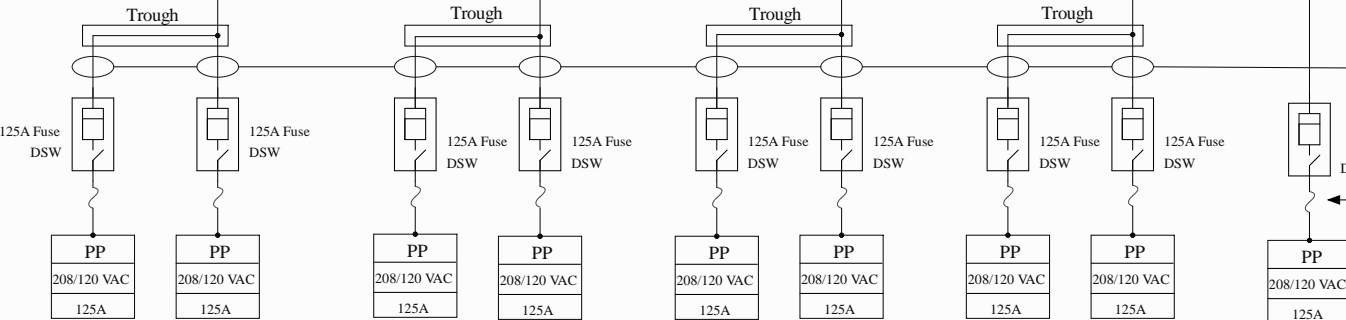


45kVA
480 VAC
208/120
Located in cryo mezzanine
(5) 46x32x28"

Isolation bushing between transformer housing and secondary conduits

2 runs of [(3)*3/0AWG+(1) 250 kcmil (neutral) + (1)#3G in 2" EMT]
135m

8' tap, (3)*1/0AWG + (2)*1/0 AWG (neutral) + (1)#6G in 2"EMT



Located in det. electronics racks
(8) 29x17.13x8.25"
w/ electrical interlock kits

Circuit breaker with shunt trip, 24V external

Located in det. electronics racks
(8) 20x38x5.75"

Fermi National Accelerator Laboratory

LBNF Level 4850 SLED

Drawn by: Arnab Ghosh

Size C	PCSM No.	DWG No.	Rev 2
Scale		176982	Sheet 1

3:08:22 PM 6/30/2020