
**ELECTRICAL SERVICE AND
DISTRIBUTION CONDITION REPORT
FIRCREST SCHOOL
SHORELINE, WA**

Prepared For:
**State of Washington
Department of Social
& Health Services**

December 11, 2013

Prepared By:
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HULTZ  **BHU**
e n g i n e e r s i n c



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December 3, 2013

State of Washington
Department of Social and Health Services
15230 15th NE
Fircrest School
Shoreline, WA 98155

RE: Electrical Service & Distribution Condition Report

Dear Fircrest School,

Please find enclosed our electrical service and condition review report for the DSHS - Fircrest School.

Respectfully Submitted by
Tom Urquhart PE

A handwritten signature in black ink that reads "Tom Urquhart". The signature is written in a cursive style and is placed on a light blue rectangular background.

ELECTRICAL SERVICE & DISTRIBUTION CONDITION REPORT

A. INTRODUCTION

Fircrest School has a 4160 volt campus electrical distribution system installed in the late 1960's and 1970's. Because of recent cable failures and malfunction of the medium voltage transfer equipment there is concern over the ability of the existing distribution system to provide reliable normal and backup power to the campus facilities. Also, as a nursing home and limited care facility with full time residents, a need has been identified to connect additional facilities to the campus standby power source.

This report provides a condition assessment and code review of the campus electrical primary and emergency power distribution system, recommendations, and cost estimate.

Site visits were conducted on November 14 and 27, 2013. The following report is based on observations made during the visits, comments offered by the plant manager, review of manhole and transformer survey documents, and study of available electrical plans, including a proposed electrical upgrade from 2001.

B. SYSTEM DESCRIPTION

Utility Services: The serving electric utility is Seattle City Light. The service transformer for the campus is utility owned and operated. It is rated 2500 KVA transformer with 4160/2400 volt secondary. Based on recent utility billing information, the 12 month peak demand on the campus system is 1334 Kw, 85% PF, 1569 KVA as identified in the October 2013 invoice. The utility company will apply charges on monthly invoices for power factor (PF) that is below 97%. Power factor is the ratio of the metered power in KW used by the customer versus the KVA delivered by the Utility. Billing charges for low PF are about \$6000 per year. Low power factor is probably associated with the reactance component of the numerous transformers serving the campus buildings.

Campus Distribution Arrangement: The Fircrest School campus electrical distribution is 4160/2400 volt, 3-phase radial feed system except some transformers are connected to allow switchover to an alternate feeder. There are two substations. The North Utility Substation is located at the utility service entrance, and the East Service Substation is located adjacent to the steam plant. The North Utility Substation has five feeders, identified as N1 through N5. The East Service Substation has a generator and transfer switch for standby power and receives its normal power on a dedicated feeder (feeder N2) from North Utility Substation. There are two standby power feeders (E1 and Steam Plant) and two normal power feeders (N2A and N2B) outgoing from the East Service Substation. All distribution feeders are installed underground in conduits that are connected by vaults and manholes.

Substation Switchgear: The North Utility Substation switchgear is ITE manufactured medium voltage, outdoor metal enclosed, fused load interrupter switches. There are five medium voltage service switches (N1, N2, N3, N4 and N5), and a utility metering section. Except for the switch N5, the North Utility Substation equipment is believed to have been installed in 1960, switch N5 was added in 1983. The East Service Substation switchgear is S&C manufactured medium voltage, outdoor metal enclosed, fused load interrupter switches. There are four (4) switches and a two (2) bus termination sections. There is also a separate Westinghouse 5KV automatic transfer switch with motorized breakers. East Service Substation equipment was installed in 1977.

Substation Feeders: Existing medium voltage feeders are 5 KV rated cables and appear to be a mixture of aluminum or copper depending on the original installation date. Recent repairs (Feeder N4), replacement cables (Feeder N1) and Feeder N5 (installed in 1983) have copper conductors. Each feeder includes a 600 volt rated conductor that service as a grounded neutral. Feeder N1 failed in 2002 and was replaced from the North Utility Substation to manhole (MH) #7. Feeder N4 failed in 2010 and was repaired. Feeders N1, N2, N3, N4, and N5 are not connected to standby power. Feeder E1 and the Steam Plant feeder are an extension of Feeder N2 that is connected to standby power through the East Service Substation transfer switch. Feeder N5 serves another State Agency (State Health Lab) and is not included in the scope of the work.

Generators: There are three fixed generators on campus. The East Service Substation generator is located in the steam plant and provides standby power over the campus distribution system to select residential and support facilities. This generator is a Caterpillar D348, Serial Number 36J02382, and rated 565 KW, 4160/2400 volts output. This generator is believed to have been installed in 1977. There is a 150 KW generator at building 80 that provides 480 volt power to "Y" resident facilities (Buildings 55 through 60) and Building 63 with step-down transformers in each building for 120/208 volts. This generator is a Cummins N743PG220, Serial Number 746181, installed in 1997. This generator and distribution are identified as emergency. A third generator is installed at the Receptions Building 67. It is a Caterpillar 3406, serial number 2WB01273, 250 KW, 208/120 volt. It is our understanding that it is not currently used since the Recreation Building is not occupied at this time.

C. CONDITION OF THE DISTRIBUTION SYSTEM

The medium voltage switchgear and transfer equipment are 1960's or 1977 equipment. The switchgear and transfer equipment are at or near end of useful life. The automatic transfer switch will not automatically reset on return of normal power. Most of the medium voltage feeder cables were also installed in 1960's and 1977, and the cables are past useful life. Medium voltage feeder cables are failing.

D. CODE ASSESSMENT OF THE DISTRIBUTION SYSTEM DESIGN

Standby Power: Requirements of National Electrical Code (NEC), Article 517.40, Nursing Home and Limited Care Facilities, as adopted by the State of Washington, would be applicable to the Fircrest School electrical distribution. Based on no surgical treatment or provisions for residents to be on sustained electrical life support, campus facilities would not be required to have essential system emergency power except for life safety circuits in accordance with NEC Article 700. NEC 700 requires that transfer equipment and wiring for life safety circuits must be separate from all other transfer equipment and wiring. With the campus generator providing backup power for feeders to building service transformers, the existing campus generator and associated distribution would be not be classified as emergency, but would be considered an optional standby power system by Code. An additional and separate life safety distribution system and transfer switch would be required from East Service Substation for the campus generator to provide a Code approved emergency power system.

Buildings 55 Through 60: Based on a site visit to a typical Y shaped resident building, medium voltage equipment and fused cutouts were found in electrical rooms without adequate clearance for safe operation, and code deficiencies related to disconnecting means and overcurrent protection of service entrance conductors, transformers, and main panel were noted. Also emergency distribution for these buildings as identified on the campus one-line diagram does not comply with Code regarding separation of life safety from standby circuits. A cost estimate is included for upgrading the distribution equipment in five of the "Y" buildings (Building 59 was upgraded in 2010).

E. CAMPUS DISTRIBUTION SYSTEM RECOMMENDATIONS

Feeders: Replace existing medium voltage cables for Feeders E1, N2, N2A, N2B, and N4. Feeder N2 should be upsized to support revised loading. Feeder N3 should be upsized to provide a redundant feeder to the East Substation. Feeder N1 has already been replaced from the North Utility Substation to MH#7. Remainder of feeder N1 should be replaced through MH#8. Feeder N5 consists of newer copper medium voltage cables that serve the facilities of another State agency. Maintenance and repair of this feeder would be covered under another budget.

Substation Switchgear: The campus medium voltage electrical service and distribution equipment should be replaced with new to include replacement of the automatic transfer equipment. The feeder to pad mount transformer #15 (Steam Plant) does not have disconnecting means to isolate the feeder for maintenance and repair, and a interrupter switch for this purpose should be included in new switchgear. Metering should also be added for load monitoring of feeders connected to the generator.

Distribution configuration: Reconfigure the distribution so the East Substation is the hub for the Fircrest School feeders (all feeders except N2,N3 and N5). Connect Feeders N2A, N2B, and N1 to the standby generator at the east substation as required to provide additional residential and support loads on backup power as identified by the plant manager. The switchgear lineup should be configured to allow future connection of the additional loads if the generator is upgraded as part of another project. Feeders N2, N3 and N5 would remain connected to normal power.

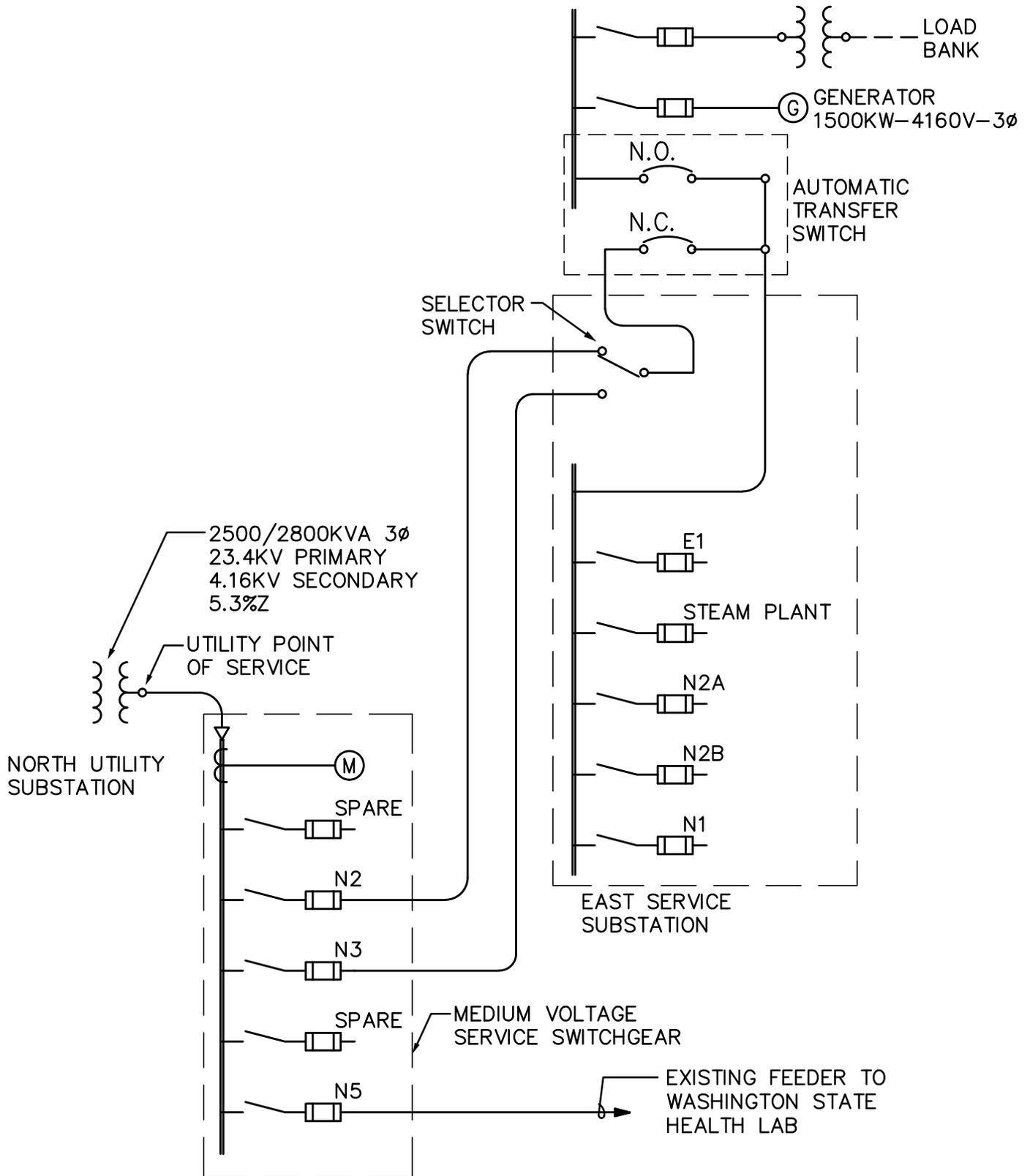
Campus Standby Generator: If additional feeders or loads are to be added to the standby generator, the existing 565KW unit must be upgraded. Based on existing campus demand data, a new 1500KW generator is recommended. The existing generator could remain in place for backup power to the Steam Plant.

Power Factor Correction: A switchgear section should be added to the North Substation for power factor correction using medium voltage capacitors. This would save about \$6000 annually in utility charges for low power factor.

Emergency Power for Life Safety Systems: A study and analysis that addresses each campus building for compliance with NEC 700 emergency system requirements is outside the scope of this study. Buildings identified with emergency systems as part of the campus distribution system (Buildings 55 through 60) were reviewed and found not to be code compliant regarding separation of life safety and non-life safety loads. Any remodel or repair projects that revise circuits in the emergency panel of these buildings will likely trigger a correction notice from L & I plan review. Design options (not cost estimated under this study) include unit batteries, central batteries, (inverter system), reconfiguring existing 150 KW generator system serving these buildings, and addition of a campus wide life safety distribution system connected to the campus main generator.

FIRCREST SCHOOL						
EXISTING FEEDER SCHEDULE						
FEEDER	TRANSFORMER	KVA	PHASE	BUILDINGS	LOOP TIE	BLDGS REMOVED
N1	T-60	75	3	BLDG 60		
	T-59	225	3	BLDG 59		
	PMT-80	150	3	BLDG 80		
	T-58	75	3	BLDG 58		
	T-55	75	3	BLDG 55		
	T-57	75	3	BLDG 57		
	T-64	75	3	BLDGS 56,64		
	T-64A	15	3	STREET LTG		
	PMT-28	225	3	BLDG 65		
N2				FEEDER TO EAST SUBSTATION		
N2A	PMT-13	112.5	3	ABANDONED		BLDG 23
	PMT-18	225	3	BLDG 22		BLDG 5
	PMT-12	300	3	BLDG 20		
	PMT-9	75	3	ABANDONED		
N2B	PMT-39			BLDGS 24,25,27		BLDG 81
	PMT-36	75	3	BLDGS 32,33,34,35		
	PMT-37	500	3	BLDGS 39,43		
	PMT-20	300	3	BLDGS 85,87,88,89,90,91		BLDG 54
N3	PMT-1	75	3	ABANDONED		BLDG 63
	PMT-2	300	3	BLDG 67		
	PMT-21	225	3	BLDG 66		
N4	PMT-4	75	3	ABANDONED		BLDGS 73, 74
	PMT-5	112.5	3	ABANDONED		
	PMT-6	75	3	ABANDONED		
N5	PMT-8	1500	3	HEALTH LAB	N2A	
E	PMT-15	300	3	BLDG 28 (Steam Plant)		

FIRCREST SCHOOL						
EXISTING FEEDER SCHEDULE						
FEEDER	TRANSFORMER	KVA	PHASE	BUILDINGS	LOOP TIE	BLDGS REMOVED
E1	PMT-17	300	3	BLDG 31	N2B	
	PMT-22	25	1	BLDG 66		
	PMT-23	75	1	BLDGS 44,45		
	PMT-24	75	1	BLDGS 46,47		
	PMT-25	75	1	BLDGS 48,49		
	MPT-26	75	1	BLDGS 50,51		
	PMT-29	25	1	ABANDONED	N4	BLDGS 76, 77, 78 VACANT
	PMT-27	75	1	BLDGS 52,53		
	PMT-37E	225	3	BLDG 39		
	PMT-14	112.5	3	ABANDONED	N2A	BLDGS 16, 17
	PMT-11	75	3	ABANDONED	N2A	BLDGS 15, 15N
	PMT-10	225	3	ABANDONED	N2A	BLDGS 2, 3, 4, 5, 13, 14
	PMT-7	150	1	BLDGS 76,77,78,79	N4	
	PMT-3	112.5	3	BLDG 71	N4	
	E2 (480/277V)	T-58E	30	3	BLDG 58	
T-55E		30	3	BLDG 55		
T-57E		75	3	BLDG 57		
T-56E		30	3	BLDG 56		
E3 (480/277)	T-59E	30	3	BLDG 59		
	T-60E	75	3	BLDG 60		
	T-36E	30	3	BLDG 63		
E4 (480/277V)	T	15	3	BLDG 80		



COST ESTIMATE - ELECTRICAL

CLIENT Department of Social & Health Services			Hultz/BHU Consulting Engineers			
PROJECT TITLE Fircrest School Campus Electrical Service & Distribution Upgrades			ESTIMATED BY Allen Hamm		SF	DATE 11-Dec-13
			STATUS OF DESIGN Budgeting			JOB NO. 13-143
DESCRIPTION	QUANTITY		ENGINEERING ESTIMATE			REMARKS
	NUMBER	UNIT	UNIT COST	TOTAL	COST/SF	
Division 26 - Electrical						
General Conditions	1	LS	\$150,000.00	\$150,000		
Demolition (Medium voltage distribution)	1	LS	\$60,000.00	\$60,000		
Temporary Power	1	LS	\$30,000.00	\$30,000		
Feeders						
E1 3-phase 2/0	6300	LF	\$30.00	\$189,000		
N1 3-phase 2/0	1800	LF	\$30.00	\$54,000		
N2 3-phase 500 KCM	800	LF	\$55.00	\$44,000		
N2 3-phase 250 KCM	1800	LF	\$40.00	\$72,000		
N2A 3-phase 2/0	2700	LF	\$30.00	\$81,000		
N2B 3-phase 2/0	2600	LF	\$30.00	\$78,000		
N3 3-phase 500 KCM	800	LF	\$30.00	\$24,000		
N3 3-phase 250 KCM	1800	LF	\$40.00	\$72,000		
N4 3-phase 2/0	3500	LF	\$30.00	\$105,000		
Cable Terminations Splices	216	EA	\$300.00	\$64,800		
Cable Terminations Equipment	216	EA	\$250.00	\$54,000		
(2) 4" PVC	300	LF	\$40.00	\$12,000		MH7 to MH8
(2) 4 " PVC	550	LF	\$40.00	\$22,000		MH8 to MH9, MH9 to MH37
(2) 4 " PVC	1200	LF	\$40.00	\$48,000		MH17 to MH13, MH12 to MH21
(2) 4 " PVC	600	LF	\$40.00	\$24,000		MH10 to MH12
(2) 4 " PVC	500	LF	\$40.00	\$20,000		MH27 TO MH30
East Substation Switchgear						
Metering Section	1	EA	\$20,000.00	\$20,000		
Load Interrupter Fused Switch	5	EA	\$25,000.00	\$125,000		
Selector Switch	1	EA	\$30,000.00	\$30,000		
Concrete Pad (6' x 24' x 8")	1	EA	\$3,000.00	\$3,000		
Subtotal				\$1,381,800		
Contingency	15%			\$207,270		
					Tax Not Included	
PAGE TOTAL (PHASE 1)				\$1,589,070		

