

Electrical Infrastructure Assessment

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Document Draft by Jay Garthwaite, CSG. Engineering, Analysis and Cost Estimating assistance
by Tres West Engineers along with CSG Project Manager Paul Clark.

Origin and Purpose of This Document.

The Construction Services Group Unit of ESD112, a statewide K12 Facilities planning, design, evaluation, project and Program management resource for school districts, was contracted by the Chimacum School District in August of 2015 to coordinate a formal assessment of the electrical infrastructure serving district facilities.

This effort, conducted by CSG with Licensed Electrical Engineer Larry Elliot of Tres West Engineers, in concert with *CSD Facilities Manager Henry Florshutz*, is intended to inform district decision-makers about the true & verified nature, vintage, suitability, condition and viability-for-continued use of the electrical site transformers and feeders, building switchgear, distribution panels and circuits on the main campus site housing elementary, middle and high school functions. The district administrative offices, Portables, Primary School, and transportation center were not within the scope of this analysis, as they are differently served by the utility, and generally less challenging.

This CSG work product is intended to inform decisions, strategies, and budgetary planning for facility maintenance, renovation, renewal, or replacement of electrical infrastructure, as well as capital construction planning.

Executive Summary of Findings: Main Campus Electrical Infrastructure:

The main campus CSD electrical service infrastructure, while presently safely maintained, and being gradually and incrementally upgraded at a very slow pace as funding allows, is the principal roadblock to the deployment of improved modern educational technology as well modernization of the Heating, Ventilation and Air conditioning (HVAC) systems so vital to student teaching and learning as well as management of growing long term energy costs.

In addition to these important factors, an overriding concern is the risk of disruptive and expensive electrical outages involving the extensive web of district-owned underground electrical feeders and aged transformers on the campus. (see accompanying site plan) Unlike most commercial or school electrical service, the district owns everything required to supply electricity beyond a PUD main switch at the highway. This arrangement, known as “primary service” is a holdover from the era of PSE utility services in Eastern Jefferson County, exposing the district to risks of service reliability, urgent highly expensive service repairs, and loss-of-use while repairs are made.

Since the CSD facilities are “all electric”, with no other energy source available, and much of the serving electrical infrastructure is (with some exceptions), similar to the HVAC infrastructure, with aged, dated equipment, and, in many areas, capacity and/or current code compliance deficiencies, most efforts to adjust and reconfigure electrical service to any area, are very challenging due to inadequate overall electrical capacity to all building areas, and technical constraints on electrical panel and circuit reconfiguration.

As examples of this constraint; 1) in order to shift electrical capacity for computers to a particular room, it was necessary to disconnect a ventilation fan serving another space, to keep breakers from tripping on the combined load, and 2) L&I mandated addition of a main disconnect for a major electrical switchgear component by a date certain. The equipment was so old that the addition of the disconnect switch was not feasible, resulting in replacement of the unit.

To make best use of the limited available funding in addressing the L&I mandate, CSD conducted load testing on the circuits, verified that the serving feeders would support eventual expansion of circuits from the gear requiring replacement, and then contracted for a combination of replacement/upgrade on this single piece of switchgear; thus adding some future reconfiguration capacity on just one of five legacy switchgear installations.

The exceptions to this general statement of electrical design and capacity constraints addressed in our evaluation, are CCP, various district portables, and the transportation facility, which are served by PUD as a “secondary service” customer, with PUD-owned and maintained transformers, site feeders, and district-maintained switchgear, distribution panels and branch circuits.

With CSD utilizing a service-to-site utility model called “primary service” (a very unusual utility relationship for public schools) it must be understood that there are capacity and configuration constraints imposed on the reconfiguration of mechanical systems by the nature, age and condition of the electrical system, and restraints to modification of that electrical system, imposed by Washington Labor & Industries in K12 occupancies.

Because of the financial and out-of-service risks associated with district ownership of the site underground high voltage cabling and the various large transformers serving the switchgear within the buildings, (see accompanying PUD map of the school district owned facilities) CSD engaged Planners, Engineers, and Legal Counsel during spring and summer 2015, in an effort to negotiate transfer of ownership of the high voltage cabling and transformers on district property to The PUD.

The negotiated arrangement, undertaken at the request of The PUD, would have traded the value of the facilities conveyed by CSD for the reduction of outage risk and restoration costs for CSD, with what PUD described as “a minimal rate increase”. Such an arrangement would also have removed L&I from direct oversight authority against CSD for the missing main disconnects. The PUD enjoys much greater autonomy in how they construct, configure, and operate PUD owned infrastructure. The true extent of the discussed “minimal rate increase” could not be established, but one (as yet un-adopted) recommendation from PUD rate consultants recommended a 68% rate increase in electrical rates for schools.

After much discussion with PUD staff, General Manager and their Legal Counsel, an Interlocal Agreement was brought to the PUD Board of Commissioners in June, 2015. Unfortunately the agreement was rejected by The PUD Commissioners, and it appears that CSD will have to continue with electrical service as a primary customer for the foreseeable future; meaning that ANY significant proposed modifications of the HVAC system (or any other electrical infrastructure element) will trigger further L&I demands for main disconnect additions on ALL switchgear as a condition of permitting.

Just this past July, as earlier mentioned, the district replaced one large switchgear unit, a replacement mandated by Labor & Industries (L&I) Electrical Inspectors because the switchgear did not have a “main disconnect” feature by which ALL of the served loads could be disconnected by throwing a single disconnect. Loads on this old panel, (as is the case with several of the remaining panels) had to be individually disconnected by the use of “sectional disconnects”: one for each large sub-breaker.

This upgrade, which was required to be completed by July 2016, was forced by L&I as a condition of approving a recent HVAC improvement in the gym.

At the time of original installation of the main switchgear panels without main disconnects, that was an acceptable method. In recent years, with changes in the codes, such installations are no longer permitted, and L&I typically mandates upgrading to the “main disconnect design” everywhere, whenever there are modifications or reconfigurations to the system, anywhere. In other words, L&I uses virtually ANY permit for system modification as a trigger to mandate the main disconnect upgrade for all switchgear owned by the school district at this site.

All of this “upgrade to current code” expense falls to the school district because the district (not PUD) owns the entire infrastructure package beyond the property line PUD pole. The accompanying ELECTRICAL SYSTEM ONE LINE DIAGRAM depicts the nature and extent of all of the system components. The development of this accurate “master one-line” map was contracted to Tres West Engineers to aggregate and correct an often inaccurate collection of diagrams and drawings from the decades of piecemeal additions and modifications.

This “triggering effect” is a very important reality because it makes a series of medium scale incremental improvements over time essentially impossible, because, now that L&I has focused on the issue, they have communicated that every future electrical modification permit request will trigger the much larger effort of global main switchgear modification for code reasons. Meanwhile, there remains the financial cost-of-restoration exposure, along with the risk of long term inability to utilize a blacked out building (or portion of a building) while extensive repairs have to made to failed primary infrastructure.

The disruptive and financial impact of such failures was demonstrated in March of 1993 with the failure of one of the large transformers, and resulting fire, back when PSE was the service provider. Such primary system failure incidents cannot be accurately forecast, but the probability of their occurrence increases with age, and many elements of the subject infrastructure are at or approaching the end of expected useful life.

Therefore, in order to address the code compliance issues raised by L&I; thus enabling some reasonable level of electrical service reconfiguration, and to make that upgraded service more reliably served by the aged primary system of high voltage underground feeders and multiple transformers, it is

our recommendation that CSD undertake an electrical infrastructure global (campus wide) modernization program, long deferred.

Undertaking some elements of such a modernization program can sometimes (even often) be implemented incrementally over a period of years, typically for capital funding reasons. But the needs in this instance, with so much already deferred for so long, combined with the L&I-mandated switchgear disconnect upgrades blocking all reconfiguration in existing facilities, and further combined with the operational and fiscal risks posed by the aging primary system, drive the need (and our recommendation) for a fully funded upgrade program, then phased for execution only for purposes of disruption limitations, and coordinated for summer and/or school vacation periods since large portions of the facility will be without utility power for extended periods.

There will be substantial engineering, scheduling, permitting, bidding & procurement work (cost of which is included in the estimates) necessary to execute the identified scope within the time slots available. There are also lead times to be addressed for switchgear, transformers and generator equipment that will affect schedules; availability will vary by season and construction general activity levels.

Another factor that will affect timing and bundling of the work here in Chimacum will be, if present construction market conditions continue as expected for the next several years, the availability of electrical workers, and to some extent, HVAC workers. Large construction projects all along the I-5 corridor are creating demand well in excess of native local resources. This may result in doing work over an extended period with less staff, despite inefficiencies.

Once the Engineering begins there will undoubtedly surface some non-electrical scope of work required to make room for large electrical switchgear, establish code-required clearances, and similar impacts not fully known until deeper discovery and design begin. The estimated costs in this analysis include a 10% construction contingency that should be sufficient to fund most such “known unknowns”.

On the next page are the elements of scope and cost to complete the ELECTRICAL INFRASTRUCTURE MASTER PLAN program. These planning estimates are made with the assumption that the district continues with primary PUD service and that there are no substantial modifications to the building configurations, except where noted.

SCOPE	ESTIMATED COST	RECOMMENDATIONS
<p>1. <u>Electrical Disconnects (Only) Upgrade to Code.</u> For all main switchboards lacking code-mandated main disconnects, add outdoor main disconnects at transformer site to permit continued primary service configuration. Excludes switchgear rehab/replacement. Includes engineering, permits, L&I fees, project management, contractor labor & materials, and 10% contingency.</p>	<p>\$515,000*</p> <p>*This is the minimum electrical improvement required by L&I to enable any other HVAC or Electrical changes, and assumes continued primary utility service arrangement.</p>	<p>This is highly recommended. There can be no further modifications to anything affecting electrical permitting without performing this L&I mandated code correction, for so long as district owns the primary electrical. L&I could, at any time, mandate this even absent new permit applications. This work could be easily done over one summer with minimal short "cutover" outages.</p>
<p>2. <u>Electrical Disconnects (Scope 1 above) PLUS Electrical Switchgear and Main Panels Replacement & Upgrade.</u> Includes provisions for code-mandated disconnects and then upgrades the main switchgear serving selected main and sub-panel gear to improve amperage capacity, serviceability, and load reconfiguration capability. Includes engineering, permits, L&I fees, project management, contractor labor & materials, and 10% contingency.</p>	<p>\$882,000*</p> <p>*This scope includes Scope 1` above, but adds the range of improvements to the main switchboards and panels needing rehab or replacement. This is the minimum electrical scope required to perform significant HVAC improvements.</p>	<p>For any long term continued occupancy, whether or not buildings are reconfigured or repurposed, this is highly recommended to "refresh and renew" the critical electrical system for another 10-20 years of useful life, with less, but continuing renewal. This work could be done over one summer with a large crew, or multiple contractors, but would require extensive outages.</p>
<p>3. <u>Electrical Primary Service Reliability and Restoration Investments.</u> Includes purchase of spare transformers and pad modifications, emergency generator, fuel system, switchgear, emergency restoration underground cable stocks, and related parts. Requires rapid response/restoration contract as well. Includes secure storage building. Engineering, permits, L&I fees, project management, contractor labor & materials, and 10% contingency.</p>	<p>\$721,000*</p> <p>*This is risk mitigation investment, affording protection against prolonged loss of use of facilities due to catastrophic failure of district-owned aged electrical infrastructure serving the building switchgear.</p>	<p>About half of this scope is highly recommended for service reliability IF THE DISTRICT CONTINUES WITH PRIMARY SERVICE. About half of this is standby generator costs, which serve other district and community shelter-in-place use agendas. Perhaps half of the remaining cost, mainly for transformers, could, in the event PUD takes over the primary, be recovered by resale of spares.</p>