PUGET SOUND ENERGY

LAKESIDE 115KV SUBSTATION REBUILD

Implementation Plan

2017

CURRENT OWNER: Molly Reed

Revisions by: Doug Long

Original by: Jens Nedrud

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Section 1. Document Revision History and Chronological Summary

1.1. Document Revision History

Revision	Date	Description	Phase
0.0	03/01/13	Initiate document based on October 2012 System Planning Notification # 11052113	Project Plan Development
0.1	8/14/13	Gate 3 PM Leadership Team Approval	Project Plan Development
0.2	9/22/14	Project Manager Turnover from Nedrud to Long	Project Plan Development
0.3	12/11/14	Updated Chronological Summary to reflect 2015 deferral	Project Plan Development
0.4	12/11/14	Submitted CSA Addendum and PCR to lower 2015 budget per budget committee	Project Plan Development
0.5	2/3/15	Updated Chronological Summary to reflect 2015/16 project plan	Project Plan Development
0.6	1/25/15	Routed PCR to reduce 2015 budget to align with Corporate Budget reductions	Project Plan Development
0.7	2/26/15	Updated Chronological Summary to include 2015 proposal	Project Plan Development
0.8	3/19/15	Updated Chronological Summary to include 2015 approval of Control House construction	Project Plan Development
1.0	**6/9/15**	**Approved Gate 3 PCR**	**Project Plan Development**
2.0	**7/22/15**	**Approved Gate 4 PCR – Control House**	**Pre-Construction**
3.0	**9/14/15**	**Approved Gate 5 PCR – Control House**	**Construction**
4.0	**3/18/16**	**Approved Gate 4 PCR – East Bus Rebuild**	**Pre-Construction**
5.0		**CSA Amendment #2 – East Bus Rebuild**	**Construction**
6.0	**10/25/16**	**Lakeside Switched In**	**Construction**
7.0		**Gate 4 – West Bus Rebuild**	**Construction**

1.2. Chronological Summary

2012

System planning notification for the Lakeside 115kV Substation Rebuild project was received by Project Management.

Fall 2012 – Engineering reviews possible solutions and sequencing for the rebuild.

2013

Winter/Spring 2013 - Engineering completes Gate 3 assessment of the project. The initial field survey and preliminary design plan is completed. The plan is reviewed by Permitting and the Project Team to assess schedule, cost and risk impacts.

Winter 2013 – Facilities is notified that the use of the existing maintenance facility is needed for the new Lakeside control house. They are reviewing alternative locations and will have possible solutions in June/July 2013. Options include an off-site relocation, or an on-site combined use control/maintenance facility.

Spring 2013 – Engineering reviews a possible on-site location for a new control house that would leave the existing maintenance facility in place. An architect contractor is brought onboard to put together preliminary designs for this control house.

Fall 2013 – Due to budget reasons, the construction of this project has been delayed until the 2015 and 2016 years. Design and permitting will be completed in 2014.

2014

Winter 2014 – Facilities notified the PM that the existing maintenance facility will be vacated and available for use for this project. PM and team confirm that they need to be out of that building by the end of 2014. Engineering and the architect will modify their design to use the existing maintenance building footprint.

December 2014 – The project is deferred by the budget committee. The 2015 budget is reduced to $150K. PCR and CSA amendments were routed 12/11/14. The following applies:

a. Approved permitting not expected until May/June 2015
b. Long lead materials (requiring 2015 payment) not ordered in 2014
c. System Planning requests a plan from the team to provide a path to move forward and construct portions of the project.

2015 - January

The V8 Budget for Lakeside 115kV Rebuild has been reduced to $150,000. The Project Team will submit PCR and SOW to construct the new Control House in 2015. Initial estimate is $2.2M, which includes a fully equipped and secure Control House. The proposal will include a recommendation to construct the entire 115kV yard in 2016. This is being discussed with the Load Office and an update will follow.

2015 - March

The project team determines that constructing the Control House in 2015 would be critical to keeping the project on track for a 2016/2017 delivery. The preferred construction option for Lakeside 115kV Rebuild is as follows:

Alternative Schedule

1. 2015 Construct the new Control House - $2,200,000 Capital
2. 2016 Construct the East Bus – Phase 1 - $6,694,102 Capital

(i) At the end of Phase 1 above half of the substation will be rebuilt in the new configuration; the other half of the substation will remain in the original breaker configuration. This is how the system will operate during the winter of 2016-2017.

3. 2017 Construct the West Bus – Phase 2 - $5,116,666 Capital

This proposal was presented to the RMT and Directors March 2, 2015 and received approval to move forward with a PCR to adjust the 2015 budget to $2.245M.

2015 - September

The project team continues to state that the construction of the control house in 2015 is critical to keeping the project on track for a 2016 and 2017 delivery. The construction sequencing remains the same as identified in March 2015 summary.

The Control House build was presented to the RMT on July 7, 2015. The project team was told to proceed to bid the project. On July 27, 2015 a bid package was issued to five contractors. Two bids were submitted to PSE on August 19, 2015. The team determined that Johansen Excavating submitted a complete bid package that met the tight timeframe. The PM requested approval from the CMT to award the bid. The Gate 5 PCR was sent with supporting documentation for approval. The CMT emailed approval to the project team that they agreed with the selected contractor. The contract was awarded to Johansen on August 27, 2015 with the formal NTP being sent on August 31, 2015. The PCR was stalled at the System Planning Manager level. Approval was sent on September 8, 2015.

System Planning has temporarily suspended any further work at Lakeside Substation, requesting further need justification for building Lakeside 115kV Rebuild prior to the Energize Eastside Project and an alternative to the rebuild by adding a second bus section breaker.

Justification was presented to Directors and VP's and approval was given to proceed with the rebuild at Lakeside.

2016 - March

The project team is moving forward with East Bus pre-execution activities. The East Bus civil scope of work went out to bid on 2/11/16. The project team has met and decided on a contractor for the work. The approval processes have changed and PCR's are no longer required as of 3/23/2016. A CSA or CSA amendment, depending on current phase of a project, is required. The Project Manager is working to get the required documentation updated in order to proceed with the new process.

Section 2. Project Overview

2.1. Purpose:

Improve reliability for the 114,000 customers in the Bellevue, Issaquah, Kirkland and Newcastle areas by rebuilding the Lakeside 115 kV Switching Station; replace aging equipment with new equipment in a more effective and reliable layout.

Project Objectives:

1. Replace twelve oil-filled circuit breakers, foundations and multiple steel support structures prior to physical failure.
2. Rebuild the 115 kV bus to a more reliable configuration.
3. Separate lines serving the same geographic areas that now connect on common bus sections and are subject to a common outage.
4. As much as possible, connect the transmission lines outside the substation to maintain reliable service to distribution substations during construction.
5. Complete the 115 kV rebuild work prior to construction of the Eastside 230 project's new 230-115 kV substation. The rebuild will leave room for a 230 kV line to pass next to the 115 kV substation yard and space to tie in the necessary 115 kV capacitor banks.

2.2. Need Statement:

The needs for this project are grouped into aging infrastructure, efficiency and reliability needs.

Aging Infrastructure

- The structures, foundations and twelve circuit breakers will require replacement within 5-10 years due to aged condition. The breakers are 35 to 45 years old, serve a large number of stations and have seen a significant number of faults. They can be replaced individually over several years, or all at once. When replaced as one project, it makes sense to improve the reliability of the bus layout at the same time. In addition, there are multiple electromechanical relay packages needing replacement in the existing control house.

Efficiency

- The 115 kV work required to accommodate the Eastside 230 kV Project and to address aging infrastructure will cost approximately the same as the cost for a piecemeal rebuild of the 115 kV substation.
- Eastside 230:
  - The Eastside 230 kV project will rebuild two existing lines between Sammamish and Lakeside from 115 kV to 230 kV. Routes utilizing the PSE corridor will bypass the existing 115 kV switching station on the east. There is currently not space within the substation for the 230 kV structures. Without reconfiguring the existing bus to make room for 230 kV structures the fence would have to be extended to the east, requiring vegetation removal, retaining wall construction, easements for tie-backs into adjacent property and water run-off retention. The civil work required for this

230 kV line bypass of the existing substation will cost in excess of one million dollars. In addition, due to the geological instability of the slope this would be a high risk construction project.
    - Rebuilding also allows space in the 115 kV yard for capacitor banks to accommodate the potential Eastside 230-115 kV transformation at the Lakeside location.
- Without this rebuild, two existing lines will require moving to the opposite side of the bus, so that two lines serving the same customers will not be at risk of losing power for a single equipment outage. This will require building a short section of double-circuit transmission line on Kamber Road where there is no line today.

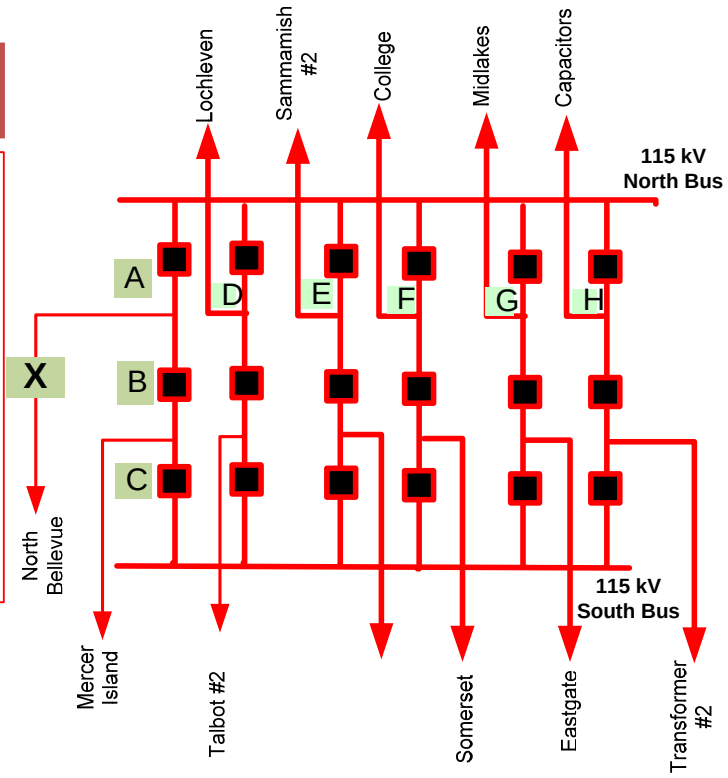
Reliability

- The single bus section breaker at Lakeside puts all of the lines at risk of opening for a bus section breaker failure. To meet NERC reliability standards and prevent the loss of multiple lines to our customers, typically we would install a second bus section breaker to restrict the outage risk to just half of the bus. However, at Lakeside, the space available in the middle of the bus will not accommodate a conventional gas insulated circuit breaker. It will be extremely challenging to shoe-horn in another bus section breaker and will require a high-cost one-of-a-kind non-standard GIS breaker.
- The Talbot-Lakeside #2 line is in jeopardy of overloading in an east bus outage at Lakeside within 5 years. Since both Talbot-Lakeside #1 and the Shuffleton-Lakeside line terminate on the east bus, they would simultaneously open for a bus fault. This could also occur when a line breaker fails to trip when needed.
- The main and auxiliary bus has served Lakeside well, even with the unusual design. However, this configuration is at risk for a bus section outage affecting multiple lines. In today's main bus configuration, if one breaker fails to trip, all of the other breakers on the bus open to isolate the fault; leading to multiple lines being served radially and all radial load being de-energized. Rebuilt to a breaker-and-a-half bus configuration, at most only one additional line will be at risk of an outage due to a breaker failure. When one line experiences a fault, the two breakers on either side of the line connection to the bus will open. If the middle breaker (in the rung) fails to open, the next breaker on the rung will open, dropping one additional element and if the bus side breaker fails to open the faulted line, then all of the breakers on the bus will open. See diagram below:

Lakeside 115kV Rebuild
Final Configuration

Features of Breaker and a Half Bus:

1. **Normal Operation**: Line fault at X on the North Bellevue line causes 2 Breakers A&B to trip
2. **Breaker Failure Analysis:**
   a. If Breaker B (the mid-rung breaker) fails to trip, then Breaker C will trip, opening the line to Mercer Island. No other lines will be affected.
   b. If Breaker A fails to trip, then all of the other breakers on the north bus (D,E,F,G, and H) will trip. All of the lines and transformers (except the North Bellevue line) will continue to be fed through the south bus.



2.3. Benefits:

Quantitative - the breaker-and-a-half configuration:

1. Provides improved transmission reliability to the 114,000 customers in the Eastside area served by Lakeside Substation by reducing exposure to bus faults and breaker failure outages. The configuration also meets NERC reliability standards.
2. Replaces twelve at-risk aged 115 kV oil breakers.
3. The cost to replace the breakers and structures now as one project is comparable to the cost of doing the work required in a piece-meal fashion. This alternative is estimated to cost an additional $1.4M, but improves reliability and reduces ongoing O&M costs for breaker/substation maintenance.

Qualitative - the breaker-and-a-half bus configuration:

1. Will prevent the overloading of the Talbot-Lakeside #2 115 kV line which is in jeopardy of overloading in a Lakeside east bus fault within five years.
2. Increases transmission reliability by reducing impacts of bus outages.
3. Increases reliability by removing aged equipment.
4. Realigns equipment to make room for the Eastside 230 kV line needed along with the proposed 230-115 kV substation to serve growing Eastside load.
5. Avoids installing an expensive and unique additional bus section breaker to meet NERC reliability standards in the current configuration.
6. Replaces aged electromechanical relays with modern electronic relays.

7. Prepares for 115 kV infusion from new 230-115 kV transformer for the Eastside 230 project by adding additional bays and space for capacitors.

2.4. Planner's Assumptions:

1. Existing substation is large enough to accommodate the rebuilt substation within the existing fence or with minor fence extension.
2. New 230-115 kV substation for the Eastside 230 project will be built on the adjacent property held for this purpose.
3. Existing 115 kV lines will be rebuilt to 230 kV to accommodate the new 230-115 kV substation.
4. Permits can be obtained.
5. Outages can be taken on half of the substation at a time.
6. Construction on half of the substation can be completed within an 8 month window.

2.5. Alternatives

1. **Rebuild the Lakeside 115 kV bus to breaker-and-a-half configuration, prior to construction of the new 230-115 kV substation needed as part of the Eastside 230 kV Project.** To maintain service to local substations, long-lining the existing transmission lines will be necessary (long-lining includes shoo-flying transmission lines around the existing substation thus extending the line temporarily during construction). This option was selected because it optimizes substation improvements while providing a more reliable substation configuration.
2. **Rebuild the Lakeside 115 kV bus to a breaker-and-a-half configuration; construct the first half of the bus before the Eastside 230 kV Project and the second half after the Eastside 230 kV Project**. To maintain service to local substations, long-lining the existing transmission lines will be necessary. This option was rejected in favor of the first alternative because better reliability and easier construction access could be achieved by completing the construction prior to the Eastside 230 kV Project.
3. **Rebuild the Lakeside 115 kV bus to a breaker-and-a-half configuration after the Eastside 230 kV Project.** To maintain service to local substations, long-lining some of the existing transmission lines will be necessary. Two of the lines must be moved over on the east bus and part of the auxiliary bus removed to accommodate the placement of 230 kV poles inside the substation. This option was rejected because better reliability and easier construction access could be achieved by completing the construction prior to the Eastside 230 kV Project.
4. **Use existing bus configuration.** During the Eastside 230 kV Project the following additional work will be required: Replace circuit breakers for the bus tie breaker and the new transformer connection in Bay L. Relocate Ardmore line one bay west. Move the Phantom Lake line to the west bus and move the Lochleven line to the east bus. Install a second bus section breaker in the mid-bus. Replace all of the remaining electromechanical relays. Extend the substation fence to north. Install the breaker off the north bus for capacitors. Replace the south deadend structures and foundations. This option was rejected because for about the same money, a newly rebuilt substation will provide better reliability and less impact on the neighborhood and allow room for the Eastside 230 PSE corridor lines to go through the substation.

5. **Rebuild the 115 kV switchyard at the pole yard to the south and then build the 230 kV substation at the existing 115 kV site.** This option was rejected because of transmission line congestion and unacceptable schedule delays to both this and the Eastside 230 project.

2.6. Scope:

1. Rebuild the Lakeside 115 kV bus to breaker-and-a-half configuration. Replace all electrical structures and foundations. Upgrade grounding and control wiring as needed. Install 6 rungs for 11 existing 115 kV line and one future 115 kV line. Prepare for 2 line bays to become 115 kV connections to 230-115 kV transformers in the future. Lay out the substation to accommodate a future double circuit 230 kV structure on the east side of the substation inside the fence. The layout should also plan for two future 42 MVAR 115 kV capacitor banks, staged with 2-21 MVAR capacitor banks each. Use 63 kA interrupting equipment. Upgrade protective relays where needed for updated protection schemes. Install new fiber/SCADA communication and security equipment in the new control house.
2. Work will be performed in two phases to reduce reliability risk. The first phase of construction will rebuild the east bus; the second phase will rebuild the west bus. Please see the diagram below for the current configuration: [**REMOVED FROM DOCUMENT AS INFORMATION IS CRITICAL ENERGY INFRASTRUCTURE INFORMATION]**

3. In Phase 1, while the east bus is under construction, the lines presently fed from that bus section will need to be temporarily connected (long-lined) outside the substation to reduce outage risk during the months of construction. Phase 1 uses three long-lines: A, B, and C. In long-line A on the south side, the Shuffleton line will be tied to the North Bellevue line. In long-line B on the north side, the Lakeside-Ardmore #1 and Lakeside-Phantom Lake lines will be tied to the Sammamish-Lakeside #1 line. In long-line C on the south side, The Lakeside-Goodes Corner line will be tied to the Talbot-Lakeside #1. (See Diagram Below)
   [**REMOVED FROM DOCUMENT AS INFORMATION IS CRITICAL ENERGY INFRASTRUCTURE INFORMATION]**

4. In Phase 2, while the west bus is under construction, the lines presently fed from that bus section will also need to be long-lined outside the substation to reduce risk of outage during the months of construction. Phase 2 is uses two long-lines: D and E. In long-line D on the south side, the Lakeside-North Bellevue line will be tied to the Lakeside-Mercer Island line and the Talbot Hill-Lakeside #2 line. In long-line E on the north side, the Sammamish-Lakeside #2 line will be tied to the Lakeside-Lochleven line. (See Diagram Below) **[REMOVED FROM DOCUMENT AS INFORMATION IS CRITICAL ENERGY INFRASTRUCTURE INFORMATION]**

5. A new control house will need to be built to accommodate the updated control panels for more circuit breakers and allow the substations to both operate independently between construction phases. See the final configuration diagram below: [**REMOVED FROM DOCUMENT AS INFORMATION IS CRITICAL ENERGY INFRASTRUCTURE INFORMATION]**

2.7. Project Assumptions:

East Bus

1. Long lining can be completed to allow for the rebuild of the east bus.
2. New control house will be complete
3. Transfer trip for the long lined lines will occur out of the new control house.
4. Permits will be approved to meet a mid-April start date.

5. Substation crew will handle demo of existing equipment and assembly of the new bus work.
6. No issues (wiring related) result in digging up the east side of the substation.
7. The civil contractor and substation crew will coordinate effectively to manage time in the schedule.

West Bus

1. Transmission line outage will occur starting 3/20/2017
2. Long lining can be completed to allow for the rebuild of the west bus
3. Contracts for civil construction and transmission line construction are in place to allow for construction to start by 3/20/2017
4. PSE Substation Crews have the capacity to complete selected civil and electrical work in coordination with the civil contractor
5. Transmission line easements for reconnect of Lakeside-Mercer line will be acquired
6. Tree removal permit will be obtained by September 2017

2.8. Project Constraints:

1. This project must not delay the Eastside 230 kV project.
2. The Olympic Pipeline is constructed on an easement along the west side of the substation property. The current plan will not affect the pipeline. As part of the project communication plan, Olympic Pipeline will be contacted and briefed on the status of the project.
3. While the east and west bus is under construction, the long-lining required will put outage constraints on all lines affected during that phase. This will potentially impact other work occurring in the Bellevue and King county area.
4. If the work cannot all be completed prior to the Eastside 230 kV project construction, it will be necessary to do some of the work before and some of the work after the Eastside 230 kV project. The team has considered layout and outage considerations and recommends constructing the east phase first followed by the west phase.
5. Construction outages will be limited to May through October.

Section 3. Budget and Schedule Milestones

3.1. Estimated Budget

Assumptions:

1. All prices are in current year dollars (2014); no escalation has been included in this estimate.
2. Labor and material quantities are based on project team member estimates
3. Material and equipment prices are derived from PSE's material price list as recorded in SAP. When material and equipment prices are unavailable in SAP, current material prices are approximated based on historic costs from past projects.
4. Internal PSE labor rates are derived from PSE's labor tables as recorded in SAP.
5. External contractor labor rates are approximated from current area market conditions.

Planning Estimate						
	Actual Costs through 2012	Current Year 2013	2014	2015		Total Lifetime
Capital	$0	$200,000	$5,800,000	$6,000,000		$12,000,000
Expense	$0	$0	$63,000	$65,000		$128,000
Gate 3 Project Team Baseline Estimate						
	Actual Costs through 2013	Cost through Year 2014	2015	2016	2017	Total Lifetime
Phase (at year end)	*Development*	*Engineering*	*Construction*	*Construction*	*Construction*	
Capital	$857,226	$598,843	$2,245,958	$6,694,102	$5,116,666	$15,512,795
Expense	$0	$0	$899	$53,050	$61,975	$115,924
Estimate to Completion (ETC)		$14,450,000				
Risk Contingency		$2,167,500				
Note: Estimate accuracy is $10.1 - 21.7M (-30% to +50%) based on ETC						

PROJECT PLAN DEVELOPMENT PHASE: CONTINGENCY = N/A, RANGE = -30% TO +50%

DETAILED ENGINEERING PHASE: CONTINGENCY = 15%, RANGE = -20% TO +30%

PROCUREMENT PHASE: CONTINGENCY = 10%, RANGE = -5% TO +15%

CONSTRUCTION PHASE: CONTINGENCY = 5%, RANGE = -2% TO +5%

Control House

Gate 4 Project Estimate						
	Actual Costs through 2014	Current Year 2015	2016	2017	20XX	Total Lifetime
Phase (at year end)	*Development*	*Construction*	*Construction*	*Construction*		
Capital	$1,456,069	$2,611,082	$6,966,126	$5,458,509		$16,491,786
Expense	$899	$0	$58,504	$58,504		$117,907
Estimate to Completion (ETC)		$15,035,717				
Risk Contingency		$751,786				
Note: Estimate accuracy is $X - XM (-X% to +X%) based on ETC						

Gate 5 Project Estimate						
	Actual Costs through 2014	Current Year 2015	2016	2017	2018	Total Lifetime
Phase (at year end)	*Development*	*Construction*	*Construction*	*Construction*	*Close-out*	
Capital	$1,456,070	$2,705,597	$6,966,126	$5,458,509		$16,586,302
Expense						$0
Estimate to Completion (ETC)		$15,130,232				
Risk Contingency		$756,512				
Note: Estimate accuracy is $X - XM (-X% to +X%) based on ETC						

Gate 6: Project Estimate vs. Actual Summary					
Gate	*Planning/ Gate 2*	*Gate 3*	*Gate 4*	*Gate 5*	Actual
Year Completed	2012	2013	20XX	20XX	
Est. Lifetime Capital	$12,000,000	$13,798,000	$1	$1	$1
Est. Lifetime Expense	$128,000	$100,000			
Capital % Delta		14.98%	-100.00%	0.00%	0.00%
Capital % Delta to Planning Estimate		14.98%	-100.00%	-100.00%	-100.00%

East Bus Rebuild

Gate 4 Project Estimate					
	Prior Year Costs	**East Bus**	**West Bus**		**Total Lifetime**
Phase (at year end)	*Construction*	*Construction*	*Construction*		
Capital	$4,397,010	$7,463,253	$7,597,610		$19,457,873
Expense	$2,882	$69,009	$46,006		$117,897
Estimate to Completion (ETC)		$15,060,863			
Risk Contingency		$348,402			

Execution Gate					
	Prior Year Actuals	**2016**	**2017**	**2018**	**Total Lifetime**
Phase (at year end)	*Development*	*Construction*	*Construction*	*Close-Out*	
Capital	$4,397,010	$7,770,648	$5,182,882		$17,350,540
Expense	$2,882	$69,009	$46,006		$117,897
Estimate to Completion (ETC)		$12,953,530			
Risk Contingency					

3.2. Milestones and Deliverables

Milestones and Deliverables	**Description**	**Schedule Baseline Date**	**Approximate Date**
	Feasibility	4/30/13	4/30/13
	Order Long Lead Material	6/3/13	6/3/13
	Develop Project Plan	8/15/13	8/15/13
	Detailed Design	9/22/14	
	Permits Obtained Control House	12/2/14	8/26/15
	Permits Obtained Station Rebuild	6/15	5/12/2016
	Control House Construct Start	9/1/15	9/14/2015
	Control House Construct Finish	11/26/15	12/11/15
	Phase 1: Construction Start	5/9/16	5/9/2016
	Phase 1: Long Lining Complete	5/6/16	5/25/2016
	Phase 1: Construction Complete	10/1/16	10/25/2016
	Phase 1: Un-long Lining Complete	10/15/16	10/24/2016
	Phase 2: Long Lining Complete	5/1/17	
	Phase 2: Construction Start	5/1/17	
	Phase 2: Construction Complete	9/15/17	
	Phase 2: Un-long Lining Complete	10/31/17	
	Project Close-Out Complete	12/28/17	

Section 4. Engineering Baseline Scope

4.1. Transmission/Distribution

Line route

The existing line routes into Lakeside substation will be used as much as possible to keep the transmission portion cost efficient. Ideally, the existing structures will be reframed if structural capacity allows.

Long Lining/Temporary Construction

The long lining of the transmission lines will be done to maintain customer reliability as much as possible while the substation is under construction, and will follow the phases of the substation rebuild. In Phase 1, the north circuits (Ardmore #1, Phantom Lake, and Sammamish #1 lines) will be long lined. For the south circuits, Goodes Corner and Talbot #1 will be long-lined while Shuffleton and North Bellevue will be long-lined. Some temporary structures and/or guy wires may be required during this time. (See diagram on pg 9)

In Phase 2, the north circuits (Sammamish #2 and Lochleven) will be long-lined. For the south circuits North Bellevue, and Mercer Island and Talbot #2 will be long-lined. Some temporary structures and/or guy wires may be required during this time. (See diagram on pg 10)

Special considerations

The special considerations for this project include the double circuit steel poles located south of Lakeside substation. If any work needs to be completed on these structures, they will need to be analyzed by the steel fabricator. Given the advanced age of the structures, there is a 20% chance that these structures will need to be replaced if a suitable solution cannot be obtained using the current structures. The structures are currently under review by the steel fabricator.

Consultant/Design Contractor

We do not foresee a need for a transmission design consultant on this project.

4.2. Station

Type of Station/Description

The Lakeside substation property is located at 13615 SE 26th St (Kamber Rd.), Bellevue, WA 98005. Station access is on the North side from Kamber Rd. with restricted access from the south side via a storage/pole yard. The site has a PSE Control House as well as an Olympic Pipeline gate station on the North side of the property; the pipeline runs along the West side of the station property, with an elementary school adjacent to the east side. The station itself is approximately 1.75 acres sitting on the property which is approximately 5 acres.

Lakeside substation is currently a main/double aux bus configuration and will be rebuilt to a 115 kV 6-rung breaker and a half switching station utilizing PSE's standard compact design with disconnect switches and CCVT's on the dead end towers. Final construction will have (11) 115 kV transmission lines terminating on the bus, and one future line bay.

The substation will be designed to accommodate two future 115 kV lines connecting to two 325 MVA 230-115 kV transformers built in the new substation to the south. It will also be designed to accommodate two future 42 MVAR 115 kV capacitor banks, each built with two stages of 21 MVAR capacitors.

The line bays need to accommodate a maximum 320 MVA winter load. The transformer bays need to accommodate a maximum 484 MVA winter load.

The station will be built in two stages with the first stage building out 3 of the 6 rungs, and the second stage completing the remaining 3 rungs. Standard substation equipment will be used wherever possible.

The equipment inside of the existing station will need to be demolished in stages to accommodate the new construction; the east section of the yard has been identified as the primary candidate for being rebuilt first. The new station will be rebuilt inside of the existing fence line of the station.

System Protection Engineering has determined that the available fault current when the station is built with 2 transformers will exceed 40 kA. Therefore circuit breakers shall be ordered with 63 kA interrupting current capability.

Property & Civil Site Work

This property is currently owned by PSE. The majority of the civil site work will occur within the existing substation fence. The work will include demolition of existing structures and foundations along with removing the existing yard rock (top 4 inches). New foundations and structures will be constructed along with a new drainage system within the yard. The new drainage system will tie into the existing drainage system in the southwest corner of the yard. Additionally, an interior perimeter driveway will be installed adjacent to the fence inside the entire station. Lastly, 4 inches of new yard rock will be spread throughout the entire yard.

In addition to the improvements listed above the following improvements are proposed to occur outside of the substation fence but still on PSE property:

1) New Control House (adjacent to the existing substation station fence but within the existing fenced area connecting the substation fence to the Maintenance building)
2) Install 5-foot yard rock shoulder (5 feet outside of the fence – all sides)
3) Install a French drain beneath the 5-foot shoulder (east side only)
4) Drainage ditch maintenance, clean up, and armoring (south side of the station)
5) Replace the existing 1,100 LF of fencing around the perimeter of the station along with the 2 access gates.

Control House

The control house will be a built-in-place style building using a slightly modified version of PSE's Mt. Si/Novelty Hill control house. The building will be constructed between the existing facilities building on the property and the existing control house.

The control house will house all new relay racks, battery room, HVAC, and other necessary substation equipment. There will also be a separate room dedicated to security, IT/telecom, and all communications functions. Conduits will be installed to/from the new/old control houses to aid in construction sequencing and energization.

Security

PSE's complete video security system will be installed at Lakeside. The existing control house will be used to house the security equipment. New card readers will be installed throughout the station.

Communications/IT Telecom

Fiber and/or copper (with protectors) communication cables will need to be pulled, terminated, etc. between the current control house and future control house through the provided conduits. Media converter or other IT/telecom communication equipment may need to be purchased depending on cutover requirements, but is not required at this time. Fiber communications into Lakeside will need to have some portions disrupted during construction, but with PSE's backbone fiber and other fiber communications in the area, the network and overall reliability will not be interrupted.

SCADA

The SCADA design for this station will use FLAT SCADA architecture. The protection relays, equipment and meters will be connected serially to the ASAT servers and Terminal servers. There will not be an RTU installed, but instead an SEL-2440 will be used for all of the I/O connections. The SCADA devices will reside in the new control house. A lockable cabinet will be installed for the ASAT, terminal server, and HMI CPU. The network will be extended to the old control house where all the Communication equipment resides. The old RTU will be retired once all the new SCADA information will be cut-over to the ASAT. All data will be sent to EMS via the DNP IP protocol.

Special Considerations

- The station will need to be designed in such a way that allows for two future 230 kV lines to pass through the station without interfering with the 115 kV operation.
- Design of lines and transformers as they connect to rungs of the breaker and a half bus must consider which elements serve common areas, so that such common sources do not both connect to the same rung of the bus. See the one-line diagram provided by System Planning.
- Design/construct the station in such a way to minimize the impacts to PSE customers due to long lining and building in phases.
- Design the station in such a way that minimizes or eliminates the rerouting of transmission lines into the substation.
- The control house will need to be complete and ready for panel installation before the end of summer of the first phase to allow for energization of phase 1.

Consultant/Design Contractor

- Lawhead Architects was used to design the control house.

- David Evans & Associates will be used to provide topographic and base mapping information of the existing site features.
- Beacon Engineers will be used to provide structural design and calculations for the custom dead end drilled pier foundations.

4.3. Equipment/Materials

Long Lead Items

A. 115kV 63kA SF6 Circuit Breakers
   i. 1 Year lead time
   ii. 9 Required in first year of construction
   iii. 8 Required in second year of construction

B. 115kV Disconnect Switches
   i. 6 Month lead time
   ii. 18 Required in first year of construction
   iii. 18 Required in second year of construction

C. Cable Trench
   i. 6 Month lead time
   ii. 1 Lot required in first year of construction
   iii. 1 Lot required in second year of construction

D. 6-Bay Dead End Structural for design and manufacturing
   i. 10 Month lead time
   ii. 1 Lot required in first year of construction
   iii. 1 Lot required in second year of construction

Special considerations

Ordering & delivery of the material will need to be coordinated so that it can arrive in stages based on the construction schedule.

Consultant/Design Contractor

The steel manufacturer for the dead ends will provide design services based off of PSE's design & load drawings. The cost for this service is included in the material cost.

4.4. Protection & Controls

Controls

Lakeside substation will require 11 racks for line bays, 2 racks for bus differential, 2 racks for RTU, 2 racks for DFR, 1 rack for HMI, and 1 rack for reserved. A total of 19 racks are required.

Relay protection packages will be based on the current design (SEL 421/SEL 311C for lines, 2 SEL 587Z for bus).

Relay packages at the end of each line should be adequate except Talbot Hill #2 which should be upgraded from electromechanical relay to a new line relay package.

Some temporary relay panel design work may be required during the various stages of construction. Most likely this would be adding communications or disabling communication circuits at some of the relays.

Protection

The upgrade at lakeside will require multiple steps of review and coordination. At each step, coordination problems may require temporary relay or communications to prevent mis-coordination. The following are the steps required:

- Step 1 is the baseline study. This will determine the current settings with the substation and line in the current configuration. No changes are expected in this step.
- Step 2 is the initial separation of the substation into two pieces. Each side of the substation must be checked for coordination on all lines. This step is important as at various times over a two year period one or both halves of the substation will end up in this configuration. Minimal changes are expected in this configuration.
- Step 3 is phase 1 of the construction. One side of the substation will be torn down and rebuilt while the other side remains intact. All lines on the portion of the substation being torn down will be reconfigured during this time.
    a. One reconfiguration option is to run each line radial, which would require minimum relay changes but potential for large load losses. The other reconfiguration option would be to tie lines together (long lining). This would minimize load losses but require extensive relay changes to every line reconfigured. Changes may affect upstream breakers also. Some of the lines may require transfer trip and may require relay upgrades to support this.
- Step 4 will have half of the substation with the new configuration and the other half of the substation in the new breaker configuration. Line relaying will be similar to phase 2. This is how the system will operate during the winter of 2014-2015.
- Step 5 is phase 2 of the construction. The remaining portion of the existing substation will be torn down and rebuilt while the other side remains intact. All lines on the portion of the substation being torn down will be reconfigured during this time.
    a. One reconfiguration option is to run the line radial, which would require minimum relay changes but potential for large load losses. The other reconfiguration option would be to tie lines together (long lining). This would minimize load losses but require extensive relay changes to every line reconfigured. Changes may affect upstream breakers also. Some of the lines may require transfer trip and may require relay upgrades to support this.
- Step 6 will have the entire substation rebuild completed and lines in the final configuration.

At a minimum, every line connected to Lakeside will require temporary and permanent settings for each breaker. Depending on the arrangement, transfer trip schemes may be removed or developed based on the results of the coordination studies. Studies will require temporary settings during each phase of construction.

New bus protection relay settings may be required during different phases. Auto transfer schemes will require review and may be changed or eliminated during various stages of construction. Under frequency and under voltage load shedding schemes may be disabled for part or all of the construction period.

Consultant/Design Contractor

A consultant such as RAI may be required for protection studies and settings. This will be determined after step 1 and 2 of the protection studies.

4.5. Special considerations

- To accomplish adequate long lining during construction, the relay package at Talbot Hill for the Lakeside line will need to be upgraded from electromechanical to a new relay package.
- Some temporary relay panel design work may be required during the various stages of construction at Lakeside and other substations affected by construction.
- The elementary school play yard is adjacent to the property on the east side. Care must be taken during construction to allow for access and create a safe working area for workers and the public.
- The Olympic pipeline runs along the west side of the property, traveling south. Care must be taken during design and construction to avoid any potential conflicts and hazards.

Section 5. Permitting Strategy

5.1. Jurisdictions Impacted

1. City of Bellevue

5.2. Permits Needed

1. Land Use Exemption (LUX) to Administrative Conditional Use Permit: If expansion does not exceed 20% and no significant impacts are identified by the city. Otherwise, a new Administrative Conditional Use Permit will be required (public notice, public meeting (informal) – no hearing).
2. Critical Area Land Use Permit: Any impacts to critical areas, including clearing out the existing stream south of the substation for drainage will trigger this permit. (public notice – no hearing). Temporary disturbance should fall under repair and maintenance and/or construction staging which requires restoration, but no Critical Areas Land Use Permit.
3. SEPA: SEPA will be triggered if pole replacement includes any disturbance (temporary or permanent) within critical areas. This will be reviewed and noticed concurrent with land use permits (ACUP and CALUP).
4. Clearing and Grading Permit: For replacement of yard rock and any clearing activity.
5. Right-of-Way Use Permit: For hauling or any work in SE 26th Street.
6. Building Permits: Building permits will be required for the new control house, equipment foundations, and a new fence.
7. Demolition Permits: Demo permits will be required for the control house (and anything that required a building permit to be constructed). The demo can generally fall under the building permit unless there is no new building permit or unless timing-wise, the demo is needed sooner.

5.3. Special considerations

- A Predevelopment Services application is advised in order to initiate discussion with city staff in land use, building, and clearing and grading prior to formal permit submittal. A LUX and ACUP do not qualify for a pre-application meeting under city code.
- The ACUP process includes public notice (site notice boards and mailing) and a public meeting (city, applicant – citizens come to ask questions). Notice of the public meeting will be sent by the city.
- A portion of the site is within the 300-foot single-family transition design district. Special code requirements may apply, but should not impact the type of permits required.
- Building code issues may impact the proposal in terms of retrofits and new construction. Any new structures must be a minimum of 6 feet from existing (to be confirmed by the city) or fire wall requirements may be triggered.

5.4. Consultant

Wetland/Stream: Dependent upon impacts to critical areas during pole replacement and/or temporary pole placement, an environmental consultant may be needed to create a mitigation proposal. A critical areas report will be necessary to identify critical areas on site and type them according to city regulations.

Geotechnical: If the city deems any part of the site as protected slope – a geotechnical report may be required. Based on the survey information, it does not appear this will be the case.

Section 6. Communications Strategy

6.1. Project External Stakeholders

1. City of Bellevue
2. Nearby neighbors within 500 feet of the project area (including but not limited to residents, schools and businesses)

6.2. Public Relations/Corporate Communications Strategy

1. Below are various channels the Communications Team plans to implement in order to communicate PSE's Lakeside 115 kV rebuild project:
    a. Construction notice (if necessary): PSE will notify all landowners and occupants within 500 feet of the project. The notice will announce the construction timeline, describe the project need and provide methods for communicating with the project team if questions arise before, during or after the project.
    b. Additional outreach to nearby school (if necessary): If there is interest from school administrators or parents PSE will be prepared to present project details to parents and administrators of the school. This option will be explored at the request of the school and will be coordinated in conjunction with PSE's Community and Business Services/Major Accounts Departments.
    c. Other project materials (if necessary): Depending on interest in the project, PSE may decide to develop materials such as:
        i. Project fact sheet
        ii. Project web page
        iii. Maps and/or other graphics to help tell our story

Section 7. Coordination with Other Projects

The rebuild of the existing Lakeside 115 kV yard has a critical coordination with the Eastside 230 project. The Lakeside 115 kV yard needs to be rebuilt before the Eastside 230 project is energized on the property to allow proper breaker sizing and space for the transmission line through the 115 kV yard.

Due to the long lining required during construction and the increased exposure for other substations, other work requiring outages in the North King area may be impacted. The load office is reviewing the plan and determining what other lines and substation will be affected.

PSE is moving forward with planned line relocations to support the Factoria Transfer Station construction project in 2014. Outages on the North Bellevue, Mercer Island and Shuffleton lines will need to be closely coordinated with the planned long lining for the Lakeside Phase 1 rebuild.

At the January 2016 MEC meeting, TFS mentioned that the new bank that was installed has some flanges that are rusting and will need to be replaced. An outage will need to be scheduled to allow for replacement.

Section 8. Summary of Risk Assessment and Mitigation Plan

8.1. Risks and Opportunities

Permitting Risk

Although we are rebuilding an existing substation that has operated for over 50 years, the permitting risk for this project can be impactful to the schedule. The City of Bellevue review and approval turn time is quite lengthy.

The new control house may trigger an administrative conditional use permit that requires public notice, but no hearing.

Construction Risk

There is a risk of contaminated soil on the substation site as it has had multiple oil breakers on site for 30+ years.

It is unknown what or where conduits and wires are located between east and west bus. There is a risk of potential dig ups during grading that would or could trip the west bus off line.

There is a risk that materials may not be delivered on time or they may arrive damaged or with missing pieces. Cable trench from Old Castle has had quality issues and missing pieces at other recent substation projects.

Construction resources to support the Lakeside Rebuild schedule. Substation crew resources will be utilized to rebuild the substation. There is always the risk of unplanned failures or emergencies that would pull these resources away from Lakeside.

Contractor resources to support the Lakeside Rebuild schedule. Potelco will be used to long line.

During construction, three sets of lines will be long lined. The additional exposure poses a risk to specific substations.

Long line Sammamish #1, Ardmore and Phantom Lake:
Additional exposure of 6.3 miles to Phantom Lake and Midlakes. Automatic switching at Midlakes and College will still function properly. A second reclose will be required to enable Phantom Lake to be restored for temporary faults.

Long line Goodes Corner to Talbot #1:
Additional exposure of 9.0 miles. Automatic switching at Eastgate will still function properly.

Long line Shuffleton to North Bellevue:
Additional exposure of 3.6 miles. Automatic switching at Somerset and Hazelwood will still function properly.

<u>Phase 2</u>

During 2017 construction, outages are planned on the North Bellevue and Mercer Island lines for 1 week each with a 4 week outage on the Shuffleton line. With the

planned long lining, the Mercer Island line outage will leave the Sammamish to Shuffleton line along with Mercer Island on one looped line. This includes ten substations on a load limited line of 201 MW in summer and 239 MW in winter. That outage will need to be monitored during summer peak. Recent peaks have been 177 MW in the summer and 273 in the winter. We plan to avoid this configuration and construction during the cold of winter, however if this is the case the line can be opened in the middle during cold days to mitigate this issue.

During construction, three sets of lines will be long lined. The additional exposure poses a risk to specific substations.

Long line Lochleven to Sammamish #2:

Additional exposure of 6.1 miles. Automatic switching at South Bellevue will still function properly.

Long line North Bellevue to Mercer Island:

Additional exposure of 3.7 miles. Automatic switching at will not be affected due to breakers at Center substation.

Long line Shuffleton to Talbot #2:

Additional exposure of 9.0 miles. Automatic switching at the north end of Mercer Island will still function properly.

8.2. Mitigation Plan

Permitting Mitigation

To mitigate the permitting risk, we have a bi-weekly meeting to discuss permitting associated with Energize Eastside with the City of Bellevue. This meeting is an opportunity to ask questions on permits or bring up issues to help resolve and keep them moving forward.

Construction Mitigation

Due to the probability of oil penetrating deep in the soil, both a level 1 and a level 2 environmental study will be performed to assess the possibility and extent of contaminated soil in the planned construction areas.

It is unknown what or where conduits and wires are located between east and west bus. There is a risk of potential dig ups during grading that would or could trip the west bus off line. Controls Engineering is going to produce red and greens and the Substation Crew will terminate wires within the east bus area.

There is a risk that materials may not be delivered on time or they may arrive damaged or with missing pieces. Cable trench from Old Castle has had quality issues and missing pieces at other recent substation projects. Materials will be ordered with necessary float and materials will be delivered prior to needing it on site so it can be inspected and approved by Construction Management so that any issues can be resolved quickly.

Construction resources to support the Lakeside Rebuild schedule. Substation crew resources will be utilized to rebuild the substation. There is always the risk of unplanned

failures or emergencies that would pull these resources away from Lakeside. The mitigation plan is to utilize other crew resources within the company or work OT to maintain the project schedule.

Contractor resources to support the Lakeside Rebuild schedule. Potelco will be used to long line. If Potelco is unable to support we can contract out to other contractors who can work with our schedule or we continue with station construction and keep the 115kV line open until resources can support the work.

During construction, three sets of lines will be long lined. The additional exposure poses a risk to specific substations. Detailed step by step one line and TSOLD plans are being created to ensure clarity regarding the different construction and operating phases for the substation. Meetings will be held with the load office, protection engineering, relay techs and Potelco line crews to ensure the sequencing for the long lining is well understood by all parties. In addition, the work during 2016 will be reviewed so that it coordinates with any other planned transmission work in East King County.

Approved By:

System Planner _____ Date _____

Project Manager _____ Date _____

Project Engineer _____ Date _____

Appendices

Appendix A. Project Team

Appendix B. Work Order Structure

Appendix C. Planner Estimate and Assumptions

Appendix D. 10-Year Plan

Appendix E. Project Change Request (PCR) History Log

Appendix F. Estimated Costs

Appendix G. Current Schedule

Appendix H. Risk Assessment and Risk Management Report

Appendix I. Project Change Approval Record (CAR) Log

Appendix J. Lessons Learned Document

Appendix A. Project Team

Name	Role Description
Molly Reed	Project Manager
Sunitha Kothapolli	Transmission Planner
Mike Wood	Project Engineer – Substation
Scott Kim	Civil Engineer – Substation
Cody Spence	Construction Management
Dan Morman	Controls Engineer
Mark Savage	Protection Engineer
Tim Sliwinski	Transmission Engineer
Kerry Kriner	Permitting
Nat Trager	Project Controls
Joel Snow	Telecomm – PM
Bob Joy	SCADA
Cody Olson	Sub Ops Supervisor
Darryl Walker	Sub Ops Relay Supervisor
Stan Haralson	Vegetation PM
LawHead Architects	Control House Architect

Appendix B. Work Order Structure

Lakeside 115 kV Rebuild
P.10012.63.02.22

Notification 11052113	CAP	REM	EXP
Phase 1 - Substation (East Bus)	P.10012.63.02.22.01		P.10012.63.02.22.02
Development (2007-2013)	101039434	n/a	n/a
	101039514	n/a	n/a
	101039515	n/a	n/a
Breaker/Bus Rebuild	111021421		571011869
	111021422		
Communications/IT			
Hardware	141XXXXXX		
Equipment	141XXXXXX		
Fiber	141XXXXXX		
Phase 2 - Substation (West Bus)	P.10012.63.02.22.03		P.10012.63.02.22.04
Breaker/Bus Rebuild	111022365	108088127	
	111XXXXXX		
Communications/IT			
Hardware	141XXXXXX		
Equipment	141XXXXXX		
Fiber	141XXXXXX		
Phase 1 - Long Line	P.10012.63.02.22.05		P.10012.63.02.22.06
Phase 1 - Long Line A (LAK-NOB)	111022338	108XXXXXX	571011711
Phase 1 - Long Line A (SHU-LAK)	111022337	108XXXXXX	571011710
Phase 1 - Long Line B (TAL-LAK#1)	111022343	108XXXXXX	571011776
Phase 1 - Long Line B (LAK-GOO)	111022344	108XXXXXX	571011777
Phase 1 - Long Line C (LAK-ARD)	111022339	108XXXXXX	571011712
Phase 1 - Long Line C (LAK-PHA)	111022340	108XXXXXX	571011713
Phase 1 - Long Line C (SAM-LAK#1)	111022341	108XXXXXX	571011714
Phase 2 - Long Line	P.10012.63.02.22.07		P.10012.63.02.22.08
Phase 2 - Long Line D (TAL-LAK#2)	111022367	108088131	571011779
Phase 2 - Long Line D (LAK-NOB)	111022368	108088132	571011780
Phase 2 - Long Line D (LAK-MER)	111022366	108088128	571011778
Phase 2 - Long Line E (LAK-LOC)	111022369	108088133	571011781
Phase 2 - Long Line E (SAM-LAK#2)	111022370	108088134	571011782
Control House	P.10012.63.02.22.09		P.10012.63.02.22.10

Control House Install	111022607	108XXXXXX	
Control House Service	101094756		
Communications/IT			
Hardware	~~141002742~~		
	141002842		
Equipment	141002761		
Fiber	141002762		
Breaker Replacement (2008)	P.10012.63.02.22.11		P.10012.63.02.22.12
Breaker Replacement (2008)	101039433	108043981	n/a

Appendix C. Planner Estimate and Assumptions

Appendix D. Project Long-line Plan Diagrams

Appendix E. 10-Year Plan

Appendix F. Project Change Request (PCR) History Log

Lakeside 115kV Bus Rebuild

Appendix G. Estimated Costs

DESCRIPTION	ACTUALS	FORECAST	SUBTOTAL	CONSTR. OH	CONT.	TOTAL
Phase 1 - Substation (East Bus)	$ 2,361,870	$5,006,892	**$7,368,762**	$957,939	$848,668	**$9,175,369**
Phase 2 - Substation (West Bus)	$ -	$4,621,703	**$4,621,703**	$600,821	$1,044,505	**$6,267,029**
Phase 1 - Long Line	$ -	$ 336,822	**$336,822**	$43,787	$ 57,091	**$ 437,700**
Phase 2 - Long Line	$ -	$ 228,855	**$228,855**	$29,751	$ 51,721	**$ 310,327**
Control House	$ 890,950	$ 109,500	**$1,000,450**	$130,059	$ 18,560	**$1,149,069**
Breaker Replacement (2008)	$ 212,390	$ -	**$212,390**	$27,611	$ -	**$ 240,001**
	$ 3,465,210	**$10,303,772**	**$13,768,982**	**$1,789,968**	**$ 2,020,546**	**$17,579,496**

Appendix H. Current Schedule

H:\~T&D Project Folders\Electric\Lakeside Sub 115 kV Rebuild_111021421\106 Schedule\Proj Sched - Held by Project Controls

Appendix I. Risk Assessment and Risk Management Report

Appendix J. Project Change Approval Record (CAR) Log

Appendix K. Lessons Learned Document