Exhibit No.___(WWB-3)
Docket Nos. UE-061546/UE-060817
Witness: Walter W. Bruehl

BEFORE THE

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, vs. PACIFICORP d/b/a PACIFIC POWER & LIGHT COMPANY Respondent.	**Docket No. UE-061546**
In the Matter of the Petition of PACIFIC POWER & LIGHT COMPANY For an Accounting Order Approving Deferral of Certain Costs Related to the MidAmerican Energy Holdings Company Transition.	**Docket No. UE-060817**

EXHIBIT NO.___(WWB-3)

CASCADE KRAFT SUBSTATION OUTAGE AND POWER QUALITY STUDY

February 16, 2007

PACIFICORP
PACIFIC POWER UTAH POWER

September 30, 2004

I would like to thank the members of the task force from Boise and PacifiCorp that prepared the Cascade Kraft Substation Outage and Power Quality Study which identified the reliability issues that have hampered the Wallula Plant over the past several years. This study identifies potential power quality and reliability improvement projects to ensure service continuity to Boise's Wallula Plant well into the future.

PacifiCorp is committed to providing safe reliable service to Boise and has every intention of implementing system improvements identified in the Outage and Power Quality Study. The study identified the root causes of lightning, vegetation management, voltage control, operating errors and equipment failures as the primary contributors to the Boise Wallula Plant's power quality and reliability issues. PacifiCorp will address these primary root causes in its system improvements.

Even with PacifiCorp's investment in reliability improvements, we cannot guarantee uninterrupted power to Boise. In order to further mitigate the impacts of short duration voltage fluctuations, it is our recommendation that Boise also implement some of the reliability improvement projects noted in the study on their system as well.

Again, thank you to all participants involved with the study and we look forward to a continued cooperative relationship with Boise to provide safe reliable electric service at the Wallula Plant

Respectfully,

Paul Capell
Director, Infrastructure Planning

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Work. Build. Create.℠

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Cascade Kraft Substation Outage and power Quality Study

Committee Members and Information Contributors:

Boise:	**Walter Bruehl**	**Senior Staff Electrical Engineer**
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	Paul Capell	**Director, Infrastructure Planning**
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	Bruce Tinhof	**Walla Walla Operation Manager**

Prepared By: **Hamid Sharifnia**

Date: January 10, 2005

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Chapter 1 - Introduction:

Boise Cascade plant, located in Wallula, is served by Cascade Kraft substation at 4.16 and 12.5 kV. Power for this substation is supplied by two 69 kV lines. Appendix 1, page 23. One 69 kV line, 5.75 miles, is an express line from Wallula substation and the second line of 12.1 miles which goes to a tap to Touchet substation, another tap to Dodd Road substation, loop in and out of Attalia substation and then ends at Cascade Kraft substation. Wallula substation is connected to major 230 kV sources through long transmission lines. Due to the recent events and history of outages and the impact to Boise plant operation, a study team was formed on June 11th, 2004. There have been 20 outages since July 1998. These outages have been grouped by Boise & PacifiCorp into seven categories, to better evaluate the impact to Boise Cascade plant. These categories are listed in the table below and Table 5.1 shows the details. The Wallula Area System One Line and the Cascade Kraft substation One Line Diagram are shown in Appendix 1.

The purpose of this study is to suggest solutions and improvements to increase the source reliability and minimize production lost. The recommendations are ranked based on their benefit to cost ratio.

Boise Cascade Root Causes of Process Interruptions (Summary)

Category	Number of Events	Specific Root Cause	Impact on Plant
A. Range fires	2	Range fire under 230 kV McNary-Wallula line	Moderate Outage
B. 230 kV Faults	2	Lightning on Interstate 230 kV line	Mill down for 24 hours
C. 69 kV Faults	6	Lightning on Lowden . (long) 69 kV line	Major Downtime
D. MV Cap Switch Transients	1	Bus 5 Cap Switching (on closing)	Various VFD Trips
E. Operating Errors	3	Operator Error	Minimal to Major mill down time
F. Equipment Failure **	4	Various Equipment and Transformer # 1 Failure	Minimal to Major mill down time
G. Weak Service w/o Loop **	2	Interaction problem with wind farm & 230 kV line	Minimal

** While some of these items have a root cause identified as other than *Operation Errors*, had prudent corrective action been taken these event could have been mitigated or eliminated entirely.

What has been done to improve the transmission performance in the past?

1. PacifiCorp added lightning arrestors in a section of 230 kV line from Wallula to Walla Walla. The arrestor installation started about 4 miles East of Wallula and continued on about every fourth structure for about 7 miles (mile 38 to 46 of the line). This would put them going up and over Nine miles hill. (1991)

2. PacifiCorp added two 230 kV circuit breakers to Wallula substation. This enhanced the 230 kV line protections and eliminated the need to trip the 69 kV circuit breaker. It also yielded a much smaller voltage sag for a 230 kV, 55 miles long line faults. The project cost $1.1 M and it was in-service in 1994.

3. PacifiCorp added Digital Fault Recorders to Wallula and Cascade Kraft substations. (1991)

What is in the very short term plan, which will enhance the transmission reliability more?

Replace all transformers high side fuses with Trans-Rupter. Completion by 10/31/06. The transformer #1 fuse is being replaced as part of current transformer replacement project.

Upgrade the DFR at Cascade Kraft substation. $20 K. Completion by 3/31/05

Perform substation grounding test, including high current injection. Completion by 3/31/05

Add status points for all of the capacitor banks to the RTU. Completion by 12/31/04

Chapter 2 - Possible Actions to Increase Power Quality & Minimize Plant Outage

Below is a summary list of twelve suggestions with their rough cost estimate (+/- 30%). A more detail study is required if any of these suggestions is in being considered for implementation, however this study recommends a few projects which have the highest benefit to cost ratio. All the suggestions are described in more detail, later in this chapter.

1. Perform a comprehensive upgrade of capacitor banks to filter banks both within the Cascade Plant distribution system and outside in the existing substation (C Cap), to improve power factor and reduce resonant distortion on all five busses.
   Conceptual estimate provided by Walter Bruehl (see Appendix 6) $4.7 M

2. Replace PacifiCorp capacitor (P Cap) banks with filter banks and reduce the size of each step. $1.5 M

3. Correct the Power Factor at bus # 5 only (Bus 5), with automatic filtered capacitor bank, $500K

4. Add 12.5 and 4.16 kV voltage regulation (LTC) to Cascade Kraft substation.
   12.5 kV, Regulation $1.6 M
   4.16 kV, Regulation $600 K

5. Add lightning arrestors to 230 and 69 kV Lines.

   5A. 20 miles of 69 kV lightning Arrestors, (69 Arr) $1.1 M
   5B. 31 miles of 230 kV lightning Arrestors, (230 Arr) $3.1 M

6. Build a new 69 kV shielded express line (New 69) from Wallula to Cascade Kraft. $3.4 M

7. Shield the existing 69 kV Lowden line, (69 Shld), $2.0 M

8. Build a new 230 kV line from Wallula to Cascade Kraft with LTC transformers at Cascade Kraft, (New 230).
   230 kV position at Wallula, $5.4 M + New 230 Substation $6.0 M +
   230 kV line $3.6 M = $15.0 M

9. Add 25 MVAR Static VAR compensator at 69 kV, (SVC) $5.0 M

10. Dynamic Voltage Restorer addition to 69 kV bus, (DVR) $19 M

11. Vegetation treatment around 230 kV poles, (Veg), $8.5 K/Yr

12. Operator training, (Train) $10 K/Yr.

Suggestions Grouped by Category

For each category of outages mentioned in the Table 3.1, corrective action is suggested and describe here. Also the Table A3.3 in appendix 3 shows which outages could be eliminated if each of the suggestion is being implemented.

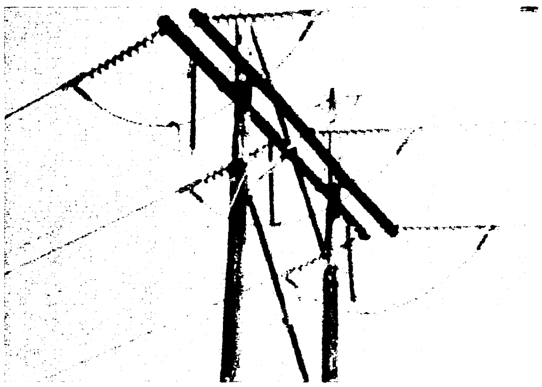
A. Vegetation Management

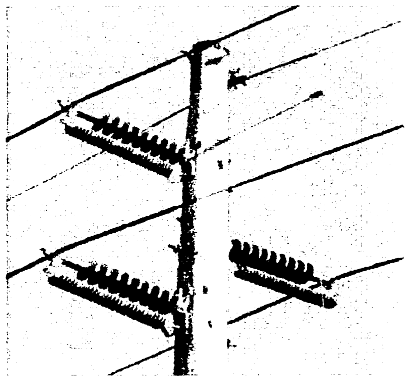
From 1998 to present two range fires have caused outages on the Walla Walla to McNary 230 KV transmission line. These occurred in the summers of 2001 and 2003. Both of these events resulted in downtime and damage to the Boise Wallula paper plant. PacifiCorp is working under a draft version of the Vegetation Management Plan until a final draft is approved. A copy of the draft Vegetation Management Specification Manual is included in the appendix. There are two sections in this manual of interest in regards to range fire protection. Section 5.2.1 of this manual states "*After clearing, the Zone A wire zone should consist of grasses, legumes, herbs, ferns, and low-growing shrubs (under 5-feet at maturity)*" and section 5.5 states "*All trees and brush should be cleared within a twenty-five foot radius of transmission H or metal structures, ten feet of single pole construction, and a five-foot radius of guy anchors*". Neither of these practices of clearing to a 5' mature height in the Right of Way or clearing all trees and brush around a pole would eliminate grass and forbs right up against the pole that is an ignition source for the pole. Ground line treating for a radius around each transmission structure would remove combustible material and would help prevent future poles burning due to range fires. There is no requirement in PacifiCorp's Vegetation Management plan for ground line treating around transmission poles and no ground line treatment is done at this time. A block estimate to provide ground line treatment of the Walla Walla to McNary 230 kV line is $16,000 bi-annually.

B & C. Shielding 69 & 230 kV Line with Lightning Arrestors

Protecta*Lite®Surge Arresters

- Reduce lightning interruptions caused by insulation flashovers
- Effective protection for unshielded and supplemental protection for shielded transmission and distribution lines
- Metal-oxide arrester works in parallel with line insulator
- During a surge, the arrester limits voltage across the insulation to a value below the insulator flashover voltage
- Arrester diverts lightning surge current to ground in a controlled manner and service is not interrupted





Cascade Kraft Area Shielding

Protecta Lite						
	Miles	Ruling Span	# Structures	# Protecta Lite	$	Cost
69 kV Line every other structure	20	250	422	633	400	$ 253,200
230 kV Line every structure	31	700	234	702	2500	$ 1,755,000
Grounding Materials			1335		$ 30	$ 40,050
	# Structures		Man-Hours, Ea Structure	Total Hours	Labor $/Hr	
Labor	445		30	13,350	97	1,294,950
Total						$ 3,343,200
Surcharge + Engineering	25%					$ 835,800
Grand Total						$ 4,179,000

Lightning arresters are used to provide the security needed to help protect the power supply from lightning, Ohio Brass polymer insulators and polymer arresters are combined in the Protecta*Lite system. The Protecta*Lite® system may virtually eliminate lightning-related breaker operations. The result: Less maintenance and improved service. With Protecta*Lite® systems, you gain performance superior to an overhead shield wire OHSW by using arresters on all three phases. Unlike shield wire, success is not limited by the requirement for a good ground. When Protecta*Lite® systems are installed on three phases, shielding failures and back flash problems are virtually eliminated. Use Protecta*Lite® systems on new and existing structures. Use where needed. Works well in trouble areas. Can be installed on lines with an OHSW to eliminate back flash problems caused by poor grounding. Electrical losses are minimal with a polymer life expectancy exceeding 50 years.

Reference:
http://www.hubbellpowersystems.com/powertest/ohio_brass/protecta_lite.html#

D. Voltage Control by Switching Capacitors

Voltage Limits
Steady-state voltage at the plant's five major buses is key to the plant's successful and profitable operation. Voltage delivered by the utility must be delivered at 4160 V (Buses 1-3) and 12,470 V (Buses 4 & 5) +5% / -2.5% (Range A) as per ANSI C84.1 standard. This standard also allows for minor variation up to +5.8% / -5% (Range B) for brief periods during switching operations. It is also a given that faults and very short term switching transients, such as when capacitors are switched, are beyond ANSI C84.1's scope.

Notwithstanding the above standards, it is recognized that some faults and switching operations on the PacifiCorp system, though they sometimes cannot be avoided, have caused operational problems for the plant. The next section explores ways to ride through these events.

Local Voltage Control Options
Riding through disturbance events on the power system is enhanced by quick fine control of voltage. And maintaining steady voltage is essential to maintaining steady energy flow to the process, especially if the process has little electrical "inertia". The primary issue with sags is the energy lost to the process during the disturbance. This is why one of the emerging concepts in the industry is an energy sag index (see [1]).

There are two factors that bear on maintaining sufficient energy in the equipment through the power delivery system. First, steady-state "pre-event" voltage should be at a level that is far from "the lower ragged edge" of acceptability to process equipment. This means that voltage at process equipment terminals should be at or slightly above nominal, and not near the lower end of ANSI Range A. Then, when a voltage sag occurs it has more "leg room" before process protection equipment trips.

The second factor in maintaining sufficient process energy is the speed with which the voltage can be restored when a sag occurs. This implies dynamic mitigation for sags. Clearly traditional voltage regulators and tap changing transformers are too slow to help out here. However, if cost effective, they could help maintain steady-state pre-event voltage.

Devices to dynamically support voltage during sags do exist, but are expensive. They go by various trade names. Some quickly add capacitors to the system (static VAr compensator - SVC) while others actually inject stored real energy into the system (dynamic voltage restorer - DVR). The SVC tends to work well with highly fluctuating inductive loads and is less expensive; the DVR works well with voltage sags on the utility system and is about 4 times the cost of the SVC. In this case a DVR-type device would be needed since the problem is mitigation of voltage sags due to utility faults. The SVC is priced for information only.

<u>Local Control Option for Highly Fluctuating Load</u>
Static VAr Compensator: about $5M for the entire plant.

<u>Local Control Option for Sag Mitigation</u>
Dynamic Voltage Restorer: about $19M for the entire plant.

Local Control Options for Maintaining Steady-state Pre-event Voltage

Change Transformers to *Load Tap-changing Transformers*: about $2.2M for the plant.

Capacitors

In order for steady-state voltage to be maintained at acceptable levels at the plant there should be sufficient VArs to support the VAr requirements of the loads within the plant. Inductive loads, such as motors, require VArs; and capacitors are most commonly used to supply these VArs. If the VAr requirements of the plant loads are perfectly met, the utility will see a "power factor" (pf) of 1.0. The pf of the Wallula plant is currently about 0.85. Another benefit of adding capacitors to plant loads is that the voltage is raised slightly when the capacitor is in service

Capacitor Deployment and Control

As a general rule, capacitors are most effectively deployed as near to the loads as possible. However, adding capacitors at each machine is usually not as cost effective as adding them nearby in a larger bank. At the Wallula plant smaller capacitors banks are deployed inside the plant for pf correction and larger banks are deployed outside in the PP&L substation to be a source for VArs and for voltage control.

When a large motor turns on, more VArs are needed as well as Watts. If the nearby capacitor banks can turn on along with the motor load then the situation is ideal, but this requires adequate sensing and control of the capacitors. This control is not generally installed at the Wallula plant. This is especially true of the large PP&L capacitor banks in the substation. Such control is presently far from optimal.

Capacitors and Resonance Problems

Whenever capacitors and inductors are put in parallel there is a frequency at which they resonate. This is not a problem as long as this frequency is not excited or triggered by something. According to a recent Siemens-Westinghouse study (see [2]), this resonant frequency at Wallula is very close to the 5th harmonic. Primarily, the substation capacitors and the plant inductance resonate near the 5th harmonic. Unfortunately there are many plant sources to excite this resonant frequency, and perhaps even some sources outside the plant.

Equipment that suffers from parallel resonance will often experience over voltage and fail. This usually happens to capacitors. When they fail, they tend to "de-tune" the circuit and are then not in service for voltage control and pf correction. This has apparently happened at the Wallula plant (see [3]). Another problem with capacitors is that they are natural "sinks" for harmonic currents, even without resonance.

The solution to this problem is to either remove the 5th harmonic excitation or filter out the harmonics with a shunt trapping filter. The first option is nearly impossible today with variable frequency drives being so prevalent in plants, and being a strong source for 5th harmonic excitation. So that leaves us with the second option: replacing the capacitors with filter banks.

Switching Capacitors

When capacitors are switched in, a common problem is that they inject ringing transients of moderate over voltage into the power system. These are damped ringing transients that oscillate at 600-800 Hz, and typically last 1-3 cycles. Normally these transients are not a problem, and they have been common in power systems for decades, but sensitive plant equipment can be tripped off by them. Variable Frequency Drives are especially susceptible. One source-side solution is to switch with zero-crossing CB's or CB's with pre-insertion resistors. Another source-side solution is to reduce the size of each switched capacitor segment and to switch these in smaller steps. A load-side solution is to desensitize the load control of each load so that it rides through the switching.

Local Capacitor Control Options

Two integrated capacitor control options were priced out for the plant, incorporating the above. The first is a comprehensive solution; the second is a medium-voltage-only solution. These are included below.

Comprehensive Shunt Trapping Filter Bank & New Control Option

Replace All Existing 12.5 kV banks (buses 4&5) with Filters:	$0.55M	
Replace All Existing 4 kV banks (buses 1-3) with Filters:	$1.30M	
Replace or Re-deploy Existing in-plant banks with Filters:	$1.23M	
Install coordinated capacitor monitoring and control:	$0.17M	
Other project costs and overheads:	$1.54M	
Total Project Cost:		$4.79M

Add Medium Voltage Shunt Trapping Filter Banks at 12.5 & 4.16 kV

This option does not include integration with in-plant capacitor control: $1.5M

References

[1] Thallam, R.S. and Heydt, G.T., *Power Acceptability and Voltage Sag Indices in the Three Phase Sense.* Presented at a Panel Session of the IEEE PES Summer Meeting, Seattle, WA, July 16-20, 2000.

[2] Siemens-Westinghouse study of Wallula plant – (need reference information from Walter Bruehl).

[3] Walter Bruehl, *Wallula Power Factor, Harmonic and Capacitor Switching Voltage Transient Study and Recommendations, Final Report.* by Boise-Cascade Paper Solutions Engineering, Summer, 2003.

E. Training and Operator Error

PacifiCorp has improved its training and maintenance procedures and policies in recent years, but it will take some time to see the full results and impact to the T&D operation and engineering.

Training:

New dispatching procedures have been developed and implemented as of 7/1/04 that greatly improve dispatching procedures by:
Standardization of terminology; Implementation of the Compass scheduling program that provides document control and a review process for all switching; Extensive training for all dispatchers and field personnel has been conducted and will continue to be done on an annual basis for all field personnel. CAPSO/COMPASS project implementation will improve operator skills and enhance the maintenance plans. (see details on next page)

Substation Inspections:

A basic monthly inspection of substation equipment occurs monthly with a detailed inspection quarterly. These inspections include: visual inspection of complete substation structures and equipment; recording of counters, metering values and hour meters; and substation security inspection.

Equipment Failures:

We have had equipment failures, but they have been minimal considering the quantity of equipment involved. The main problems have been with Transformer #1 and it is being replaced. There is nothing out of the range of what would be considered a normal or low equipment failure rate as seen in the utility industry or any other industry. Simply replacing equipment would likely result in an increased short term failure rate because of "infant mortality" which occurs in our industry as it does in other industries. The aesthetics of the substation and equipment is affected by the constant raining of sawdust from the plant operations and requires extensive work to stay up with, but this has not historically been shown to contribute to equipment failures or outages.

Transmission Line Inspection:

Here is the history of the 69 and 230 kV line inspection over the past 13 years.

1. April 2004, Safety Inspection- Fly
2. February 2004, Safety Inspection – Drive
3. April 2003, Safety Inspection
4. January 2002, Detail Inspection, Test and Treat
5. October 2001, Safety Inspection
6. October 1991 Detail Inspection, Test and Treat

The next inspection, Test and Treat will be scheduled in 2012 and the regular annual safety inspection is in the plan.

Purpose and Necessity for the CAPSO/COMPASS Project

The PacifiCorp Power Delivery Transmission and Distribution business units currently manage the operations, maintenance and dispatching of all main-grid transmission and distribution assets, which include both substation and lines. The Coordination and Planning of Scheduled Outages (CAPSO) project will develop and implement a standardized process for coordination and notification of scheduled outages. To enable the new process to effectively bridge the Grid Operations, East-West Dispatch and Field Operations business units, an application will be implemented that will enable users within these business groups to effectively communicate and schedule planned maintenance of PacifiCorp transmission and distribution assets.

By implementing this application the manner in which scheduled outages are handled will improve, resulting in a more efficient process. The process will move from being a manually intensive process to an automated notification and coordination process that enables sending timely information to all individuals involved in a scheduled outage event. This will improve procedures within grid operations; region dispatch and field operations by reducing the number of hours involved in scheduling/completing an outage through effective coordination. With the inclusion of the Standardized Switching Order work stream, an overall improvement in performance in taking an outage on the network will improve. An estimated annual cost saving of $160K is expected through the reduction of damage claims that result from not having established outage procedures. Ultimately this will improve the availability, reliability and sustainability of the company network resulting in PacifiCorp customers receiving better service.

The technology enabler, COMPASS, will provide an easy-to-understand process that will standardize procedures within grid operations, region dispatch and field operations reducing the number of hours required in scheduling/completing an outage through effective coordination. Ultimately this will improve the availability, reliability and sustainability of the company network, improve usage of company resources and present overall cost avoidance. (Cost Avoidance occurs when company resources are better utilized saving costs associated with ineffective processes.) Moving to a standardized method for notification and approval will result in PacifiCorp customers receiving better service and align Power Delivery to meet a number of stated initiatives.

F. Equipment Malfunction:

This substation was built in 1968 and the majority of the equipment is of the original vintage.

Major equipment is 15 to 54 years old in this substation. The oldest equipment is the Shunt Capacitor 134 and Shunt Capacitor 144 which were built in 1950. It seems that they were transferred to this substation from another location. Transformers range from 15 to 47 years old and capacitor banks range from 25 to 54 years old.

Equipment Failure, Bathtub Curve

Failures rates over time fall into three distinct regions. The first region is referred to as infant mortality, or parts that fail at some relatively higher rate over a short period of time, due to manufacturing defects. Once the infant mortality is removed from the population, the useful life period is reached with a relatively lower failure rate. During the useful life failures are random in time. The final stage is wear out, the parts begin to wear out and fail at some relatively higher rate. If the failure rate of the parts versus time is plotted on a curve, the high failure rates initially and at end of life with relatively low failure rates during the middle period results in a bath tub shaped curve.

Even though the maintenance has been adequate, due to the contamination from the plant which is mainly sawdust the equipment doesn't look clean. However it is functioning properly, except transformer #1, the rest of the equipment is in good working order. There is no indication of any increase in equipment failure rate in this substation to justify equipment replacement.

Equipment

Transformer Repair and Failure: Transformer #1 failed for the first time in 1990 for a high side winding failure; it was completely repaired and re-conditioned. It failed again in 1996 of "infant mortality" and again in 1998, which was covered by warranty. This time it was repaired for low side winding failure. The recent failure in April 2004 seems to be a internal winding damage. A new transformer is being installed and will be in-service by end of October 2004.

G. Weak Service During 69 kV Loop Outage.

If everything else is in order this issue should not be a problem. The 69 kV regulators at Wallula should take care of this concern. With the current load levels and wind generation, any 230 kV line outage needs to be coordinated with Area Planning to insure the system impact has been evaluated prior to the outage authorization. The amount of wind generation and/or the reactive support from the wind mill may be required, during any 230 kV line outages.

Other Concerns:

1. **Wallula Area Relaying Scheme.**
   The 69 kV has a high speed clearing relay scheme, which is using a lease phone line for communication. The phone line probably is least reliable piece to this scheme. Also the relaying equipment at 69 kV Wallula substation are electrometrical relays. It will be an enhancement to upgrade these relays with Schweitzer relays. The leased phone line is monitored by SCADA.

   Another enhancement to Wallula Area relaying scheme would be a fiber optic communication for existing 69kV line current differential relays between Cascade Kraft and Wallula substations.

2. **Oil Spill Plan at Cascade Kraft**
   Since the Boise plant in manned 24/7, any catastrophic failure of a transformer resulting in loss of power will be reported to PacifiCorp quickly. This will reduce the response time. PacifiCorp's environmental spill plan is to assure that all of the oil will stay within the substation fence in case of any spill. This is PacifiCorp's oil spill standard policy for any substation. The method to accomplish this may be different at a different location.

3. **Equipment Maintenance Standards**
   PacifiCorp provided a copy of its Standard Policy to Boise.

4. **Bi-Annual Meeting at the Wallula Plant**

   Schedule, March 15th, 2005; Vince Crawford will coordinate the exact schedule.

   Agenda: How is the service quality, discuss outage report, maintenance records.

5. **Invitation to Visit PacifiCorp Dispatch**
   PacifiCorp offers a tour of its dispatch facility in Portland at any time Boise desires. Please consider an advance notice to schedule the appropriate personnel.

6. **Question:** Can we monitor the phone line between Cascade Kraft and Wallula substations?
   Can we get an alarm if it is out of service? The answer is yes to both question and the current phone line is monitored by SCADA.

Chapter 3 - Solution Analysis

This study has been initiated due to the number of outages since 1998 at Boise Cascade Plant and the concerns on power quality and system performance. The twenty events are evaluated and a root caused is identified. The detail of plant process interruption is shown in appendix 3, page 28 & 29.

For each of the above interruption an associated cost has been calculated. Also it is identified, which interruption could be eliminated if any of the suggestion has been implemented. This is listed in appendix 3, page 30.

The benefit and cost of each suggestion on an annual bases are listed in appendix 3, page 31. To identify the best bang for buck solution the above information is plotted in appendix 3, page 32 and 33 which shows clearly some of these suggestions have a lot better benefit to cost ratio.

A summary of the above information is present in the next two pages.

As mentioned earlier, four of the suggestions, 1) Training, 2) Vegetation, 3) Lightning Protection and 4) Improve Voltage Control & harmonic Mitigation, have much higher benefit to cost ratio and being recommended for more in depth evaluation and possible implementation.

Table 3.1

Boise Cascade Root Causes of Process Interruptions			
(beginning in 1998 & sorted by cause category)			
Rev 3: 29 Sep 2004			
Category	**Date/Time**	**Specific Root Cause**	**Impact on Plant**
A. Range fires	7/29/01 5:30	Range fire under 230 kV McNary-Wallula line	Distortion, damage & downtime
	6/29/03 15:00	Range fire under 230 kV McNary-Wallula line	Mill down for 10 hours
B. 230 kV Faults	7/3/98 14:00	Lightning on Interstate 230 kV line	Damage & Major Downtime
	4/27/01 16:36	Lightning on Interstate 230 kV line	Mill down for 24 hours
C. 69 kV Faults	7/8/98 3:12	Lightning on Lowden (long) 69 kV line	Major Downtime
	8/6/99 18:39	Lightning on Lowden (long) 69 kV line	Major Damage & Downtime
	5/9/00 13:24	Lightning on a 69 kV line (1 phase to ground)	Minimal
	7/6/01 6:34	Lightning on Lowden (long) 69 kV line	Most of mill down for 12 hours
	6/20/02 7:22	Fault of unknown cause (???) at Dodd Road sub	Minimal
	8/4/04 0:00	Lightning on Lowden (long) 69 kV line	Major Downtime
D. MV Cap Switch Transients	12/27/01 0:00	Bus 5 Cap Switching (on closing)	Various VFD Trips
E. Operating Errors	12/15/98 8:48	Opened wrong CB; Interrupted Wallula Sub for 14 min	Entire mill down
	4/23/02 4:00	Wallula tap changer load share problem	Minimal
	2/21/04 7:04	Ground switch closed on 69 kV line near Touchet	Minimal to moderate
F. Equipment Problems	10/31/98 22:50	#1 Transformer Failure (sudden pressure)	Bus 1 down; spare put in
(Major Equip or Prot/Control)	5/14/01 7:04	Bus 4 faulty Cap Bank Control	Moderate damage, downtime
	* 4/8/04 10:33	230 kV relay misop; CB fail misop on re-energization	Major downtime
	4/15/04 9:49	#1 Transformer Failure (sudden pressure)	Major
G. Weak Service w/o Loop	* 9/17/03 11:00	69 kV maintenance on K-C CB's	Minimal
	* 7/6/04 15:00	Interaction problem with wind farm & 230 kV line	Minimal
	*While some of these items have a root cause identified as other than *Operating Errors*, had prudent corrective action been taken these event could have been mitigated or eliminated entirely.		

Table 3.2

Boise-Cascade Electric Supply Suggestion and Costs			
Rev 2		9/29/2004	
Option #	**Abbrev.**	**Description**	**Capital Cost ($k)**
1	C Cap	Comprehensive Capacitor Addition	$4,700
2	P Cap	Replace P'Corp Cap Banks	$1,500
3	Bus 5	Bus 5 MV auto filter bank (rep. bus-by-bus sol'ns)	$500
4	LTC	Add LTCs (12kV) and Regulators	$2,200
5A	69 Arr	Add Arrestors to 69 kV Lowden line	$1,100
5B	230 Arr	Add Arrestors to 230 kV line	$3,100
6	New 69	Build New 69kV shielded line	$3,400
7	69 Shld	Shield existing Lowden line	$2,000
8	New 230	Build new 230kV line/sub	$15,000
9	SVC	Install Static Var Compensator	$5,000
10	DVR	Install Dynamic Voltage Restorer	$19,000
11	Veg	Improved Vegetation Management	
12	Train	Improved Training & Maintenance	
These mitigations are the top 12 options chosen on 9/20/04 by a team meeting comprised of Boise-Cascade and PacifiCorp team members. Some of these options are extremely costly, but they made it on the list because they were seen as effective.			

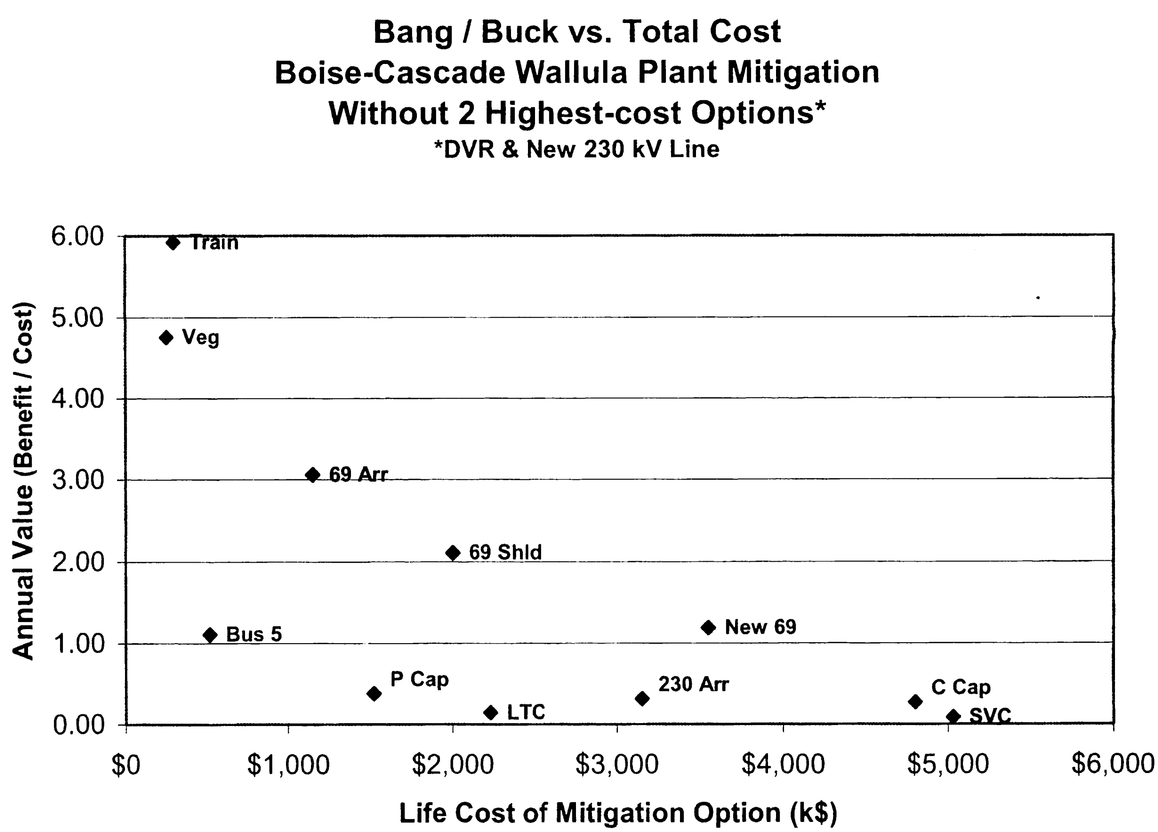


Figure 3.1

Chapter 4 – Conclusion & Next Steps:

Cascade Kraft substation had twenty events since July 1998. These events are grouped in seven categories by Boise and PacifiCorp and evaluated to suggest possible actions to minimize plant outage and increase power quality of electrical supply.

A team drawn from Boise and PacifiCorp evaluated the events and suggested several improvements. Among these suggestions four projects have a higher benefit to cost ratio with a much higher impact on Plant performance and the electric supply quality. These four projects are: 1) Training 2) Vegetation. 3) Lightning Protection and 4) Improve Voltage Control & harmonic Mitigation. The later two suggestions require a more detail study to define more exact cost and scope of the work.

The Boise Cascade events are listed in Table 5.1 and are categorized in seven groups. The suggestions are listed in Table 5.2, including cost of each project. The summary of benefit-to-cost chart is shown in Figure 5.1.

The team suggests implementing the above mentioned four projects: 1) Training 2) Vegetation. 3) Lightning Protection and 4) Improve Voltage Control & harmonic Mitigation. As it seems prudent to take action on the projects, which have a higher benefit to cost ratio, to gain an improvement in power quality and Plant performance. It is essential for Boise Plant to improve localized power factor correction as part of project number 4 mentioned above. This report will be discussed further with both companies' upper management to achieve an action list with specifics on funding and schedule.

Next Steps

Have the team members review the Draft and give comment to Hamid.

Finalize and distribute the study to Boise and PacifiCorp.

Share final report with Boise and PacifiCorp Management for review and comments on the 4 recommendations.

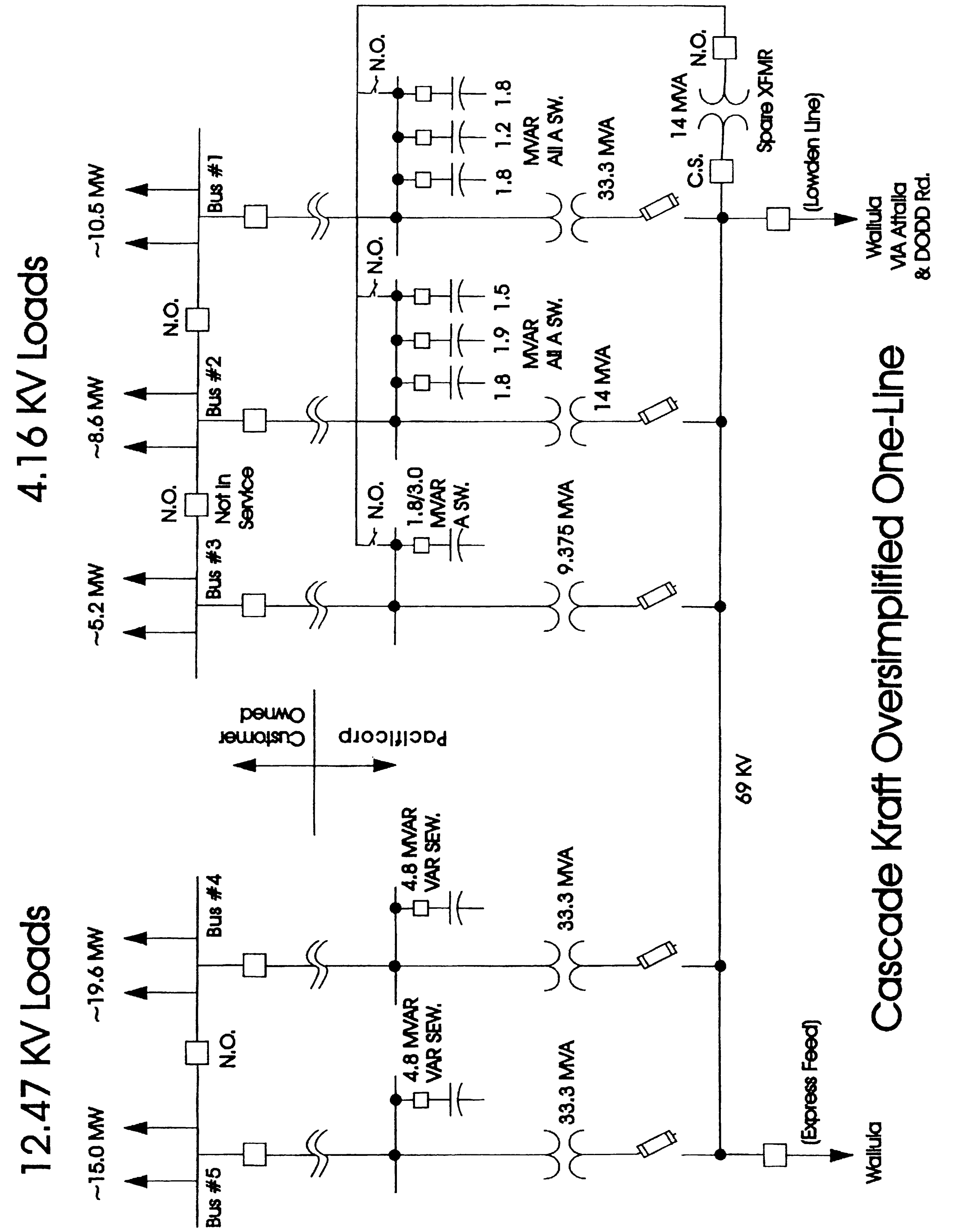
Get team together at the plant to review management comments, and develop an implementation plan for the agreed upon recommendations.

Complete recommendations.

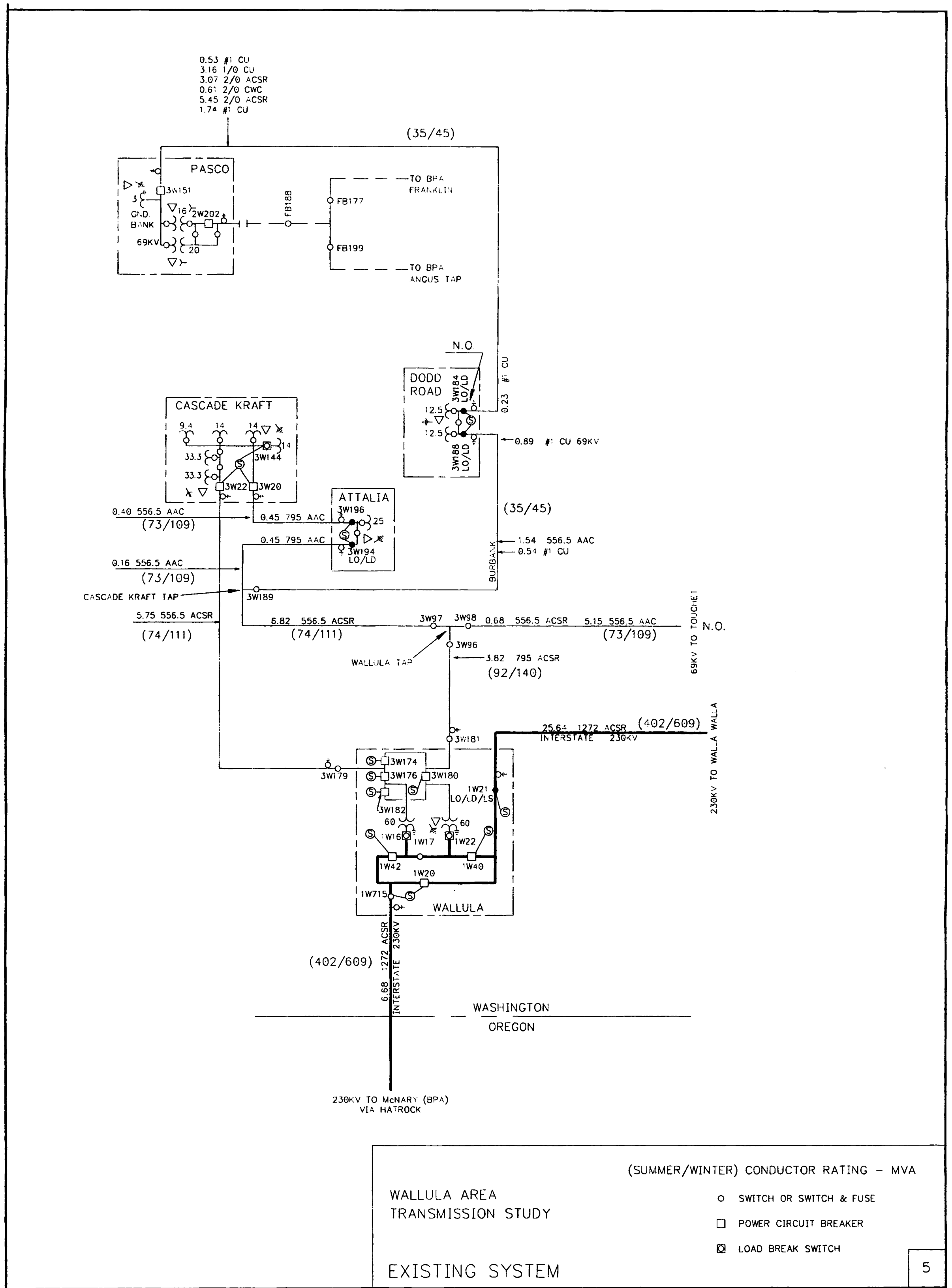
Appendix:

1. Cascade Kraft Substation & Wallula Area Simplified One Line Diagram
2. Details of Outage Report
3. Details of Outages and Cost Analysis of Suggestions
4. Harmonic Mitigation Cost and Benefits
5. PacifiCorp Contingency Plan for loss of transformer while transformer #1 is out of service.
6. Comprehensive capacitor addition to Cascade Plant
7. Future Wallula Area Expansion

Appendix 1: **Cascade Kraft Substation One Line Diagram**



Appendix 1: Wallula Area One Line Diagram



Appendix: 2 **Power Bumps / April 1998 - Present**

2004

August 4, 4:40pm, 8:20pm – A lightning strike hit one of the two 69kV lines between the mill and Wallula Sub. Voltage on our 69kV system dipped to 15kV for 9 cycles. Took down large number of drives and starters. Wound up losing the whole mill for 12 hours but did not lose air or steam initially. No damage to equipment, resets on most VFDs. Extensive lost production. (power outage 0.0 seconds)

July 6, 11:45 am – The 230kV line from McNary was out of service and voltage appeared to be fine with Wallula being fed from the Walla Walla line and the wind farm. When the wind died down, the 230kV started dropping off and the tap changers at Wallula sub tapped all the way up to maintain voltage at Cascade. They were not able to tap high enough to maintain 69kV and bus 4 which was likely the most heavily loaded bus saw the worst of the sagging voltage. Voltage sagged until numerous VFDs began dropping out in the Lime Kiln and Hog Fuel areas. PP&L reported line voltage on the 69kV line was at 68.1kV. Specific drives that tripped included 543-041-052, 543-041-010, and 324-041-010. MCC voltages in LI and LX read as low as 430 Volts. Atleast one medium voltage starter tripped as a result of the phase loss relay (461-041-049). During this time we saw voltages at Bus 4 incoming as low as 10.5 to 11 kV (by the analog meters, the digital meter is failed and out of service). Bus 5 was observed down below 12 kV. (power outage 59.0 seconds)

April 15, 9:49 am – A fault occurred inside PP&L's Bus 1 transformer located at our site, that resulted in the 69kV system tripping at breakers 3W176 and 3W180. The relaying could not specify the location of the fault so PP&L after a single reclosure attempt, began tracing lines and subs for the problem. We called and let them know that smoke had been reported at our sub and crews were dispatched to investigate. A primary fuse had dropped on the feed to bus 1 transformer on the reclose. PP&L completed a walk through of the substation to look for any visible fault conditions. It was noted that in addition to the primary fuse dropping, the sudden gas pressure switch on bus 1 transformer was indicating. They then proceeded to isolate the bus 1 transformer on both the primary and secondary side. Power was restored to the 69kV system in several steps until bus 1 was the only de-energized section. We then closed our bus tie between bus 1 and 2 after opening the bus 1 incoming breaker. Power was off the entire mill for approximately 1 hour. The MOST UPS system held for the full hour maintaining the PLCs and Honeywell DCS. We then proceeded to start up the mill. The spare transformer in PP&L's sub was then switched in to feed bus 1 (12:30 pm). At this point full power was restored. Startup took slightly less time as it went more smoothly with the recent practice. Lost opportunity is still being calculated and a claim will be submitted to PP&L. (power outage 59.0 minutes)

Appendix: 2

April 8, 10:33 am - A line protection relay on the 230kV line between McNary Dam and Wallula Substation failed, causing breakers 1W42 and 1W20 to operate isolating the 230kV line. At this point, power was still being fed from the Walla Walla 230kV line to Wallula and on to the mill at 69kV. A tech was dispatched to Wallula to investigate. When the failed relay was discovered, the tech disabled the trip circuit from the relay and closed the two breakers to reenergize the line. A separate circuit on the failed relay enabled a 'breaker failure relay'. When the original two breakers were reclosed, the 'breaker failure relay' saw enough current through 1W42 to initiate a breaker failure trip of breakers 1W42, 1W20 and 1W40.

PP&L is investigating whether this relay initiated a trip correctly or if it may have experienced a failure as well. This isolated both the 230kV lines to Wallula sub and put us completely with out power for approximately 30 seconds to 1 minute. The UPS' kept all control systems up. We lost the mill and instrument air systems and water to the Centac compressors. There was no equipment damage from the Electrical perspective; however, the mill lost close to 8 hours of production. The estimated impact from the outage is $183,200. (power outage 30.0 seconds)

February 21, 7:04 am - PP&L was doing maintenance on the 69kV overhead line between Touchet and Walla Walla. A switching error closed a grounding switch on the energized line. This caused a significant dip in the 69kV feed to the mill until breaker 3W20 cleared leaving us on the single 69kV feed from Wallula. Virtually all variable speed drives tripped throughout the mill. None were damaged. Most 480V and 4160V starters stayed in (including the Centac starters). As a result the entire mill went down except the power house. This allowed us to start back up relatively quickly. Estimated lost revenue $22,000. (power outage 0.0 seconds)

2003

September 17, ~11:00 am - PP&L was performing maintenance on one of the two 69kV breakers that feed the ring bus at our mill. When they isolated the 69kV line, voltage started to sag at the mill. By the time they realized what was happening we lost 3 medium voltage starters which resulted in downtime in the Bleach plant. (power outage 0.0 seconds)

June 29, ~3:00 pm - A fault occurred on the 230kV line between Wallula sub and McNary sub as a result of a fire which burned a pole on that line. This resulted in a significant voltage sag causing the entire mill to go down. We lost a variable speed drive in the Lime Kiln due to a board failure. It took the mill approximately 9 – 10 hours to start back up. (power outage 0.0 seconds)

2002

June 20, ~7:22 am - A fault occurred on the secondary side of transformers 3W184 and 3W188 at Dodd road substation. The fault resulted in a voltage sag on the 69kV line and eventually 3W20 operated clearing the line. We lost a number of 4160V motors on UV trips throughout the mill. For the most part, the equipment was all able to be restarted with minimal impact on production. One day later we lost a 1000Hp Raffinator motor with very suspicious winding damage that suggested it may have seen a significant voltage spike. Plots of the waveform at our substation during the fault showed no spikes, only a general sag. (power outage 0.0 seconds)

Appendix: 2

April 23, ~4:00 am – Maintenance and an upgrade modification were being done on one of the two transformer tap changers at Wallula Substation. These tap changers have a control feature that has them adjust taps on each transformer to share the load between the two transformers. They also control to maintain a set line voltage. The load sharing control was not disabled when the transformer was taken out of service. The remaining in service transformer continued tapping down to try and have the out of service transformer pick up load. Our voltage dropped at the mill to a level where two variable speed drives (530-041-080 and 530-041-081) tripped on low bus voltage and a 4160V starter (461-041-007) dropped out on phase loss. This resulted in short durations of downtime in Recaust and the Bleach Plant.

Voltage at LI was measured at 439V and PP&L reported their PTs in our Sub were as low as 112V (normally 120V). Also recorded voltage at Hog Fuel of 3885V on the 4160V sub. As soon as PP&L was contacted, they manually tapped the system back up to normal levels. (power outage 0.0 seconds)

2001

December 27 - Over the course of the last several months we had been experiencing VFD trip outs during the start up of #3 PM on High bus voltage. Among the drives tripping were drainage aid pumps that immediately affect the runability of the Paper Machine. On this occasion it happened twice during the start up and caused significant downtime and damage to the machine. At this time Dan Young contacted PP&L and discovered the overvoltage trips coincided with PP&L's Bus 5 Cap Bank switch closing. Bus 5 Cap Bank switches in and out based on Power Factor and during shutdown days (when bus 5 is lightly loaded) the switch opens. During startup when the inductive load comes up on bus 5, the switch closes and the caps come back on line. We did subsequent testing (15 Jan 02) during a #3 PM S/D and discovered an extreme spike and oscillation that occurs in the line voltage when the cap bank switches on. For the time being we have asked PP&L to leave the cap bank switch closed and in manual control until we can collectively come up with a solution to this problem. The negative side of this approach is that the line voltage during a PM outage exceeds PP&L's power delivery spec. because with minimal load on the bus, the voltage exceeds 5% above nominal. (power outage 0.0 seconds)

July 29, ~5:30 am - A wildfire at Wallula Junction burned a number of poles on the 230kV line between McNary and Wallula substations. When the relaying operated we saw severe distortion on the lines to the mill. We experienced downtime mill wide with damage to drives in the following areas: #3 PM 4th section dryer drive – failed board, IV Outlet Device drive – failed SCRs, Baldor drive in MCC M – failed board, Eaton drive for Kiln Reburn Screw – failed board. We also had to reset most drives on high bus voltage trips. Following this occurrence we had issues around our incoming voltage to the mill being too low. PP&L wound up putting tap changers at Wallula in manual and tapping up to get our voltage back to a reasonable level. PP&L had some issues around the remote operation of these tap changers (appeared to be reverse operating). (power outage 0.0 seconds)

Appendix: 2

July 6, 6:34 am - A lightning strike occurred on PP&L's 69kV line between our substation and the Wallula Sub. This resulted in operation of breaker 3W20 at our sub and 3W174, 3W180 at Wallula sub. These breakers all auto closed in less than a second; however, the resulting voltage swing tripped most of our drives and starters particularly in the Kraft mill and Power/Recovery area. There was no damage to any drives but most of the Kraft mill and Power/Recovery drives had to be manually reset. The mill was down close to 12 hours. (power outage 0.0 seconds)

May 14, 7:04 am - A faulty metering component on PP&L's Bus 4 Capacitor bank, caused the 4800 kVAR cap bank to switch on and off 8 times between 7:04 and 7:09 am. This caused spiking and severe harmonic distortion on bus 4 loads. The hardest hit were the Bleach Plant Washer DC drives D1, D2, E1, and E2 suffering blown fuses, blown SCR packs, and blown diode packs. We also lost the #2 M&D Presteamer Feeder AC Drive (replaced) and the Kamyr Chip Meter Drive (diodes).

The Kamyr High Pressure Feeder required card replacements, fuses and a field supply replacement. Several other drives on Bus 4 required resets as they faulted on high bus voltage. The Bleach Plant, Kamyr, and #2 M&D suffered extensive downtime as a result. The remainder of the mill was unaffected. (power outage 0.0 seconds)

April 27, 4:36 pm - A lightning strike occurred on the interstate 230 kV line between McNary Dam and the Wallula Substation. To clear the fault, breakers 1W20 and 1W42 opened at Wallula Substation. We did not trip completely off line but saw line voltage dip to approximately 50% for 6 cycles (0.1 seconds). This resulted in all starters, HID lights, and drives shutting down. While there were few cases of damage caused by the Power Bump, the entire mill was lost. The lost production time was in excess of 24 hours. (power outage 0.0 seconds)

2000

May 9, 1:24 pm - A lightning strike occurred on one of the 69kV lines between our mill and the Wallula Substation which dragged the voltage down to approximately 70% of normal voltage for 6 to 7 cycles before breakers 3W176, 3W174, and 3W22 operated isolating the line. Two of the three breakers auto-reclosed and the system was returned to normal operation. The third breaker 3W174 was manually reclosed at Wallula Sub. We experienced a handful of drives tripping which resulted in brief downtime on #3 PM, #2 PM, B-Row, and #1 M&D. There was no equipment damage and the areas affected started up smoothly within minutes. (power outage 0.0 seconds)

1999

August 6, 6:39 pm - A lightning strike occurred on the 69kV Lowden line between Touchet and the Wallula Mill resulting in this line isolating and causing a voltage spike and dip at Wallula mill. The breakers reclosed and the system was back to normal within 23 cycles (or less than 0.5 seconds). Several of our old Eaton VFDs lost fuses and two lost control cards. The remaining downtime was due to issues around startup. There are lightning arrestors on this line and they had operated. (power outage 0.0 seconds)

Appendix: 2

1998

December 15, 8:48 am - A switching error occurred as a result of the recent relocation of the control center from Union Gap to Portland. The switch and feedback signals on breakers 1w40 and 1w42 were reversed, as a result, the wrong breaker was opened during a maintenance isolation causing a complete power outage to Wallula for approx. 13 – 14 minutes. This would have been a shorter outage except operator infamiliarity extended it when the operator attempted to close the synchronizing breaker at Cascade Kraft before the non-synchronizing breaker. (power outage 14.0 minutes)

October 31, 10:50 pm - Transformer T-3220 at Cascade Kraft faulted tripping its Sudden Gas relay which caused the main incoming breakers 3W20 and 3W22 to open. This removed all power to the mill for 11 seconds while MOD 3W24 operated. Then 3W20 and 3W22 reclosed leaving only Bus 1 down until the spare transformer was put into service. In the interim, limited power was restored to Bus 1 via the bus tie from Bus 2. (power outage 11.0 seconds)

July 8, 3:12 am - A lightning strike occurred on the Lowden 69kV transmission line tripping breakers 3W174, 3W180, and 3W20. While this did not completely remove power from Wallula, it caused a large enough disturbance on the transmission lines to trip multiple drives through out the mill and cause extensive downtime. (power outage 0.0 seconds)

July 3, 2:00 pm - A lightning strike occurred on the Interstate 230 kV line tripping 1W20, 1W42, and A-400. Once again, power was not lost at Wallula but significant damage was done to our VFD Drives causing extensive downtime and lost production. (power outage 0.0 seconds)

Appendix: 3 – Table A3-1

Wallula Plant Log of Events and their Costs

Date Order	Date	Event	Cause	Time w/o Power	Recovery Lost Tons	Recovery Lost Cont.	W3 Lost Time	W3 Lost Contribut.	W2 Lost Time	W2 Lost Contribut.	Misc. Costs	Lost Production Dollars	Notes
20	08/04/04	Voltage Dip	Act of Nature	0 seconds	117	$23,283	732	$142,191	786	$47,750	$145,750	$358,974	Misc includes purchased pulp to offset #3 Recovery lost tones.
19	07/06/04	Voltage Sag	Operator Error	0 seconds	0	$0	0	$0	0	$0	$0	$0	
18	04/15/04	Power Outage	Transformer Failure	59 minutes	445	$55,078	490.98	$69,365	435	$18,818	$74,500	$217,760	
17	04/08/04	Power Outage	Relay Failure / Ops Error?	30 seconds	625	$50,827	523.98	$74,027	600	$24,520	$34,000	$183,373	
16	02/21/04	Voltage Dip	Operator Error	0 seconds		$0	0	$0		$0	$22,000	$22,000	
15	09/17/03	Voltage Dip	Operator Error	0 seconds	0	$0	0	$0	0	$0	$0	$0	Affected Bleach plant only.
14	06/29/03	Voltage Dip	Act of Nature	0 seconds	273.2	$6,372	542	$76,573	565	$23,089	$0	$106,034	Lost air system and entire mill
13	06/20/02	Voltage Dip	3rd Party Equip Failure	0 seconds	0	$0	0	$0	0	$0	$0	$0	Tripped several motors, no lost production.
12	04/23/02	Voltage Dip	Operator Error	0 seconds	0	$0	0	$0	0	$0	$0	$0	Tripped several motors, no lost production.
11	12/27/01	Voltage Spikes	Equipment Design	0 seconds	0	$0	457	$64,564	0	$0	$30,000	$64,564	Caused drainage aid pumps to trip during startup. May have caused clothing damage and definitely lost production.
10	07/29/01	Voltage Distortion	Act of Nature	0 seconds	414	$13,926	737	$104,122	450	$18,390	$0	$136,437	
9	07/06/01	Voltage Spike	Act of Nature	0 seconds	209.8	-$159	516	$72,899	575	$23,498	$0	$96,239	
8	05/14/01	Voltage Distortion	Equipment Failure	0 seconds	0	$0	0	$0	0	$0	$0	$0	Caused damage to drives on Bus 4 only, no impact to machines or powerhouse.
7	04/27/01	Voltage Dip	Act of Nature	0 seconds	229.6	$7,406	415	$58,630	475	$19,411	$0	$85,447	
6	05/09/00	Voltage Dip	Act of Nature	0 seconds	0	$0	17	$2,402	0	$0	$0	$2,402	
5	08/06/99	Voltage Spike and Dip	Act of Nature	0 seconds	1304		1475	$208,385	682	$27,871	$0	$236,255	
4	12/15/98	Power Outage	Operator Error	14 minutes	504		?	?	?	?	?	$150,000	
3	10/31/98	Power Outage	Transformer Failure	11 seconds	375		?	?	?	?	?	$150,000	
2	07/08/98	Voltage Spike and Dip	Act of Nature	0 seconds	484		732	$103,415	?	?	?	$150,000	
1	07/03/98	Voltage Spike and Dip	Act of Nature	0 seconds	344		409	$57,783	?	?	?	$150,000	
						Complete data not available, data extrapolated.							
											Total	$1,750,512	
0	none	No Event	Null Event										
100	continuous	Power Factor	Power Factor Penalty						Cost/month:	$3,000	Six year:	$216,000	
101	continuous	Cap failures & losses	Harm Sources/Resonance						Cost/month:	$1,500	Six year:	$108,000	

Appendix: 3– Table A3-2

Boise Cascade Root Causes of Process Interruptions

(beginning in 1998 & sorted by cause category)

Rev 2: 27 Sep 2004

Category	Date Order	Date/Time	Specific Root Cause	Impact on Plant	Estimated Cost to B-C
A. Range fires	10	7/29/01 5:30	Range fire under 230 kV McNary-Wallula line	Distortion, damage & downtime	$136,437
	14	6/29/03 15:00	Range fire under 230 kV McNary-Wallula line	Mill down for 10 hours	$106,034
B. 230 kV Faults	1	7/3/98 14:00	Lightning on Interstate 230 kV line	Damage & Major Downtime	$150,000
	7	4/27/01 16:36	Lightning on Interstate 230 kV line	Mill down for 24 hours	$85,447
C. 69 kV Faults	2	7/8/98 3:12	Lightning on Lowden (long) 69 kV line	Major Downtime	$150,000
	5	8/6/99 18:39	Lightning on Lowden (long) 69 kV line	Major Damage & Downtime	$236,255
	6	5/9/00 13:24	Lightning on a 69 kV line (1 phase to ground)	Minimal	$2,402
	9	7/6/01 6:34	Lightning on Lowden (long) 69 kV line	Most of mill down for 12 hours	$96,239
	13	6/20/02 7:22	Fault of unknown cause (???) at Dodd Road sub	Minimal	$0
	20	8/4/04 0:00	Lightning on Lowden (long) 69 kV line	Major Downtime	$358,974
D. MV Cap Switch Transients	11	12/27/01 0:00	Bus 5 Cap Switching (on closing)	Various VFD Trips	$64,564
E. Operating Errors	4	12/15/98 8:48	Opened wrong CB; Interrupted Wallula Sub for 14 min	Entire mill down	$150,000
	12	4/23/02 4:00	Wallula tap changer load share problem	Minimal	$0
	16	2/21/04 7:04	Ground switch closed on 69 kV line near Touchet	Minimal to moderate	$22,000
F. Equipment Problems (Major Equip or Prot/Control)	3	10/31/98 22:50	#1 Transformer Failure (sudden pressure)	Bus 1 down; spare put in	$150,000
	8	5/14/01 7:04	Bus 4 faulty Cap Bank Control	Moderate damage, downtime	$0
	17*	4/8/04 10:33	230 kV relay misop; CB fail misop on re-energization	Major downtime	$183,373
	18	4/15/04 9:49	#1 Transformer Failure (sudden pressure)	Major	$217,760
G. Weak Service w/o Loop	15*	9/17/03 11:00	69 kV maintenance on K-C CB's	Minimal	$0
	19*	7/6/04 15:00	Interaction problem with wind farm & 230 kV line	Minimal	$0

*While these items have a root cause identified as other than *Operating Errors*, had prudent corrective action been taken these event could have been mitigated or eliminated entirely.

Appendix: 3– Table A3-3

Boise-Cascade Electric Supply Reliability Mitigation Benefits and Costs

Rev 2 9/29/2004

Option #	Abbrev.	Description	Capital Cost ($k)	Events Mitigated*
1	C Cap	Comprehensive Capacitor Addition	$4,700	8,11,15,19,pf*,hm*
2	P Cap	Replace P'Corp Cap Banks	$1,500	8,11,15,19,hm
3	Bus 5	Bus 5 MV auto filter bank	$500	11,hm
4	LTC	Add LTCs (12kV) and Regulators	$2,200	8,11,12,15,19
5A	69 Arr	Add Arrestors to 69 kV Lowden line	$1,100	2,5,6,9,20
5B	230 Arr	Add Arrestors to 230 kV line	$3,000	1,7
6	New 69	Build New 69kV shielded line	$3,400	2,5,6,9,13,15,20
7	69 Shld	Shield existing Lowden line	$2,000	2,5,6,9,15,20
8	New 230	Build new 230kV line/sub	$15,000	2,5,6,8,9,11
9	SVC	Install Static Var Compensator	$5,000	8,11,15,19,hm
10	DVR	Install Dynamic Voltage Restorer	$19,000	1,2,5,6,7,8,9,13,15,20
11	Veg	Improved Vegetation Management		10,14
12	Train	Improved Training & Maintenance		4,12,15,16,17,19

These mitigations are the top 12 options out of 14 options chosen on 9/20/04 by a team meeting comprised of Boise-Cascade and PacifiCorp team members. Some of these options are extremely costly, but they made it on the list because they were seen as effective.

*Event numbers in this column are Date Order numbers from Event Cost sheet; pf is power factor; hm is harmonics

Appendix: 3– Table A3-4

Boise-Cascade Bang/Buck Analysis Sheet

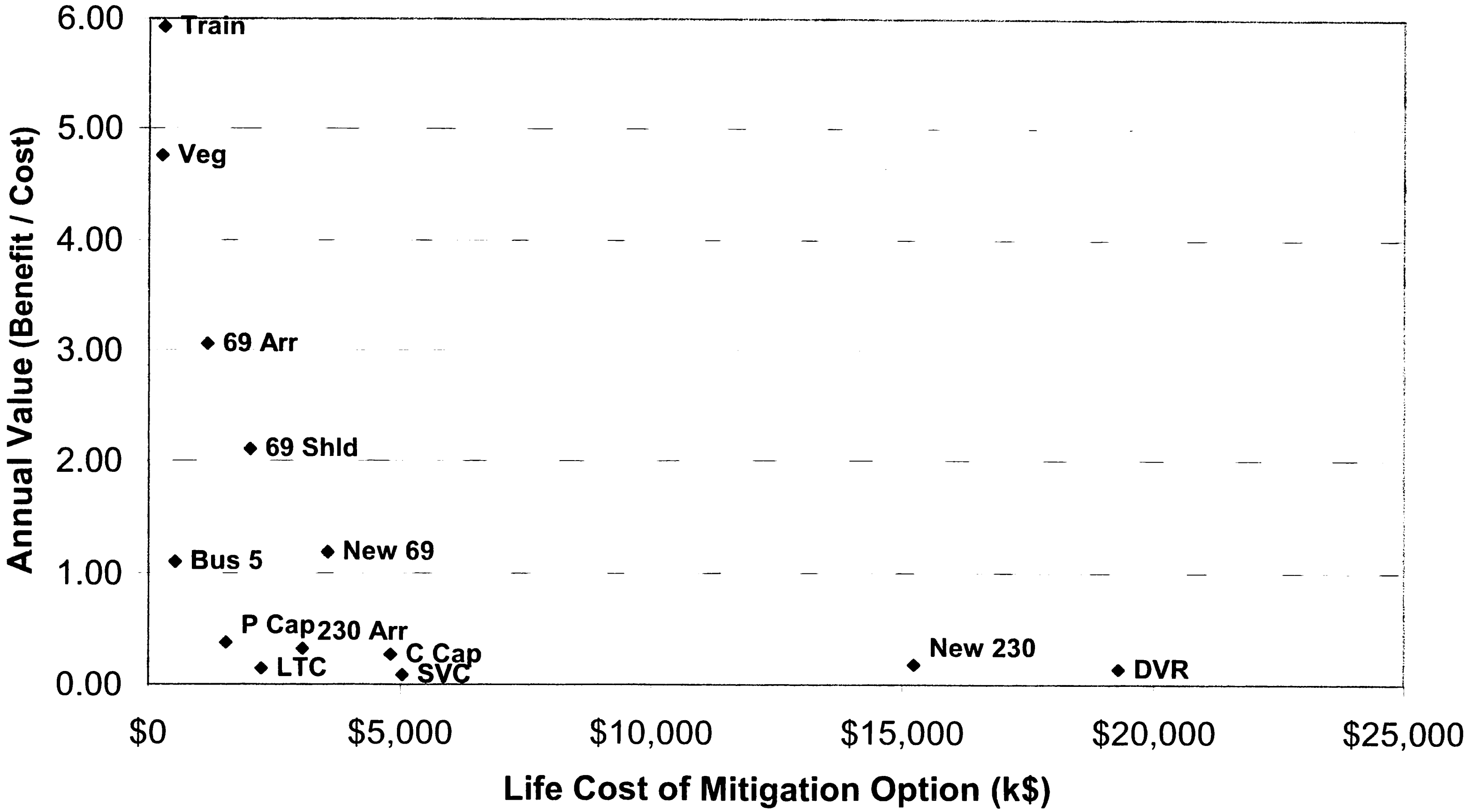
Rev 1: 9/29/04

Mit. Abbrev.	Mit. Capital Cost ($k)	Cap. Mit. Life in Years	Annual Cap Cost (k$)	Annual O&M (k$)	Total Annual Cost (k$)	Total Life Cost (k$)	Events numbers) this Option				hm =101)		(date order Mitigated by (null = 0; pf =100;				6-Year Benefit of Option (k$)	Annual Benefit of Option (k$)	Annual Benefits / Costs (Bang/Buck)
	Cost Analysis of Option						Benefit Analysis of Option												
C Cap	$4,700	20	$235	5	$240	$4,800	8	11	15	19	100	101	0	0	0	0	$389	$65	0.27
P Cap	$1,500	20	$75	1	$76	$1,520	8	11	15	19	101	0	0	0	0	0	$173	$29	0.38
Bus 5	$500	20	$25	1	$26	$520	11	101	0	0	0	0	0	0	0	0	$173	$29	1.11
LTC	$2,200	30	$73	1	$74	$2,230	8	11	12	15	19	0	0	0	0	0	$65	$11	0.14
69 Arr	$1,100	25	$44	2	$46	$1,150	2	5	6	9	20	0	0	0	0	0	$844	$141	3.06
230 Arr	$3,000	25	$120	2	$122	$3,050	1	7	0	0	0	0	0	0	0	0	$235	$39	0.32
New 69	$3,400	30	$113	5	$118	$3,550	2	5	6	9	13	15	20	0	0	0	$844	$141	1.19
69 Shld	$2,000	30	$67	0	$67	$2,000	2	5	6	9	15	20	0	0	0	0	$844	$141	2.11
New 230	$15,000	30	$500	8	$508	$15,240	2	5	6	9	8	11	0	0	0	0	$549	$92	0.18
SVC	$5,000	15	$333	2	$335	$5,030	8	11	15	19	101	0	0	0	0	0	$173	$29	0.09
DVR	$19,000	15	$1,267	20	$1,287	$19,300	1	2	5	6	7	8	9	13	15	20	$1,079	$180	0.14
Veg		30		8.5	$9	$255	10	14	0	0	0	0	0	0	0	0	$242	$40	4.75
Train		30		10	$10	$300	4	12	15	16	17	19	0	0	0	0	$355	$59	5.92

800k

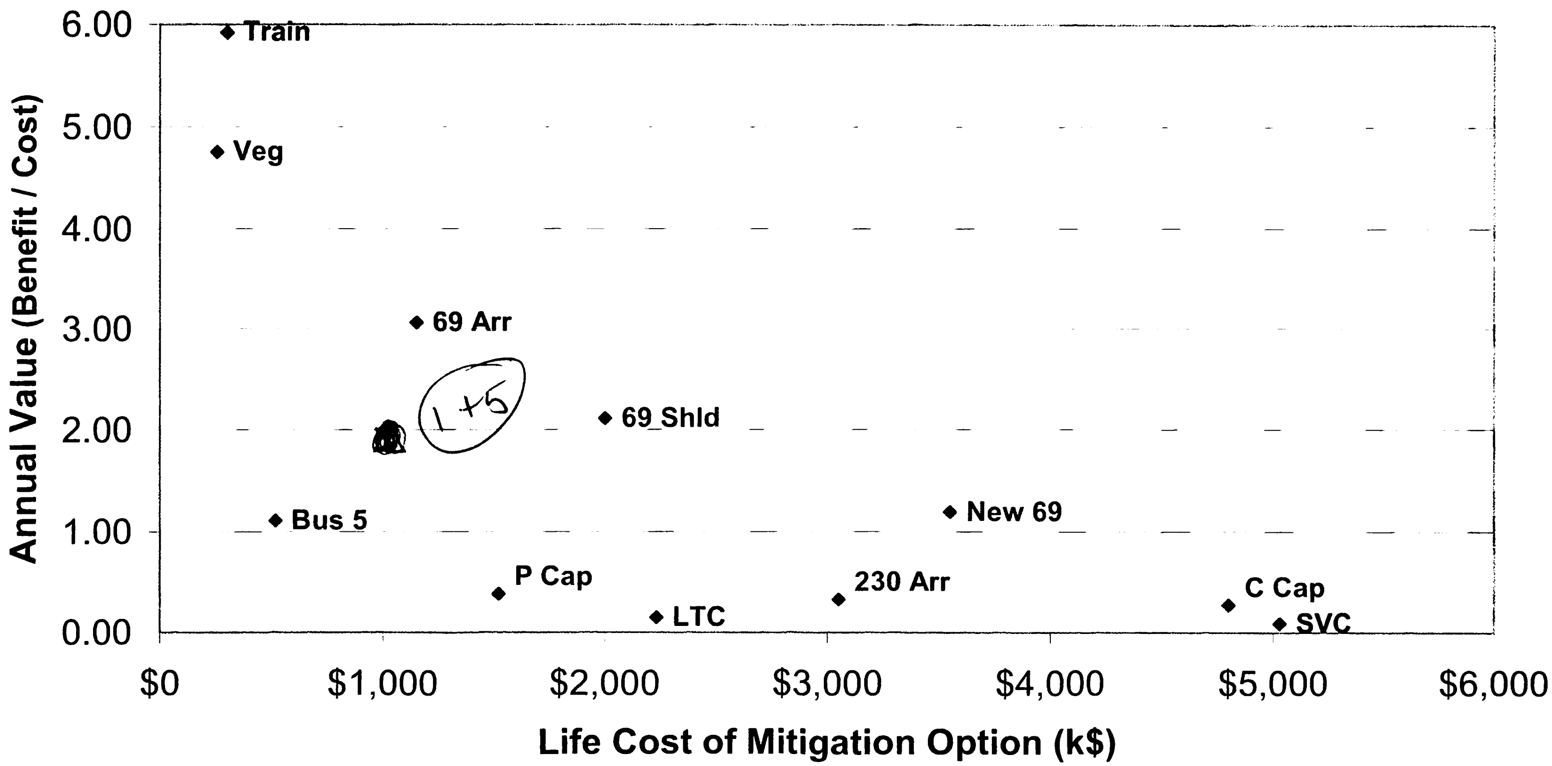
Appendix: 3– Table A3.5

Bang / Buck vs. Total Cost
Boise-Cascade Wallula Plant Mitigation Options



Appendix:3– Table A3.6

Bang / Buck vs. Total Cost
Boise-Cascade Wallula Plant Mitigation
Without 2 Highest-cost Options*
***DVR & New 230 kV Line**



Appendix: 4 Benefits of Harmonic Mitigation:

The costs associated with harmonics can be broken down into three categories:

1. Capacitor failures and blown capacitor fuses
2. Power factor penalties from capacitors that have failed
3. Additional losses in the system

Capacitor Failures:

- 4160 volt units (38) three phase units
- 480 volt banks (7) 300 kVAR banks
- Failures have occurred over a 5 year period
- Cost per year $16,000 (See attached estimate)

Power factor penalty due to failed units.

- The KVAR deficit has increased by about 6,000 KVAR due to failed capacitor units. This has raised the PF penalty approximately $3000 per month or about $36,000 per year.

Additional Losses in the system

- Total distribution system losses are estimated to be 730kW. The percentage attributable to harmonics = not significant.
- Cost per year = $0

Total annual benefit: $52,000 per year

Appendix: **4 – Table A4.1**

PROJECT Harmonic Mitigation Repair Cost
LOCATION Wallula Washington

ESTIMATE OF COST

Boise Cascade Paper Group

PAGE 1 OF 1
DATE 9/29/2004
BY Moe Moneigh

filename Wallula-06

EQUIPMENT OR ACCOUNT NUMBER	DESCRIPTION	MATERIAL					CONTRACTOR LABOR				SUB-CONTRACT Labor & Mat'l	GRAND TOTAL
		QTY.	UNIT	UNIT PRICE	OWNER FURNISHED TOTAL	CONTRACTOR FURNISHED TOTAL	M.H. UNIT	MAN-HOURS	RATE	TOTAL		
	300Kvar 480 volt capacitor	5	ea	$2,141	$10,705		8.00	40	$50.00	$2,000		$13,000
	100Kvar 4160 volt capacitor	38	ea	$1,491	$56,658		6.00	228	$50.00	$11,400		$68,000
	TOTAL				$67,000			268	$50.00	$13,000		$80,000

Appendix 5

PacifiCorp Contingency Plan for loss of transformer at Cascade Kraft Substation while transformer #1 is out of service. (By Bruce Tinhof)

1. Inspect substation to determine damage and check relay activity.
2. Contact Boise personnel to check their switchgear for damage and relay activity.
3. Notify Pacificorp Dispatch of present conditions
4. If transformer cannot be returned to service and there is no damage in Boise switchgear.
    b. Get switching orders from Pacificorp Dispatch to isolate transformer and transfer bus load to the other buses via the Boise's switchgear.
    c. Notify Duty Supervisor of conditions and whether mobile is needed.
        i. Duty Supervisor arranges to have mobile T-XXXX headed to the substation.
        Mobile transformer to be determined by availability with several options available to support 69KV Delta to 4.16KV Wye or 69KV Delta to 12.47 Wye. Contact support personnel for assistance.
            a. MVA determined by current bus loading and the availability of reactive support on the bus that is out. 8/04 conditions:
                i. Bus 1 = 10.3 MW / 3.06 MVAR 2 out of 3 capacitors in service, third one available.
                ii. Bus 2 = 8.56 MW / 2.32 MVAR 2 out of 3 capacitors in service, third one available.
                iii. Bus 3 = 4.94 MW / 2.22 MVAR capacitor in service.
                iv. Bus 4 = 19.16 MW / 11.44 MVAR capacitor in service.
                v. Bus 5 = 14.4 MW / 2.82 MVAR capacitor in service.
    d. Prepare for mobile.
        i. Connect to line side of 69KV breaker to facilitate switching.
        Line side 3W22 provides easiest high side connection, but may vary depending on single or double unit and logistics of removing failed transformer.
        ii. When the problem is in the 12KV bus arrange to connect to available 12KV mobile tap
        iii. When the problem is in the 4KV bus, contact stores personnel to locate and deliver (to be identified) ft of 1000 MCM underground cable (SI# 4200016), as many as require 2 hole lug connectors (SI# 1740636) and as many as require termination kits (SI# 1740274).
        Number of runs of will vary with time of year, mobile size and the amount of load on the bus that you will be picking up. In a worse case condition it may take three parallel runs of 1000 MCM. Refer to wire tables to determine number of runs required.
        Coordinate line crew to arrive with the wire to make up terminations.
5. Monitor load conditions on transformers.
    e. As the Boise load comes back up and there is a need for more reactive support it may be necessary to back feed the substation bus to take advantage of the capacitors on that bus.
    f. Monitor transformer temperatures and load sharing.
    g. If necessary restrict Boise loading.

Appendix: 5

6. Inspect substation to determine damage and check relay activity.
7. Contact Boise personnel to check their switchgear for damage and relay activity.
8. Notify Pacificorp Dispatch of present conditions
9. If transformer cannot be returned to service and there is no damage in Boise switchgear.
    a. Get switching orders from Pacificorp Dispatch to isolate transformer and transfer bus load to the other buses via the Boise's switchgear.
    b. Notify Duty Supervisor of conditions and whether mobile is needed.
        i. Duty Supervisor arranges to have mobile T-XXXX headed to the substation. Mobile transformer to be determined by availability with several options available to support 69KV Delta to 4.16KV Wye or 69KV Delta to 12.47 Wye. Contact support personnel for assistance.
            a. MVA determined by current bus loading and the availability of reactive support on the bus that is out. 8/04 conditions:
                i. Bus 1 = 10.3 MW / 3.06 MVAR 2 out of 3 capacitors in service, third one available.
                ii. Bus 2 = 8.56 MW / 2.32 MVAR 2 out of 3 capacitors in service, third one available.
                iii. Bus 3 = 4.94 MW / 2.22 MVAR capacitor in service.
                iv. Bus 4 = 19.16 MW / 11.44 MVAR capacitor in service.
                v. Bus 5 = 14.4 MW / 2.82 MVAR capacitor in service.
    c. Prepare for mobile.
        i. Connect to line side of 69KV breaker to facilitate switching. Line side 3W22 provides easiest high side connection, but may vary depending on single or double unit and logistics of removing failed transformer.
        ii. When the problem is in the 12KV bus arrange to connect to available 12KV mobile tap
        iii. When the problem is in the 4KV bus, contact stores personnel to locate and deliver (to be identified) ft of 1000 MCM underground cable (SI# 4200016), as many as require 2 hole lug connector (SI# 1740636) and as many as require termination kits(SI# 1740274).
            1. Number of runs of will vary with time of year, mobile size and the amount of load on the bus that you will be picking up. In a worse case condition it may take three parallel runs of 1000 MCM. Refer to wire tables to determine number of runs required.
            2. Coordinate line crew to arrive with the wire to make up terminations.
10. Monitor load conditions on transformers.
    a. As the Boise load comes back up and there is a need for more reactive support it may be necessary to back feed the substation bus to take advantage of the capacitors on that bus.
    b. Monitor transformer temperatures and load sharing.
    c. If necessary restrict Boise loading.

Appendix 6

Conceptual Estimate
Wallula Power Factor Correction
9/08/2004
Boise Paper Solutions

Background:

This estimate was developed at the request of Pacificorp to address issues with both Pacifiorp and Boise owned power factor correction equipment. Four issues are addressed by the scope of the project: 1) Raise the overall power factor to 0.97 to avoid power factor penalties. 2) Improve the voltage profile of the system especially when fed under "weak system" conditions. 3) Mitigate the harmonic currents that have had injurious effects on existing equipment. 4) Eliminate the Pacificorp owned power factor correction equipment that has had injurious effects to Boise equipment.

Scope of Work:

The following describes the major components:

Low voltage equipment (480volts) Provide 28 new low voltage power factor correction (PFC) units with harmonic tuning and automatic control. Redeploy and reuse 14 existing low voltage PFC units. Upgrade 42 over current devices in the circuit breakers that feed these devices from peak sensing to RMS sensing. Provide automation to the existing 14 PFC units.

Medium voltage equipment (4160volts) Provide 5 new medium voltage PFC units with harmonic tuning and automatic control. Bus 3 will utilize a spare breaker position. Bus 1 and 2 will utilize cable bus extension of the existing switchgear bus to a new breaker to feed the PFC equipment. The PFC equipment will be located in the Pacificorp yard.

Medium voltage equipment (12.5kV) Provide 3 new medium voltage PFC units with harmonic tuning and automatic control. Bus 4 will have one existing one high breaker section replaced with a two high breaker section. Bus 5 will utilize a spare breaker. The PFC equipment *will be* located in the Pacificorp yard.

Monitoring equipment: Provide additional inputs and devices to the existing impact system and update system displays to include monitoring of the power factor correction equipment.

Engineering: System design will be the responsibility of Siemens Westinghouse engineering services. Detailed design and engineering services will be by a 3rd party consulting design firm.

Construction: Installation of equipment will be a joint effort of contract and in-house labor. Contract labor will set equipment and run the raceway and conductors in house labor will do the connection to the existing system, checkout and testing of the equipment.

For more detail refer to the attached order of magnitude estimate.

Appendix 6 – Table A6.1

PROJECT PF Correction, All Vars in Plant
LOCATION Wallula, Wa
filename Wallula-01

ESTIMATE OF COST

Boise Cascade Paper Group

PAGE 1 OF 1
DATE 9/30/2004
BY Moe Moneigh

EQUIPMENT OR ACCOUNT NUMBER	DESCRIPTION	QTY.	UNIT	UNIT PRICE	MATERIAL OWNER FURNISHED TOTAL	MATERIAL CONTRACTOR FURNISHED TOTAL	CONTRACTOR LABOR M.H. UNIT	CONTRACTOR LABOR MAN-HOURS	CONTRACTOR LABOR RATE	CONTRACTOR LABOR TOTAL	SUB-CONTRACT Labor & Mat'l	GRAND TOTAL
	Low Voltage Tuned Units								$80.00			
	300kVAR tuned, six step automatic bank	28		$19,800	$554,400		4.00	112	$80.00	$8,960		$563,000
	Fabricate mounting brackets for bank	28		$300		$8,400	4.00	112	$80.00	$8,960		$17,000
	Rig and set bank	28		$300		$8,400	16.00	448	$80.00	$35,840		$44,000
	Power wiring 500mcm in conduit w/two fittings & hubs	28	100/ft	$2,500		$70,000	60.00	1,680	$80.00	$134,400		$204,000
	Control wiring, 10 conductors in 3/4" conduit	28	150/ft	$250		$7,000	30.00	840	$80.00	$67,200		$74,000
	Connection	28		$50		$1,400	12.00	336	$80.00	$26,880		$28,000
	Checkout	28					8.00	224	$80.00	$17,920		$18,000
	New trip unit in DS 206	28		$2,000		$56,000						$56,000
	Set and test DS 206 capacitor feeder breaker	28					2.00	56	$80.00	$4,480		$4,000
	Redeploy Existing Units and automate											
	New trip units in DS 206	14		$2,000		$28,000						$28,000
	Controller	14		$3,000		$42,000	36.00	504	$80.00	$40,320		$82,000
	Motor operator for DS 206	14		$2,000		$28,000	36.00	504	$80.00	$40,320		$68,000
	Relocate units	6		$2,500		$15,000	60.00	360	$80.00	$28,800		$44,000
	TOTAL				$554,000	$264,000		5,176	$80.00	$414,000		$1,232,000

Appendix 6– Table A6.2

PROJECT LOCATION: PF Correction, All Vars in Plant, Wallula, Wa

filename: Wallula-02

ESTIMATE OF COST

Boise Cascade Paper Group

PAGE 1 OF 1
DATE 9/30/2004
BY Moe Moneigh

EQUIPMENT OR ACCOUNT NUMBER	DESCRIPTION	MATERIAL QTY.	MATERIAL UNIT	MATERIAL UNIT PRICE	MATERIAL OWNER FURNISHED TOTAL	MATERIAL CONTRACTOR FURNISHED TOTAL	CONTRACTOR LABOR M.H. UNIT	CONTRACTOR LABOR MAN-HOURS	CONTRACTOR LABOR RATE	CONTRACTOR LABOR TOTAL	SUB-CONTRACT Labor & Mat'l	GRAND TOTAL
									$80.00			
	2MVAR 4kV tuned two step unit	5		$112,500	$562,500		16.00	80	$80.00	$6,400		$569,000
	Fabricate mounting brackets	5		$5,000		$25,000	16.00	80	$80.00	$6,400		$31,000
	Rig and set unit	5		$300		$1,500	8.00	40	$80.00	$3,200		$5,000
	Power wiring 2/0 in 3" conduit	5	200			$16,000	120.00	600	$80.00	$48,000		$64,000
	Control wiring , 10 conductors in 3/4" conduit	5	300			$2,500	60.00	300	$80.00	$24,000		$27,000
	Stress cones (6 per unit)	5		$750		$3,750	24.00	120	$80.00	$9,600		$13,000
	Connection	5		$600		$3,000	8.00	40	$80.00	$3,200		$6,000
	Checkout	5					8.00	40	$80.00	$3,200		$3,000
	The following requires an outage for the tie-in											
	Cable bus 2000 Amp 5kV	2	200	$670	$268,000		240.00	480	$80.00	$38,400		$306,000
	Vacuum circuit breakers	2		$60,000	$120,000		120.00	240	$80.00	$19,200		$139,000
	Modifications to incomming section	2		$10,000		$20,000	40.00	80	$80.00	$6,400		$26,000
	Extension of DC control power	2		$2,000		$4,000	20.00	40	$80.00	$3,200		$7,000
	Foundations	2		$5,000		$10,000						$10,000
	Cable Bus Supports	10		$1,500		$15,000						$15,000
	Stress cones (48 per unit)	2		$6,000		$12,000	192.00	384	$80.00	$30,720		$43,000
	Connection	2		$2,500		$5,000	40.00	80	$80.00	$6,400		$11,000
	Checkout	2					16.00	32	$80.00	$2,560		$3,000
	Fence Modifications	1				$2,000						$2,000
	Easement Adjustment	1				$5,000						$5,000
	Control wiring , 10 conductors in 3/4" conduit	2	300			$600	60.00	120	$80.00	$9,600		$10,000
	TOTAL				$951,000	$125,000		2,756	$80.00	$220,000		$1,296,000

Appendix 6– Table A6.3

PROJECT PF Correction, All Vars in plant
LOCATION Wallula, Wa
filename Wallula-03

ESTIMATE OF COST

Boise Cascade Paper Group

PAGE 1 OF 1
DATE 9/30/2004
BY Moe Moneigh

EQUIPMENT OR ACCOUNT NUMBER	DESCRIPTION	MATERIAL					CONTRACTOR LABOR				SUB-CONTRACT Labor & Mat'l	GRAND TOTAL
		QTY.	UNIT	UNIT PRICE	OWNER FURNISHED TOTAL	CONTRACTOR FURNISHED TOTAL	M.H. UNIT	MAN-HOURS	RATE	TOTAL		
									$80.00			
	3 MVAR 12.5kV automatic tuned cap unit	3		$113,700	$341,100		24.00	72	$80.00	$5,760		$347,000
	2/0 armored cable and supports, 250 ft run	3		$6,000		$18,000	120.00	360	$80.00	$28,800		$47,000
	Control conduit, 250 feet with 10 conductors	3		$500		$1,500	60.00	180	$80.00	$14,400		$16,000
	Modify existing breaker on Bus 5	1		$4,000		$4,000	60.00	60	$80.00	$4,800		$9,000
	Remove one breaker on Bus 4	1					40.00	40	$80.00	$3,200		$3,000
	Install 2 high breaker stack on bus 4	1		$80,000	$80,000	$2,000	80.00	80	$80.00	$6,400		$88,000
	Foundations	2		$5,000		$10,000						$10,000
	DC control power circuit	2		$1,000		$2,000	20.00	40	$80.00	$3,200		$5,000
	Modify main breakers	2		$3,000		$6,000	40.00	80	$80.00	$6,400		$12,000
	Stress cones (6each unit)	2		$750		$1,500	24.00	48	$80.00	$3,840		$5,000
	Connect	2		$600		$1,200	16.00	32	$80.00	$2,560		$4,000
	Checkout	2					16.00	32	$80.00	$2,560		$3,000
	TOTAL				$421,000	$46,000		1,024	$80.00	$82,000		$549,000

Appendix 6– Table A6.4

PROJECT LOCATION	PF Correction, All Vars in Plant Wallula, Wa	**Boise Cascade Paper Group**	PAGE 1 OF 2 DATE 9/30/2004
filename	Wallula-04		BY Moe Moneigh

ESTIMATE OF COST

EQUIPMENT OR ACCOUNT NUMBER	DESCRIPTION	MATERIAL					CONTRACTOR LABOR				SUB-CONTRACT Labor & Mat'l	GRAND TOTAL
		QTY.	UNIT	UNIT PRICE	OWNER FURNISHED TOTAL	CONTRACTOR FURNISHED TOTAL	M.H. UNIT	MAN-HOURS	RATE	TOTAL		
	Summary and Overheads								$80.00			
	Total, 480 Volt work Sheet Wallula-01				$554,000	$264,000		5,176	$80.00	$414,080		$1,232,000
	Total, 4160 Volt work Sheet Wallula-02				$951,000	$125,000		2,756	$80.00	$220,480		$1,296,000
	Total 12,500 Volt work Sheet Wallula-03				$421,000	$46,000		1,024	$80.00	$81,920		$549,000
	Total Monitoring Sheet Wallula-05				$70,000	$25,000		984	$80.00	$78,720		$174,000
	TOTAL				$1,996,000	$460,000		9,940	$80.00	$795,000		$3,251,000

Appendix 6– Table A6.5

PROJECT LOCATION	PF Correction, All Vars in Plant Wallula, Wa			**ESTIMATE OF COST**		**Boise Cascade Paper Group**			**PAGE 2 OF DATE**	2 9/30/2004
filename	Wallula-04								**BY**	Moe Moneigh
TOTAL DIRECT COST			$1,996,000	$460,000		9,940	$80.00	$795,000		$3,251,000
CONTRACTOR INDIRECTS						9940				
CONTRACTOR'S FEE										
TOTAL CONSTRUCTION COST			$1,996,000	$460,000		9940	$80.00	$795,000		$3,251,000
CONSULTANT ENGINEERING	12.00 %									$390,000
ALL PRE-PROJECT COSTS/BCC ENGINEERING	2.00 %									$65,000
OTHER OUTSIDE ENGRG SERVICES (Siemens/Westinghouse)										$25,000
ENVIRONMENTAL / LEGISLATIVE										
CAPITALIZED SPARES	2.00 %									$65,000
TAXES	%									
CONSTRUCTION INSURANCE										$4,000
TOTAL BOISE INDIRECTS										$549,000
SUBTOTAL DIRECTS AND INDIRECTS										$3,800,000
CONTINGENCY	20 %									$760,000
TOTAL PP&E										$4,560,000
ESCALATION	5 %									$228,000
CAPITALIZED INTEREST	None									None
DEFERRED STARTUP COSTS	None									None
WORKING CAPITAL	None									None
OPERATOR TRAINING AND STARTUP	None									None
TOTAL A.F.E						9,940		795,000		**$4,788,000**

Appendix 6– Table A6.6

PROJECT LOCATION: PF Correction, All Vars in Plant, Wallula, Wa

filename: Wallula-05

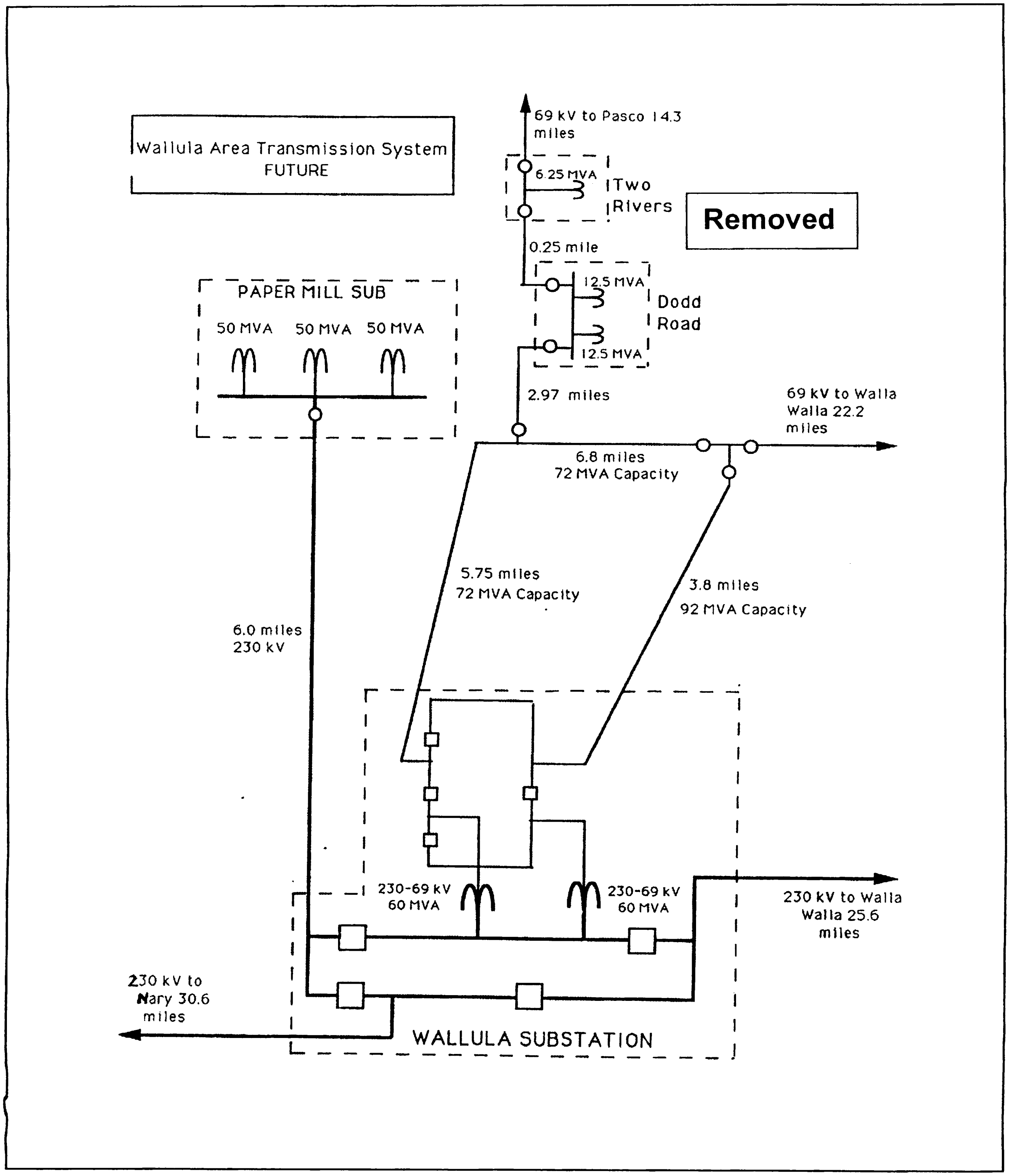
ESTIMATE OF COST

Boise Cascade Paper Group

PAGE 1 OF 1
DATE 9/30/2004
BY Moe Moneigh

EQUIPMENT OR ACCOUNT NUMBER	DESCRIPTION	MATERIAL QTY.	UNIT	UNIT PRICE	OWNER FURNISHED TOTAL	CONTRACTOR FURNISHED TOTAL	CONTRACTOR LABOR M.H. UNIT	MAN-HOURS	RATE	TOTAL	SUB-CONTRACT Labor & Mat'l	GRAND TOTAL
									$80.00			
	Monitoring Equipment and Supervisory											
	Addressable Relay II (2 inputs 2 outputs)	8		$470	$3,760		2.00	16	$80.00	$1,280		$5,000
	IQ 200 Power Meter	42		$1,580	$66,360		4.00	168	$80.00	$13,440		$80,000
	Control wiring to capacitor units	50		$250		$12,500	8.00	400	$80.00	$32,000		$45,000
	Connection to existing Impact System	50		$250		$12,500	8.00	400	$80.00	$32,000		$45,000
	TOTAL				$70,000	$25,000		984	$80.00	$79,000		$174,000

Appendix 7


Wallula Area Transmission System
FUTURE
69 kV to Pasco 14.3 miles
6.25 MVA
Two Rivers
Removed
0.25 mile
12.5 MVA
Dodd Road
12.5 MVA
PAPER MILL SUB
50 MVA
50 MVA
50 MVA
2.97 miles
69 kV to Walla Walla 22.2 miles
6.8 miles
72 MVA Capacity
5.75 miles
72 MVA Capacity
3.8 miles
92 MVA Capacity
6.0 miles
230 kV
230-69 kV
60 MVA
230-69 kV
60 MVA
230 kV to Walla Walla 25.6 miles
230 kV to Nary 30.6 miles
WALLULA SUBSTATION