Transmission and Distribution System Development Plan

November 26, 2004

Table of Contents

1 Introduction ... 3
1.1 Capital Plan Priority Analysis ... 4
1.2 Review of 1998 Master Plan ... 6
1.3 Significant Projects Undertaken Since 1998 Plan Issued ... 6
2 Bulk FortisBC Transmission System ... 8
2.1 Existing System ... 8
2.2 Bulk System Deficiencies ... 9
2.3 Maintenance Assessment ... 10
2.4 Bulk Transmission Capital Projects ... 11
3 Okanagan Region Transmission and Distribution Systems ... 18
3.1 Kelowna Area ... 18
3.2 Penticton – Summerland Area ... 27
3.3 Oliver – Osoyoos Area ... 29
3.4 Princeton – Keremeos (Similkameen) Area ... 33
4 Kootenay Region Transmission and Distribution Systems ... 35
4.1 Castlegar Area ... 35
4.2 Crawford Bay Area ... 37
4.3 Creston – Wynndel Area ... 38
4.4 Grand Forks – Boundary Area ... 40
4.5 Kaslo – Coffee Creek Area ... 44
4.6 South Slocan Area ... 46
4.7 Trail – Salmo Area ... 48
5 General ... 50
5.1 Station Sustaining General ... 50
5.2 Transmission General ... 52
5.3 Distribution General ... 54
6 Communications, SCADA, Teleprotection and Other Systems ... 56
6.1 Telecommunications Scope ... 56
6.2 Introduction ... 58
6.3 Teleprotection and Remedial Action Schemes (RAS) ... 58
6.4 Transmission, Generation and Distribution SCADA ... 60
6.5 Power quality and Customer metering ... 63
6.6 Protection Relay Status and Fault Recorders ... 64
6.7 Mobile Voice (VHF Radio and Cellular) ... 65
6.8 Fixed Voice - Operations ... 67
6.9 Wide Area Network and Administrative Voice ... 67
6.10 Neighboring Utilities ... 68
6.11 Backbone Telecommunications System ... 69
6.12 Possible Future Requirements ... 70
6.13 Projects ... 72

Appendices

Appendix A – Maps and Diagrams
1. FortisBC Service Area
2. System Single Line Diagram
3. Okanagan Region System
4. Kootenay Region System
5. Boundary Area System
6. Neighboring Systems
7. New Osoyoos Substation
8. Boundary Area Conversion
9. South Okanagan Upgrade
10. Kootenay Area Upgrade
11. Kelowna Official 2020 Community Plan - New Residential Development

Appendix B –Load Forecast
Central Okanagan (Kelowna)
Okanagan-Similkameen
Central Kootenay
Kootenay - Boundary

Appendix C – Capital Forecast
1. Summary
2. Transmission Projects
3. Distribution Projects
4. Telecommunications, SCADA and Protection Projects
5. Priority Matrix

Appendix D – Maintenance Planning Report

Appendix E – Distribution Planning Manual

1 Introduction

This report documents the System Development Plan for the FortisBC transmission and distribution systems. The report identifies necessary reinforcements in the bulk (or backbone) transmission system, the regional transmission and distribution systems, the communications and SCADA (System Control and Data Acquisition) networks, and protection systems owned and operated by FortisBC. The Capital Forecast included with this report distinguishes between “Sustaining Projects” which are directed at adequately maintaining existing facilities and modernizing obsolete equipment and systems, and “Growth Projects” which are required to serve increasing loads driven by population growth and new commercial and industrial operations in the FortisBC service area.

This System Development Plan has a broader focus than the 1998 Master Plan previously filed with the BC Utilities Commission. The new System Development Plan is a more comprehensive plan including protection and control facilities, communication facilities plus analysis of the maintenance requirements. The plan includes a long-term (20 year) study of the transmission system, a shorter (6 year) study for the distribution system, plus a detailed review of the maintenance programs and condition-based assessments of the lines and equipment.

The plan shows a significant shift in the long-term plans for some areas including rebuilding of legacy (older deteriorated) substations and rebuilding of much of the old infrastructure. One example of the impact of this change is in the Boundary area. The current plan is to construct two substations which are supplied from the high voltage transmission lines and then supplies the Boundary loads from a new distribution backbone. This plan removes the need to rebuild the sub-transmission lines and associated legacy substations in the Boundary area. The overall impact of the new plan is a significantly lower total capital cost, better ability to serve new customer growth, increased reliability, fewer facilities to maintain and increased system flexibility.

As the Okanagan continues to grow and become a larger urban load, there is a need to recognise the changing requirements of the area. In addition to the load growth driving significant transmission and distribution investments to meet the increasing demand, the larger load centre requires a new look at the reliability requirements of the area. The plan recognises this need and shows an advancement of the transmission system development to both meet the increasing loads and provide a higher level of reliability expected in large urban environments. The current South Okanagan Supply Reinforcement project set the stage to meet the increasing demands in the Okanagan.

The Kootenay region has a much lower load growth with the condition and aging infrastructure driving the rebuild of much of the system. The situation in the Kootenay does not support the elimination of the subtransmission system as is the case in the Boundary area. The distances are too great to allow a distribution system to replace the

subtransmission system as in the Boundary area. As a result, rebuilding some of the older transmission facilities plus improving the reliability at the Lambert (Creston area) Terminal will meet the area needs for both capacity and reliability.

A complete assessment of our maintenance plans and equipment condition was undertaken as part of the system development planning process. The result of this review confirmed the condition based maintenance cycles were consistent with utility practice for the age of the facilities. The corrective work being identified requires a greater investment level than was historically applied. The plan documents both the age and condition of the facilities and recommends capital spending levels to adequately maintain the safety and reliability of the system. The recommended levels are based on a combination of condition based analysis and criticality of facilities.

A priority matrix was developed to help ensure the required capital projects were completed in an orderly manner. This matrix considers safety, public impact, thermal capacity, voltage support, and restoration time. The various aspects of the matrix are weighted to reflect the importance of that item. Safety has the highest rating resulting in safety being the largest contributor to the priority rating. The overall results of this priority system compare the impact of each situation that exceeds the planning criteria and ranks it against other projects. A discussion of the priority matrix can be found at Appendix C, Section 5.

1.1 Capital Plan Priority Analysis

The System Development Plan identifies more than 100 system development and improvement projects to be implemented over the next six years at an estimated cost of more than $400 million. In order to ensure appropriate spending a priority matrix was developed. This matrix assigns various weighting factors to six different categories. Also a “Mandatory” category is provided for a project that must proceed, therefore carries a weighting greater than all other categories. The table below lists the weighting factors for the six variable categories as applied to the System Development Plan projects.

Safety

This category is weighted the highest of the variable categories to demonstrate FortisBC’s commitment to worker and public safety. This category demonstrates the ability to improve safety by doing the project. If a system element is deemed unsafe at present, it is elevated to the Mandatory category.

Restoration Time

This category demonstrates the reliability improvement value of the project as measured by outage duration or restoration time.

Thermal Capacity

This category demonstrates the risk of equipment failure due to overload as measured by the percentage of overload compared to manufacturer rating of the equipment.

System Effect of Failure

This category demonstrates the consequence to the system if a system element failure were to occur without doing the project.

Voltage Related

This category (similar to the Thermal Capacity category) quantifies the power quality as measured by customer voltage level that is driving the project.

Public Impact

Public Impact is a measurement of the quantity of customers affected by the project.

Weighting Factors for Capital Expenditures Prioritization Matrix

Category	Unit	Rating	Weighting Factor
Safety		High	**10**
		Medium	**5**
		Low	**1**
Public Impact	Number of Customers	>2000	**3**
		<1000	**2**
		<500	**1**
Restoration Time	hours	> 8	**7**
		4 to 8	**4**
		< 4	**2**
Thermal Capacity	(overloads)	> 25%	**5**
		0 to 25%	**3**
		0	**0**
System Effect of Failure		High	**3**
		Med	**2**
		Low	**1**
Voltage Related		<110V	**5**
		<115V	**2**
		N/A	**0**

A complete list of projects included in the System Development Plan and their combined weightings can be found in Appendix C Section 5.

1.2 Review of 1998 Master Plan

The last comprehensive Transmission and Distribution System Master Plan for the FortisBC System was issued in November 1998 just before initiation of the most significant set of reinforcements of the FortisBC backbone transmission system in several decades. The 1998 Master Plan identified the urgent requirement to reinforce the transmission system in both the West Kootenay and South Okanagan regions. A number of system development permutations were described which would adequately mitigate the identified system deficiencies, although the ultimate configurations had not been decided at the time the plan was issued.

In the six years since the last planning report was issued the Kootenay 230 kV System Development Project has been completed, and South Okanagan Supply Reinforcement Project to reinforce the South Okanagan region is now underway. The implementation of these two projects marks substantial completion of the bulk system upgrades identified in the previous planning report, and provides a solid foundation for the next stages of modernizing and improve the adequacy of the backbone transmission system throughout the FortisBC service territory.

1.3 Significant Projects Undertaken Since 1998 Plan Issued

- Comprehensive rehabilitation initiatives on 44 Line to Osoyoos and 49 Line to Summerland.
- Complete distribution system rebuilds and voltage upgrades in Rossland, Warfield and West Trail.
- Capacitor additions at FA Lee Terminal in Kelowna and Vernon Terminal (BC Hydro) to improve import capacity into Okanagan Region.
- Circuit Switcher additions at Kaleden, OK Falls and Waterford to improve 63 kV sub-transmission performance in the South Okanagan.
- The AA Lambert Terminal in Creston rehabilitation project to provide distribution backup to the Creston area was completed in 2004 and included preparation for planned 230 kV bus reconfiguration in 2006 and 2007.
- The Kootenay 230 kV System Development Project, In Service Date (ISD) 2004 – New 230 kV transmission circuit connecting BC Hydro's Kootenay Canal Generating Station with Columbia Power Corporation's (CPC) new Brilliant Terminal Station (BTS) and the new Warfield Terminal Station (WTS). This project also involved salvage of most of the deteriorated 63 kV transmission lines in the West Kootenay between South Slocan and Trail, along with salvage of the deteriorated Warfield and Tadanac substations.

- South Okanagan Supply Reinforcement Project, ISD 2005 – New 500/230/161 kV substation connecting the BC Hydro 500 kV circuit between Selkirk and Nicola to the FortisBC transmission system. The 230 kV bus will be temporarily operated at 161 kV until the first 230 kV circuit is completed between the Vaseux Lake and RG Anderson (Anderson) Terminals, at which time the bus will be energized at its planned 230 kV operating. The ultimate configuration will involve a six position 230 kV ring bus terminating three 500/230 kV transformers, two 230 kV circuits between Vaseux Lake and Anderson and a single 230 kV circuit between Vaseux Lake and the proposed new Bentley Terminal near Oliver.
- Kelowna Area Upgrade including DG Bell (Bell) Terminal 230 kV Upgrade, ISD 2005 – Termination of 230 kV circuit 73 Line at Bell and the addition of a new 230/138 kV transformer and FA Lee Terminal (Lee) Upgrade ISD 2006 - Reconfigure 138 kV bus and transformer protection to improve capacity and reliability of supply to the City of Kelowna.

The timeliness of these ongoing system reinforcements was dramatically illustrated by the multi-day power outage to 50 million customers in Ontario and the US Northeast in August 2003. This event has been directly implicated in the negative third quarter 2003 GDP growth for Canada, even though two of the outage days occurred on a weekend. This event demonstrates concretely the economic and social impacts of not maintaining an adequate transmission system.

Other major electrical system developments which have taken place in the area since the last planning report was issued include the completion of CPC's 180 MW Arrow Lakes Generating Station at the Hugh Keenleyside Dam on the main stem of the Columbia River near Castlegar and the related 230 kV interconnection via the Brilliant Terminal Station to BC Hydro's Selkirk 500 kV substation. Work has now commenced on the Brilliant Expansion Project, which involves construction of a new 120 MW generating unit and associated water diversion facilities at the existing Brilliant Dam on the Kootenay River near Castlegar. This generator will be interconnected with the FortisBC system at the recently completed Brilliant Terminal Station.

A significant proposed regional power facility is the Waneta Expansion (TeckCominco), which will involve a new generator and diversion tunnel at the existing Waneta Dam on the Pend d'Oreille River.

2 Bulk FortisBC Transmission System

2.1 Existing System

The existing FortisBC transmission system is represented geographically in Map 1 of Appendix A, and a switching single line diagram of the system is provided in Map 2. In the west, FortisBC serves the Okanagan region which includes the cities of Kelowna and Penticton and extends south to Osoyoos and west up the Similkameen River valley to Princeton. In the east, FortisBC serves the West Kootenay region which spans the southern part of British Columbia from Creston to Rock Creek. The Kootenay region also extends north up Kootenay Lake to Kaslo and also from Trail north up to Slocan City. The nominal voltages used on the bulk system are 230 kV, 161 kV, 138 kV and 63 kV.

The FortisBC system is interconnected with the BC Hydro 500 kV and 230 kV networks at Vernon, Princeton, Kootenay Canal, Creston, Brilliant and Waneta. The generation resources that supply FortisBC's load are primarily located in the Kootenay region or external to the FortisBC network.

The BC Hydro interconnections at Vernon, Princeton and Vaseux Lake Terminal (2005/06) play a very important role in transporting power into the Okanagan region from the generating plants in the Kootenay region. The completion of Vaseux Lake Terminal at the end of 2005 will improve the reliability of the FortisBC transmission system in the South Okanagan valley. It will also defer or eliminate the need to upgrade the existing 161 kV circuit to 230 kV (11 Line) that links the Kootenay and Okanagan regions between Trail and Oliver. However, the completion of South Okanagan Supply Reinforcement Project will substantially increase the operating complexity of the south interior transmission system, with the requirement to have additional Remedial Action Schemes (RAS) in place to trip the underlying parallel FortisBC transmission path (combinations of 11 Line, 43 Line, 73 Line and 71 Line) to avoid facility overload for various combinations of 500 kV contingencies on the BC Hydro system. Additional RAS will also be required at the south interior generation plants Kootenay Canal, Arrow Lakes Generating Station, Waneta and Seven Mile for various combinations of 500 kV contingencies within the BC Hydro system.

These interconnections are also used on an ongoing basis to import power from external suppliers and to export to external consumers during periods of excess power, typically off peak hours during the spring freshet. In 2003 the FortisBC system had net energy imports of approximately 731 GWh, comprising nearly a quarter of the 3,182 GWh of energy consumed in the system. The peak import level in January 2004 was 400 MW, more than half the peak demand of 718 MW. FortisBC only exports energy in excess of local requirements during spring freshet, with maximum export in 2004 of 245 MW recorded during July.

2.2 Bulk System Deficiencies

System impact studies were carried out to evaluate the performance of the system following various single (N-1) and selective double N-1-1 (one element out of service for maintenance, second element fails) or N-2 (double unrelated) contingency outages. The following are some of the key contingencies that were studied:

N-1 Contingencies

- 5L98 Vaseux Lake to Nicola 500 kV
- 5L96 Vaseux Lake to Selkirk 500 kV
- 5L91 Selkirk to Ashton Creek 500 kV
- One of 2L255 or 2L256 Ashton Creek to Vernon 230 kV
- One of 72 Line or 74 Line Vernon to Lee 230 kV
- 77 Line Warfield Terminal Station to Brilliant Terminal Station 230 kV
- 79 Line Kootenay Canal to Brilliant Terminal Station 230 kV
- 73 Line Anderson to Bell Terminal 230 kV
- 82 Line Brilliant Terminal Station to Selkirk 230 kV
- 30 Line South Slocan to Coffee Creek 161 kV
- 40 Line Vaseux Lake to Oliver 161 kV
- 76 Line Vaseux Lake to Anderson 161 kV
- Various N-1 transformer contingencies

N-1-1 and N-2 Contingencies

- 2L255 and 2L256 Ashton Creek to Vernon 230 kV
- 72 Line and 74 Line Vernon to Lee Terminal 230 kV
- 5L76 and 5L79 Ashton Creek to Nicola 500 kV
- 5L98 and 5L96 Vaseux Lake to Nicola and Vaseux Lake to Selkirk 500 kV
- 5L91 and 5L96 Ashton Creek to Selkirk and Vaseux Lake to Selkirk 500 kV
- Vaseux Lake 500 / 161 kV Transformer 1 and Transformer 2

In considering N-1-1 or N-2 contingencies, it must be noted that the contingency classification designates only that one or more system elements are simultaneously out of service rather than suggesting the infrequent coincidence of several low-probability events. Many N-2 contingencies actually result from a single credible event, including protection failure, stuck breaker or breaker failure, double circuit structure collapse or bus failure. For example, both 230 kV circuits between Lee Terminal and Vernon Terminal have been simultaneously forced out of service on at least four occasions in the last five years. As the load increases in the Kelowna area this event will create significant outages in Kelowna.

A number of the most significant bulk system deficiencies identified in the 1998 Master Plan have either been addressed by the Kootenay 230 kV System Development Project, or will shortly be mitigated by the South Okanagan Supply Reinforcement Project.

The next echelon of bulk system priorities includes integrating the Vaseux Lake Terminal Station into the Okanagan transmission system to addressing supply reliability deficiencies for the City of Kelowna.

Following completion of the Vaseux Lake Terminal, the City of Kelowna will still be exposed to significant load loss for coincident loss of the 230 kV circuits 72 Line and 74 Line or 2L255 and 2L256, which share a common right of way, under almost any loading condition. Completion of the Vaseux Lake Terminal is the first step in addressing this deficiency, but the new substation must be fully integrated into the FortisBC system to realize all the benefits of this new substation.

The next step involved in integrating the new Vaseux Lake Terminal into the FortisBC Okanagan region transmission system involves the almost immediate addition of a 230 kV circuit to replace existing 161 kV circuit 76 Line between the new Vaseux Lake Terminal and existing Anderson Terminal Station in Penticton. This addition will mitigate the regular occurrence of total or substantial load loss in Kelowna for outages to 72 Line and 74 Line or 2L255 and 2L256 between BC Hydro's Vernon and Ashton Creek Terminals.

Subsequent bulk system additions will be driven by load in the major population growth centers, especially Kelowna, Penticton, Oliver and Osoyoos. The ultimate loadings considered in this System Development Plan are 450 MW for the City of Kelowna, and 270 MW for the Okanagan-Similkameen area. At these loading levels for Kelowna and Penticton, the total Okanagan Valley load between Vaseux Lake Terminal and Lee Terminal will be in the 720 MW range.

2.3 Maintenance Assessment

The condition of the FortisBC bulk system facilities varies widely by asset class, vintage and location. Notable bulk system facilities of specific concern include:

- 11 Line (161 kV) between the AS Mawdsley (Mawdsley) Terminal in Trail and the Oliver Terminal, requires a comprehensive thermal rating review, including verification of all spans to confirm maximum loading capacity. In addition to 11 Line, 63 kV circuits 9 Line and 10 Line have many segments in advanced states of deterioration. 9 Line and 10 Line were originally constructed in 1919, and although significant sustaining expenditures have been made over the last 85 years to maintain these facilities, the overall rate of deterioration is accelerating, indicating that the facilities have exceeded reasonable service life expectancy and will require either complete rebuild or abandonment in the near term to avoid unacceptably compromising supply reliability to Boundary area load centers.

- 30LE (161 kV) which is owned by TeckCominco between Crawford Bay Terminal and Kimberley, requires a thorough right of way review and appropriate vegetation management if it is to be kept in service as a backup supply for Crawford Bay, Coffee Creek and Kaslo substation.
- 32 Line (63 kV) between AA Lambert (Lambert) in Creston and Crawford Bay Terminal is in much deteriorated condition and is a candidate for a complete rebuild.

One longer-range goal for the FortisBC system is to reduce the number of nominal system voltages to three widely used standard classes: 230 kV, 138 kV and 63 kV. This will require a staged migration away from the 161 kV voltage level, a class not employed by neighboring utilities and not commonly used by utilities in North America. Because it is a relatively uncommon voltage class, maintaining 161 kV as a system voltage requires a spare parts policy for 161 kV equipment which is entirely self-contained to FortisBC, since equipment cannot be borrowed or purchased from neighboring utilities in the event of equipment failure. In addition, since the 161 kV voltage level is non-standard, there is typically a cost premium involved in purchasing equipment with this rating. Abandoning the 161 kV voltage class will require that existing 161 kV facilities are either upgraded to 230 kV as required due to load growth, or reduced to a 138 kV nominal voltage as equipment needs to be replaced if the lower voltage is adequate to meet system needs. Immediate or rapid abandonment of this voltage level would be costly and is not proposed in this System Development Plan.

A more comprehensive condition assessment of the FortisBC transmission facilities is provided in Appendix D of this report.

2.4 Bulk Transmission Capital Projects

2.4.1 South Okanagan Supply Reinforcement

2.4.1.1 Vaseux Lake Terminal Station

This project involves development of a new 500/230/161 kV Terminal Station connecting the BC Hydro 500 kV circuit between the Selkirk and Nicola Terminal Stations to the FortisBC transmission system in the Okanagan. The project also involves upgrades at the Anderson, Oliver, Grand Forks and Mawdsley Terminal Stations to enable networked operation of the FortisBC Kootenay and Okanagan transmission systems, which are presently operated as two radial systems, normally open south of Penticton. The 230 kV bus at Vaseux Lake Terminal will be temporarily operated at 161 kV until the first 230 kV circuit is completed between the Vaseux Lake and Anderson Terminals, at which time the bus will be energized at its planned 230 kV operating voltage. The ultimate configuration will involve a six position 230 kV ring bus terminating three 500/230 kV transformers, two 230 kV circuits between Vaseux Lake and Anderson and a single 230 kV circuit between Vaseux Lake and the proposed new Bentley Terminal near Oliver.

2.4.1.2 Vaseux Lake Terminal RAS Schemes

Due to the bus configuration in the initial phase of Vaseux Lake Terminal Station, failure of one 500/161 kV transformer will result in the transformer protection disconnecting both transformers. Prior to the auto sectionalizing and restoration of the healthy transformer, excessive voltage drop or voltage instability will occur in the Oliver area. To mitigate against the scenario of voltage instability in the Oliver / Penticton area, a RAS scheme is proposed to temporarily open breakers 41, 42, 43 and 44 at Oliver to shed sufficient load in the Oliver / Penticton area to ensure a stable voltage profile. Upon restoration of the healthy transformer at Vaseux Lake Terminal those same breakers can be reclosed to restore the loads.

Similarly, a simultaneous loss of both BC Hydro 500 kV lines 5L98 and 5L96, (N-2 event) or a 500 kV line breaker failure at Vaseux Lake Terminal (N-2 event) will result in a similarly extreme low voltage condition in the South Okanagan area. The same RAS can be used to maintain adequate operating voltage in the South Okanagan area during this contingency.

For prolonged N-2 contingencies, the system load can be restored by manually re-configuring the Penticton load to be fed from Anderson substation and keeping 40 Line opened at Oliver.

In conjunction with outages to various combinations of BC Hydro's 500 kV bulk transmission system in BC's south interior, under different operating scenarios, direct transfer trip (DTT) of up to four FortisBC transmission lines are required as listed in Table 2.4.1.2 below. A few of these DTT schemes are already in existence and the remaining schemes are being designed and implemented in conjunction with the Vaseux Lake Terminal 500 kV project.

Table 2.4.1.2: RAS Required for Vaseux Lake and BC Hydro 500 kV contingencies

1	Operating Scenario	Contingency	11L	71L*	73L	76L	41L	42L	44L
2									
3	System Normal	5L76 and 5L79							
4		5L91			DTT				
5		5L91 and 5L96	DTT	DTT					
6		5L96	DTT						
7		5L96 and 5L98					DTT	DTT	DTT
8		5L98			DTT				
9		Vaseux Lake					DTT	DTT	DTT
10		T1 and T2							
11	5L91 oos	5L76 and 5L79							
12		5L96	DTT	DTT					
13		5L96 and 5L98		DTT		DTT			
14		5L98		DTT	DTT				
15	5L96 oos	5L76 and 5L79	DTT	DTT	DTT				
16		5L91	DTT	DTT					
17		5L98							
18	5L98 oos	5L76 and 5L79		DTT					
19		5L91		DTT		DTT			
20		5L91 and 5L96	DTT	DTT					
21		5L96							

* DTT only if 71 Line is connected to BPA Boundary

2.4.1.3 RAS to Prevent Voltage Collapse or Blackout in Kelowna

Prior to the completion of the first 230 kV circuit between Vaseux Lake and Anderson Terminals, a planned or forced outage to any one of the Ashton Creek to Vernon 230 kV circuits (2L255/2L256), requires that RAS be designed and armed to prepare for the next 230 kV line sequential double contingency (N-1-1). Once armed, should there be an outage to the remaining 230 kV circuit, the RAS will automatically initiate a direct transfer trip to both Vernon to Lee 230 kV circuits (72 Line/74 Line) in addition to shedding approximately 200 MW of load in the Kelowna area to prevent overloading of Anderson Transformer 2. This scheme must also be designed to initiate the same action if and when both Ashton Creek to Vernon 230 kV circuits are lost in a simultaneous double (N-2) contingency.

A similar RAS s also needed for the Vernon to Lee 230 kV circuits (72 Line/74 Line) to cover for N-1-1 or N-2 events of the Vernon to Lee 230 kV circuits.

2.4.2 Vaseux Lake Terminal to Anderson Terminal 230 kV Circuit

With the completion of Vaseux Lake Terminal in 2005/06, simultaneous (N-2) or sequential (N-1-1) loss of 72 Line and 74 Line between Vernon and Lee or BC Hydro 230 kV circuits 2L255 and 2L256 between Vernon and Ashton Creek will result in severe voltage drop in the City of Kelowna and overloading of both Anderson Terminal transformers. To avoid this abnormal system condition, in 2005/06, as much as 200 MW of Kelowna load will be shed by an automatic RAS, only 70 MW of Kelowna load can be served from the South Okanagan under the initial Vaseux Lake Terminal configuration.

In order to provide secure supply capability to the City of Kelowna after completion of Vaseux Lake 500 kV Terminal Station, a 25 km 230 kV circuit will be constructed between Vaseux Lake and Anderson Terminals in the 2007/08 timeframe. Refer to Figure 2.4 A. The new structures will be located on the centerline of existing 161 kV circuit 40 Line to make the most efficient use of existing right of way and to avoid a protracted new right of way acquisition process. Termination of the 230 kV circuit will require completion of the 230 kV ring bus in Anderson Terminal and reconnection of the existing 168 MVA kV transformer for 230 kV operation.

Once the 230 kV circuit is in service, the RAS as described in the previous project can be turned off and retained for use during maintenance outages and other sustained system outages. Refer to Figures 2.4.2 A, B, and C for the recommended development sequence of the 230 kV bulk transmission facilities in the South Okanagan system.

Figure 2.4.2 A: Existing South Okanagan Configuration

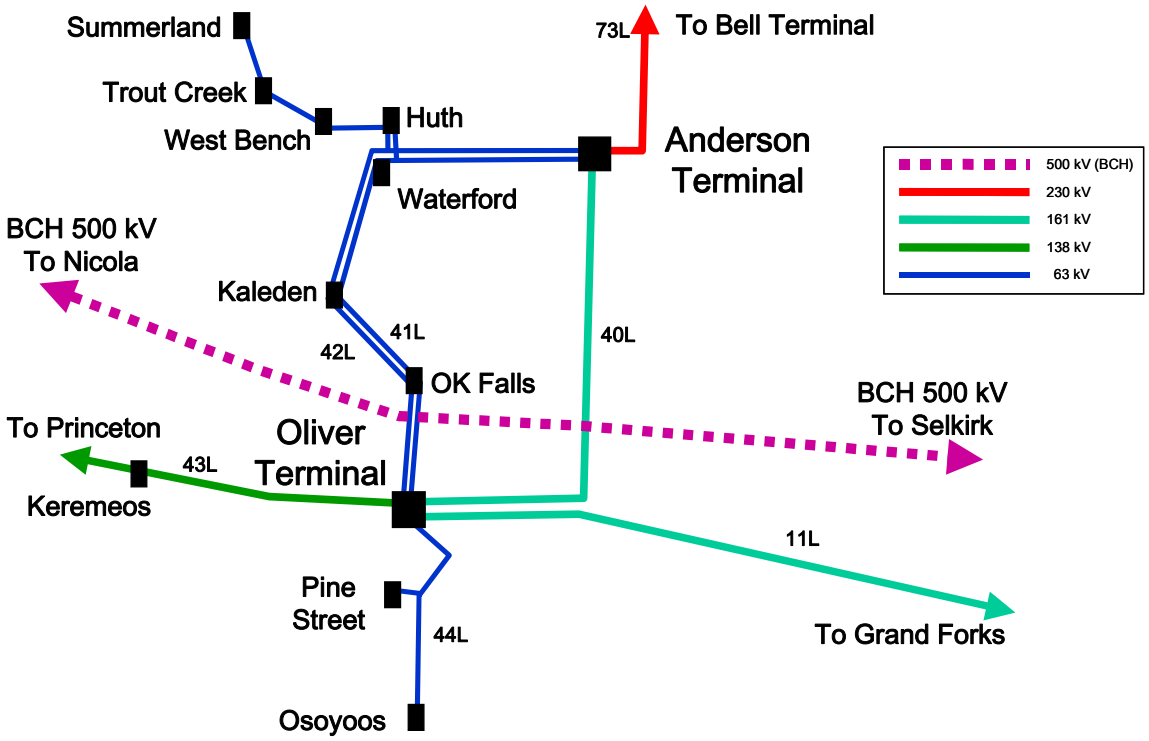


Figure 2.4.2 B: Add Vaseux Lake Terminal and 230 kV Circuit to RG Anderson Terminal

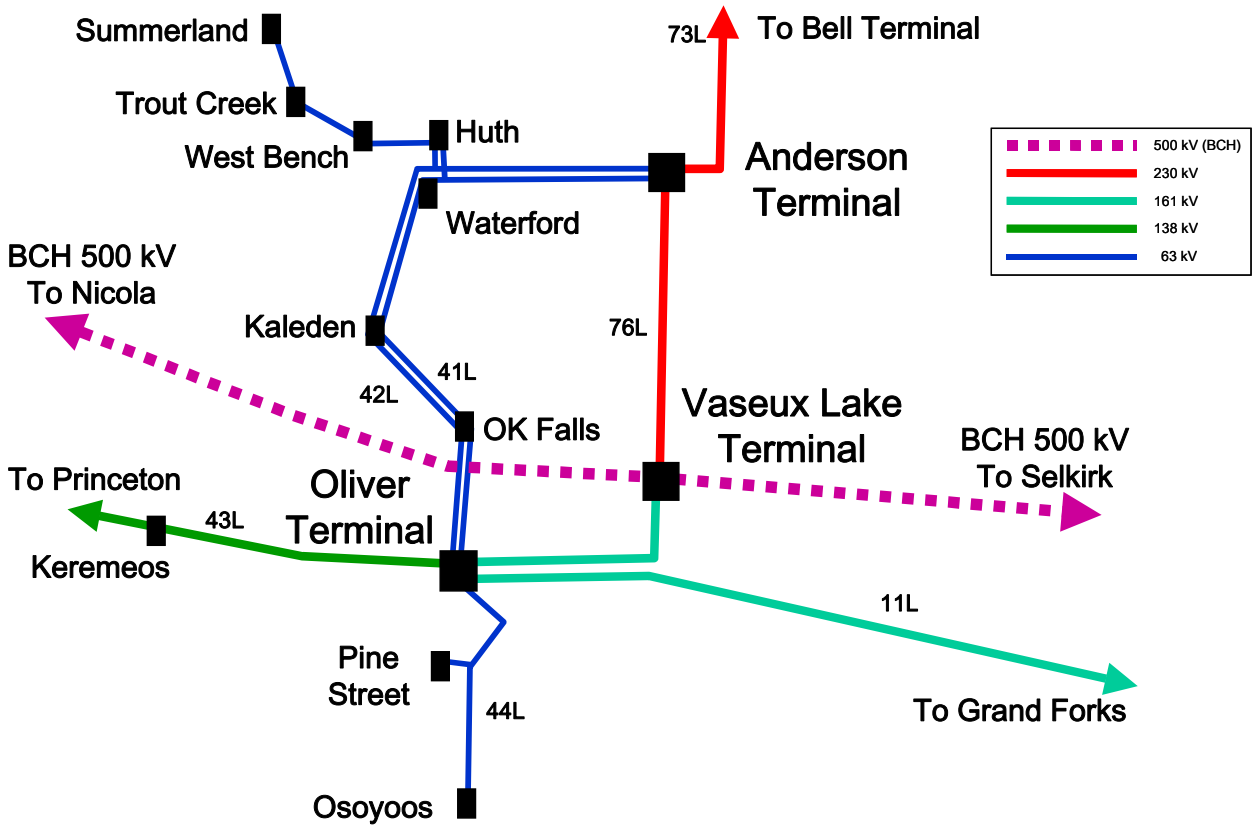
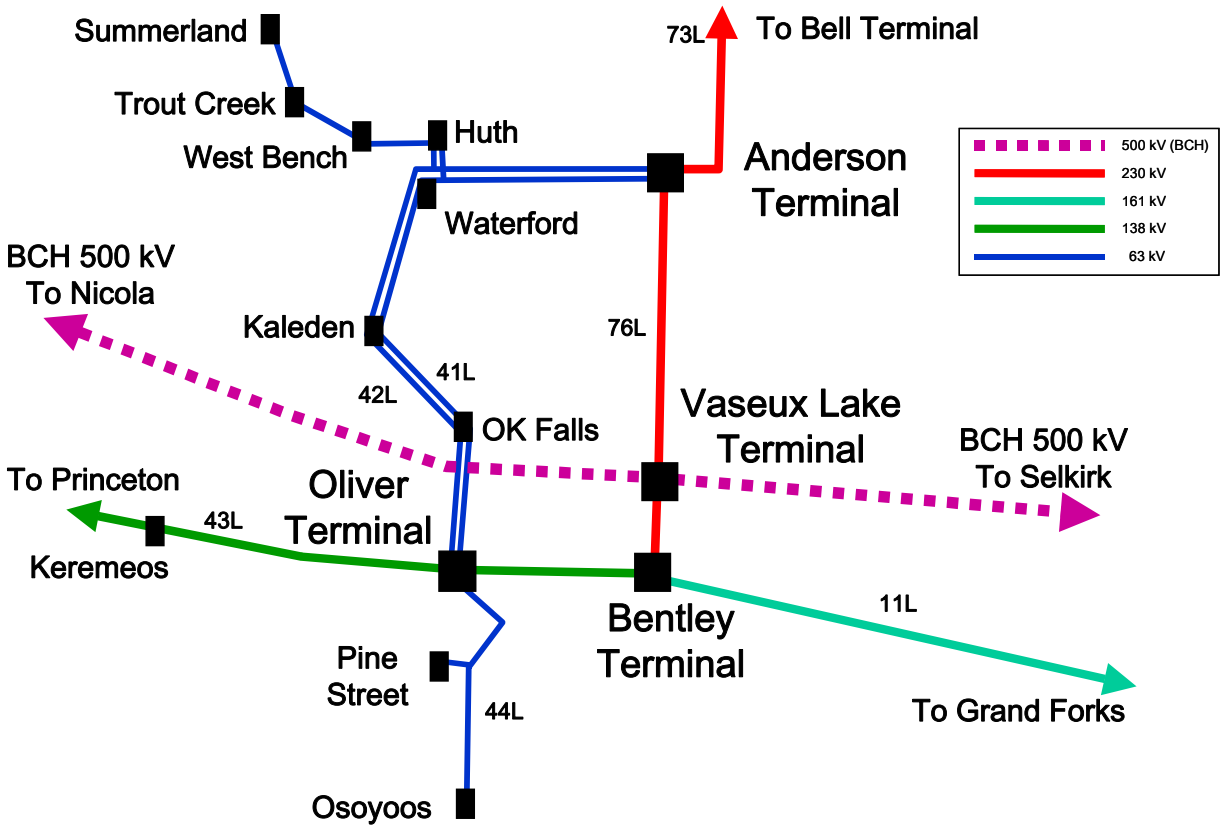


Figure 2.4.2 C: Add Bentley Terminal, 230 kV Bentley to Vaseux, 138 kV Bentley to Oliver



2.4.3 New Bentley Terminal Station

Once Vaseux Lake is converted to 230 kV, a new terminal substation is required near Oliver to supply 11 Line east to Grand Forks at 161 kV plus create a new 138 kV source to support the load growth in the Oliver-Osoyoos area. The new terminal station will be constructed at the junction of existing 161 kV circuits 40 Line and 11 Line east of Oliver Terminal. This terminal will be equipped with 230 kV, 161 kV and 138 kV buses. The 138 kV bus will be used to feed Oliver Terminal Station which will be reconfigured to include a 138 kV ring bus (modified existing 161 kV bus). The new 138 kV bus will be used to terminate 43 Line from Keremeos and Princeton and the new 138 kV from Bentley, as well as two 138/63 kV transformers to supply the 63 kV subtransmission system in the South Okanagan. The 138 kV bus at Bentley will also terminate a new 138 kV circuit which will supply a new east Osoyoos distribution source substation. The 161 kV bus at Bentley will terminate existing 11 Line from Grand Forks Terminal and Mawdsley Terminal.

As part of the Bentley Terminal Station, a new 10 km 230 kV circuit will be constructed between Vaseux Lake and Bentley Terminals on the existing 40 Line centreline. Refer to Figure 2.4.2 C.

2.4.4 Kelowna Switched Shunts and Static VAr Compensator

Almost immediately following completion of the 230 kV double circuit between Vaseux Lake and Anderson Terminals, it will be necessary to install approximately 30 MVAr of additional shunt capacitors at both Bell and Lee Terminals to provide adequate voltage support for loss of both 230 kV lines between Lee and Vernon.

When the Okanagan load reaches 530 MW, the loss of the supply from Vernon will result in extremely low voltages or voltage collapse in the Kelowna area. A 150 MVAr Static VAr Compensator (SVC) or equivalent dynamic reactive support facility will be required at the Lee or Bell Terminal Stations in 2011 under the present load growth forecast.

2.4.5 Kelowna Area Upgrade

The entire Kelowna area load is supplied by two 230/138 kV terminal transformers at the Lee Terminal station. The Kelowna area load is at risk from both reliability and capacity perspectives. Reliability is compromised at the Lee Terminal by the present switchyard configuration and inadequate transformer and bus protection that has resulted in the total loss of supply to the area for certain faults. Post-contingency capacity is compromised because an outage of one Lee Terminal transformer will overload the remaining transformer requiring load shedding as early as the summer of 2005. This area is the fastest growing load center of FortisBC's network. The proposed solution will add capacity (a new transformer, equal in size to the Lee Terminal transformers) at Bell Terminal and improve

the switchgear, switchyard configuration, and protection at Lee Terminal to ensure reliable power supply to Kelowna area distribution substations for the foreseeable future.

3 Okanagan Region Transmission and Distribution Systems

A geographically referenced system map for the FortisBC Okanagan Region is included in Appendix A as Map 3.

3.1 Kelowna Area

3.1.1 Existing Transmission and Distribution System

The Kelowna area is the fastest growing part of the FortisBC system, and one of the fastest growing urban centres in British Columbia. The load additions resulting from this growth have put the transmission and distribution systems in the area under significant stress, and will continue to drive the need for both transmission and distribution reinforcements in both the short and longer term.

Since the initial transmission interconnection between the Kootenay and Okanagan regions was first developed, Kelowna has grown from a small town into a significant urban hub. Greater Kelowna now comprises the largest urban area in British Columbia east of the lower mainland, and development of the transmission system has barely kept up with the City's growth and the increasing power reliability expectations of its residents, many of whom have relocated to the Kelowna region from other urban areas with more robust and fully integrated transmission supply systems.

3.1.2 Kelowna Area System Deficiencies

At the transmission level, the reinforcements linked to the Vaseux Lake Terminal and the subsequent transmission line developments will provide a substantially improved transmission superstructure to provide reliable electric supply. Reliability of supply throughout the City of Kelowna will be further improved by operating the existing 138 kV transmission system as a fully meshed network. The key constraint preventing this operating mode is the lack of adequate 138 kV short-line protections between the various distribution source substations in the City. Due to the lack of adequate protections, the 138 kV system is presently operated as three separate radial lines, 50 Line, 51 Line and 55 Line. Outages to any of these lines creates supply interruption to all connected load until the line is restored or the affected loads are reconnected to one of the other transmission lines by manual switching (where this is possible). Looping the three radial lines into a fully meshed system would eliminate such outages for most single-line 138 kV contingencies within the City. In the longer term looping of the 138 kV system will be required to provide secure supply to all distribution sources in the City via the 230 kV circuits from the South Okanagan for loss of the 230 kV transmission circuits from the north.

Development is occurring in almost all areas of Kelowna but is especially concentrated on the City perimeters. New distribution supply transformation capacity will be needed to address the growing loads. Planned developments in the northern and western sectors of the City cannot continue to be supported by the existing single transformer source at the Sexsmith substation. Some short term relief can be obtained by transferring load from the Sexsmith substation to the Lee Terminal, Glenmore and Duck Lake substations by constructing additional distribution line connections, although continued distribution load additions at Lee Terminal should be avoided to prevent increased risk to the system transformer which supplies this distribution load via its tertiary winding. As new subdivisions continue to be added in the north end of Kelowna it will be necessary to add a new 138 kV source substation in the area. Similarly, rapid development on the cities eastern boundary at the base of Black Mountain and on the southern boundary in what is called the South Ridge area will require additional source substations.

Significant property developments being proposed for the downtown waterfront area will exceed the existing transformer capacity at the Recreation substation, and the limited footprint at this site will make addition of further transformation capacity a challenging proposition. At present, several 20+ storey hotels are before city council for consideration, although rezoning and relaxation of existing height restrictions would be necessary for these projects to proceed as presently proposed.

Constraints on the Big White 25 kV feeder from the Joe Rich substation due to rapid load growth at the Big White Resort will be addressed by development of a proposed new 138 kV source substation at Big White. It may be necessary to add temporary local generation supply near the resort to adequately serve loads over the next several winters until the new transmission facilities are complete.

The distribution system in Kelowna is generally not adequate to serve the growing loads in the area with reasonable backup capacity. Many feeders within the Kelowna area are already at or near their loading limits and do not have adequate capacity to serve additional point loads caused by the development of new residential subdivisions and commercial facilities such as malls or light industry. Most feeders do not have extra capacity to backup a significant portion of the load fed by adjacent feeders under either planned or emergency situations. In a number of cases fuses have blown under non-contingency loading conditions and must be replaced by higher rated fuses simply to continue serving the connected load, leading to potential loss of fuse coordination and threatening excessive load loss under fault conditions.

3.1.3 Maintenance Assessment

The condition of the Kelowna area transmission facilities is generally acceptable and on average better than some of the much older facilities in other parts of the system. Some protection equipment is outdated or obsolete and is scheduled for replacement in the near term.

The area distribution facilities represent a fairly wide demographic range. The newer facilities in recently developed subdivisions are in generally good condition (as would be expected), but facilities in the older communities, especially those adjacent to the City of Kelowna-owned core area are in mixed condition. As the City grows, the main feeders from the source substations are subjected to increasing loads as new communities are added, but many of the older feeders were originally constructed with small-gauge conductor and are unable to accommodate the extra loading imposed by additional subdivisions. In many cases the structures would not be adequate to carry heavier gauge conductor and would require complete replacement as part of a conductor upgrade.

The structure maintenance program has not been able to keep up with the eight year test cycle and many structures identified as being in poor condition have remained in service out of necessity, or repairs have been rolled forward into future years leading to an ever-increasing backlog of required structure replacements.

3.1.4 Transmission Projects

3.1.4.1 Big White 138 kV Line and Substation

The objective of this project is to accommodate the load growth around the Big White Ski Resort. Presently the load in the area is supplied from the Joe Rich 138 kV substation via a long 25 kV distribution line. According to the new load forecast the Joe Rich substation will be loaded beyond its winter peak rating by 2005/06. Based on the history of recent years the load in the Big White area is expected to continue to grow at approximately 10%-15% for a few more years. The scope of work for this project is under investigation at this time. It is expected the scope will include:

- Integrate a new line (57 Line) into the 138 kV bus at a new Black Mountain substation and Tap the existing 51 Line build, a new 138 kV line approximately 20 km in length from a point near the existing Joe Rich substation using single bundle 397 MCM ACSR conductor to the new Big White substation site.
- Complete the Big White substation and install a new 138/25 kV, 31.5 MVA transformer. A second transformer will be required by 2015 if load growth continues at the present rate. This project will also involve installation of the necessary protection and SCADA equipment at the Big White substation.

3.1.4.2 Ellison Distribution Source Substation

A new 138/13 kV source substation is proposed for construction approximately 5.5 km north of the existing Sexsmith substation.

The Sexsmith distribution substation is a 138/13kV single 32MVA transformer station with 4 feeders. 2004 summer load at Sexsmith was 27MVA or 84% of transformer rating. This substation supplies a large area of north Kelowna including Glenmore Valley to the west, sections of Hwy 97 including the Okanagan University and Kelowna International airport to the north, and Old Vernon Road to the east and north.

Currently underway and planned development in the Clifton/Glenmore Highlands and South and North University areas of over 6,000 residential units(refer to Appendix A-11) will add approximately 1.6 MW's of load to this substation per year. This does not include development in the McKinley Landing area which has not been determined at this point. This will result in capacity limits of Sexsmith being reached as early as 2008. In addition, failure of this single transformer would result in unacceptable long term outages to over 60% of the load currently fed by this substation based on current backup capabilities.

A feeder tie from Sexsmith to Duck Lake can mitigate the shorter term overload issue, however the long term capacity solution requires an additional transformer be installed in the area. Both the long term capacity and backup limitations at Sexsmith could be addressed by adding a second transformer at Sexsmith itself. However with the emerging load center in the North/South University area, the recommended solution is to position an additional source at this new load center allowing offloading of some 15 MVA of existing load plus planned development in this area. Sexsmith substation would then be utilized in conjunction with Glenmore substation to address the current load and growth in the Clifton/Glenmore Highlands development area.

Ultimate build out of this substation should incorporate three transformer bays with nine feeder termination points. Initial build will include a single 32 MVA transformer with four feeder terminations. Two feeders will head south towards Sexsmith, one along Hwy 97 supplying the Airport and University area, and the other south along Old Vernon Road. The third feeder will be the original tie to Duck Lake substation. A future fourth feeder would head west to the McKinley area, then south to create another tie with Sexsmith.

3.1.4.3 Black Mountain Distribution Source Station

A new 138/13 kV source substation is proposed for construction approximately 5 km east of Hollywood substation and 5 km south of Lee substation.

There is currently underway and planned residential development in the combined Black Mountain, Rutland, Tower Ranch and South-East Kelowna areas of over 5,500 residential units (refer to Appendix A-11). This growth will add 16.5 MVA of additional load to the area serviced by Lee and Hollywood substations. Lee 13 kV distribution source is drawn from a tertiary winding off the 230/138 kV 168 MVA main Kelowna area supply transformers. This tertiary supply is then distributed by two 13 kV distribution feeders. Hollywood substation is a typical Kelowna area 138/13 kV dual 32 MVA transformer station with six 13 kV distribution feeders.

2004 summer peak was 13 MVA at Lee substation and 48 MVA at Hollywood substation. Increased reliance on the present Lee tertiary source is not recommended due to increased risk the use of the tertiary for distribution has on these main supply transformers. Current demand on Hollywood is at 75% of total installed capacity with less than full backup capabilities from local and adjacent sources for loss of one of the two transformers. Capacity is limited for further load additions.

Increasing capacity at Hollywood, installing a separate distribution supply transformer at Lee or building a new distribution source are options to serve the existing and new load. The shorter term plan is to incorporate both the Hollywood capacity increase and the new distribution source into the system plan. The development of the Tower Ranch area would drive the addition of a separate distribution supply transformer at Lee but is not considered in this plan at this time. The immediate recommendation is to add an additional distribution source substation in the Black Mountain area where over 50% of the new growth load center is located. This source would serve this area as well as supply backup capabilities back into the central Kelowna area currently served by the Hollywood substation. The development of a substation at this site also benefits the Big White Supply project by creating a suitable tap location for the Big White transmission line described in separately.

3.1.4.4 Fault Level Reduction

Fifteen existing substations have fault levels at the distribution bus in excess of acceptable levels presenting a safety risk to workers and the public. A program to limit fault levels at these stations by installing current limiting reactors will be initiated immediately.

3.1.4.5 Loop Kelowna 138 kV Circuits

This project involves a number of breaker additions, bus modifications and the installation of new short line protections and associated communications to enable operating the 138 kV subtransmission in Kelowna as a looped network. This project will begin in 2006 and be complete by 2009.

3.1.4.6 Recreation Capacity Upgrade

The wholesale municipal distribution load served by the Recreation substation near the downtown lakefront district in Kelowna is growing at a rate significantly greater than system average. Several 20+ storey residential and commercial buildings have recently been proposed for this area but are pending rezoning and relaxation of the Kelowna building height restrictions before they can proceed. These proposals are in addition to either constructed or in progress of construction of several 10+ story residential complexes and numerous civic, commercial and institutional developments in this core area of the City. The scope of this project is to install a new 138/13 kV distribution transformer, and associated protection.

3.1.4.7 Hollywood Capacity Upgrade

The distribution load served from the Hollywood substation is increasing rapidly due to commercial developments and higher density housing projects. The scope of this project is to install a new 138/13 kV distribution transformer, and associated protection.

3.1.4.8 Braeloch (SW) Kelowna Distribution Source Substation

Distribution loads are growing rapidly southwest of Bell Terminal with several large subdivisions currently underway and more planned for a 10-15 year time frame. In the longer term a new source substation will be constructed to serve this area and provide backup to the Bell Terminal distribution loads. The scope of this project is to install a new 138/13 kV distribution transformer, a new 138 kV transmission line from Bell Terminal, and associated switchgear and protection.

3.1.4.9 OK Mission Capacity Upgrade

The distribution load served from OK Mission substation (Mission) is growing and will overload the existing transformers beyond 2010, especially when providing backup to adjacent distribution stations. The scope of this project is to install a new 138/13 kV distribution transformer, and associated protection.

3.1.5 Distribution Growth Projects

3.1.5.1 Duck Lake to Sexsmith Feeder Tie

In conjunction with the planned new Ellison distribution source in north Kelowna, a feeder tie from Sexsmith to Duck Lake will provide interim relief to the area loading issues. When the Ellison supply is completed, this tie will form part of the feeder network.

3.1.5.2 Quail Development Loopfeed

The Quail residential development in north Kelowna is growing at a rate which will soon exceed the capacity of the existing radial primary system supplying the area. A second supply into this area is required.

3.1.5.3 Dilworth Development Loopfeed

The Dilworth Mountain residential development in central Kelowna is creating load growth which exceeds the capacity of the existing radial primary system supplying the area. A second supply into this area is required.

3.1.5.4 Mission Feeder 5 to Mission Feeder 4 Extend to Springfield (Tie to Glenmore Feeder 1)

Load growth in the Mission Feeder 4 and Glenmore Feeder 1 areas is substantially eroding both capacity and backup capabilities of these two feeders. An extension of Mission Feeder 5 along Richter to Springfield tying into Glenmore Feeder 1 will allow splitting of the Guishachan load centre and also provide backup to both feeders and sources.

3.1.5.5 Bell Feeder 2 to Mission Feeder 3 Tie

In conjunction with the planned new distribution source in south west Kelowna, a feeder tie from Bell Terminal to Mission substation between Bell Feeder 2 and Mission Feeder 3 will provide interim relief to the area loading issues. When the Southwest Kelowna supply is completed, this tie will form part of the feeder network.

3.1.5.6 Glenmore Feeder 5 - Sexsmith Feeder 2 Tie Add Normally Open

With completion of a City four lane project along Glenmore Drive, a tie between Glenmore Feeder 5 and Sexsmith Feeder 3 can be completed. A new Normally Open (N.O.) point will be established along Sexsmith Feeder 3 to transfer additional load from Sexsmith to Glenmore substations to support the interim offloading of the highly loaded Sexsmith substation. This tie will also provide operational load transfer capabilities

3.1.5.7 Kelowna Feeder Protection

As load has steadily increased on feeders in the Kelowna area, fuse sizes on feeder taps have been increased accordingly. Overloading and mis-coordination of fuses with

upstream devices has become an increasing problem. To resolve the issue will require combinations of load splitting and protection upgrades on a number of feeders.

3.1.5.8 McKinley Landing Capacity Upgrade

McKinley Landing is situated in the northwest corner of the Kelowna service area along the Okanagan Lake. Load growth in this area will exceed existing supply capacity by 2007, requiring a rebuild of the current distribution supply to higher capacity. A future feeder from the proposed Ellison source is planned into this area along with a tie to Glenmore Feeder 5 and Glenmore Feeder 6 through Clifton as load grows in this area.

3.1.5.9 New Glenmore Feeder 6 (50 Line Under Build High Road to Clifton)

A combination of high load growth in the Magic Estates, Clifton, and Glenmore Highlands development areas will exceed existing distribution supply capabilities by 2008. A new feeder from Glenmore substation into the Clifton area is required. This feeder will also tie through to McKinley Landing.

3.1.5.10 Hollywood Feeder 1 to Lee Feeder 2 Tie

In conjunction with the planned new distribution source in the Black Mountain area, a feeder tie from Hollywood substation to Lee Terminal between Hollywood Feeder 1 and Lee Feeder 2 will provide interim relief to the supply issues in the Gallagher area. When the Black Mountain supply is completed, this tie will form part of the feeder network.

3.1.5.11 Hollywood Feeder 1 to Mission Feeder 1 Tie along KLO Rd

The area between Rose Road, Gordon Road, KLO, and Springfield has heavy development on its boundaries and therefore contains ties between several major feeders including Hollywood Feeder 1, Mission Feeder 1, Mission Feeder 4, Glenmore Feeder 2, Bell Feeder 3 and Hollywood Feeder 7. These ties, other than a section along Benvoulin Road are generally small gauge conductor. As loading issues arise in the perimeter areas, upgrading these ties to a larger gauge will provide improved transfer capabilities between substations and offer operational flexibility. The Hollywood Feeder 1 to Mission Feeder 1 tie would provide a means to transfer significant load from Hollywood to Mission substations or Bell Terminal stations.

3.1.5.12 McKinley to Clifton Tie

Implementation of the McKinley Capacity Upgrade project and new Glenmore feeder to Clifton will provide an opportunity to close the two feeders between Glenmore and Sexsmith substations providing supply redundancy into the area. This tie would be built when a narrow gap between the two areas is developed.

3.1.5.13 Lee Feeder 2 to Hollywood Feeder 5 Tie

In conjunction with the planned new distribution source in the Black Mountain area, a feeder tie from Hollywood to Black Mountain between Hollywood Feeder 5 and Lee Feeder 2 will provide source transfer and feeder backup capabilities between the two substations and feeders.

3.1.5.14 Reterminate Lee Feeders

This project is required to offload the 13 kV tertiary on the 230/138 kV system transformer at Lee to reduce the system risk due to distribution faults. Ultimately the loads presently served by the Lee system transformer will be entirely fed from the new Ellison source, the new Black Mountain source and the existing Sexsmith and Hollywood sources.

3.1.5.15 New Feeder Ellison Substation

Ongoing high levels of load growth in north Kelowna will drive the need for a fourth feeder in this area, to be fed from the planned Ellison source.

3.1.5.16 Future Kelowna Distribution Upgrades

Assuming load growth in the general Kelowna area continues to grow at 3% per year, an equivalent of one additional source feeder and associated ties per year are required to maintain pace. The precise location and tie configurations will be dependent on the rate of growth in each of the development areas. Initial indications are that additional feeders would most likely be required out of Mission substation and Bell Terminal.

3.2 Penticton – Summerland Area

3.2.1 Existing Transmission and Distribution System

The Transmission system in the Penticton - Summerland area primarily consists of 63 kV subtransmission circuits fed from the 230 kV and 161 kV bulk system at RG Anderson Terminal in the City of Penticton, with alternate supply from the 161 kV Oliver Terminal to the south.

Naramata and Westminster substations are served radially via 45 Line, a single 63 kV line emanating from Anderson Terminal. The mixed urban and rural loads at Summerland, Trout Creek and West Bench are served from a radial 63 kV line (49 Line) out of Huth substation. Under normal system operating conditions, these loads are essentially being served via the BC Hydro's Vernon 230 kV interconnection from the north as 161 kV 40 Line at Anderson and 63 kV lines 41 Line and 42 Line between Huth and Oliver are typically operated in an open configuration.

A series of small distribution substations are connected to either 41 Line and 42 Line south of Penticton, including Waterford, Kaleden and OK Falls.

3.2.2 Penticton - Summerland Area System Deficiencies

Summerland, Trout Creek and West Bench loads are radially fed from the Huth substation via 49 Line. An alternate supply is required to provide a backup to the loads in the area to increase reliability.

The Huth substation is a legacy substation with most major switching equipment at or near end of service life. The existing configuration of Huth does not enable automatic sectionalizing of the various 63 kV subtransmission circuits which terminate there, leading to multiple element losses for many single events. A substantial reconfiguration of this substation is required to adequately serve the growing South Okanagan valley loads fed from the networked subtransmission system via Huth substation.

3.2.3 Maintenance Assessment

Naramata substation is in need of major rehabilitation of the 63 kV switching facilities, 13 kV switchgear, station civil and station security. The station switch structures and equipment structures have degraded to the point of being unsafe. The station ground grid and security fence are identified by the condition assessment as in need of repair. The mobile substation, which is required for maintenance and emergency supply, cannot be parked at the existing site and no further property can be acquired adjacent to the existing site. The transformer tap changer has failed frequently and has reached the end of service life based on recent maintenance inspections.

As mentioned in Section 3.2.2, Huth substation is a legacy substation with most major equipment, and especially the 63 kV breakers, at or near end of useful service life. A complete replacement of the Huth breaker equipment should be carried out in combination with the planned reconfiguration of the substation into a proper 63 kV ring bus.

3.2.4 Transmission Projects

3.2.4.1 Waterford Substation Upgrade

The Waterford Distribution Source Substation requires increased transformer capacity to serve growing 13 kV loads in Penticton, as the city continues to upgrade from 8 kV to 13 kV. It is proposed to replace the existing 15 MVA transformer with a 25 MVA unit.

3.2.4.2 Naramata Substation Replacement

The scope of the project involves a complete rebuild of the existing substation, including a new 63/13 kV, 12/16/20 MVA transformer and ultimate accommodation for three distribution feeders, with two distribution feeders connected initially. The new 63 kV and 13 kV switching structures and equipment structures will meet modern clearance standards, and will accommodate mobile substation access and connection. A new control building will house metering, communication and protection equipment.

3.2.4.3 Summerland 63 kV Backup

A 16 km radial line (49 Line) from the Huth 63 kV substation supplies the Summerland, Trout Creek and West Bench loads. A previous project to upgrade 49 Line has increased its capacity and reduced exposure to equipment failures as a main cause of line faults. The objective of this new project is to provide a supply backup to the loads in the area and further reduce the average duration of supply interruptions and increase the reliability. The two options presently under consideration are:

- Build a new 63 kV line approximately 12 km in length using 477 MCM ACSR conductor, from Huth to Trout Creek substation. For the new line, install 63 kV line termination at Huth substation. Further, provide remote controlled line switches at West Bench and Trout Creek.
- Build a new 63 kV line approximately 16 km in length using 477 MCM ACSR conductor, from Huth to Summerland substation. For the new line, install 63 kV line termination at Huth substation. Further, provide remote controlled line switches at West Bench and Trout Creek and Summerland.

3.2.4.4 Huth Substation Rebuild

This project will involve a complete rebuild of the existing 63 kV bus and line terminations at Huth substation, including replacement of all 63 kV breakers and switches and reconfiguration of the 63 kV bus into a ring bus configuration. An alternative project which has been considered would involve eliminating the 49 Line termination at Huth and bypassing the substation to terminate 49 Line directly at Anderson Terminal. Huth would be reconfigured as a tapped 63/13 kV distribution source substation fed via taps from 52 Line and 53 Line. This simpler configuration would be a lower cost alternative, but would not provide the same flexibility and reliability as the full ring bus configuration. This project is scheduled to start in 2010

3.2.4.5 Westminster Transformer 1 Replacement

This transformer has been identified as requiring replacement. It forms part of the transformer rehabilitation and replacement program.

3.2.4.6 Trout Creek Transformer 1 Rehabilitation

This transformer has been identified as requiring rehabilitation. It forms part of the transformer rehabilitation and replacement program.

3.2.5 Distribution Growth Projects

3.2.5.1 West Bench Feeder 1 Regulator

West Bench Feeder 1 voltage is at the lower planning limit. A voltage regulator will be required on this feeder to maintain acceptable system voltage.

3.3 Oliver – Osoyoos Area

3.3.1 Existing Transmission and Distribution System

The local transmission network operates at three distinct nominal voltage levels: 161 kV, 138 kV and 63 kV. With the completion of the South Okanagan Supply Reinforcement Project, a fourth transmission voltage level, 230 kV, will be added to the mix. This set of voltages requires a more complex transmission network than is necessary to adequately serve the South Okanagan, and it would be desirable to eliminate the 161 kV voltage level in the longer term.

Most of the distribution source substations in the area are served at the 63 kV subtransmission voltage level, with the exception of the Oliver source, where the 13 kV distribution system is fed from the tertiary winding of the 161/63 kV transformer.

Most of the distribution source substations in the area are served at the 63 kV subtransmission voltage level, with the exception of the Oliver source, where the 13 kV distribution system is fed from the tertiary winding of the 161/63 kV transformer.

3.3.2 Oliver – Osoyoos Area System Deficiencies

Distribution

Loads in Oliver and Osoyoos are growing rapidly, predominantly due to in-migration from urban centres outside of the Okanagan. The rate of in-migration is expected to continue or increase over the forecast period, producing ongoing load growth well above the system average.

In 2004 over 600 residential were completed or started within the Town of Osoyoos. Another 300 residential units are underway and expected to be on stream over the next two to three years. Phase 1 of the Osoyoos Indian Band's Spirit Ridge development on the north-east boundary of Osoyoos is underway with at least 800 kVA of committed load installed at present.(refer to drawing A-7) By the summer of 2005, the load on the east side of Osoyoos will have exceeded the capacity of the single 13 kV feeder supplying this area.

Population centers such as Osoyoos are considered for loop fed transmission supply. Currently Osoyoos and areas south of Oliver serviced by Pine Street substation are fed radially at 60 kV on 44 Line. The Oliver area can be backed up by distribution but loss of 44 Line would result in complete load shedding of Osoyoos. Additionally, the failure of one of the two existing 63/13 kV 15 MVA distribution transformers in Osoyoos will result in load shedding because the remaining transformer is not capable of carrying the combined area load.

2004 summer peak demand on the Osoyoos substation was 21 MVA with 2.6 MVA of additional load expected in 2005 and future yearly additions of up to 1.5 MVA. Total load in the Osoyoos area is forecast to reach 30 MVA by 2009 exceeding presently installed transformer capacity.

Transmission

The existing Oliver Terminal station is not large enough to accommodate the planned future termination of a 230 kV circuit from Vaseux Lake Terminal. It would not be suggested to add another voltage level to this station in any case, given that it already has 161 kV, 138 kV, 63 kV and 13 kV buses, and access for a new line at a different voltage level would be impractical. Among the possible alternatives to address this limitation would be to eliminate the 161 kV voltage level. The transformation from 230 kV to 138 kV could happen either at the Vaseux Lake Terminal (if the footprint is adequate for a third bus voltage) or at a new Oliver Terminal station. Regardless of which alternative is ultimately selected, the Oliver distribution load should be served by a dedicated 63/13 kV transformer to reduce risk to the system transformer.

3.3.3 Maintenance Assessment

The condition of transmission facilities in this area is generally acceptable with a few specific areas of concern. Several Moloney tapchanging transformers have been identified for rehabilitation or replacement in the near future. The 63 kV subtransmission circuit 42 Line between Huth and Oliver is in need of rehabilitation. 42 Line has been kept in service mainly as a backup to 41 Line which is the primary subtransmission line in the area. If 42 Line is ultimately rebuilt to modern standards it may be prudent to use taller poles to enable suspension of an All Dielectric Self Supporting (ADSS) fibre optic cable between Vaseux Lake and Anderson Terminals to replace the ADSS which will be initially strung on 40 Line to enable initial energization of Vaseux Lake Terminal in 2005.

The existing transformers in the Osoyoos distribution source substation are both rated as condition 4 (immediate rehabilitation required) based on dissolved gas analysis. These transformers should be evaluated for their condition. They are both Moloney transformers which are known for leaking tapchangers.

3.3.4 Transmission Projects

3.3.4.1 New East Osoyoos Substation

To address the Osoyoos area supply deficiencies a new East Osoyoos 138/63/13 kV source substation is proposed in east Osoyoos. The station will be fed via a new 15 km 138 kV line from the new Bentley Terminal and a 60 kV tie to 44 Line (Appendix A7)

Ultimate layout of the substation would include two distribution supply transformers with capabilities to terminate up to six 13 kV distribution feeders. Initially one transformer and three feeder terminations will be installed supplying the east Osoyoos and Anarchist mountain areas as well as tying back to the west Osoyoos substation via 13 kV feeder tie.

The alternative is to increase station capacity in west Osoyoos either at the existing site or a new location. Additional distribution feeders across the causeway would be required to supply east Osoyoos. As the bulk of the growing load center is emerging on the east side of Osoyoos and there is more direct access to the Oliver area 138 kV source, the preferred alternative is to locate the new source substation on the east side of the town.

3.3.4.2 West Osoyoos Transformer Rehabilitation

The Osoyoos transformers are Moloney transformers. It is typical that these transformers have broken barriers between the tapchanger compartment and the main

transformer tank. There is a requirement to assess the condition of the two transformers to ensure that the gassing that is occurring in the transformers is from this type of leak or determine if the gas is coming from and internal fault in the transformer. It is expected that one transformer will require replacement and one will require rehabilitation.

3.3.4.3 Rebuild Oliver as Distribution Source Substation

With the transfer of the 138 kV, 161 kV and 230 kV buses to the new Bentley Terminal Station, the existing Oliver Terminal station will be converted to a 138/63/13 kV subtransmission and distribution source substation, with allowance for possible future 13 kV feeders. The initial configuration will utilize the existing 161/63/13 kV Transformer 2 to supply the 13 kV distribution circuits from the 63 kV bus, with the 161 kV terminals capped. Similarly, the 161 kV terminals will be capped on the existing 161/138/63 kV transformer.

3.3.4.4 Rebuild Pine Street Transformer 1

This transformer has been identified as requiring rehabilitation. It forms part of the transformer rehabilitation and replacement program.

3.3.5 Distribution Growth Projects

3.3.5.1 Three Phase 4.4 km Osoyoos Feeder 2

A single phase tap currently supplying the Anarchist Mountain area is excessively loaded, causing voltage regulation and protection issues, and creating high phase current unbalance. Rebuilding this line section to Three Phase will address the voltage, load balance and protection concerns on this line. This line rebuild will be integrated with the new east Osoyoos supply and Boundary area supply projects.

3.3.5.2 New Osoyoos Feeder 4 to East Osoyoos

Load growth in east Osoyoos is exceeding the capacity of the single feeder currently supplying the area. A second 13 kV distribution feeder from the Osoyoos substation will provide the required capacity. This feeder will be integrated into the East Osoyoos supply project planned for the area.

3.3.5.3 25 kV Tie to Bridesville

As load develops in the Bridesville area, a tie from the new East Osoyoos source to the Boundary area would provide capacity and load transfer capabilities between the two

areas. Because of the difference in distribution nominal voltages, the tie would also include a 13 kV to 25 kV stepdown transformer.

3.4 Princeton – Keremeos (Similkameen) Area

3.4.1 Existing Transmission and Distribution System

The Similkameen Valley load centres of Princeton, Mascot Mines, Hedley and Keremeos are interconnected by 138 kV transmission circuit 43 Line. The Princeton load is normally supplied from BC Hydro's Nicola Terminal via 138 kV circuit 56 Line, and 43 Line is opened at Keremeos. Under specific loading, seasonal generation and power exchange situations 56 Line is opened and the Princeton load is fed by 43 Line from Oliver.

3.4.2 Princeton – Keremeos Area System Deficiencies

Princeton was historically the most distant load centre supplied from the Kootenay generation area via internal FortisBC transmission (11 Line and 43 Line). Service reliability was typically poor as any outage along this lengthy radial supply path would cause an outage at Princeton. With the interconnection of the Princeton substation to BC Hydro's Nicola Terminal via 56 Line and the typical operating configuration with 43 Line opened at Keremeos, the reliability of supply at Princeton increased significantly.

The completion of the South Okanagan Supply Reinforcement Project will dramatically shorten the supply path from the east to the Similkameen loads. 43 Line is not presently configured for networked operation between Oliver and Nicola. Operating 43 Line network configuration does not help support the South Okanagan area during a major outage.

The loss of the Vaseux Lake Terminal due to transformer failure or a BC Hydro 500 kV outage would result in the need to automatically shed loads to avoid a voltage collapse in the South Okanagan. The installation of a load shed remedial action scheme is required to shed the required amount of load and keep the system stable.

Princeton Light and Power is expanding the 25 kV system north along Hwy 5A. This 25 kV system is presently supplied by a 13/25 kV step-up bank in the field. This configuration will be optimized by upgrading to dual secondary voltage (13 and 25 kV) transformers at Princeton, facilitating the ongoing expansion of the 25 kV distribution system similar to the proposed upgrades for the Boundary area.

3.4.3 Maintenance Assessment

43 Line which connects Oliver to Keremeos and Princeton is in generally good condition. Several of the source substations in the Similkameen valley are very old and require extensive condition assessments.

Many of the distribution circuits in the Town of Keremeos, in the village of Hedley and throughout the Similkameen valley are at or near end of service life and will require extensive rehabilitation over the next several years. The old lines on 10th Avenue from Boundary Road east to 5th Street and 11th Avenue in Keremeos need to be rebuilt for condition-related reasons (old copper, poles are time-expired), as should the 10th Street and 11th Street distribution lines. The Town of Keremeos wants to widen the 10th Street roadway in 2005 and would like to coordinate that project with FortisBC's planned activities. They would like to see the poles relocated to the south side of the road where the Telus poles are presently located. The existing facilities are at end of service life.

Several trespass issues (inadequate easements or rights-of-way) in the Similkameen area have been addressed over the last few years, although a number of trespass situations still exist which may require facility relocation or right of way negotiations.

3.4.4 Transmission Projects

3.4.4.1 Princeton Reconfiguration and Transformer Replacements

The Princeton source substation is no longer supplied at 63 kV, enabling reconfiguration to a 138/25/13 kV arrangement including salvage and relocation of any remaining 63 kV major equipment which is still in good service condition. This project requires the installation of two 138/25/13 kV 20/30/40 MVA transformers to supply both Princeton and FortisBC distribution loads. The existing Princeton transformers may form the starting point of the transformer rehabilitation and replacement program since, depending upon their condition, they will become spares. This project will also address deficiencies in the 138 kV switches and 56 Line breaker.

3.4.5 Distribution Growth Projects

3.4.5.1 Keremeos Feeder

Load on Keremeos Feeder 2 is reaching the thermal limit. Operational transfer of this load to adjacent feeders is limited. A third feeder is required in the area to meet capacity needs.

4 Kootenay Region Transmission and Distribution Systems

A geographically referenced system map of the FortisBC Kootenay Region is included in Appendix A as Map 4.

4.1 Castlegar Area

4.1.1 Existing Transmission and Distribution System

Castlegar is located amid an intensive concentration of hydro electric generating plants on the Kootenay and Columbia Rivers, and the high voltage transmission system in the area is primarily designed to move the locally generated power to more remote load centres.

Loads in the Castlegar area are served from the 63 kV subtransmission system primarily 6 Line and 26 Line. Following completion of the Kootenay 230 kV System Development Project which now links the generation systems at South Slocan and Brilliant to the Warfield Terminal Station near Trail and BC Hydro's Selkirk 500 kV Terminal there were as many as eight parallel 63 kV circuits in the Columbia Valley between Castlegar and Trail. These circuits are now de-energized and are in the process of being salvaged. The remaining 63 kV lines are used to supply the distribution source substation at Castlegar as well as nearby source stations at Tarrys north east of Castlegar and the Blueberry source south of Castlegar, in addition to the industrial loads at the Celgar Pulp Mill and the Pope and Talbot sawmill.

Close proximity to the generating plants keeps Castlegar area supply secure and transmission voltages stable, except in cases where the main interconnections are lost with the external network. To prevent extreme over voltage and over frequency events under such circumstances, several automatic generation shedding RAS have been implemented.

4.1.2 Castlegar Area System Deficiencies

Generally the power system in the Castlegar area is secure due to the proximity of significant local generation and a fairly robust transmission grid. Most area transmission outages are caused by structure failures, tree falls and insulation failures on the older vintage 63 kV subtransmission facilities. Reliability could be enhanced by installing remotely operable Motor Operated Disconnect Switches (MODs) at several 63 kV distribution source stations, including Castlegar, Blueberry and Tarrys.

Due to phase mismatches in the local distribution system it is presently not possible to back up the distribution circuits between Castlegar and the adjacent distribution system at Tarrys.

Correcting the problem will involve reconnecting the transformer drops requiring an concurrent outages at Castlegar and Blueberry to enable ongoing load backup between the two stations.

4.1.3 Maintenance Assessment

The remaining 63 kV subtransmission facilities in the area were originally constructed in the late 1950's, and although substantial sustaining investments have been made over the years, a significant number of deteriorated poles, crossarms and insulators still remain in service in the area.

The distribution system in the area is generally in acceptable condition, and the ongoing eight year pole testing and repair program will be adequate to keep the facilities in good operating condition.

4.1.4 Capital Projects

4.1.4.1 Castlegar Capacity Upgrade

A capacity upgrade will be required at the Castlegar distribution source substation. A second transformer will be installed as a capacity upgrade, that being the rehabilitated Princeton Transformer 3. This will allow the existing Castlegar Transformer 1 to be taken off-line and rehabilitated.

4.1.4.2 Correct Transformer Connections at Castlegar and Blueberry

This project will correct the historical misconnections of the transformers at these stations, enabling backup between all the distribution sources in the area.

4.1.4.3 Add MODs and Communications Castlegar and Blueberry

This project involves addition of motorized disconnects, associated communications and controls at the Castlegar and Blueberry distribution source stations to enable remote sectionalizing and load restoration for permanent faults on the 63 kV system, to significantly reduce outage durations. This project will occur in 2008 and 2009.

4.2 Crawford Bay Area

4.2.1 Existing Transmission and Distribution System

Crawford Bay is served by 161 kV circuit 30 Line which interconnects South Slocan, Coffee Creek, Crawford Bay, and Kimberley, and from Creston in the south via 63 kV circuit 32 Line. The Terminal is configured with 161 kV, 63 kV and 13 kV simple buses, with a single 20 MVA transformer connecting the 161 kV and 63 kV buses, and separate 2.5 MVA and 1.5 MVA transformers feeding the area 13 kV distribution loads.

4.2.2 Crawford Bay Area System Deficiencies

The 1.5 MVA 63/13 kV Transformer 3 in the Crawford Bay Terminal is overloaded. It is proposed that this transformer can be replaced with one of the spare transformers coming from the Boundary area re-configuration. This project will also address the replacement of the 32 Line breaker and associated switches.

The Crawford Bay area is subjected to inadequate voltages when supplied from the south via 32 Line following forced outages to either 30 Line or the 20 MVA 161/63 kV transformer which ties Crawford Bay to 30 Line.

4.2.3 Maintenance Assessment

32 Line between AA Lambert (Lambert) and Crawford Bay Terminals requires significant ongoing maintenance efforts to be kept in a serviceable condition. Many of the structures are presently stubbed, crossarms have often been replaced due to extreme deterioration while the related poles have been left in place. The facilities are subjected to frequent tree falls and landslides due to the narrow shore space between Kootenay Lake and the adjacent steep mountain slopes. The narrow and winding shore is shared with Highway 3A, further compromising the right-of-way.

4.2.4 Transmission Projects

4.2.4.1 Crawford Bay Capacity Increase and Grounding Bank

The Crawford Bay Terminal distribution load has gradually grown over time to the point where, by 2005, the failure of one of the two existing distribution transformers will result in load shedding because the remaining transformer is not capable of carrying the remaining load. There is no distribution backup from any other location.

The scope of this project is to install a transformer that has been made redundant by the Boundary area re-configuration. This project will also address the replacement of the 32 Line breaker and switches and associated protection.

4.2.4.2 Replace Crawford Bay Transformer 1

The Crawford Bay Transformer 1 has a long history of hydrogen gassing. This transformer may be replaced by one of the 161/63 kV transformers coming available from the Boundary area upgrades or it may be replaced with an upgrade to the Kootenay Lake crossing so that the Crawford area is only served at 63 kV. Further studies are required to choose the best option and this must be combined with the above capacity increase project because there are efficiencies to doing so. A single 161/63/13 kV transformer may be sufficient to accomplish the need for Crawford Bay.

4.3 Creston – Wynndel Area

4.3.1 Existing Transmission and Distribution System

The Creston area is primarily served from the BC Hydro 230 kV system via a 230/63 kV transformer at the Lambert Terminal station. Outages to the 230 kV BC Hydro transmission line 2L294, or the 230/63 kV transformer at Lambert, result in loss of service to most Creston area load.

Backup supply to Creston is notionally provided by 63 kV circuit 32 Line, described in more detail in the previous Crawford Bay section.

The distribution system in the Creston area is also very old, phase identification is inaccurate and requires verification, and the phases are typically poorly balanced. The existing Wynndel substation is in an advanced state of deterioration and is scheduled to be salvaged, with all Wynndel loads slated to be transferred to either the Creston substation or Lambert Terminal station.

4.3.2 Creston – Wynndel Area System Deficiencies

It is not possible to provide backup to all Creston area loads via 63 kV circuit 32 Line. Voltage levels cannot be maintained when the entire Creston area load is served from Crawford Bay. It would be necessary to upgrade 32 Line to either 138 kV or 161 kV to enable complete backup of Creston for loss of either BC Hydro circuit 2L294 or the 230/63 kV transformer Lambert Transformer 1.

4.3.3 Maintenance Assessment

The existing Wynndel 63/13 kV distribution source substation is in advanced deterioration and will be salvaged in 2005 in conjunction with the Lambert upgrade.

The distribution facilities in the Creston area are typically very old with specific sections in need of substantial rebuild.

4.3.4 Transmission Projects

4.3.4.1 230 kV Ring Bus and New Transformer at Lambert Terminal

To provide backup supply to the City of Creston, it is proposed that a second 230/63 kV 90 MVA transformer bank be installed in Lambert Terminal station. The 230 kV bus will be re-arranged into a ring bus configuration with the addition of three 230 kV breakers. This configuration will enable secure provision of Creston area loads under N-1 contingencies. An alternative configuration to be considered for this project would involve adding a fourth single phase transformer as a backup to the existing three single phase transformers which comprise the present 230/63 kV bank, with associated transfer bus and switching arrangement.

4.3.4.2 Crawford Bay – Creston 32 Line Rehabilitation

63 kV circuit 32 Line requires comprehensive rehabilitation to be kept in service. Approximately 50% of the structures require replacement or reinforcement based on the most recent condition assessment.

In the last Master Plan issued in 1998 it was recommended to upgrade 32 Line to a higher nominal voltage to enable Creston backup via an internal FortisBC circuit, thereby avoiding the anticipated longer term operating cost impact due to wheeling tariff increases into Lambert Terminal. With the stabilization of wheeling costs agreed to under the Vaseux Lake agreement with BC Hydro the operating cost differential has been substantially reduced, and the most economical overall solution to providing adequate backup to Creston is the Lambert Terminal 230 kV ring bus and second transformer alternative recommended above.

4.3.5 Distribution Projects

4.3.5.1 Creston Area Distribution Feeder Upgrades

The Wynndel distribution source station is currently being replaced by a new distribution source at Lambert Terminal, requiring a number of distribution network upgrades. The existing two feeders out of Wynndel will be replaced by two feeders from Lambert Terminal north to the load area previously served by Wynndel. To address the main Creston area distribution feeder and station backup issues another two feeders will be built from Lambert Terminal to tie into the current Creston feeder network.

4.4 Grand Forks – Boundary Area

4.4.1 Existing Transmission and Distribution System

The transmission system serving the Boundary area consists of a 161 kV circuit 11 Line which is terminated in the Kootenays at Mawdsley Terminal (and from there into Warfield Terminal via a short 63 kV connector) and in the Okanagan at Oliver Terminal. 11 Line is connected to the simple 161 kV bus at Grand Forks Terminal, and supports the underlying 63 kV subtransmission system via a 60 MVA 161/63 kV transformer. A geographically referenced map of the FortisBC Boundary area system is provided in Appendix A as Map 5.

The subtransmission system consists primarily of two 63 kV circuits, 9 Line and 10 Line, which run parallel with 11 Line from Warfield Terminal station to Rock Creek. From that point westward 9 Line has been salvaged, and 10 Line continues to feed the 2.4 kV delta connected loads at Baldy resort and the McKinney microwave site. Remnants of 10 Line still exist on the old right-of-way west of McKinney.

4.4.2 Grand Forks – Boundary Area System Deficiencies

Service reliability in the Boundary area has been below system average in part due to the deteriorated condition of the subtransmission facilities and the extreme geography which they traverse. 9 Line and 10 Line cross high elevations between Paterson and Christina Lake, and between Grand Forks and Greenwood. 10 Line goes over high elevations west of Rock Creek to its effective present termination at McKinney. Outages due to harsh weather and tree falls are common during the winter season, and it is not unusual for both circuits to be affected simultaneously on the high elevation sections.

The resort distribution system needs to be converted to a grounded Y-connected 25 kV system to reduce the safety risk posed by the existing 2.4 kV delta-configuration. The system can be served by converting 63 kV circuit 10 Line to 25 kV from the new Kettle Valley 161/25 kV distribution source near Rock Creek.

Under the existing system configuration it is not possible to serve all the Boundary Area loads following outages to 11 Line between Mawdsley and Grand Forks Terminal stations. Most of the Boundary area load is immediately lost for 11 Line outages between Mawdsley and Grand Forks Terminals because 9 Line and 10 Line are normally operated open between Christina Lake and Paterson. For extended 11 Line outages it is possible to restore service to some Boundary loads by closing the Paterson to Christina Lake segments of 9 Line and 10 Line but 9 Line and 10 Line together are inadequate to serve all Boundary area loads from the Trail end. At a minimum all loads west of Grand Forks need to remain disconnected until 11 Line can be restored. This situation will change following completion of the South Okanagan Supply Reinforcement Project, since it will then be possible to feed Grand Forks Terminal from either the Okanagan or the Kootenay systems.

4.4.3 Maintenance Assessment

9 Line and 10 Line were originally constructed in 1919, and although extensive maintenance has been performed over the years, many segments of these facilities have effectively reached the end of their expected service lives. Significant portions of these facilities will require accelerated sustaining investments to be kept in service throughout the forecast period of this System Development Plan, making them prime candidates for either complete rebuild or salvage.

Several of the 63 kV distribution source substations in the Boundary Area are also at or near the end of their expected service lives such as Baldy, Midway, Rock Creek, Ruckles, and Greenwood. Some equipment and structures are in advanced states of deterioration, and individual pieces of major equipment have been in service for more than 70 years. A Midway substation rebuild was planned for 2005 but has been replaced with the new Kettle Valley substation project.

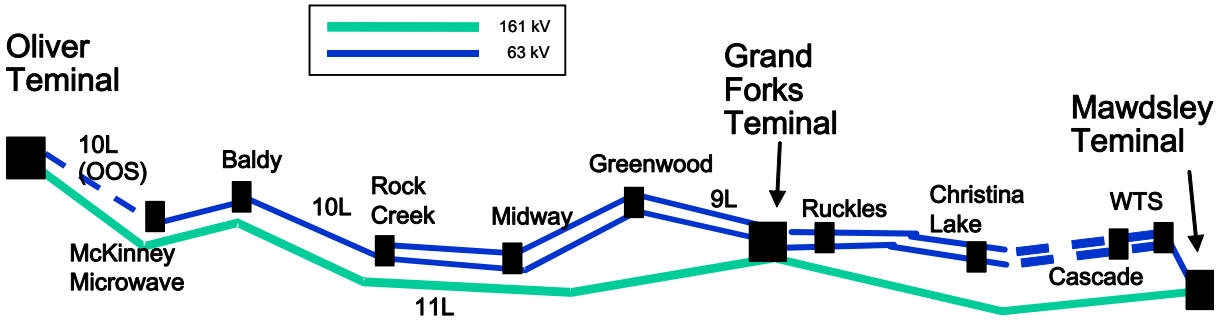
4.4.4 Transmission Projects

4.4.4.1 New Kettle Valley and Grand Forks 161/25 kV Distribution Source Substations

Given growing area loads and the deteriorated condition of 9 Line and 10 Line and the 63 kV legacy distribution source substations between Christina Lake and McKinney Microwave, two new 161/25 kV distribution sources will be constructed. One will require new property in the Rock Creek area while the other will reside at the existing Grand Forks Terminal. These new sources will serve the distribution loads west to Anarchist Mountain and east to Christina Lake, requiring some immediate upgrades of the existing 13 kV distribution systems.

As an interim step the existing 13 kV small urban load centres such as Midway Greenwood and Christina Lake will be served using 25/13 kV step down transformers fed by the newly upgraded 25 kV main feeders. The ultimate configuration will enable 25 kV backup west of Kettle Valley from the new East Osoyoos distribution source, and east of Grand Forks and Christina Lake from the existing 25 kV system at Cascade substation in Rossland. These new 161 kV/25 kV stations will be configured for In/Out 161 kV supply with automatic breaker sectionalising, and dual transformers to enable full distribution load backup for transformer outages. See Figure 4.4 A, B C and for project staging.

Figure 4.4 A: Existing Boundary Area Configuration



Kettle Valley Distribution Source

The above mentioned west Boundary deficiencies and growth patterns mandate the Kettle Valley substation be developed first and will consist of two 30 MVA transformers connected by a meshed bus to 11 Line. The station will initially provide four 25 kV distribution feeders.

Figure 4.4 B: Add Kettle Valley 161/25 kV Source Station

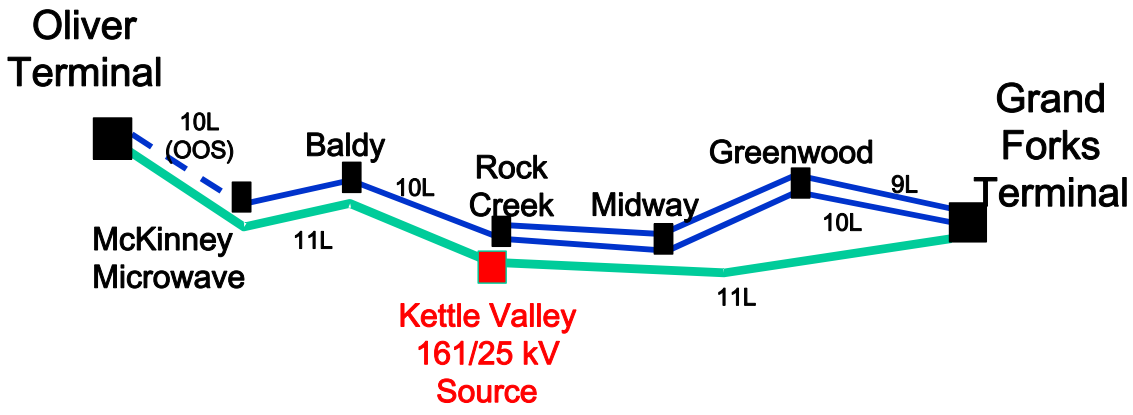
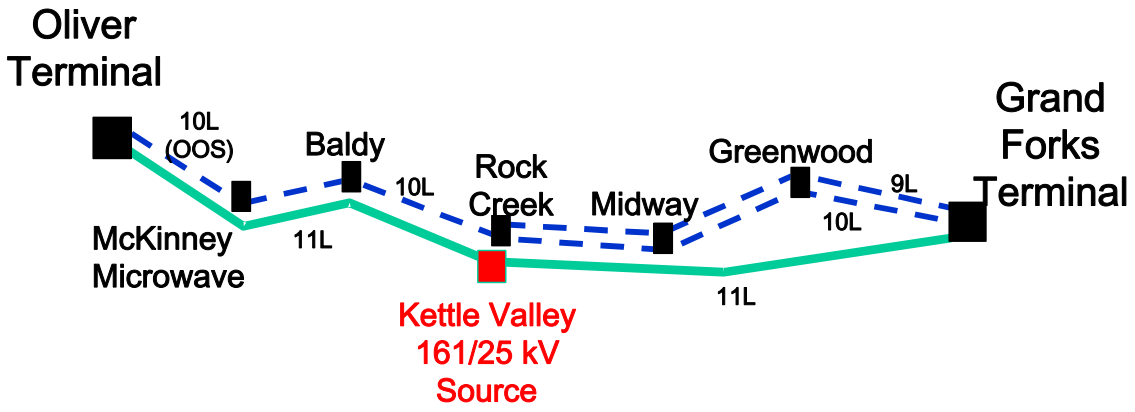


Figure 4.4 C Salvage 9 Line and 10 Line between Oliver and Grand Forks

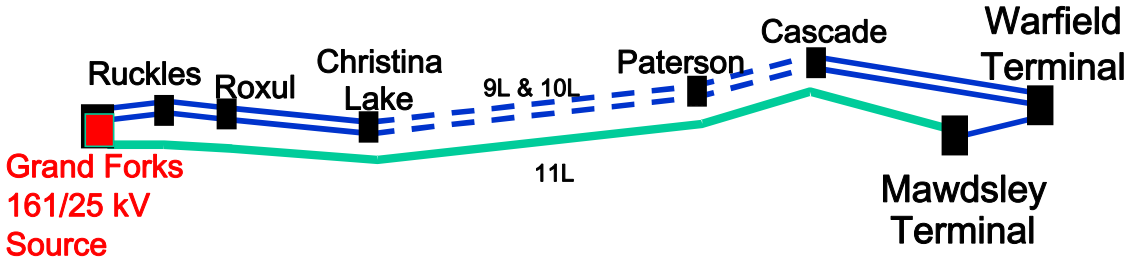


Following construction of the new Kettle Valley source, the five existing 63 kV source substations between Grand Forks and Oliver Terminals can be salvaged: Greenwood, Midway, Rock Creek, Baldy and McKinney Microwave. In addition, 63 kV circuits 9 Line and 10 Line will be salvaged or converted to 25 kV (where appropriate) between Grand Forks and Oliver Terminals. This project should enable a significant Operations and Maintenance cost reduction in the mid-term as these facilities are generally in poor condition and in need of major rehabilitation to be kept in service.

Grand Forks Distribution Source

A second substation at Grand Forks will be developed identical to the Kettle Valley substation and will serve east Boundary area.

Figure 4.4 D Add Second 161/25 kV Source at Grand Forks Terminal and Salvage 9 Line and 10 Line between Grand Forks and Cascade



Following construction of the new Grand Forks source, the three existing 63 kV source substations Ruckles, Christina Lake and Paterson can be salvaged. The customer owned Roxul station will have to be converted to 25 kV. In addition, 63 kV circuits 9 Line and 10 Line will be salvaged or converted to 25 kV (where appropriate) between Grand Forks Terminal and Cascade substation. This project should enable a further significant Operations and Maintenance cost reduction in the mid-term as these facilities are generally in poor condition and in need of major rehabilitation to be kept in service.

4.4.5 Distribution Growth Projects

4.4.5.1 Feed Baldy and Anarchist at 25 kV from Rock Creek and Convert Baldy to 25 kV

The existing distribution system at Baldy is 2400 Volt delta which is not a preferred configuration for providing proper primary feeder protection. In addition there are source capacity limitations and condition issues at Baldy substation and growth plans for the Anarchist area as well as Baldy. This project will convert 63 kV from existing Rock Creek source to Baldy and Baldy town site to 25 kV. This distribution upgrade will be coordinated with the new Kettle Valley Source project.

4.4.5.2 Boundary Area Voltage Conversion

To facilitate the reduction of the Boundary area distribution sources from eight stations to two stations will require a distribution voltage conversion to 25 kV of all area loads. This will be accomplished through a combination of load conversion and installing several new 25/13 kV step-down sources. Where appropriate existing 63 kV line facilities will be utilized as 25 kV facilities.

4.5 Kaslo – Coffee Creek Area

4.5.1 Existing Transmission and Distribution System

Coffee Creek is connected to 161 kV circuit 30 Line which runs between South Slocan and Kimberley. The substation is configured with 161 kV, 63 kV and 13 kV simple buses, with one 22.5 MVA transformer and one 10 MVA transformer connecting the 161 kV and 63 kV buses. Local distribution loads are presently fed by an 8.4 MVA 63/13 kV transformer. The station also includes a 1.5 MVA grounding transformer.

Coffee Creek is the source of 63 kV circuit 37 Line which runs north along the west shore of Kootenay Lake to the Kaslo distribution source substation. The 63/25 kV Kaslo source feeds distribution loads south and north of the town along the lakeshore, including the BC Hydro loads at Lardeau at the north end of Kootenay Lake.

4.5.2 Kaslo – Coffee Creek Area System Deficiencies

The west shore of Kootenay Lake is narrow and mountainous, so tree fall and landslide induced outages to the radial 63 kV circuit 37 Line are relatively common. The town of Kaslo has endured a number of multi-day outages in the past, although it would be extremely costly to close the loop between Kaslo and the nearest alternative power source at New Denver in the BC Hydro system due to the distance and mountainous terrain. The most practical short-term solution to address future multi-day outages at Kaslo would be to use a mobile generator to enable serving at least the most critical area loads.

4.5.3 Maintenance Assessment

37 Line between Coffee Creek and Kaslo is in mixed condition. Some sections have been entirely replaced due to landslides or rebuilds and are of recent vintage, other sections are fairly deteriorated with a high percentage of structures in poor condition.

The 3.2 km long 30 Line Kootenay Lake crossing requires a comprehensive condition assessment to determine if it can be kept in service in the longer term. This extremely long crossing consists of steel rope conductors suspended between structures anchored into the mountain sides far above the shoreline on each side of the lake. Past condition assessments were performed from a custom man-basket apparatus which travelled along the conductors across the lake. The condition of the conductors is now uncertain enough that using this equipment might be unsafe, so future condition assessments may need to be performed by helicopter.

The Kaslo substation is a candidate for rehabilitation or rebuild, demonstrating significant deterioration of equipment and structures.

4.5.4 Transmission Projects

4.5.4.1 Kaslo Substation Rehabilitation

The Kaslo substation site is a candidate for either relocation or reconditioning. The existing transformer also has condition issues that could be addressed through rehabilitation. It is proposed that this transformer be inserted into the transformer rehabilitation and replacement program.

4.5.4.2 Coffee Creek Transformer 3 Capacity Addition

By the winter of 2006/07, the total substation load at Coffee Creek is projected to exceed the maximum capacity of the existing 8.4 MVA transformer. To address the transformer overload, the existing Transformer 3 would be retired and replaced.

Breaker and grounding transformer deficiencies will also be addressed during the course of this project.

4.5.4.3 Coffee Creek Capacitor

With the loss of 30 Line anywhere between South Slocan and Coffee Creek, the loads at Crawford Bay Terminal, Coffee Creek Terminal and Kaslo substation can be served from Lambert Terminal via the 63 kV circuit 32 Line and the lake crossing segment of 30 Line with the addition of 30 MVAr of reactive compensation at Coffee Creek Terminal and 5 MVAr at Kaslo. Note that the Kootenay Lake crossing of 30 Line will be converted to 63 kV after 30 Line from Crawford Bay Terminal to Kimberley is abandoned. This project will need to occur in the 2005/2006 timeframe if 30LE to Kimberley has already been abandoned by that time. If 30LE has not been abandoned by 2005/06 the capacitor will be required as soon as that does occur.

4.6 South Slocan Area

4.6.1 Existing Transmission and Distribution System

The FortisBC subtransmission system in the South Slocan area primarily consists of extremely old 63 kV circuits which were originally constructed to link the generating plants along the Kootenay River to loads in the Castlegar and Trail areas in the 1930s and 1940s. The 63 kV subtransmission network terminates at the South Slocan switchyard, which is connected to BC Hydro's Kootenay Canal via two short 63 kV circuits (12 Line and 13 Line) which cross the Kootenay River, and from there to the 230 kV network which links Kootenay Canal with Brilliant Terminal Station, Warfield Terminal Station and BC Hydro's Selkirk 500 kV Terminal.

Area distribution loads are supplied via a series of older 63/13 kV source substations. Many of these facilities are served as simple taps or dual taps off the 63 kV subtransmission system without automated subtransmission sectionalising capability.

4.6.2 South Slocan Area System Deficiencies

Following completion of the Kootenay 230 kV System Development Project and installation of the overspeed and overvoltage RAS at the Kootenay generating plants, the subtransmission system in the South Slocan area is generally adequate. One exception is the radial 63 kV circuit 19 Line which feeds Passmore and the Slocan Valley loads at Valhalla and Slocan City. Loads served by this circuit have been subjected to extended outages due to landslides in the recent past. The circuit has experienced relatively frequent outages caused by tree falls during high winds. The location of the loads in this mountainous setting makes backup provision extremely difficult and costly.

Most of the distribution sources in this area are served as simple taps or dual taps off the 63 kV subtransmission system. Most of these sites do not have automated subtransmission sectionalising capability, so failures anywhere on the subtransmission lines can cause extended interruptions until a service crew reaches the area to perform manual switching.

4.6.3 Maintenance Assessment

Most of the remaining 63 kV circuits in the South Slocan area have extensive sections in deteriorated condition. Most of these subtransmission facilities were originally constructed in the first half of the previous century, and although substantial sustaining investments have been made over time, many of the structures are at or near end of useful service life and will require replacement in the near future.

Most of the distribution source stations in this area are also extremely old and much of the major equipment is nearing end of service life. It will be important to closely monitor the condition of these facilities to avoid significant reliability decreases in the future.

4.6.4 Transmission Projects

4.6.4.1 Add MODs and Communications at Tarrys and Playmor Substations

This project involves addition of motorized disconnects, associated communications and controls at the Tarrys and Playmor distribution source stations to enable remote sectionalizing and load restoration for permanent faults on the 63 kV system, to significantly reduce outage durations. This project will occur in 2006 and 2007.

4.6.4.2 Loop Slocan City to New Denver (BC Hydro)

This project would involve closing the 63 kV loop between Slocan City and New Denver. Construction of this circuit will be very challenging due to the narrow shore area between Slocan Lake and the mountains, which is also shared with a highway. Voltages at Slocan City will be extremely low when fed from New Denver, requiring the addition of capacitors at the substation, which will need to be energized only upon loss of 19 Line from South Slocan.

4.6.5 Distribution Growth Projects

4.6.5.1 Passmore Feeder 2 Upgrade

Passmore Feeder 2 has very limited capacity due to small conductor sizing and limited three phasing on the circuit. Voltage concerns were addressed in 2003 and 2004 with voltage regulation resulting in feeder voltage marginally above minimum planning limits. However, the heavily loaded single phase taps don't allow for fuse coordination with the

station breaker, resulting in widespread outages for localized faults. Aggressive three phasing of this feeder will mitigate the reliability issues as well as addressing the long term capacity requirements.

4.6.5.1 Playmor-Tarrys Feeder Upgrade

The distribution line from Playmor to Tarrys does not have the capacity to pick up Tarrys load. Load at Tarrys substation is above recommended continuous rating of the station transformer. To reduce load on Tarrys substation, separate the rural load from the Kalesnikoff sawmill load to provide outage and maintenance backup between Tarrys and Playmor. An upgrade of the feeder between the two stations to allow for operating re-configuration of the distribution system is required.

4.7 Trail – Salmo Area

4.7.1 Existing Transmission and Distribution System

The subtransmission system in the Trail – Salmo area is extremely old, with original construction dating from the 1930's and 1940's. 63 kV circuits 20 Line and 27 Line link the communities of Montrose, Fruitvale, Hearns, Salmo, Ymir and the Whitewater Ski Resort to the surrounding FortisBC transmission system. The geography consists primarily of steep-sided mountain valleys, with dense forest cover and significant snowfall. The circuits are subjected to frequent tree fall and snow related outages, requiring either remote sectionalising (where possible) or crew mobilization to restore loads. The loads are mostly concentrated near local distribution sources fed from the 63 kV network, although there are also some fairly long single phase distribution circuits which parallel the subtransmission circuits, often on common structures.

4.7.2 Trail – Salmo Area Deficiencies

This area has inadequate remote sectionalising capability to quickly restore loads for frequent 63 kV circuit outages. Voltages are quite weak when loads must be served from the remote end (i.e. Fruitvale from Nelson or Ymir from Trail), indicating that switched shunt capacitors will be required at several locations to enable adequate load backup.

It is presently not possible to remotely sectionalize and backup the 63 kV distribution source substations fed from 20 Line and 27 Line for outages on various sections of these circuits. A program to upgrade, motorize and automate the sectionalizing switches on these circuits needs to be implemented.

Future consideration should also be given to upgrading the entire Fruitvale – Salmo – Ymir distribution system to 25 kV, enabling full distribution backup between these sources which is not practical with the existing 13 kV distribution voltage.

4.7.3 Maintenance Assessment

The subtransmission system in the Trail – Salmo area is extremely old, exhibiting extensive structure deterioration. Many of the structures which comprise 20 Line and 27 Line between Fruitvale and Nelson have already been stubbed, and the poles and crossarms are generally in poor condition. The 13 kV distribution underbuild on 20 Line has inadequate clearance from the 63 kV circuit, and regularly experiences outages and overvoltage transients. Substandard sections of these circuits should be rebuilt or separated to improve reliability.

The Ymir transformer is at end of service life and requires replacement.

Hearns distribution substation is at end of service life and the local load can be supplied via the Fruitvale distribution source.

4.7.4 Transmission Projects

4.7.4.1 Ymir Transformer Replacement

The Ymir transformer has condition related issues attributable to its advanced age (built in 1950), and should be replaced. It is part of the overall transformer rehabilitation and replacement program. The old Ymir transformer will be retired. Additional capacity will be required to serve the Whitewater substation load at distribution voltage level (13 kV).

The Whitewater substation facilities have reached end of service life. The existing 13 kV switchgear configuration presents an extreme safety risk as the station does not meet engineering and clearance standards. The substation is located on leased property that is not accessible by the mobile substation for backup purposes. No additional property can be acquired at the existing site. The substation is considered a “legacy” substation and will be eliminated as a result of the increased capacity at Ymir.

4.7.5 Distribution Growth Projects

4.7.5.1 West Trail Voltage Conversion

A few outstanding Trail area voltage conversion items still remain to be completed. These include salvage of the Trail substation and transmission feed and conversion of a few remaining services, including the Trail Memorial Centre.

4.7.5.2 Paterson 25 kV Feed and Voltage Conversion

The condition of Paterson substation requires it be either upgraded or eliminated. Load on this source is relatively small and can easily be supplied by the Cascade substation

in Rossland. This project will be integrated into the Boundary area voltage conversion project.

5 General

5.1 Station Sustaining General

5.1.1 Kootenay Mobile Substation

With the immediate retirement of the Kootenay 6.5 MVA mobile, a replacement mobile substation should be purchased. The recommend unit is 20/24/30 MVA with 63 kV primary and 13 kV/25 kV secondary, and breaker protection.

5.1.2 Station Urgent Repairs

The urgent unforeseen projects are an ongoing project required for failures that occur without warning.

5.1.3 Load Tap Changer (LTC) Oil Filtration Program

The transformer load tap changers are known to develop a coke on the contacts and switches. This coking is a result of the development of carbon deposits from arcing of the connection and disconnection of the contacts. This carbon resides in the oil until it saturates and then forms a high resistance path on the contacts which causes heating and pitting of the contacts.

The filtration of the load tap changers removes these carbon deposits. The result is a longer time between fixing and/or maintaining the load tap changers. With some tapchangers, this can lead to moving maintenance cycles from two years to four years.

The business need for this project is reliability and reduced maintenance. This project will allow FortisBC to significantly reduce the amount of maintenance required for tapchangers. Load tap changers are the most common system to fail in a substation. Extending the service life of these apparatus makes good economic sense. The program is a five year project so that the filtration system may be installed during the course of the scheduled maintenance of the transformers. This project will be included in the transformer rehabilitation program where it is applicable.

5.1.4 Station Assessments, Ground Grid Upgrades and Minor Planned Program

Two projects are operating under this program. The Station Condition Assessment program reviews the safety and reliability issues at seven to eight stations per year. There are a total

of 70 stations that are in need of review. These stations are tracked in a ten-year cycle. Included in this project is a ground grid assessment completed by a specialized testing group.

The work resulting from the condition assessments is then planned for the following year in the Station Minor Planned Program.

Historically, assessment of the condition of the ground grid has indicated poor grounding at some stations. The ground grid upgrades project is to attend to any grid rehabilitations that were identified in the tests from the previous year.

5.1.5 Bulk Oil Breaker Replacement Program

The Company has a total of 14 bulk oil circuit breakers that are 1927 to 1968 vintage. All are showing signs of significant wear and deterioration. Replacement parts are no longer available and some breakers are leaking oil that will require lengthy and costly outages to repair.

This program will see the replacement of these breakers over the course of the next ten years. By replacing two of the most critical breakers spare parts will be available for the remaining breakers allowing a timely replacement of the remaining breakers as identified by the condition based program. Planning replacement over a number of years ensures the equipment can be properly assessed and replaced only when the breaker's condition or ratings require replacement.

The first breakers scheduled for replacement will take place at Coffee Creek Terminal Station. Both breakers have reached the end of their service life. One was acquired in 1950 and the other in 1951. Routine maintenance in 2000 identified that both breakers need to be replaced.

5.1.6 Computerized Maintenance Management System (CMMS)

The current FortisBC investment in upgraded generation, transmission and substation assets demands an enhanced maintenance management system to properly maintain the equipment and ensure system reliability. The existing maintenance system will not allow FortisBC to employ new methods of maintenance management such as condition based maintenance that uses predictive tasks to measure the condition of the equipment. This system requires the use of computerized tools to track all of the data to support proper maintenance.

A computerized maintenance management system is a tool that tracks assets and identifies what condition will cause equipment to require maintenance. It then trends, stores history and schedules the maintenance work accordingly. FortisBC's current system does not track maintenance notifications, identify deficiencies or schedule maintenance of the assets.

Computerized maintenance management is standard in the electrical industry. It is fundamental to assuring that the utility's apparatus operate well. The trend in maintenance philosophy is towards condition based monitoring and predictive analysis prior to doing intrusive maintenance. An effective management system is required to accomplish this. It is the backbone of the maintenance program. All analysis techniques, maintenance tasks and maintenance schedules are triggered from the management system.

5.1.7 Tap Changer Leak Repair and Upgrades

FortisBC has a number of Federal Pioneer tap changers that are high maintenance and are known for their failures due to contact wear. This is where contacts wear and leakage occurs into the main tank. This project is for repairing the leaks and upgrading the tap changers at the same time.

5.2 Transmission General

5.2.1 Transmission Line Urgent Repairs

Component failures on the transmission system due to inclement weather, defective equipment, animal intrusions, vandalism, abnormal operating conditions, vehicle collisions and human error cause outages or present risks that must be addressed in an expedient manner to ensure that employee and public safety is not at risk and electrical service continuity is maintained.

This project is for capital expenditures for repair or replacement of failed equipment. This strategy ensures provision of a safe, reliable transmission system.

5.2.2 Right of Way and Easements

This project is required for acquiring rights of ways and easements for power systems that cross over a customer's property. The estimate for this project is based on historical cost. This project has historically been used to obtain easements to remove existing trespass situations. New easements are obtained as part of the new projects requiring easement and are not included in this project.

5.2.3 Right of Way Reclamation

The reclamation project is required to allow FortisBC to remove trees increasing the tree free zone around the transmission lines. The increased tree free zones improve clearances improving both safety and reliability of the transmission system. The trees included are ones that FortisBC can economically remove versus cycle trim or brush. The estimate for 2005 is based on historical cost.

5.2.4 Transmission Line Assessment and Rehabilitation

The transmission line assessment program is an eight-year cycle test and patrol program for all of FortisBC's transmission lines. 2005 will brings the transmission lines to year eight of an eight year patrol cycle that began in 1997. The cycle will start over again in 2006.

The rehabilitation project involves expenditures for structural stabilization of multiple transmission lines that were identified for rehabilitation in the previous year. Included in the scope of work are replacement of cross-arms and poles and maintenance of structures according to the needs at each specific pole location. Also, there are some minor requirements in terms of insulator and guy wire changes and pole wraps.

The up-to-date patrol data supports a broadly based program of remediation.

5.2.5 Switch Additions

To improve the reliability of the existing power supply and to provide acceptable service after a contingency some of the old disconnect switches in the system need to be replaced. These disconnect switches are neither capable of switching load nor can they be remotely operated from SCC. Installing new disconnect switches with remote controlled switching capability will not only enhance sectionalizing ability it will also improve the reliability of power supply and minimize load interruptions by reducing the restoration times after contingencies. The switches that need to be replaced are:

- Disconnect switches on 20 Line and 27 Line at the Glenmerry, Beaver Park and Ymir substations.
- Disconnect switches Grand Forks 10-1, 9-10 and 9-1 at Grand Forks Terminal.

The existing disconnect switch Keremeos 43-1 on 43 Line at the Keremeos substation is currently not capable of interrupting line charging current and is subjected to arcing problems when the line is de-energized with the circuit breaker open at Oliver end. Installing vacuum interrupters on this switch will allow sectionalizing of 43 Line without outage of Keremeos substation.

A disconnect switch is currently being installed on 9 Line near Christina Lake substation. The objective is to shift the Christina Lake load from the outage prone section of 10 Line to 9 Line with the new disconnect as the open point on 9 Line between Christina Lake and Paterson. This will increase the reliability of the power supply to Christina Lake substation that in the past has had one of the most customer hours of outage due to transmission problems.

5.3 Distribution General

5.3.1 Small Capacity Improvements

Unforeseen load emergence will require capacity upgrades and voltage correction projects not accounted for in the present five year capital plan. The projects may include service upgrades, voltage regulation, ties to accommodate load splitting, single to three phase upgrades, and conductor upgrades.

5.3.2 Distribution Condition Assessment and Rehabilitation

Aging distribution poles require a proactive program to manage the risk of employee and public safety, and ensure acceptable level of service.

The FortisBC system poles are patrolled and tested on an eight-year cycle.

Pole Testers and Powerline Technicians (PLT) condemn poles during pole testing and detail patrol on distribution circuits. Pole testers are to condemn poles because of internal decay and severe surface rot. A Powerline Technician will condemn a pole because of climbability on critical structures (Transformer and Switching Structures). This program looks at the condition of the attachments to the poles and will replace cross-arms, guying, insulators and grounding as part of the program.

Extending the service life of poles, limits the number of new poles required and costs associated with replacement. FortisBC treats, stubs, wraps and replaces distribution poles to ensure public and personnel safety and to maintain a reliable distribution system.

As the age of the distribution poles increase, so does the incidence of decay and insect infestation, decreasing the structural integrity of the poles to the point where the poles will structurally fail causing outages and safety hazards. The incidences of decay dramatically increase after 20 years which is consistent with Industry findings. There are two methods possible to decrease the incidence of rot on distribution poles. Replacing all of the poles that have significant decay and/or are insect infested provides the most significant impact to reduce the incidence of decay. However, applying the proper combination of replacement, stubbing, wrapping, and treatment to poles still significantly reduces the incidence of rot and is less expensive than the former method. This method extends the service life of the poles from 7 to 30 years depending on the type of treatment.

FortisBC manages the program to obtain maximum service life of existing poles.

5.3.3 Distribution Right of Way Reclamation

The reclamation project is required to allow FortisBC to remove trees increasing the tree free zone around the transmission lines. The increased tree free zones improve clearances improving both safety and reliability of the transmission system. The trees included are ones

that FortisBC can economically remove versus cycle trim or brush. The estimate for 2005 is based on historical cost.

5.3.4 Distribution Line Rebuilds

In 2003, the Maintenance Planning group audited all of the FortisBC distribution feeders. This audit comprised of field visits with service crews in the entire service territory. Formal discussions and physical site visits were completed for all FortisBC distribution feeders.

The results of these audits were prioritized for safety, reliability and for compliance. Each recommendation resulting in rebuild was prioritized and scheduled over the next four to five years.

This project is for the rebuilding of specific safety and reliability deficiencies on the distribution system. Projects include rebuilding failing conductor, replacing rotted platforms, replace leaking transformers, installing ground grids at services that do not have grounding.

5.3.5 Small Planned Capital

Repairs to distribution line due to weather, clearance issues, and aging equipment are addressed to maintain a safe and reliable power system.

Each year operational and safety concerns are identified on the distribution system as a result of storm damage, clearance problems, aging equipment, reports by Powerline Technicians, and other inspections or inadequate design due to standards changes. Repairs to address these concerns are required to maintain a safe and reliable power system. Each year a plan is established to pro-actively address these concerns. These concerns are prioritized according to their impact of the reliability of the system in the event of a failure, safety of employees and the public, and the likelihood of such a failure / occurrence. These repairs are generally non-urgent in nature and are performed within one year of the initial request.

5.3.6 PCB Program

FortisBC has approximately 26,000 in-service, oil filled distribution apparatus that do not undergo oil testing as part of regular maintenance. Draft legislation, expected to be enacted within a few years, will require that all remaining in service equipment containing PCB concentrations greater than 50 ppm must be inventoried and reported annually. There is also a requirement to label any equipment that is found to contain concentrations greater than 50 ppm. To meet these requirements, FortisBC must first determine the concentrations in each device.

The gathering of equipment data and identification of sensitive locations will be undertaken as part of a scheduled line patrol over an eight-year period. This project is expected to cost approximately $750,000 annually, beginning in 2005, with the commencement of oil

sampling, lab testing and any necessary mitigation measures taken on in-service, oil-filled distribution apparatus.

5.3.7 Forced Upgrades and Line Moves

Requests are received each year from the Ministry of Transportation (MoT), municipalities and customers to relocate distribution lines to accommodate road widening or improvements.

This project is to relocate distribution lines due to highway/road widening or improvements that are initiated based on requests from MoT and/or municipalities. Each project is approved on a case by case basis. Miscellaneous customer requests where FortisBC does not have sufficient land rights for the facilities located on customer property also falls within this project.

5.3.8 Distribution Urgent Repairs

Component failures on the distribution system due to inclement weather, defective equipment, animal intrusions, vandalism, abnormal operating conditions, vehicle collisions and human error cause outages or present risks that must be addressed in an expedient manner to ensure that employee and public safety is not at risk and electrical service continuity is maintained.

This project is for capital expenditures for repair or replacement of failed equipment. This strategy ensures provision of a safe, reliable distribution system.

6 Communications, SCADA, Teleprotection and Other Systems

6.1 Telecommunications Scope

In planning telecommunications systems for vertically integrated electric utilities, it is desirable and common to consider all traffic types that may benefit from the dramatic cost advantages and operational efficiencies of shared facilities. For that reason, the telecommunications part of the Transmission and Distribution System Development Plan considers telecom traffic in transmission, distribution, generation and administrative areas of FortisBC, as well as traffic to/from surrounding utilities that impacts the FortisBC telecom systems.

Traffic for the telecommunications systems may be driven from a variety of systems that are needed for the operation of the utility. To adequately assess these traffic needs now and in future, the contributing systems must be characterized, and future growth forecast. The systems in List 5.1 below are in service, planned or possible in future at FortisBC. Also

noted are neighboring utilities whose actions may have an impact on FortisBC systems or telecom.

List 6.1 FortisBC Systems affecting Telecom

i) Teleprotection and RAS systems

ii) Transmission, Generation and Distribution SCADA

iii) Power quality and metering

iv) Customer metering

v) Relay Status and fault recorders

vi) Mobile Voice (VHF Radio and cellular)

vii) Fixed Voice – Operations

viii) Wide Area Network

ix) Neighboring utilities: TeckCominco and BC Hydro

x) Backbone Telecommunications System

xi) Administrative Voice - Centrex

xii) Video surveillance

xiii) Possible future requirements

(1) Virtual Call Center

(2) Automated Meter Reading

(3) Voice over internet protocol

(4) Demand Side Management to customers

(5) Transformer condition monitoring

For each of these systems the study included:

- Updating the assessment of existing facilities - Situation analysis: a description of the system and its use in FortisBC, planning criteria, updating from the 2001 study.
- Requirements analysis - identifying future needs by assessment of:
  - the existing system deficiencies,
  - the impact of near-term projects,
  - the impact of the Transmission and Distribution System Development Plan,
  - any possible impact of telecommunications activities in surrounding utilities: BC Hydro, and TeckCominco, for example, the BC Hydro Capital Plan of May 2004
  - likely future administrative and operations systems additions.
- Budget planning: evaluating alternatives and preparing budgetary studies and integrated timeframes.

6.2 Introduction

FortisBC operates a private telecommunications system to support protection, control and monitoring for the power system, as well as operations and business communications requirements. Some 106 locations are presently or potentially served by the telecommunications system, including some 59 distribution locations, 11 generation, 12 transmission, and 6 office locations. The telecommunications system also connects to other utilities for the exchange of protection signals and operating voice communications.

A variety of telecommunications transport systems are used, depending on technical requirements, economics and system reliability requirements. These include power line carrier, fibre-optic cable, copper pairs, Telus leased lines, and radio (VHF, microwave, spread spectrum and packet radio). The primary purpose of the telecommunications system is to be an integral component of the protection relaying system, RAS, substation operations and control, and generation dispatch systems. It also provides a low-cost alternative to the public network for internal business data and some voice traffic.

6.3 Teleprotection and Remedial Action Schemes (RAS)

6.3.1 Description and Planning Criteria

Teleprotection (TP) is a means of transmitting protective relaying signals amongst the protection relays between substation locations. This provides fast and accurate fault clearing, and implements RAS, thereby protecting transmission equipment from damage and improving stability and reliability of the system.

Criteria

- locations, number of channels, and bandwidth of teleprotection and RAS channels are set by the layout of the protection zones, the particular protection techniques used in the transmission design, and the system stability requirements.
- Performance requirements for teleprotection and RAS channels are stringent in availability, absolute delay, and delay asymmetry, and thus common carrier (telephone company) channels are not normally used in this application.
- Where teleprotection or RAS on the bulk system affect other utilities, redundant communications paths are required by WECC standards.
- Where teleprotection channels are implemented by radio technology, licensed frequencies must be acquired – unlicensed bands are inappropriate for teleprotection.

6.3.2 Existing facilities

Power line carrier (PLC) is traditionally used for teleprotection within FortisBC, but recently optical fibre channels are being installed, and the teleprotection channels are being transferred to the fibre facilities using JungleMux and new technology. By the end of 2005, the only PLC facilities will be in the Oliver - Mawdsley, Brilliant Terminal Station – Kraft, Joe Rich – Big White, and South Slocan – Coffee Creek cross sections; all other teleprotection channels will run on fibre.

Most of the existing PLC equipment is obsolete, aging and unreliable, and some upgrades are being done coincident with station construction and rehabilitation activities, as follows:

Vernon (BC Hydro) – Oliver Terminal: existing PLC channels, to be replaced with fibre in 2005

Oliver Terminal – Mawdsley Terminal: PLC channels. Upgrades to the Oliver – Mawdsley PLC are being done in 2005 to improve noise performance and redundancy, funded by the South Okanagan Supply Reinforcement Project.

Mawdsley – South Slocan: Fibre rings

South Slocan – Coffee Creek: PLC Carrier

Princeton – Oliver: no teleprotection channels

South Slocan – Slocan City: no teleprotection channels

Coffee Creek – Kaslo, Crawford Bay and Lambert: no teleprotection channels

South Slocan – Emerald – Waneta: PLC decommissioned in 2004, these TP channels are now run on TeckCominco OC1 microwave.

6.3.3 Teleprotection and RAS Deficiencies

The age of the teleprotection channel equipment is affecting its reliability and maintainability – some shelves are so old that test switches have been designated “do not operate” by FortisBC because they will fail if operated. So the channels cannot be tested nor preventative maintenance adjustments done. After the upgrades of 2005, the Kraft - Brilliant Switching Station and South Slocan - Coffee Creek cross sections will remain critically obsolete.

Non-redundant teleprotection channel equipment: All PLC teleprotection channel equipment in FortisBC is non-redundant. Upgrades in 2005 will improve the redundancy of the Oliver - Mawdsley cross section by duplicating the channel equipment, but the channels will still run on only one carrier channel on one transmission line. Kraft - Brilliant Switching Station and South Slocan - Coffee Creek will remain non-redundant.

BC Hydro bulk power interconnections will require RAS changes. This may require upgrading to redundant communications paths as per Western Electricity Coordinating Council (WECC) standards in some cross sections.

Kelowna Loop: FortisBC intends to reconfigure the Kelowna 138 kV subtransmission system into a loop or mesh arrangement with automatic fault isolation. If so, Lee Terminal, Bell Terminal and each of six distribution substations will require teleprotection signaling to its neighbors. This number increases to ten if considering the proposed new Ellison, Black Mountain and South West Kelowna substations, and eleven if Duck Lake is also looped. The present 900 MHz radio system used in this area for SCADA is inadequate in speed, capacity and redundancy for teleprotection purposes.

6.4 Transmission, Generation and Distribution SCADA

6.4.1 Description and Planning Criteria

The SCADA system provides real time telemetering of MVA, kV and VARS from equipped substations, with central historical records kept in the Warfield SCC database, and in some locations this is used for revenue metering. These measurements are used in balancing load flows and adjusting voltage performance on the bulk transmission system.

The system also provides substation status and visibility to SCC operators and remote control of terminal and substation switches. SCC operators assume “person in charge” (PIC) responsibilities for these substations. Included in this function are approximately 20 isolated line switches remotely operated by SCC for fault isolation and restoration purposes.

Increasing duties in the operation of the system are being undertaken by SCC operators. This trend is motivated by cost savings, freeing up field personnel for other duties, safety concerns, and maintaining the performance of a system operating increasingly closer to capacity.

Technology improvements have made it economical to extend remote monitoring and control to smaller stations. This will reduce on-site manual operating visits and costs and improve performance of the transmission and distribution systems. Specifically capabilities that will reduce operator visits and save Operations and Maintenance are:

(1) remote tap changing (lowering voltage to less than the automatic control range to avoid load shedding),

(2) remote restoration (switching feeders to other transformer[s] in multiple transformer sites)

(3) remote automatic recloser disable (for brushing and hot line crews, now requires one visit in morning, one evening).

(4) remote relay and reclosure settings.

Criteria:

- All terminal stations, any new distribution substations, and significant distribution substation upgrades will have an installed Remote Terminal Unit (RTU) for telemetering, visibility and control.
- Where warranted by sufficient levels of activity, sufficient load (>10MW), or sufficient criticality to customer load, existing older distribution subs will have RTU's and communications installed, staged at an achievable rate over the next few years. Remote, failure prone areas, or difficult to access substations will have priority.
- Where important to restoration plans, line switches (e.g. Rosemont, Grand Forks) will have SCADA control.
- SCC shall have redundancy in operator stations, processors, databases and communications.
- SCC operating functionality shall be available at a retreat site in the event of site failure or evacuation, or at a minimum, the system shall be safely operable by field personnel should SCC functions fail.
- Where SCADA communication channels are implemented by radio technology, licensed frequencies must be acquired – unlicensed bands are inappropriate for SCADA, except for temporary or emergency situations.

6.4.2 Existing facilities

Fifty-three remote terminal units communicate to the system control centre over FortisBC power line carrier, radio systems (VHF, data radio and microwave), fibre-optic circuits and via common carrier leased circuits. The SCADA system supports the operation of 12 generation, 12 transmission, and 3 switching station locations, 23 line switches, and 3 distribution substations.

Generation SCADA is a separate system from the transmission SCADA system. The generation SCADA system communicates to Programmable Logic Controllers (PLC's) at the stations via fibre optic circuits. In addition, water level gauges at dam sites and at Nelson and Queen's Bay (between Nelson and Coffee Creek) are monitored. The generation operator is responsible for generation dispatch and tagging energy transactions on the central internet site.

The SCC central site has dual redundant DEC Alpha servers, four operating stations (transmission, distribution, generation and development) connected via a local area network. The SCC is one node on the Trail fibre loop, which provides communications to the RTU's, PLC's and the mobile radio system.

Transmission RTU's are a variety of vintages, the older Quindar / Surveillant RTU's using 3 mutually incompatible protocols. FortisBC has standardized on Harris RTU's. RTU upgrades will be done in 2005 in Anderson, Vaseux Lake, Oliver (South Okanagan System Development Project), and Lee, Bell (Kelowna Area Upgrade project) Terminals.

Twenty three motor operated line switches are controlled remotely via DART RTU's using a Simrex packet radio system at SCC (via the Red Mountain Repeater), or "poll on demand" mRTU's that piggyback on the mobile radio VHF system, or, in the Kelowna area, over microwave radio from Okanagan Mountain.

6.4.3 SCADA Deficiencies

System coverage and control of distribution substations: The SCADA system provides visibility and control of only a few distribution substations. An opportunity to improve safety, system performance and Operations and Maintenance costs exists by, for example, adding remote control of tap changers, reclosers, and feeder switching.

MRTU narrowbanding: Nineteen of the small RTU's have integral VHF radios and will have to be upgraded or replaced in the period 2004 – 2010, see Section 5.8.

Telecom speed constraints: Most of the SCADA remote locations are constrained by low telecommunications bandwidth, because of high capital or Operations and Maintenance costs to provide normal channels to these locations. Thus far, no operational impact has resulted from this constraint, but as the operational responsibilities of the SCADA system evolve, the bandwidth and reliability requirements will increase, and the existing limitations may become impediments. These systems should be replaced over time as opportunity and requirements dictate. Systems affected are the VHF system (see Section 5.8), PLC carrier (see Section 5.12), the Red Mountain data radios, and the Grouse Mountain multipoint system.

SCC backup operations capability: As SCC becomes more pivotal to the operation of the system and assumes more operating responsibilities, backup operational capability will become a concern. Planning for the loss of SCC capability may include procedures for operating safely from the field, a retreat site and communications for SCC operators, or backup operating positions located elsewhere on the telecommunications loop.

Internet access for Energy Transaction Tagging: Increased FortisBC responsibilities for energy transaction tagging may require improved security of web access for SCC generation operator.

6.5 Power quality and Customer metering

6.5.1 Description and Planning Criteria

FortisBC uses electronic power quality station meters to monitor line and bus performance, voltage quality (sag, swell, disturbance), and harmonics for the purposes of load monitoring, power quality analysis, and energy consumption tracking. A few meters are also used as check meters and for revenue purposes.

Older electromechanical meters are used for non time-critical load monitoring purposes.

Criteria:

It is valuable to utility operations to have all transformers and feeders monitored with electronic power quality meters. The deployment of power quality meters will continue at an achievable rate over time, with the following criteria and priorities:

- Bulk power transformers and lines,
- all substation busses that support customer load 10 MW or greater (including transmission or generation subs that may supply a distribution feeder),
- all feeders at new substations,
- individual feeders where large load (10 MW), large customers or critical conditions exist.
- Where meter information is critical and viewed regularly, permanent telecommunications access is required (WAN system access is preferable where telecommunications is feasible). Where the information is required on a daily basis, dial up access is acceptable. Where metering information is not time critical, manual monthly visits are sufficient.
- Where radio communications is used, unlicensed radio bands are suitable.

Revenue meters are deployed at larger customer locations (>500KVA) to achieve not only timely load information, but power quality monitoring as well. Remote or difficult to read locations are also candidates for remote or automatic meter reading through a suitable communication system.

6.5.2 Existing facilities

FortisBC currently has 400 meters (electromechanical or electronic) installed on transformers, most feeders and critical customer locations. Some 130 of these are electronic meters that can monitor power quality parameters, and of these, 74 (less than 20% of the total meters) are remotely accessible via communications at five out of six

generation locations, 8/11 transmission terminal locations, 15 out of 70 distribution substation, and 25 customer locations. Of the meters that have the capability of being accessed remotely by FortisBC personnel, most use dial access (largely cellular) every 24 hours, some use the WAN system. The remaining meters are read manually, usually monthly. Power Measurement ION meters are used, with the ION Enterprise server system located in Trail. Revenue meters are dialed from Calgary (changing to Trail in 2004).

6.5.3 Metering Deficiencies

Location and Feeder Coverage: The existing power quality electronic meters tend to be deployed at the generation and bulk transmission levels, with poor coverage at the distribution substation and feeder levels. Continued installation of remotely accessible electronic meters at lower levels will improve the proper characterization of load profiles (temperature and time) at feeder and transformer levels, and improve performance monitoring. Communications increases the timeliness and therefore usefulness of the information gathered by these meters.

Telecommunications costs: As the FortisBC telecommunications and WAN systems extend to more FortisBC locations, meter information can be obtained faster and at lower cost by either connecting meters directly to the FortisBC systems, or arranging dial access from closer locations that are on the system, which lowers long distance costs. These arrangements to avoid external Operations and Maintenance costs are ongoing and will continue.

6.6 Protection Relay Status and Fault Recorders

6.6.1 Description and Planning Criteria

FortisBC uses protection relay status information and fault recorder data for identifying fault locations, post-fault analysis, and outage duration calculation and tracking.

6.6.2 Existing facilities

At the end of 2005, about 20% of the data from the system relays and existing digital fault recorders will be remotely accessible (WAN and dial up) by authorized FortisBC personnel. Information from the remaining relays is inspected on-site, and captured by month-end reports.

Tesla digital fault recorders will be installed at all transmission terminal subs within 2005. Tesla and Schweitzer software and databases are used for central information access.

Schweitzer relays in newer substations are accessed via the WAN, with firewall protection limited to certain personnel.

6.6.3 Relay Status and Fault Recorder Deficiencies

The lack of remote telecommunications access to relay and distribution fault recorder information can hamper or delay restoration efforts. There is presently no regular upgrade program in this regard.

Three transmission level substations do not have up to date capabilities in remotely accessible relays and digital fault recorders (Lambert, Grand Forks, Princeton).

Since remote access to these capabilities can be achieved using dial up facilities, there is not a big impact on telecommunications loads.

6.7 Mobile Voice (VHF Radio and Cellular)

6.7.1 Description and Planning Criteria

Mobile voice communications is used in FortisBC for dispatching field personnel and coordinating maintenance and restoration activities by crews in the field. Mobile communications is an essential element of FortisBC operations, both from SCC to the field, and for crew to crew communications. Cellular communications from Telus is used for less critical operational and business communications.

Criteria:

Operations crews shall have access to non-blocking voice communications to other crews and SCC:

- Over 90% of the service area
- At all substations

Where voice communications does not exist or is unreliable, effective procedures shall be in place to assure safe operation of the system.

6.7.2 Existing facilities

FortisBC operates a 153 MHz. VHF radio system for voice telecommunications comprised of some 13 repeater sites, 22 base stations, and 200+ vehicle and handheld mobile radios, and tie trunks linking to the System Control Centre. The system provides communications coverage to about 90% of the service area, and covers all of the 67 substations.

Telus Mobility covers about 75% of the FortisBC service area, and is commonly used by operations personnel. It is particularly weak in the Princeton – Grand Forks area, except areas immediately surrounding Princeton, Oliver, Osoyoos and Grand Forks. About 10 substations have no cellular coverage. Telus Mobility coverage improvements are "planned" along the boundary highways, but no committed timeframe is offered. Telus Mobility has the potential to block during major traffic times or outage events, and cannot be solely relied upon for contingency operations.

6.7.3 Mobile Voice Deficiencies

Narrowbanding: Industry Canada is rearranging the VHF mobile communications band, with deadlines over the period 2004 – 2010. This will require FortisBC VHF equipment to use denser and narrower frequency band allocations than previous. FortisBC systems affected will be the 200+ mobile radios, portables and pagers, 22 base stations, 13 repeaters, and about 19 small SCADA RTU's with integrated VHF radios. (the Simrex data radios used for SCADA control of Paterson, Fruitvale and Whitewater line switches are not affected by the "narrowbanding" issue, as these radios are already narrow band.) Some equipment can be modified to comply and some will need to be replaced. These systems will encounter small but increasing risk of interference from other users over the next few years. Where interference occurs, FortisBC could be required to comply or stop using the affected frequency within 90 days. It is prudent to begin narrowbanding or replacing at this time, and continue over the next few years.

Mobile trunks E-W: All mobile radio repeater sites are linked to the System Control Centre with trunk circuits. Where high capacity fibre circuits are not installed, leased lines or power line carrier are used. The Oliver - Mawdsley telecommunications cross section is capacity limited, so leased lines are used with accompanying cost and reliability concerns.

Shared use with SCADA: Because of the excellent coverage of the VHF mobile system, FortisBC has used the mobile communications system to "piggyback" SCADA communications for 12 locations. The SCADA communications occurs only rarely, but when it does, it interferes with voice communications. Unfortunately, the communications conflicts occur in contingency conditions (during storm outages, for example, crews are active in the field at the same time the System Control Centre will be performing switches on the SCADA system). Efforts should be made over time to remove these SCADA transmissions from the VHF system to more reliable channels.

6.8 Fixed Voice - Operations

6.8.1 Description and Planning Criteria

Operations personnel require dedicated voice access to transmission and generation control rooms, and from the System Control Centre for switching and restoration coordination and safety guarantees. Switched voice from Telus is suitable for distribution, but not for transmission, substations. Telecommunications personnel usually have “order wire” channels normally supplied as part of radio or multiplex equipment.

6.8.2 Existing facilities

Station fixed voice to transmission stations is provided on the FortisBC high capacity systems, where they exist. Other transmission locations have voice telecommunications provided on power line carrier, and after 2005, voice on power line carrier will only be used in the Oliver - Mawdsley, Kraft - Brilliant Terminal Station and South Slocan - Coffee Creek cross sections. For distribution, dial access is available to about a third of the substations.

6.8.3 Fixed Voice Deficiencies

PLC age and reliability: The same age-related performance and reliability issues as described in 6.3. Teleprotection affect the fixed voice system in the power line carrier cross sections.

VHF Piggybacking: The Coffee Creek voice access shares the telecommunications channel with the SCADA link, and both use the VHF mobile radio system to Crawford Bay, resulting in occasional interference amongst these varied uses.

Dial access to Transmission substations: Lambert and Princeton are transmission stations that only have dial up telecommunications to the control rooms, which could be blocked given a public emergency in the area.

6.9 Wide Area Network and Administrative Voice

6.9.1 Description and Planning Criteria

The FortisBC enterprise Wide Area Network (WAN) is used extensively by operations crews in their work order process, and by other personnel for access to meter, relay and digital fault recorder information. The company wide voice system is used by FortisBC personnel in ten office locations and most transmission and generation stations. Both are supplied by

Telus as an enterprise voice and data system, based largely on the Telus ATM network. The Telus contract is presently being renegotiated, with an expected decision by year end 2004.

6.9.2 Existing facilities

The WAN will extend (after 2005) to nine district offices, nine terminal stations, nine dam locations, SCC, Bell Terminal, the Trail office, and Calgary. The Telus ATM network is used for WAN access to most offices, the FortisBC fibre network is used for the terminal and dam stations, SCC, Bell and Benvoulin Road. Wireless access is available in Warfield, Benvoulin and Trail, dial access is available from other locations not served by the WAN. Access to critical substation operating functions is protected by firewall.

A test of spread spectrum radio technology for WAN bus extension is presently underway from Benvoulin to Lee. This will complete when the Okanagan fibre loops are completed in 2005.

6.9.3 WAN and Administrative Communication Deficiencies

Operations and Maintenance costs from Telus for WAN and voice channels on their ATM network are significant, and are increasingly being avoided by using the FortisBC fibre facilities for 10 MbpS WAN busses (used operationally for access to meters and protection relay information), and for voice. This will continue as the fibre network grows to more locations.

WAN access to more locations and at higher transmission speeds would be useful to FortisBC operations personnel, particularly as increasing amounts of data on status and condition of the Transmission and Distribution system become more available.

6.10 Neighboring Utilities

FortisBC communications, control and protection systems governing the operation of the system interface with BC Hydro and TeckCominco at several system points. In addition, BC Hydro will be providing two T-1 channels for FortisBC use from Vaseux Lake to Kootenay Canal, which will be used for partially interconnecting the existing fibre rings in the West Kootenay to the Okanagan region ring (2005).

There are no further changes foreseen to the TeckCominco interfaces after the completion of the 230 kV changes in the West Kootenay area in 2004.

BC Hydro has an aggressive capital plan for 2005 – 2010. No major impacts on FortisBC telecommunications facilities as a result of this BC Hydro work are evident at this time, beyond the changes resulting from the South Okanagan Supply Reinforcement Project. However, the BC Hydro projects as they develop may have an impact and thus bear watching. Example BC Hydro projects that should be monitored for possible operational or planning impact on FortisBC telecommunications include:

- BC Hydro Growth – "Nelway 71 Line Re-termination" – year unknown
- BC Hydro sustaining – "5L77/79/91/92/30 – Line Protection Replacement" – 2005
- BC Hydro sustaining – "Line Protection Replacements - 500 kV, Stage 1 (5L98)" – was scheduled for 2004, possibly included in the South Okanagan Supply Reinforcement Project.

6.11 Backbone Telecommunications System

6.11.1 Description and Planning Criteria

Criteria - FortisBC-owned private telecommunications are installed where:

- Protection designs require communications,
- Non blocking communications must be available for use in contingency circumstances (e.g. mobile voice)
- Traffic volumes are such that a private shared system is more economic.
- If radio is used, licensed frequencies are required for teleprotection and SCADA, unlicensed bands may be used for metering and administrative traffic.
- Fibre optics cable is the preferred option where future traffic growth is anticipated.

6.11.2 Existing facilities

FortisBC uses a combination of fibre, leased circuits, power line carrier, BC Hydro circuits, 900 MHz. microwave, and VHF radio. Wireless spread spectrum technology is presently being tested.

Vernon – Oliver: presently power line carrier, will be upgraded to folded loop fibre (including Joe Rich and Benvoulin) in 2005. FortisBC has access to:

- 6 fibres Vernon – Anderson;
- 12 fibres Anderson to OK Falls;
- 72 fibres OK Falls to Vaseux Lake
- 40 fibres Vaseux Lake to Oliver.

Princeton – Oliver: 4-w leased line for SCADA, dial-up for meters.
Oliver – Mawdsley: existing Power line carrier, BC Hydro 2T-1's (2005)
Mawdsley – Brilliant Terminal Station: Trail (South) Ring - folded loop fibre
Brilliant Terminal Station – South Slocan and Plants: River Ring - folded loop fibre
South Slocan – Coffee Creek: Power line carrier, VHF radio to Crawford Bay
Brilliant Terminal Station – Kraft: Power line carrier
Joe Rich – Big White (2005): Power line carrier

FortisBC has been implementing a progressive change to fibre facilities where required by transmission improvements, then progressively converting other circuits to the fibre facilities - e.g.: some operations Centrex voice circuits to SCC, WAN facilities to substations and plants, and Telus 4-w circuits rearranged to the closest fibre location to reduce Operations and Maintenance.

6.11.3 Backbone Telecom System Deficiencies

Oliver – Mawdsley cross section limited bandwidth (4 channels): This limitation will be somewhat relieved by the BC Hydro channels that will be installed from Vaseux Lake to South Slocan during 2005, but this solution does not provide for long term growth, nor redundancy. As traffic and reliability requirements build in coming years, this cross section will again become a constraint.

Folded loops: FortisBC fibre optics channels are engineered as redundant loop systems, but both loop directions are contained in the same cable sheath, which does not meet the "diverse path" requirement as standardized by the WECC.

Outer areas are weak: Telecommunications facilities to Princeton, Coffee Creek, Crawford Bay, Lambert, Kaslo and Kraft are very limiting, resulting in leased lines Operations and Maintenance costs, poor operating reliability, and no provision for growth.

6.12 Possible Future Requirements

It is challenging to create a 20 year plan for communicating systems in a transmission and distribution system when there are support technologies just in the embryonic stages of development. Although none of these are in active development at FortisBC, this plan assumes that some, not all, of the following application technologies will prove effective in the FortisBC system in the 2010 to 2025 time period. Any of them will have an effect, small or large, on the telecommunications and control systems of FortisBC, and thus should be considered in long term planning.

Video Surveillance: FortisBC has begun using video surveillance in several locations around the Warfield yard and in the Trail Office, carried on the FortisBC networks. In 2005, the Bell and Lee Terminals, both in vandalism – prone areas, will have video surveillance installed, routed to SCC on the network. Other utilities are also making more extensive use of video, even including in some cases using video to visually verify switch operation. Although the use of video will probably reach only a limited number of locations, it can consume large bandwidth. FortisBC's present strategy of implementing fibre for the telecommunications backbone is prudent for this and similar future applications as fibre provides ample bandwidth for growth.

Automatic Meter Reading (AMR): Utilities similar to FortisBC in size and geography have found AMR systems effective in reducing residential customer meter reading cost, errors and complaints. These systems can be implemented with a central computer and customer meter interface modules, and often use the distribution wires for local communications, coupled with the company's backbone telecommunications system. Sometimes the systems are shared with municipalities for combined electrical, water and gas meter reading.

Administrative Voice Traffic: It may become attractive to carry more of the FortisBC administrative traffic on the internal network, because of two factors:

(1) the increasing coverage of the FortisBC fibre backbone; and

(2) the developing technology (and suppliers) in Voice-over Internet Protocol (VoIP), as noted in the 2001 communications study.

At a minimum, holding this as an active possibility will assist in negotiations with common carriers such as Telus.

Demand Side Management (DSM) to Customers: As the electrical industry evolves, various versions of DSM and customer access to time of day or other rate choices may become prevalent. Implementing these may have a drastic effect on FortisBC's communications and control systems.

Feeder Automation: The technology for providing automated functions on distribution feeder lines (communicating mid-point reclosers, for example) is developing, and some utilities are finding these technologies beneficial. Benefits that contribute to the business case for feeder automation are more localized fault clearing, more accurate network monitoring, more intelligent protection and restoration switching designs.

Transformer Condition Monitoring: Advances in transformer instrumentation are allowing closer monitoring of this critical asset. For example, the newer transformers at Lambert, Warfield Terminal Station and Brilliant Terminal Station have Hydran oil monitoring equipment installed. This (and perhaps other future condition monitoring mechanisms) will require communications to a central database to capture and trend the information. This will likely have only a minor additional effect on the communications and control systems, as

the substation automation project will provide communications for this and similar low bandwidth requirements.

6.13 Projects

The major drivers of the development of the telecommunications systems at FortisBC are

- the completion of the backbone and
- substation automation.

Additionally, a number of particular cross sections and technical issues should be addressed:

- Off-backbone extensions: Princeton, Coffee Creek (TP), Kraft (TP)
- VHF piggybacking
- Kelowna Loop
- Wide Area Network extension to more locations

6.13.1 Mawdsley-Okanagan High Capacity Communication Network

Project Description: This project will enable the transfer of data at high speeds and volumes in FortisBC's entire service territory (Kootenay and Okanagan). This is required for system protection purposes as well as for monitoring and controlling the system remotely, and will displace Operations and Maintenance costs for east-to-west leased lines used for system control and operational communications. The project will be undertaken in segments, coincident with the decommissioning of 9 Line and10 Line and the replacement of the distribution substations along this route in 2005 - 2015.

Discussion: FortisBC has secured rights to fibre communications paths in the Vernon to Penticton area, and will be constructing fibre facilities from Penticton to Oliver as part of the South Okanagan Supply Reinforcement project. Previous high capacity communications exists in the Kootenay area. The overall communications system remains constrained (both in capacity and reliability) in the Oliver to Trail cross section. This causes increased Operations and Maintenance costs for leased facilities to compensate for the constraint, and a lower degree of system protection and control in this area and across the system from east to west. Improved protection and control capability on this cross section becomes more critical as the system becomes more fully interconnected and is operated closer to capacity.

The securing of some BC Hydro communications paths from Vaseux Lake to South Slocan will relieve some of the constraining effects of the Oliver – Mawdsley cross

section, but does not provide for redundancy or growth. Additionally, redundant paths east to west may be required for system protection and RAS improvements required by interconnection to the BC Hydro 500 kV system.

FortisBC is increasing the level of protection and control of the Transmission and Distribution system, including locations along this route. Accessing intermediate points (Grand Forks, Kettle Valley) on a telecommunications route in a “drop and insert” fashion is far less expensive with fibre loop technology rather than radio.

The understrung fibre option requires a review of the structure capacity and conditions of 11 Line. Deteriorated structures, clearance issues and span length considerations may drive up the cost of fibre in some parts of the build, and radio options may prove more suitable for some parts of this cross section. Conversely, a fibre sharing arrangement with another company could decrease the net cost of the fibre option dramatically. Detailed engineering and negotiations will determine the appropriate choices.

6.13.2 Distribution Substation Automation

Project Description: This multi-year project will extend the coverage of substation automation in the FortisBC system. This project broadens the integration and use of remote monitoring and control to distribution level substations, including the quality monitoring of lines, transformers and feeders, fault recording and locating, and equipment condition monitoring. It will provide common communications mechanisms for gathering, storage, access and analysis of the resulting data. Resulting benefits are improvements in system performance, productivity, safety and economics. The project includes the initial study to define the engineering standards and benefits, the development of a central data repository, individual projects in appropriate substations (synchronized with station rebuild or major addition), and an emergency backup plan.

Discussion: Utilities are increasingly recognizing the cost, safety and reliability advantages of substation automation. The improvement of technology in this field, the technical standards development by the Institute of Electrical and Electronics Engineers (IEEE), the International Engineering Consortium (IEC) and industry organizations, and the decreasing cost of these technologies will allow smaller utilities such as FortisBC to make the best of these advantages.

Substation automation is a “catch all” term used to describe the integration and use of system information from substations for the remote monitoring and control of substation equipment, the quality monitoring of lines, transformers and feeders, fault recording and locating, equipment condition monitoring, automatic closed loop switching, as well as common communications mechanisms for gathering, storage, access and analysis of the resulting data. Resulting benefits are improvements in system performance, productivity, safety and economics, as follows.

Substation Automation Benefits:

SCADA visibility and control

- Energy metering – wider and more exact visibility and monitoring of system load flow will allow more exact energy and VAR management, improving system performance and reducing energy costs.
- Recloser enable and disable – when brushing a rural line, auto reclosers must be disabled for safety reasons, requiring one visit to the substation by a PLT in the morning to disable reclosing, and one in the evening to re-enable them. Remote control avoids these labour costs.
- Line isolation switching – Faults will be sectionalized remotely and faster, improving restoration performance, and reducing Operations and Maintenance costs for line crews.
- Line source switching – Where distribution substations can be fed from two transmission lines (Playmor, Tarrys, Christina Lake, etc.), remote control of line switches enables faster restoration switching, and avoids labour costs to dispatch a lineman.
- Tap changer – extending remote control to more distribution tap changers will help to avoid exceeding the peak energy capacity penalty.
- Support for future feeder distribution automation, for example, midpoint reclosers which can localize the outage effects of a distribution fault.
- Breaker switching – energize remotely will speed restoration, rather than PLT returning to substation.
- Feeder switching – to one transformer if capacity permits, restores non-faulted feeders faster, or recovers from a faulted transformer.

Metering

- Individual feeder metering – more accurate load profiling (e.g. time of day, temperature variability) will assist system load balancing.
- Electronic meters improve time resolution of load data, and provide improved monitoring of quality factors - more accurate load profiling improves forecasting and system planning (avoids unnecessary capital), improved quality data supports troubleshooting and improves customer service.
- Remote access – more timely data analysis results in faster corrective actions.

Intelligent relays

- Remotely accessible fault location – speeds crew dispatch to the exact fault location, lowering outage times.
- Fault recording – improved fault analysis from accessing all appropriate data reduces future outages
- Condition monitoring – allows condition-based, “just in time” maintenance which reduces labour, outages, and equipment damage

Human Machine Interface (HMI)

- Reduces station complexity, standardizes station operator interface, allows remote operation.

Local Area Network (LAN) / Firewall

- Eliminates redundant sensors, wiring and transducers, which reduces capital cost. Prevents unauthorized access and operation.

Central database

- Provides more comprehensive and more accurate data for analysis of equipment condition, fault analysis and operational history, which will improve system reliability, safety and economics.

This project will ultimately enable remote operating and automated load and quality metering of all substations in the system. This will aid in averting equipment overloads and associated damage. The automation component will enable rapid remote circuit reconfiguration, thereby reducing outage times and reducing operating expenses associated with sending out crews to perform manual adjustments and switching. Equipment use will be better monitored, which will aid in the effective deployment of maintenance resources to the equipment experiencing the greatest loading.

The project requires the installation of intelligent electronic devices at many substations for data capture, as well as building a communications network to substations with no existing remote communications and building an informational database to accept the data.

The project includes a preparation stage followed by substation installations as follows:

Study, database and emergency response planning: The major hurdle to developing station automation is ensuring that a common platform is used to ensure that all of the intelligent electronic devices in the stations work with each other. This project includes the engineering study that is required to identify the common intelligent electronic devices being implemented inside the stations and to set standards for future systems. The study will also assess the benefits to be expected and establish a business case for proceeding. The project will also include the development of an emergency restoration plan for SCC. As SCC becomes more pivotal to the operation of the system, the risk of an evacuation–type contingency can no longer be tolerated. This project will also examine if minimum system operating capability can be restored elsewhere on the high capacity communications system by the provision of a spare operating station at that location, and if that would be justified.

As detailed standards and deployment plans have not yet been developed, this project is still in the planning stage. For outage coordination, safety and cost reasons, we

assume that substation automation installations will largely be done in coordination with other substation work.

Major terminal station work: Terminal automation changes and additions will be included in all major projects in terminal and switching substations. The required funds will be included in the budget amounts for that work, and are thus not included here.

New substation builds: during rehabilitation, rebuild, relocation or new sub projects. This project budgets only the automation and communications costs (remote terminal unit (RTU), LAN, communications, meters, hub, firewall, Positron, HMI, labour), but not the basic cost of the substation (switches, Schweitzer relays, DFR, transducers, potential transformers (PT), current transformers (CT), Hydran, building, battery) which, where appropriate, will be included in the substation project. Planning examples used for budgetary estimates are new substations at Ellison, Black Mountain, Braeloch, East Osoyoos and Kettle Valley, as well as rebuilds and upgrades at Grand Forks, Ruckles, Christina Lake and at the conversion of Oliver to a distribution substation.

New distribution transformer in distribution or transmission substation: Retrofit existing subs with standard automation and communications when adding a new transformer, major load redistribution or transformer rotation. Planning examples used for budgetary estimates are Crawford Bay, Recreation capacity addition, and transformer rotations at (old, west) Osoyoos, Westminster (rotation and breaker replacements), Pine Street, Trout Creek and Ymir.

Existing critical, remote or vulnerable lines or substations: Where substations serve long vulnerable lines where restoration efforts are difficult, or which have a significant customer load or significant effect on system loading, FortisBC can achieve significant operational benefits by increasing automation levels. The project includes SCADA controlled motor operated line switches to aid in sectionalizing and restoration, remotely controlled line switches to substations that have feeds off two transmission lines for restoration purposes, and remote substations.

6.13.3 Protection and Communications Upgrades

Project Description: This multiyear program will upgrade protection and control equipment in several substations, will upgrade telecommunications routes in the West Kootenay region, and will improve emergency response capability. The program is expected to continue at similar expenditure rates until 2015.

Discussion: Much of the FortisBC protection and telecom equipment is near or beyond its designed operational service life, some being up to 40 years old. It is no longer reliable, and the manufacturers no longer supply spare parts. In some extreme cases, equipment can no longer be tested and adjusted regularly because it fails when test systems are operated, and cannot reliably be put back into service.

The impact is that this equipment can cause failure of the transmission and distribution systems it supports, or prevent restoration efforts, exposing the system to possible equipment damage, extended outage times, or possibly causing public safety issues.

FortisBC will pursue a two-fold strategy to address this issue:

- upgrade parts of the telecom, protection and control systems regularly over several years, and
- prepare an emergency response plan and supply spare new systems that may be used in emergency restoration.

The 1999 System Protection Study performed by Acres International Ltd. identified the need for protection upgrading and replacement requirements for FortisBC's systems. This work was structured into a multi-year program that has been running since 2000 at a level of between $150,000 and $300,000, and at this rate, the identified work has not been capable of being completed. To work through the identified backlog, it is recommended to ramp up expenditures over the next years. The benefit of work captured in this category is primarily in system protection and control, and deferring this work would prolong the risk of system damage, and public exposure to obsolete protection techniques, and thus possible exposure to downed, energized lines.

There are two databases being developed to track what protection and telecommunications equipment is operational in the system, and its condition. This is the first step in developing the needs for the rehabilitation and maintenance of the equipment. The success of the rehabilitation program depends critically on this database work.

Since immediate replacement of all the "at-risk" equipment is impractical, emergency response planning for telecommunication, protection and control systems needs to be improved, a spare radio hop and other equipment should be provided, disaster planning, regular exercising of plan (emergency scenarios) and regular updating will be undertaken.

It is anticipated that the communication, protection and control upgrade expenditures will continue at a similar level as a result of implementing the communication

equipment test/maintenance process. The new process will identify and prioritize the required replacements.

6.13.4 Communications and Relay Testing and Maintenance Program Studies

FortisBC plans to carry out a study of the existing communications systems and required maintenance cycles to continue providing adequate communications service. The study will utilize test records, environmental factors, manufacturer recommended tests and maintenance cycles and operational history for existing circuits and equipment.

FortisBC is also undertaking a study of the protection relays in the system and the maintenance cycle requirements for each type of relay in each type of application. The data gathered will include the individual relay testing history, environmental situation, manufacturer recommended tests and maintenance cycle, and the operating history. Data will be accumulated in an existing FortisBC database, and the study will set standards for the maintenance program for relays, system wide.

6.13.5 VHF Narrowbanding (2004/05 project)

Project Description: This project will upgrade FortisBC's existing VHF mobile telecommunications equipment, driven by a spectrum management change from Industry Canada. The project will start in 2004 and be complete by 2005.

Discussion: Industry Canada is rearranging the VHF mobile communications band, with deadlines over the period 2004 – 2010. This will require equipment to use denser and narrower frequency band allocations than previous. FortisBC systems affected will be the mobile radios, portables, pagers, base stations, repeaters, and about 19 small SCADA RTU's with integrated VHF radios. Some equipment can be modified to comply and some will need to be replaced. These systems will encounter small but increasing risk of interference from other users over the next few years, so it is prudent to begin narrowbanding or replacing them at this time.

6.13.6 Telecommunications Backbone Loop Close

Project Description: This project will complete the FortisBC telecommunications backbone system into a loop configuration as commonly used by most utilities, and as required by WECC standards. The system will be completed in about 2020 by building fibre or radio channels from Vernon to South Slocan. Several sharing options with other companies will be explored before committing project monies.

Discussion: In the long term, providing a complete loop for the telecommunications systems will be required.

The medium term system (after the completion of the Okanagan fibre installations from Vernon to Oliver and the high capacity link from Oliver to Mawdsley), will be a series of interconnected folded loops. But the communications system will not be redundant in the strict sense, which requires alternate diverse paths. Diverse paths are required by WECC standards for bulk power systems and are normally used in utility telecommunications.

The BC Hydro channels acquired as part of the South Okanagan Supply Reinforcement Project provide a limited amount of path diversity which will cover some requirements for some years, but the Oliver – Kelowna (and Vernon) leg is unprotected. Long term loop closing requires a high capacity path from Vernon to South Slocan.

Several broad alternatives are available:

- Build fibre or microwave. This alternative is expensive ($10 – $20 million), will encounter environmental and land acquisition issues, and should be saved for a last resort.
- Unfold loops – short spans. The existing folded loops can be made somewhat more path diverse by selecting high risk areas and providing another fibre cable path for some kilometres around the risk location. (An example risk area is the part of 25 Line where the fibre cable is close to the road and a vehicle accident could cause an outage of both loop paths [same cable] and the transmission facility at the same time. Providing another cable route around the immediate area for one of the fibre loop paths would mitigate the risk.) Providing short loop paths in high risk situations (where the fibre cable runs beside roads, through high vandalism areas, over fire prone valleys, high impact TP or RAS cross sections, etc.) would reduce the folded loop vulnerability significantly, and may be sufficient to postpone the need for overall loop closing.
- Unfold Interior Loops – provide a diverse path for the interior loops (OLI – AS Mawdsley is a good candidate), since they carry the accumulated traffic from the end loops, and thus have more of a failure impact. This would result in a system that is fully redundant in parts. Continuing this strategy for other loops over years has the advantage of achieving a fully redundant system in smaller increments than the major “closing the loop” build.
- Tolerate risk and mitigate. Accepting that a long term communications disruption is possible, FortisBC can prepare for operating the system under this eventuality. Spare protection and communications equipment can be deployed in several locations, capability for operating the west area without SCC oversight may be developed, (perhaps a backup SCC in the west), databases could be duplicated several places, perhaps a backup customer call centre, and so forth. This

alternative would require significant response planning closely integrated across transmission, distribution, generation and administrative systems.

- BC Hydro negotiations. BC Hydro has assets that could prove extremely useful to FortisBC:
  - Channels from Vernon – SLC for emergency restoration only. BC Hydro is very adverse toward committing their bandwidth to others. But perhaps they would consider providing Vernon to SLC bandwidth limited to (a) a bona fide FortisBC emergency situation, (b) while it was spare and unused, (c) a limited length of time, and (d) a limited amount.
  - Vernon to Vaseux Lake channels from BC Hydro would loop the Okanagan area communications portion of the backbone nicely.
  - right of way sharing on 5L91 to reduce cost of build for fibre
  - Share their microwave sites? Install FortisBC OC3 radios at BC Hydro sites and towers, cooperative maintenance agreement.
  - Trade fibres Vaseux Lake to Waneta for channels Vernon – South Slocan, FortisBC staff have developed a scenario where BC Hydro might be interested in FortisBC dark fibres from Vaseux Lake to Waneta, such that they might consider a trade: upgrading their existing radio system to OC3 and giving FortisBC an OC1, preferably from Vernon to South Slocan, in return for the dark fibres.
- Shared build
  - Shaw or others, but the low population of the Castlegar – Trail area probably limits the interest of other companies. However, the government of BC is contemplating a broadband system to all communities in BC, similar to Alberta's SuperNet, and Telus has indicated a willingness to consider shared builds in this regard, so shared builds may be achievable in routes of interest to FortisBC.

Assuming some combination of the above will prove suitable for operating the system in the long term, $10 million is budgeted in year 2010+.

6.13.7 Business systems

Project Description: This far future project provides for the use of the FortisBC telecommunications system for possible future applications that may be developed for company operations in the period 2010 – 2025. In each case, use of the FortisBC telecommunications system will improve the performance of these systems, and lower the Operations and Maintenance costs for the telecom portion of the systems (displacing common carrier costs).

Discussion: As system operations mature in the long term and technology advances, more and more of the system operations will become dependent on communications and automation. It will become economically viable to use capacity on the FortisBC telecommunications backbone, when completed, for these applications, motivated by Operations and Maintenance savings. Example systems used for rough budgetary estimates might be:

(1) a VoIP system for company wide switched voice traffic that would displace a portion of the $150,000 per month Telus charges,

(2) a system-wide automatic meter reading system that would automate meter reading, reducing meter reading costs, reading errors, estimates, and re-reads, and

(3) Feeder automation. Although none of these application developments are certain, these and several others are possible, and it is prudent to assume that at least some of them will prove viable and proceed.

6.13.8 Harmonic Remediation

Project Description: This project provides for investigating and resolving harmonic problems as they arise.

Discussion: FortisBC's experience with harmonic difficulties is that they arise periodically and typically need to be investigated, although only infrequently mitigated. FortisBC has recently resolved a harmonic problem in Kaslo with a harmonic filter, and has data gathering and investigations underway on 43 Line, in the Glenmore area, and on 20 Line. Investigation involves installing test equipment for a period of time, then engaging a consultant for detailed analysis.

6.13.9 Creston Central Protection Upgrade (plus RTU)

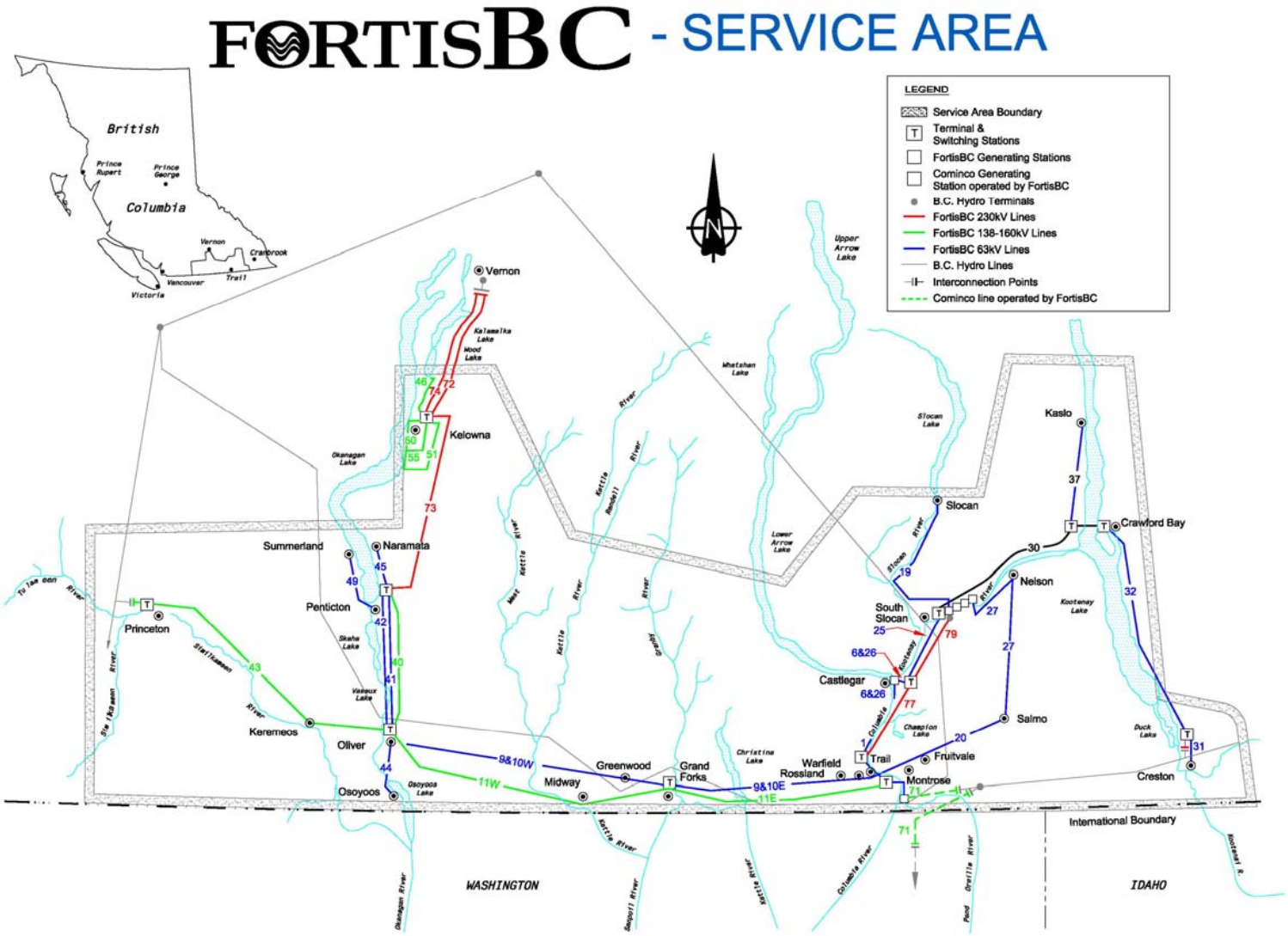
Project Description: The project will establish state of the art electronic protection and metering for feeders as well as improved line transfer trip protection for transformer fault clearing and an RTU for proper control and status reporting of station condition. The work will be completed in 2005. The existing systems in Creston are obsolete, and have not been updated or coordinated with the changes in Lambert.

Discussion: 1998 fault studies confirmed inadequate protection for feeders, and this has been experienced by field staff. The existing 200E transformer high side fuses do not coordinate with 31 Line and 32 Line protection at Lambert Terminal. They are also too large to reliably recognize 13 kV bus ground faults or to provide backup for the distribution feeder protection. A breaker failure, protection failure, or bus fault will result in loss of total station by protective relay operation at Lambert (31 Line distance protection). Inadequate metering creates operational and planning inaccuracies.

Appendix A – Maps and Diagrams

1. FortisBC Service Area
2. System Single Line Diagram
3. Okanagan Region System
4. Kootenay Region System
5. Boundary Area System
6. Neighboring Systems
7. New Osoyoos Substation
8. Boundary Area Conversion
9. South Okanagan Upgrade
10. Kootenay Area Upgrade
11. Kelowna Official 2020 Community Plan - New Residential Development

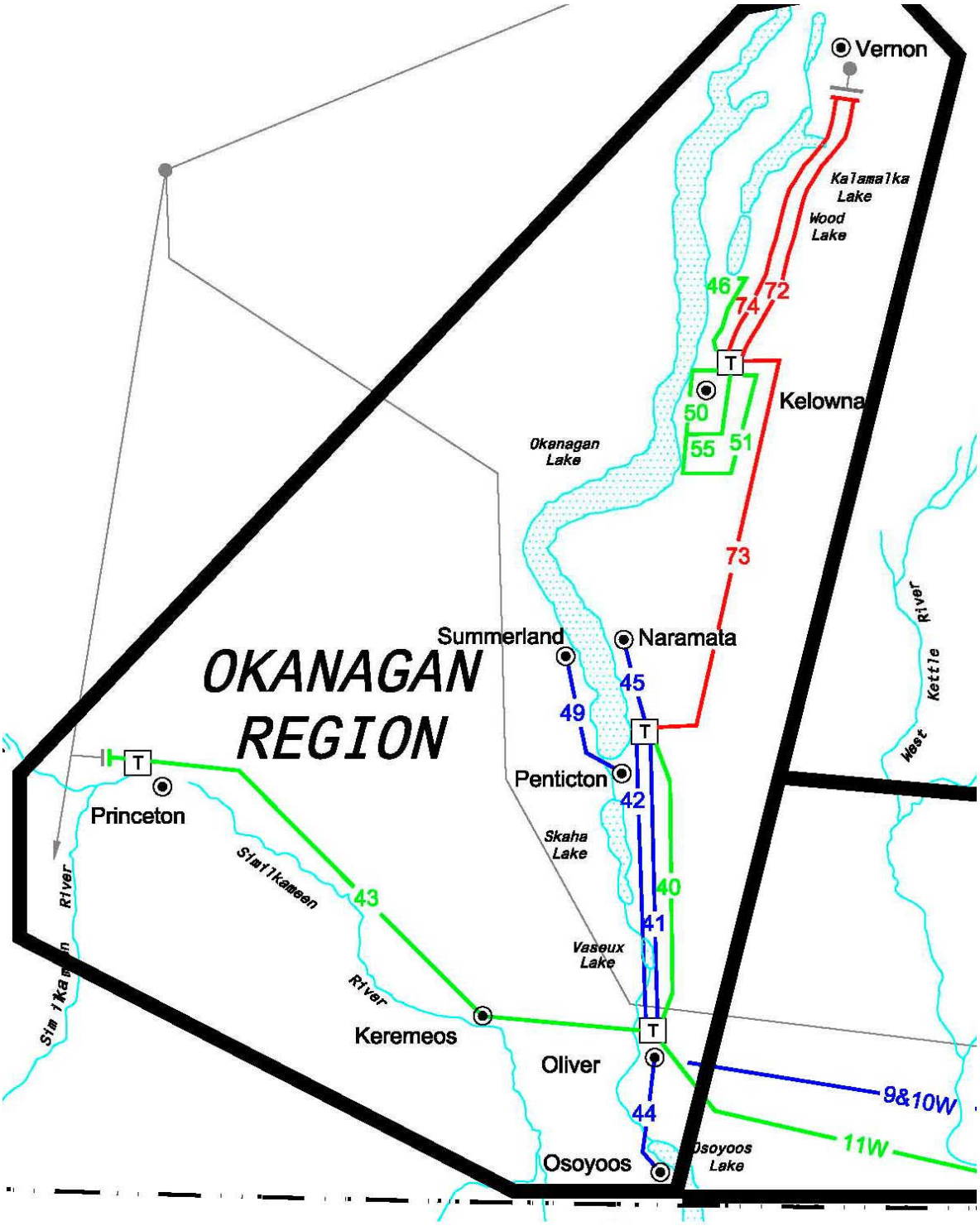
1. FortisBC Service Area



2. System Single Line Diagram

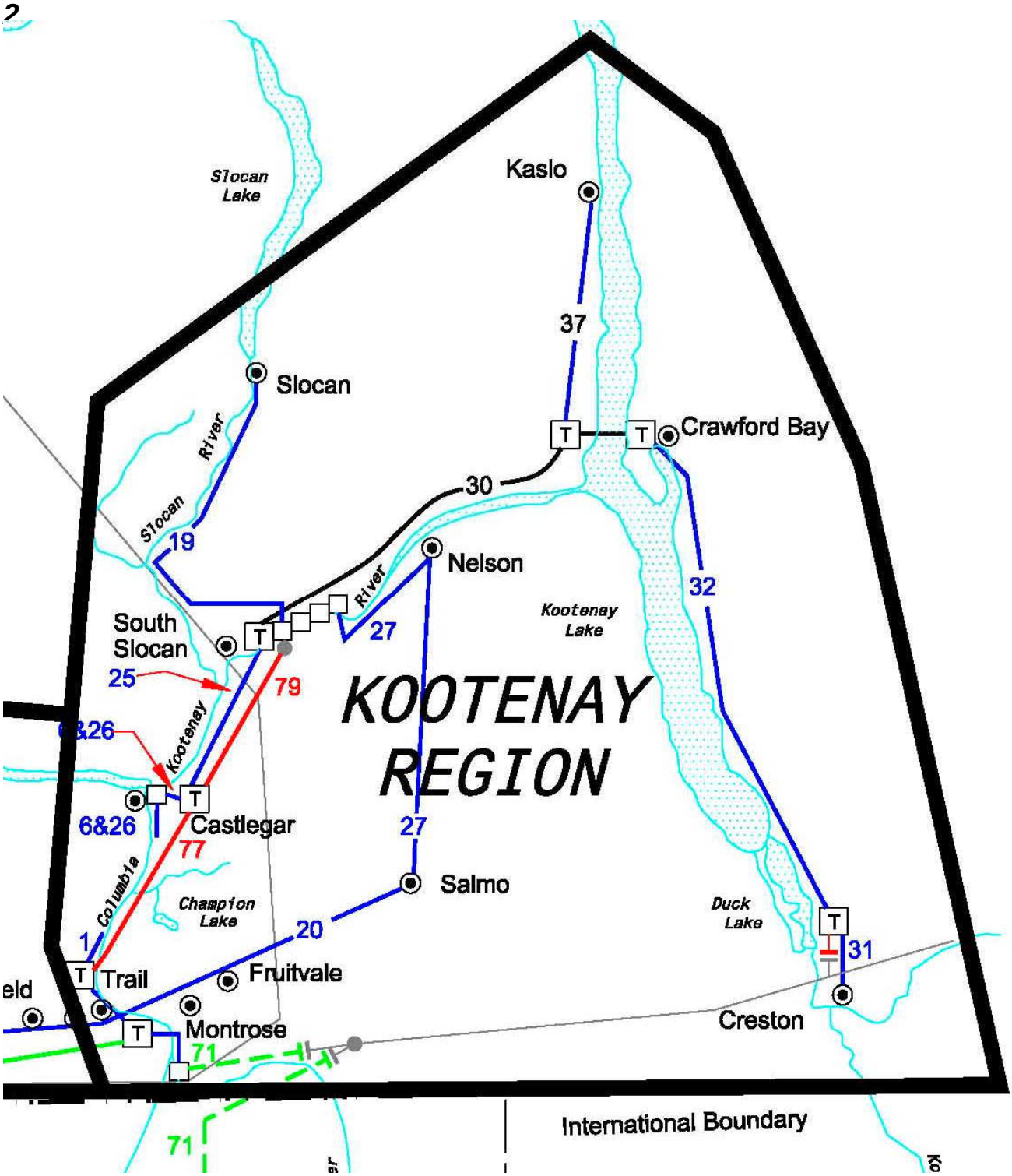
Single Line Diagram is available in Hard Copy only.

3. Okanagan Region System

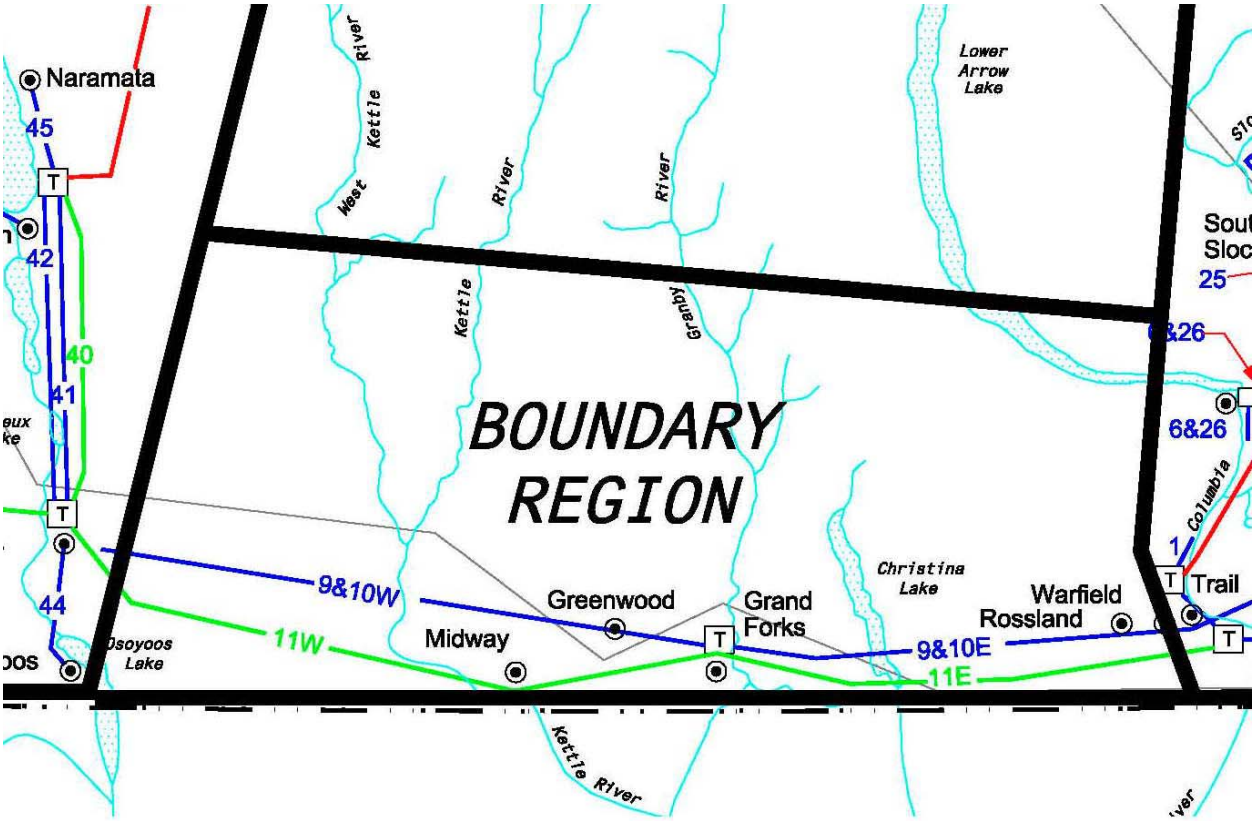


4. Kootenay Region System

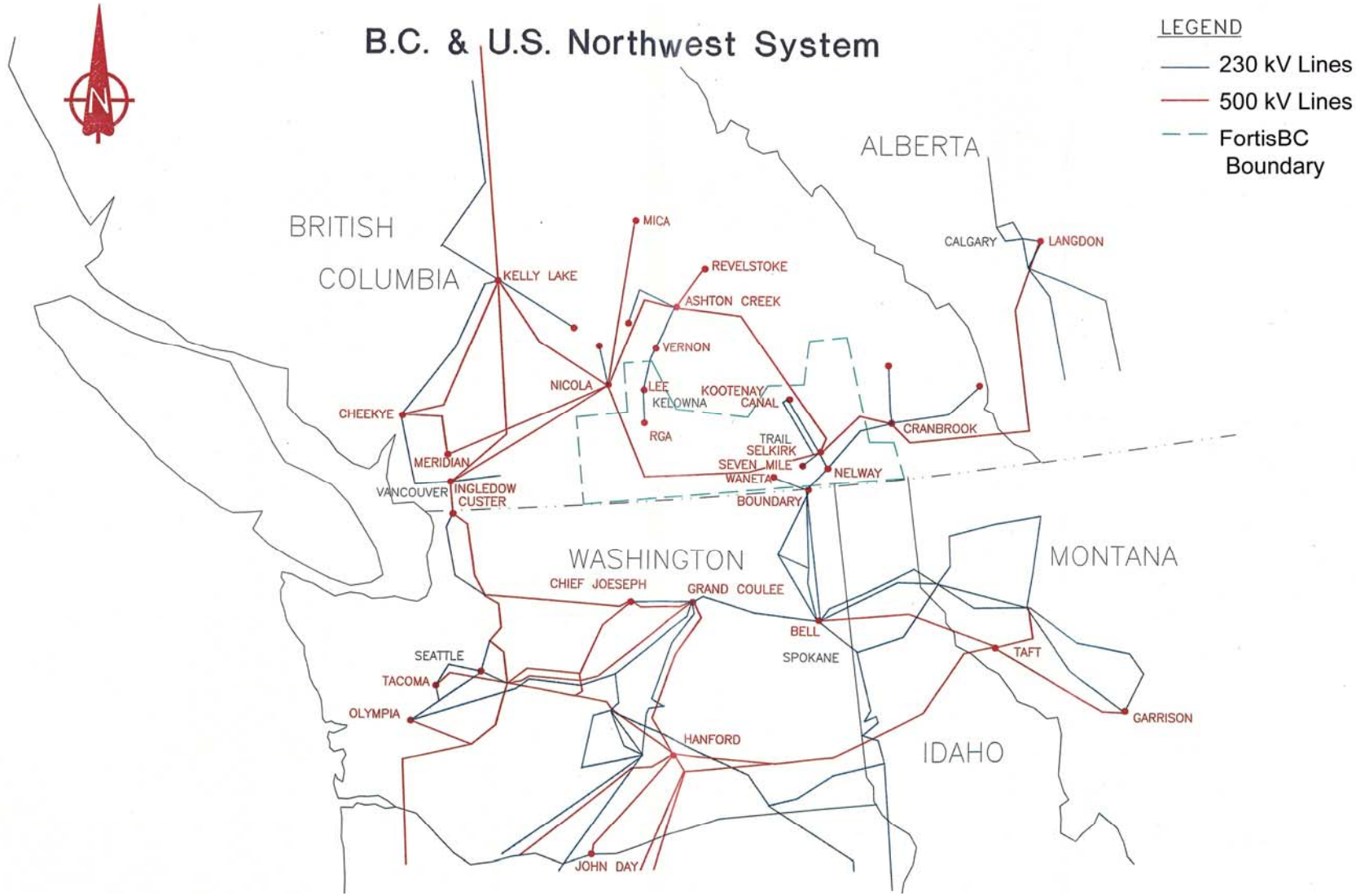
2



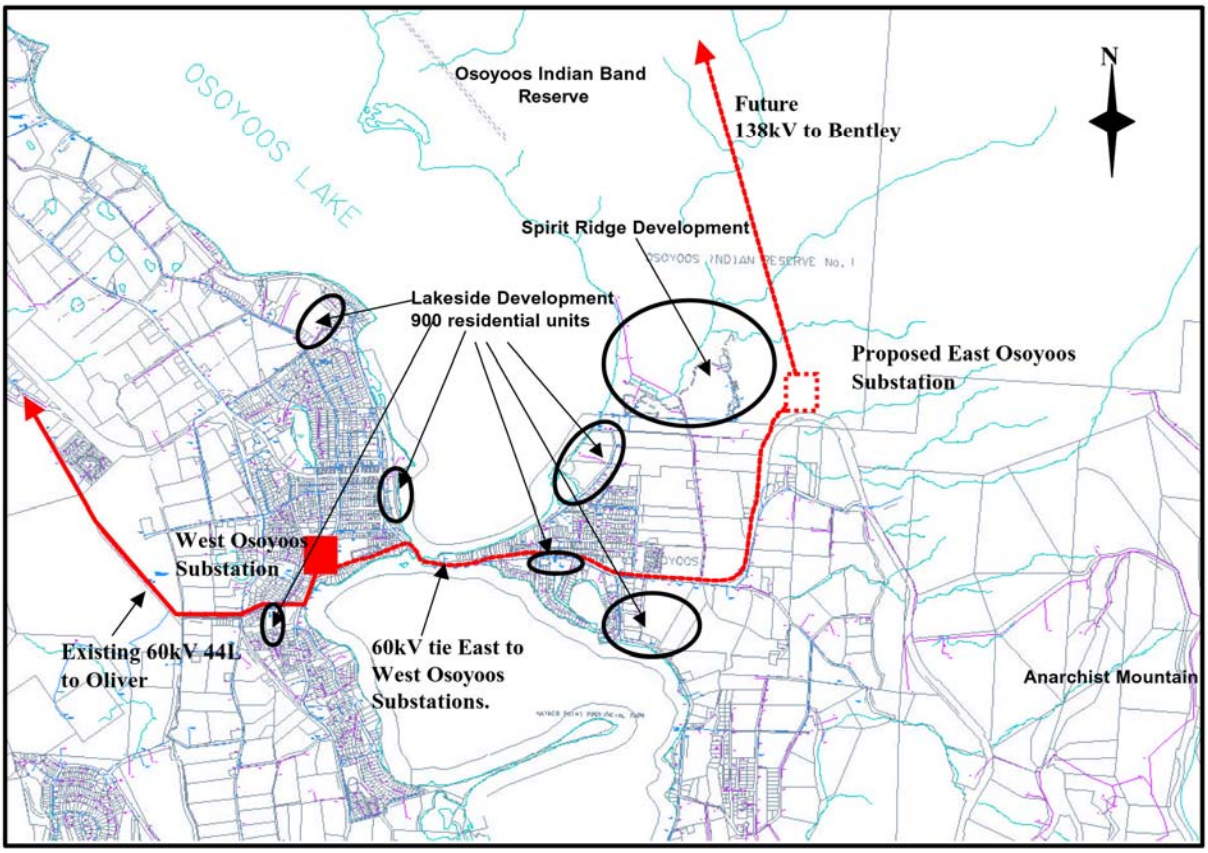
5. Boundary Area System



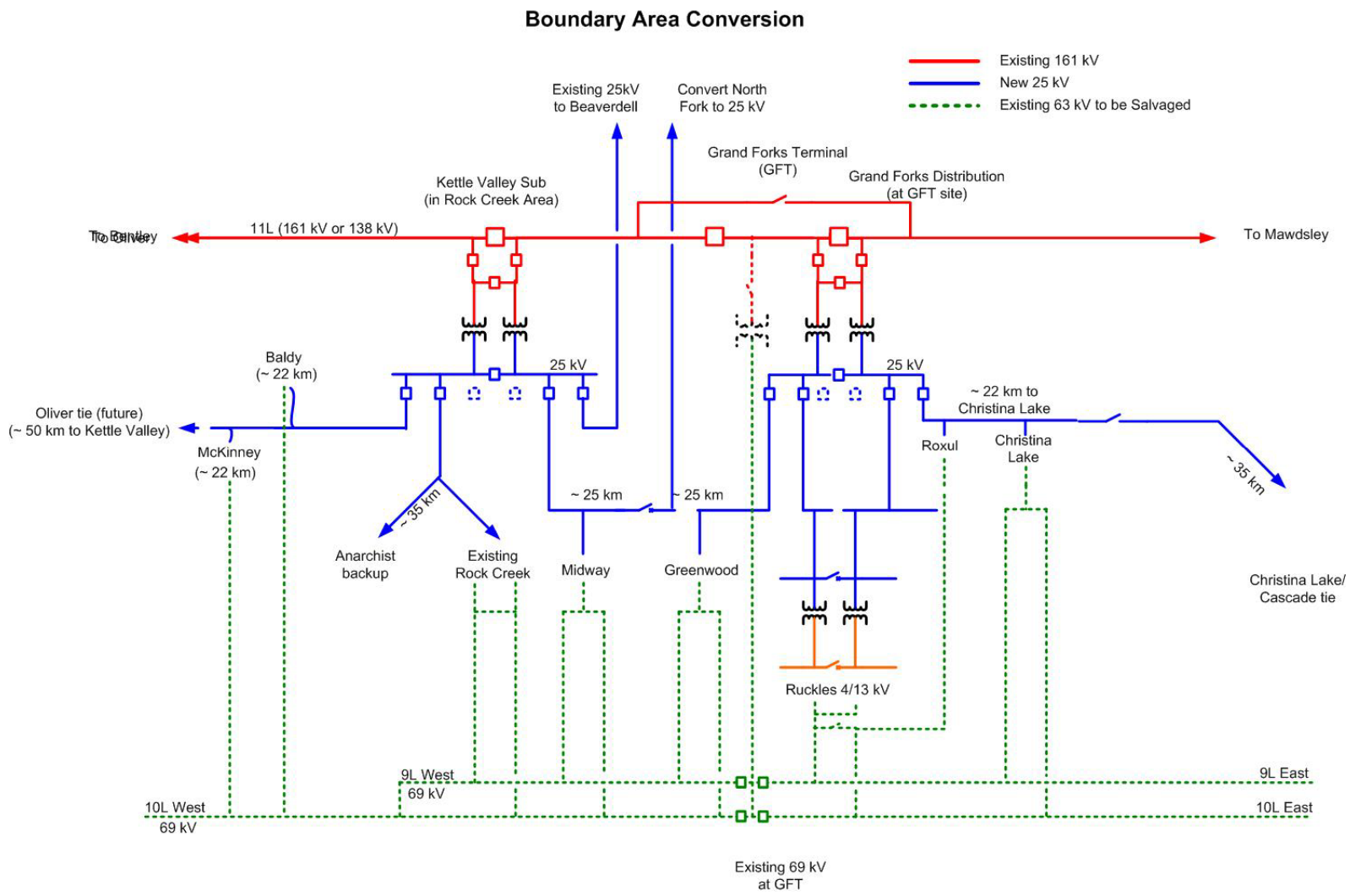
6. *Neighboring Systems*



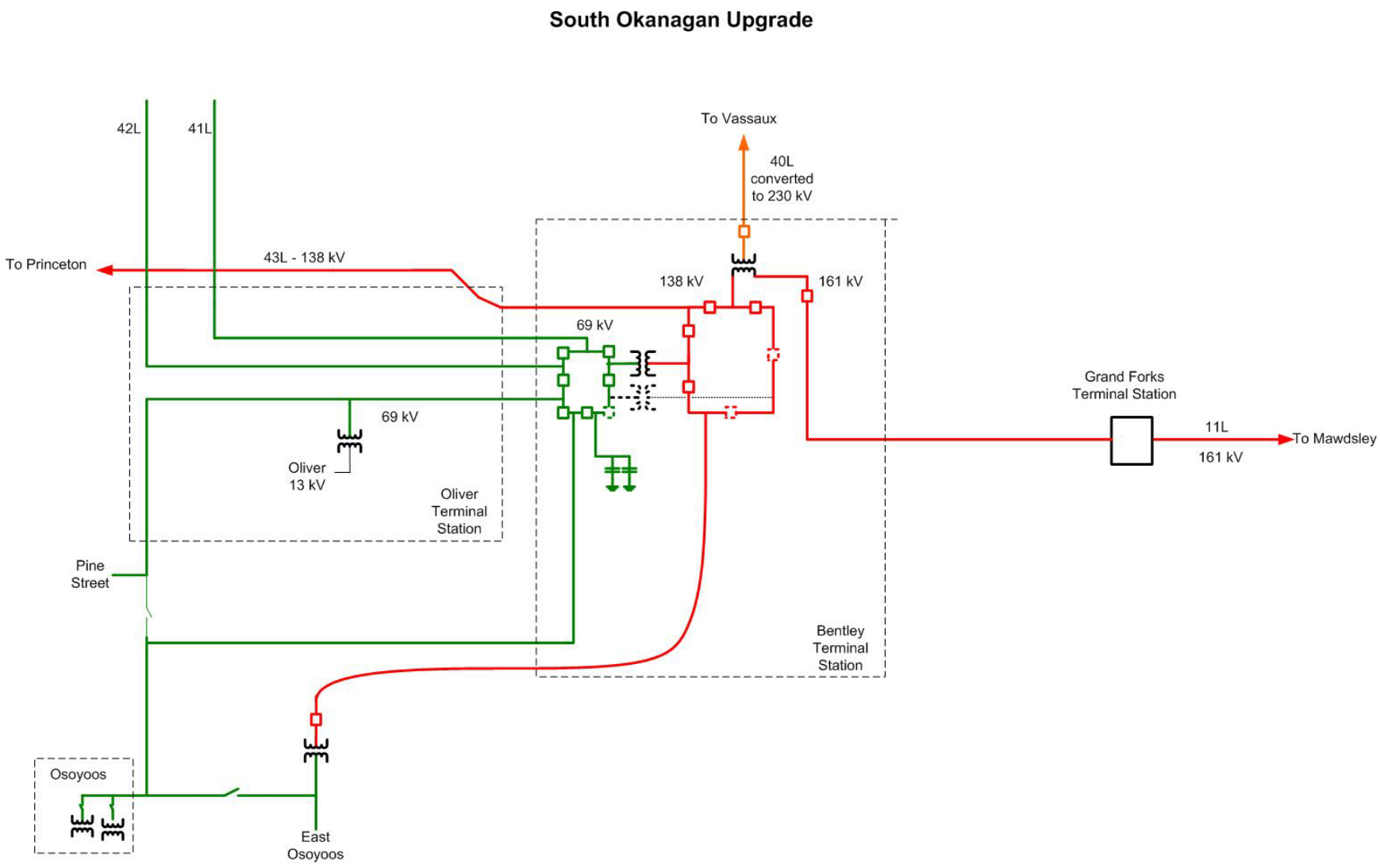
7. New Osoyoos Substation



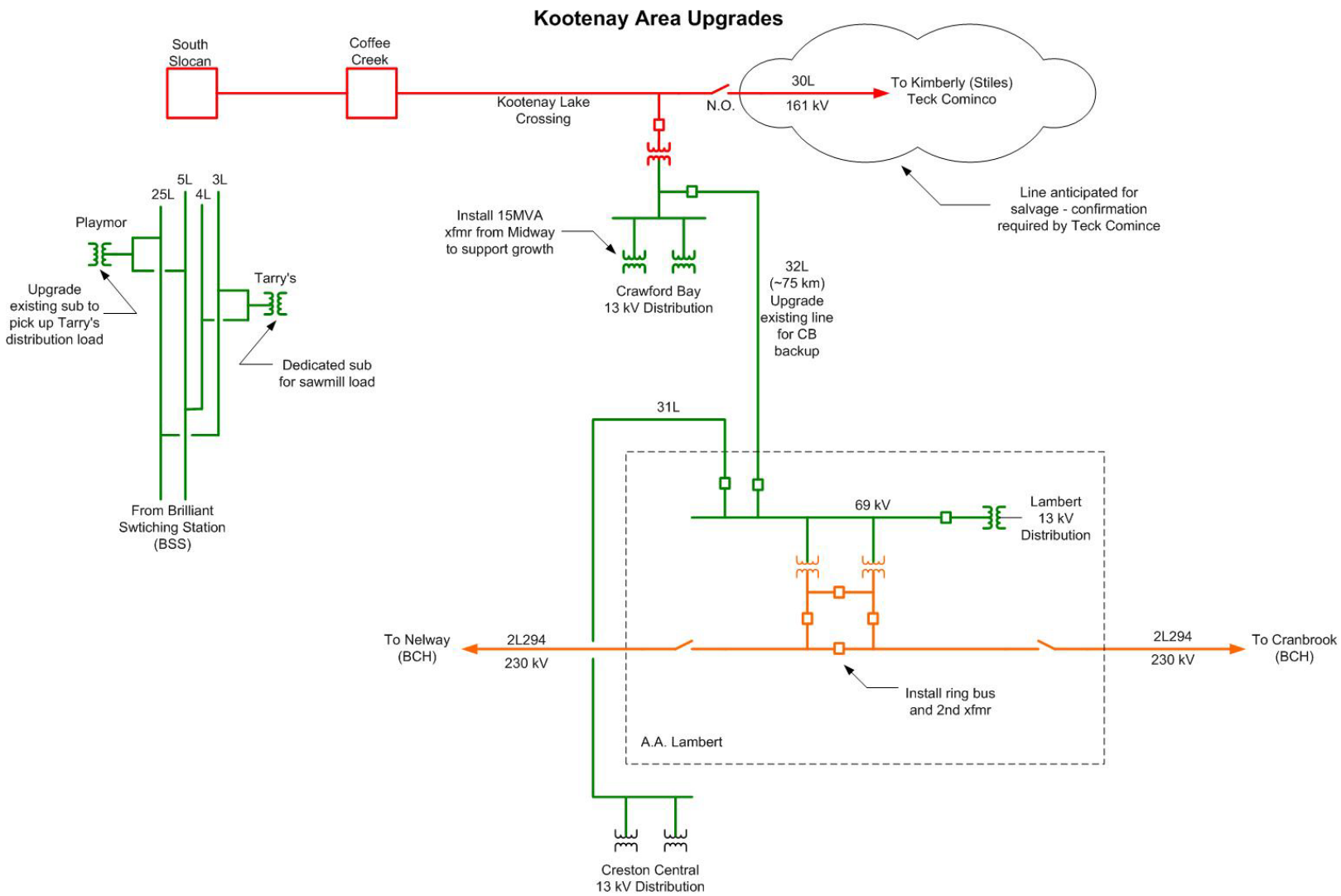
8. Boundary Area Conversion



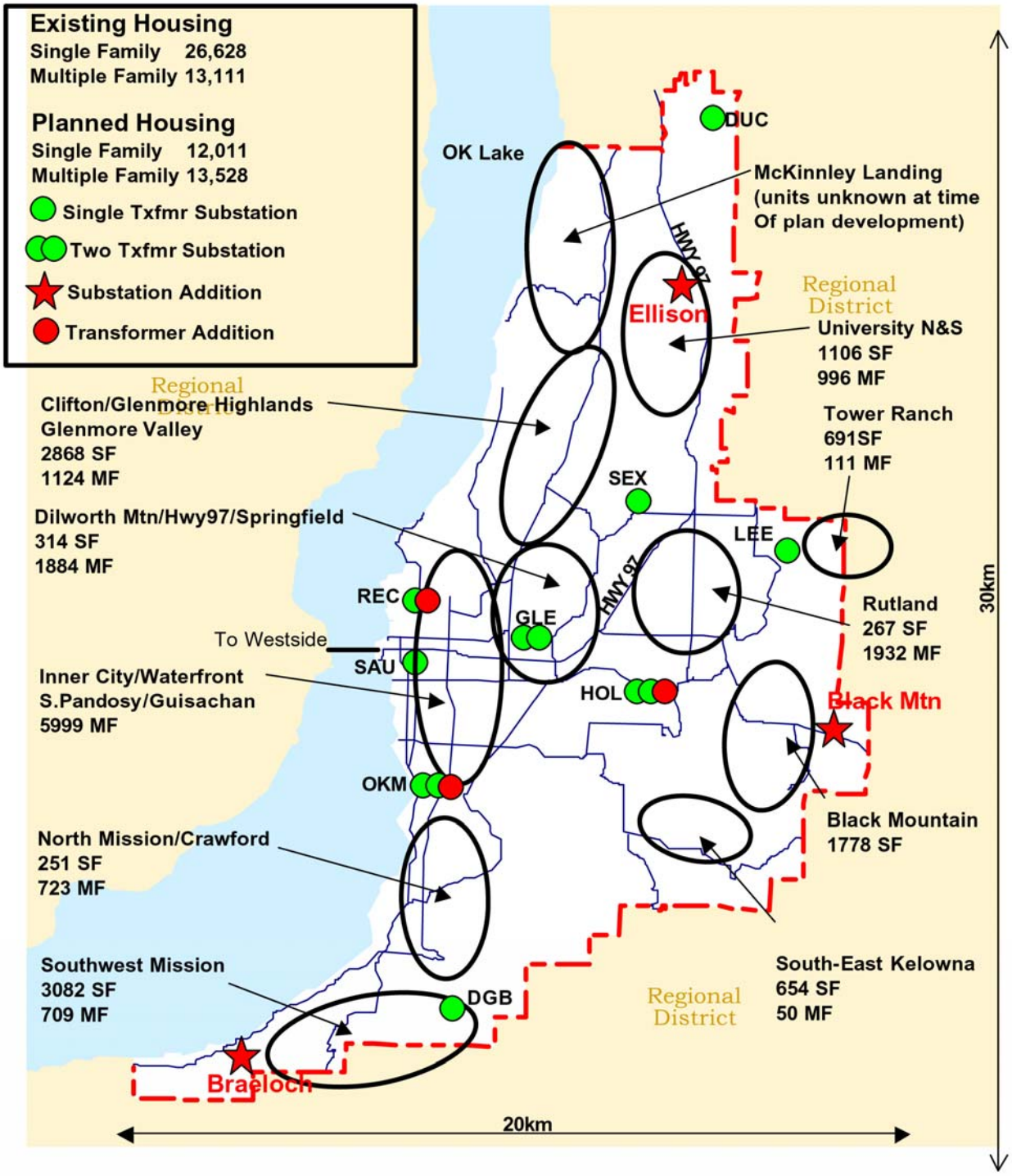
9. South Okanagan Upgrade



10. Kootenay Area Upgrade



11. Kelowna Official 2020 Community Plan - New Residential Development



Appendix B – Load Forecast

- Note that the "Ultimate" loadings in these listings indicate expected load in the year 2023.
- Substations are listed under the BC Health Districts in which they are physically located, although some feeders connected to certain substations may serve a small portion of load in an adjacent district.

Central Okanagan (Kelowna)

					PROJECTED - LOADING						
					2004 kVA	2005 kVA	2006 kVA	2007 kVA	2008 kVA	2009 kVA	Ultimate kVA
BUS NUM	Name	Transforme	PF		1	2	3	4	5	6	
52607	Glenmore	T2 & T3	0.98	W	41811	42274	38379	38639	38991	39389	49934
52613	Hollywood	T1 & T3	0.99	W	41097	41729	48974	49619	50376	51188	69082
52614	Okanagan M	T1 & T2	1.00	W	35586	36437	35045	36184	37391	38630	61035
52608	Recreation	T1	0.99	W	22096	22221	22189	22373	22610	22873	29450
52606	Sexsmith	T1	0.98	W	28275	29826	27257	28577	29942	31326	54895
52609	Saucier	T1	0.99	W	21755	21663	21427	21406	21438	21499	25025
52619	Joe Rich	T1	0.97	W	15548	18890	21675	24583	27496	30401	75486
52691	Duck Lake	T1	0.98	W	4514	4723	4848	5016	5194	5375	8623
52604	D.G. Bell	T1	0.99	W	15957	17121	20319	21445	22603	23772	43356
52208	Lee	Tertiary	0.97	W	18301	19051	19280	19688	20138	20608	29841
				Total	244941	253935	259393	267530	276179	285062	446725
				Growth		3.67%	2.15%	3.14%	3.23%	3.22%	

Okanagan-Similkameen

					PROJECTED - LOADING						
					2004 kVA	2005 kVA	2006 kVA	2007 kVA	2008 kVA	2009 kVA	Ultimate kVA
BUS NUM	Name	Transforme	PF		1	2	3	4	5	6	
52649	Huth	T7/T4-6	0.97	W	15533	15754	15793	15937	16082	16227	19881
52664	Huth	T8	0.99	W	12623	12544	12575	12690	12805	12920	15830
52621	KAL1	T1	0.97	W	4431	4494	4505	4546	4588	4629	5671
52650	Naramata	T1	0.97	W	7039	7139	7157	7222	7288	7354	9010
52622	Okanagan F	T1	0.95	W	13775	14265	14301	14431	14562	14693	18002
52654	Summerlan	T2	0.99	W	16732	16627	16669	16821	16974	17127	20984
52663	Waterford	T1	0.99	W	10498	10432	10459	10554	10650	10745	13165
52656	West Bench	T1	0.97	W	6409	6500	6517	6576	6636	6695	8203
52651	Westminste	T1/T2	0.99	W	22634	22493	22550	22755	22962	23168	28386
52655	Trout Creek	T1	0.97	W	7183	7286	7304	7370	7437	7504	9194
52629	Keremeos	T1	0.98	W	10928	10970	10998	11098	11199	11300	13844
52630	Hedley	T1	0.99	W	4651	4622	4633	4675	4718	4760	5832
1	HED4	step up?	0.97	W	0	0	0	0	0	0	0
52632	Anderson	T3	0.98	W	13620	13673	13708	13832	13958	14084	17256
52623	Princeton	T3	0.95	W	18298	18949	18997	19170	19345	19518	23914
52230	HED138 - P	m PSSE mo	0.96	W	2347	2388	2389	2390	2391	2392	2570
52426	Mas138 - P	m PSSE mo	0.98	W	1623	1618	1618	1619	1620	1620	1741
52647	Pine Street	T1 & T2	0.98	W	17067	17082	17125	17281	17438	17595	21558
52648	Osoyoos	T1 & T2	0.98	W	16532	17527	18594	19737	20948	22231	27238
52243	Oliver	T1	0.97	W	7986	8099	8120	8193	8268	8342	10221
				Total	209909	212462	214013	216899	219870	222905	272501
				Growth		1.22%	0.73%	1.35%	1.37%	1.38%	

Central Kootenay

					PROJECTED - LOADING						
					2004 kVA	2005 kVA	2006 kVA	2007 kVA	2008 kVA	2009 kVA	Ultimate kVA
BUS NUM	**Name**	**ransforme**	**PF**		1	2	3	4	5	6	
52603	Kaslo	T1	0.97	W	8009	8075	8119	8227	8325	8428	9741
52672	Coffee Cree	T3	0.95	W	7645	7708	7750	7852	7946	8044	9297
52670	Crawford Ba	T2 & T3	0.96	W	5484	5529	5559	5632	5700	5770	6669
52755	VAL1	T1	0.99	W	4194	4228	4251	4308	4359	4413	5101
52750	Passmore	T1	0.94	W	3629	3659	3679	3728	3772	3819	4414
52714	Playmor	T1	0.98	W	11007	11097	11158	11306	11441	11582	13386
52751	SLO1	T1	0.97	W	4328	4364	4388	4446	4499	4554	5264
52713	Tarry's	T1	0.95	W	3286	3313	3331	3375	3416	3458	3996
52754	YMR1	T1	0.97	W	1090	1099	1105	1120	1133	1147	1326
52615	Castlegar	T1	0.99	W	9238	9313	9364	9488	9601	9720	11234
52612	Blueberry	T1	0.98	W	8022	8088	8132	8240	8338	8441	9757
52252	CON63 - PS	m PSSE mo	0.99	W	24813	25016	25152	25486	25790	26108	30176
52916	CEL63 - PS	m PSSE mo	0.98	W	12076	12175	12242	12404	12552	12707	14687
52917	WST63 -PS	m PSSE mo	0.98	W	5631	5678	5709	5784	5853	5925	6849
52653	WHI1	T1	0.95	W	329	331	333	338	342	346	400
52730	Salmo	T1	0.95	W	6830	6886	6924	7016	7099	7187	8307
52702	Wynndel	T1	0.97	W	4123	4157	4180	4235	4286	4339	5015
52708	Creston	T1 & T2	0.97	W	27333	27557	27707	28074	28409	28760	33241
				Total	147069	148275	149082	151059	152861	154746	178857
				Growth		0.82%	0.54%	1.33%	1.19%	1.23%	

Kootenay - Boundary

					PROJECTED - LOADING						
					2004 kVA	2005 kVA	2006 kVA	2007 kVA	2008 kVA	2009 kVA	Ultimate kVA
BUS NUM	Name	Transforme	PF		1	2	3	4	5	6	
52704	CHR1	T1	0.99	W	3490	3514	3524	3563	3598	3631	4001
52605	Ruckles	1-13KV & 4.	0.97	W	17037	17156	17203	17395	17565	17726	19533
52598	Ruckles	T2	0.97	W	9170	9234	9259	9363	9454	9541	10513
52681	GFT1	T3	0.99	W	4029	4058	4069	4114	4154	4193	4620
52707	Midway	T1	0.95	W	6801	6848	6867	6944	7012	7076	7797
52689	ROC1	T1 & T2	0.95	W	3112	3134	3142	3177	3209	3238	3568
52690	BAL1	T1	0.79	W	682	687	689	696	703	709	782
52706	Greenwood	T1	0.95	W	2069	2083	2089	2112	2133	2153	2372
52626	Hearns	T1	0.95	W	252	254	254	257	260	262	289
52628	Fruitville	T1	0.89	W	8385	8443	8467	8561	8645	8724	9613
52723	Trail	T1	0.97	W	2533	2551	2558	2586	2611	2635	2904
52627	Beaver Park	T1	0.97	W	6185	6228	6245	6315	6377	6435	7091
52722	Glenmerry	T1	0.97	W	9905	9975	10002	10114	10213	10306	11357
52611	Stoney Cree	T1	0.97	W	5846	5887	5903	5969	6028	6083	6703
52703	PAT1	T1	0.97	W	812	818	820	829	838	845	931
52601	Cascade	T1	0.99	W	7389	7441	7461	7544	7618	7688	8472
				Total	87696	88310	88554	89541	90417	91247	100546
				Growth		0.70%	0.28%	1.11%	0.98%	0.92%	

Appendix C - Capital Forecast Summary

CATEGORY	05-'10 Total	Project Total	2004	2005	2006	2007	2008	2009	2010	2011+
	($000s)									
TRANSMISSION	284,677	368,762	53,885	67,051	60,136	40,100	50,380	48,160	18,850	30,200
Transmission Growth	235,267	314,880	50,613	52,381	49,936	34,000	45,500	42,100	11,350	29,000
Transmission Line Sustaining	21,410	23,482	2,072	8,620	2,900	2,300	2,530	2,660	2,400	0
Stations Sustaining	28,000	30,400	1,200	6,050	7,300	3,800	2,350	3,400	5,100	1,200
DISTRIBUTION	82,961	101,631	11,670	19,782	15,640	10,985	12,026	13,135	11,394	7,000
Distribution Growth	44,661	57,811	6,150	11,732	9,590	4,935	5,976	7,085	5,344	7,000
Distribution Sustaininng	38,300	43,820	5,520	8,050	6,050	6,050	6,050	6,050	6,050	0
TELECOM, SCADA, P&C	20,629	44,979	100	2,007	4,382	3,515	5,085	1,890	3,750	24,250
Telecom Growth	13,700	34,200	0	600	3,500	2,000	4,000	600	3,000	20,500
Telecom Sustaining	6,929	10,779	100	1,407	882	1,515	1,085	1,290	750	3,750
TOTAL T&D CAPITAL FORECAST	388,267	515,372	65,655	88,840	80,158	54,600	67,491	63,185	33,994	61,450

Transmission Projects

TRANSMISSION PROJECT DESCRIPTION	05-'10 Total	Project Total	2004	2005	2006	2007	2008	2009	2010	2011+
	($000s)									
TRANSMISSION GROWTH										
BULK SYSTEM										
KOOTENAY 230 KV DEVELOPMENT	-3,133	12,280	15,413	-3,133						
SOK PROJECT (VASEUX LAKE TERMINAL)	42,287	69,487	27,200	38,809	3,478					
KELOWNA AREA UPGRADE	10,863	13,363	2,500	8,105	2,758					
DOUBLE CIRCUIT 230 KV VAS TO RGA	29,500	29,500				3,500	16,500	9,500		
230/161/138 BENTLEY TERMINAL	20,500	20,500				500	5,000	15,000		
230 KV VASEUX TO BENTLEY	5,000	5,000				500	1,000	3,500		
KELOWNA SHUNTS & SVC	2,000	17,000					1,000	1,000		15,000
T3 VAS (500/230 KV)	1,500	5,000					500	1,000		3,500
KELOWNA AREA										
BIG WHITE 138 kV LINE & SUBSTATION	24,500	26,000	1,500	3,000	5,500	16,000				
ELLISON DISTRIBUTION SOURCE	8,250	8,250		250	1,500	6,500				
BLACK MOUNTAIIN DISTRIBUTION SOURCE	7,250	7,250		250			7,000			
FAULT LEVEL REDUCTION	2,000	2,000		1,000	1,000					
CLOSE 138 KV LOOPS KELOWNA	12,000	12,000			500	4,000	4,000	3,500		
RECREATION CAPACITY INCREASE	2,000	2,000					2,000			
HOLLYWOOD CAPACITY INCREASE	2,000	2,000					2,000			
BRAELOCH (SW) DISTRIBUTION SOURCE	1,250	4,750							1,250	3,500
OK MISSION CAPACITY INCREASE	0	3,000								3,000
PENTICTON/SUMMERLAND AREA										
WATERFORD UPGRADE	1,700	1,700		1,700						
NARAMATA REHABILITATION	3,250	3,250		2,000	1,250					
HUTH REBUILD AS 63 KV RING BUS	5,000	5,000							5,000	
SUMMERLAND 63kV BACKUP	2,700	2,700						600	2,100	
OSOYOOS/OLIVER AREA										
NEW EAST OSOYOOS SOURCE	5,750	5,750		250	5,500					
CONVERT EXISTING OLIVER TO 138/63/13 KV DISTRIBUTION SOURCE STATION	4,000	4,000				500	3,500			
PRINCETON/KEREMEOS AREA										
PRINCETON TRANSFORMER REPLACEMENTS	6,000	6,000			6,000					
BOUNDARY/GRAND FORKS AREA										
KETTLE VALLEY DISTRIBUTION SOURCE	7,650	7,650		150	7,500					
KETTLE VALLEY VOLTAGE CONVERSION	5,000	5,000			1,500	1,500	2,000			
BOUNDARY AREA STATION CONVERSIONS	2,000	2,000			1,000	1,000				
GRAND FORKS AREA VOLTAGE CONVERSIONS	3,000	3,000						2,000	1,000	
GRAND FORKS DISTRIBUTION SOURCE	8,000	8,000						6,000	2,000	
CASTLEGAR AREA										
CASTLEGAR SUB CAPACITY INCREASE	2,100	2,100			2,100					
COFFEE CREEK - KASLO AREA										
CAPACITOR AT COFFEE CREEK	800	800			800					
CAPACITOR AT KASLO	800	800			800					
COFFEE CREEK T3 REPLACEMENT	1,000	1,000					1,000			
CRAWFORD BAY AREA										
CRAWFORD BAY CAPACITY INC. & GND. BNK.	1,250	1,250			1,250					
CRESTON/WYNDELL AREA										
LAMBERT SUBSTATION UPGRADE	0	4,000	4,000							
NEW LAMBERT 230/63 KV TRANSFORMER & 230 KV RING BUS	5,000	5,000			5,000					
SOUTH SLOCAN AREA										
SLOCAN - NEW DENVER 63KV LOOP	0	4,000								4,000
TRAIL/SALMO AREA										
YMIR UPGRADE	1,500	1,500			1,500					
NEW 18L BREAKER AT WANETA	1,000	1,000			1,000					
SUBTOTAL - TRANSMISSION GROWTH	235,267	314,880	50,613	52,381	49,936	34,000	45,500	42,100	11,350	29,000

Transmission Projects cont'd

TRANSMISSION PROJECT DESCRIPTION	05-'10 Total	Project Total	2004	2005	2006	2007	2008	2009	2010	2011+
	($000s)									
TRANSMISSION LINE SUSTAINING										
TRANSMISSION LINE URGENT REPAIRS	1,050	1,150	100	300	150	150	150	150	150	
RIGHT OF WAY ENHANCEMENTS	1,500	1,750	250	250	250	250	250	250	250	
ROW RECLAMATIONS	70	235	165	70						
TRANSMISSION CONDITION ASSESSMENTS	700	937	237	700						
9, 10, LINE REHABILITATION GFT - CHR	500	500		500						
11 LINE REHABILITATION	0	250	250							
56 LINE REHABILITATION	0	20	20							
72 LINE REHABILITATION	0	250	250							
18 LINE REHABILITATION	50	50		50						
19 LINE REHABILITATION	900	900		900						
25 LINE REHABILITATION	500	500		500						
29 LINE REHABILITATION	100	100		100						
30 LINE REHABILITATION	500	500		500						
42 LINE REHABILITATION	100	100		100						
43 LINE AND 43AL REHABILITATION WORK	250	250		250						
73 LINE REHABILITATION	500	500		500						
32 LINE REHABILITATION	3,500	4,100	600	3,500						
SWITCH ADDITIONS	1,900	2,100	200	400	300	300	300	300	300	
20 LINE REHABILITATION	500	500			500					
21 - 24 LINE REHABILITATION	500	500			500					
51, 51A LINE REHABILITATION	100	100			100					
53 LINE REHABILITATION	100	100			100					
74 LINE REHABILITATION	500	500			500					
FUTURE YEAR REHABILITATION AND CONDITION ASSESSMENTS	7,200	7,200			500	1,600	1,700	1,700	1,700	
6A LINE REHABILITATION	50	50					50			
26 LINE REHABILITATION	80	80					80			
27 LINE REHABILITATION	250	250						250		
28 LINE REHABILITATION	10	10						10		
SUBTOTAL - TRANSMISSION LINE SUSTAINING	21,410	23,482	2,072	8,620	2,900	2,300	2,530	2,660	2,400	0
STATION SUSTAINING										
STATION ASSESSMENT AND MINOR PROJECTS	5,950	6,550	600	950	1,000	1,000	1,000	1,000	1,000	
STATION UNFORESEEN REPAIRS	1,800	2,000	200	300	300	300	300	300	300	
GLENMERRY SOIL RECLAMATION	0	400	400							
10/12 MVA MOBILE UPGRADE	300	300		300						
KOOTENAY MOBILE STATION	2,000	2,000		2,000						
CMMS	700	700		500	200					
COF, CRA, WES AND BULK OIL BRKR REPLACEMENT	3,400	4,600		500	900	800	400	400	400	1,200
GROUND GRID UPGRADES	1,500	1,500		250	250	250	250	250	250	
TRANSFORMER OIL FILTRATION/REPLACEMENT	1,500	1,500		250	250	250	250	250	250	
LTC OIL FILTRATION	900	900		150	150	150	150	150	150	
WEST OSOYOOS TRANSFORMER REHAB	1,900	1,900		100	1,800	0	0			
GRAND FORKS TERMINAL NOISE REDUCTION				150						
KASLO SUB UPGRADE	2,000	2,000			1,200	800				
PINE STREET T1 REHAB , 44L BREAKERS, SWITCHES	1,000	1,000			750	250				
WESTMINSTER T1 REPLACE	500	500			500	0				
TROUT CREEK T1 REHAB	800	800						550	250	
REPLACE COFFEE CREEK T2	1,500	1,500						250	1,250	
REPLACE CRAWFORD BAY T1	1,500	1,500						250	1,250	
TAP CHANGER LEAK REPAIR AND UPGRADE	600	600		600						
SUBTOTAL - STATIONS SUSTAINING	28,000	30,400	1,200	6,050	7,300	3,800	2,350	3,400	5,100	1,200
TOTAL - TRANSMISSION	284,677	368,762	53,885	67,051	60,136	40,100	50,380	48,160	18,850	30,200

Distribution Projects

DISTRIBUTION PROJECT DESCRIPTION	05-'10 Total	Project Total	2004	2005	2006	2007	2008	2009	2010	2011+
	($000s)									
DISTRIBUTION GROWTH										
NEW CONNECTS SYSTEM-WIDE	36,095	60,682	10,000	9,123	8,080	6,670	6,152	6,070	6,587	8,000
CIAC (credit amount)	-18,048	-30,341	-5,000	-4,562	-4,040	-3,335	-3,076	-3,035	-3,294	-4,000
KELOWNA AREA										
DUC1-SEX1 477 TIE	450	450		450						
QUAIL DEVELOPMENT LOOPFEED	200	200		200						
DILWORTH DEVELOPMENT LOOPFEED	200	200		200						
OKM5-OKM4 TIE, EXTD TO SPRINGFIELD RD	600	600		600						
DGB2-OKM3 TIE, REBUILD 4.5 KM TO 477	550	550			550					
COMPLETE GLE5-SEX2 TIE ADD N.O.	85	85		85						
KELOWNA GENERAL FEEDER PROTECTION	450	450		150	100	50	50	50	50	
MCKINLEY LANDING CAPACITY UPGRADE(#2 TO 477) FED FROM SEX3	450	450				450				
NEW GLE6 FEEDER(50L U/B HIGH RD-CLIFTON)	1,000	1,000					1,000			
HOL1-DGB3/LEE2 TIE	600	600				600				
HOL1-OKM1 TIE ALONG KLO RD	450	450					450			
MCKINLEY TO CLIFTON TIE	200	200					200			
LEE2-HOL5 TIE, ADD N.O.	200	200					200			
RETERMINATE LEE FEEDERS AT NEW N. KELOWNA SUBSTATION	500	500					500			
NEW FEEDER N.KELOWNA SUBSTATION	0	1,500								1,500
FUTURE KELOWNA DISTRIBUTION UPGRADES	3,000	4,500						1,500	1,500	1,500
PENTICTON										
WEB1 VOLTAGE REGULATOR	85	85		85						
OSOYOOS/OLIVER										
3 PHASE 4.4KM 1&2PHASE OSO2	350	350		350						
NEW FEEDER D/C OSO4 ACROSS CAUSEWAY TO EAST OSOYOOS + BREAKER	650	650		650						
25 KV TIE TO ANARCHIST/BRIDESVILLE	2,000	2,000						2,000		
SIMILKAMEEN										
KEREMEOS FEEDER	600	600			600					
BOUNDARY/GRAND FORKS										
FEED BALDY & ANARCHIST @ 25 kV FROM ROCK CREEK & CONVERT BALDY TO 25 kV	650	650		650						
TRAIL/ROSSLAND AREA										
W. TRAIL VOLTAGE CONVERSION	300	1,450	1,150	300						
PATTERSON 25 kV FEED	300	300			300					
SOUTH SLOCAN										
PASSMORE FEEDER2 UPGRADE	950	950		950						
PLAYMOR - TARRYS FEEDER UPGRADE	1,500	1,500			1,500					
CRESTON AREA										
CRESTON DIST FEEDER UPGRADES RELATED TO LAMBERT	4,000	4,000		2,000	2,000					
GENERAL										
SMALL CAPACITY IMPROVEMENTS (UNFORSEEN PRIMARY & SECONDARY VOLTAGE PROBLEMS, NEW OPERATIONAL SWITCHES)	3,000	3,000		500	500	500	500	500	500	
SUBTOTAL - DISTRIBUTION GROWTH	44,661	57,811	6,150	11,732	9,590	4,935	5,976	7,085	5,344	7,000
DISTRIBUTION SUSTAINING										
DISTRIBUTION CONDITION ASSESSMENTS	2,700	3,050	350	450	450	450	450	450	450	
DISTRIBUTION REHABILITATION	9,000	10,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	
ROW RECLAMATION	3,390	3,955	565	565	565	565	565	565	565	
DISTRIBUTION LINE REBUILDS	4,500	5,270	770	750	750	750	750	750	750	
SMALL PLANNED CAPITAL	3,210	3,645	435	535	535	535	535	535	535	
PCB PROGRAM	4,500	4,600	100	750	750	750	750	750	750	
FORCED UPGRADES AND LINE MOVES	3,000	3,500	500	500	500	500	500	500	500	
DISTRIBUTION URGENT REPAIRS	6,000	7,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
GLENMERRY UNDERGROUND	2,000	2,300	300	2,000						
SUBTOTAL - DISTRIBUTION SUSTAINING	38,300	43,820	5,520	8,050	6,050	6,050	6,050	6,050	6,050	0
TOTAL - DISTRIBUTION	82,961	101,631	11,670	19,782	15,640	10,985	12,026	13,135	11,394	7,000

Telecommunications, SCADA and Protection Projects

TELECOM, SCADA, P&C PROJECT DESCRIPTION	05-'10 Total	Project Total	2004	2005	2006	2007	2008	2009	2010	2011+
	($000s)									
TELECOM, SCADA, P&C GROWTH										
DISTRIBUTION SUBSTATION AUTOMATION, METERING AND COMMUNICATIONS	6,200	10,200		600	2,000	2,000	1,000	600		4,000
TRAIL-OLIVER HIGH CAPACITY COMMUNICATIONS	7,500	10,500			1,500		3,000		3,000	3,000
TELECOMMUNCIATIONS BACKBONE LOOP CLOSE	0	10,000								10,000
TELECOMMUNICATIONS FOR BUSINESS SYSTEMS	0	3,500								3,500
	0	0								
SUBTOTAL - TELECOM, SCADA, P&C GROWTH	13,700	34,200	0	600	3,500	2,000	4,000	600	3,000	20,500
TELECOM, SCADA, P&C SUSTAINING										
NARROW SPECTRUM CONVERSION	455	455		255	200					
HARMONIC REMEDIATION	600	700	100	100	100	100	100	100	100	
RELAY TEST & MAINT PROCESS	150	150		150						
COMM EQUIP TEST/MAINTAIN PROCESS	150	150		150						
PROTECTION UPGRADES	3,324	5,824		422	242	955	725	730	250	2,500
FAULT LOCATING INACCESSIBLE LINES	900	900		150	150	150	150	150	150	
COMMUNICATIONS UPGRADES	1,350	2,600		180	190	310	110	310	250	1,250
SUBTOTAL - TELECOM, SCADA, P&C SUSTAINING	6,929	10,779	100	1,407	882	1,515	1,085	1,290	750	3,750
TOTAL - TELECOM, SCADA, P&C	20,629	44,979	100	2,007	4,382	3,515	5,085	1,890	3,750	24,250

Priority Matrix

				Safety			Restoration Time hours			Thermal Capacity (overloads)			System Effect of Failure			Voltage Related			Public Impact Number of Customers		
T&D Project Description	Priority	Weighting	Mandatory	High	Medium	Low	> 8	4 to 8	< 4	> 25%	0 to 25%	0	High	Med	Low	<110V	<115V	N/A	>2000	<1000	<500
FAULT LEVEL REDUCTION	H	112	x			x			x		x		x		x			x	x		
NEW 18 LINE BREAKER AT WANETA	H	111	x			x		x				x	x					x	x		
GROUND GRID UPGRADES	H	110	x		x				x			x						x	x		
CMMS	H	103	x									x						x	x		
NARAMATA REHABILITATION	H	29		x			x				x			x		x				x	
11 LINE REHABILITATION	H	28		x			x				x		x				x		x		
72 LINE REHABILITATION	H	28			x		x			x			x			x			x		
KETTLE VALLEY DISTRIBUTION SOURCE	H	26		x			x			x				x	x			x		x	
GRAND FORKS DISTRIBUTION SOURCE	H	25		x			x			x				x	x			x			x
PCB PROGRAM	H	25		x			x				x						x		x		
CRESTON DIST FEEDER UPGRADES RELATED TO LAMBERT	H	24		x					x	x				x	x		x		x		
KETTLE VALLEY VOLTAGE CONVERSION	H	24		x				x			x			x			x		x		
HOLLYWOOD CAPACITY INCREASE	H	23				x	x			x				x		x			x		
GRAND FORKS AREA VOLTAGE CONVERSIONS	H	23				x	x			x				x		x			x		
NEW LAMBERT 230/63 kV TRANSFORMER & 230 kV RING BUS	H	21			x			x			x		x		x	x					x
BIG WHITE 138 kV LINE & SUBSTATION	H	20		x			x					x		x	x			x			x
74 LINE REHABILITATION	H	20		x				x				x	x					x	x		
BOUNDARY AREA STATION CONVERSIONS	H	20			x		x				x			x	x		x				x
CASTLEGAR SUB CAPACITY INCREASE	H	20			x		x				x			x				x	x		
CRAWFORD BAY CAPACITY INC. & GND. BNK.	H	19		x			x					x			x			x			x
FEED BALDY & ANARCHIST @ 25 kV FROM ROCK CREEK & CONVERT BALDY TO 25 kV	H	19		x					x			x			x	x					x
56 LINE REHABILITATION	H	19		x				x				x		x				x	x		
18 LINE REHABILITATION	H	19		x				x						x					x		
3 PHASE 4.4KM 1&2PHASE OSO2	H	19				x	x			x					x		x		x		
73 LINE REHABILITATION	H	19				x	x					x	x			x			x		
51, 51A LINE REHABILITATION	H	19				x	x			x			x					x	x		
SOK PROJECT (VASEUX LAKE TERMINAL)	M	18		x					x			x	x		x			x	x		
BRAELOCH (SW) DISTRIBUTION SOURCE	M	18				x	x					x		x		x			x		
RECREATION CAPACITY INCREASE	M	18				x	x			x				x				x	x		
OK MISSION CAPACITY INCREASE	M	18				x	x					x		x		x			x		
FAULT LOCATING INACCESSIBLE LINES	M	18				x	x				x			x			x		x		
9, 10, LINE REHABILITATION GFT - CHR	M	18				x	x				x			x			x		x		
25 LINE REHABILITATION	M	18				x	x				x			x			x		x		
PRINCETON TRANSFORMER REPLACEMENTS	M	17		x					x			x		x	x			x	x		
30 LINE REHABILITATION	M	17		x					x			x		x				x	x		
29 LINE REHABILITATION	M	17			x		x					x		x				x	x		
42 LINE REHABILITATION	M	17			x		x					x		x				x	x		
KELOWNA AREA UPGRADE	M	16				x		x			x		x		x		x		x		
DOUBLE CIRCUIT 230 kV VAS TO RGA	M	16				x		x			x		x		x		x		x		
230/161/138 BENTLEY TERMINAL	M	16				x		x			x		x		x		x		x		
T3 VAS (500/230 kV)	M	16				x	x				x		x		x			x		x	
DUC1-SEX1 477 TIE	M	16				x	x					x				x			x		
OKM5-OKM4 TIE, EXTD TO SPRINGFIELD RD	M	16				x	x					x				x			x		
43L AND 43AL REHABILITATION WORK	M	16				x	x				x			x				x	x		
NEW GLE6 FEEDER(50L U/B HIGH RD-CLIFTON)	M	15		x					x			x						x	x		
DGB2-OKM3 TIE, REBUILD 4.5 KM TO 477	M	15			x		x					x						x	x		
53 LINE REHABILITATION	M	15				x		x			x			x			x		x		
26 LINE REHABILITATION	M	15				x		x			x			x			x		x		
27 LINE REHABILITATION	M	15				x		x			x			x			x		x		
28 LINE REHABILITATION	M	15				x		x		x				x				x	x		

Priority Matrix cont'd

				Safety			Restoration Time hours			Thermal Capacity (overloads)			System Effect of Failure			Voltage Related			Public Impact Number of Customers		
T&D Project Description	Priority	Weighting	Mandatory	High	Medium	Low	> 8	4 to 8	< 4	> 25%	0 to 25%	0	High	Med	Low	<110V	<115V	N/A	>2000	<1000	<500
REPLACE CRAWFORD BAY T1	M	15				x		x			x			x			x		x		
SLOCAN - NEW DENVER 63KV LOOP	M	15				x		x			x			x			x		x		
RETERMINATE LEE FEEDERS AT NEW N. KELOWNA SUBSTATION	M	15			x			x				x	x					x	x		
TRAIL-OLIVER HIGH CAPACITY COMMUNICATIONS	M	15			x			x				x	x					x	x		
32 LINE REHABILITATION	M	14				x	x				x			x	x			x			x
19 LINE REHABILITATION	M	14			x			x				x		x	x			x	x		
20 LINE REHABILITATION	M	14			x			x				x		x				x	x		
21 - 24 LINE REHABILITATION	M	14			x			x				x		x				x	x		
10/12 MVA MOBILE UPGRADE	M	14			x			x				x		x				x	x		
KOOTENAY MOBILE STATION	M	14			x			x				x		x				x	x		
COF, CRA, WES AND BULK OIL BRKR REPLACEMENT	M	14			x			x				x		x				x	x		
WEST OSOYOOS TRANSFORMER REHAB	M	14			x			x				x		x				x	x		
PINE STREET T1 REHAB , 44L BREAKERS, SWITCHES	M	14			x			x				x		x				x	x		
YMIR UPGRADE	M	13				x	x				x				x			x			x
PASSMORE FEEDER2 UPGRADE	M	13			x			x				x			x			x	x		
PROTECTION UPGRADES	M	13				x	x					x		x	x			x	x		
230 kV VASEUX TO BENTLEY	M	13			x				x			x	x		x			x	x		
KELOWNA SHUNTS & SVC	M	13				x			x			x	x		x	x				x	
QUAIL DEVELOPMENT LOOPFEED	M	13				x		x			x						x		x		
CLOSE 138 kV LOOPS KELOWNA	M	13			x				x			x	x					x	x		
CONVERT EXISTING OLIVER TO 138/63/13 kV DISTRIBUTION SOURCE STATION	M	12		x										x							
REPLACE COFFEE CREEK T2	M	12		x										x							
PLAYMOR - TARRYS FEEDER UPGRADE	M	12				x			x			x			x	x			x		
SMALL CAPACITY IMPROVEMENTS (UNFORSEEN PRIMARY & SECONDARY VOLTAGE PROBLEMS, NEW OPERATIONAL SWITCHES)	M	12				x			x			x			x	x			x		
GLENMERRY UNDERGROUND	M	12				x		x			x				x			x	x		
DISTRIBUTION SUBSTATION AUTOMATION, METERING AND COMMUNICATIONS		12				x			x		x		x		x			x	x		
DILWORTH DEVELOPMENT LOOPFEED	M	12			x			x				x						x	x		
SWITCH ADDITIONS	M	12			x			x				x						x	x		
6A LINE REHABILITATION	M	12			x			x				x						x	x		
CAPACITOR AT COFFEE CREEK	M	12			x			x											x		
CAPACITOR AT KASLO	M	12			x			x				x						x	x		
COMPLETE GLE5-SEX2 TIE ADD N.O.	M	12			x			x				x						x	x		
SUMMERLAND 63 kV BACKUP	M	12			x			x				x						x	x		
KELOWNA GENERAL FEEDER PROTECTION	M	12			x			x				x						x	x		
WEB1 VOLTAGE REGULATOR	M	12			x			x				x						x	x		
PATERSON 25 kV FEED	M	12			x			x				x						x	x		
NEW FEEDER N.KELOWNA SUBSTATION	M	12			x			x				x						x	x		
FUTURE KELOWNA DISTRIBUTION UPGRADES	M	12			x			x				x						x	x		
NEW FEEDER D/C OSO4 ACROSS CAUSEWAY TO EAST OSOYOOS + BREAKER	M	11			x			x				x			x			x			x
FUTURE YEAR REHABILITATION AND CONDITION ASSESSMENTS	M	11				x	x					x						x	x		
STATION MINOR PLANNED WORK	M	11				x	x					x						x	x		
STATION UNFORESEEN REPAIRS	M	11				x	x					x						x	x		
COFFEE CREEK T3 REPLACEMENT	L	10		x																	
MCKINLEY LANDING CAPACITY UPGRADE(#2 TO 477) FED FROM SEX3	L	10		x																	
HOL1-DGB3/LEE2 TIE	L	10		x																	
ELLISON DISTRIBUTION SOURCE	L	10				x			x			x		x	x		x		x		
BLACK MOUNTAIIN DISTRIBUTION SOURCE	L	10				x		x				x		x	x			x	x		
KEREMEOS FEEDER	L	10			x				x			x						x	x		
NEW EAST OSOYOOS SOURCE	L	9				x			x		x			x	x			x			x
SUBSTATION CONDITION ASSESSMENT	L	9				x			x		x							x	x		
KASLO SUB UPGRADE	L	7				x			x			x		x	x			x		x	
WESTMINSTER T1 REPLACE	L	7				x			x			x		x	x			x		x	
TROUT CREEK T1 REHAB	L	7				x			x			x		x	x			x		x	
WATERFORD UPGRADE	L	6				x			x			x		x	x			x			x
HOL1-OKM1 TIE ALONG KLO RD	L	6				x			x			x						x	x		
LEE2-HOL5 TIE, ADD N.O.	L	6				x			x			x						x	x		
25 kV TIE TO ANARCHIST/BRIDESVILLE	L	6				x			x			x						x	x		
MCKINLEY TO CLIFTON TIE	L	6				x			x			x						x	x		
HUTH REBUILD AS 63 kV RING BUS	L	5				x			x			x			x			x			x

Transmission and Distribution System Development Plan

Appendix D

Maintenance Planning Report

November 26, 2004

Table of Contents

Maintenance of Substations and Transmission Lines 2
1 Introduction 2
2 Maintenance Strategy 3
2.1 Maintenance Strategies 3
2.2 Equipment Categories 8
3 Demographics of Equipment 11
3.1 Category 1 Equipment 11
3.1.1 Transformers 11
3.1.2 Breakers 13
3.1.3 Transmission Lines 14
3.1.4 Mobile Substations 16
3.2 Category 2 and Category 3 Equipment 18
3.2.1 Disconnect Switches 18
3.2.2 Substations (ground grids, surfaces and structures) 20
4 Review of Past Practice 21
4.1 Capital Program 21
4.2 Operating and Maintenance (O&M) Program 23
5 Effect on Future Sustaining Capital and Programs 25
5.1 Transformers and Stations 25
5.2 Breakers and Disconnect Switches 32
5.3 Transmission Lines 36
5.4 Staging and Schedule 38
6 Recommendations 38
7 References 40

Maintenance of Substations and Transmission Lines

1 Introduction

For the entire period since the 1998 Master Plan, the FortisBC workforce has maintained the system in a Performance Based Regulation (PBR) environment utilizing an Asset Management philosophy and decision structure. Since that time, the Transmission and Distribution asset base has grown from $319 million in 1998 to $470 million at the end of 2003, driven by demand in specific regions. This increase in asset base reflects complete replacement of selected portions of the system where demand growth has been highest, rather than increased expenditures across all components in all areas of the system. This has resulted in a system that has both new state-of-the-art equipment and design, and old equipment and infrastructure that has been kept running without upgrades to serve areas of static or declining demand.

Several maintenance strategies and objectives are discussed in this chapter. The ability to apply different strategies to different classes of equipment defines FortisBC's maintenance program for the future. Next, the effect of the condition of the installed base on the near-term maintenance program is evaluated in order to define the investment necessary to bring the installed base to an overall condition from which a "levelized" maintenance program can then be established to keep pace with needs of the system.

Finally, the effect of the above investment strategy is reflected in a long-term capital investment profile and benchmarked against available data.

2 Maintenance Strategy

There are two basic maintenance modes: reactive and proactive. When in reactive mode, the best an organization can do to have an effect on reliability indicators (SAIFI, SAIDI, CAIDI) is in the speed of response. However, once an organization adopts a proactive maintenance approach, a variety of maintenance strategies are available that will each incrementally improve reliability indicators, but with corresponding increasing effort and cost.

Not all equipment failures have similar effects on the reliability indicators. Therefore, equipment should be separated into various categories, with the categorization criteria being that a different maintenance strategy applies to each category of equipment. This philosophy traces its roots back to Reliability Centred Maintenance[1] (RCM) as a foundation, but with the realization that there are several maintenance strategies available to deliver optimal reliability/cost performance.

2.1 Maintenance Strategies

In general, the two most basic approaches to maintenance are an unplanned approach (corrective, fix when broken) and a planned approach that offers many decision trees of how and when to fix equipment before it breaks down. A corrective maintenance strategy can not deliver equal reliability at the same cost as a planned maintenance strategy. The reason for this is twofold: first, a successful corrective maintenance strategy requires that sufficient resources (both labour and equipment) must always be on hand to handle the higher frequency of unanticipated failures (because planned maintenance reduces failure rates), and second, planned maintenance cost-effectively extends the service life of certain equipment, thereby reducing capital replacement costs.

Therefore, the two primary motivations for a utility to depart from a strategy of a simple corrective program is to cost-effectively improve (or prevent from degrading) reliability indicators, and to reduce overall costs to the ratepayers. Once the decision is made to

move towards a planned maintenance program, a variety of techniques are available as shown in Figure 2.1:

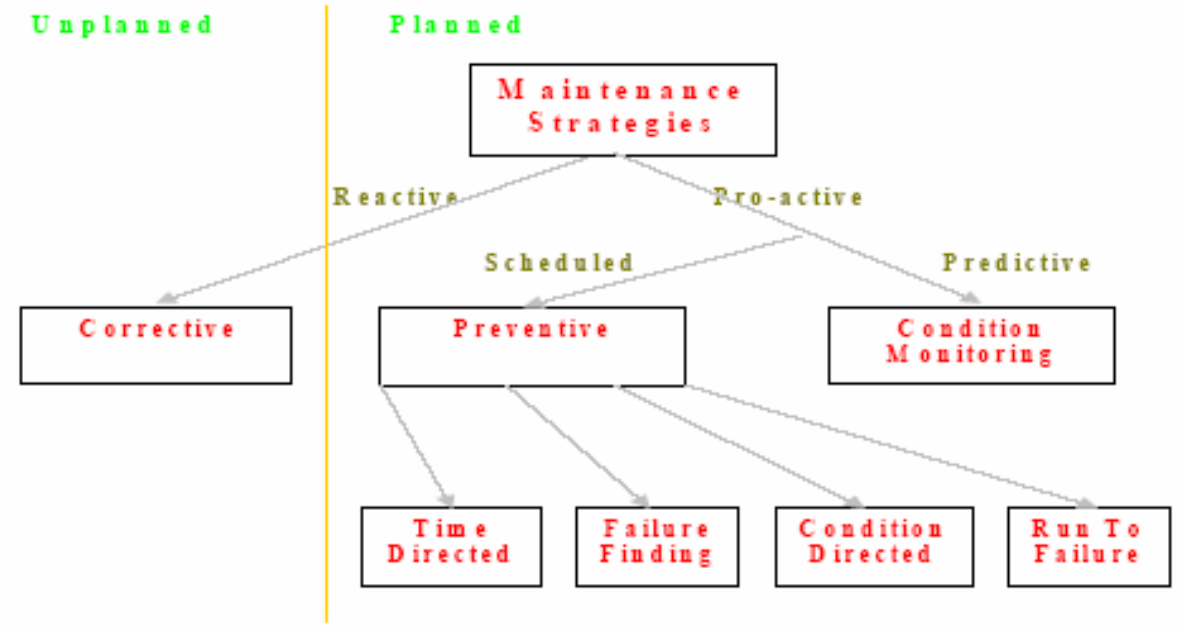


Figure 2.1 Maintenance Strategies

The easiest move away from a simple corrective maintenance strategy is to plan and initiate the adoption of a time-based strategy. This approach has been attempted in the past and has more often than not, failed to achieve the levels of success that had been expected. One reason for this is that when moving from an unplanned program to a time-based planned program, more maintenance personnel are not usually added, or not enough are added. Even if enough personnel are added to address a given planned maintenance program, these programs have failed in the past because unplanned failures do not stop occurring, and resources are re-assigned to urgent corrective tasks. The result is that the time-based planned maintenance program gets further and further behind each passing year. This has driven the development of techniques that modify planned maintenance programs from doing a task every-so-often, to intelligently being able to skip that task for one or more periods based on knowledge of the equipment's condition and function.

An additional complication is introduced if records are not kept up-to-date, and the confidence to determine when a piece of equipment was last maintained is lost. In these situations, significant effort is required to re-capture that history. A computerized maintenance management system (CMMS) is a useful tool to prevent the loss of important equipment history, but is usually not enough to guarantee the success of a time-based planned maintenance program. Therefore, it has been recognized that more sophisticated planned maintenance strategies must be employed to advance from the shortcomings of the past.

A powerful technique to design the most effective maintenance program for a particular industry is Reliability Centered Maintenance (RCM). Reliability Centered Maintenance was developed in response to the needs of the aviation industry and the creation of the 747 aircraft which would have been unprofitable to operate if maintenance was performed by the conventional methods of the time. The adoption of Reliability Centered Maintenance resulted in significant cost reductions in labour, material and inventory. The method was soon adopted by the nuclear power industry for many of the same reasons.

The electrical transmission and distribution industry has adopted Reliability Centered Maintenance, but not to the same degree as the classical Reliability Centered Maintenance approach in the airline and nuclear industry. The classical Reliability Centered Maintenance approach analyzes the specific function of each component in the larger system and determines the consequences of failure, and thereby designs a customized maintenance approach for each piece of equipment in the system, based on its specific function and criticality. This is a time and effort intensive exercise to apply to each piece of equipment in a system. Instead, the electrical transmission and distribution industry has classified the equipment into various categories, and through knowledge of equipment failure modes gained over a long history, determined the best maintenance strategy to apply to a given class of equipment. Thus, the Reliability Centered Maintenance exercise becomes one of implementing the correct maintenance strategy for a given class of equipment as depicted in Figure 2.2. This can also include relying on corrective (reactive) strategies for some equipment.

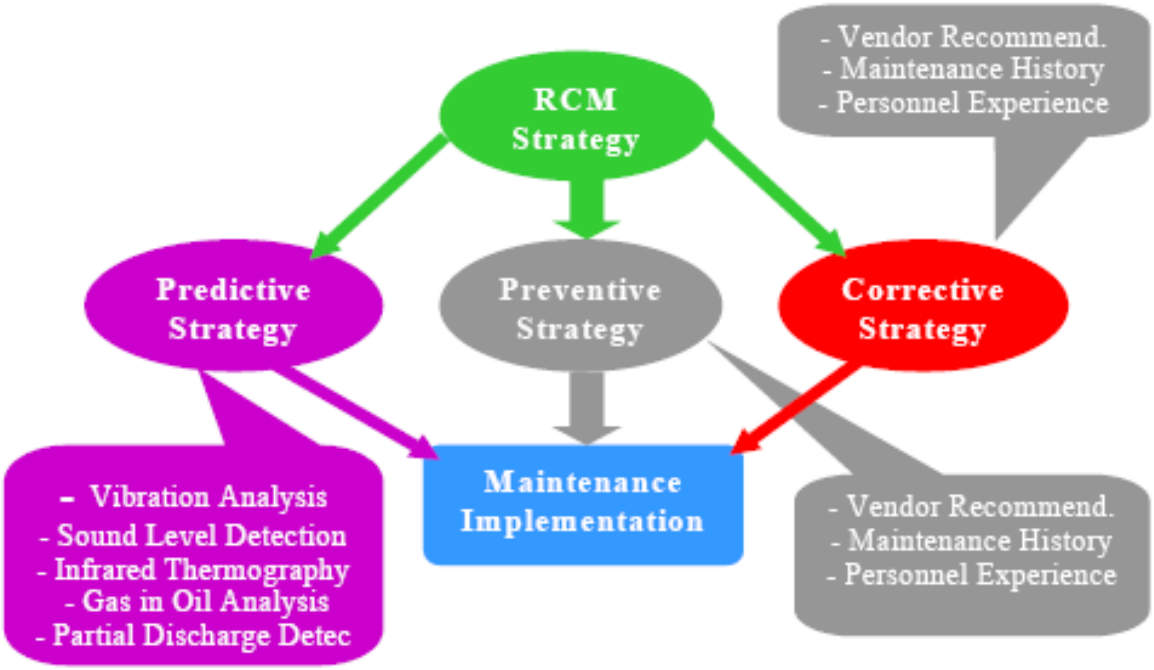


Figure 2.2 Application of Reliability Centered Maintenance in Maintenance Strategy Selection

Planned Maintenance strategies can be broken down into two categories, preventative strategies and predictive strategies. Preventative strategies rely on performing maintenance according to some frequency that is determined by something other than the actual performance characteristics of the equipment. These maintenance drivers could be things such as time (maintain every given time period), failure finding (testing for operational functionality, for example protective relay testing, or cycling of disconnect switches), condition other than actual performance characteristics (maintain after a pre-determined number of operations), or even run-to-failure. Although these strategies are useful for some types of equipment, there are inherent shortcomings when these strategies are applied to critical equipment because they do not consider the actual condition of the equipment. This can result in maintenance being performed when it is not required, or more importantly, unanticipated failure of equipment that could have been detected and prevented.

Predictive maintenance strategies rely on condition based information to schedule maintenance activities. This is particularly useful for critical equipment in electrical

transmission systems because knowledge of equipment condition can be used to perform "just-in-time" maintenance and reduce failure rates.

Diagnostic procedures that do not require equipment to be taken out of service are key to predictive maintenance programs, because the key point is not having to take the equipment out of service in the first place. Some examples of techniques used for predictive maintenance strategies are:

- Oil analysis
- Infrared thermography
- Partial discharge and corona detection

Other diagnostic techniques can be used when the equipment is removed from service for preventative maintenance procedures. Useful predictive tasks can be derived from the data gathered, but an equipment outage is required:

- Power Factor and dielectric loss measurements
- Breaker timing and contact resistance

It should be recognized that it is acceptable to have several maintenance strategies for a given equipment category, but pre-defined targets should be set for the level of each maintenance strategy. In this way, if targets are being met, they can be adjusted to determine the most cost effective maintenance mix for a given class of equipment. For instance, in the case of disconnect switches, it may be acceptable to annually employ some predictive maintenance (infra-red scanning a percentage of the population), some preventative maintenance (refurbishing switches with excessive operations), and accepting a small percentage of reactive maintenance (one random switch failure per year). In this way, the most cost effective mix of maintenance effort can be evaluated by performing a cost-benefit analysis of the amount of maintenance versus the component's contribution to system reliability indicators.

2.2 Equipment Categories

The equipment considered in this evaluation is confined to the transmission system, defined as including those assets from the fence of the generation substations to the low side of the distribution substation transformers. This transmission system equipment is further divided into three categories, based on criticality of failure and its function in the system. Each category of equipment demands a different approach to its maintenance in order to get the best balanced level of effect on reliability indicators versus maintenance effort and investment.

Category 1 equipment is defined as that equipment that will cause an immediate degradation of a reliability indicator upon its failure, and whose condition can be reasonably determined through existing standard routine diagnostic procedures. This equipment is almost exclusively that which actually carries transmission system current (except in the case of line structures). The following equipment is in this category:

- Circuit breakers
  - Types: Bulk Oil, Minimum Oil, SF_6, Vacuum
  - Components: Contacts and Media, Bushings
- Transformers
  - Types: Power (Two-winding, Three-winding, Auto) and oil-filled current transformers and potential transformers
  - Components: Oil, active component, bushings, tap changer
- Lines
  - Types: 63 kV, 138 kV, 161 kV, 230 kV
  - Components: Poles, vegetation
- Mobile substations

The proposed target for Category 1 equipment is no reactive maintenance, with all equipment failures being anticipated and prevented by suitable predictive (condition-based) techniques. There are some pieces of equipment whose failure can have the same effect on reliability indicators as Category 1 equipment above, but for which no standard diagnostic procedure is in place to predict failure, or equipment where failure can occur

sporadically, even immediately following inspection. Examples of this type of equipment include transmission line and bus support insulators and disconnect switches. There are continuing advances in diagnostic techniques that may lend themselves to predictive condition analysis for this equipment, and as those techniques become accessible, this equipment will be incorporated into Category 1. Until that time, this equipment is placed in Category 2.

Category 2 equipment covers the broadest range. The following criteria identify a piece of equipment as belonging to Category 2:

- Non-power current carrying equipment that supports Category 1 equipment, but whose failure would not cause an immediate outage to the Category 1 component, or
- Power current carrying equipment for which no predictive diagnostic techniques can be used to predict incipient failure, or
- Non-power current carrying equipment whose failure would not cause an outage, but would prolong the extent of the next outage.

The following equipment is in this category:

- Non oil-filled current and voltage protection and metering transformers
- Protection and metering relays
- Shunt capacitors and harmonic filters
- Line and station insulators
- Disconnect switches
- Bus bar and line conductor
- Wiring systems
- Surge arrestors
- Battery banks, back-up power systems, and station service power (including emergency generators)
- Communications (Power line carrier, microwave, and fibre)
- Fire protection systems
- Lighting

This equipment is best placed in a time or frequency based preventative maintenance program, specifically tailored to each type of equipment in the category. Some amount of reactive maintenance should be expected in this category, as some equipment displays random failure frequency, and may fail immediately after being tested. Therefore, testing should be used as a means of validating operation only in cases where the equipment has not been called upon to operate since the last time or frequency testing cycle.

Category 3 equipment contains all other equipment and facilities not found in Category 1 and/or Category 2. The maintenance regime in this category is one of reactive maintenance, or where the period of time or frequency based preventative maintenance is greater than ten years. The equipment and facilities in this category are:

- Station ground grids
- Station surface conditions
- Fences, buildings and structures
- Access roads
- Other civil works (berms, etc.)

This categorization strategy is only applicable when the particular equipment is within its useful service life window since initial installation or last life-cycle rehabilitation. Typical useful life windows for equipment are:

Breakers	35 years
Transformers	40 years
Communications	20 years
Protection and Control	30 years
Buildings	50 years
Substation civil and grounding	30 years
Transmission poles and insulators	50 years

After a piece of equipment reaches the end of its service life, a comprehensive evaluation of that piece of equipment should be conducted. There are three outcomes to the evaluation: equipment replacement, life-cycle rehabilitation, or a re-assessment of remaining life. This should be considered outside the normal maintenance requirements of the equipment.

3 Demographics of Equipment

The data in this section is taken from the most recent FortisBC equipment assessment database. The methods of collecting and managing this information are not tightly coordinated or cross-referenced and would benefit from the utilization of a Computerized Maintenance Management System (CMMS). All Category 1 equipment and specific Category 2 and 3 equipment that could benefit from structured programs addressing that class of equipment is discussed. The rest of the equipment in these categories is addressed through the substation condition assessment program where specific deficiencies are identified and corrected.

3.1 Category 1 Equipment

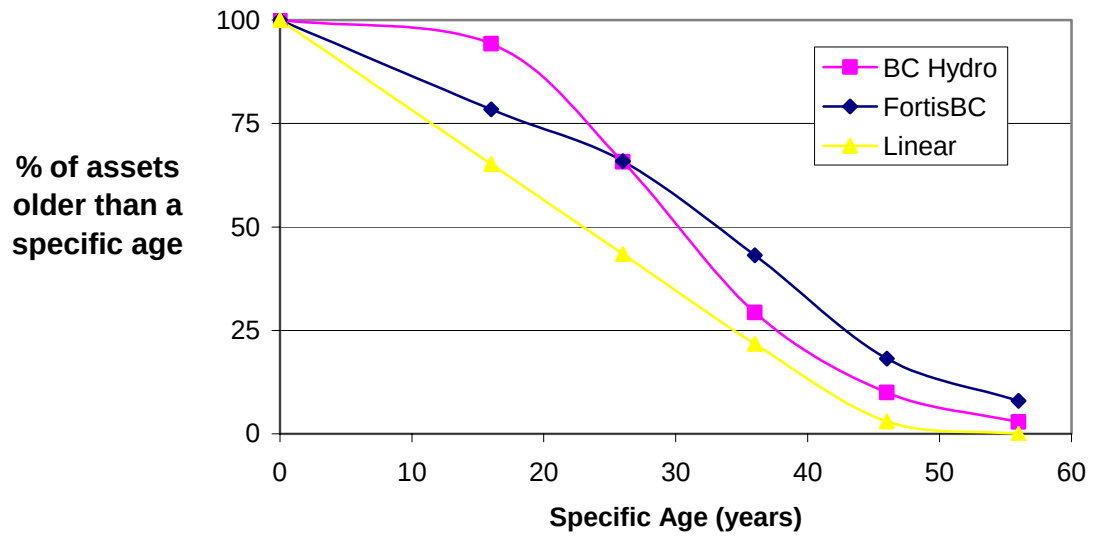
3.1.1 Transformers

The chart in Figure 3.1 shows the age of the FortisBC transformer population base compared to BC Hydro. BC Hydro is chosen as a comparable utility because although it is roughly ten times larger than FortisBC, the two companies share many characteristics including:

- Similar regulatory environment
- Main resource is hydro electricity
- Sparse load distribution over the majority of the service area with one major load growth center located away from majority of generation

The total population of transformers for Figure 3.1 was 89 in the case of FortisBC, and 700 in the case of BC Hydro, again reflecting a rough ten to one ratio. The figure shows an interesting crossover at about 25 years, where each company has 66% of their equipment older than this age. What is of particular concern to FortisBC is that there is roughly twice as much equipment as BC Hydro older than 40 years and still in service. There are several reasons why this particular situation may have come about, but the result is that FortisBC is faced with a higher amount of equipment replacement or refurbishment given that the equipment design life is roughly 40 years.

Figure 3.1: Transformer Age distribution

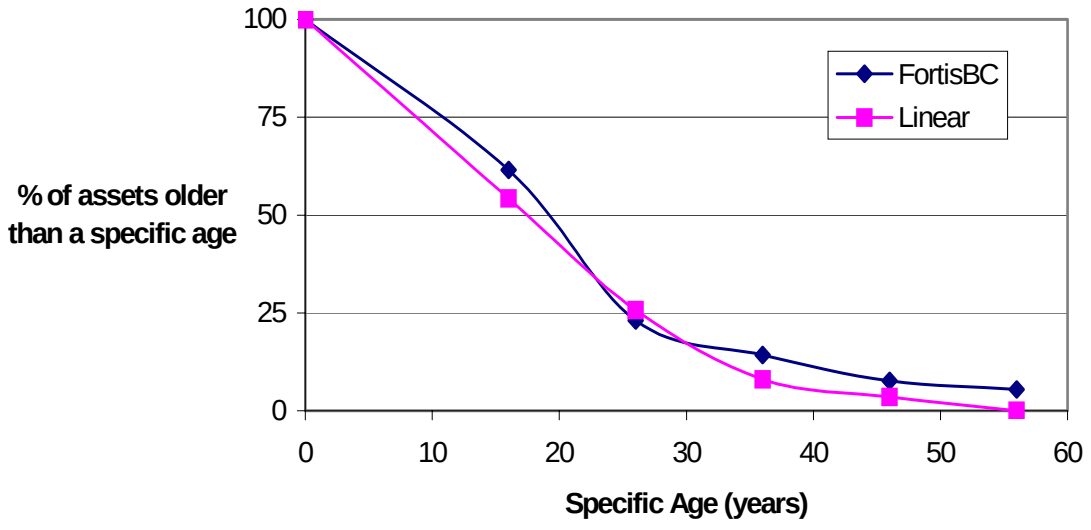


The linear projection is based on a maximum useful life of 40 to 45 years for the average transformer. A transformer built to CSA standards is designed to have a useful service life of 20 years if it is continuously loaded to nameplate thermal capacity. After this time, the cellulose insulation will have degraded to the point of losing the mechanical and electrical qualities necessary for reliable operation. In a utility application, especially for load serving purposes, transformers rarely go into service at their full rating and are never continuously loaded at maximum. Exceptions to this are generator step-up transformers and transformers at terminal stations that serve as inter-utility tie points or on congested transmission paths. However, for most transformers in load-serving applications, the useful thermal life is typically between 40 and 45 years. Some transformers may be exceptionally lightly loaded through their lifetimes, and do not suffer thermal end of service life, but rather mechanical deterioration. This segment of the population is reflected by the small percentage older than 45 years in the linear extrapolation.

3.1.2 Breakers

The chart in Figure 3.2 shows the breaker age distribution. The total population of breakers rated at 60 kV or greater is 98 with 31 SF_6 breakers, 14 bulk oil breakers and 53 minimum oil breakers. The age distribution of the breaker population is remarkably good, and is not a major driver of re-investment requirements in this five year window because only about 15% of the breakers are 35 years of age or older. There is a caveat in that there is a small population of breakers that are over 55 years old. As with transformers, breakers will have a portion of the population that will exceed the intended 35-year service life because of relatively light duty and because of their location in the system, require limited interrupting capability. Again, general mechanical deterioration will govern the need to replace these typically bulk oil breakers, some of which can remain in service for 50 years. This prolonged life expectancy is unique to bulk oil breakers, and as discussed below, probably is not applicable to SF_6 and minimum oil designs. Therefore, as the bulk oil breakers get phased out, the "tail" of the "linear" trend line in Figure 3.2 will be truncated at least ten years earlier than it is now.

Figure 3.2 Breaker Age Distribution table



The most aged breakers are of the bulk oil variety and have significant over-capacity built in by virtue of their design. However, although the breakers may have sufficient fault

interrupting capability, this is offset by gradual mechanical deterioration and the environmental risk associated with bulk oil equipment, and their replacement is a prudent step.

Industry experience is indicating that the minimum oil and SF_6 technologies do not posses the same longevity as their bulk oil counterparts, and will require replacement/refurbishment at a greater rate as their design life is surpassed. Consequently, there are two distinct technological life cycles that are both coming due at the same time (long-lived bulk oil, and shorter life minimum oil and SF_6), and both driving the need for capital re-investment in breakers. In addition to the 5% of breakers that are currently in service beyond their design lifetime (all of the bulk oil design), approximately another 10% of the breaker population will reach or exceed their design life over the next ten years. These will be both minimum oil and bulk oil design. The installed base of SF_6 breakers is relatively young and will not start reaching their intended design lifetimes until at least 2020.

3.1.3 Transmission Lines

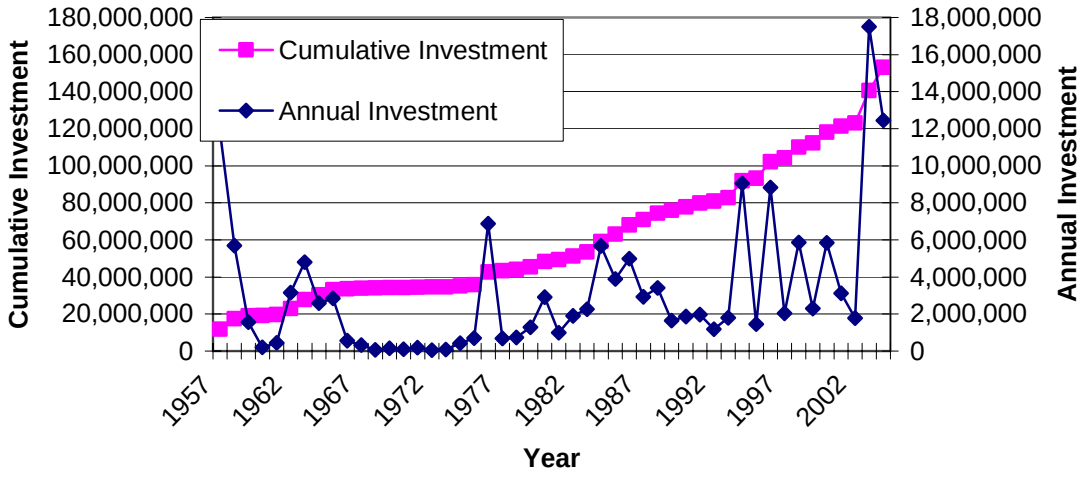
The FortisBC asset database shows capital investments in various assets starting in 1957. The 48 years of data compares well with the overall expected life of transmission line assets; however, this does not completely capture the end of service life asset replacement impacts which would probably start impacting within the next five or ten years. The following lines predate the start of the 1957 asset record, and their construction dates are taken from Mouat[3]:

- 9 & 10 Lines (Warfield to Oliver), 1919
- 49 Line (Huth to Summerland), 1921
- 27 Line (Corra Linn to Salmo), 1928
- 20 Line (Tadanac to Salmo), 1931
- 44 Line (Oliver to Osoyoos), 1936
- 28 Line (Upper Bonnington to the City of Nelson), 1938
- 31 and 32 Lines (Crawford Bay to Creston), 1953

There are obviously lines in existence that pre-date the asset record, however they have been substantially rebuilt since they were first installed. In fact, from the list above, both 44 Line and 49 Line have been significantly replaced in 2000 and 1998 respectively. The other lines above are in need of significant investment to replace their function.

The investment in transmission line assets since 1957 is shown in Figure 3.3. The investment values have been normalized to 2004 dollars using Canadian CPI. Figure 3.3 includes both original and sustaining investments.

Figure 3.3 Transmission Line Investment (normalized to $2004)

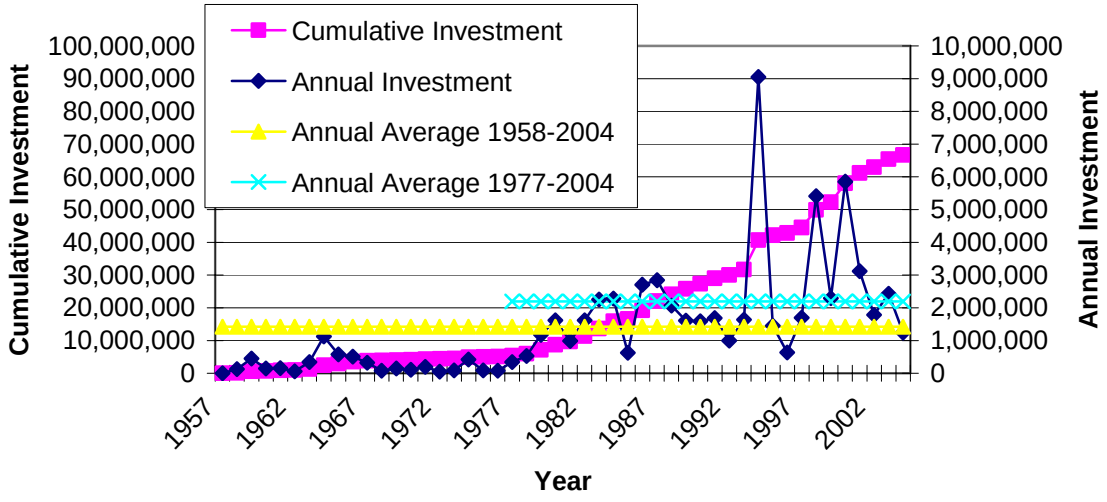


The graph shows that there was practically no investment in the system for a decade between 1967 and 1976, and this is reflected in the substation investments as well. The recent capital investments can be seen in context as “historic” investments.

From a maintenance perspective, it is more useful to show the sustaining capital that has been applied to the asset after the initial investment. This is shown in Figure 3.4, again normalized to 2004 dollars and with the initial capital costs stripped out. The large investments in 1994, 1998 and 2000 were the rebuilds of 43 Line, 49 Line and 44 Line and are considered sustaining capital for three reasons: the lines were pre-existing, their function was largely the same both before and after investment, and most condition related issues were addressed by the investments. It is interesting to note that these large

investments are not reflected in recent base capital budgets, nor do the "sustaining" or "rehabilitation" categories of the recent budgets reflect the amount of capital actual flowing into the line assets. This is discussed further in Section 4.0. Another point to note is that over the last 25 years, sustaining capital has outstripped new capital.

Figure 3.4 Transmission Line Sustaining Investment (normalized to $2004)



The long term (57-04) average annual sustaining capital has been approximately $1.4 million but this includes a decade of no investment. In the last 25 years, the average annual sustaining capital investment has been 50% higher or approximately $2.2 million annually. Although it may appear that the three recent line rebuilds skew the recent average, this data should not be treated as an anomaly because it is representative of future trends. This will be discussed in greater detail in Section 4.1.

3.1.4 Mobile Substations

Mobile substations represent both contingency response capability and the ability to plan de-energized work in distribution substations. There has been a practice to keep a fleet of four mobile substations, two in the Okanagan and two in the Kootenay. The mobile substations were not interchangeable for all applications because of the secondary voltage requirements. The Okanagan has virtually no 2.4 kV distribution, which was common until

recently in the Kootenay. This effectively meant that the two mobiles in each region normally did not move outside their region.

The oldest mobile in the fleet is the 6.5 MVA unit in the Kootenay region with the equipment built in 1957. Several factors are leading toward its retirement. These factors are the advanced deterioration of the mobile trailer and the fact that most of the 2.4 kV distribution voltage level in the Kootenay region had been converted to other voltage levels. The development of the 161 kV system in the boundary system will eventually remove the need for the 2.4 kV installations and the existing 10/12 MVA mobile (the only mobile left with 2.4 kV secondary capability) would be sufficient to cover any emergencies until the system is converted. The planned 2.4 kV distribution loads will be converted as part of the development of the boundary area eliminating the need for the 2.4 kV mobile supply. Nevertheless, a second mobile unit must be considered for post-contingency support in the Kootenay region, especially since many of the older distribution substations may be undergoing rehabilitation that requires the use of the other mobile.

The 10/12 MVA mobile that remains is also in need of improvements because its design reflects past practice of a fused rather than breaker protected primary connection.

Both Okanagan mobile substations are in good condition and have many years of useful service life ahead.

In situations involving multiple contingences, a small fleet of mobile substations owned by other entities may be available for short-term deployments. An active contact list is maintained, but FortisBC has often offered the use of the spare mobile rather than been in the position of having to rent a mobile substation.

3.2 Category 2 and Category 3 Equipment

Although protective relaying and communications equipment is important to the operation of the system, special consideration of this equipment is not included in this section of the system development plan for two reasons. Firstly, there is an overall project that is addressing communications system-wide, and secondly, many of the problematic relaying situations are being addressed by the investments associated with the South Okanagan Supply Reinforcement Project. The items considered in this section of the plan satisfy the following criteria: they are not captured by other planned projects and they have a significant impact on the safety and operability of the system. A structured investment program that is presented below addresses these issues. Two categories of equipment satisfy these criteria: disconnect switches and substation infrastructure (ground grid, buildings).

3.2.1 Disconnect Switches

In today's system, disconnect switches are still the pieces of equipment that receive the greatest amount of interaction with the operating personnel. The system is not fully automated, and manual switching is still both required and commonplace. Table 3.1 below displays the population and type of switches in use on the transmission system.

There are switches of many different vintages, and aside from relying on specific failure or trouble reports or thermographic imaging while in operation, there is little that can be done to predict or prevent failures. The switches typically have far greater current ratings than their application, so thermal imaging shows loose connections reasonably well against a cooler background. However, the most common problem with switches is misalignment and this must wait until the circuit can be de-energized before the problem can be rectified. If this problem is detected when the switch is being operated for another maintenance procedure, it is frequently too late or time consuming to coordinate necessary upstream isolation to isolate the switch for maintenance. Misalignment tends to be more tolerated but less common on breaker isolating switches. The greater tolerance stems from less frequent operation, and the lower frequency is because of better alignment of breaker and bus

support structures as compared to transformer and line applications. The substation condition database has identified 20 switches in "priority" applications that are in sub-optimal condition or should be replaced because of their age and specific application.

Table 3.1 Population and Type of Disconnect Switches

	60 kV	138 kV	170 kV	230 kV
Manual Switches	183	73	19	42
Motor Operated Switches	34	27	10	15
Fused Switches and/or removable fuses	37	1		

There have been some switches that have recently failed when called on to operate, but this appears to be manufacturer-specific at this time with a limited installed base. The remaining switches from that manufacturer have been visually inspected, and there is no further remedial action program for remaining switches from the affected manufacturer.

Many remote operation switches are now used for line sectionalizing purposes where there are sources at both ends of a line and a number of distribution substations along its length. In the recent past, many lines were only fed from one end (radial lines), and the substations along the line typically had only fused switches protecting the distribution transformer. With the recent system improvements, many lines are now looped, and a jump in reliability can be realized by installing remotely operable switches to sectionalize faulted portions of lines. This is the next step until in/out breakers can be installed at the substations, followed by small ring bus architectures. This level of system security is still some way off, but as mentioned the implementation of remotely operable disconnect switches is the next step on that path.

With all the above taken into account, a program to install remotely operable switches in key locations will help improve reliability. In many cases, this program would also capture switches that have been identified for replacement because of their age, condition and

application. A targeted replacement program would address the rest of the switches identified for replacement. This is captured under the switch additions and 20/27 Line operating switch projects in the Transmission Line Sustaining project for a total of $300,000 per year.

3.2.2 Substations (ground grids, surfaces and structures)

Both the Kootenay and Okanagan regions have substations and sites that go back many decades. However a key difference between the two areas is that demand in the Okanagan area has increased steadily over time, whereas, the Kootenay loads are below historical peaks at many individual distribution substations. This trend has resulted in Okanagan locations undergoing periodic rebuilds to add capacity, whereas more Kootenay locations are “frozen in time”. With no demand to drive upgrades, more Kootenay stations typically are rebuilt when condition degradation results over time and reliability or safety is unacceptably compromised. For example, there are eleven Kootenay stations that fall into this category as compared to only four Okanagan stations.

Another characteristic of these old stations is that they do not reflect modern standards, and what was once acceptable and common practice is now lacking as compared to recently built stations. Station grounding is an important example of this trend. New modelling software and testing methods are showing that the old stations do not have adequate ground grids to limit step and touch potentials in all locations. This is a difficult feature of a station to upgrade with undertaking an overall rehabilitation. Other typical improvements that are necessary at these older substations include replacement of timber supports with steel members, redesign of bus bar supports and clearance requirements, security improvements, surface rehabilitation (vegetation control, drainage and crushed rock), mobile substation access and improvements to control buildings or cubicles. For substations where there is no appreciable demand growth to drive improvements via capacity upgrades, a program to address the condition of the older “legacy” substations is proposed to bring them up to present day standards. The cost for this program is Ground Grid Upgrades for $250,000 per year for five years in the Station Sustaining section of the System Development Project budget.

4 Review of Past Practice

4.1 Capital Program

The 1998 Master Plan identified both a five-year and ten-year projection of transmission level maintenance-related capital expenditures, but did not include separate identification of distribution level expenditures. At the time, the distribution concerns were being addressed at a regional level, and sustaining investments were most likely incorporated into feeder and demand-driven distribution substation upgrades.

The transmission level maintenance capital was separated into terminal station and line categories for both the Kootenay and Okanagan regions. The system plan did not identify individual projects. The budget planning consisted of two project categories: the first category was based on the past year's unplanned (emergency capital) expenditures, and this amount was forecasted into future years. The second category included condition-based jobs that had been discovered in the last or present year, but did not require immediate investment. The jobs were then separately identified and planned as rehabilitation projects in the coming years. Neither of the project categories were supported by a structured program that looked at the maintenance needs of the system in a planned fashion. In the case of the first category, the expectation was that the coming years' failures would roughly approximate the past years' failures, and in the case of the second category, a problem had to be known before it was addressed. Although it was a reactive program, there were some attempts to modify future years' budgets based on the expectations of system condition. For instance, the 1998 Master Plan budget reflected a reduction in Kootenay Line maintenance when the Kootenay 230 kV System Development Project was due to be completed (in 2002). Table 4.1 shows these trends.

Table 4.1 Sustaining Capital Budgetary and Actual Expenditures

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1998 System Plan											
Kootenay Lines		0.81	0.98	1.39	0.24	0.15	0.19	0.41	1.03	0.55	0.85
Okanagan Lines		0.15	0.15	0.21	0.73	0.38	0.44	0.26	0.15	0.15	0.15
Kootenay Terminals		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Okanagan Terminals		0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Kootenay Substations		No separate identification									
Okanagan Substations											
Budget of the Year											
Kootenay Lines	0.43	0.81	0.88	1.52	0.60	0.63	1.07	2.63	1.28	1.08	1.21
Okanagan Lines	0.18	0.15	0.17	0.23	0.43	0.59	0.49	1.13	0.98	1.08	1.13
Kootenay Terminals	0.10	0.15	0.15	0.12	0.11	0.00	Combined into substations below				
Okanagan Terminals	0.10	0.21	0.15	0.14	0.09	0.00					
Kootenay Substations	0.48	0.47	0.48	1.23	1.33	1.04	1.42	2.98	1.80	2.20	1.40
Okanagan Substations	0.20	0.39	0.25	0.32	0.36	1.04	0.73	1.15	1.60	3.00	1.10
Actuals of the Year											
Kootenay Lines	0.77	1.11	0.93	1.62	0.80	0.84					
Okanagan Lines	0.11	0.22	0.08	0.14	0.92	0.44					
Kootenay Terminals	0.11	0.48	0.13	0.04	0.01	0.04					
Okanagan Terminals	0.07	0.21	0.09	0.08	0.05	0.00					
Kootenay Substations	0.33	0.26	0.38	1.13	0.58	0.77					
Okanagan Substations	0.22	0.32	0.26	0.05	0.53	1.01					

As the 1998 Master Plan was being prepared, a transmission line condition assessment program was initiated. The 1998 budget did not contain any targeted line rehabilitation, but based on early indicators from the condition assessment, it was recognized that transmission line investment would have to increase. The condition assessment program focused on several of the oldest lines first, and it was thought that these would represent the worst of the population. Once the oldest lines were addressed, it was believed that the rest of the population would not require as much capital to stabilize. This belief is reflected in the 1998 Master Plan capital projection, where the 1999 through 2002 budgets are approximately double the 1998 actual expenditures. Starting in 2003, the budget goes back down to the historic levels of 1998 and before. The program was intended to have an eight year cycle, and this is reflected by the increase in the 2006 budget, when the oldest lines were due to be re-assessed. However, after the first two years of condition assessment, it was apparent that the bulk of the asset base was in far worse condition than previously thought, and that a doubling of the budget would be necessary to stabilize the lines within the desired eight year cycle. In the capital constrained environment that existed, the most prudent course of action was the stabilization of the lines to less than the full eight year

cycle, with an accompanying commitment to re-visit the condition related issues as their term came up.

In any given year it has been difficult to complete all budgeted Kootenay distribution substation sustaining projects because the actual expenditures are below budget in all years, yet it is the Kootenay substations that continue to show the most action items during substation condition assessments. This is indicative of a need for a structured program to address the entire population of distribution substations rather than attempting to do numerous small projects at many locations. Notwithstanding this apparent annual under spending, there is projected growth of distribution substation sustaining capital expenditures in the years 2004 to 2008. This is driven partly by the elimination of the "Extraordinary" category of projects, but also by the introduction of the sustaining programs. In fact, if past sustaining extraordinary capital projects were included in Table 4.1, the past annual expenditures would be much closer to the future budgeted amounts. The South Okanagan System Reinforcement Project and the Kootenay 230 kV System Development Project corrected action items in many terminal stations; now those terminals (Coffee Creek, Crawford Bay, Princeton) not affected by those or other major projects must be addressed. Because the development plan of the Boundary area removes many of the stations that are of concern. The scope of work for all of the stations has been significantly reduced.

4.2 Operating and Maintenance (O&M) Program

The deployment of the available maintenance resources within FortisBC is difficult to track because of ineffective task identification in time and equipment tracking systems. The enterprise level platform to track Operating and Maintenance has changed twice within the last seven years, and this has created inconsistencies in time tracking methods. A dedicated system integrated into, but separate from, the enterprise level platform should be implemented to start building equipment history and tracking deployment of maintenance resources.

Some data is available for the Okanagan region based on a stand-alone time tracking initiative that was pursued internally. This data has been analyzed annually, and will be

used as a proxy for the activities in the Kootenay Region. Reports for 2001, 2002 and 2003 [3] have been analyzed for corrective/preventative utilization and activity by equipment category.

5 Effect on Future Sustaining Capital and Programs

5.1 Transformers and Stations

This section discusses the need for addressing certain transformers within the existing population. This need arises from replacement within the growth capital budget, some rehabilitation program in the sustaining budget, or by removing the need for the substation or transformer altogether.

There are four major drivers that influence the structure and sequence of sustaining investments for the transformer population.

1) transformer condition as indicated by dissolved gas analysis (DGA), and electrical tests such as Doble tests;
2) transformer loading compared to nameplate capacity;
3) transformer age (>55 years) and mechanical condition; and
4) substation age and application.

Once all these factors are known, a sequenced program can be designed that addresses the known problems in a manner that both uses capital funds efficiently, and can achieve a desired investment profile over time. As a starting point, it is assumed that the desired investment profile is flat (constant investment over time).

The transformer condition as indicated by dissolved gas analysis is tracked in the Transformer Oil Analyst (TOA) database program. The results of individual tests are entered into the database and can be trended, analyzed and archived. The Transformer Oil Analyst program also provides some “expert system” suggestions, and classifies the equipment into four categories, ranging from 1 (good) to 4 (address immediately). There are currently seven transformers in the Transformer Oil Analyst database as condition 4, and a further eight that have been at condition 4 in the recent past. Table 5.1 identifies the current condition 4 transformers and the suggested actions to address the individual units. Most of the poor dissolved gas analysis readings in Table 5.1 are caused by oil migration from the tap-changing compartment to the main tank. This in itself won’t cause imminent transformer problems, but the high gas readings could mask problems due to other more

serious causes in the main tank. The Westminster Transformer 1 could fall into this category.

A trend that has been noticed is that most Moloney transformers between 10 and 20 MVA and manufactured between 1970 and 1985 show gas and oil migration from the tap-changer compartment into the main tank. Rehabilitation for these transformers and tests for their condition is suggested to address the Moloney transformers.

Table 5.1 – Transformer Oil Analyst Current Condition 4 Transformers

Location	TOA Condition	Action / Analysis	Timeframe
Osoyoos Transformer 2 (#1399)	4	Recondition LTC and barrier between Main tank and LTC to prevent the migration of gasses between the tank and LTC.(DGA most likely tap-changer and load related)	2005
Grand Forks Transformer 1 (#12530)	4	Install new conservator for the LTC and separate the transformer conservator from the LTC. Treat the oil with Fuller's earth and degas the transformer. Sample for gases at 3, 6 and 9 months and if all is normal, put into an annual oil testing program.	2005
Westminster Transformer 1 (#20142)	4	Treat oil immediately. Replace in 2005. The gassing and cellulose deterioration in this transformer are significant (DGA is possibly tap-changer related, but may have other problems, careful internal examination required)	2005
Oliver Transformer 2 (#20153)	4	Oil Treatment immediately and remove from service after terminal conversion in 2008 (possible spare) (DGA indicates internal arcing, internal examination required) This transformer has also had a fault in it in 1998 which was not completely isolated.	2005/2008
Trout Creek Transformer 1 (#20258)	4	Known gas migration from tap changer. Seal the LTC and upgrade the LTC to 1200 amp to improve the operation and maintenance of the LTC.	2005
Osoyoos Transformer 1 (#20274)	4	Recondition LTC and barrier between Main tank and LTC to prevent the migration of gasses between the tank and LTC. (DGA most likely tap-changer and load related)	2005
Pine Street Transformer 1 (#20356)	4	Recondition LTC and barrier between Main tank and LTC to prevent the migration of gasses between the tank and LTC. (DGA most likely tap-changer and load related)	2005

Table 5.2 identifies those transformers that have shown gassing problems in the recent past, and have either been repaired, or are "band-aided" and will need attention in the near

future. The DG Bell unit is also a Moloney transformer and has been performing well after a recent tapchanger replacement.

There are several transformers for which there were no current results for dissolved gas analysis. It is of some concern that Summerland Transformer 1 (a 1982 Moloney) has caused past concern. It is recommended to either recover the data from previous tests (which are believed to have been done), or collect and analyze oil samples immediately.

Table 5.2 – Transformer Oil Analyst Recent Condition 4 Transformers

Location	TOA Condition	Action / Analysis	Timeframe
6.5/8 MVA Mobile (#1072)	Was 4, now 3	Remove from service when new mobile station is available. The mobile is well past useful life mechanically and electrically.	2006
AS Mawdsley Transformer 1 (#12969)	Was 4, now 3	Remove from service and refurbish, and spare for Mawdsley Transformer 2 and Crawford Bay Transformer 1.	2006
Coffee Creek GT's (#14521,2,3)	Was 4, now 1	Advanced age of units (built in 1933) dictates replacement is the best option with Brilliant Generating Station spare grounding transformer	2008
Ruckles Transformer 2 (#14576)	Was 4, now 1	Reconditioned and running well, remove from service and use in other location when the Grand Forks 25 kV conversion is completed	2010+
Crawford Bay Transformer 1 (#14863)	Was 4, now 3	Replace with reconditioned Grand Forks Transformer 1, Mawdsley Transformer 2 or Oliver Transformer 1 when the Boundary area plan is completed. Crawford Bay Transformer 1 has a long history of hydrogen gassing.	2008
DG Bell Transformer 1 (#21165)	Was 4, now 1	Tapchanger repaired, unit OK	
FA Lee Transformer 4 (#22171)	Was 4, now 3	Ongoing gassing. Perform Fuller's Earth and vacuum degasification and monitor closely. Continue monitoring monthly.	2005

The second driver for "sustaining" transformer capital investments is related to demand exceeding nameplate capacity. Although these are perhaps more correctly termed "growth" investments, they can sometimes accomplish some "sustaining" goals as well when the improvement is located at an existing, rather than Greenfield, site. There are several sites that fall into this category. The Distribution Planning Manual at Appendix E has identified a number of transformers that must be replaced due to overload. The summary for this is

included for continuity sake and visibility of all of the transformer replacements within the FortisBC service territory.

Table 5.3 – Transformer Capacity Replacements

Location	Action / Analysis	Timeframe
Crawford Bay Transformer 2, Crawford Bay Transformer 3	Overloaded at 140% in 2005, but very low growth in the area so replace when a 60/13 kV transformer comes available from the recondition program. – 2- 6/8 MVA transformers are preferred.	2006/2007
Ruckles Transformer 1	Overload in 2007/2008. Condition 4 for DGA. Will be removed when the Boundary area plan is implemented.	2007
Naramata Transformer 1	Overloaded in 2006/2007, the LTC on this unit is inoperable, gassing, power factor of the transformer is significantly deteriorating, and the transformer is 1962	2006
Huth 4,5,6 7	Overloaded in 2008/9, But Waterford installation will offload all of this in 2005 when it is installed. Salvage Huth transformers in 2006.	2006
OK Falls Transformer 1	Replace due to loading constraints	2014
Princeton Transformer 1, Transformer 2, Transformer 3	The T3 transformer is overloaded in 2004/2005 and the gas results are indicating faults in the transformer and migration of gases from the LTC. T1 has gasses migrating from the LTC to the main tank. T2 has very advanced cellulose deterioration. It is a 1957 transformer and it is not required if T1 and T3 are replaced with 138/13kV transformers,	2005
Sexsmith Transformer 2	Sexsmith T1 will be overloaded in 2009/10 and will require an additional transformer.	2009
Hollywood Transformer 2	Hollywood T1 will be at capacity in 2007. Install a third transformer at Hollywood in the mobile location	2007
Recreation Transformer 2	Additional loads in the downtown core (if approved by the city) will require a new transformer. Time lines for this project are variable. 2008 was used to keep the project at the forefront.	2008

Other sites in need of some “sustaining” work that have been addressed by “growth” investment are Rock Creek, Baldy, Midway and Greenwood. For instance, the need for additional capacity at Rock Creek offers an opportunity to relocate the distribution supply source to another location, and eliminate the existing site with its numerous condition and

location related concerns. The development plan for the Boundary area will resolve all these sustaining issues. The transformers and stations that will be addressed are:

- Oliver T1
- Oliver T2
- Baldy T1
- Rock Creek T1
- Midway T1
- Greenwood T1
- McKinney
- Rock Creek T2

The third driver for sustaining transformer capital investment is the replacement of units that are so old that their mechanical integrity has become compromised. For the first five years of this capital plan it is suggested that all transformers older than 55 years be phased out. Table 5.4 lists the transformers manufactured in 1950 or earlier and the suggested courses of action. If the replacement and rehabilitation program recommended in Tables 5.1, 5.2, and 5.3 is adopted, the second five year window of the System Development Plan (2010 to 2014) would see only three transformers being replaced because of age, those being Coffee Creek Transformer 2, Kaleden, and Passmore.

Table 5.4 – Transformers Manufactured in 1950 or Earlier

Location	Manufacture Date	Action	Timeframe
Ymir Transformer 1 (#12916)	1950	Replace, and scrap Ymir Transformer 1. This enables the elimination of Whitewater substation	2009

The remainder of the transformers that need attention must be addressed either through rehabilitation or removal. A class of transformers that deserves focussed attention is the fleet of Moloney transformers where a rehabilitation program is proposed. There are 15 Moloney tap-changing transformers in the FortisBC fleet. One (DG Bell T1) has already been repaired, three are in service on the remaining three mobile substations, and the programs described in the tables above address further units (Osoyoos Transformer 1 and Transformer 2, Princeton Transformer 3, Westminster Transformer 1, Pine Street Transformer 1, and Waterford). This leaves two units unrepaired (Castlegar and Kaslo), and one unit for which no dissolved gas analysis data is available (Summerland). At this time, it is a prudent step to schedule the rehabilitation of the Kaslo and Castlegar in 2005 and 2007 respectively. Kaslo is also driven by site condition. The Summerland unit may be

more problematic to rehabilitate because of its size, and may require the full-time deployment of a mobile substation in 2009.

The final driver of sustaining capital for transformers is associated with substations that have been termed “legacy” substations. These are substations that are at least 30 years old that were built to the standards of the day, and have either experienced a decline in load or no load growth. Consequently, the substations have not required capacity upgrades, and tended to be “left behind” in terms of investment. Stations that have already been addressed by this program include Rossland (replaced with Cascade), Slocan (still in service for light industrial load, but largely replaced by Valhalla), and Trail, Warfield, and Wynndel. In some cases, the strategy has been to supply distribution-level voltages from nearby substations, and in other cases, a complete rehabilitation or relocation of the substation. There are still many substations in the system that fall into this category. These are:

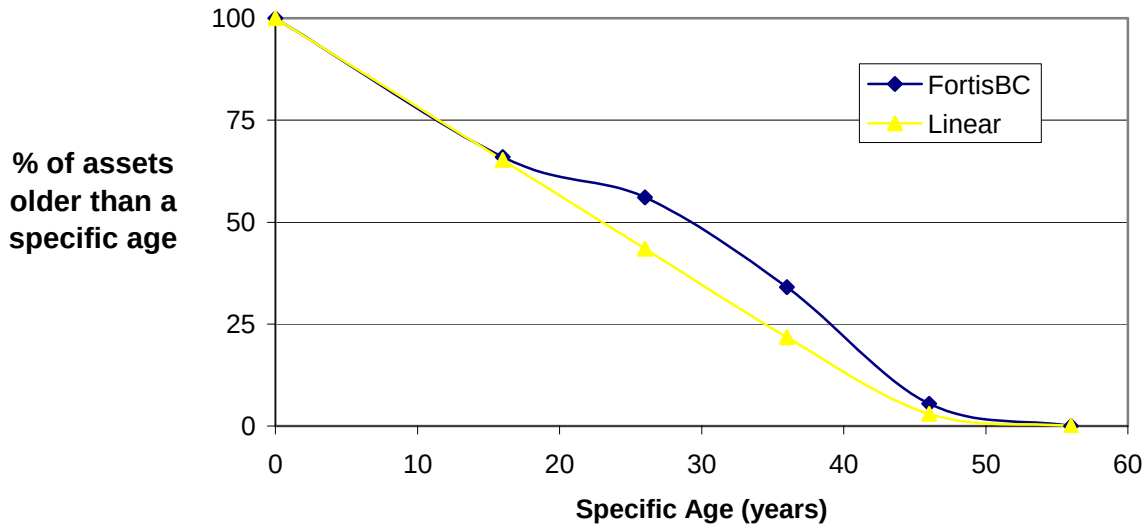
- Naramata
- Whitewater
- Hearns
- Kaslo
- Paterson

The majority of these stations mesh well with the activities already described. Naramata, and Kaslo are condition-driven site reconstruction or relocation projects. The common issues are clearance distances to live equipment, mobile substation access, ground grid integrity and overall perimeter security. Both also have transformers in need of attention, thus the opportunity to combine site and transformer rehabilitation.

The Hearns, Whitewater and Paterson substations will be removed from service and their loads supplied by nearby distribution sources. In the case of Hearns, less than 1 MVA of local load remains, and can be supported from either Fruitvale or Salmo. The option to rebuild Hearns in the future will be kept as a contingency plan in case the local light industrial spot load re-materializes. Whitewater substation will be eliminated following upgrading of the Ymir substation transformer, with the possible introduction of a regulator bank to maintain voltage at the ski hill. Paterson will be replaced by 25 kV distribution from Cascade.

Figure 5.1 depicts the resulting overall demographic profile of the FortisBC transformer population in 2010 if the capital plan, including the above described projects, is implemented.

Figure 5.1: Transformer Age Distribution in 2010



With the retirement of the Kootenay 6.5 MVA mobile substation, it would be prudent to purchase a second mobile substation for the Kootenay region immediately. This station should be configured with a 63 kV primary for future flexibility. With the consolidation of distribution voltages in the Kootenay area, secondary voltages of 13 kV and 25 kV should suffice. The transformer should be sized between a 12/16/20 MVA or a 24/32/40 MVA depending on the technology being used by the manufacturer. New generation mobile substation transformers have started incorporating advanced thermal insulation, such as Nomex, in order to get transformer size to a minimum. For the Kootenay region, an ultimate capacity of 25 MVA would be sufficient to replace any single unit in the region, but a 24/32/40 MVA unit should be considered if Okanagan support is to be provided. The primary role of the second mobile in either region is to provide post-contingency support in the event the other unit is being deployed for maintenance activities.

5.2 Breakers and Disconnect Switches

Breakers and disconnect switches have been included together in this section because they have been used interchangeably in the past throughout the FortisBC system. Breaker replacements through sustaining capital fall into two categories: those breakers that have reached end of service life, and those that are added to enhance system operation and reliability. The disconnect switch sustaining capital investments are focussed on those applications that are "quasi-breakers", that is, they are used to re-configure the system, rather than those applications that are used solely for equipment isolation. The former switches must be very dependable, and are used in real-time situations, whereas the latter switches are normally used in maintenance situations where the time and operational pressure is not as great, so more compromises are tolerable in their performance.

Breaker end of service life can be driven by mechanical, electrical, environmental or operational factors. Although a number of old bulk oil breakers are still acceptable from an electrical perspective, the dependability of their mechanical operation comes into question, and their environmental characteristics are no longer acceptable by modern standards. Conversely, some minimum oil breakers may still be mechanically and environmentally sound, but no longer can be depended upon to have the electrical performance that is required.

For this plan, analysis of the breaker population has identified three investment drivers: age, condition indicators, and overall facility rehabilitation. There were no instances found of breakers not being fit for purpose that were not already captured by one of the foregoing criteria. Table 5.5 identifies the breakers that should be addressed in the next five-year investment cycle, the driver, and the suggested action.

As noted in the table, over 50% of the breaker work should be combined with other capital work going on at the station. Breakers at Princeton, Huth, and Oliver should be included as line items in larger project at those stations, while breakers at Westminster, Pine Street, Coffee Creek and Crawford Bay can stand as separate items in the capital budget, but the work on those breakers should be coordinated with other work at the stations, (typically the

transformer rehabilitation program) to make the most efficient use of the mobile substation and crew mobilization.

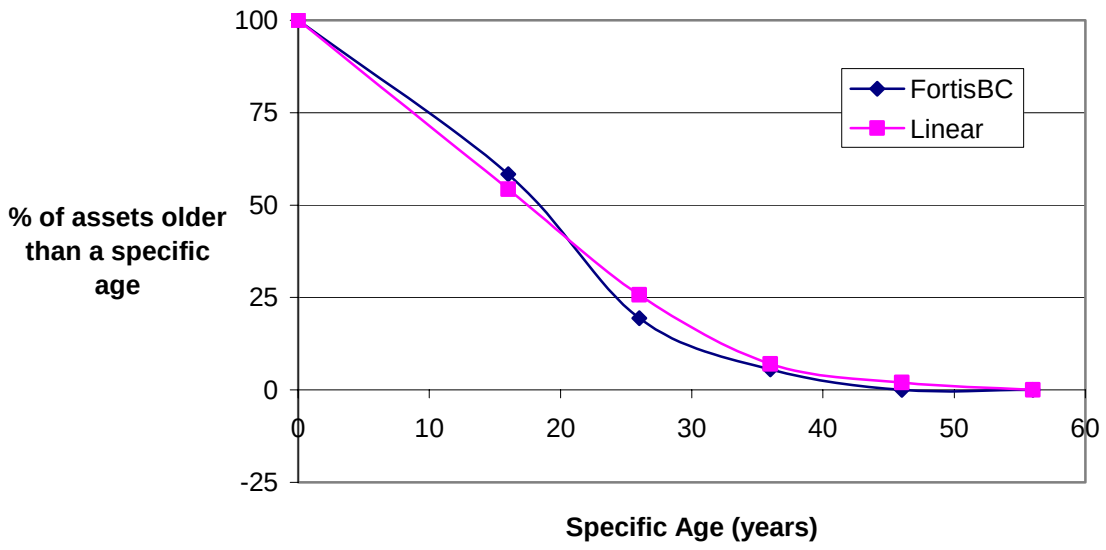
The work identified in Table 5.5 will address most bulk oil breaker issues for the next ten years, and the installed base of minimum oil and SF_6 breakers should not be experiencing any age related issues for at least another ten years. Therefore, the sustaining capital investments in breakers should hit something of a minimum between 2010-2014 before requiring new investment starting in about 2015.

Table 5.5 – Existing Breaker Investment Requirements

Location	Condition	Action
Westminster 45L	Sheer age. This bulk oil breaker is over 70 years old, and there are no Doble results to review. Mechanical condition identified in database	2007 (combine with transformer rehab)
RG Anderson 45L	Age and interrupting capability insufficient for duty. Mechanical condition identified in database	2005 Replace as part of South Okanagan (VAS) Supply Reinforcement Project (no separate budget line item)
Huth 53A	Age with no supporting Doble date. Bulk oil breaker manufactured in 1936. Mechanical condition identified in database	2007 Replace as part of Huth replacement (no separate budget line item)
Pine Street 44L	Age with no supporting Doble date. Bulk oil breaker manufactured in 1945. Mechanical condition identified in database	2006 (combine with transformer rehab)
Coffee Creek 37L Coffee Creek T1	Although not yet triggering replacement solely due to age (built in 1951). Mechanical condition identified in database.	2007 (coordinate with transformer work)
Crawford Bay 32L	Aged bulk oil breaker. Mechanical condition identified in database	2008 (combine with transformer work)
Hedley 43A	Bushing Replacement required and is de-energized, replace with a fuse.	2005
Princeton 56L Grand Forks Terminal T3 Duck Lake 46L Oliver TA	Either condition related issues identified, or Doble bushing test data is misleading, CONFIRM CONDITION.	2005-2009

Figure 5.2 depicts the projected overall demographic profile of the FortisBC breaker population in 2010 following the investments contained in the capital plan. For the breaker population greater than 25 years old, the FortisBC population will be "under" the modelled life curve, which supports a reduction is sustaining capital investment for approximately five years.

Figure 5.2: Breaker Age Distribution in 2010



For switching applications, the system is broken down into three categories. The first category is that part of the system where suitable configuration flexibility already exists, and the objective is to keep the equipment functioning (for example 41 Line and 42 Line, or 43 Line). The second category is that part of the system where additional switching capability will yield measurable reductions in outage times to be able to switch around bad portions of transmission line (e.g. 20 Line and 27 Line). The third category is that part of the system that will undergo considerable reconfiguration in the next few years, so although new switching would benefit reliability, the addition would be short-lived (for example, 9 Line and 10 Line). The sustaining capital budget as applied to disconnect switches focuses on that part of the system that is in the second category, where measurable reductions in outage times can be realized with new switches that can be used for system configuration changes. Work in the first category should be addressed via a "minor station capital" budget line item, and work in the third category should be deferred until after the system is reconfigured.

The biggest opportunity for reduction of outage times is in the 20 Line and 27 Line loop. Although full supply of the loop from either end is still problematic because of the poor voltage profile at the opposite end of the line, in N-1 scenarios outside peak loading times, substantial relief can still be provided.

Table 5.6 identifies locations where switch problems and/or switch opportunities have been identified and classifies the switches into one of the three previous categories.

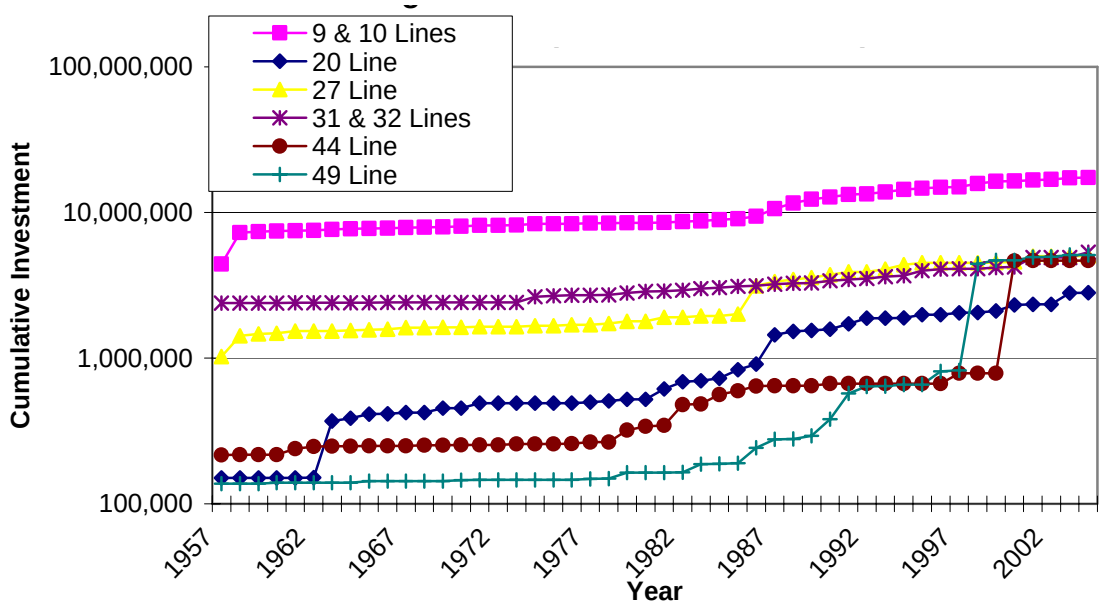
Table 5.6 – Disconnect/Sectionalizing Switch Investment Requirements

Category 1 Repair switch under maintenance or "minor station capital" budget	Category 2 Install new switch based on outage time reduction opportunities	Category 3 Although opportunity/problem exists, defer investment until after system reconfiguration
Keremeos 43-1 OK Falls Fruitvale Mawdsley Crawford Passmore Joe Rich	Ymir Beaver Park Castlegar Blueberry Creek Tarrys Glenmerry West Bench	9L and 10L applications (Christina, Ruckles, Baldy, Rock Creek, Greenwood, etc.) Whitewater Hearns Paterson Kaslo Huth Oliver

5.3 Transmission Lines

Transmission line sustaining capital investment needs to be focussed on the lines that have been in existence the longest with major rehabilitations. From Figure 5.2, it can be seen that 20 Line, 27 Line and 32 Line are strongly in this category, while 44 Line and 49 Line have been rebuilt recently. The trends associated with 44 Line and 49 Line are informative. Prior to their rebuilds, the amount of capital flowing into these lines to keep them in acceptable condition had ramped up considerably. At some point, the continuing need for investment was deemed to be inefficient, and the decision was made to perform a complete rebuild, at a cost that was half-an-order-of-magnitude higher than what had been invested to-date. For instance, the invested capital in 49 Line prior to rebuilding was $870,000 over 40 years, and the rebuild required $3.8 million. 44 Line shows the same pattern. The important trend to note is that 9 Line, 10 Line, 20 Line, 27 Line and 32 Line are all showing the rising need for investment. It is interesting to note that a rebuild of 20 Line appears to have occurred in the early 1960s, and the same-half-an-order-of-magnitude investment was required four decades ago.

Figure 5.2 Transmission Line Investment (normalized to $2004)



It has been decided to retire 9 and 10 Lines in favour of a reconfiguration of the Boundary area supply. The enabling condition that has led to this decision is the new ability to source 11 Line from either Oliver or Mawdsley.

The same level of analysis is required prior to the decision to rebuild 32 Line. This is another area of the system that has some potential for reconfiguration, but the most cost-effective solution may still end up being a reconstruction of the existing configuration. Current rehabilitation efforts are running at $600,000 per year, and based on the past experiences of 44 Line, and 49 Line, a reconstruction of 32 Line could reach $15 million to $20 million. For the present plan, a rebuild of the line in 2005 and 2006 is recommended

The combination of 20 Line and 27 Line do not appear to have the same opportunity for system configuration changes as other areas. Therefore, line reconstruction must be anticipated in due course. 20 Line appears to have been reconstructed in 1962 so, it should not require large investments yet. However, 27 Line does appear to be overdue for investment. An allowance of $1 million should be allocated to 27 Line over this planning cycle to address rehabilitation and reconstruction issues.

The annual average sustaining investment in transmission lines over the last 25 years has been $2.2 million per year. This includes the reconstruction of 43 Line, 44 Line and 49 Line, but with looming needs identified for 20 Line and 27 Line, this average may even be understating the annual sustaining capital requirements.

The level of sustaining capital required to maintain a system is partially dependent on the design life of the system. Lines have generally accepted design life of about 50 years. This would translate into an annual replacement rate of 2% per year resulting new lines every 50 years. With an investment in transmission line assets of about $140M since 1957 this represents an annual investment of $2.8M. This investment is not a linear investment since new lines require much less replacement and maintained and as they age the requirement for replacement increases. The FortisBC system is an older system requiring greater levels of capital investment at this time.

The transmission line assessment program started in 1997 has done much to identify where the need for sustaining capital is the greatest, and offers the opportunity to create a baseline for the amount of degradation that occurs over eight years (the cycle time of the assessment program). Based on the amount of identified rehabilitation work that has occurred in the past, the backlog that has accumulated and the known age and condition of the lines, in addition to the lines mentioned above, the following lines should be given priority in the sustaining capital budget: 21 Line to 24 Line, 30 Line and 42 Line.

5.4 Staging and Schedule

The sequence of the transformer rehabilitation and replacement program may lend itself well to integration with the overall growth and reconfiguration capital expenditures. However, for optimal capital efficiency, the timing of certain project may have to be delayed or advanced by one year to coordinate properly. There are accompanying risks with the delays or advancements, but these are mitigated by the presence of specific action plans, so the risks should be prudent and manageable.

As an added advantage, the transformer rehabilitation and replacement program is mostly focussed around older stations. The breaker and disconnect switch work that has been identified is at most of the same stations, allowing another opportunity for coordinating the work and achieving some efficiency by combining outages and reducing repeated mobilizations.

6 Recommendations

1. Adopt a philosophy of “Condition Based Maintenance”. This will ensure the equipment is maintained on an as needed bases. This philosophy will ensure the proper level of maintenance is completed and show operating and maintenance savings as older equipment is replaced with new equipment. A good condition based maintenance system will ensure work load is reduced on newer equipment initially requiring less maintenance.

2. Identify maintenance regimes for each of three equipment categories, with Category 1 equipment receiving the most attention based on criticality and development of diagnostic techniques.

3. Replace older vintage disconnect switches in single transformer feed and line switching applications, and install more remote capability switches.

4. For older substations, where forecasted demand growth will not drive capacity upgrades for at least ten years, a rehabilitation program is recommended to address ground grids, security, surface condition, clearances to live equipment, mobile substation access and control enclosures.

5. Initiate a rehabilitation, re-conditioning and replacement program for the questionable transformers.

6. Purchase immediately a new mobile transformer for the Kootenay region rated at 30 MVA, with a 63 kV primary.

7. Implement a computerized maintenance management system to help the design and management of ongoing maintenance programs, and assist in being able to verify maintenance activities in response to increasingly comprehensive audit obligations.

7 References

[1] J. Moubray, Reliability-Centered Maintenance, Industrial Press Inc., 1991.

[2] S. Asgarpoor and M. Doghman, “A Maintenance Optimization Program for Utilities' Transmission and Distribution Systems”, Proceedings of the 1999 North American Power Symposium, San Luis Obispo, CA, October 1999, pp.454-459

[3} J. Mouat, The Business of Power, Sono Nis Press, 1997.

[4] J. O’Brien and J. Fransen, “2001 Year-End Maintenance Report”, “2002 Year-End Maintenance Report”, and “2003 Year-End Maintenance Report”, Internal FortisBC Circulation

Transmission and Distribution System Development Plan

Appendix E

Distribution Planning Manual

November 26, 2004

Table of Contents

1 Distribution Planning Philosophy 3
1.1 Goals 3
1.2 Activities 3
1.3 Standards of Service 3
2 Planning Criteria 4
2.1 Voltage - Steady State Criteria 4
2.1.1 Introduction 4
2.1.2 Planning Criteria 4
2.1.3 Background 4
2.1.4 Process 5
2.2 Overhead Conductor and Underground Cable Ampacity 5
2.2.1 Introduction 5
2.2.2 Planning Criteria 5
2.2.3 Overhead Conductor 6
2.2.4 Underground Cable 7
2.3 Capacity of Distribution Equipment 7
2.3.1 Introduction 7
2.3.2 Planning Criteria 8
2.3.3 Distribution Service Transformers, Voltage Regulators and Switches 8
2.3.4 Distribution Source Transformers 8
3 Backup Planning Guidelines 9
3.1 Introduction 9
3.2 Backup Requirements 9
3.2.1 Distribution Contingencies 9
3.2.2 Transmission Contingencies 9

1 Distribution Planning Philosophy

This document identifies the philosophy utilized by System Planning in the development of the distribution system with voltage levels 35 kV and below.

1.1 Goals

- To plan the development of the most economical distribution systems that will provide service within specified standards to meet projected distribution loads of the future.
- Determine the changes required over the next five years to maintain standards of service while at the same time providing the most economical development of future distribution systems.
- Evaluate new facilities or anticipated rebuilds by comparing alternatives and recommending changes that will produce the most economical long-term development of the future distribution system.

1.2 Activities

- Project growth rates and forecast future load for areas within the service boundaries. Communicate with Regional Districts, Town Planners, etc., to gather information on anticipated development plans in their respective areas to incorporate into load forecasts.
- Develop alternative plans for systems that will supply projected future loads. Analyze each plan. Select the most economical as the long-range plan. Revise the long range plans and five year plans as a result of changing load patterns, regional and municipal plans or changing service standards.

1.3 Standards of Service

- Maximum feeder load during normal operating conditions is limited to the ampacity of the underground cable or overhead conductor exiting the substation. Refer to section 2.2 “Overhead Conductor and Underground Cable Ampacity”
- Maximum distribution equipment load during normal operating conditions is limited to the continuous rating of the equipment unless otherwise specified. Refer to section 2.3 “Capacity of Distribution Equipment”.
- Minimum Voltage as per CSA publication C235 “preferred Voltage Levels for AC Systems, 0 to 50,000 Volts”. Refer to Section 2.1
- Maximum Voltage as per CSA publication C235 “preferred Voltage Levels for AC Systems, 0 to 50,000 Volts”. Refer to Section 2.1
- Maximum three phase fault current is 8000 amps on primary distribution systems.
- Maximum single line to ground fault current is 5000 amps on primary distribution systems.
- Maximum load/L-G short circuit ratio is 25%.
- Maximum load/3-P short circuit ratio is 40%.

2 Planning Criteria

2.1 Voltage - Steady State Criteria

2.1.1 Introduction

This Planning criteria covers the application of minimum and maximum voltage levels on the distribution system. This criteria specifies the minimum and maximum voltage levels under steady state conditions used to plan the distribution system.

2.1.2 Planning Criteria

Planning designs the distribution feeders to ensure that customers have acceptable voltage at their utilization point. Planning will take corrective action when the predicted loading on the distribution feeder model indicates that the primary voltage (three phase and/or single phase) is outside of the minimum or maximum voltage parameters stated below:

Table 1- Planning Voltage Criteria

(on a 120 Volt base)	Minimum	Maximum
Three Phase Voltage	115 V	127 V
Single Phase Voltage	113 V	127 V

The minimum voltages shown above apply when the source voltage is set at 123.5 V and the maximum voltages shown above apply when the source voltage is set at 126.5 V. The 123.5 V and 126.5 V levels reflect the typical operating range of a source substation.

2.1.3 Background

Planning assesses the need for voltage support to ensure that customers have acceptable voltage at their utilization point in accordance with CSA Standard CAN3-C235-83: “Preferred Voltage Levels for AC systems 1 to 50 000 V”. This standard outlines the recommended steady state voltage variation limits for circuits up to 1000 V at the utilization point (i.e. plug in) as follows:

Table 2 – CSA Preferred Voltage Levels

	NORMAL	EXTREME
Three Phase	110 V – 125 V	108 V – 127 V
Single Phase	108 V – 125 V	104 V – 127 V

Planning will initiate voltage improvements when the voltage reaches or is projected to reach the minimum recommended voltage under normal operating conditions. Corrective action is also initiated for instances where the voltage is or is expected to be in excess of the maximum recommended levels under normal operating conditions.

Some extreme operating conditions are temporary in nature. So the decision to initiate system improvements will depend on factors such as location, customer type and the extent to which limits are exceeded (i.e. magnitude and duration reflecting safety concerns as well as the probability of equipment damage).

2.1.4 Process

Recognizing that the specified CSA voltage limits apply at the utilization point, some allowance must be made for the voltage regulation through the service transformer as well as the secondary and internal wiring voltage drop to the plug ins. Generally, a 3-5 Volt drop from the main line to the customer utilization point under peak loading conditions and a 1 – 2 volt drop under light load is assumed. In order to comply with CSA limits, Planning models the distribution feeder and will take corrective action when the primary voltage of a peak load feeder model indicates an existing or projected steady state voltage of 115 V (120 V base) or less on the three phase lines and/or 113 V (120 V base) or less on single phase lines. Similarly, Planning will take corrective action when the primary voltage of a light load feeder model (three phase or single phase) indicates an existing or projected steady state voltage of 127 V (120 V base) or more.

2.2 Overhead Conductor and Underground Cable Ampacity

2.2.1 Introduction

This document covers the Planning Criteria for the application of ampacity levels for overhead conductors and underground cable used in the distribution system. This document specifies the maximum ampacity levels used to plan the distribution system.

During actual operations, higher ampacity ratings may be used taking into account actual temperatures, wind speed, pre-loading and duration of loading. Operation at higher ampacity levels may reduce the life of the equipment in order to supply load and such risks will be assessed at time of operation.

2.2.2 Planning Criteria

Planning designs the distribution feeders to ensure that the conductors, cables and connectors, on the distribution system, have the capability to supply customer load for forecast load conditions without any conductor, cable and connector loss of life.

This document outlines the normal ampacity ratings for overhead conductors, underground cable, and the maximum feeder loading used by Planning in the distribution system.

2.2.3 Overhead Conductor

Planning models the distribution feeders to ensure that the overhead conductors are not loaded above their ratings. Planning will take corrective action, when the model of the distribution feeder indicates that any equipment will be operated above its rating under the forecast peak load conditions.

Table 3 – Overhead Conductor Ampacity Limits

Conductor Type	Trigger Ampacity	MVA by Voltage			
		25 kV_{LL} 3Ø	14.4 kV_{LG} 1Ø	13 kV_{LL} 3Ø	7.2 kV_{LG} 1Ø
8C	110	4.8	1.6	2.4	0.8
6C	147	6.4	2.1	3.2	1.1
4C	195	8.4	2.8	4.2	1.4
3C	228	9.8	3.3	4.9	1.6
2ACSR	210	9.1	3.0	4.5	1.5
2C	276	11.9	4.0	6.0	2.0
2/oACSR	318	13.7	4.6	6.9	2.3
3/oACSR	385	16.6	5.5	8.3	2.8
90C	329	14.2	4.7	7.1	2.4
266ACSR	510	22.0	7.3	11.0	3.7
336ACSR	652	28.2	9.4	14.1	4.7
397ACSR	660	28.5	9.5	14.3	4.8
477ACSR	745	32.2	10.7	16.1	5.4
927AAC	1118	48.3	16.1	24.1	8.0

2.2.4 Underground Cable

Planning models the distribution feeders to ensure that the underground cables are not loaded above their ratings. Planning will take corrective action, when the model of the distribution feeder indicates that any equipment will be operated above their rating under the forecast peak load conditions.

Table 4 – Underground Cable Ampacity Limits

		Trigger Ampacities (Three phase)			
		In Duct		Cable at Riser	
Cable	Grounding	Normal	Emergency	Normal	Emergency
#2 Cu	Both Ends	164	200	125	179
#1 Cu	Both Ends	183	222	140	201
350Al	Both Ends	322	389	286	420
750Al	Both Ends	435	543	418	619
750Al	One End	555	667	550	781
1000Al	Both Ends	484	609	472	704
1000Al	One End	663	799	668	950
1000Cu	Both Ends	634	801	611	918
1000Cu	One End	828	1002	835	1193

Note: Emergency rating is limited to 1500 hours in the life of the cable.

2.3 Capacity of Distribution Equipment

2.3.1 Introduction

This document covers Planning Criteria for the application of ampacity levels for equipment used on the distribution system. This document specifies the maximum ampacity levels used to plan the distribution system.

Under actual operations, higher ampacity ratings may be used taking into account actual temperatures, wind speed, pre-loading and duration of loading. Operation at higher ampacity levels may reduce the life of the equipment in order to supply load and such risks will be assessed at time of operation.

2.3.2 Planning Criteria

Planning designs the distribution feeders to ensure that the equipment on the distribution system has the capability to supply customer load for forecast load conditions. This Planning criteria outlines the ampacity ratings for equipment used in the distribution system.

2.3.3 Distribution Service Transformers, Voltage Regulators and Switches

Planning models the distribution feeders to ensure that the distribution line voltage regulators and switching devices are not loaded above their ratings.

Planning does not model individual service transformer loading, but recommends that when load is found to exceed the rating on these transformers that corrective action is taken.

Planning will take corrective action, when the model of the distribution feeder indicates that any equipment will be operated above the rating of the equipment under the forecast peak load conditions.

Table 5 – Distribution Equipment Capacity

Voltage Regulators	100% of Nameplate Rating
Switches and Cutouts	100% of Continuous Rating
Distribution Service Transformers	100% of Nameplate Rating

2.3.4 Distribution Source Transformers

Planning monitors the load on distribution source transformers to ensure that they are not loaded above their ratings.

Distribution source transformers are those that supply distribution feeders at 25 kV or below, predominantly 25 kV and 13 kV, including transmission transformer tertiaries where used.

Transformer capacity upgrades will be planned in the year that the forecasted transformer load:

(1) exceeds nameplate rating at the forecast summer peak, or
(2) exceeds nameplate rating plus 25% at the forecast winter peak.

3 Backup Planning Guidelines

3.1 Introduction

This guideline addresses the criteria for backup associated with the distribution system. Backup in addition to service continuity (i.e., absence of interruptions) composes reliability. Backup refers to the ability to restore service after an interruption without necessarily first repairing the cause of the interruption.

3.2 Backup Requirements

3.2.1 Distribution Contingencies

Planning will assess the distribution system to determine the backup capability for a single Distribution contingency event. In the event of a single Distribution contingency, a percentage of the peak load must be able to be supplied from the remaining distribution feeders in the study area. The percentage of peak load to be supplied is determined from the load duration curve shown below if available or 80% of peak load.

After the interruption, without first repairing the cause of the interruption, the remaining distribution feeders should have the capability to supply the load on the upper flat portion of the load duration curve. In the graph below, this would be 7 MW. Hence, it is recognized, that during peak load conditions the remaining distribution system may not have the capability to supply the entire load in the event of a distribution contingency.

In municipalities that require subdivisions be supplied underground, the company will ensure that all new underground circuits are looped and that the load can be fully supplied by either end of the loop for a single cable section failure.

When determining the capability of the remaining distribution system in the event of a distribution contingency, the minimum voltage level will be allowed to drop by 2 V to 113 V for three phase and 111 V for single phase.

Planning will take corrective action, when for the predicted loading, the distribution system is not capable of meeting this backup criteria.

3.2.2 Transmission Contingencies

Planning will study the distribution system to develop the backup requirement for the loss of one substation transformer in either a single or multi transformer substation.

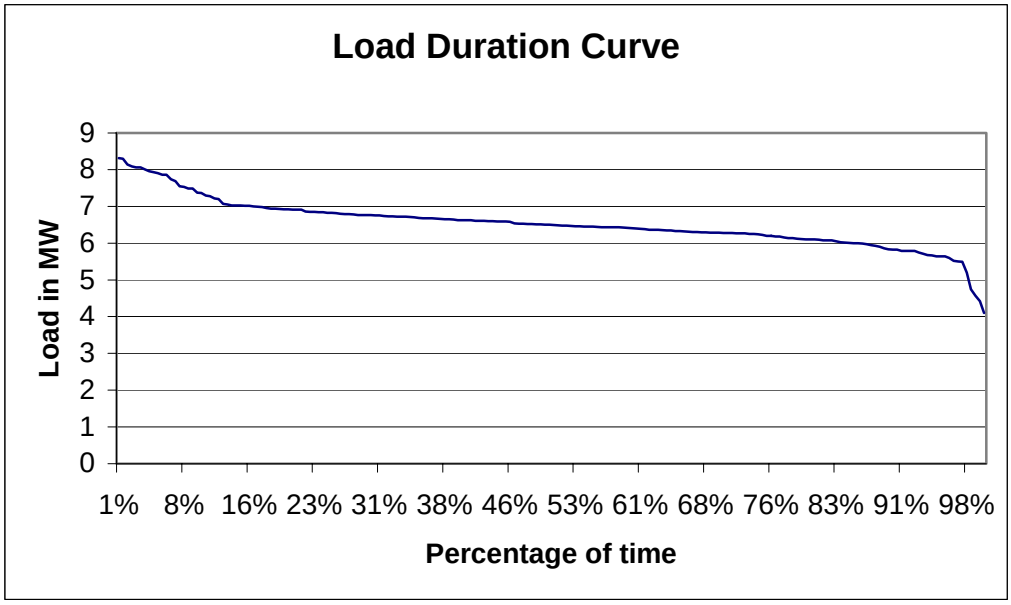
- For loss of the transformer in a single transformer substation, a percentage of the peak load normally supplied by that transformer must be able to be supplied from the remaining distribution feeders and substations in the study area. The percentage of peak load to be supplied is determined from the load duration curve shown below if available or 80% of peak load. After the interruption, without first repairing the cause of the interruption, the remaining distribution feeders should have the capability to supply the load on the upper flat portion of the load duration curve. In the graph below, this would be 7 MW. Hence, it is recognized, that during peak load conditions the distribution system may not have the capability to supply the entire load in the event of the loss of the single transformer and full recovery may be dependent on installation of a mobile transformer.

- For loss of a single transformer in a multi transformer substation, 100 percent of the peak load must be able to be supplied from the remaining station transformer or a combination of the remaining station transformer and other supplies in the study area.

When determining the capability of the distribution system, in the event of the loss of the single transformer, the minimum voltage level will be allowed to drop by 2 V to 113 V for three phase and 111 V for single phase.

Planning will take corrective action, when for the predicted loading, the distribution system is not capable of meeting this backup criteria.

Graph 1 – Typical Load Duration Curve



2006 Capital Budget Application

2006 System Development Plan Update

(“2006 SDP Update”)

Table of Contents

1 Introduction 3
2 Plan Update by Category 4
2.1 Transmission & Stations (Growth) 4
2.1.1 Bulk Transmission System 4
2.1.2 Okanagan Region 5
2.1.3 Kootenay Region 11
2.2 Transmission & Stations (Sustaining) 16
2.2.1 Transmission 16
2.2.2 Stations 18
2.3 Distribution (Growth) 19
2.3.1 New Connects - System Wide 19
2.3.2 Small Capacity Improvements 19
2.3.3 Okanagan Region 20
2.3.4 Kootenay Region 22
2.4 Distribution (Sustaining) 24
2.5 Telecommunications, SCADA and Protection 24
2.5.1 Telecommunications, SCADA and Protection (Growth) 25
2.5.2 Telecommunications, SCADA and Protection (Sustaining) 27
2.6 Alternative System Development Project Schedule 27
Appendix 1 34
Appendix 1 - Load Forecast 35
Appendix 2 39
Appendix 2 - Project Schedule and Expenditure Estimate 40
Appendix 3 48
Appendix 3 - Annual Rate Impacts 49

1 Introduction

FortisBC's long term System Development Plan 2005-2024 ("SDP") filed on November 26, 2004 identified necessary reinforcements in the Company's bulk transmission system, the regional transmission and distribution systems, the telecommunication and SCADA networks, and protection systems. The SDP outlined the sustaining projects directed at maintaining existing facilities and modernizing obsolete equipment and growth projects required to serve increasing load, driven by population growth and the new commercial activities in the FortisBC service area.

An effective system development plan must be responsive to changing circumstances such as may arise from variations in load growth, rates or location, or from results of equipment condition assessments. During the course of the 2005 Revenue Requirements written and oral hearing process, FortisBC indicated that it would file annual updates to the SDP. This report ("2006 SDP Update") outlines the changes to the 2006 projects originally planned and provides a summary of the five year capital expenditure plan necessary to maintain the integrity of the existing electrical system and to meet the needs of new customer and load growth within the FortisBC service area.

The British Columbia Utilities Commission ("BCUC") in its Decision accompanying Order G-52-05 expressed concern with the rate impacts associated with the proposed capital expenditures and suggested that "FortisBC should develop alternative scenarios that envision a perhaps less efficient plan but which would involve delaying capital expenditures." In compliance with the BCUC Decision, FortisBC has developed an alternative scenario (see Section 2.6) that describes a less desirable option to delay certain projects. The impact of the alternate plan is shown in Appendix 2. FortisBC believes that the 2006 SDP Update, which contains its preferred scenario, is in the public interest and should be executed as proposed. The annual rate impacts of the original plan, the updated plan and the alternate plan are summarized in Section 2.6 and are provided in detail in Appendix 3.

2 Plan Update by Category

2.1 Transmission & Stations (Growth)

The 2006 update contains very few changes from the 2005 plan. The major factor influencing changes to the Transmission and Station (Growth) projects is the substation load forecast. The 2005 load forecast showing actual loads for the past four years, together with forecast loads for the next six years is found in Appendix 1.

The following sections outline the projects identified by the SDP and gives a brief update of the current status. Appendix 2 shows the original schedule and estimated costs as well as the schedule and estimates for the updated plan.

2.1.1 Bulk Transmission System

The SDP forecast a high level of load growth in Okanagan valley population centres such as Kelowna, Penticton, Oliver and Osoyoos. The non-coincident substation peak load for these areas is currently forecast to be 736 MW in 2024, an increase of approximately 270 MW from the 2004 actual non-coincident substation peak load.

The SDP proposed that due to this growth and concern with security of supply for the City of Kelowna, the following projects should be undertaken, subsequent to the completion of the South Okanagan Supply Reinforcement Project in 2006.

2.1.1.1 Vaseux Lake Terminal to Anderson Terminal 230 kV Circuit

The conversion of the existing 161 kV circuit to 230 kV and construction of a second 230 kV circuit between Vaseux Lake Terminal and RG Anderson Terminal in the 2007/08 timeframe.

This also involves the expansion of the 230 kV ring bus in RG Anderson Terminal and reconfiguration of the existing 168 MVA transformer (T2) for 230 kV operation.

2006 UPDATE: This project is unchanged.

2.1.1.2 New Bentley Terminal Station

The construction in 2008/09 of a new Bentley Terminal Station near Oliver supplied by a 230 kV line from Vaseux Lake Terminal.

This terminal would be equipped with 230 kV, 161 kV and 138 kV buses and would serve Oliver Terminal to the west, Grand Forks Terminal to the east and Osoyoos area to the south.

2006 UPDATE: This project is unchanged.

2.1.1.3 Kelowna Switched Shunts and Static VAr Compensator

The installation of approximately 30 MVAr of Shunt Capacitors at both Bell and Lee terminals in 2008/09 to provide adequate voltage support for loss of the 230 kV lines between Lee Terminal and Vernon.

2006 UPDATE: This project is unchanged.

2.1.1.4 Vaseux Lake Terminal Station Transformer T3

The installation of a third transformer (T3) at Vaseux Terminal.

2006 UPDATE: This project is unchanged.

2.1.2 Okanagan Region

The Okanagan Region consists of Kelowna, Penticton, Summerland, Oliver-Osoyoos, and Princeton-Keremeos.

2.1.2.1 Kelowna:

The SDP identified the Kelowna area as the fastest growing part of the FortisBC system and one of the fastest growing urban centres in British Columbia. The load addition resulting from the growth has resulted in a requirement for a number of subtransmission and station projects. The 2005 update shows that the forecast loads for the stations in the Kelowna area has exceeded the 2004 forecast.

As a result of forecast customer and load growth in this area the following projects were identified in the SDP.

(a) Big White 138 kV Line and Substation

Construction of a substation at the Big White ski resort to be served via a 138 kV transmission line from Joe Rich substation in the 2005/07 timeframe.

2006 UPDATE: The project will be staged and will operate at 25 kV until Joe Rich substation capacity is reached in 2007/08. An application for a CPCN will be completed and filed with the BC Utilities Commission in late 2005 or in 2006.

(b) Ellison Distribution Source Substation

Construction of a distribution source substation “Ellison” approximately 5.5 km north of Sexsmith substation in 2006/07. Included in this station project are four 13 kV lines out of the station to connect the station to the existing distribution in the Ellison and Glenmore area.

2006 UPDATE: This project is unchanged.

(c) Black Mountain Distribution Source Station

Construction of a distribution source substation “Black Mountain” approximately 5 km east of Hollywood substation in the 2008/09 timeframe.

2006 UPDATE: This project is unchanged.

(d) Fault Level Reduction

Installation of current limiting reactors in Kelowna area substations in 2005/06.

2006 UPDATE: Detailed engineering has identified that many of the substations do not have adequate space for the additional reactors, resulting in a requirement for major reconfiguration at these sites. This has caused FortisBC to investigate alternate solutions for some sites. The change in scope will increase the cost of the project as well as the schedule. The project is currently planned to continue in 2006 and 2007 based on the outcome of the additional investigations.

(e) Loop Kelowna 138 kV Circuits

Installation of circuit breakers and modification of existing bus networks to enable the operation of the 138kV subtransmission in Kelowna as a looped network. The engineering for this project was scheduled for 2006 with construction scheduled for the 2007/09 timeframe.

2006 UPDATE: The project to install current limiting reactors in Kelowna area substations as noted in (d) above, has increased in scope with scheduled completion extended to 2007. In order to mitigate the coordination issues associated with having project (d) and (e) scheduled in parallel, this project has been deferred. The engineering for this project is now scheduled for 2008.

(f) Recreation Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at the Recreation substation in the 2008 timeframe.

2006 UPDATE: This project is unchanged.

(g) Hollywood Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at Hollywood substation in the 2009 timeframe.

2006 UPDATE: This project is unchanged.

(h) Braeloch (SW) Kelowna Distribution Source Substation

Construction of a distribution source substation “Braeloch” in southwest Kelowna in the 2010/11 timeframe.

2006 UPDATE: This project is unchanged.

(i) OK Mission Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at OK Mission substation in the 2011+ timeframe.

2006 UPDATE: This project is unchanged.

2.1.2.2 Penticton - Summerland

This area has seen modest growth over the past number of years. The forecast growth for the area continues to be approximately 1.0% for the forecast period. The SDP identified the following projects for the 2006/11+ period.

(a) Naramata Substation Replacement

Rebuilding of Naramata substation in 2005/06.

2006 UPDATE: The priority and schedule of the Naramata project is unchanged. The demand on the existing Naramata station transformer dropped from 128% of nameplate in 2004 to 115% of nameplate in 2005 due to winter temperature moderation in 2004/05 compared to 2003/04. The forecast demand for 2006 is 131% of T1 nameplate. With the station tapchanger non-functional, voltage regulation is being provided by SCC control of the 63 kV transmission at RG Anderson. With manual control, voltage regulation continues to be a problem at this location. Property acquisition has taken longer than expected, however, it is anticipated that the new substation will be in-service by early 2006 as currently scheduled in the system plan. Minor distribution alterations including off load adjustment of the existing Naramata tapchanger and installation of feeder regulation will be completed during 2005 to provide interim voltage improvement for the 2005/06 winter loading period.

(b) Summerland 63 kV Backup

Construction of a new 63 kV line from Huth substation to Trout Creek substation or from Huth substation to Summerland substation to provide backup for the Summerland area in the 2009/10 timeframe.

2006 UPDATE: This project is unchanged.

(c) Huth Substation Rebuild

Rebuilding of the 63 kV bus and line termination at Huth substation in the 2010 timeframe.

2006 UPDATE: This project is unchanged.

2.1.2.3 Oliver -Osoyoos

The SDP load growth in the Oliver-Osoyoos area is forecast to exceed the system average. The growth is predominantly due to migration from urban centres outside of the Okanagan. The load in this area is currently forecast to grow by approximately 10.5 MVA or 40% over the next five years.

The SDP identified the following projects for the 2006/10 period.

(a) New East Osoyoos Substation

Construction of a distribution source substation in East Osoyoos (Nk' Mip) in 2006.

2006 UPDATE: The priority and schedule for this project is unchanged. The forecast summer peak for the Osoyoos substation for 2004 was 20.8 MVA. The measured peak was 20.1 MVA. Load is forecast to exceed the T1 rating by the summer of 2006. Distribution load transfers can be made to allow load transfer from T1 to T2, however the total area load is forecast to exceed the total T1 and T2 capacity by summer 2008. This is due to continued active new development in Osoyoos and the fact that many of the multi-unit housing/condominium projects underway during the summer of 2004 are now

complete and expected to be fully occupied in the upcoming summer season. The new east Osoyoos substation (Nk' Mip) will be supplied by an extension of 44 Line from the existing Osoyoos substation along Hwy 3 through Osoyoos. The circuit will include distribution underbuild to accommodate the existing distribution supply from the west side of Osoyoos to the east side. The distribution system currently supplied by the single east side feeder will be split into three load centers requiring three breaker terminations in the new substation. As directed by the Commission Order G-52-05 and Decision dated May 31, 2005, FortisBC will submit an application for a CPCN for this project in 2005.

(b) Rebuild Oliver as Distribution Source Substation

Conversion of the existing Oliver Terminal Station to accommodate a distribution source substation in the 2007/08 timeframe.

2006 UPDATE: This project is unchanged. The project schedule is dependent on the removal of the 63 kV supply from Oliver terminal and is therefore dependent on timing of Bentley terminal.

2.1.2.4 Princeton-Keremeos:

The SDP forecast load growth in the Princeton-Keremeos area to be modest.

However, during the winter of 2005, the peak load on T3 at Princeton substation is forecast to exceed capacity by approximately 23%. This necessitates the following project in the 2006/07 timeframe.

(a) Princeton Reconfiguration and Transformer Replacement

Installation of two 138/25/13 kV transformers to supply both Princeton and FortisBC distribution loads.

2006 UPDATE: The priority for this project is unchanged. However, the schedule for the second transformer has been adjusted. The first transformer will be in service by the end of 2006. The second transformer will be in service by the end of 2009. The historical peak on the existing Princeton transformer (T3) is 18.5 MVA (123% nameplate). The 2004/05 winter forecast was 18.1 MVA while the actual 2004/05 peak was 17.4 MVA (116% nameplate).

2.1.3 Kootenay Region

The Kootenay Region consists of the following areas: Castlegar, Crawford Bay, Creston-Wynndel, Grand Forks-Boundary, Kaslo-Coffee Creek, South Slocan, and Trail-Salmo.

2.1.3.1 Castlegar:

The SDP forecast modest load growth for this area. However, cumulative growth over time has resulted in the need for the following project.

(a) Castlegar Capacity Upgrade

Installation of a new 63/13 kV transformer and associated protection in 2006.

2006 UPDATE: The preliminary engineering assessment indicates that the existing substation is inadequate to accommodate the new transformer; consequently, the capacity upgrade will require replacement of the substation or construction of an additional substation near the load centre to offload a portion of the Castlegar load. As a result this project has been deferred to 2007.

2.1.3.2 Crawford Bay:

The Crawford Bay load has grown to a point where the peak load exceeds the nameplate rating of the two 13 kV distribution transformers. In addition, failure of one of the two existing transformers at peak will result in load shedding. The SDP identified the following project for this area.

(a) Crawford Bay Capacity Increase and Grounding Bank

Installation of a new 63/13 kV distribution transformer and associated protection to serve the Crawford Bay area in 2006.

2006 UPDATE: Consideration is being given to converting the transmission line voltage at Crawford Bay from 161 kV to 63 kV. This would result in salvage of a significant section of the substation. The installation of the proposed new distribution transformer has been deferred pending final decision with respect to the voltage conversion.

2.1.3.3 Creston Wynndel:

The Creston area is served from the BC Hydro 230 kV system via a single 230/63 kV transformer at Lambert Terminal Station. Failure of the existing 230/63 kV transformer would result in significant customer outages in the Creston Area. In addition, outages to the 230 kV BC Hydro transmission line 2L294 results in loss of service to all of the Creston area customers. The SDP proposed the following projects to address this issue:

(a) 230 kV Ring Bus and New Transformer at Lambert Terminal

Installation of a second 230/63 kV transformer at Lambert Terminal and re-arrangement of the station to form a ring bus configuration in the 2006 timeframe.

2006 UPDATE: The engineering for the transformer addition is scheduled for 2006 with construction scheduled for 2007. A reliability analysis will be carried out for the ring bus portion of the Lambert project. However, this portion of the

project, which involves a joint effort between FortisBC and BC Hydro, is not anticipated to be completed in 2006/10 timeframe.

2.1.3.4 Grand Forks - Boundary:

This area is served by a network of two 63 kV transmission lines (9 Line and 10 Line) and eight distribution source substations. The lines and stations are at or near the end of their expected service lives. The SDP identified that the Electrical System in this area is in need of a major upgrade and proposed the following projects for the 2006/10 timeframe.

(a) New Kettle Valley 161/25 kV Distribution Source Substation

Construction of a distribution source substation in the Kettle Valley area, salvage the five existing 63 kV source substations between Grand Forks and Oliver Terminal Station and convert the distribution to 25 kV in the 2006/08 timeframe.

2006 UPDATE: The priority and schedule for this project are unchanged. As directed by the Commission Order G-52-05 and Decision dated May 31, 2005, FortisBC will submit an application for a CPCN for this project in 2005.

(b) New Grand Forks 161/25 kV Distribution Source Substation

Construction of a distribution source substation at Grand Forks, salvage the three existing 63 kV source substations between Grand Forks and Mawdsley Terminal Station and convert the distribution to 25 kV in the 2009/10 timeframe.

2006 UPDATE: Further assessment of this project indicated that due to load changes, it is necessary to maintain 63 kV (9 Line and 10 Line) between Grand Forks and an industrial customer (Roxul) on the east side of Grand Forks. The remainder of the project remains unchanged.

2.1.3.5 Kaslo - Coffee Creek:

This area is forecast to experience modest growth over the forecast period; however, by the winter of 2006/07 the Coffee Creek Terminal is projected to exceed the maximum capacity of the existing 8.4 MVA transformer. As well, it has been determined that with the installation of capacitors at Coffee Creek Terminal and Kaslo substation, these two locations could be served via 32 Line from Lambert Terminal in the event of an outage on 30 Line from South Slocan Terminal. The SDP identified the following projects for this area.

(a) Coffee Creek Capacitors

Installation of capacitors at Coffee Creek Terminal Station in 2006.

2006 UPDATE: The installation of the second 230/63 kV transformer at Lambert Terminal in 2006 will secure the power supply to Creston and reduce the need of 32 Line as a backup between Crawford Bay and Creston. Further, the decommissioning by TeckCominco of 30 Line between Crawford Bay and Kimberley, traditionally considered a backup for loads at Crawford Bay, Coffee Creek and Kaslo, will make it possible to operate line 30 Line between South Slocan and Crawford Bay at 63 kV. It will be a radial supply with a similar level of reliability as FortisBC customers in other areas. With modest load growth, adequate voltage can be maintained by providing reactive compensation as required in the future. As a result this project has been deferred to 2008 pending further investigation of modern electronic voltage and VAR support technology that could avoid more costly system support options.

(b) Kaslo Capacitor

Installation of capacitors at Kaslo substation in 2006.

2006 UPDATE: Project deferred to 2008 as per (a) above.

(c) Coffee Creek Transformer T3

Replacement of transformer T3 at Coffee Creek Terminal Station in the 2008 timeframe.

2006 UPDATE: This project is unchanged.

2.1.3.6 South Slocan:

This area is forecast to see modest load growth over the forecast period. The SDP identified the following project in the 2011+ timeframe to improve reliability in the area.

(a) Slocan City to New Denver (BC Hydro)

Construction of a 63 kV transmission line from South Slocan to New Denver in the 2011+ timeframe.

2006 UPDATE: This project is unchanged.

2.1.3.7 Trail-Salmo:

This area is forecast to see modest load growth over the forecast period. The SDP identified the following project for this area.

(a) Ymir Transformer Replacement (Cottonwood Substation)

2006 UPDATE: The engineering assessment indicates that the Ymir substation, constructed in the 1950s cannot accommodate additional transformer capacity without major rehabilitation work. Consequently the project scope has been changed to install a new substation (Cottonwood) in the Whitewater-Ymir area. This Cottonwood substation will allow for the salvage of the existing Whitewater substation and Ymir substation, and will service future load growth in the Ymir area.

(b) 18 Line Breaker at Waneta

Installation of a new circuit breaker on 18 Line at Waneta in 2006 to accommodate increased fault levels.

2006 UPDATE: This project is rescheduled to 2008. It is driven by TeckCominco schedule to rebuild Waneta substation.

2.2 Transmission & Stations (Sustaining)

FortisBC has 45 transmission lines and 63 terminals and stations. The transmission system consists of approximately 1,600 km of line and approximately 16,000 poles. Close to 64% of these lines are more than 30 years old. The terminals and substations consist of approximately 110 transformers, 350 circuit breakers, 950 fused switches and disconnects. The average age of the transformers and many other devices exceed 30 years.

Like most North American utilities, FortisBC must address the issue of aging infrastructure. As the infrastructure ages, the power system becomes less safe, less reliable and more costly to operate and maintain. The Company therefore continues to focus on the replacement of deteriorated, defective or obsolete electrical equipment.

The SDP gave an assessment of the condition of the Company's transmission and substation and provided an overview of the inspection and maintenance procedures currently utilized to ensure that FortisBC continue to identify the sustaining capital projects that are required for rehabilitation and ongoing upgrades of the system to ensure safe, reliable service. Appendix 2, page 3-4, shows the original schedule and estimate as well as the current schedule and estimate for the Transmission and Stations sustaining projects identified in the SDP.

2.2.1 Transmission

The SDP identified the following specific sustaining capital projects for transmission.

(a) Rehabilitation of 32 Line Crawford Bay-Creston in 2005

2006 UPDATE: The SDP identified that based on a condition assessment, 32 Line was in need of a significant rebuild to keep it in a safe and reliable condition. The project involved expenditures for structure replacement of the line from Crawford Bay to Wynndel to AA Lambert Terminal in Creston. Included in the scope of work were replacement of cross-arms, poles and all attached hardware for this line.

The budget estimate used in the 2005 Capital Plan was based on information from condition assessments performed in the previous few years. The actual detailed engineering plans being prepared in 2005 for construction purposes have identified that much more work than originally anticipated is now required. This project will be completed in 2006.

(b) Rehabilitation of 20 Line, 20-24 Line, 51-51A Line, 53 Line, and 74 Line in 2006

2006 UPDATE: The 2005 condition assessment of these lines did not reveal the level of deficiencies that were originally anticipated. These projects have now been consolidated into one project called 6, 18, 20, 21, 26, 45, 55 Line rehabilitation.

(c) Rehabilitation of 6A Line in 2008

2006 UPDATE: This project is unchanged.

(d) Rehabilitation of 26 Line in 2008

2006 UPDATE: This project is unchanged.

(e) Rehabilitation of 27 Line in 2009

2006 UPDATE: This project is unchanged.

(f) Rehabilitation of 28 Line in 2009

2006 UPDATE: This project is unchanged.

2.2.2 Stations

The SDP identified the following specific sustaining projects for stations.

(a) West Osoyoos Transformer Rehabilitation

Upgrading or replacement of the West Osoyoos transformer in 2006.

2006 UPDATE: This project is unchanged.

(b) Kaslo Substation Rehabilitation

Upgrading Kaslo Substation in 2006 and 2007.

2006 UPDATE: Further analysis and engineering is required to finalize the design of this project. The project has been deferred to 2007.

(c) Rebuild Pine Street Transformer

Rehabilitation of Pine Street transformer (T1) in 2006 and 2007.

2006 UPDATE: Further analysis has indicated that this transformer should be replaced due to multiple concerns and current operating conditions (high temperatures) the unit cannot be rehabilitated cost effectively.

(d) Westminster Transformer (T1) Replacement in 2006.

2006 UPDATE: Further analysis has indicted that this transformer should be rehabilitated instead of replaced. The transformer shows signs of poor insulation and oil quality but can be cost effectively rehabilitated.

(e) Trout Creek Transformer (T1) Rehabilitation in 2009/10.

2006 UPDATE: This project is unchanged.

(f) Replacement of Coffee Creek transformer (T3) Capacity Addition in 2009/10.

2006 UPDATE: The conversion of 30 Line from 161 kV to 63 kV removes the requirement for this transformer.

(g) Replacement of Crawford Bay transformer (T1) in 2009/10.

2006 UPDATE: The conversion of 30 Line from 161 kV to 63 kV removes the requirement for this transformer.

2.3 Distribution (Growth)

This section outlines the projects identified by the SDP as growth projects and gives a brief update of the current status. Appendix 2 page 5 shows the original schedule and estimate as well as the current schedule and estimate for these projects.

2.3.1 New Connects - System Wide

This project includes installation of new services requiring additions to FortisBC overhead and underground facilities in all regions of its service territory. These capital expenditures allow FortisBC to meet its obligation to serve. The number of customers connected directly affects increases or decreases to this account.

2006 UPDATE: This project is unchanged.

2.3.2 Small Capacity Improvements

On an annual basis, the distribution feeder network is evaluated for voltage, thermal and backup capabilities based on forecast load growth. Where standards of service are not met, an appropriate solution involving regulators, capacitors, or other equipment is

identified. As well experience has shown that unforeseen load emergencies will require capacity upgrades and voltage correction projects not accounted for in the Capital Plan. This project provides the funding for such requirements.

2006 UPDATE: This project is unchanged.

2.3.3 Okanagan Region

The Okanagan region consists of the following areas: Kelowna, Penticton-Summerland, Oliver-Osoyoos and Princeton-Keremeos.

2.3.3.1 The SDP identified the following growth-related projects in this area.

(a) Bell Feeder 2 to Mission Feeder 3 Tie

Construction of a feeder tie between Bell Feeder 2 and OK Mission Feeder 3 to provide interim load relief for the southwest Kelowna area in 2006.

2006 UPDATE: This project is unchanged.

(b) McKinley Landing Capacity Upgrade

Upgrading of a section of Sexsmith Feeder 3 from #2 conductor to #477 conductor to accommodate load growth in the McKinley Landing area in the 2007 timeframe.

2006 UPDATE: This project is unchanged.

(c) Hollywood Feeder 1 to Lee Feeder 2 Tie

Construction of a feeder tie between Hollywood Feeder 1 and Lee Feeder 2 to provide interim load relief in the Gallagher area in the 2007 timeframe.

2006 UPDATE: This project is unchanged.

(d) New Glenmore Feeder 6

Construction of a new feeder (Feeder 6) from Glenmore substation to accommodate load growth in the Magic Estates, Clifton and Glenmore Highlands development areas in the 2008 timeframe.

2006 UPDATE: This project is unchanged.

(e) Hollywood Feeder 1 to Mission Feeder 8

Upgrading of a section of line between Hollywood Feeder 1 and OK Mission Feeder 8 along KLO Road to accommodate load transfer from Hollywood substation to OK Mission substation or Bell Terminal Station in the 2008 timeframe.

2006 UPDATE: This project is unchanged.

(f) McKinley to Clifton Tie

Construction of a feeder tie between Glenmore Feeder 6 and Sexsmith Feeder 3 to accommodate load transfer in the Clifton, McKinley Landing area in the 2008 timeframe.

2006 UPDATE: This project is unchanged.

(g) Lee Feeder 2 to Hollywood Feeder 5 Tie

Construction of a feeder tie between Hollywood Feeder 5 and Lee Feeder 2 to accommodate load transfer in the Rutland and Black Mountain area in the 2008 timeframe.

2006 UPDATE: This project is unchanged.

(h) New Feeder Ellison Substation

Construction of a feeder at the new Ellison substation to offload the 13 kV tertiary on the 230/138 kV system transformer at Lee Terminal Station to reduce system risk due to distribution faults. The SDP scheduled this project for the 2008 timeframe.

2006 UPDATE: This project is unchanged.

(i) Future Kelowna Distribution Upgrades

Upgrade feeders in the Kelowna area to accommodate load growth in the 2009/10 timeframe.

2006 UPDATE: This project is unchanged.

2.3.3.2 Osoyoos - Oliver:

The SDP identified the following growth-related project in this area.

(a) 25 kV Tie to Bridesville

Construction of a feeder tie from the new East Osoyoos substation (Nk' Mip) to the new Kettle Valley substation to accommodate load growth in the Bridesville area. The SDP scheduled this project for the 2009 timeframe.

2006 UPDATE: This project is unchanged

2.3.3.3 Princeton - Keremeos:

The SDP identified the following growth related project in this area.

(a) Keremeos Feeder

Construction of Keremeos Feeder 3 to offload Keremeos Feeder 2 which will reach its thermal limits in the 2006 timeframe.

2006 UPDATE: This project will be deferred to 2007. Winter peak levels in Keremeos over the last two years were substantially higher than historical levels and therefore indicated feeder limits would be exceeded by 2007. The current 2005 forecast has moderated demand growth slightly resulting in adequate capacity until the winter peak of 2008.

2.3.4 Kootenay Region

The Kootenay Region consists of the following areas: Castlegar, Crawford Bay, Creston-Wynndel, Grand Forks-Boundary, Kaslo-Coffee Creek, South Slocan, and Trail-Salmo.

2.3.4.1 Trail-Salmo:

The SDP identified the following growth related project in this area.

(a) Paterson 25 kV feeder and Voltage Conversion

Conversion of Paterson Feeder to 25 kV, transfer the feeder to the Cascade substation and salvage Paterson substation in 2006.

2006 UPDATE: This project is unchanged

2.3.4.2 South Slocan area:

The SDP identified the following growth project for this area.

(a) Playmor - Tarrys Feeder Upgrade

Upgrade Playmor Feeder 1 between Playmor and Tarrys, and transfer Tarrys residential load to Playmor. This will offload Tarrys substation which is loaded above the recommended continuous rating of the substation transformer. The SDP scheduled this project for 2006.

2006 UPDATE: This project is unchanged.

2.3.4.3 Creston Area:

The SDP identified the following project for this area.

(a) Creston Area Distribution Feeder Upgrades

Upgrade the Creston area distribution by constructing distribution feeders at Lambert substation and transferring load from Creston substation and Wynndel substation to the new Lambert distribution source in the 2005/06 timeframe.

2006 UPDATE: This project is unchanged.

2.4 Distribution (Sustaining)

FortisBC has approximately 117 distribution feeders consisting of approximately 5,000 km of line, 82,000 support structures and 30,000 oil filled distribution transformers. Distribution sustaining capital expenditures are required for the replacement of poles, crossarms, conductor and transformers, etc, that are deteriorated, defective or obsolete. The projects in this group are primarily focused on maintaining reliability and safety. This classification also includes capital expenditures related to the relocation of plant at the request of third parties. A significant portion is recovered from the parties making the request.

Appendix 2 page 6 shows the schedule and estimate as contained in the SDP as well as the current schedule and estimate.

2.5 Telecommunications, SCADA and Protection

FortisBC operates a telecommunications system to support protection, control and monitoring for the power system, as well as operations and business communications requirements. Approximately 106 locations are presently or potentially served by the telecommunications system, including some 59 distribution locations, 11 generation, 12 transmission, and 6 office locations. The telecommunications system also connects to other utilities for the exchange of protection signals and operating voice communications.

A variety of telecommunications transport systems are used, depending on technical requirements, economics and system reliability requirements. These include power line carrier, fibre-optic cable, copper pairs, Telus leased lines, and radio (VHF, microwave, spread spectrum and packet radio). The primary purpose of the telecommunications system is to be an integral component of the protection relaying system, Remedial Action Schemes (“RAS”), substation operations and control, and generation dispatch

systems. It also provides a low-cost alternative to the public network for internal business data and some voice traffic.

2.5.1 Telecommunications, SCADA and Protection (Growth)

The SDP identified the following projects.

(a) Distribution Substation Automation, Metering and Communication
The intent of this multi-year project is to extend the coverage of substation automation in the FortisBC system. This project broadens the integration and use of remote monitoring and control to distribution level substations, including automated load restoration to reduce outage durations, power quality monitoring of lines, transformers and feeders, fault recording and locating, and equipment condition monitoring. It will provide common communications mechanisms for gathering, storage, access and analysis of the resulting data. Resulting benefits are improvements in system performance, productivity, safety and economics. The project includes the initial study (scheduled for 2005 and to continue into 2006) to investigate the available alternatives, define the engineering standards and benefits, and subsequent projects including the development of a central data repository, individual projects in appropriate substations (synchronized with station rebuild or major addition), and an emergency backup plan.

The SDP scheduled this project for the 2006/09 timeframe with anticipated further projects in the 2012/24 timeframe.
2006 UPDATE: As directed by the BCUC decision, dated May 31, 2005, FortisBC will submit an application for a CPCN for this project in 2006.

(b) Trail-Oliver High Capacity Communications Network

A high capacity network will enable the transfer of data at high speeds and volumes in FortisBC's entire service territory (Kootenay and Okanagan). This is required for system protection purposes as well as for monitoring and controlling the system remotely. It will displace costs for east-to-west leased lines currently used for system control and operational communications. The project will be undertaken in segments, coincident with the decommissioning of 9 Line and 10 Line and the replacement of the distribution substations in the Grand Forks / Boundary area.

2006 UPDATE: As part of construction of the new Kettle Valley substation, the section of the communications backbone between Oliver and Kettle Valley will be required in 2006 to provide the operational and protection communications needed by this station. Justification for this work will be contained in the CPCN to be submitted for the Kettle Valley substation in 2005.

(c) Telecommunications Backbone Loop Close

This project will complete the FortisBC telecommunications backbone system loop configuration as commonly used by most utilities, and as required by WECC standards. The SDP scheduled this project for the 2011/20 timeframe.

2006 UPDATE: This project is unchanged.

(d) Telecommunications for Business Systems

This project provides for the use of the FortisBC telecommunications system for future applications that may be developed for company operations in the period 2010/25. In each case, use of the FortisBC telecommunications system will be dependent on its ability to improve the performance of the application, and lower the operating and maintenance costs for the telecom portion of the systems (displacing common carrier costs). The SDP scheduled this project for the 2011/25 timeframe.

2006 UPDATE: This project is unchanged.

2.5.2 Telecommunications, SCADA and Protection (Sustaining)

This is a multiyear project consisting of a number of items, necessary to maintain the integrity of the Company's telecommunication, SCADA and protection network in order to supply safe, reliable electrical service. It includes items such as harmonic remediation, protection upgrades, and fault locating for inaccessible lines and communication upgrades.

Appendix 2 page 7 shows the schedule and estimate as contained in the SDP as well as the current schedule and estimate.

2.6 Alternative System Development Project Schedule

In its Decision and Order G-52-05 the BCUC expressed concern with respect to the rate impacts associated with FortisBC's capital expenditures to complete its System Development Plan and suggested that "FortisBC should develop alternative scenarios that envision a perhaps less efficient plan but which could involve delaying capital expenditures."

The Company developed the original System Development Plan 2005-2024 and the subsequent 2006 SDP Update, using industry accepted planning criteria and based on forecast load growth and condition assessments of its existing plant. FortisBC believes that its plan is appropriate and reasonable based on the information available to it. Nevertheless, as noted in the BCUC decision, FortisBC views the SDP as a living document subject to changes as dictated by changing conditions such as customer growth, load growth, material availability and natural events such as weather, etc. Pursuant to Order G-52-05, the Company has developed an alternative project schedule incorporating some project delays, which while undesirable should not have

unmanageable consequences for customer service, reliability or safety in the short term. The alternative project schedule is contained in Appendix 2.

The most significant changes are the deferral of the following projects: 1) Close 138 kV loops in Kelowna, 2) Huth Substation rebuild, 3) Summerland 63 kV backup, and 4) Grand Forks Distribution Source and Area voltage conversion. In summary, the Alternate plan results in approximately $39.5 million being deferred beyond the 2006-10 time frame. It is anticipated that these projects would be completed in 2011 and 2012. The difference in the net present value of the capital expenditures under the Update and Alternate scenarios is approximately $6.1 million. The rate impacts of the Original, Update and Alternate scenarios are shown in the table at the end of this section.

2.6.1 Deferred projects

The following projects have been assigned an alternate schedule, subject to current assessments of forecast loads and equipment condition.

(a) Kelowna Switched Shunts and Static VAr Compensator

The installation of approximately 30 MVAr of Shunt Capacitors at DG Bell and FA Lee terminals in 2008/09 to provide adequate voltage support for loss of the 230 kV lines between Lee Terminal and Vernon.

2006 Alternate Schedule: This project has been delayed to the 2011+ timeframe. Failure to complete this project when required may result in power quality issues or load shedding in the Kelowna area during loss of the 230 kV lines between Lee Terminal and Vernon.

(b) Vaseux Lake Terminal Station Transformer T3

The installation of a third transformer (T3) at Vaseux Terminal.

2006 Alternate Schedule: This project would be delayed to the 2011+ timeframe. This project was intended to take advantage of the construction activity occurring at Vaseux Terminal in the 2008/09 timeframe to minimize the cost of the preparatory work associated with the installation of T3, which would be required for load purposes in 2015 timeframe. Failure to complete the project in the 2008/09 timeframe may result in higher costs in the future.

(c) Loop Kelowna 138 kV Circuits

Installation of circuit breakers and modification of existing bus networks to enable operation of the 138 kV subtransmission in Kelowna as a looped network. The engineering for this project was scheduled for 2006 with construction scheduled for the 2007/09 timeframe.

2006 Alternate Schedule: This project would be delayed to the 2009/10 timeframe. Failure to complete this project as originally scheduled will delay the incremental reliability gains envisioned for the Kelowna area when the project has been completed.

(d) Recreation Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection

2006 Alternate Schedule: This project would be delayed to 2009. Failure to complete the project as originally scheduled may result in the peak load exceeding the transformer capacity.

(e) Hollywood Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection

2006 Alternate Schedule: This project would be delayed to 2009. Failure to complete the project as originally scheduled may result in the peak load exceeding the transformer capacity.

(f) Summerland 63 kV Backup

Construction of a new 63 kV line from Huth substation to Trout Creek substation or from Huth substation to Summerland substation to provide backup for the Summerland area in the 2009/10 timeframe.

2006 Alternate Schedule: This project would be delayed to the 2011+ timeframe. Failure to complete the project as originally scheduled will delay the incremental reliability gains envisioned for the Penticton-Summerland area when the project is completed.

(g) Huth Substation Rebuild

Rebuilding of the 63 kV bus and line termination at Huth substation in the 2010 timeframe.

2006 Alternate Schedule: This project would be delayed to the 2011+ timeframe. Failure to complete the project as originally scheduled will delay the incremental reliability gains envisioned for the Penticton-Summerland area when the project is completed.

(h) Princeton Reconfiguration and Transformer Replacement

Installation of two 138/25/13 kV transformers to supply both Princeton and FortisBC distribution loads.

2006 Alternate Schedule: The installation of the second transformer at Princeton substation would be delayed to the 2011+ timeframe. Failure to complete the project in 2009 will delay the incremental reliability gain associated with having dual transformer capacity at the substation.

(i) New Grand Forks 161/25 kV Distribution Source Substation

Construction of a distribution source substation at Grand Forks, salvage the three existing 63 kV source substations between Grand Forks and Mawdsley Terminal Station and convert the distribution to 25 kV in the 2009/10 timeframe.

2006 Alternate Schedule: This project would be delayed from the 2009/10 timeframe to the 2010/2011+ timeframe. Failure to complete the project as originally scheduled will result in incrementally higher costs associated with maintaining existing plant in safe, reliable condition.

(j) Coffee Creek Transformer T3

Replacement of transformer (T3) at Coffee Creek Terminal Station in the 2008 timeframe.

2006 Alternate Schedule: This project would be delayed from 2008 to 2009. Failure to complete the project as originally scheduled may result in load shedding in the Coffee Creek area in the 2008 timeframe.

(k) Future Kelowna Distribution Upgrades

Upgrade feeders in the Kelowna area to accommodate load growth in the 2009/10 timeframe.

2006 Alternate Schedule: This project would be delayed to 2010. Failure to complete the project as originally scheduled may result in inadequate load

transfer capabilities between distribution feeders and substations to mitigate load growth in specific locations

(l) 25 kV Tie to Bridesville

Construction of a feeder tie from the new East Osoyoos substation (Nk' Mip) to the new Kettle Valley substation to accommodate load growth in the Bridesville area. The SDP scheduled this project for the 2009 timeframe.

2006 Alternate Schedule: This project would be delayed from 2009 to the 2011+ timeframe. Failure to complete the project as originally scheduled may result in power quality issues as new customers are added to an inadequate source of supply.

(m) Distribution Substation Automation, Metering and Communication

2006 Alternate Schedule: The start of this project would be delayed to 2006, with a less aggressive implementation plan. Failure to complete this project as originally scheduled will delay the incremental reliability and efficiency benefit anticipated with the implementation of this project. This Project will be addressed by a CPCN in 2006.

(n) Trail-Oliver High Capacity Communications Network

2006 Alternate Schedule: The second and third phase of this project would be delayed to 2010 and 2011+ respectively. Deferral of the Grand Forks conversion project to 2010 would permit the communications network deferral as well.

The total cost of the alternate plan contained in Appendix 2 for the 2006/10 period is approximately $317 million which is approximately $39.5 million or 11% less than the 2006 updated plan.

The rate impact associated with the proposed project schedule contained in Table 2.6 of this report and the alternative project schedule is contained in Appendix 3.

The table below shows the annual rate changes attributable to the 2005-updated plan as well as the alternate plan for 2006 to 2010 inclusive.

Table 2.6

Rate Impact of Transmission and Distribution Projects

Year		Original Plan %		Updated Plan %		Alternate Plan %
2005		1.2		1.1		1.1
2006		6.2		5.7		5.7
2007		5.2		4.7		4.6
2008		3.9		3.9		3.6
2009		4.0		4.5		3.8
2010		3.1		3.3		2.8
Cumulative		25.9		25.4		23.4

Appendix 1

Substation Load Forecast
SDP - 2006

System Development Plan 2005 - 2024

2006 Update

Appendix 1 - Load Forecast

- Note that the “Ultimate” loadings in these listings indicate expected load in the year 2025.
- Substations are listed under the BC Health Districts in which they are physically located, although some feeders connected to certain substations may serve a small portion of load in an adjacent district.

Central Okanagan (Kelowna)

Central Okanagan 2005 Forecast					HISTORICAL LOADING				PROJECTED - LOADING						
					2001	2002	2003	2004	2005 kVA 0	2006 kVA 1	2007 kVA 2	2008 kVA 3	2009 kVA 4	2010 kVA 5	Ultimate kVA
BUS NUM	Name	Transforme	PF												
52607	Glenmore	T2 & T3	0.99	W	37961	39451	43652	40721	46169	47768	49367	50965	52564	54163	72078
52613	Hollywood	T1 & T3	0.99	W	36024	38208	43344	46824	48918	50339	51761	53182	54604	56026	74557
52614	Okanagan N	T1 & T2	0.98	W	30140	34869	37911	38381	38817	40288	41759	43230	44701	46172	61444
52608	Recreation	T1	0.99	W	20664	20280	23304	23136	24338	25372	26406	27441	28475	29509	39269
52606	Sexsmith	T1	0.98	W	25416	24648	29520	29232	22408	23937	25465	26993	28522	30050	39989
52609	Saucier	T1	0.99	W	16344	21024	22944	20808	23453	23962	24471	24980	25489	25998	34598
52619	Joe Rich	T1	0.97	W	12028	13760	16067	15829	17849	19632	21414	23197	24979	26762	35614
52691	Duck Lake	T1	0.98	W	3496	3716	4713	4929	11681	12364	13346	14128	14710	14893	19819
52604	D.G. Bell	T1	0.99	W	13395	13337	16829	16780	19850	20845	21841	22837	23833	24828	33041
52208	Lee	Tertiary	0.97	W	14574	15100	18912	17622.18	19192	19471	19751	20031	20311	20590	28971
				Total	210042	224393	257196	254262	272675	283979	295582	306985	318188	328991	439379
				Growth		6.8%	14.6%	-1.1%	7.2%	4.1%	4.1%	3.9%	3.6%	3.4%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of next year. i.e. 2003 data includes Jan. & Feb. 2004 data.

Okanagan-Similkameen

Okanagan-Similkameen-Boundary 2005 Forecast					HISTORICAL LOADING				PROJECTED - LOADING						
					2001 kVA	2002 kVA	2003 kVA	2004 kVA	2005 kVA	2006 kVA	2007 kVA	2008 kVA	2009 kVA	2010 kVA	Ultimate kVA
BUS NUM	Name	Transforme	PF						0	1	2	3	4	5	
52649	Huth	T7/T4-6	0.97	W	11840	11664	16051	16051	16292	16533	16773	17014	17255	17496	20795
52664	Huth	T8	0.99	W	11792	11221	13313	12621	13513	13712	13912	14112	14311	14511	17247
52621	KAL1	T1	0.97	W	4845	4706	4489	6317	6412	6507	6601	6696	6791	6886	8184
52650	Naramata	T1	0.97	W	4995	5142	7200	6465	7445	7697	7956	8222	8495	8775	10430
52622	Okanagan F	T1	0.95	W	11172	11600	13941	13419	14508	15092	15693	16310	16944	17594	19405
52654	Summerlan	T2	0.99	W	12598	12343	17647	15343	18018	18388	18759	19129	19500	19871	24561
52663	Waterford	T1	0.99	W	8608	8144	11072	10496	11238	11404	11570	11736	11902	12068	14344
52656	West Bench	T1	0.97	W	4995	6170	5942	7192	7473	7762	8059	8364	8677	8999	10696
52651	Westminste	T1/T2	0.99	W	18032	17392	23872	21328	24137	24402	24667	24931	25196	25461	30262
52655	Trout Creek	T1	0.97	W	6530	6122	7346	6556	7543	7745	7950	8159	8373	8590	10618
52629	Keremeos	T1	0.98	W	8929	8387	11409	11390	11707	12011	12321	12637	12958	13285	15952
52630	Hedley	T1	0.99	W	3643	3681	4905	4859	5112	5328	5553	5787	6031	6284	7545
52632	Anderson	T3	0.98	W	13044	13320	14220	16332	16550	16771	16995	17223	17454	17688	21023
52623	Princeton	T3	0.95	W	13200	13895	18519	17388	18704	18890	19079	19269	19461	19655	19038
52230	HED138 - P	m PSSE mo	0.96	W	2347	2347	2347	2347	2347	2347	2347	2347	2347	2347	2347
52426	Mas138 - P	m PSSE mo	0.98	W	1623	1623	1623	1623	1623	1623	1623	1623	1623	1623	1623
52647	Pine Street	T1 & T2	0.98	W	14753	13787	17125	16845	17602	17869	18138	18410	18684	18962	20914
52648	Osoyoos	T1 & T2	0.98	W	14484	12485	17260	17929	19526	21237	23063	25003	27058	29227	32236
52243	Oliver	T1	0.97	W	6191	5781	5277	7631	7800	7972	8148	8326	8508	8694	9589
				Total	173621	169810	213558	212132	227548	233289	239206	245299	251569	258015	296808
				Growth		-2.2%	25.8%	-0.7%	7.3%	2.5%	2.5%	2.5%	2.6%	2.6%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of next year. i.e. 2003 data includes Jan. & Feb. 2004 data.

Central Kootenay

Central Kootenay 2005 Forecast					HISTORICAL LOADING				PROJECTED - LOADING						
					2001 kVA	2002 kVA	2003 kVA	2004 kVA	2005 kVA	2006 kVA	2007 kVA	2008 kVA	2009 kVA	2010 kVA	Ultimate kVA
BUS NUM	Name	Transforme	PF						0	1	2	3	4	5	
52603	Kaslo	T1	0.97	W	8619	9256	10620	9232	10726	10832	10939	11045	11151	11257	13051
52672	Coffee Cree	T3	0.95	W	5997	5997	7817	6853	7895	7973	8052	8130	8208	8286	8718
52670	Crawford Ba	T2 & T3	0.96	W	4070	4649	5812	5500	5841	5870	5899	5928	5957	5986	6940
52755	VAL1	T1	0.99	W	2900	2936	3925	3413	3964	4004	4043	4082	4121	4161	4377
52750	Passmore	T1	0.94	W	3606	2808	4100	3820	4141	4182	4223	4264	4305	4346	4573
52714	Playmor	T1	0.98	W	8000	8916	11610	12242	11668	11726	11784	11842	11900	11958	12582
52751	SLO1	T1	0.97	W	7200	5635	4519	5186	5186	5186	5186	5186	5186	5186	5186
52713	Tarry's	T1	0.95	W	3500	2880	3360	3360	3368	3377	3385	3394	3402	3410	3648
52754	YMR1	T1	0.97	W	900	972	1224	1187	1236	1248	1261	1273	1285	1297	1365
52615	Castlegar	T1	0.99	W	16667	14733	17250	16644	17474	17699	17923	18147	18371	18596	19888
52612	Blueberry	T1	0.98	W	7500	7640	8375	7640	8434	8492	8551	8610	8668	8727	9334
52252	CON63 - PS	m PSSE mo	0.99	W	16416	22680	24228	22140	24591	24955	25318	25682	26045	26409	27786
52916	CEL63 - PS	m PSSE mo	0.98	W	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000
52917	WST63 -PS	m PSSE mo	0.98	W	8148	7949	7298	7560	7560	7560	7560	7560	7560	7560	7560
52653	WHI1	T1	0.95	W	320	365	345	323	352	359	366	373	380	386	407
52730	Salmo	T1	0.95	W	5436	5616	6984	7056	7109	7162	7215	7268	7321	7374	7758
52702	Wynndel	T1	0.97	W	4065	4016	4114	3428	3445	3462	3479	3497	3514	3531	3608
52708	Creston	T1 & T2	0.97	W	23020	23221	28536	26090	28593	28650	28707	28764	28821	28878	29512
				Total	142363.9	146269	166117	157674	167585	168737	169890	171043	172195	173348	182294
				Growth		2.7%	13.6%	-5.1%	6.3%	0.7%	0.7%	0.7%	0.7%	0.7%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of next year. i.e. 2003 data includes Jan. & Feb. 2004 data.

Kootenay-Boundary

Kootenay-Boundary 2005 Forecast					HISTORICAL LOADING				PROJECTED - LOADING						
					2001 kVA	2002 kVA	2003 kVA	2004 kVA	2005 kVA	2006 kVA	2007 kVA	2008 kVA	2009 kVA	2010 kVA	Ultimate kVA
BUS NUM	Name	Transforme	PF						0	1	2	3	4	5	
52704	CHR1	T1	0.99	W	4320	4583	4437	4275	4481	4526	4570	4614	4659	4703	5102
52605	Ruckles	1-13KV & 4.	0.97	W	9209	9209	11532	11278	11753	11978	12207	12440	12676	12916	14013
52598	Ruckles	T2	0.97	W	7310	7310	9775	9040	9941	10107	10274	10440	10606	10772	11686
52681	GFT1	T3	0.99	W	2503	3141	4384	4221	4472	4559	4647	4735	4823	4910	5327
52707	Midway	T1	0.95	W	6735	6552	7100	7100	7145	7190	7236	7283	7331	7379	8006
52689	ROC1	T1 & T2	0.95	W	3680	3138	3226	3908	3974	4041	4107	4174	4240	4307	4672
52690	BAL1	T1	0.79	W	592	592	592	1039	1143	1247	1351	1455	1559	1662	1803
52706	Greenwood	T1	0.95	W	2400	2086	2160	2160	2210	2261	2313	2366	2420	2474	2684
52626	Hearns	T1	0.95	W	2693	1367	263	160	265	267	269	271	274	276	274
52628	Fruitville	T1	0.89	W	5750	5760	7445	6465	7497	7549	7601	7653	7706	7758	7717
52723	Trail	T1	0.97	W	3000	3000	2700	0	0	0	0	0	0	0	0
52627	Beaver Park	T1	0.97	W	7200	6826	8263	7870	8346	8428	8511	8594	8676	8759	8713
52722	Glenmerry	T1	0.97	W	8500	8015	10559	10388	10717	10876	11034	11193	11351	11509	11449
52611	Stoney Cree	T1	0.97	W	4700	4805	6232	7367	7477	7587	7698	7808	7919	8029	7987
52703	PAT1	T1	0.97	W	850	942	857	673	861	866	870	874	878	883	878
52601	Cascade	T1	0.99	W	7087	7087	8000	8112	8331	8550	8769	8988	9207	9426	9377
				Total	76529	74413	87525	84055	88614	90034	91458	92888	94324	95764	99689
				Growth		-2.8%	17.6%	-4.0%	5.4%	1.6%	1.6%	1.6%	1.5%	1.5%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of next year. i.e. 2003 data includes Jan. & Feb. 2004 data.

FORTISBC

Appendix 2

Project Schedule and Expenditure Estimate
SDP - 2006

System Development Plan 2005 - 2024

2006 Update

Appendix 2 - Project Schedule and Expenditure Estimate

Summary

CATEGORY	06-'10 Total			2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
TRANSMISSION	217,626	221,453	194,253	60,136	49,170	49,170	40,100	42,536	42,536	50,380	58,737	50,137	48,160	50,660	40,660	18,850	20,350	11,750	64,900
Transmission Growth	182,886	187,779	160,579	49,936	38,086	38,086	34,000	35,386	35,386	45,500	53,857	45,257	42,100	45,100	35,100	11,350	15,350	6,750	63,700
Transmission Line Sustaining	12,790	14,774	14,774	2,900	4,884	4,884	2,300	2,300	2,300	2,530	2,530	2,530	2,660	2,660	2,660	2,400	2,400	2,400	0
Stations Sustaining	21,950	18,900	18,900	7,300	6,200	6,200	3,800	4,850	4,850	2,350	2,350	2,350	3,400	2,900	2,900	5,100	2,600	2,600	1,200
DISTRIBUTION	63,180	63,555	61,055	15,640	16,540	16,540	10,985	11,460	11,460	12,026	12,026	12,026	13,135	12,635	9,635	11,394	10,894	11,394	9,000
Distribution Growth	32,930	31,305	28,805	9,590	8,490	8,490	4,935	5,410	5,410	5,976	5,976	5,976	7,085	6,585	3,585	5,344	4,844	5,344	9,000
Distribution Sustaininng	30,250	32,250	32,250	6,050	8,050	8,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	0
TELECOM, SCADA, P&C	18,622	18,622	14,622	4,382	3,982	3,982	3,515	3,515	2,515	5,085	5,085	2,085	1,890	2,290	4,290	3,750	3,750	1,750	21,250
Telecom Growth	13,100	13,100	9,100	3,500	3,100	3,100	2,000	2,000	1,000	4,000	4,000	1,000	600	1,000	3,000	3,000	3,000	1,000	17,500
Telecom Sustaining	5,522	5,522	5,522	882	882	882	1,515	1,515	1,515	1,085	1,085	1,085	1,290	1,290	1,290	750	750	750	3,750
TOTAL T&D CAPITAL FORECAST	299,428	303,630	269,930	80,158	69,692	69,692	54,600	57,511	56,511	67,491	75,848	64,248	63,185	65,585	54,585	33,994	34,994	24,894	95,150
AFUDC and Loading	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	17.259%	
	51,678	52,403	46,587	13,834	12,028	12,028	9,423	9,926	9,753	11,648	13,091	11,089	10,905	11,319	9,421	5,867	6,040	4,296	
Total including AFUDC & Loading	**351,106**	**356,033**	**316,517**	**93,992**	**81,720**	**81,720**	**64,023**	**67,437**	**66,264**	**79,139**	**88,939**	**75,337**	**74,090**	**76,904**	**64,006**	**39,860**	**41,033**	**29,190**	

2005 Projects Deferred to 2006	Update	Alternate
Kootenay 230KV System Development Plan	(3,350)	(3,350)
Fault Level Reduction	811	811
Computerized Maintenance Management System	487	487
Subtotal	(2,052)	(2052)
Total 2006 Expenditures	**79,668**	**79,668**

Transmission

TRANSMISSION PROJECT DESCRIPTION	06-'10 Total	06-'10 Total	06-'10 Total	2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
TRANSMISSION GROWTH																			
BULK SYSTEM																			
KOOTENAY 230 KV DEVELOPMENT	0	0	0																
SOK PROJECT (VASEUX LAKE TERMINAL)	3,478	1,300	1,300	3,478	1,300	1,300													
KELOWNA AREA UPGRADE	2,758	5,150	5,150	2,758	5,150	5,150													
DOUBLE CIRCUIT 230 KV VAS TO RGA	29,500	29,500	29,500				3,500	3,500	3,500	16,500	16,500	16,500	9,500	9,500	9,500				
230/161/138 BENTLEY TERMINAL	20,500	20,500	20,500				500	500	500	5,000	5,000	5,000	15,000	15,000	15,000				
230 KV VASEUX TO BENTLEY	5,000	5,000	5,000				500	500	500	1,000	1,000	1,000	3,500	3,500	3,500				
KELOWNA SHUNTS & SVC	2,000	2,000	0							1,000	1,000		1,000	1,000					17,000
T3 VAS (500/230 KV)	1,500	1,500	0							500	500		1,000	1,000					3,500
		0	0																
KELOWNA AREA	0	0	0																
BIG WHITE 138 kV LINE & SUBSTATION	21,500	17,979	17,979	5,500	3,236	3,236	16,000	7,486	7,486		7,257	7,257							
ELLISON DISTRIBUTION SOURCE	8,000	8,000	8,000	1,500	1,500	1,500	6,500	6,500	6,500										
ELLISON DISTRIBUTION AND TRANSMISSION LINES	0	2,000	2,000					2,000	2,000										1,000
BLACK MOUNTAIIN DISTRIBUTION SOURCE	7,000	7,000	7,000							7,000	7,000	7,000							3,000
BLACK MOUNTAIIN DISTRIBUTION AND TRANSMISSION LINES	0	1,500	1,500								1,500	1,500							1,000
FAULT LEVEL REDUCTION	1,000	3,000	3,000	1,000	1,000	1,000		2,000	2,000										
CLOSE 138 KV LOOPS KELOWNA	12,000	8,500	500	500	0	0	4,000		0	4,000	500	0	3,500	4,000			4,000	500	3,500
RECREATION CAPACITY INCREASE	2,000	2,000	2,000							2,000	2,000				2,000				
HOLLYWOOD CAPACITY INCREASE	2,000	2,000	2,000							2,000	2,000				2,000				
BRAELOCH (SW) DISTRIBUTION SOURCE	1,250	1,250	1,250													1,250	1,250	1,250	3,500
OK MISSION CAPACITY INCREASE	0	0	0																3,000
	0	0	0																
PENTICTON/SUMMERLAND AREA	0	0	0																
WATERFORD UPGRADE	0	0	0																
NARAMATA REHABILITATION	1,250	1,250	1,250	1,250	1,250	1,250													
HUTH REBUILD AS 63 KV RING BUS	5,000	5,000	0													5,000	5,000		5,000
SUMMERLAND 63kV BACKUP	2,700	2,700	0										600	600		2,100	2,100		2,700
	0	0	0																
OSOYOOS/OLIVER AREA	0	0	0																
LINE	5,500	6,100	6,100	5,500	6,100	6,100													
TRANSMISSION LOOP BENTLEY TO EAST OSOYOOS	0	0	0																5,000
CONVERT EXISTING OLIVER TO 138/63/13 KV DISTRIBUTION SOURCE STATION	4,000	4,000	4,000				500	500	500	3,500	3,500	3,500							
	0	0	0																

Transmission cont'd

TRANSMISSION PROJECT DESCRIPTION	06-'10 Total	06-'10 Total	06-'10 Total	2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
TRANSMISSION GROWTH																			
PRINCETON/KEREMEOS AREA	0	0	0																
PRINCETON TRANSFORMER REPLACEMENTS	6,000	6,000	4,000	6,000	4,000	4,000								2,000					2,000
HEDLEY STEP UP 5 MVA TRANSFORMER	0	300	300				0	300	300										
	0	0	0																
BOUNDARY/GRAND FORKS AREA	0	0	0																
KETTLE VALLEY DISTRIBUTION SOURCE	7,500	8,000	8,000	7,500	8,000	8,000													
KETTLE VALLEY VOLTAGE CONVERSION	5,000	5,000	5,000	1,500	1,500	1,500	1,500	1,500	1,500	2,000	2,000	2,000							
BOUNDARY AREA STATION CONVERSIONS	2,000	2,000	2,000	1,000	1,000	1,000	1,000	1,000	1,000										
GRAND FORKS AREA VOLTAGE CONVERSIONS	3,000	3,000	2,000										2,000	2,000		1,000	1,000	2,000	1,000
GRAND FORKS DISTRIBUTION SOURCE	8,000	8,000	3,000										6,000	6,000		2,000	2,000	3,000	5,000
	0	0	0																
CASTLEGAR AREA	0	0	0																
CASTLEGAR SUB CAPACITY INCREASE	2,100	4,100	4,100	2,100				4,100	4,100										
	0	0	0																
COFFEE CREEK - KASLO AREA	0	0	0																
CAPACITOR AT COFFEE CREEK	800	800	800	800							800				800				
CAPACITOR AT KASLO	800	800	800	800							800				800				
COFFEE CREEK T3 REPLACEMENT	1,000	1,000	1,000							1,000	1,000				1,000				
	0	0	0																
CRAWFORD BAY AREA	0	0	0																
CRAWFORD BAY CAPACITY INC.	1,250	3,500	3,500	1,250				3,500	3,500										
	0	0	0																
CRESTON/WYNDELL AREA	0	0	0																
LAMBERT SUBSTATION UPGRADE	0	0	0																
NEW LAMBERT 230/63 KV TRANSFORMER & 230 KV RING BUS	5,000	3,750	3,750	5,000	1,750	1,750		2,000	2,000										3,500
	0	0	0																
SOUTH SLOCAN AREA	0	0	0																
SLOCAN - NEW DENVER 63KV LOOP	0	0	0																4,000
	0	0	0																
TRAIL/SALMO AREA	0	0	0																
YMIR UPGRADE (Cottonwood Substation)	1,500	2,800	2,800	1,500	2,300	2,300								500	500				
NEW 18L BREAKER AT WANETA	1,000	1,500	1,500	1,000							1,500	1,500							
	0	0	0																
SUBTOTAL - TRANSMISSION GROWTH	182,886	187,779	160,579	49,936	38,086	38,086	34,000	35,386	35,386	45,500	53,857	45,257	42,100	45,100	35,100	11,350	15,350	6,750	63,700

Transmission cont'd

TRANSMISSION PROJECT DESCRIPTION	06-'10 Total	06-'10 Total	06-'10 Total	2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
	0	0	0																
TRANSMISSION LINE SUSTAINING	0	0	0																
TRANSMISSION LINE URGENT REPAIRS	750	750	750	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	
RIGHT OF WAY ENHANCEMENTS	1,250	1,250	1,250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	
ROW RECLAMATIONS	0	150	150	0	150	150													
TRANSMISSION CONDITION ASSESSMENTS	500	500	500	500	500	500													
9, 10, LINE REHABILITATION GFT - CHR	0	0	0																
11 LINE REHABILITATION	0	0	0																
56 LINE REHABILITATION	0	0	0																
72 LINE REHABILITATION	0	0	0																
18 LINE REHABILITATION	0	0	0																
19 LINE REHABILITATION	0	0	0																
25 LINE REHABILITATION	0	0	0																
29 LINE REHABILITATION	0	0	0																
30 LINE REHABILITATION	0	0	0																
42 LINE REHABILITATION	0	0	0																
43 LINE AND 43AL REHABILITATION WORK	0	0	0																
73 LINE REHABILITATION	0	0	0																
32 LINE REHABILITATION	0	3,000	3,000		3,000	3,000													
SWITCH ADDITIONS	1,500	1,500	1,500	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	
6 18 20 21 26 45 55 LINE REHABILITATION	500	534	534	500	534	534													
21 - 24 LINE REHABILITATION	500	0	0	500															
51, 51A LINE REHABILITATION	100	0	0	100															
53 LINE REHABILITATION	100	0	0	100															
74 LINE REHABILITATION	500	0	0	500															
FUTURE YEAR REHABILITATION AND CONDITION ASSESSMENTS	6,700	6,700	6,700		0	0	1,600	1,600	1,600	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	
6A LINE REHABILITATION	50	50	50							50	50	50							
26 LINE REHABILITATION	80	80	80							80	80	80							
27 LINE REHABILITATION	250	250	250										250	250	250				
28 LINE REHABILITATION	10	10	10										10	10	10				
	0	0	0																
SUBTOTAL - TRANSMISSION LINE SUSTAINING	12,790	14,774	14,774	2,900	4,884	4,884	2,300	2,300	2,300	2,530	2,530	2,530	2,660	2,660	2,660	2,400	2,400	2,400	0

Transmission cont'd

TRANSMISSION PROJECT DESCRIPTION	06-'10 Total	06-'10 Total	06-'10 Total	2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
	0	0	0																
STATION SUSTAINING	0	0	0																
STATION ASSESSMENT AND MINOR PROJECTS	5,000	5,000	5,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
STATION UNFORESEEN REPAIRS	1,500	1,500	1,500	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	
GLENMERRY SOIL RECLAMATION	0	0	0																
10/12 MVA MOBILE UPGRADE	0	0	0																
KOOTENAY MOBILE STATION	0	0	0																
CMMS	200	200	200	200	200	200													
COF, CRA, WES AND BULK OIL BRKR REPLACEMENT	2,900	2,900	2,900	900	900	900	800	800	800	400	400	400	400	400	400	400	400	400	1,200
GROUND GRID UPGRADES	1,250	1,250	1,250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	
TRANSFORMER OIL FILTRATION/REPLACEMENT	1,250	1,450	1,450	250	350	350	250	350	350	250	250	250	250	250	250	250	250	250	
LTC OIL FILTRATION	750	750	750	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	
WEST OSOYOOS TRANSFORMER REHAB	1,800	1,800	1,800	1,800	1,800	1,800	0	0	0	0	0	0							
GRAND FORKS TERMINAL NOISE REDUCTION	0	0	0																
KASLO SUB UPGRADE	2,000	2,000	2,000	1,200	0	0	800	2,000	2,000										
PINE STREET T1 REPLACEMENT	1,000	1,000	1,000	750	1,000	1,000	250	0	0										
WESTMINSTER T1 REPLACEMENT	500	250	250	500	250	250	0	0	0										
TROUT CREEK T1 REHAB	800	800	800										550	550	550	250	250	250	
REPLACE COFFEE CREEK T2	1,500	0	0										250	0	0	1,250	0	0	0
REPLACE CRAWFORD BAY T1	1,500	0	0										250	0	0	1,250	0	0	0
TAP CHANGER LEAK REPAIR AND UPGRADE	0	0	0																
SUBTOTAL - STATIONS SUSTAINING	21,950	18,900	18,900	7,300	6,200	6,200	3,800	4,850	4,850	2,350	2,350	2,350	3,400	2,900	2,900	5,100	2,600	2,600	1,200
TOTAL - TRANSMISSION	217,626	221,453	194,253	60,136	49,170	49,170	40,100	42,536	42,536	50,380	58,737	50,137	48,160	50,660	40,660	18,850	20,350	11,750	64,900

Distribution

DISTRIBUTION PROJECT DESCRIPTION	06-'10 Total	06-'10 Total	06-'10 Total	2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
DISTRIBUTION GROWTH																			
NEW CONNECTS SYSTEM-WIDE	33,559	33,559	33,559	8,080	8,080	8,080	6,670	6,670	6,670	6,152	6,152	6,152	6,070	6,070	6,070	6,587	6,587	6,587	8,000
CIAC (credit amount)	-16,780	-16,780	-16,780	-4,040	-4,040	-4,040	-3,335	-3,335	-3,335	-3,076	-3,076	-3,076	-3,035	-3,035	-3,035	-3,294	-3,294	-3,294	-4,000
	0	0	0																
KELOWNA AREA	0	0	0																
DUC1-SEX1 477 TIE	0	0	0																
QUAIL DEVELOPMENT LOOPFEED	0	0	0																
DILWORTH DEVELOPMENT LOOPFEED	0	0	0																
OKM5-OKM4 TIE, EXTD TO SPRINGFIELD RD	0	0	0																
DGB2-OKM3 TIE, REBUILD 4.5 KM TO 477	550	1,000	1,000	550	1,000	1,000													
COMPLETE GLE5-SEX2 TIE ADD N.O.	0	0	0																
KELOWNA GENERAL FEEDER PROTECTION	300	0	0	100	0	0	50	0	0	50	0	0	50	0	0	50	0	0	0
MCKINLEY LANDING CAPACITY UPGRADE(#2 TO 477) FED FROM SEX3	450	325	325		0	0	450	325	325										
NEW GLE6 FEEDER(50L U/B HIGH RD-CLIFTON)	1,000	1,000	1,000							1,000	1,000	1,000							
HOL1-DGB3/LEE2 TIE	600	600	600				600	600	600										
HOL1-OKM1 TIE ALONG KLO RD	450	450	450							450	450	450							
MCKINLEY TO CLIFTON TIE	200	200	200							200	200	200							
LEE2-HOL5 TIE, ADD N.O.	200	200	200							200	200	200							
RETERMINATE LEE FEEDERS AT NEW N. KELOWNA SUBSTATION	500	500	500							500	500	500							
NEW FEEDER N.KELOWNA SUBSTATION	0	0	0																1,500
FUTURE KELOWNA DISTRIBUTION UPGRADES	3,000	2,000	1,500										1,500	1,000		1,500	1,000	1,500	1,500
	0	0	0																
PENTICTON	0	0	0																
WEB1 VOLTAGE REGULATOR	0	0	0																
	0	0	0																
OSOYOOS/OLIVER	0	0	0																
3 PHASE 4.4KM 1&2PHASE OSO2	0	0	0																
NEW FEEDER D/C OSO4 ACROSS CAUSEWAY TO EAST OSOYOOS + BREAKER	0	0	0																
25 KV TIE TO ANARCHIST/BRIDESVILLE	2,000	2,000	0										2,000	2,000					2,000
	0	0	0																
SIMILKAMEEN	0	0	0																
KEREMEOS FEEDER	600	600	600	600				600	600										
	0	0	0																
BOUNDARY/GRAND FORKS	0	0	0																
FEED BALDY & ANARCHIST @ 25 kV FROM ROCK CREEK & CONVERT BALDY TO 25 kV	0	0	0																

Distribution cont'd

DISTRIBUTION PROJECT DESCRIPTION	06-'10 Total	06-'10 Total	06-'10 Total	2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
DISTRIBUTION GROWTH																			
TRAIL/ROSSLAND AREA	0	0	0																
W. TRAIL VOLTAGE CONVERSION	0	0	0																
PATTERSON 25 kV FEED	300	500	500	300	500	500													
	0	0	0																
SOUTH SLOCAN	0	0	0																
PASSMORE FEEDER2 UPGRADE	0	0	0																
PLAYMOR - TARRYS FEEDER UPGRADE	1,500	750	750	1,500	750	750													
	0	0	0																
CRESTON AREA	0	0	0																
CRESTON DIST FEEDER UPGRADES RELATED TO LAMBERT	2,000	1,000	1,000	2,000	1,000	1,000													
	0	0	0																
GENERAL	0	0	0																
PRIMARY & SECONDARY VOLTAGE PROBLEMS, RELIABILITY IMPROVEMENTS, SWITCHING IMPROVEMENTS)	2,500	3,400	3,400	500	1,200	1,200	500	550	550	500	550	550	500	550	550	500	550	550	
	0	0	0																
SUBTOTAL - DISTRIBUTION GROWTH	32,930	31,305	28,805	9,590	8,490	8,490	4,935	5,410	5,410	5,976	5,976	5,976	7,085	6,585	3,585	5,344	4,844	5,344	9,000
DISTRIBUTION SUSTAINING	0	0	0																
DISTRIBUTION CONDITION ASSESSMENTS	2,250	2,250	2,250	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	
DISTRIBUTION REHABILITATION	7,500	9,500	9,500	1,500	3,500	3,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	
ROW RECLAMATION	2,825	2,825	2,825	565	565	565	565	565	565	565	565	565	565	565	565	565	565	565	
DISTRIBUTION LINE REBUILDS	3,750	3,750	3,750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	
SMALL PLANNED CAPITAL	2,675	2,675	2,675	535	535	535	535	535	535	535	535	535	535	535	535	535	535	535	
PCB PROGRAM	3,750	3,750	3,750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	750	
FORCED UPGRADES AND LINE MOVES	2,500	2,500	2,500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	
DISTRIBUTION URGENT REPAIRS	5,000	5,000	5,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	
GLENMERRY UNDERGROUND	0	0	0																
SUBTOTAL - DISTRIBUTION SUSTAINING	30,250	32,250	32,250	6,050	8,050	8,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	6,050	0
TOTAL - DISTRIBUTION	63,180	63,555	61,055	15,640	16,540	16,540	10,985	11,460	11,460	12,026	12,026	12,026	13,135	12,635	9,635	11,394	10,894	11,394	9,000

Telecommunications, SCADA and Protection & Control

TELECOM, SCADA, P&C PROJECT DESCRIPTION	06-'10 Total	06-'10 Total	06-'10 Total	2006			2007			2008			2009			2010			2011+
	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	original	update	alternate	
TELECOM, SCADA, P&C GROWTH																			
DISTRIBUTION SUBSTATION AUTOMATION, METERING AND COMMUNICATIONS	5,600	5,600	4,600	2,000	600	600	2,000	2,000	1,000	1,000	2,000	1,000	600	1,000	1,000			1,000	1,000
TRAIL-OLIVER HIGH CAPACITY COMMUNICATIONS	7,500	7,500	4,500	1,500	2,500	2,500				3,000	2,000				2,000	3,000	3,000		3,000
TELECOMMUNCIATIONS BACKBONE LOOP CLOSE	0	0	0																10,000
TELECOMMUNICATIONS FOR BUSINESS SYSTEMS	0	0	0																3,500
	0	0																	
SUBTOTAL - TELECOM, SCADA, P&C GROWTH	13,100	13,100	9,100	3,500	3,100	3,100	2,000	2,000	1,000	4,000	4,000	1,000	600	1,000	3,000	3,000	3,000	1,000	17,500
TELECOM, SCADA, P&C SUSTAINING																			
NARROW SPECTRUM CONVERSION	200	200	200	200	200	200													
HARMONIC REMEDIATION	500	500	500	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	
RELAY TEST & MAINT PROCESS	0	0	0																
COMM EQUIP TEST/MAINTAIN PROCESS	0	0	0																
PROTECTION UPGRADES	2,902	2,902	2,902	242	242	242	955	955	955	725	725	725	730	730	730	250	250	250	2,500
FAULT LOCATING INACCESSIBLE LINES	750	750	750	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	
COMMUNICATIONS UPGRADES	1,170	1,170	1,170	190	190	190	310	310	310	110	110	110	310	310	310	250	250	250	1,250
	0	0	0																
SUBTOTAL - TELECOM, SCADA, P&C SUSTAINING	5,522	5,522	5,522	882	882	882	1,515	1,515	1,515	1,085	1,085	1,085	1,290	1,290	1,290	750	750	750	3,750
TOTAL - TELECOM, SCADA, P&C	18,622	18,622	14,622	4,382	3,982	3,982	3,515	3,515	2,515	5,085	5,085	2,085	1,890	2,290	4,290	3,750	3,750	1,750	21,250

Appendix 3

Annual Rate Impacts

SDP - 2006

System Development Plan 2005 - 2024

2006 Update

Appendix 3 - Annual Rate Impacts

Original

Revenue Requirements 2006 -2010

Impact of Capital Plan

Line No.	Year	2005	2006	2007	2008	2009	2010
	Summary						
	Incremental Revenue Requirements						
1	Power Supply	0	0	0	0	0	0
2	O&M Expense	0	0	0	0	0	0
3	Property Taxes	1,350	2,665	3,562	4,670	5,707	6,265
4	Depreciation Expense	0	2,121	4,189	5,597	7,338	8,968
4	Return on Rate Base	659	8,692	16,065	21,952	28,341	33,562
5	Revenue Requirement	2,008	13,478	23,815	32,219	41,387	48,795
6							
7	**Sales (GWh)**		3,038	3,069	3,130	3,193	3,257
8	**Average Rate**		64.94	68.30	70.99	73.86	76.13
9	**Rate Impact**						
10	Revenue at Prior Year Rates	172,973	185,804	199,286	213,816	226,665	240,549
11	Incremental Revenue Requirement Associated with the capital expenditures	2,008	11,469	10,337	8,404	9,167	7,409
12	Total Revenue Requirement Associated with the capital expenditures	174,981	197,273	209,624	222,220	235,832	247,957
13							
14	Rate Impact	1.2%	6.2%	5.2%	3.9%	4.0%	3.1%
15							
16	**Cumulative Rate Impact**	1.2%	7.4%	13.0%	17.4%	22.2%	25.9%
17	Average Annual Rate Impact						
18							
19	**Regulatory Assumptions**						
20	Equity Component	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%
21	Debt Component	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%
22	Equity Return	9.43%	9.43%	9.43%	9.43%	9.43%	9.43%
23	Debt Return	6.54%	6.54%	6.54%	6.54%	6.54%	6.54%
24							
25							
26	**Capital Cost**						
27	Generation						
28	Transmission	67,051	60,136	40,100	50,380	48,160	18,850
29	Distribution	19,782	15,640	10,985	12,026	13,135	11,394
30	Telecom, SCADA, P&C	2,007	4,382	3,515	5,085	1,890	3,750
31	General Plant (Including DSM)						
32	AFUDC & Loadings	7,557	13,834	9,423	11,648	10,905	5,867
37	Total Capital Cost in Year	96,397	93,992	64,023	79,139	74,090	39,860
38	Cumulative Capital Cost	96,397	190,389	254,412	333,551	407,641	447,501
39							
40							
41							
42	**Annual Operating Costs / (Savings)**						
43	Annual Cost Savings (line losses or other savings)	0	0	0	0	0	0
44	Annual Maintenance Savings	0	0	0	0	0	0
45	Property Taxex - Incremental	0	0	0	0	0	0
46	Total Incremental Operating Costs (Savings)	0	0	0	0	0	0
47	(Forecast inflation rate 2%)						
48							
49							
50							
51	**Depreciation Expense**						
52	Opening Cash Outlay	0	96,397	190,389	254,412	333,551	407,641
53	Additions in Year	96,397	93,992	64,023	79,139	74,090	39,860
54	Cumulative Total	96,397	190,389	254,412	333,551	407,641	447,501
55	Depreciation Rate - composite average	2.20%	2.20%	2.20%	2.20%	2.20%	2.20%
56	Depreciation Expense	0	2,121	4,189	5,597	7,338	8,968
57							
58							
59	**Net Book Value**						
60	Gross Property	96,397	190,389	254,412	333,551	407,641	447,501
61	Accumulated Depreciation		(2,121)	(6,309)	(11,906)	(19,244)	(28,213)
62	Net Book Value	96,397	188,268	248,103	321,645	388,397	419,288
63							
64	**Carrying Costs on Average NBV**						
65	Return on Equity	1,818	5,369	8,230	10,745	13,391	15,233
66	Interest Expense	1,891	5,585	8,562	11,178	13,931	15,847
67	AFUDC	(2,723)	(2,506)	(1,707)	(1,437)	(1,133)	(480)
68	**Total Carrying Costs**	986	8,448	15,085	20,487	26,189	30,600
69							
70							
71	**Income Tax Expense**						
72	Combined Income Tax Rate	35.62%	35.62%	35.62%	35.62%	35.62%	35.62%
73							
74	**Income Tax on Equity Return**						
75	Return on Equity	1,818	5,369	8,230	10,745	13,391	15,233
76	Gross up for revenue (Return / (1- tax rate)	2,824	8,339	12,783	16,691	20,801	23,661
77	Income tax on Equity Return	1,006	2,970	4,553	5,945	7,409	8,428
78							
79	**Income Tax on Timing Differences**						
80	Depreciation Expense	0	2,121	4,189	5,597	7,338	8,968
81	Less: Capital Cost Allowance	2,410	7,049	10,647	13,694	16,840	18,847
82	Total Timing Differences	(2,410)	(4,928)	(6,459)	(8,097)	(9,502)	(9,878)
83	Gross up for tax (Total Timing Differences/(1-tax rate))	(3,743)	(7,655)	(10,032)	(12,576)	(14,759)	(15,344)
84	Income tax on Timing Differences	(1,333)	(2,727)	(3,573)	(4,480)	(5,257)	(5,466)
85							
86	**Total Income Tax**	(327)	244	980	1,465	2,152	2,963
87							
88							
89	**Capital Cost Allowance**						
90	Opening Balance - UCC	0	93,987	180,930	234,306	299,751	357,001
91	Total Cash Outlay	96,397	93,992	64,023	79,139	74,090	39,860
92	Subtotal UCC	96,397	187,979	244,953	313,445	373,841	396,861
93	Composite Capital Cost Allowance Rate	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
94	CCA on Opening Balance	0	4,699	9,046	11,715	14,988	17,850
95	CCA on Capital Expenditures (1/2 yr rule)	2,410	2,350	1,601	1,978	1,852	997
96	Total CCA	2,410	7,049	10,647	13,694	16,840	18,847
97	Ending Balance UCC	93,987	180,930	234,306	299,751	357,001	378,015

Update

Revenue Requirements 2006 -2010

Impact of Capital Plan

Line No.	Year	2005	2006	2007	2008	2009	2010
	Summary						
	Incremental Revenue Requirements						
1	Power Supply	0	0	0	0	0	0
2	O&M Expense	0	0	0	0	0	0
3	Property Taxes	1,257	2,401	3,345	4,590	5,667	6,241
4	Depreciation Expense	0	1,975	3,772	5,256	7,213	8,905
4	Return on Rate Base	613	8,044	14,549	20,113	27,091	32,795
5	Revenue Requirement	1,870	12,419	21,666	29,959	39,970	47,941
6							
7	**Sales (GWh)**		3,038	3,069	3,130	3,193	3,257
8	**Average Rate**		64.63	67.65	70.29	73.43	75.88
9	**Rate Impact**						
10	Revenue at Prior Year Rates	172,973	185,804	198,357	211,756	224,449	239,150
11	Incremental Revenue Requirement Associated with the capital expenditures	1,870	10,549	9,247	8,293	10,012	7,971
12	Total Revenue Requirement Associated with the capital expenditures	174,843	196,353	207,604	220,048	234,461	247,121
13							
14	Rate Impact	1.1%	5.7%	4.7%	3.9%	4.5%	3.3%
15							
16	**Cummulative Rate Impact**	1.1%	6.8%	11.8%	16.2%	21.4%	25.4%
17	Average Annual Rate Impact						
18							
19	**Regulatory Assumptions**						
20	Equity Component	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%
21	Debt Component	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%
22	Equity Return	9.43%	9.43%	9.43%	9.43%	9.43%	9.43%
23	Debt Return	6.54%	6.54%	6.54%	6.54%	6.54%	6.54%
24							
25							
26	**Capital Cost**						
27	Generation						
28	Transmission	63,973	49,170	42,536	58,737	50,660	20,350
29	Distribution	25,153	16,540	11,460	12,026	12,635	10,894
30	Telecom, SCADA, P&C	629	3,982	3,515	5,085	2,290	3,750
31	General Plant (Including DSM)						
32	AFUDC & Loadings		12,028	9,926	13,091	11,319	6,040
37	Total Capital Cost in Year	89,755	81,720	67,437	88,939	76,904	41,033
38	Cumulative Capital Cost	89,755	171,475	238,912	327,851	404,755	445,788
39							
40							
41							
42	**Annual Operating Costs / (Savings)**						
43	Annual Cost Savings (line losses or other savings)	0	0	0	0	0	0
44	Annual Maintenance Savings	0	0	0	0	0	0
45	Property Taxex - Incremental	0	0	0	0	0	0
46	Total Incremental Operating Costs (Savings)	0	0	0	0	0	0
47	(Forecast inflation rate 2%)						
48							
49							
50							
51	**Depreciation Expense**						
52	Opening Cash Outlay	0	89,755	171,475	238,912	327,851	404,755
53	Additions in Year	89,755	81,720	67,437	88,939	76,904	41,033
54	Cumulative Total	89,755	171,475	238,912	327,851	404,755	445,788
55	Depreciation Rate - composite average	2.20%	2.20%	2.20%	2.20%	2.20%	2.20%
56	Depreciation Expense	0	1,975	3,772	5,256	7,213	8,905
57							
58							
59	**Net Book Value**						
60	Gross Property	89,755	171,475	238,912	327,851	404,755	445,788
61	Accumulated Depreciation		(1,975)	(5,747)	(11,003)	(18,216)	(27,120)
62	Net Book Value	89,755	169,500	233,165	316,848	386,539	418,668
63							
64	**Carrying Costs on Average NBV**						
65	Return on Equity	1,693	4,890	7,594	10,373	13,266	15,186
66	Interest Expense	1,761	5,087	7,900	10,791	13,800	15,798
67	AFUDC	(2,535)	(2,179)	(1,798)	(2,371)	(2,050)	(1,094)
68	**Total Carrying Costs**	918	7,797	13,697	18,793	25,016	29,890
69							
70							
71	**Income Tax Expense**						
72	Combined Income Tax Rate	35.62%	35.62%	35.62%	35.62%	35.62%	35.62%
73							
74	**Income Tax on Equity Return**						
75	Return on Equity	1,693	4,890	7,594	10,373	13,266	15,186
76	Gross up for revenue (Return / (1- tax rate)	2,629	7,595	11,796	16,113	20,606	23,588
77	Income tax on Equity Return	937	2,705	4,202	5,739	7,340	8,402
78							
79	**Income Tax on Timing Differences**						
80	Depreciation Expense	0	1,975	3,772	5,256	7,213	8,905
81	Less: Capital Cost Allowance	2,244	6,419	9,827	13,245	16,728	18,840
82	Total Timing Differences	(2,244)	(4,444)	(6,054)	(7,989)	(9,516)	(9,936)
83	Gross up for tax (Total Timing Differences/(1-tax rate))	(3,485)	(6,903)	(9,404)	(12,408)	(14,781)	(15,433)
84	Income tax on Timing Differences	(1,241)	(2,459)	(3,350)	(4,420)	(5,265)	(5,497)
85							
86	**Total Income Tax**	(305)	247	852	1,319	2,075	2,905
87							
88							
89	**Capital Cost Allowance**						
90	Opening Balance - UCC	0	87,511	162,813	220,423	296,117	356,293
91	Total Cash Outlay	89,755	81,720	67,437	88,939	76,904	41,033
92	Subtotal UCC	89,755	169,231	230,250	309,362	373,021	397,326
93	Composite Capital Cost Allowance Rate	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
94	CCA on Opening Balance	0	4,376	8,141	11,021	14,806	17,815
95	CCA on Capital Expenditures (1/2 yr rule)	2,244	2,043	1,686	2,223	1,923	1,026
96	Total CCA	2,244	6,419	9,827	13,245	16,728	18,840
97	Ending Balance UCC	87,511	162,813	220,423	296,117	356,293	378,485

Alternate

Revenue Requirements 2006 -2010
Impact of Capital Plan

Line No.	Year	2005	2006	2007	2008	2009	2010
	Summary						
	Incremental Revenue Requirements						
1	Power Supply	0	0	0	0	0	0
2	O&M Expense	0	0	0	0	0	0
3	Property Taxes	1,257	2,401	3,328	4,383	5,279	5,688
4	Depreciation Expense	0	1,975	3,772	5,230	6,888	8,296
4	Return on Rate Base	613	8,044	14,508	19,539	25,428	30,125
5	Revenue Requirement	1,870	12,419	21,608	29,153	37,595	44,108
6							
7	**Sales (GWh)**		3,038	3,069	3,130	3,193	3,257
8	**Average Rate**		64.63	67.63	70.04	72.68	74.68
9	**Rate Impact**						
10	Revenue at Prior Year Rates	172,973	185,804	198,357	211,697	223,626	236,710
11	Incremental Revenue Requirement Associated with the capital expenditures	1,870	10,549	9,189	7,544	8,443	6,513
12	Total Revenue Requirement Associated with the capital expenditures	174,843	196,353	207,546	219,241	232,069	243,223
13							
14	Rate Impact	1.1%	5.7%	4.6%	3.6%	3.8%	2.8%
15							
16	**Cummulative Rate Impact**	1.1%	6.8%	11.8%	15.8%	20.1%	23.4%
17	Average Annual Rate Impact						
18							
19	**Regulatory Assumptions**						
20	Equity Component	40.00%	40.00%	40.00%	40.00%	40.00%	40.00%
21	Debt Component	60.00%	60.00%	60.00%	60.00%	60.00%	60.00%
22	Equity Return	9.43%	9.43%	9.43%	9.43%	9.43%	9.43%
23	Debt Return	6.54%	6.54%	6.54%	6.54%	6.54%	6.54%
24							
25							
26	**Capital Cost**						
27	Generation						
28	Transmission	63,973	49,170	42,536	50,137	40,660	11,750
29	Distribution	25,153	16,540	11,460	12,026	9,635	11,394
30	Telecom, SCADA, P&C	629	3,982	2,515	2,085	4,290	1,750
31	General Plant (Including DSM)						
32	AFUDC & Loadings		12,028	9,753	11,089	9,421	4,296
37	Total Capital Cost in Year	89,755	81,720	66,264	75,337	64,006	29,190
38	Cumulative Capital Cost	89,755	171,475	237,739	313,076	377,082	406,272
39							
40							
41							
42	**Annual Operating Costs / (Savings)**						
43	Annual Cost Savings (line losses or other savings)	0	0	0	0	0	0
44	Annual Maintenance Savings	0	0	0	0	0	0
45	Property Taxex - Incremental	0	0	0	0	0	0
46	Total Incremental Operating Costs (Savings)	0	0	0	0	0	0
47	(Forecast inflation rate 2%)						
48							
49							
50							
51	**Depreciation Expense**						
52	Opening Cash Outlay	0	89,755	171,475	237,739	313,076	377,082
53	Additions in Year	89,755	81,720	66,264	75,337	64,006	29,190
54	Cumulative Total	89,755	171,475	237,739	313,076	377,082	406,272
55	Depreciation Rate - composite average	2.20%	2.20%	2.20%	2.20%	2.20%	2.20%
56	Depreciation Expense	0	1,975	3,772	5,230	6,888	8,296
57							
58							
59	**Net Book Value**						
60	Gross Property	89,755	171,475	237,739	313,076	377,082	406,272
61	Accumulated Depreciation		(1,975)	(5,747)	(10,977)	(17,865)	(26,161)
62	Net Book Value	89,755	169,500	231,992	302,099	359,217	380,111
63							
64	**Carrying Costs on Average NBV**						
65	Return on Equity	1,693	4,890	7,572	10,073	12,472	13,944
66	Interest Expense	1,761	5,087	7,877	10,479	12,975	14,506
67	AFUDC	(2,535)	(2,179)	(1,798)	(2,371)	(2,050)	(1,094)
68	**Total Carrying Costs**	918	7,797	13,651	18,181	23,397	27,355
69							
70							
71	**Income Tax Expense**						
72	Combined Income Tax Rate	35.62%	35.62%	35.62%	35.62%	35.62%	35.62%
73							
74	**Income Tax on Equity Return**						
75	Return on Equity	1,693	4,890	7,572	10,073	12,472	13,944
76	Gross up for revenue (Return / (1- tax rate)	2,629	7,595	11,762	15,646	19,373	21,658
77	Income tax on Equity Return	937	2,705	4,189	5,573	6,901	7,715
78							
79	**Income Tax on Timing Differences**						
80	Depreciation Expense	0	1,975	3,772	5,230	6,888	8,296
81	Less: Capital Cost Allowance	2,244	6,419	9,797	12,847	15,689	17,234
82	Total Timing Differences	(2,244)	(4,444)	(6,025)	(7,617)	(8,801)	(8,938)
83	Gross up for tax (Total Timing Differences/(1-tax rate))	(3,485)	(6,903)	(9,358)	(11,832)	(13,670)	(13,884)
84	Income tax on Timing Differences	(1,241)	(2,459)	(3,333)	(4,214)	(4,869)	(4,945)
85							
86	**Total Income Tax**	(305)	247	856	1,359	2,031	2,769
87							
88							
89	**Capital Cost Allowance**						
90	Opening Balance - UCC	0	87,511	162,813	219,279	281,769	330,086
91	Total Cash Outlay	89,755	81,720	66,264	75,337	64,006	29,190
92	Subtotal UCC	89,755	169,231	229,077	294,616	345,775	359,276
93	Composite Capital Cost Allowance Rate	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
94	CCA on Opening Balance	0	4,376	8,141	10,964	14,088	16,504
95	CCA on Capital Expenditures (1/2 yr rule)	2,244	2,043	1,657	1,883	1,600	730
96	Total CCA	2,244	6,419	9,797	12,847	15,689	17,234
97	Ending Balance UCC	87,511	162,813	219,279	281,769	330,086	342,042

FortisBC Inc.

2007 System Development Plan Update

(“2007 SDP Update”)

July 26, 2006

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 3
2. PLAN UPDATE BY CATEGORY 6
2.1 Transmission and Stations (Growth) 6
2.1.1 Bulk Transmission System 6
2.1.2 Okanagan Region 8
2.1.3 Kootenay Region 14
2.2 Transmission and Stations (Sustaining) 19
2.2.1 Transmission 19
2.2.2 Stations 20
2.3 Distribution (Growth) 22
2.3.1 New Connects - System Wide 22
2.3.2 Small Capacity Improvements 22
2.3.3 Okanagan Region 22
2.3.4 Kootenay Region 27
2.4 Distribution (Sustaining) 28
2.5 Telecommunications, SCADA and Protection 29
2.5.1 Telecommunications, SCADA and Protection (Growth) 30
2.5.2 Telecommunications, SCADA and Protection (Sustaining) 31
APPENDIX 1 32
APPENDIX 1 - LOAD FORECAST 33
APPENDIX 2 41
APPENDIX 2 - PROJECT SCHEDULE AND EXPENDITURE ESTIMATE 42

1. Executive Summary

FortisBC Inc.'s 2005-2024 System Development Plan ("2005 SDP") filed with the British Columbia Utilities Commission ("Commission") on November 26, 2004 identified necessary reinforcements in the Company's bulk transmission system, the regional transmission and distribution systems, the telecommunication and SCADA networks, and protection systems. The 2005 SDP outlined the sustaining projects directed at maintaining existing facilities and modernizing obsolete equipment; and growth projects required to serve increasing load, driven by population growth and the new commercial activities in the FortisBC service area. In Order G-52-05 the Commission Panel encouraged FortisBC to treat this plan as a living document, to continue to consult with stakeholders and to keep the plan current as the plan evolves. In 2006, an update ("2006 SDP Update") to the 2005 SDP was filed with the Company's 2006 Capital Expenditure Plan. An effective system development plan must be responsive to changing circumstances that may arise from variations in load growth rates or location, or from results of equipment condition assessments. This report ("2007 SDP Update") outlines the changes to the original project plan schedule and provides a summary of the upcoming five year capital expenditure plan necessary to maintain the integrity of the existing electrical system and to meet new customer demand within the FortisBC service territory.

The current load forecast developed in the second quarter of 2006 is included as Appendix 1. It continues to show a high level of load growth in the north and south Okanagan and in parts of the Boundary areas with average winter growth rates of 4.8%, 2.1% and 2.1% respectively over the next five years. The Kootenay area continues to experience modest growth with an average annual growth rate of 0.8% over the next five years.

Appendix 2 provides the cost and schedule for the various projects identified in the 2005 SDP updated for currently approved overhead and Allowance for Funds Used During Construction ("AFUDC") rates.

Expenditures in the 2007-2011 timeframe increased from $305.8 million as originally scheduled to $377.1 million in the 2007 SDP Update.

The major changes between the 2005 SDP and the 2007 SDP Update are summarized below by category. The details of each are included in the 2007 SDP Update.

Transmission Growth

Project Timing

1. The construction of the Big White 138 kV transmission line and substation has been rescheduled from 2005/07 to 2006/08,

2. The Recreation Substation capacity upgrade has been rescheduled from 2008 to 2010,

3. The Lambert Substation transformer addition has been scheduled over 2006/07 rather than just 2006,

4. The Castlegar Substation capacity upgrade has been rescheduled from 2006 to 2008,

5. The Crawford Bay capacity increase has been rescheduled from 2006 to 2007,

6. The delay of the reconstruction at Teck Cominco's Waneta plant has allowed the deferral of 18 Line breaker installation from 2006 to 2008.

7. Unanticipated delays for the Kettle Valley project have deferred a significant portion of this project from 2006 to 2007.

8. Unanticipated delays for the East Osoyoos (Nk'Mip) project have deferred a significant portion of this project from 2006 to 2007.

Increasing Scope and new projects

1. The scope of the proposed Ellison project has increased to include the transmission and distribution lines that were not specifically included in the 2005 SDP.

2. The scope of the Hollywood and OK Mission capacity upgrade projects have changed from transformer additions to the construction of a new substation (Benvoulin).

Transmission Line Sustaining – Forecast changes in this category have occurred primarily due to:

1. The continued requirement for ROW reclamation (no expenditures had been included in the original plan for 2007/11);
2. Ongoing assessments that are anticipated to identify a significant amount of deteriorated and substandard plant, resulting in increased activity in the condition assessment and rehabilitation project.

Stations Sustaining – The most significant changes associated with this category is attributable to:

1. The cancellation of the Coffee Creek Transformer 2 and Crawford Bay Transformer 1 replacements as a result of the conversion of 30 Line; and
2. The completion of the bulk oil breakers replacement project in 2009.

Distribution Growth – The changes in this category are explained primarily by:

1. Forecast higher customer growth rates and subsequent increase in construction associated with the need to provide service; and
2. The addition of new projects to increase the capacity of existing distribution circuits in order to deliver voltage levels within acceptable limits

Distribution Sustaining – The changes in this category are explained primarily by:

1. The increased activity associated with forced upgrades and line moves; and
2. The ongoing assessments that have highlighted a significant amount of deteriorated and substandard plant, resulting in increased activity in the rebuild project.

Telecommunications – The change in this category is due primarily to a reduction in the estimate to complete the Trail to Oliver high capacity communications link.

2. Plan Update by Category

2.1 Transmission and Stations (Growth)

The 2007 SDP Update contains very few changes from the 2006 SDP Update. The major factor influencing changes to the Transmission and Station (Growth) projects is the substation load forecast. The 2006 load forecast showing actual loads for the past five years, together with forecast winter and summer loads for the next six years is found in Appendix 1.

The following sections outline the projects as originally identified by the 2005 SDP and give a brief update of the current status. Appendix 2 shows the original schedule and estimated costs as well as the schedule and estimates for the updated plan.

2.1.1 Bulk Transmission System

The 2007 SDP Update continues to forecast a high level of load growth in north and south Okanagan and in parts of the Boundary areas with average winter growth rates of 4.8%, 2.1% and 2.1% respectively over the next five years. The Kootenay area continues to experience modest growth with an average annual growth rate of 0.8% over the next five years.

The 2005 SDP proposed that due to the high load growth and concern with security of supply for the City of Kelowna, the following projects should be undertaken, subsequent to the completion of the South Okanagan Supply Reinforcement Project in 2006.

The four projects listed in this category have been grouped and are currently referred to as the Okanagan Transmission Reinforcement project ("OTR"). An application for a CPCN will be filed for the OTR project in 2007.

2.1.1.1 Vaseux Lake Terminal to Anderson Terminal 230 kV Circuit:

The conversion of the existing 161 kV circuit to 230 kV and construction of a second 230 kV circuit between Vaseux Lake Terminal and RG Anderson Terminal stations in the 2007/09 timeframe.

This also involves the expansion of the 230 kV ring bus in RG Anderson Terminal station and reconfiguration of the existing 168 MVA Transformer 2 for 230 kV operations.

2007 UPDATE: This project is unchanged. An application for a CPCN for the OTR project is anticipated to be filed with the Commission in 2007.

2.1.1.2 New Bentley Terminal Station

The construction in 2008/09 of a new Bentley Terminal station near Oliver supplied by a 230 kV line from Vaseux Lake Terminal station.

This terminal station would be equipped with 230 kV, 161 kV and 138 kV buses and would serve Oliver Terminal station to the west, Grand Forks Terminal station to the east and the Osoyoos area to the south.

2007 UPDATE: This project is currently scheduled for the 2008/10 timeframe. An application for a CPCN for the OTR project is anticipated to be filed with the Commission in 2007.

2.1.1.3 Kelowna Switched Shunts and Static VAr Compensator

The installation of approximately 30 MVA of shunt capacitors at both DG Bell Terminal and FA Lee Terminal stations in 2008/09 to provide adequate voltage support for loss of the 230 kV lines between FA Lee Terminal station and Vernon.

2007 UPDATE: This project is currently scheduled for the 2010 timeframe. An application for a CPCN for the OTR project is anticipated to be filed with the Commission in 2007.

2.1.1.4 Vaseux Lake Terminal Station Transformer 3

Preparatory work for the installation of a third transformer (T3) at Vaseux Terminal station in 2009 with installation occurring in the 2011+ timeframe.

2007 UPDATE: An application for a CPCN for the OTR project is anticipated to be filed with the Commission in 2007 and will address the preparatory work. The installation is unchanged.

2.1.2 Okanagan Region

The Okanagan region consists of Kelowna, Penticton, Summerland, Oliver-Osoyoos, and Princeton-Keremeos.

2.1.2.1 Kelowna:

The 2005 SDP identified the Kelowna area as the fastest growing part of the FortisBC system and one of the fastest growing urban centres in British Columbia. The load addition resulting from that growth has resulted in a requirement for a number of subtransmission and station projects. The 2007 SDP Update shows that the forecast loads for the stations in the Kelowna area has exceeded the 2004 forecast.

As a result of forecast customer and load growth in this area the following projects were identified in the 2005 SDP.

(a) Big White 138 kV Line and Substation

Construction of a substation at the Big White ski resort to be served via a 138 kV transmission line from the Joe Rich Substation as well as a distribution upgrade, in the 2005/07 timeframe.

2007 UPDATE: The project is now scheduled for the 2006/08 timeframe. An application for a CPCN was filed in March 2006 and an oral public hearing was held on July 4 and 5, 2006.

(b) Ellison Distribution Source Substation

Construction of a distribution source substation (Ellison) approximately 5.5 kilometres north of the Sexsmith Substation in 2006/07. Included in this station project are four 13 kV lines out of the station to connect the station to the existing distribution in the Ellison and Glenmore area and a transmission line from the Duck Lake Substation.

2007 UPDATE: This project is unchanged. An open house for this project was held on July 6, 2006. An application for a CPCN for this project is anticipated to be filed with the Commission in the third quarter of 2006.

(c) Black Mountain Distribution Source Station

Construction of a distribution source substation (Black Mountain) approximately 5 kilometres east of the Hollywood Substation in the 2008 timeframe.

2007 UPDATE: This project is unchanged. An application for a CPCN for this project is anticipated to be filed with the Commission in the fourth quarter of 2006.

(d) Fault Level Reduction

Installation of current limiting reactors in Kelowna area substations in 2005/06.

2007 UPDATE: Detailed engineering has identified that many of the substations do not have adequate space for the additional reactors, resulting in a requirement for major reconfiguration at these sites. This has caused FortisBC to investigate alternate solutions for the sites. A solution will be implemented at Glenmore Substation in 2006; however other sites will be rectified in future as upgrades take place at these substations. Work practices and changes to protection settings have been implemented to reduce the impact of high fault levels at these sites. A report titled “FortisBC Distribution Substation Fault Level Control Guidelines” is filed as Appendix 8 of the 2007/08 Capital Expenditure Plan.

(e) Loop Kelowna 138 kV Circuits

Installation of circuit breakers and modification of existing bus networks to enable the operation of the 138 kV subtransmission in Kelowna as a looped network. The engineering for this project was scheduled for 2006 with construction scheduled for the 2007/09 timeframe.

2007 UPDATE: This project has been deferred to the 2010/12 timeframe due to other major projects that are occurring in the Kelowna area. The application for a CPCN for the proposed Ellison project will contain details of a transmission loop for the Sexsmith, Ellison and Duck Lake substations.

(f) Recreation Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at the Recreation substation in the 2008 timeframe.

2007 UPDATE: The load growth in this area has allowed deferral of this project to 2010.

(g) Hollywood Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at Hollywood substation in the 2008 timeframe.

2007 UPDATE: Cancelled. An analysis of the load growth patterns in Kelowna indicates that the preferred solution for the load growth in the central/south Kelowna area is to construct a distribution source substation in the Casorso Road and Benvoulin Road area. This project is included in the Benvoulin Substation project and is scheduled for the 2008/09 timeframe.

(h) Braeloch (SW) Kelowna Distribution Source Substation

Construction of a distribution source substation (Braeloch) in southwest Kelowna in the 2010/11 timeframe.

2007 UPDATE: This project is unchanged.

(i) OK Mission Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at the OK Mission Substation in the 2011+ timeframe.

2007 UPDATE: Cancelled. An analysis of the load growth patterns in Kelowna indicates that the preferred solution for the load growth in the central/south Kelowna area is to construct a distribution source substation in the Casorso Road and Benvoulin Road area. This project is included in the Benvoulin Substation project and is scheduled for the 2008/09 timeframe.

(j) NEW - Benvoulin Substation: This project replaces the Hollywood and OK Mission Capacity Upgrade projects.

(k) NEW - Duck Lake Regulator Bank: Load growth at the Duck Lake Substation has exceeded the capacity of the voltage regulators located at the substation and will require replacement in 2007.

(l) NEW - Glenmore 6 – New Feeder: Addition of a circuit breaker at the Glenmore Substation to accommodate a new feeder (Feeder 6).

(m) NEW - North Kelowna Transformer Addition: Current load growth patterns indicate that a transformer will be required at one of the north Kelowna substations (Duck Lake, Ellison and Sexsmith) in the 2012 + timeframe.

2.1.2.2 Penticton - Summerland

This area has seen modest growth over the past number of years. The 2005 SDP identified the following projects for the 2006/11+ period.

(a) Naramata Substation Replacement

Rebuilding of the Naramata Substation in the 2005/06 timeframe.

2007 UPDATE: The requirement for the Naramata project is unchanged. The project was approved by Order G-52-05. Property acquisition has taken longer than expected, however, it is anticipated that the new substation (Arawana) being in service by early 2007.

(b) Summerland 63 kV Backup

Construction, in the 2009/10 timeframe, of a new 63 kV line from the Huth Substation to the Trout Creek Substation or from the Huth Substation to the Summerland Substation to provide backup for the Summerland area.

2007 UPDATE: This project has been rescheduled to the 2012+ timeframe to align with the Huth Substation rebuild project.

(c) Huth Substation Rebuild

Rebuilding of the 63 kV bus and line termination at the Huth Substation in the 2010 timeframe.

2007 UPDATE: This project is unchanged.

(d) NEW - Westbench Regulator Bank: Load growth at the Westbench Substation has exceeded the capacity of the voltage regulators located at the substation and requires replacement in 2007.

2.1.2.3 Oliver -Osoyoos

The 2005 SDP load growth in the Oliver-Osoyoos area is forecast to exceed the system average. The growth is predominantly due to migration from urban centres outside of the Okanagan.

The 2005 SDP identified the following projects for the 2006/11 timeframe.

(a) New East Osoyoos Substation

Construction of a distribution source substation in East Osoyoos (Nk'Mip) in 2006.

2007 UPDATE: This project was approved by Commission Order C-1-06 and is currently scheduled for completion in the 2006/07 timeframe.

(b) Rebuild Oliver as Distribution Source Substation

Conversion of the existing Oliver Terminal station to accommodate a distribution source substation in the 2007/08 timeframe.

2007 UPDATE: This project schedule is dependent on the timing of the Bentley Terminal station. It will be addressed as part of the OTR project and covered in the application for the CPCN that will be filed in 2007. The project is now tentatively scheduled for the 2009/10 timeframe.

2.1.2.4 Princeton-Keremeos:

The 2005 SDP forecast modest load growth in the Princeton-Keremeos area.

However, during the winter of 2005, the peak load on Transformer 3 at Princeton Substation exceeded the nameplate rating. This necessitated the replacement of the transformer.

(a) Princeton Reconfiguration and Transformer Replacement:

Installation of two 138/25/13 kV transformers to supply both Princeton and FortisBC distribution loads.

2007 UPDATE: The installation of one transformer was approved in Commission Order G-8-06 and will be completed in 2006. The second transformer has been deferred to the 2012+ timeframe.

(b) NEW - Hedley Substation Step-up Transformer. Load growth at the Hedley Substation has exceeded the capacity of the step-up transformer requiring its replacement in 2007.

2.1.3 Kootenay Region

The Kootenay Region consists of the following areas: Castlegar, Crawford Bay, Creston-Wynndel, Grand Forks-Boundary, Kaslo-Coffee Creek, South Slocan, and Trail-Salmo.

2.1.3.1 Castlegar:

The 2005 SDP forecast modest load growth for this area. However, cumulative growth over time has resulted in the need for the following project.

(a) Castlegar Capacity Upgrade

Installation of a new 63/13 kV transformer and associated protection in 2006.

2007 UPDATE: The preliminary engineering assessment indicates that the existing substation is inadequate to accommodate the new transformer; consequently, the capacity upgrade will require the construction of an additional substation near the load centre to offload a portion of the Castlegar load. As an interim measure a portion of the load has been temporarily transferred to the Blueberry Substation. This project has now been deferred to 2008.

2.1.3.2 Crawford Bay:

The Crawford Bay load has grown to a point where the peak load exceeds the nameplate rating of the two 13 kV distribution transformers. In addition, failure of one of the two existing transformers at peak will result in load shedding. The 2005 SDP identified the following project for this area.

(a) Crawford Bay Capacity Increase and Grounding Bank

Installation of a new 63/13 kV distribution transformer and associated protection to serve the Crawford Bay area in 2006.

2007 UPDATE: The installation of the distribution transformer has been scheduled for 2007.

2.1.3.3 Creston - Wynndel:

The Creston area is served from the BC Hydro 230 kV system via a single 230/63 kV transformer at Lambert Terminal station. Failure of the existing 230/63 kV transformer would result in significant customer outages in the Creston area. In addition, outages to the 230 kV BC Hydro transmission line 2L294 results in loss of service to all of the Creston area customers. The 2005 SDP proposed the following projects to address this issue:

(a) 230 kV Ring Bus and New Transformer at Lambert Terminal

Installation of a second 230/63 kV transformer at Lambert Terminal station and re-arrangement of the station to form a ring bus configuration in the 2006 timeframe.

2007 UPDATE: The project to install the second transformer was approved in Commission Order G-8-06. The engineering for the transformer addition is scheduled for 2006 with construction scheduled for 2007.

A reliability analysis will be carried out for the ring bus portion of the Lambert project. However, this portion of the project, which involves a joint effort between FortisBC and BC Hydro, has been rescheduled for the 2012+ timeframe.

2.1.3.4 Grand Forks - Boundary:

This area is served by a network of two 63 kV transmission lines (9 Line and 10 Line) and eight distribution source substations. The lines and stations are at or near the end of their expected service lives. The 2005 SDP identified that the electrical system in

this area is in need of a major upgrade and proposed the following projects for the 2006/10 timeframe.

(a) New Kettle Valley 161/25 kV Distribution Source Substation

Construction of a distribution source substation in the Kettle Valley area, salvage the five existing 63 kV source substations between Grand Forks and Oliver Terminal Station and convert the distribution to 25 kV in the 2006/08 timeframe.

2007 UPDATE: The priority and schedule for this project are unchanged. As directed by the Commission Order G-52-05 and Decision dated May 31, 2005, FortisBC submitted an application for a CPCN for this project in October 2005.

(b) New Grand Forks 161/25 kV Distribution Source Substation

Construction, in the 2009/10 timeframe, of a distribution source substation at Grand Forks, salvage of the three existing 63 kV source substations between the Grand Forks Terminal and the Mawdsley Terminal stations and conversion of the distribution to 25 kV.

2007 UPDATE: Further assessment of this project indicated that due to load changes, it is necessary to maintain 63 kV (9 Line and 10 Line) between Grand Forks Terminal station and an industrial customer on the east side of Grand Forks. The schedule for this project has been changed to the 2010/11 timeframe.

2.1.3.5 Kaslo - Coffee Creek:

Modest growth is expected for this area over the forecast period; however, by the winter of 2006/07 the Coffee Creek Terminal station is projected to exceed the maximum capacity of the existing 8.4 MVA transformer. As well, it has been determined that with the installation of capacitors at the Coffee Creek Terminal station and the Kaslo Substation, these two locations could be served via 32 Line from the Lambert Terminal station in the event of an outage on 30 Line from the South Slocan Terminal station. The 2005 SDP identified the following projects for this area.

(a) Coffee Creek Capacitors

Installation of capacitors at the Coffee Creek Terminal station in 2006.

2007 UPDATE: This project is currently scheduled for 2007

(b) Kaslo Capacitor

Installation of capacitors at the Kaslo Substation in 2006.

2007 UPDATE: This project is currently scheduled for 2007.

(c) Coffee Creek Transformer 3

Replacement of Transformer 3 at the Coffee Creek Terminal station in the 2008 timeframe.

2007 UPDATE: As a result of modest load growth, this project has been rescheduled to 2009.

(d) NEW - Convert 30 Line from 161 kV to 63 kV: The installation of a second 230/63 kV transformer at Lambert Terminal station in 2006/07 will secure the power supply to Creston and reduce the need of 32 Line as a backup between Crawford Bay and Creston. Further, the decommissioning by Teck Cominco of 30 Line between Crawford Bay and Kimberley, traditionally considered a backup for loads at Crawford Bay, Coffee Creek and Kaslo, will make it possible to operate 30 Line between South Slocan and Crawford Bay at 63 kV. It will be a radial supply with a similar level of reliability for FortisBC customers in other areas. With modest load growth, adequate voltage can be maintained by providing reactive compensation as required in the future. This project cancels the requirement for the transformer replacement project at Coffee Creek and Crawford Bay (T3), listed in Section 2.2.2 (f) and 2.2.2 (g). This project is currently scheduled for 2009.

2.1.3.6 South Slocan:

Modest load growth is expected for this area over the forecast period. The 2005 SDP identified the following project in the 2011+ timeframe to improve reliability in the area.

(a) Slocan City to New Denver (BC Hydro)

Construction of a 63 kV transmission line from South Slocan to New Denver in the 2011+ timeframe.

2007 UPDATE: This project has been rescheduled for the 2012+ timeframe.

2.1.3.7 Trail-Salmo:

Modest load growth is expected for this area over the forecast period. The 2005 SDP identified the following project for this area.

(a) Ymir Transformer Replacement (Cottonwood Substation)

2007 UPDATE: This project was approved by Commission Order G-8-06 and will be completed in 2006. This project has not changed.

(b) 18 Line Breaker at Waneta

Installation of a new circuit breaker on 18 Line at Waneta in 2006 to accommodate increased fault levels.

2007 UPDATE: This project is rescheduled to 2008. It is driven by Teck Cominco's schedule to rebuild the Waneta Substation.

(c) NEW - Convert Ymir Feeder 1 to 25 kV: This project is scheduled for the 2011 timeframe.

2.2 Transmission and Stations (Sustaining)

FortisBC has 55 transmission lines and 64 terminal and substations. The transmission system consists of approximately 1,400 kilometres of line and approximately 16,000 poles. Close to 65% of these lines are more than 30 years old. The terminals and substations consist of approximately 110 transformers, 350 circuit breakers, 950 fused switches and disconnects. The average age of the transformers and many other devices exceed 30 years.

Like most North American utilities, FortisBC must address the issue of aging infrastructure. As the infrastructure ages, the power system becomes less safe, less reliable and more costly to operate and maintain. The Company therefore continues to focus on the replacement of deteriorated, defective or obsolete electrical equipment.

The 2005 SDP gave an assessment of the condition of the Company's transmission and substation infrastructure and provided an overview of the inspection and maintenance procedures currently utilized to identify the sustaining capital projects that are required for rehabilitation and ongoing upgrades of the system. These projects are required to ensure safe, reliable service. Appendix 2 shows the original schedule and estimate as well as the current schedule and estimate for the Transmission and Stations sustaining projects identified in the 2005 SDP.

2.2.1 Transmission

The 2005 SDP identified the following specific sustaining capital projects for transmission.

(a) Rehabilitation of 32 Line Crawford Bay-Creston in 2005

2007 UPDATE: This project has been completed.

(b) Rehabilitation of 20 Line, 21-24 Line, 51-51A Line, 53 Line, and 74 Line in 2006

2007 UPDATE: This project has been completed.

(c) Rehabilitation of 6A Line in 2008

2007 UPDATE: This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.

(d) Rehabilitation of 26 Line in 2008

2007 UPDATE: This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.

(e) Rehabilitation of 27 Line in 2009

2007 UPDATE: This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.

(f) Rehabilitation of 28 Line in 2009

2007 UPDATE: This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.

2.2.2 Stations

The 2005 SDP identified the following specific sustaining projects for stations.

(a) West Osoyoos Transformer Rehabilitation

Upgrading or replacement of the West Osoyoos transformer in 2006.

2007 UPDATE: This project was approved by Commission Order G-8-06 and will be completed in 2007.

(b) Kaslo Substation Rehabilitation

Upgrading the Kaslo Substation in 2006 and 2007.

2007 UPDATE: An analysis of this substation has indicated that the project can be deferred to 2010.

(c) Rebuild Pine Street Transformer

Rehabilitation of Pine Street Transformer 1 in 2006 and 2007.

2007 UPDATE: This project was approved as a transformer replacement by Commission Order G-8-06 and will be completed in 2006.

(d) Westminster Transformer 1 Replacement in 2006.

2007 UPDATE: This project was approved as a transformer rehabilitation in Commission Order G-8-06 and will be completed in 2006. This project has not changed.

(e) Trout Creek Transformer 1 Rehabilitation in 2009/10.

2007 UPDATE: This transformer continues to show signs of deterioration and is scheduled to be replaced with the transformer previously in use at the Waterford Substation, in 2007.

(f) Replacement of Coffee Creek Transformer 2 Capacity Addition in 2009/10.

2007 UPDATE: Cancelled - The conversion of 30 Line from 161 kV to 63 kV removes the requirement for this transformer.

(g) Replacement of Crawford Bay Transformer 1 in 2009/10.

2007 UPDATE: Cancelled - The conversion of 30 Line from 161 kV to 63 kV removes the requirement for this transformer.

2.3 Distribution (Growth)

This section outlines the projects identified by the 2005 SDP as growth projects and gives a brief update of the current status. Appendix 2 shows the original schedule and estimate as well as the current schedule and estimate for these projects.

2.3.1 New Connects - System Wide

This project includes installation of new services requiring additions to FortisBC overhead and underground facilities in all regions of its service territory. These capital expenditures allow FortisBC to meet its obligation to serve. The number of customers connected directly affects increases or decreases to this account.

2007 UPDATE: This project is unchanged.

2.3.2 Small Capacity Improvements

On an annual basis, the distribution feeder network is evaluated for voltage, thermal and backup capabilities based on forecast load growth. Where standards of service are not met, an appropriate solution involving regulators, capacitors, or other equipment is identified. Experience has shown that unforeseen load emergencies will require capacity upgrades and voltage correction projects not accounted for in the capital plan. This project provides the funding for such requirements.

2007 UPDATE: This project is unchanged.

2.3.3 Okanagan Region

The Okanagan region consists of the following areas: Kelowna, Penticton-Summerland, Oliver-Osoyoos and Princeton-Keremeos.

2.3.3.1 The 2005 SDP identified the following growth-related projects in this area.

(a) DG Bell Feeder 2 to OK Mission Feeder 3 Tie

Construction of a feeder tie between DG Bell Feeder 2 and OK Mission Feeder 3 to provide interim load relief for the south west Kelowna area in 2006.

2007 UPDATE: This project was approved by Commission Order G-8-06 and will be completed in 2006. This project is unchanged.

(b) McKinley Landing Capacity Upgrade

Upgrading of a section of Sexsmith Feeder 3 from #2 conductor to #477 conductor to accommodate load growth in the McKinley Landing area in the 2007 timeframe.

2007 UPDATE: This project has been rescheduled to 2008 to help mitigate Capital Plan expenditures.

(c) Hollywood Feeder 1 to FA Lee Feeder 2 Tie

Construction of a feeder tie between Hollywood Feeder 1 and FA Lee Feeder 2 to provide interim load relief in the Gallagher area in the 2007 timeframe.

2007 UPDATE: This project is has been rescheduled to 2009 to help mitigate Capital Plan expenditures.

(d) New Glenmore Feeder 6

Construction of a new feeder (Feeder 6) from the Glenmore Substation to accommodate load growth in the Magic Estates, Clifton and Glenmore Highlands development areas in the 2008 timeframe.

2007 UPDATE: As a result of increasing load growth in this area, this project has been rescheduled to 2007.

(e) Hollywood Feeder 1 to OK Mission Feeder 1

Upgrading of a section of line between Hollywood Feeder 1 and OK Mission Feeder 1 along KLO Road to accommodate load transfer from the Hollywood Substation to the OK Mission Substation or the Bell Terminal station in the 2008 timeframe.

2007 UPDATE: This project is unchanged.

(f) McKinley to Clifton Tie

Construction of a feeder tie between Glenmore Feeder 6 and Sexsmith Feeder 3 to accommodate load transfer in the Clifton, McKinley Landing area in the 2008 timeframe.

2007 UPDATE: This project has been rescheduled to 2010.

(g) FA Lee Feeder 2 to Hollywood Feeder 5 Tie

Construction of a feeder tie between Hollywood Feeder 5 and FA Lee Feeder 2 to accommodate load transfer in the Rutland and Black Mountain area in the 2008 timeframe.

2007 UPDATE: This project is unchanged.

(h) Ellison Substation - New Feeder

Construction of a new feeder at the Ellison Substation to offload the 13 kV tertiary on the 230/138 kV system transformers at the FA Lee Terminal station in order to reduce the system risk associated with distribution faults. The 2005 SDP scheduled this project for the 2008 timeframe.

2007 UPDATE: The project need is unchanged. The project description and cost has been included in the proposed Ellison project. An application for a CPCN will filed for this project in the third quarter of 2006.

(i) Future Kelowna Distribution Upgrades

Upgrade feeders in the Kelowna area to accommodate load growth in the 2009/11 timeframe.

2007 UPDATE: This project is unchanged.

(j) NEW - Feeder Egress Cable Upgrade: The underground cables from the OK Mission and Hollywood substations to the distribution lines are inadequate for the forecast growth on OK Mission Feeder 1, OK Mission Feeder 4, Hollywood Feeder 1, Hollywood Feeder 3, Hollywood Feeder 4, and Hollywood Feeder 5. Additional cables will be installed in 2007.

(k) NEW - Glenmore and Hollywood Underground Cable Replacement: Sections of cables at several road crossings are inadequate to accommodate forecast load. The cable installations are currently scheduled for Glenmore Feeder 1, Glenmore Feeder 2 and Hollywood Feeder 4 in the 2007/08 timeframe.

(l) NEW - Hollywood Feeder 3 - Sexsmith Feeder 3 Tie: Construct a feeder tie between Hollywood Feeder 3 and Sexsmith Feeder 3 to accommodate load transfer in the 2009 timeframe.

(m) NEW - Hollywood Feeder 1 - Hollywood Feeder 2 Tie: Construct a feeder tie between Hollywood Feeder 1 and Hollywood Feeder 2 to accommodate load transfer in the 2007 timeframe.

(n) NEW - FA Lee Feeder 2 Regulator: Install a voltage regulator on FA Lee Feeder 2, in the 2007 timeframe, to provide voltage within acceptable limits.

(o) NEW - Sexsmith Feeder 4 Regulator: Install a voltage regulator, in the 2008 timeframe, on Sexsmith Feeder 4 to provide voltage within acceptable limits.

2.3.3.2 Osoyoos - Oliver:

The SDP identified the following growth-related project in this area.

(a) 25 kV Tie to Bridesville

Construction of a feeder tie from the new East Osoyoos substation (Nk'Mip) to the proposed Kettle Valley Substation to accommodate load growth in the Bridesville area. The 2005 SDP scheduled this project for the 2009 timeframe.

2007 UPDATE: This project has been rescheduled to the 2012+ timeframe since the anticipated load growth has not materialized in this area.

2.3.3.3 Princeton - Keremeos:

The 2005 SDP identified the following growth related project in this area.

(a) Keremeos Feeder

Construction of Keremeos Feeder 3 to offload Keremeos Feeder 2 which will reach its thermal limits in the 2006 timeframe.

2007 UPDATE: This project will be deferred to 2010. Winter peak levels in Keremeos over the last two years were substantially higher than historical levels and therefore indicated feeder limits would be exceeded by 2007. The current 2006 forecast has moderated demand growth slightly resulting in adequate capacity until the winter peak of 2010.

(b) NEW - Keremeos Feeder 1 Capacity Upgrade: Upgrade sections of Keremeos Feeder 1 in the 2007 timeframe to maintain customer voltage levels within acceptable limits.

(c) NEW - Keremeos Feeder 2 Capacity Upgrade: Upgrade sections of Keremeos Feeder 2 in the 2007 timeframe to maintain customer voltage levels within acceptable limits.

(d) NEW - Princeton Feeder 4 Capacity Upgrade: Upgrade sections of Princeton Feeder 4 in the 2007 and 2009 timeframe to maintain customer voltage levels within acceptable limits.

2.3.3.4 Penticton – Okanagan Falls:

(a) NEW - OK Feeder 3 Capacity Upgrade: Upgrade sections of OK Falls Feeder 3 in the 2007/08 timeframe to maintain customer voltage levels within acceptable limits.

2.3.4 Kootenay Region

The Kootenay Region consists of the following areas: Castlegar, Crawford Bay, Creston-Wynndel, Grand Forks-Boundary, Kaslo-Coffee Creek, South Slocan, and Trail-Salmo.

2.3.4.1 Trail-Salmo:

The 2005 SDP identified the following growth related project in this area.

(a) Paterson 25 kV feeder and Voltage Conversion

Conversion of the Paterson feeder to 25 kV, transfer the feeder to the Cascade Substation and salvage of the Paterson Substation in 2006.

2007 UPDATE: This project was approved by Commission Order G-8-06 and will be completed in 2006. This project is unchanged.

(b) NEW - Valhalla Feeder 1 Capacity Upgrade: Upgrade sections of Valhalla Feeder 1 in the 2008 timeframe to maintain customer voltage levels within acceptable limits.

2.3.4.2 South Slocan area:

The 2005 SDP identified the following growth project for this area.

(a) Playmor - Tarrys Feeder Upgrade

Upgrade Playmor Feeder 1 between Playmor and Tarrys substations, and transfer Tarrys residential load to Playmor. This will offload Tarrys Substation which is loaded above the recommended continuous rating of the substation transformer. The 2005 SDP scheduled this project for 2006.

2007 UPDATE: This project was approved in Commission Order G-8-06 and will be completed in 2006. This project is unchanged.

2.3.4.3 Creston Area:

The 2005 SDP identified the following project for this area.

(a) Creston Area Distribution Feeder Upgrades

Upgrade the Creston area distribution by constructing distribution feeders at Lambert Terminal station and transferring load from Creston Substation and Wynndel Substation to the new Lambert distribution source in the 2005/06 timeframe.

2007 UPDATE: This project was approved in Commission Order G-8-06 and will be completed in 2006.

(b) NEW - Crawford Bay Feeder 2 Capacity Upgrade: Upgrade sections of Crawford Bay Feeder 2 in the 2007 timeframe to maintain customer voltage levels within acceptable limits.

2.4 Distribution (Sustaining)

FortisBC's distribution network consists of approximately 5,000 kilometres of line, 77,000 support structures and 31,000 oil filled distribution transformers. Distribution sustaining capital

expenditures are required for the replacement of poles, crossarms, conductor and transformers that are deteriorated, defective or obsolete. The projects in this group primarily focus on maintaining reliability and safety. This classification also includes capital expenditures related to the relocation of plant at the request of third parties. A significant portion is recovered from the parties making the request.

Appendix 2 shows the schedule and estimate as contained in the 2005 SDP as well as the current schedule and estimate.

2.5 Telecommunications, SCADA and Protection

FortisBC operates a telecommunications system to support protection, control and monitoring of the power system, as well as operations and business communications requirements. Approximately 102 locations are presently or potentially served by the telecommunications system, including 49 distribution stations, 11 terminal stations, 4 generation stations, 12 mountain-top radio repeaters and 6 office locations. The telecommunications system also connects to other utilities for the exchange of protection signals and operational voice and data communications.

A variety of telecommunications transport systems are used, depending on technical requirements, economics and system reliability requirements. These include power line carrier, fibre-optic cable, copper pairs, Telus leased lines, and radio (VHF, microwave, spread spectrum and packet radio). The primary purpose of the telecommunications system is to be an integral component of the protection relaying system, remedial action schemes (“RAS”), substation operations and control, and generation dispatch systems. It also provides a low-cost alternative to the public network for internal business data and some voice traffic.

2.5.1 Telecommunications, SCADA and Protection (Growth)

The 2005 SDP identified the following projects.

(a) Distribution Substation Automation, Metering and Communication

The intent of this multi-year project is to extend the coverage of substation automation in the FortisBC system. This project broadens the integration and use of remote monitoring and control to distribution level substations, including automated load restoration to reduce outage durations, power quality monitoring of lines, transformers and feeders, fault recording and locating, and equipment condition monitoring. The project will provide common communications mechanisms for gathering, storage, access and analysis of the resulting data. Resulting benefits are improvements in system performance, productivity, safety and economics.

The 2005 SDP scheduled this project for the 2006/09 timeframe with anticipated further projects in the 2012/24 timeframe.

2007 UPDATE: As directed by Commission Order G-52-05 and Decision, dated May 31, 2005, FortisBC will submit an application for a CPCN for this project in 2006.

(b) Trail-Oliver High Capacity Communications Network

A high capacity network will enable the transfer of data at high speeds and volumes in FortisBC's entire service territory (Kootenay and Okanagan). This is required for system protection purposes as well as for monitoring and controlling the system remotely. It will displace costs for east-to-west leased lines currently used for system control and operational communications. The project will be undertaken in segments, coincident with the decommissioning of 9 Line and 10 Line and the replacement of the distribution substations in the Grand Forks / Boundary area.

2007 UPDATE: As part the Kettle Valley project, the section of the communications backbone between Oliver and Kettle Valley will be required in 2007 to provide the operational and protection communications needed by this station. Justification for this

work was contained in the application for the CPCN that was submitted for the Kettle Valley project in October 2005.

(c) Telecommunications Backbone Loop Close

This project will complete the FortisBC telecommunications backbone system loop configuration as commonly used by most utilities, and as required by WECC standards. The 2005 SDP scheduled this project for the 2011/20 timeframe.

2007 UPDATE: This project has been rescheduled to the 2012/2025 timeframe.

(d) Telecommunications for Business Systems

This project provides for the use of the FortisBC telecommunications system for future applications that may be developed for company operations in the period 2010/25. In each case, use of the FortisBC telecommunications system will be dependent on its ability to improve the performance of the application, and lower the operating and maintenance costs for the telecom portion of the systems (displacing common carrier costs). The 2005 SDP scheduled this project for the 2011/25 timeframe.

2007 UPDATE: This project has been rescheduled to the 2012/2025 timeframe.

2.5.2 Telecommunications, SCADA and Protection (Sustaining)

This is a multiyear project consisting of a number of items, necessary to maintain the integrity of the Company's telecommunication, SCADA and protection network in order to supply safe, reliable electrical service. It includes items such as harmonic remediation, protection upgrades, and fault locating for inaccessible lines and communication upgrades.

Appendix 2 shows the schedule and estimate as contained in the 2005 SDP as well as the current schedule and estimate.

Appendix 1

Substation Load Forecast

2007 SDP Update

Appendix 1 - Load Forecast

- Note that the "Ultimate" loadings in these listings indicate expected load in the year 2026/27.
- Substations are listed under the area in which they are physically located, although some feeders connected to certain substations may serve a small portion of load in an adjacent area.

North Okanagan (Kelowna) – (summer)

					Summer Historical					Summer Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/2027
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
NOK	W302S	Glenmore	T2	S	22267	26168	23484	18799	16645	18799	19258	19717	20175	20634	21093	27859
NOK	W302S	Glenmore	T3	S	18475	19800	22475	25172	28665	30080	31259	32438	33617	34796	35975	47516
NOK	W304S	Hollywood	T1	S	16680	17712	18312	19536	17760	19600	20178	20756	21334	21912	22490	29704
NOK	W304S	Hollywood	T3	S	14618	15432	17904	23736	23832	26764	27487	28209	28932	29655	30377	40122
NOK	W305S	Okanagan Mission	T1	S	18425	19135	18488	20142	19527	21712	22502	23291	24081	24870	25660	33891
NOK	W305S	Okanagan Mission	T2	S	10131	9540	12444	12949	12774	14152	14631	15110	15589	16067	16546	21854
NOK	W306S	Recreation	T1	S	20616	20208	22200	22200	19560	24196	24012	24630	24776	25326	26439	34038
NOK	W308S	Sexsmith	T1	S	22584	22488	25992	27696	25944	27909	29343	30777	32211	33645	35078	46331
NOK	W313S	Saucier	T1	S	16248	20832	18168	18240	16824	19049	19454	19859	20264	20668	21073	27833
NOK	W315S	Joe Rich	T1	S				4702	5000	4834	4900	4966	5032	5098	5165	6821
NOK	W316S	Duck Lake	T1	S	3812	4143	4496	4469	7744	13777	16704	19665	23301	26936	30426	40187
NOK	W371S	D.G. Bell	T1	S	9448	11095	12188	13510	14203	15322	16429	17537	18645	19753	20861	27553
NOK	W372S	Lee	T tert	S	10808	10808	12808	13129	11762	13517	14174	14830	15487	16143	16800	22475
		Sub-Total			184111.75	197361	208959	224280	220241	249711	260331	271785	283443	295505	307984	406184
		Growth									4.25%	4.40%	4.29%	4.26%	4.22%	

South Okanagan-Similkameen

					Summer Historical					Summer Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/2027
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
SOK	W320S	Huth	T7//T4-6	S	11734	12144	12371	12371	10496	10653	10839	11025	11210	11396	11581	13707
SOK	W320S	Huth13kV(HUT1)	T8	S	13176	13503	14213	13673	13775	14639	14853	15066	15279	15492	15705	18588
SOK	W321S	Kaleden(KAL1)	T1	S	2911	3281	3441	2793	2738	3544	3596	3647	3699	3751	3802	4500
SOK	W322S	Naramata	T1	S	3526	2938	3526	3526	3086	3769	3896	4026	4160	4297	4438	5253
SOK	W323S	Okanagan Falls	T1	S	9081	10948	11643	11384	8639	12449	12870	13302	13745	14200	14667	16130
SOK	W324S	Summerland	T2	S	9152	10222	11255	11330	11203	11806	12044	12282	12520	12758	12996	16013
SOK	W325S	Waterford	T1	S	8373	8272	9088	8608	8752	9361	9497	9633	9770	9906	10042	11885
SOK	W326S	West Bench	T1	S	3522	3358	5090	5293	5283	5602	5763	5927	6095	6267	6443	7626
SOK	W327S	Westminster	T1/T2	S	15488	17024	17968	17056	16864	18367	18566	18766	18965	19164	19364	22917
SOK	W329S	Trout Creek	T1	S	4897	6530	5714	5224	4949	5887	5976	6067	6160	6254	6350	7825
SOK	W333S	Pine Street(PIN2)	T1	S	6912	7079	6838	5820	7771	7887	7990	8092	8195	8297	8400	9237
SOK	W333S	Pine Street	T2	S	9044	9860	9747	10268	10404	10597	10765	10936	11109	11284	11462	12605
SOK	W338S	Osoyoos	T1	S	11556	11639	12360	12554	12760	15511	17186	18992	20929	22997	25196	27708
SOK	W338S	Osoyoos(OSO3)	T2	S	4427	4967	6623	7523	7234	8275	8651	9028	9404	9780	10156	11169
SOK	W345S	Keremeos	T1	S	9556	9492	9694	9953	9857	10436	10685	10939	11197	11460	11727	14126
SOK	W347S	Hedley	T1	S	1431	1542	1724	1414	1231	1834	1874	1915	1957	2000	2044	2462
SOK	W380S	Anderson	T3	S	14880	13212	17124	14028	16368	17621	17875	18132	18393	18658	18927	22400
SOK	W386S	Oliver	T1	S	5572	6141	6544	6616	6660	6896	7041	7188	7337	7490	7645	8407
SOK	W390S	Princeton	T3	S	10560	11368	11621	11755	11755	12001	12155	12311	12470	12631	12795	12304
SOK	138kV	Terasen Similkameen	T	S	2785	2826	1630	86	60	1630	1630	1630	1630	1630	1630	1630
SOK	138kV	Mascot	T	S				1623	0	0	0	0	0	0	0	0
		Sub-Total			158583	166346	178214	172898	169885	188767	193751	198903	204224	209713	215371	246492
		Growth									2.64%	2.66%	2.68%	2.69%	2.70%	

Kootenay

					Summer Historical					Summer Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/2027
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
KT	W102S	Kaslo	T1	S	5566	6200	5257	5500	6133	5610	5665	5720	5775	5830	5885	6755
KT	W103S	Coffee Creek	T3	S	2653	3853	2730	3140	4313	3202.8	3234	3266	3297	3328	3360	3504
KT	W110S	Crawford Bay	T2	S	1253	1429	1820	1367	2062	1838	1847	1856	1866	1875	1884	2162
KT	W110S	Crawford Bay	T3	S	1440	2024	2337	1738	3016	0	0	0	0	0	0	0
KT	W120S	Wynndel	T1	S	2693	3085	2938	3036	2939	3066.36	3082	3097	3112	3127	3142	3193
KT	W121S	Creston	T1	S	13264	10000	10274	10307	7495	10348	10369	10389	10410	10431	10451	10622
KT	W121S	Creston	T2	S	8225	6779	6514	6700	7313	6727	6740	6754	6767	6780	6794	6905
KT	W124S	Lambert	T1	S				1400	1442	1428	1442	1456	1470	1484	1498	1522
KT	W129S	Valhalla (VAL1)	T1	S	2300	2300	3004	2508	2709	3064	3094	3124	3154	3184	3214	3353
KT	W130S	Passmore	T1	S	1677	2160	1910	2351	2000	2398	2422	2445	2469	2492	2516	2624
KT	W131S	Playmor	T1	S	4032	5267	7160	5733	5992	7232	7267	7303	7339	7375	7411	7729
KT	W132S	Slocan City (SLO1)	T1	S	6627	4900	4117	3853	4025	4117	4117	4117	4117	4117	4117	4117
KT	W135S	Tarry's	T1	S	2808	2400	2880	2880	2400	2894	2894	2894	2894	2894	2894	3032
KT	W200S	Whitewater (WHI1)	T1	S	110	115	112	112	73	114	115	116	118	119	120	125
KT	W202S	Salmo	T1	S	3637	3456	3564	4104	4320	4166	4196	4227	4258	4289	4319	4505
KT	W204S	Hearns	T1	S	2400	1119	192	178	133	195	197	198	200	201	203	200
KT	W205S	Fruitville	T1	S	4250	4224	4244	4244	3648	4303	4333	4363	4393	4422	4452	4386
KT	W206S	Ymir (YMR1)	T1	S	550	590	569	583	563	595	600	606	612	618	624	651
KT	W221S	Castlegar	T1	S	10835	10702	11888	11888	9806	12197	12352	12506	12661	12815	12970	13585
KT	W222S	Blueberry	T1	S	4702	4408	5289	5583	5437	5661	5700	5739	5778	5817	5857	6134
KT	W244S	Trail	T1	S	2800	2800	2900	0	0	0	0	0	0	0	0	0
KT	W246S	Beaver Park	T1	S	6154	6480	6408	6500	6500	6630	6695	6760	6825	6890	6955	6852
KT	W247S	Glenmerry	T1	S	8041	8617	8799	8400	8500	9063	9195	9327	9459	9591	9723	9578
KT	W248S	Stoney Creek	T1	S	3203	3594	3631	5838	3045	6013	6101	6189	6276	6364	6451	6356
KT	W256S	Patterson (PAT1)	T1	S	612	612	661	575	600	668	671	674	678	681	684	674
KT	W258S	Cascade	T1	S	6500	6500	6792	4204	4799	7159	7342	7526	7709	7892	8076	7956
KT	63 kV	Celgar		S	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000
KT	63 kV	P&T - Castlgar	T	S	7318	8022	7308	7644	7455	7455	7455	7455	7455	7455	7455	7455
KT	63 kV	City of Nelson	T	S			19620	17424	19459	20209	20503	20797	21092	21386	21680	22612
		Sub-Total				127636	148918	143790	142177	152353	153629	154905	156182	157458	158734	162586
		Growth									0.84%	0.83%	0.82%	0.82%	0.81%	

Boundary

					Summer Historical					Summer Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/2027
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
SOK	W270S	Christina(CHR1)	T1	S	3480	3709	3798	3515	3596	3874	3912	3950	3988	4026	4064	4374
SOK	W271S	Ruckles	T1 -13 k	S	8231	8231	8492	9244	8791	7602	7751	7903	8058	8216	8377	9017
SOK	W271S	Ruckles	T2	S	7966	7966	7966	7986	8310	8258	8393	8529	8665	8801	8936	9619
SOK	W275S	Grand Forks Terminal	T3	S	1699	1948	2911	2768	3591	5686	5735	5785	5834	5884	5933	6387
SOK	W291S	Midway	T1	S	5784	4902	6302	6302	6050	6380	6419	6460	6501	6542	6585	7088
SOK	W292S	Rock Creek(ROC1)	T1	S		1729	1632	1507	1680	1687	1715	1743	1771	1798	1826	1966
SOK	W292S	Rock Creek(ROC2)	T2	S		928	989	846	1022	1023	1056	1090	1124	1157	1191	1282
SOK	W294S	Baldy(BAL1)	T1	S		184	152	152	0	0	0	0	0	0	0	0
SOK	W296S	Greenwood	T1	S	1440	1594	1428	1428	1457	1490	1521	1553	1586	1619	1653	1779
SOK	63 kV	Roxul	T	S	7224	7403	8127	8001	8022	8127	8127	8127	8127	8127	8127	8127
		Sub-Total			35823	38593	41797	41749	42518	44126	44631	45140	45653	46171	46692	49638
		Growth									1.14%	1.14%	1.14%	1.13%	1.13%	

.

- Note that the "Ultimate" loadings in these listings indicate expected load in the year 2026/27.
- Substations are listed under the area in which they are physically located, although some feeders connected to certain substations may serve a small portion of load in an adjacent area.

North Okanagan (Kelowna) (winter)

					Winter Historical					Winter Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/27
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
NOK	W302S	Glenmore	T2	W	15715	16623	19792	13396	13404	14158	14485	14812	15139	15467	15794	20860
NOK	W302S	Glenmore	T3	W	22246	22828	23860	27325	23079	25757	26767	27777	28786	29796	30806	40688
NOK	W304S	Hollywood	T1	W	20568	23064	25224	24552	21792	25766	26512	27258	28005	28751	29497	38959
NOK	W304S	Hollywood	T3	W	15456	15144	18120	22272	22056	24242	24917	25593	26268	26943	27619	36479
NOK	W305S	Okanagan Mission	T1	W	20118	22342	22953	23296	22537	25122	26035	26948	27862	28775	29688	39211
NOK	W305S	Okanagan Mission	T2	W	10022	12527	14958	15085	13339	16222	16780	17338	17896	18453	19011	25110
NOK	W306S	Recreation	T1	W	20664	20280	23304	23136	21864	25372	28990	29747	30030	30719	31970	41343
NOK	W308S	Sexsmith	T1	W	25416	24648	29520	29232	28464	29719	30987	32267	33560	34980	36226	47847
NOK	W313S	Saucier	T1	W	16344	21024	22944	20808	20184	23962	24471	24980	25489	25998	26508	35011
NOK	W315S	Joe Rich	T1	W	12028	13760	16067	15829	17849	18249	20449	22149	22849	24799	25543	33737
NOK	W316S	Duck Lake	T1	W	3496	3716	4713	4929	8514	11603	15298	18225	21848	25507	29117	38457
NOK	W371S	D.G. Bell	T1	W	13395	13337	16829	16780	17357	18800	20180	21560	22940	24320	25700	33944
NOK	W372S	Lee	T tert	W	14574	15100	18912	17622	18712	20629	21575	22520	23466	24411	25357	34657
		Sub-Total			210042	224393	257196	254262	249151	279602	297447	311174	324138	338920	352835	466303
		Growth									6.38%	4.62%	4.17%	4.56%	4.11%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. & Feb. 2004 data.

South Okanagan-Similkameen

					Winter Historical					Winter Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/27
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
SOK	W320S	Huth	T7//T4-6	W	11840	11664	16051	16051	13136	13333	13574	13815	14055	14296	14537	17205
SOK	W320S	Huth13kV(HUT1)	T8	W	11792	11221	13313	12621	12621	13712	13912	14112	14311	14511	14711	17411
SOK	W321S	Kaleden(KAL1)	T1	W	4845	4706	4489	6317	4726	4796	4891	4986	5080	5175	5270	6237
SOK	W322S	Naramata	T1	W	4995	5142	7200	6465	7347	7697	7956	8222	8495	8775	9063	10726
SOK	W323S	Okanagan Falls	T1	W	11172	11600	13941	13419	13338	14860	15339	15832	16338	16857	17389	19123
SOK	W324S	Summerland	T2	W	12598	12343	17647	15343	15266	18388	18759	19129	19500	19871	20241	24940
SOK	W325S	Waterford	T1	W	8608	8144	11072	10496	8752	11404	11570	11736	11902	12068	12235	14480
SOK	W326S	West Bench	T1	W	4995	6170	5942	7192	6802	7762	8059	8364	8677	8999	9329	11041
SOK	W327S	Westminster	T1/T2	W	18032	17392	23872	21328	20064	24402	24667	24931	25196	25461	25726	30447
SOK	W329S	Trout Creek	T1	W	6530	6122	7346	6556	6252	7657	7817	7980	8146	8316	8489	10460
SOK	W333S	Pine Street(PIN2)	T1	W	5184	4619	5542	5755	5876	5928	6014	6100	6187	6273	6359	6993
SOK	W333S	Pine Street	T2	W	9569	9168	11583	11090	10904	11941	12124	12310	12498	12689	12882	14167
SOK	W338S	Osoyoos	T1	W	9143	8885	10841	10879	10721	11235	11831	12456	13109	13791	14501	15947
SOK	W338S	Osoyoos(OSO3)	T2	W	5341	3600	6419	7050	6424	7402	7578	7755	7931	8107	8283	9109
SOK	W345S	Keremeos	T1	W	8929	8387	11409	11390	10416	12011	12321	12637	12958	13285	13619	16404
SOK	W347S	Hedley	T1	W	3643	3681	4905	4859	2709	5334	5476	5621	5770	5922	6078	7321
SOK	W380S	Anderson	T3	W	13044	13320	14220	16332	20520	16771	16995	17223	17454	17688	17925	21215
SOK	W386S	Oliver	T1	W	6191	5781	5277	7631	7336	7972	8148	8326	8508	8694	8883	9768
SOK	W390S	Princeton	T3	W	13200	13895	18519	17388	16653	18890	19157	19429	19706	19988	20275	19498
SOK	138kV	Terasen Similkameen	T	W	2347	2347	2347	2347	105	2818	2818	2818	2818	2818	2818	2818
SOK	138kV	Mascot	T	W	1623	1623	1623	1623	0	0	0	0	0	0	0	0
		Sub-Total			173621	169810	213558	212132	199969	224313	229005	233781	238640	243584	248611	285310
		Growth									2.09%	2.09%	2.08%	2.07%	2.06%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. & Feb. 2004 data.

Kootenay

					Winter Historical					Winter Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/27
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
KT	W102S	Kaslo	T1	W	8619	9256	10620	9232	8702	10000	10106	10212	10319	10425	10531	12088
KT	W103S	Coffee Creek	T3	W	5997	5997	7817	6853	5450	7973	8052	8130	8208	8286	8364	8724
KT	W110S	Crawford Bay	T2	W	1600	1992	2312	2200	5488	5841	5853	5864	5876	5887	5899	6771
KT	W110S	Crawford Bay	T3	W	2470	2657	3500	3300	0	0	0	0	0	0	0	0
KT	W120S	Wynndel	T1	W	4065	4016	4114	3428	3552	3570	3587	3604	3621	3639	3656	3715
KT	W121S	Creston	T1	W	12628	13268	16116	14719	11850	12450	12482	12514	12547	12579	12611	12817
KT	W121S	Creston	T2	W	10392	9953	12420	11371	11500	12100	12125	12150	12175	12199	12224	12423
KT	W124S	Lambert	T1	W				1800	3850	4050	4068	4086	4104	4122	4140	4207
KT	W129S	Valhalla (VAL1)	T1	W	2900	2936	3925	3413	3278	4004	4043	4082	4121	4161	4200	4380
KT	W130S	Passmore	T1	W	3606	2808	4100	3820	3549	4182	4223	4264	4305	4346	4387	4576
KT	W131S	Playmor	T1	W	8000	8916	11610	12242	11398	12850	12908	12966	13024	13082	13140	13705
KT	W132S	Slocan City (SLO1)	T1	W	7200	5635	4519	5186	4400	5186	5186	5186	5186	5186	5186	5186
KT	W135S	Tarry's	T1	W	3500	2880	3360	3360	2880	2900	2900	2900	2900	2900	2900	3038
KT	W200S	Whitewater (WHI1)	T1	W	320	365	345	323	350	360	367	374	381	388	395	411
KT	W202S	Salmo	T1	W	5436	5616	6984	7056	6912	7162	7215	7268	7321	7374	7426	7746
KT	W204S	Hearns	T1	W	2693	1367	263	160	200	267	269	271	274	276	278	274
KT	W205S	Fruitville	T1	W	5750	5760	7445	6465	6432	7549	7601	7653	7706	7758	7810	7694
KT	W206S	Ymir (YMR1)	T1	W	900	972	1224	1187	1075	1248	1261	1273	1285	1297	1310	1366
KT	W221S	Castlegar	T1	W	16667	14733	17250	16644	17064	17699	17923	18147	18371	18596	18820	19712
KT	W222S	Blueberry	T1	W	7500	7640	8375	7640	8330	8492	8551	8610	8668	8727	8785	9202
KT	W244S	Trail	T1	W	3000	3000	2700	0	0	0	0	0	0	0	0	0
KT	W246S	Beaver Park	T1	W	7200	6826	8263	7870	8082	8428	8511	8594	8676	8759	8841	8710
KT	W247S	Glenmerry	T1	W	8500	8015	10559	10388	9977	10876	11034	11193	11351	11509	11668	11494
KT	W248S	Stoney Creek	T1	W	4700	4805	6232	7367	6783	7587	7698	7808	7919	8029	8140	8019
KT	W256S	Patterson (PAT1)	T1	W	850	942	857	673	790	866	870	874	878	883	887	874
KT	W258S	Cascade	T1	W	7087	7087	8000	8112	7336	8550	8769	8988	9207	9426	9645	9502
KT	63 kV	Celgar		W	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000
KT	63 kV	P&T - Castlgar	T	W	8148	7949	7298	7560	7870	7870	7870	7870	7870	7870	7870	7870
KT	63 kV	City of Nelson	T	W	16416	22680	24228	22140	24263	24955	25318	25682	26045	26409	26772	27923
		Sub-Total			182144	184071	210436	200509	197361	213015	214789	216563	218337	220111	221885	228428
		Growth									0.83%	0.83%	0.82%	0.81%	0.81%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. & Feb. 2004 data.

Boundary

					Winter Historical					Winter Projected Loading						
					2001/2	2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2026/27
										Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 20
Region	**Sub No**	**Name**	**Trans**		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
SOK	**W270S**	**Christina(CHR1)**	T1	W	4320	4583	4437	4275	4116	4526	4570	4614	4659	4703	4748	5110
SOK	**W271S**	**Ruckles**	T1 -13 k	W	9209	9209	11532	11278	10076	9978	10167	10360	10556	10756	10960	11797
SOK	**W271S**	**Ruckles**	T2	W	7310	7310	9775	9040	9815	10107	10274	10440	10606	10772	10938	11774
SOK	**W275S**	**Grand Forks Terminal(GFT1)**	T3	W	2503	3141	4384	4221	6392	6500	6575	6649	6724	6798	6873	7398
SOK	**W291S**	**Midway**	T1	W	6735	6552	7100	7100	7227	7190	7236	7283	7331	7379	7428	7996
SOK	**W292S**	**Rock Creek(ROC1)**	T1	W	2255	2024	1983	2468	2448	2552	2594	2636	2678	2720	2762	2973
SOK	**W292S**	**Rock Creek(ROC2)**	T2	W	1426	1114	1243	1440	2253	2291	2838	3385	3933	4480	5027	5411
SOK	**W294S**	**Baldy(BAL1)**	T1	W	592	592	592	1299	0	0	0	0	0	0	0	0
SOK	**W296S**	**Greenwood**	T1	W	2400	2086	2160	2160	2411	2261	2313	2366	2420	2474	2530	2723
SOK	**63 kV**	**Roxul**	T	W	7350	8148	8211	8190	8043	8211	8211	8211	8211	8211	8211	8211
		Sub-Total			44099	44759	51417	51471	52781	53616	54778	55944	57116	58293	59476	63391
		Growth									2.17%	2.13%	2.09%	2.06%	2.03%	

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. & Feb. 2004 data.

Appendix 2

Project Schedule and Expenditure Estimate

2007 SDP Update

Appendix 2 - Project Schedule and Expenditure Estimate

Summary -

	07-'11 Total	07-'11 Total	2007		2008		2009		2010		2011		2012+
CATEGORY	original	update	original	update	original	update	original	update	original	update	original	update	
TRANSMISSION	217,875	253,681	48,218	64,405	61,675	59,320	58,936	58,083	24,283	41,174	24,763	30,699	51,119
Transmission Growth	182,901	219,206	41,140	56,925	55,965	53,063	51,783	51,907	14,818	33,458	19,195	23,853	51,119
Transmission Line Sustaining	14,765	18,822	2,645	3,671	2,960	3,738	3,112	3,439	2,976	3,864	3,072	4,110	0
Stations Sustaining	20,209	15,653	4,433	3,809	2,750	2,519	4,041	2,737	6,489	3,852	2,496	2,736	0
DISTRIBUTION	69,526	108,876	12,729	20,004	14,244	20,245	15,611	23,319	14,251	22,203	12,691	23,105	15,500
Distribution Growth	33,166	61,232	5,771	11,891	7,166	11,224	8,532	13,631	6,749	12,161	4,947	12,325	15,500
Distribution Sustaininng	36,361	47,644	6,958	8,113	7,079	9,021	7,079	9,688	7,502	10,042	7,744	10,780	0
TELECOM, SCADA, P&C	18,389	14,575	4,162	4,941	6,189	3,088	2,247	4,635	4,830	932	960	979	21,250
Telecom Growth	11,978	8,858	2,420	3,458	4,920	2,000	738	3,400	3,900	0	0	0	17,500
Telecom Sustaining	6,411	5,717	1,742	1,483	1,269	1,088	1,509	1,235	930	932	960	979	3,750
TOTAL T&D CAPITAL FORECAST	305,790	377,132	65,109	89,350	82,108	82,653	76,794	86,037	43,364	64,309	38,414	54,783	87,869

Transmission

TRANSMISSION PROJECT DESCRIPTION	07-'11 Total	07-'11 Total	2007		2008		2009		2010		2011		2012+
	original	update	original	update	original	update	original	update	original	update	original	update	
TRANSMISSION GROWTH													
BULK SYSTEM													
DOUBLE CIRCUIT 230 kV VAS TO RGA	36,215	38,995	4,235	1,998	20,295	16,997	11,685	20,000	0		0		
230/161/138 BENTLEY TERMINAL	25,205	21,933	605	499	6,150	2,500	18,450	15,000	0	3,934	0		
230 KV VASEUX TO BENTLEY	6,140	6,499	605	499	1,230	1,000	4,305	5,000	0		0		
KELOWNA SHUNTS & SVC	2,460	2,930	0		1,230		1,230		0	2,930	0		17,000
VASEUX TRANSFORMER 3 (500/230 kV)	1,845	0	0		615		1,230		0		0		3,500
KELOWNA AREA													
BIG WHITE 138 kV LINE & SUBSTATION	19,360	18,213	19,360	9,969	0	8,244	0		0		0		
ELLISON DISTRIBUTION SOURCE	7,865	13,319	7,865	13,319	0		0		0		0		
ELLISON TRANSMISSION LOOP	0	3,489	0		0		0		0	3,489	0		1,000
BLACK MOUNTAIIN DISTRIBUTION SOURCE	8,610	9,224		497	8,610	8,727	0		0		0		3,000
LINES	0	0	0		0		0		0		0		1,000
FAULT LEVEL REDUCTION	0	3,371	0		0		0		0	1,634	0	1,737	
CLOSE 138 kV LOOPS KELOWNA	14,065	5,220	4,840	0	4,920	0	4,305		0		0	5,220	3,500
RECREATION CAPACITY INCREASE	2,460	2,749	0		2,460		0		0	2,749	0		
HOLLYWOOD CAPACITY INCREASE	2,460	11,119	0		2,460	4,812		6,307	0		0		
BRAELOCH (SW) DISTRIBUTION SOURCE	6,280	9,192	0		0		0		1,625	1,582	4,655	7,610	
OK MISSION CAPACITY INCREASE	3,900	0	0		0		0		0		3,900		
DUCK LAKE REGULATOR BANK	0	294		294	0		0		0		0		
NORTH KELOWNA TRANSFORMER ADDITION	0	0	0		0		0		0		0		3,919
GLENMORE SUBSTATION NEW FEEDER	0	392		392	0		0		0		0		
PENTICTON/SUMMERLAND AREA													
NARAMATA REHABILITATION	0	1,959	0	1,959	0		0		0		0		
HUTH REBUILD AS 63 kV RING BUS	6,500	6,333	0		0		0		6,500	6,333			
SUMMERLAND 63 kV BACKUP	3,531	0	0		0		738		2,793				2,700
WESTBENCH SUBSTATION REGULATOR BANK	0	294		294			0		0		0		
OSOYOOS/OLIVER AREA													
NEW EAST OSOYOOS SOURCE	0	12,707	0	12,489	0		0		0		0	218	
EAST OSOYOOS-BENTLEY TRANSMISSION	6,650	0	0		0		0		0		6,650		
CONVERT EXISTING OLIVER TO 138/63/13 kV DISTRIBUTION SOURCE STATION	4,910	4,716	605		4,305		0	500		4,216	0		
PRINCETON/KEREMEOS AREA													
PRINCETON TRANSFORMER REPLACEMENTS	0	0	0		0		0		0		0		2,000
HEDLEY STEP UP 5 MVA TRANSFORMER	0	391	0	391	0		0		0		0		
KEREMEOS NEW FEEDER	0	263			0		0		0	263	0		

Transmission cont'd

TRANSMISSION PROJECT DESCRIPTION	07-'11 Total	07-'11 Total	2007		2008		2009		2010		2011		2012+
	original	update	original	update	original	update	original	update	original	update	original	update	
TRANSMISSION GROWTH													
BOUNDARY/GRAND FORKS AREA													
KETTLE VALLEY DISTRIBUTION SOURCE	0	6,809	0	5,811	0	998	0		0		0		
KETTLE VALLEY VOLTAGE CONVERSION	4,275	4,026	1,815	2,840	2,460	1,186	0		0		0		
BOUNDARY AREA STATION CONVERSIONS	1,210	1,261	1,210	840	0	421	0		0		0		
GRAND FORKS AREA VOLTAGE CONVERSIONS	5,090	4,048	0		0		2,460		1,300	2,532	1,330	1,516	1,000
GRAND FORKS DISTRIBUTION SOURCE	12,640	10,533	0		0		7,380		2,600	3,796	2,660	6,737	5,000
CASTLEGAR AREA													
CASTLEGAR SUB CAPACITY INCREASE	0	6,378	0		0	6,378	0		0		0		
	0	0	0		0		0		0		0		
COFFEE CREEK - KASLO AREA	0	0	0		0		0		0		0		
CAPACITOR AT COFFEE CREEK	0	245	0	245	0		0		0		0		
CAPACITOR AT KASLO	0	78	0	78	0		0		0		0		
COFFEE CREEK T3 REPLACEMENT	1,230	2,600	0		1,230		0	2,600	0		0		
30 LINE CONVERT TO 63 kV	0	2,500			0		0	2,500	0		0		
CRAWFORD BAY AREA													
CRAWFORD BAY CAPACITY INC.	0	1,714	0	1,714	0		0		0		0		
CRESTON/WYNDELL AREA													
NEW LAMBERT 230/63 KV TRANSFORMER & 230 kV RING BUS	0	2,797	0	2,797	0		0		0		0		3,500
SOUTH SLOCAN AREA													
SLOCAN - NEW DENVER 63KV LOOP	0	0	0		0		0		0		0		4,000
TRAIL/SALMO AREA													
YMIR FEEDER CONVERSION	0	815			0		0		0			815	
NEW 18 L BREAKER AT WANETA	0	1,800	0		0	1,800	0		0		0		
SUBTOTAL - TRANSMISSION GROWTH	182,901	219,206	41,140	56,925	55,965	53,063	51,783	51,907	14,818	33,458	19,195	23,853	51,119
TRANSMISSION LINE SUSTAINING													
TRANSMISSION LINE URGENT REPAIRS	902	1,584	173	257	176	308	176	326	186	331	192	362	
RIGHT OF WAY ENHANCEMENTS	1,503	1,820	288	334	293	350	293	347	310	384	320	405	
ROW RECLAMATIONS	0	1,807	0	339	0	359	0	326	0	383	0	400	
TRANSMISSION CONDITION ASSESSMENTS	0	3,520	0	616	0	647	0	680	0	760	0	817	
SWITCH ADDITIONS	1,803	552	345	362	351	190	351		372		384		
FUTURE YEAR REHABILITATION	10,102	9,539	1,840	1,763	1,989	1,884	1,989	1,760	2,108	2,006	2,176	2,126	
6A LINE REHABILITATION	59	0	0		59		0		0		0		
26 LINE REHABILITATION	94	0	0		94		0		0		0		
27 LINE REHABILITATION	293	0	0		0		293		0		0		
28 LINE REHABILITATION	12	0	0		0		12		0		0		
SUBTOTAL - TRANSMISSION LINE SUSTAINING	14,765	18,822	2,645	3,671	2,960	3,738	3,112	3,439	2,976	3,864	3,072	4,110	0

Transmission cont'd

TRANSMISSION PROJECT DESCRIPTION	07-'11 Total	07-'11 Total	2007		2008		2009		2010		2011		2012+
	original	update	original	update	original	update	original	update	original	update	original	update	
STATION SUSTAINING													
STATION ASSESSMENT AND MINOR PROJECTS	6,010	6,201	1,150	1,145	1,170	1,186	1,170	1,210	1,240	1,298	1,280	1,362	
STATION UNFORESEEN REPAIRS	1,803	2,131	345	353	351	401	351	447	372	445	384	485	
CMMS	0	246	0	246	0		0		0		0		
BULK OIL BRKR REPLACEMENT	2,352	780	920		468		468	780	496				
WARFIELD TERMINAL CONNECTOR REPLACEMENT AND DEFICIENCY CORRECTION	0	1,268		869		399							
GROUND GRID UPGRADES	1,503	1,543	288	284	293	299	293	300	310	322	320	338	
TRANSFORMER OIL FILTRATION/REPLACEMENT	1,503	542	288		293		293		310	264	320	278	
LTC OIL FILTRATION	902	991	173	226	176	234	176		186	258	192	273	
WEST OSOYOOS TRANSFORMER REHAB	0	343	0	343	0	0	0		0		0		
KASLO SUB UPGRADE	968	1,265	968		0		0		0	1,265	0		
PINE STREET T1 REPLACEMENT	303	0	303	0	0		0		0		0		
TROUT CREEK T1 REHAB	1,002	343	0	343	0		677		325				
REPLACE COFFEE CREEK T2	1,933	0	0		0		308	0	1,625	0		0	0
REPLACE CRAWFORD BAY T1	1,933	0	0		0		308	0	1,625	0		0	0
TAP CHANGER LEAK REPAIR AND UPGRADE													
SUBTOTAL - STATIONS SUSTAINING	20,209	15,653	4,433	3,809	2,750	2,519	4,041	2,737	6,489	3,852	2,496	2,736	0
TOTAL - TRANSMISSION	217,875	253,681	48,218	64,405	61,675	59,320	58,936	58,083	24,283	41,174	24,763	30,699	51,119

Distribution

DISTRIBUTION PROJECT DESCRIPTION	07-'11 Total	07-'11 Total	2007		2008		2009		2010		2011		2012+
	original	update	original	update	original	update	original	update	original	update	original	update	
DISTRIBUTION GROWTH													
NEW CONNECTS SYSTEM-WIDE	38,569	43,050	7,671	7,245	7,198	7,977	7,102	8,401	8,168	9,291	8,431	10,136	12,000
CIAC (credit amount)	-19,285	0	-3,835		-3,599		-3,551		-4,084		-4,216		
KELOWNA AREA													
KELOWNA GENERAL FEEDER PROTECTION	315	0	61	0	62	0	62	0	65	0	67	0	0
MCKINLEY LANDING CAPACITY UPGRADE(#2 TO 477) FED FROM SEX3	545	359	545		0	359	0		0		0		
NEW GLE6 FEEDER(50L U/B HIGH RD-CLIFTON)	1,230	1,371	0	1,371	1,230		0		0		0		
HOL1-DGB3/LEE2 TIE	726	1,500	726		0		0	1,500	0		0		
HOL1-OKM1 TIE ALONG KLO RD	554	349	0		554	349	0		0		0		
MCKINLEY TO CLIFTON TIE	246	633	0		246		0		0	633	0		
LEE2-HOL5 TIE, ADD N.O.	246	419	0		246	419	0		0		0		
RETERMINATE LEE FEEDERS AT NEW N. KELOWNA SUBSTATION	615	0	0		615		0		0		0		
FUTURE KELOWNA DISTRIBUTION UPGRADES	3,795	3,852	0		0		1,845	1,200	1,950	1,292	0	1,360	1,500
Feeder Egress Cables	0	244		244	0		0		0		0		
GLE1/GLE2/HOL4 U/G CABLES	0	94		44	0	50	0		0		0		
HOL3-SEX4 TIE	0	250			0		0	250	0		0		
HOL1 HOL2 TIE	0	49	0	49	0								
LEE2 REGULATOR	0	157		157	0		0		0		0		
SEX4 REGULATOR	0	160			0	160	0		0		0		
PENTICTON													
WEB1 VOLTAGE REGULATOR	0	0	0		0		0		0		0		
PRI4 CAPACITY UPGRADE	0	2,231		881	0		0	1,350	0		0		
OKF1 CAPACITY UPGRADE	0	594		294	0	300	0		0		0		
OSOYOOS/OLIVER													
25 KV TIE TO ANARCHIST/BRIDESVILLE	2,460	0	0		0		2,460		0		0		2,000
SIMILKAMEEN													
KEREMEOS FEEDER	0	158	0		0		0		0	158	0		
KER1 CAPACITY UPGRADE	0	553		353	0		0	200	0		0		
KER2 CAPACITY UPGRADE	0	196		196	0		0		0		0		
SOUTH SLOCAN	0	0	0		0		0		0		0		
VAL1 CAPACITY UPGRADE	0	897			0	897	0		0		0		
	0	0	0		0		0		0		0		
CRESTON AREA	0	0	0		0		0		0		0		
CRA2 CAPACITY UPGRADE	0	372		372	0		0		0		0		

Distribution cont'd

DISTRIBUTION PROJECT DESCRIPTION	07-'11 Total	07-'11 Total	2007		2008		2009		2010		2011		2012+
	original	update	original	update	original	update	original	update	original	update	original	update	
DISTRIBUTION GROWTH													
GENERAL													
PRIMARY & SECONDARY VOLTAGE PROBLEMS, RELIABILITY IMPROVEMENTS, SWITCHING IMPROVEMENTS)	3,150	3,744	605	685	615	713	615	730	650	787	665	829	
SUBTOTAL - DISTRIBUTION GROWTH	33,166	61,232	5,771	11,891	7,166	11,224	8,532	13,631	6,749	12,161	4,947	12,325	15,500
DISTRIBUTION SUSTAINING													
DISTRIBUTION CONDITION ASSESSMENTS	2,705	3,581	518	637	527	678	527	710	558	760	576	796	
DISTRIBUTION REHABILITATION	9,015	9,411	1,725	1,606	1,755	1,645	1,755	2,060	1,860	1,974	1,920	2,126	
ROW RECLAMATION	3,396	3,245	650	609	661	593	661	639	701	686	723	718	
DISTRIBUTION LINE REBUILDS	4,508	9,917	863	1,576	878	1,945	878	1,931	930	2,143	960	2,322	
SMALL PLANNED CAPITAL	3,215	1,999	615	339	626	378	626	410	663	419	685	453	
PCB PROGRAM	4,508	4,458	863	852	878	868	878	870	930	919	960	949	
FORCED UPGRADES AND LINE MOVES	3,005	7,038	575	1,168	585	1,400	585	1,396	620	1,472	640	1,602	
DISTRIBUTION URGENT REPAIRS	6,010	7,483	1,150	1,228	1,170	1,414	1,170	1,572	1,240	1,564	1,280	1,705	
AESTHETIC & ENVIRONMENTAL UPGRADES	0	512	0	98	0	100	0	100	0	105	0	109	
SUBTOTAL - DISTRIBUTION SUSTAINING	36,361	47,132	6,958	8,113	7,079	9,021	7,079	9,688	7,502	10,042	7,744	10,780	0
TOTAL - DISTRIBUTION	69,526	108,364	12,729	20,004	14,244	20,245	15,611	23,319	14,251	22,203	12,691	23,105	15,500

Telecommunications, SCADA and Protection & Control

TELECOM, SCADA, P&C PROJECT DESCRIPTION	07-'11 Total	07-'11 Total	2007		2008		2009		2010		2011		2012+
	original	update	original	update	original	update	original	update	original	update	original	update	
TELECOM, SCADA, P&C GROWTH													
DISTRIBUTION SUBSTATION AUTOMATION, METERING AND COMMUNICATIONS	4,388	4,999	2,420	1,999	1,230	2,000	738	1,000	0		0		1,000
TRAIL-OLIVER HIGH CAPACITY COMMUNICATIONS	7,590	3,859	0	1,459	3,690		0	2,400	3,900				3,000
TELECOMMUNCIATIONS BACKBONE LOOP CLOSE	0	0	0		0		0		0		0		10,000
TELECOMMUNICATIONS FOR BUSINESS SYSTEMS	0	0	0		0		0		0		0		3,500
SUBTOTAL - TELECOM, SCADA, P&C GROWTH	11,978	8,858	2,420	3,458	4,920	2,000	738	3,400	3,900	0	0	0	17,500
TELECOM, SCADA, P&C SUSTAINING													
NARROW SPECTRUM CONVERSION													
HARMONIC REMEDIATION	601	537	115	97	117	101	117	105	124	114	128	120	
PROTECTION UPGRADES	3,431	3,737	1,098	935	848	723	854	651	310	697	320	731	2,500
FAULT LOCATING INACCESSIBLE LINES	902	459	173	147	176	154	176	158	186		192		
COMMUNICATIONS UPGRADES	1,478	984	357	304	129	110	363	321	310	121	320	128	1,250
SUBTOTAL - TELECOM, SCADA, P&C SUSTAINING	6,411	5,717	1,742	1,483	1,269	1,088	1,509	1,235	930	932	960	979	3,750
TOTAL - TELECOM, SCADA, P&C	18,389	14,575	4,162	4,941	6,189	3,088	2,247	4,635	4,830	932	960	979	21,250

FortisBC Inc.

2009 System Development Plan Update

("2009 SDP Update")

June 27, 2008

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 3
2. PLAN UPDATE BY CATEGORY 7
2.1 Transmission and Stations (Growth) 7
2.1.1 Bulk Transmission System 7
2.1.2 Okanagan Region 10
2.1.3 Kootenay Region 18
2.2 Transmission and Stations (Sustaining) 24
2.2.1 Transmission 25
2.2.2 Stations 27
2.3 Distribution (Growth) 30
2.3.1 New Connects - System Wide 30
2.3.2 Small Capacity Improvements and Unplanned Growth Projects 31
2.3.3 Okanagan Region 31
2.3.4 Kootenay Region 38
2.4 Distribution (Sustaining) 40
2.5 Telecommunications, SCADA and Protection 40
2.5.1 Telecommunications, SCADA and Protection (Growth) 41
2.5.2 Telecommunications, SCADA and Protection (Sustaining) 43

APPENDIX 1 LOAD FORECAST 44
APPENDIX 2 PROJECT SCHEDULE AND ESTIMATE 52

1. Executive Summary

FortisBC Inc.'s 2005-2024 System Development Plan ("2005 SDP") filed with the British Columbia Utilities Commission ("Commission") on November 26, 2004 identified necessary reinforcements in the Company's bulk transmission system, the regional transmission and distribution systems, the telecommunication and SCADA networks, and protection systems. The 2005 SDP outlined the sustaining projects directed at maintaining existing facilities and modernizing obsolete equipment; and growth projects required to serve increasing load, driven by population growth and the new commercial activities in the FortisBC service area. In Order G-52-05 the Commission Panel encouraged FortisBC to treat this plan as a living document, to continue to consult with stakeholders and to keep the plan current as it evolves. In 2006 and 2007 updates to the 2005 SDP were filed with the Company's 2006 and 2007/08 Capital Expenditure Plans. An effective System Development Plan must be responsive to changing circumstances that may arise from variations in load growth rates or location, or from results of equipment condition assessments. This report ("2009 SDP Update") outlines the changes to the original as well as the 2007 project plan schedule and provides a summary of the upcoming two year capital expenditure plan necessary to maintain the integrity of the existing electrical system and to meet new customer demand within the FortisBC service territory. The current status of all projects identified in the 2005 SDP is summarized in the tables in Appendix 2.

The current load forecast developed in the first quarter of 2008 is included as Appendix 2. It continues to show a high level of load growth in the north and south Okanagan areas with average winter growth rates exceeding 5 percent, and 3 percent respectively over the next five years. The Kootenay and Boundary areas continue to experience modest growth with an average annual growth rate of less than 2 percent over the next five years.

Appendix 3 provides the cost and schedule for the various projects identified in the 2005 SDP that will be completed in 2009 and 2010. They have been updated for inflation, currently approved overheads and Allowance for Funds Used During Construction ("AFUDC") rates.

Expenditures in the 2009-2010 timeframe increased from $150.3 million as originally scheduled to $251.1 million in the 2009 SDP Update. The changes are primarily attributable to increases in

the Okanagan Transmission Reinforcement (OTR), Black Mountain, Benvoulin, Naramata projects and the addition of the 20 Line and 27 Line rebuild, Copper Conductor Replacement and other sustaining projects; offset somewhat by the rescheduling of the Huth Substation rebuild and the Grand Forks Conversion and Distribution Source projects.

The major changes between the 2007 SDP Update and the 2009 SDP Update are summarized below by category. The details of each are included in the 2009 SDP Update.

Transmission Growth

Project Timing

1. Unanticipated delays and scope refinement have shifted the substantial completion date of the OTR Project from 2009 to 2010.

2. Unanticipated delays for the Black Mountain Distribution Source project have deferred a significant portion of this project from 2008 to 2009.

3. The 2010 Fault Level Reduction Project has been cancelled as a result of an investigation and subsequent report contained as Appendix 8 in the 2007/08 Capital Plan. The report concluded that upon completion of Glenmore in 2007, no further action was required in the foreseeable future.

4. The Braeloch Distribution Source Project has been deferred from 2010 as a result of load relief provided by the construction of the Benvoulin Substation.

5. Unanticipated delays for the Naramata project have deferred a significant portion of this project from 2007 to 2009.

6. Huth Substation rebuild has been deferred from 2010 to 2011 to avoid conflicts with the OTR construction schedule.

7. Grand Forks Conversion and Distribution Source have been deferred from 2010 to the 2011+ timeframe due to uncertainty associated with the load in that area.

Changing Scope and new projects

1. The scope of the proposed OTR Project has been updated as the detailed engineering has progressed. It now includes items that were not specifically defined in the 2005 SDP.

2. The Tarrys Substation upgrade project is a new project for 2009 to address load at that station.

Transmission Line Sustaining – Forecast changes in this category have occurred primarily due to:

1. The requirement for increased transmission right-of-way expenditures associated with the removal of trees damaged from the Pine Beetle infestation problem;

2. The requirement to upgrade specific transformer and substation protection to provide appropriate levels of protection and improve service reliability; and

3. The requirement to rebuild sections of 20 Line and 27 Line and to rehabilitate 30 Line in order to provide appropriate levels of safety and service reliability.

Stations Sustaining – The most significant changes associated with this category are attributable to:

1. The completion of the DG Bell bulk oil breakers replacement project in 2010 has been deferred to 2011;

2. Slocan City–Valhalla is a new project for 2009 to rectify issues associated with the existing Slocan City transformer and substations;

3. The Passmore Substation upgrade project is a new project for 2010 to address deficiencies associated with the existing transformer and line protection; and

4. The Princeton Substation upgrade is a new project for 2010 to address deficiencies associated with the deterioration of the existing reclosers.

Distribution Growth – The changes in this category are explained primarily by:

1. Forecast higher customer growth rates and subsequent increase in construction associated with the need to provide service; and

2. The addition of new projects to increase the capacity of existing distribution circuits in order to deliver voltage levels within acceptable limits.

Distribution Sustaining – The changes in this category are explained primarily by:

1. The requirement for increased distribution right-of-way expenditures associated with the removal of trees damaged from the Pine Beetle infestation problem;

2. The recognition of the safety issues associated with hot tap connectors has resulted in increased activity in the rehabilitation project; and

3. An assessment of aged copper conductor which has identified the conductor as a safety and reliability issue.

Telecommunications – The change in this category are due primarily to the deferral of the Grand Forks to Trail high capacity communications link in conjunction with the Grand Forks Conversion Project.

The execution of the projects listed in the 2009/10 Capital Plan will complete all of the major projects outlined in the original 2005 SDP with the exception of those that have been deferred or cancelled as previously discussed. With the completion of these major projects as summarized in Appendix 2, it is essential that the Company develop another long range plan, taking into account the significant impact that these projects have had on the electrical system and to take into account the continued high levels of growth within specific sections of the service territory. In 2010/11 the Company will file a new Long Term System Development Plan with details for the five year period (2011-2015). The 2010/11 filing will reflect the impact of major projects that have been completed since 2004 and results of the Company's Resource Plan as well any changes to legislation that may affect public utility filing requirements.

2. Plan Update by Category

The following sections outline the projects as originally identified by the 2005 SDP. Project information from the 2007 SDP Update is restated in italics for reference and is followed by the 2009 updated information. Appendix 3 shows the 2007 updated project schedule and estimated costs for 2009/10 projects as well as the 2009 updated schedule and estimates for 2009 and 2010.

2.1 Transmission and Stations (Growth)

The 2009 SDP Update contains a number of changes from the 2007 SDP Update. The major factor influencing changes to the Transmission and Station (Growth) projects is the OTR Project as well as unanticipated delays in other projects.

The 2008 load forecast showing actual loads for the past five years, together with forecast winter and summer loads for the next six years is found in Appendix 2.

2.1.1 Bulk Transmission System

The 2009 SDP Update continues to forecast a high level of load growth in the north and south Okanagan areas with average winter growth rates exceeding 5 percent and 3 percent respectively over the next five years. The Kootenay area and Boundary areas continue to experience modest growth with an average annual growth rate of less than 2 percent over the next five years.

The 2005 SDP proposed that due to the high load growth and concern with security of supply for the City of Kelowna, the following projects should be undertaken, subsequent to the completion of the South Okanagan Supply Reinforcement Project in 2006.

The four projects listed in this category have been grouped and are currently referred to as the Okanagan Transmission Reinforcement Project (“OTR”). An application for a CPCN for the OTR Project was filed with the Commission on December 14, 2007. An oral hearing is scheduled for June 23, 2008.

2.1.1.1 Vaseux Lake Terminal to Anderson Terminal 230 kV Circuit:

The conversion of the existing 161 kV circuit to 230 kV and construction of a second 230 kV circuit between Vaseux Lake Terminal and RG Anderson Terminal stations in the 2007/09 timeframe.

This also involves the expansion of the 230 kV ring bus in RG Anderson Terminal station and reconfiguration of the existing 168 MVA Transformer 2 for 230 kV operations.

2007 UPDATE: *This project is unchanged. An application for a CPCN for the OTR Project is anticipated to be filed with the Commission in 2007.*

2009 UPDATE: An application for a CPCN for the OTR Project was filed with the Commission on December 14, 2007. An oral hearing is scheduled for June 23, 2008.

2.1.1.2 New Bentley Terminal Station

The construction in 2008/09 of a new Bentley Terminal station near Oliver, supplied by a 230 kV line from Vaseux Lake Terminal station.

This terminal station would be equipped with 230 kV, 161 kV and 138 kV buses and would serve Oliver Terminal station to the west, Grand Forks Terminal station to the east and the Osoyoos area to the south.

2007 UPDATE: *This project is currently scheduled for the 2008/10 timeframe. An application for a CPCN for the OTR Project is anticipated to be filed with the Commission in 2007.*

2009 UPDATE: An application for a CPCN for the OTR Project was filed with the Commission on December 14, 2007. An oral hearing is scheduled for June 23, 2008.

2.1.1.3 Kelowna Switched Shunts and Static var Compensator

The installation of approximately 30 MVA of shunt capacitors at both DG Bell Terminal and FA Lee Terminal stations in 2008/09 to provide adequate voltage support for loss of the 230 kV lines between FA Lee Terminal station and Vernon.

2007 UPDATE: *This project is currently scheduled for the 2010 timeframe. An application for a CPCN for the OTR Project is anticipated to be filed with the Commission in 2007.*

2009 UPDATE: An application for a CPCN for the OTR Project was filed with the Commission on December 14, 2007. An oral hearing was held on June 23, 2008. Expenditures for the capacitors at DG Bell and FA Lee were included in the OTR CPCN. While justifications for the Static var Compensator (SVC) were discussed in the OTR CPCN application, approval for this component was not requested as part of the OTR Project. Instead FortisBC intends to file a separate CPCN application for the SVC installation in 2010.

2.1.1.4 Vaseux Lake Terminal Station Transformer 3

Preparatory work for the installation of a third transformer (T3) at Vaseux Terminal station in 2009 with installation occurring in the 2011+ timeframe.

2007 UPDATE: *An application for a CPCN for the OTR Project is anticipated to be filed with the Commission in 2007 and will address the preparatory work. The installation is unchanged.*

2009 UPDATE: While this transformer installation is not a component of the proposed OTR Project, the future work is discussed in the project CPCN application filed with the Commission on December 14, 2007. An oral hearing was held on June 23, 2008.

2.1.2 Okanagan Region

The Okanagan region consists of Kelowna, Penticton, Summerland, Oliver-Osoyoos, and Princeton-Keremeos.

2.1.2.1 Kelowna:

The 2005 SDP identified the Kelowna area as the fastest growing part of the FortisBC system and one of the fastest growing urban centres in British Columbia. The load addition resulting from that growth has resulted in a requirement for a number of subtransmission and station projects. The 2009 SDP Update shows that the forecast loads for the stations in the Kelowna area continue to exceed the 2004 forecast.

As a result of forecast customer and load growth in this area the following projects were identified in the 2005 SDP:

(a) Big White 138 kV Line and Substation

Construction of a substation at the Big White ski resort to be served via a 138 kV transmission line from the Joe Rich Substation as well as a distribution upgrade in the 2005/07 timeframe.

2007 UPDATE: *The project is now scheduled for the 2006/08 timeframe. An application for a CPCN was filed in March 2006 and an oral public hearing was held on July 4 and 5, 2006.*

2009 UPDATE: This project has received CPCN approval by Commission Order C-17-06. Construction of the new transmission line (57 Line) was completed in 2007, the substation is scheduled to be completed in 2008.

(b) Ellison Distribution Source Substation

Construction of a distribution source substation (Ellison) approximately 5.5 kilometres north of the Sexsmith Substation in 2006/07. Included in this station project are four

13 kV lines out of the station to connect the station to the existing distribution in the Ellison and Glenmore area and a transmission line from the Duck Lake Substation.

2007 UPDATE: *This project is unchanged. An open house for this project was held on July 6, 2006. An application for a CPCN for this project is anticipated to be filed with the Commission in the third quarter of 2006.*

2009 UPDATE: This project has received CPCN approval by Commission Order C-4-07 and is scheduled to be completed in 2009.

(c) Black Mountain Distribution Source Substation Project

Construction of a distribution source substation (Black Mountain) approximately 5 kilometres east of the Hollywood Substation in the 2008 timeframe.

2007 UPDATE: *This project is unchanged. An application for a CPCN for this project is anticipated to be filed with the Commission in the fourth quarter of 2006.*

2009 UPDATE: This project has received CPCN approval by Commission Order C-7-07 and is scheduled to be completed in 2009.

(d) Fault Level Reduction

Installation of current limiting reactors in Kelowna area substations in 2005/06.

2007 UPDATE*: Detailed engineering has identified that many of the substations do not have adequate space for the additional reactors, resulting in a requirement for major reconfiguration at these sites. This has caused FortisBC to investigate alternate solutions for the sites. A solution will be implemented at Glenmore Substation in 2006, however other sites will be rectified in future as upgrades take place at these substations. Work practices and changes to protection settings have been implemented to reduce the impact of high fault levels at these sites. A report titled "FortisBC Distribution Substation Fault Level Control Guidelines" is filed as Appendix 8 of the 2007/08 Capital Plan.*

2009 UPDATE: A solution has been implemented at Glenmore Substation. As no other substations require attention in the foreseeable future, this project is considered complete.

(e) Loop Kelowna 138 kV Circuits

Installation of circuit breakers and modification of existing bus networks to enable the operation of the 138 kV sub transmission in Kelowna as a looped network. The engineering for this project was scheduled for 2006 with construction scheduled for the 2007/09 timeframe.

2007 UPDATE: *This project has been deferred to the 2010/12 timeframe due to other major projects that are occurring in the Kelowna area. The application for a CPCN for the proposed Ellison project will contain details of a transmission loop for the Sexsmith, Ellison and Duck Lake substations.*

2009 UPDATE: The transmission loop for the Sexsmith, Ellison and Duck Lake Substations has been scheduled for 2011+ timeframe. The other network loop projects have been deferred to the 2012+ timeframe and will be further assessed as part of the 2011 long range plan.

(f) Recreation Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at the Recreation Substation in the 2008 timeframe.

2007 UPDATE: *The load growth in this area has allowed deferral of this project to 2010.*

2009 UPDATE: This project is scheduled for 2010.

(g) Hollywood Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at Hollywood substation in the 2008 timeframe.

2007 UPDATE: *Cancelled. An analysis of the load growth patterns in Kelowna indicates that the preferred solution for the load growth in the central/south Kelowna area is to construct a distribution source substation in the Casorso Road and Benvoulin Road area. This project is included in the Benvoulin Substation project and is scheduled for the 2008/09 timeframe.*

2009 UPDATE: A CPCN application for the Benvoulin Project will be filed with the Commission in the third quarter of 2008. This project is scheduled to be completed in 2010.

(h) Braeloch (SW) Kelowna Distribution Source Substation

Construction of a distribution source substation (Braeloch) in southwest Kelowna in the 2010/11 timeframe.

2007 UPDATE: *This project is unchanged.*

2009 UPDATE: The load relief provided by the Benvoulin Substation project has allowed this project to be deferred to the 2014+ timeframe. Funds have been included in the 2009/10 Capital Plan under the "Kelowna Distribution Capacity Requirements" to undertake necessary investigative studies associated with this project.

(i) OK Mission Capacity Upgrade

Installation of a new 138/13 kV distribution transformer and associated protection at the OK Mission substation in the 2011+ timeframe.

2007 UPDATE: *Cancelled. An analysis of the load growth patterns in Kelowna indicates that the preferred solution for the load growth in the central/south Kelowna area is to construct a distribution source substation in the Casorso Road and*

Benvoulin Road area. This project is included in the Benvoulin Substation project and is scheduled for the 2008/09 timeframe.

2009 UPDATE: A CPCN application for the Benvoulin Project will be filed with the Commission in the third quarter of 2008. This project is scheduled to be completed in 2010.

(j) NEW - 2007 - Benvoulin Substation: This project replaces the Hollywood and OK Mission Capacity Upgrade Projects.

2009 UPDATE: A CPCN application for the Benvoulin Project will be filed with the Commission in the third quarter of 2008. This project is scheduled to be completed in 2010.

(k) NEW - 2007 - Duck Lake Regulator Bank: Load growth at the Duck Lake Substation has exceeded the capacity of the voltage regulators located at the substation and will require replacement in 2007.

2009 UPDATE: Complete

(l) NEW - 2007 - Glenmore 6 – New Feeder: Addition of a circuit breaker at the Glenmore Substation to accommodate a new feeder (Feeder 6).

2009 UPDATE: Complete.

(m) NEW - 2007 - North Kelowna Transformer Addition: Current load growth patterns indicate that a transformer will be required at one of the north Kelowna substations (Duck Lake, Ellison and Sexsmith) in the 2012+ timeframe.

2009 UPDATE: Funds have been included in the 2009/10 Capital Plan under the "Kelowna Distribution Capacity Requirements" to undertake necessary investigative studies associated with this project.

(n) NEW - 2009 - Kelowna Distribution Capacity Requirements: Forecasted load growth patterns indicate a need for additional distribution capacity in the greater Kelowna area in the 2011+ timeframe. Funds have been included in the 2009/10 Capital Plan to undertake necessary investigative studies associated with this project.

2.1.2.2 Penticton - Summerland

This area has seen modest growth over the past number of years. The 2005 SDP identified the following projects for the 2006/11+ period:

(a) Naramata Substation Replacement

Rebuilding of the Naramata Substation in the 2005/06 timeframe.

2007 UPDATE: *The requirement for the Naramata project is unchanged. The project was approved by Order G-52-05. Property acquisition has taken longer than expected, however, it is anticipated that the new substation (Arawana) being in service by early 2007.*

2009 UPDATE: Unanticipated delays have deferred the completion of this project to 2009.

(b) Summerland 63 kV Backup

Construction, in the 2009/10 timeframe, of a new 63 kV line from the Huth Substation to the Trout Creek Substation or from the Huth Substation to the Summerland Substation to provide backup for the Summerland area.

2007 UPDATE: *This project has been rescheduled to the 2012+ timeframe to align with the Huth Substation rebuild project.*

2009 UPDATE: This project is unchanged and will be updated as part of the 2011 Long Term System Development Plan.

(c) Huth Substation Rebuild

Rebuilding of the 63 kV bus and line terminations at the Huth Substation in the 2010 timeframe.

2007 UPDATE: *This project is unchanged.*

2009 UPDATE: The completion of this project requires 41 Line and 42 Line to be out of service however, the completion of the OTR Project requires that 76 Line be out of service. Outages on 41 Line or 42 Line at the same time as 76 Line is out, increases the risk of interruptions to customers in this area. Consequently the Huth Substation Rebuild project is rescheduled to 2010/2011 following the completion of the OTR Project.

(d) NEW - 2007 - Westbench Regulator Bank: Load growth at the Westbench substation has exceeded the capacity of the voltage regulators located at the substation and requires replacement in 2007.

2009 UPDATE: Complete.

2.1.2.3 Oliver - Osoyoos

The 2005 SDP load growth in the Oliver-Osoyoos area is forecast to exceed the system average. The growth is predominantly due to migration from urban centres outside of the Okanagan.

The 2005 SDP identified the following projects for the 2006/11 timeframe:

(a) New East Osoyoos Substation

Construction of a distribution source substation in East Osoyoos (Nk'Mip) in 2006.

2007 UPDATE: *This project was approved by Commission Order C-1-06 and is currently scheduled for completion in the 2006/07 timeframe.*

2009 UPDATE: Complete.

(b) Rebuild Oliver as Distribution Source Substation

Conversion of the existing Oliver Terminal station to accommodate a distribution source substation in the 2007/08 timeframe.

2007 UPDATE: *This project schedule is dependent on the timing of the Bentley Terminal station. It will be addressed as part of the OTR Project and covered in the application for the CPCN that will be filed in 2007. The project is now tentatively scheduled for the 2009/10 timeframe.*

2009 UPDATE: A CPCN application for the OTR Project was filed with the Commission on December 14, 2007. An oral hearing is scheduled for June 23, 2008.

2.1.2.4 Princeton - Keremeos

The 2005 SDP forecast modest load growth in the Princeton-Keremeos area. However, during the winter of 2005, the peak load on Transformer 3 at Princeton Substation exceeded the nameplate rating. This necessitated the replacement of the transformer.

(a) Princeton Reconfiguration and Transformer Replacement

Installation of two 138/25/13 kV transformers to supply both Princeton and FortisBC distribution loads.

2007 UPDATE: *The installation of one transformer was approved in Commission Order G-8-06 and will be completed in 2006. The second transformer has been deferred to the 2012+ timeframe.*

2009 UPDATE: The installation of one transformer is complete. The installation of the second transformer continues to be deferred to the 2012+ timeframe.

(b) NEW - 2007 - Hedley Substation Step-up Transformer. Load growth at the Hedley Substation has exceeded the capacity of the step-up transformer requiring its replacement in 2007.

2009 UPDATE: Complete.

2.1.3 Kootenay Region

The Kootenay region consists of the following areas: Castlegar, Crawford Bay, Creston-Wynndel, Grand Forks-Boundary, Kaslo-Coffee Creek, South Slocan, and Trail-Salmo.

2.1.3.1 Castlegar:

The 2005 SDP forecast modest load growth for this area. However, cumulative growth over time has resulted in the need for the following project:

(a) Castlegar Capacity Upgrade

Installation of a new 63/13 kV transformer and associated protection in 2006.

2007 UPDATE: *The preliminary engineering assessment indicates that the existing substation is inadequate to accommodate the new transformer; consequently, the capacity upgrade will require the construction of an additional substation near the load centre to offload a portion of the Castlegar load. As an interim measure a portion of the load has been temporarily transferred to the Blueberry Substation. This project has now been deferred to 2008.*

2009 UPDATE: This project which has been renamed "Ootischenia Substation" received CPCN approval by Commission Order C-10-07 and is scheduled to be complete in 2009.

(b) NEW - 2009 - Tarrys Substation upgrade: This project, scheduled for 2009, involves the installation of fans to increase the capacity of the Tarrys transformer and the addition of regulators to provide backup from the Passmore substation in case of transformer failure. Tarrys is a single transformer substation that feeds the Kalesnikoff Lumber Mill. The transformer has a nameplate capacity of 2.5 MVA with fans and 2 MVA without fans. Currently there are no fans installed. The peak load for this station last year was 2.9 MVA

2.1.3.2 Crawford Bay:

The Crawford Bay load has grown to a point where the peak load exceeds the nameplate rating of the two 13 kV distribution transformers. In addition, failure of one of the two existing transformers at peak will result in load shedding. The 2005 SDP identified the following project for this area:

(a) Crawford Bay Capacity Increase and Grounding Bank

Installation of a new 63/13 kV distribution transformer and associated protection to serve the Crawford Bay area in 2006.

2007 UPDATE: *The installation of the distribution transformer has been scheduled for 2007.*

2009 UPDATE: The installation of the distribution transformer has been completed. The installation of the grounding bank has been cancelled as a result of the 30 Line conversion project scheduled for 2009.

2.1.3.3 Creston - Wynndel:

The Creston area is served from the BC Hydro 230 kV system via a single 230/63 kV transformer at Lambert Terminal station. Failure of the existing 230/63 kV transformer would result in significant customer outages in the Creston area. In addition, outages to the 230 kV BC Hydro transmission line 2L294 result in loss of service to all of the Creston area customers. The 2005 SDP proposed the following projects to address this issue:

(a) 230 kV Ring Bus and New Transformer at Lambert Terminal

Installation of a second 230/63 kV transformer at Lambert Terminal station and re-arrangement of the station to form a ring bus configuration in the 2006 timeframe.

2007 UPDATE: *The project to install the second transformer was approved in Commission Order G-8-06. The engineering for the transformer addition is scheduled for 2006 with construction scheduled for 2007.*

A reliability analysis will be carried out for the ring bus portion of the Lambert project. However, this portion of the project, which involves a joint effort between FortisBC and BC Hydro, has been rescheduled for the 2012+ timeframe.

2009 UPDATE: The second transformer has been installed. The status with respect to the ring bus project has not changed.

2.1.3.4 Grand Forks - Boundary:

This area is served by a network of two 63 kV transmission lines (9 Line and 10 Line) and eight distribution source substations. The lines and stations are at or near the end of their expected service lives. The 2005 SDP identified that the electrical system in this area is in need of a major upgrade and proposed the following projects for the 2006/10 timeframe:

(a) New Kettle Valley 161/25 kV Distribution Source Substation

Construction of a distribution source substation in the Kettle Valley area, salvage the five existing 63 kV source substations between Grand Forks and Oliver Terminal Station and convert the distribution to 25 kV in the 2006/08 timeframe.

2007 UPDATE: *The priority and schedule for this project are unchanged. As directed by the Commission Order G-52-05 and Decision dated May 31, 2005, FortisBC submitted an application for a CPCN for this project in October 2005.*

2009 UPDATE: This project has received CPCN approval by Commission Order C-6-06 and is scheduled to be complete in 2008. The Rock Creek load has already been transferred to the new substation. Salvage of plant will occur in 2009.

(b) New Grand Forks 161/25 kV Distribution Source Substation

Construction, in the 2009/10 timeframe, of a distribution source substation at Grand Forks, salvage of the three existing 63 kV source substations between the Grand Forks Terminal and the Mawdsley Terminal stations and conversion of the distribution to 25 kV.

2007 UPDATE: *Further assessment of this project indicated that due to load changes, it is necessary to maintain 63 kV (9 Line and 10 Line) between Grand Forks Terminal station and an industrial customer on the east side of Grand Forks. The schedule for this project has been changed to the 2010/11 timeframe.*

2009 UPDATE: A further assessment of this project has deferred implementation to 2011+ timeframe.

2.1.3.5 Kaslo - Coffee Creek:

Modest growth is expected for this area over the forecast period; however, by the winter of 2006/07 the Coffee Creek Terminal station is projected to exceed the maximum capacity of the existing 8.4 MVA transformer. As well, it has been determined that with the installation of capacitors at the Coffee Creek Terminal Station and the Kaslo Substation, these two locations could be served via 32 Line from the Lambert Terminal station in the event of an outage on 30 Line from the South Slocan Terminal Station. The 2005 SDP identified the following projects for this area:

(a) Coffee Creek Capacitors

Installation of capacitors at the Coffee Creek Terminal station in 2006.

2007 UPDATE: *This project is currently scheduled for 2007.*

2009 UPDATE: This project has been rescheduled to 2009 in conjunction with the 30 Line conversion project.

(b) Kaslo Capacitor

Installation of capacitors at the Kaslo Substation in 2006.

2007 UPDATE: *This project is currently scheduled for 2007.*

2009 UPDATE: This project has been rescheduled to the 2009 in conjunction with the 30 Line conversion project.

(c) Coffee Creek Transformer 3

Replacement of Transformer 3 at the Coffee Creek Terminal station in the 2008 timeframe.

2007 UPDATE: *As a result of modest load growth, this project has been rescheduled to 2009.*

2009 UPDATE: As a result of continued modest load growth, this project has been rescheduled to the 2011+ timeframe.

(d) NEW - 2007 - Convert 30 Line from 161 kV to 63 kV: The installation of a second 230/63 kV transformer at Lambert Terminal station in 2006/07 will secure the power supply to Creston and reduce the need of 32 Line as a backup between Crawford Bay and Creston. Further, the decommissioning by Teck Cominco of 30 Line between Crawford Bay and Kimberley, traditionally considered a backup for loads at Crawford Bay, Coffee Creek and Kaslo, will make it possible to operate 30 Line between South Slocan and Crawford Bay at 63 kV. It will be a radial supply with a similar level of reliability for FortisBC customers in other areas. With modest load growth, adequate voltage can be maintained by providing reactive compensation as required in the future. This project cancels the requirement for the transformer replacement project at Coffee

Creek and Crawford Bay (T3), listed in Section 2.2.2 (f) and 2.2.2 (g). This project is currently scheduled for 2009.

2009 UPDATE: No Change.

2.1.3.6 South Slocan:

Modest load growth is expected for this area over the forecast period. The 2005 SDP identified the following project in the 2011+ timeframe to improve reliability in the area:

(a) Slocan City to New Denver (BC Hydro)

Construction of a 63 kV transmission line from South Slocan to New Denver in the 2011+ timeframe.

2007 UPDATE: *This project has been rescheduled for the 2012+ timeframe.*

2009 UPDATE: This project has been deferred indefinitely due to the high cost.

2.1.3.7 Trail-Salmo:

Modest load growth is expected for this area over the forecast period. The 2005 SDP identified the following project for this area:

(a) Ymir Transformer Replacement (Cottonwood Substation)

2007 UPDATE: *This project was approved by Commission Order G-8-06 and will be completed in 2006. This project has not changed.*

2009 UPDATE: The new Cottonwood substation has been completed and has replaced the legacy Whitewater substation. The future conversion of the area distribution system to 25 kV and retirement of the Ymir substation is scheduled for the 2011+ timeframe as per item c below.

(b) 18 Line Breaker at Waneta

Installation of a new circuit breaker on 18 Line at Waneta in 2006 to accommodate increased fault levels.

2007 UPDATE: *This project is rescheduled to 2008. It is driven by Teck Cominco's schedule to rebuild the Waneta Substation.*

2009 UPDATE: Complete.

(c) NEW - 2007 - Convert Ymir Feeder 1 to 25 kV: This project is scheduled for the 2011+ timeframe.

2009 UPDATE: No change.

2.2 Transmission and Stations (Sustaining)

FortisBC has 58 transmission lines and 68 terminal and substations. The transmission system consists of approximately 1,600 kilometres of line and approximately 16,000 poles. Close to 65 percent of these lines are more than 30 years old. The terminals and substations consist of approximately 110 transformers, 350 circuit breakers, 950 fused switches and disconnects. The average age of the transformers and many other devices exceed 30 years.

Like most North American utilities, FortisBC must address the issue of aging infrastructure. As the infrastructure ages, the power system becomes less safe, less reliable and more costly to operate and maintain. The Company therefore continues to focus on the replacement of deteriorated, defective or obsolete electrical equipment.

The 2005 SDP gave an assessment of the condition of the Company's transmission and substation infrastructure and provided an overview of the inspection and maintenance procedures currently utilized to identify the sustaining capital projects that are required for rehabilitation and ongoing upgrades of the system. These projects are required to ensure safe, reliable service. Appendix 3 shows the original schedule and estimate as well as the current schedule and estimate for the transmission and stations sustaining projects identified in the 2005 SDP.

2.2.1 Transmission

The 2005 SDP identified the following specific sustaining capital projects for transmission:

(a) Rehabilitation of 32 Line Crawford Bay-Creston in 2005

2007 UPDATE: *This project has been completed.*

(b) Rehabilitation of 20 Line, 21-24 Line, 51-51A Line, 53 Line, and 74 Line in 2006

2007 UPDATE: *This project has been completed.*

(c) Rehabilitation of 6A Line in 2008

2007 UPDATE: *This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.*

(d) Rehabilitation of 26 Line in 2008

2007 UPDATE: *This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.*

(e) Rehabilitation of 27 Line in 2009

2007 UPDATE: *This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.*

2009 UPDATE: The assessment of the 27 Line in 2007 indicates that a major rebuild of this Line is required in the 2009/2010 timeframe; consequently it is shown as a separate project in the 2009 Capital Plan.

(f) Rehabilitation of 28 Line in 2009

2007 UPDATE: *This project is now included in a general project called the Future Year Rehabilitation and Condition Assessment Project for 2009 and beyond.*

(g) Transmission Switch Replacements and Additions

2009 UPDATE: Transmission switch upgrades will take place at Castlegar substation in 2010.

(h) NEW - 2009 - Rebuild 20 Line in 2009/10: The 2007/08 condition assessment of this line indicates that a major rebuild of this line is necessary.

(i) NEW - 2009 - Rehabilitation of 30 Line Lake-crossing in 2010: The 2006/07 condition assessment of this line indicates that a major rehabilitation of the lake-crossing is necessary.

(j) NEW - 2009 - Pine Beetle Hazard Allocation: Recent consecutive mild winters have accelerated the Mountain Pine Beetle (MPB) infestation within the FortisBC service area. Provincial infestation concentration maps for 2001 and 2006 show that MPB infestation has spread from the north central region of the province into the southern reaches of the province. Concentrations of MPB infestation are now clearly evident in the FortisBC service territory and are certain to increase in severity. This project is required to remove hazard trees killed by the MPB.

(k) NEW - 2009 - Transformer Protection Upgrades: In 2010 a program will be initiated to upgrade protection to transformers equipped with high side fuses or faulting switches to comply with current FortisBC standards. For legacy transformers with a capacity of 10 MVA or greater that are not in compliance with standards the protection will be removed and replaced with switches or breakers. The Joe Rich transformer protection will be upgraded in 2010.

(l) NEW - 2009 - Creston Substation Protection Upgrade: This project, scheduled for 2009 consists of an upgrade of the fusing/protection at Creston Central substation, so that it will coordinate with the Lambert 63 kV protection scheme and eliminate nuisance trips to the Creston Central substation customers. In addition, the project will upgrade the bus configuration to improve the switching and isolation capabilities in the station.

2.2.2 Stations

The 2005 SDP identified the following specific sustaining projects for stations:

(a) West Osoyoos Transformer Rehabilitation

Upgrading or replacement of the West Osoyoos transformer in 2006.

2007 UPDATE: *This project was approved by Commission Order G-8-06 and will be completed in 2007.*

2009 UPDATE: Complete.

(b) Kaslo Substation Rehabilitation

Upgrading the Kaslo Substation in 2006 and 2007.

2007 UPDATE: *An analysis of this substation has indicated that the project can be deferred to 2010.*

2009 UPDATE: Small upgrades completed under the condition and minor projects group has allowed this project to be deferred to 2011+.

(c) Rebuild Pine Street Transformer

Rehabilitation of Pine Street Transformer 1 in 2006 and 2007.

2007 UPDATE: *This project was approved as a transformer replacement by Commission Order G-8-06 and will be completed in 2006.*

2009 UPDATE: Complete

(d) Westminster Transformer 1 Replacement in 2006

2007 UPDATE: *This project was approved as a transformer rehabilitation in Commission Order G-8-06 and will be completed in 2006. This project has not changed.*

2009 UPDATE: Complete

(e) Trout Creek Transformer 1 Rehabilitation in 2009/10

2007 UPDATE: *This transformer continues to show signs of deterioration and is scheduled to be replaced with the transformer previously in use at the Waterford Substation, in 2007.*

2009 UPDATE: During the detailed design for this project, it was discovered that the ex-Waterford Transformer was physically incompatible with the existing bus connection arrangement at the Trout Creek Substation. The costs to engineer and install the required bus transition would have significantly exceeded the budgeted amount for the project. Additionally, FortisBC's planning group also identified the need for a more detailed analysis of the entire Westbench and Summerland distribution system to determine future substation requirements. This will be undertaken as part of the 2011 System Development Plan (2011 SDP). The outcome could result in the reduction of the number of substations in the area. In light of this, it has been decided to defer the installation of the transformer until the 2011 SDP is complete. As a result of the deferral, the Company has developed a contingency plan to address the possible failure of the Trout Creek Transformer.

(f) Replacement of Coffee Creek Transformer 2 Capacity Addition in 2009/10

2007 UPDATE: *Cancelled - The conversion of 30 Line from 161 kV to 63 kV removes the requirement for this transformer replacement.*

(g) Replacement of Crawford Bay Transformer 1 in 2009/10

2007 UPDATE: *Cancelled - The conversion of 30 Line from 161 kV to 63 kV removes the requirement for this transformer replacement.*

(h) Bulk Oil Breaker Replacement

2009 UPDATE: Breaker replacement on the 12 MVA Kootenay Mobile substation will take place in 2010. The two breaker replacement at DG Bell scheduled for 2009 have been rescheduled to 2011.

(i) Ground Grid Upgrades

2009 UPDATE: Ground grid upgrades have been scheduled for the Castlegar substation in 2009.

(j) NEW - 2009 - Slocan City - Valhalla Substation Upgrade: This project scheduled for 2009 involves the transfer of the Slocan City substation load to the Valhalla substation and the salvage of the Slocan City substation transformer. The transformer at Slocan City is a legacy transformer and needs major attention since it is seeping oil in several locations. Maintenance test records indicate that it is nearing the end of its useful life. The Valhalla substation which was built in 2002, has adequate space for another transformer and is located only one kilometer away from the Slocan City substation.

(k) NEW - 2009 - Passmore Substation Upgrade: The project scheduled for 2010 involves the expansion of the Passmore substation to accommodate the addition of a circuit breaker on 19 Line as well as space for a mobile substation in case of an emergency. The 63 kV transmission line (19 Line) radially serves the Passmore substation and supplies two other substations in the Slocan Valley. The transmission line north of the Passmore substation follows the highway in a very tight corridor and has a high outage rate. With the current configuration of the line, an unplanned outage anywhere on the line will cause the entire line to trip off as the only line protection is located at the source (South Slocan Generating station). This can cause unnecessary

outages to the Passmore Substation customers. The breaker addition on the north side of the Passmore station will prevent the majority of transmission outages to the north of the station from affecting the Passmore customers, and further improve reliability by improving restoration switching.

(l) NEW - 2009 - Pine Street Substation Distribution Breaker Replacement: This project scheduled for 2009 involves the replacement of circuit breakers at the substation. The breakers were installed in 1967 and are at the end of their life. Parts for the units are no longer available; consequently failed or deteriorated parts must be replaced by parts produced by custom machining. Safety hazards associated with operating the equipment, require that it be replaced

(m) NEW - 2009 - Princeton Substation Distribution Recloser replacement in 2010: In 2010 circuit breakers will be installed at the Princeton Substation to replace the existing reclosers. As a result of capacity addition at the substation, the existing reclosers are no longer adequate to interrupt the available fault current that is possible at the substation.

2.3 Distribution (Growth)

This section outlines the projects identified by the 2005 SDP as growth projects and gives a brief update of the current status. Appendix 3 shows the original schedule and estimate as well as the current schedule and estimate for these projects.

2.3.1 New Connects - System Wide

This project includes installation of new services requiring additions to FortisBC overhead and underground facilities in all regions of its service territory. These capital expenditures allow FortisBC to meet its obligation to serve. The number of customers connected directly affects increases or decreases to this account.

2007 UPDATE: *This project is unchanged.*

2009 UPDATE: This project is unchanged.

2.3.2 Small Capacity Improvements and Unplanned Growth Projects

On an annual basis, the distribution feeder network is evaluated for voltage, thermal and backup capabilities based on forecast load growth. Where standards of service are not met, an appropriate solution involving regulators, capacitors, or other equipment is identified. Experience has shown that unforeseen load emergencies will require capacity upgrades and voltage correction projects not accounted for in the capital plan. This project provides the funding for such requirements.

2007 UPDATE: *This project is unchanged.*

2009 UPDATE: There is only one small Capacity Improvement (<$250,000) planned for 2009 or 2010. It involves the installation of a regulator on Oliver Feeder 1.

2.3.3 Okanagan Region

The Okanagan region consists of the following areas: Kelowna, Penticton-Summerland, Oliver-Osoyoos and Princeton-Keremeos.

2.3.3.1 The 2005 SDP identified the following growth-related projects in this area:

(a) DG Bell Feeder 2 to OK Mission Feeder 3 Tie

Construction of a feeder tie between DG Bell Feeder 2 and OK Mission Feeder 3 to provide interim load relief for the south west Kelowna area in 2006.

2007 UPDATE: *This project was approved by Commission Order G-8-06 and will be completed in 2006. This project is unchanged.*

2009 UPDATE: Complete.

(b) McKinley Landing Capacity Upgrade

Upgrading of a section of Sexsmith Feeder 3 from No. 2 conductor to No. 477 conductor to accommodate load growth in the McKinley Landing area in the 2007 timeframe.

2007 UPDATE: *This project has been rescheduled to 2008 to help mitigate Capital Plan expenditures.*

2009 UPDATE: This project is scheduled to be completed in 2008.

(c) Hollywood Feeder 1 to FA Lee Feeder 2 Tie

Construction of a feeder tie between Hollywood Feeder 1 and FA Lee Feeder 2 to provide interim load relief in the Gallagher area in the 2007 timeframe.

2007 UPDATE: *This project is has been rescheduled to 2009 to help mitigate Capital Plan expenditures.*

2009 UPDATE: This project has been included in the Black Mountain substation project and is scheduled to be completed in 2009.

(d) New Glenmore Feeder 6

Construction of a new feeder (Feeder 6) from the Glenmore Substation to accommodate load growth in the Magic Estates, Clifton and Glenmore Highlands development areas in the 2008 timeframe.

2007 UPDATE: *As a result of increasing load growth in this area, this project has been rescheduled to 2007.*

2009 UPDATE: Complete.

(e) Hollywood Feeder 1 to OK Mission Feeder 1

Upgrading of a section of line between Hollywood Feeder 1 and OK Mission Feeder 1 along KLO Road to accommodate load transfer from the Hollywood Substation to the OK Mission Substation or the Bell Terminal station in the 2008 timeframe.

2007 UPDATE: *This project is unchanged.*

2009 UPDATE: This project is scheduled for completion in 2008.

(f) McKinley to Clifton Tie

Construction of a feeder tie between Glenmore Feeder 6 and Sexsmith Feeder 3 to accommodate load transfer in the Clifton, McKinley Landing area in the 2008 timeframe.

2007 UPDATE: *This project has been rescheduled to 2010.*

2009 UPDATE: This project has been deferred to the 2011+ time frame due to modest growth in this area.

(g) FA Lee Feeder 2 to Hollywood Feeder 5 Tie

Construction of a feeder tie between Hollywood Feeder 5 and FA Lee Feeder 2 to accommodate load transfer in the Rutland and Black Mountain area in the 2008 timeframe.

2007 UPDATE: *This project is unchanged.*

2009 UPDATE: This project is scheduled to be completed in 2008.

(h) Ellison Substation - New Feeder

Construction of a new feeder at the Ellison Substation to offload the 13 kV tertiary on the 230/138 kV system transformers at the FA Lee Terminal station in order to reduce the system risk associated with distribution faults. The 2005 SDP scheduled this project for the 2008 timeframe.

2007 UPDATE: *The project need is unchanged. The project description and cost has been included in the proposed Ellison project. An application for a CPCN will filed for this project in the third quarter of 2006.*

2009 UPDATE: This project is scheduled to be completed in 2009.

(i) Future Kelowna Distribution Upgrades

Upgrade feeders in the Kelowna area to accommodate load growth in the 2009/11 timeframe.

2007 UPDATE: *This project is unchanged.*

2009 UPDATE: No Change

(j) NEW - 2007 - Feeder Egress Cable Upgrade: The underground cables from the OK Mission and Hollywood substations to the distribution lines are inadequate for the forecast growth on OK Mission Feeder 1, OK Mission Feeder 4, Hollywood Feeder 1, Hollywood Feeder 3, Hollywood Feeder 4, and Hollywood Feeder 5. Additional cables will be installed in 2007.

2009 UPDATE: Cancelled. As noted in the budget update letter filed on Sept 28, 2006, a further assessment of the cables indicated that the cable had adequate capacity.

(k) NEW - 2007 - Glenmore and Hollywood Underground Cable Replacement: Sections of cables at several road crossings are inadequate to accommodate forecast load. The cable installations are currently scheduled for Glenmore Feeder 1, Glenmore Feeder 2 and Hollywood Feeder 4 in the 2007/08 timeframe.

2009 UPDATE: Complete

(l) NEW - 2007 - Hollywood Feeder 3 - Sexsmith Feeder 3 Tie: Construct a feeder tie between Hollywood Feeder 3 and Sexsmith Feeder 3 to accommodate load transfer in the 2009 timeframe.

2009 UPDATE: The reference to Sexsmith Feeder 3 is in error, it should read Sexsmith Feeder 4. This project has been rescheduled for 2010.

(m) NEW - 2007 - Hollywood Feeder 1 - Hollywood Feeder 2 Tie: Construct a feeder tie between Hollywood Feeder 1 and Hollywood Feeder 2 to accommodate load transfer in the 2007 timeframe.

2009 UPDATE: Complete

(n) NEW - 2007 - FA Lee Feeder 2 Regulator: Install a voltage regulator on FA Lee Feeder 2, in the 2007 timeframe, to provide voltage within acceptable limits.

2009 UPDATE: Complete

(o) NEW - 2007 - Sexsmith Feeder 4 Regulator: Install a voltage regulator, in the 2008 timeframe, on Sexsmith Feeder 4 to provide voltage within acceptable limits.

2009 UPDATE: Cancelled. An alternate solution involving the identification of alternate feed points to be used during emergencies cancelled the need for this project.

(p) NEW - 2009 - New Glenmore Feeder: This project is required in 2009 to accommodate the increased load associated with the construction of a commercial building which has an estimated load of 3 MVA, and a residential development of multi family apartments on Dickson Avenue which has an estimated load requirement of 1 MVA.

(q) NEW - 2009 - Airport Way Upgrade: This project is required in 2010 to upgrade an existing underground circuit along Airport Way to accommodate increased load associated with the airport expansion and the commercial growth in the area.

2.3.3.2 Osoyoos - Oliver:

The SDP identified the following growth-related project in this area:

(a) 25 kV Tie to Bridesville

Construction of a feeder tie from the new East Osoyoos substation (Nk'Mip) to the proposed Kettle Valley Substation to accommodate load growth in the Bridesville area. The 2005 SDP scheduled this project for the 2009 timeframe.

2007 UPDATE: *This project has been rescheduled to the 2012+ timeframe since the anticipated load growth has not materialized in this area.*

2009 UPDATE: No Change

(b) NEW - 2009 - Christina Lake Feeder 1 Capacity Upgrade: The Christina Lake feeder (CHR1) is experiencing end of line voltages below the standard criteria of 115V (3phase) and 113V (single Phase) during peak periods of the year. This project scheduled for 2009/10 involves reconductoring about 5 kilometres of No. 6 copper conductor to ensure all customers are supplied with acceptable voltages at their utilization point.

2.3.3.3 Princeton - Keremeos:

The 2005 SDP identified the following growth related project in this area:

(a) Keremeos Feeder

Construction of Keremeos Feeder 3 to offload Keremeos Feeder 2 which will reach its thermal limits in the 2006 timeframe.

2007 UPDATE: *This project will be deferred to 2010. Winter peak levels in Keremeos over the last two years were substantially higher than historical levels and therefore indicated feeder limits would be exceeded by 2007. The current 2006 forecast has*

moderated demand growth slightly resulting in adequate capacity until the winter peak of 2010.

2009 UPDATE: Due to modest load growth, this project has been rescheduled for 2011+.

(b) NEW - 2007 - Keremeos Feeder 1 Capacity Upgrade: Upgrade sections of Keremeos Feeder 1 in the 2007 timeframe to maintain customer voltage levels within acceptable limits.

2009 UPDATE: This project is scheduled to be completed in 2008

(c) NEW - 2007 - Keremeos Feeder 2 Capacity Upgrade: Upgrade sections of Keremeos Feeder 2 in the 2007 timeframe to maintain customer voltage levels within acceptable limits.

2009 UPDATE: Complete

(d) NEW- 2007 - Princeton Feeder 4 Capacity Upgrade: Upgrade sections of Princeton Feeder 4 in the 2007 and 2009 timeframe to maintain customer voltage levels within acceptable limits.

2009 UPDATE: Complete

2.3.3.4 Penticton – Okanagan Falls:

(a) NEW - 2007 - OK Feeder 3 Capacity Upgrade: Upgrade sections of OK Falls Feeder 3 in the 2007/08 timeframe to maintain customer voltage levels within acceptable limits.

2009 UPDATE: Complete

2.3.4 Kootenay Region

The Kootenay Region consists of the following areas: Castlegar, Crawford Bay, Creston-Wynndel, Grand Forks-Boundary, Kaslo-Coffee Creek, South Slocan, and Trail-Salmo.

2.3.4.1 Trail-Salmo:

The 2005 SDP identified the following growth related project in this area:

(a) Paterson 25 kV feeder and Voltage Conversion

Conversion of the Paterson feeder to 25 kV, transfer the feeder to the Cascade Substation and salvage of the Paterson Substation in 2006.

2007 UPDATE: *This project was approved by Commission Order G-8-06 and will be completed in 2006. This project is unchanged.*

2009 UPDATE: Complete

(b) NEW - 2007 - Valhalla Feeder 1 Capacity Upgrade: Upgrade sections of Valhalla Feeder 1 in the 2008 timeframe to maintain customer voltage levels within acceptable limits.

2009 UPDATE: This project is scheduled to be completed in 2008

(c) NEW - 2009 - Upgrade Beaver Park Feeder 2 The Beaver Park and Fruitvale substations are currently at 80 percent and 93 percent capacity respectively. The tie between the two substations consists mainly of No. 4 and No. 6 legacy copper conductor. This project will upgrade the tie between Beaver Park 2 and Fruitvale 1, to allow for a transfer of load from the Fruitvale substation to the Beaver Park substation, and to address forecast capacity issues at the Fruitvale substation.

2.3.4.2 South Slocan area:

The 2005 SDP identified the following growth project for this area.

(a) Playmor – Tarrys Feeder Upgrade

Upgrade Playmor Feeder 1 between Playmor and Tarrys substations, and transfer Tarrys residential load to Playmor. This will offload Tarrys Substation which is loaded above the recommended continuous rating of the substation transformer. The 2005 SDP scheduled this project for 2006.

2007 UPDATE: *This project was approved in Commission Order G-8-06 and will be completed in 2006. This project is unchanged.*

2009 UPDATE: Complete

2.3.4.3 Creston Area:

The 2005 SDP identified the following project for this area:

(a) Creston Area Distribution Feeder Upgrades

Upgrade the Creston area distribution by constructing distribution feeders at Lambert Terminal station and transferring load from Creston Substation and Wynndel Substation to the new Lambert distribution source in the 2005/06 timeframe.

2007 UPDATE: *This project was approved in Commission Order G-8-06 and will be completed in 2006.*

2009 UPDATE: Complete

(b) NEW - 2007 - Crawford Bay Feeder 2 Capacity Upgrade: Upgrade sections of Crawford Bay Feeder 2 in the 2007 timeframe to maintain customer voltage levels within acceptable limits.

2009 UPDATE: Complete

2.4 Distribution (Sustaining)

FortisBC's distribution network consists of approximately 5,000 kilometres of line, 77,000 support structures and 31,000 oil filled distribution transformers. Distribution sustaining capital expenditures are required for the replacement of poles, crossarms, conductor and transformers that are deteriorated, defective or obsolete. The projects in this group primarily focus on maintaining reliability and safety. This classification also includes capital expenditures related to the relocation of plant at the request of third parties. A significant portion is recovered from the parties making the request.

Appendix 3 shows the schedule and estimate as contained in the 2005 SDP as well as the current schedule and estimate.

(a) NEW - 2009 - Copper Conductor Replacement Program: Copper conductor ranging in sizes from No. 8 gauge to No. 4 gauge as well as No. 90 kcmil was commonly used for distribution lines 40-50 years ago due to its excellent electrical characteristics. During the past number of years, the company has experienced a significant number of conductor failures associated with this particular conductor. An analysis of the issues has identified a requirement to replace a significant amount of this legacy conductor with present aluminium standard conductor to avoid safety risk to workers and the public. A CPCN application that describes this issue and the plan for mitigation will be filed concurrently with the 2009/10 Capital Plan.

2.5 Telecommunications, SCADA and Protection

FortisBC operates a telecommunications system to support protection, control and monitoring of the power system, as well as operations and business communications requirements. Approximately 102 locations are presently or potentially served by the telecommunications system, including 49 distribution stations, 11 terminal stations, 4 generation stations, 12 mountain-top radio repeaters and 6 office locations. The telecommunications system also connects to other utilities for the exchange of protection signals and operational voice and data communications.

A variety of telecommunications transport systems are used, depending on technical requirements, economics and system reliability requirements. These include power line carrier, fibre-optic cable, copper pairs, Telus leased lines, and radio (VHF, microwave, spread spectrum and packet radio). The primary purpose of the telecommunications system is to be an integral component of the protection relaying system, remedial action schemes ("RAS"), substation operations and control, and generation dispatch systems. It also provides a low-cost alternative to the public network for internal business data and some voice traffic.

2.5.1 Telecommunications, SCADA and Protection (Growth)

The 2005 SDP identified the following projects:

(a) Distribution Substation Automation, Metering and Communication

The intent of this multi-year project is to extend the coverage of substation automation in the FortisBC system. This project broadens the integration and use of remote monitoring and control to distribution level substations, including automated load restoration to reduce outage durations, power quality monitoring of lines, transformers and feeders, fault recording and locating, and equipment condition monitoring. The project will provide common communications mechanisms for gathering, storage, access and analysis of the resulting data. Resulting benefits are improvements in system performance, productivity, safety and economics.

The 2005 SDP scheduled this project for the 2006/09 timeframe with anticipated further projects in the 2012/24 timeframe.

2007 UPDATE: *As directed by Commission Order G-52-05 and Decision, dated May 31, 2005, FortisBC will submit an application for a CPCN for this project in 2006.*

2009 UPDATE: This project has received CPCN approval by Commission Order C-11-07 and is scheduled to be completed in 2011

(b) Trail-Oliver High Capacity Communications Network

A high capacity network will enable the transfer of data at high speeds and volumes in FortisBC's entire service territory (Kootenay and Okanagan). This is required for system protection purposes as well as for monitoring and controlling the system remotely. It will displace costs for east-to-west leased lines currently used for system control and operational communications. The project will be undertaken in segments, coincident with the decommissioning of 9 Line and 10 Line and the replacement of the distribution substations in the Grand Forks / Boundary area.

2007 UPDATE: *As part the Kettle Valley project, the section of the communications backbone between Oliver and Kettle Valley will be required in 2007 to provide the operational and protection communications needed by this station. Justification for this work was contained in the application for the CPCN that was submitted for the Kettle Valley project in October 2005.*

2009 UPDATE: This project to install fibre between Oliver and Grand Forks has received CPCN approval as part of the Kettle Valley project and is scheduled for completion in 2008. The project to install fibre between Grand Forks and Trail will form part of the Grand Forks Conversion project which has been deferred to the 2011+ timeframe

(c) Telecommunications Backbone Loop Close

This project will complete the FortisBC telecommunications backbone system loop configuration as commonly used by most utilities, and as required by WECC standards. The 2005 SDP scheduled this project for the 2011/20 timeframe.

2007 UPDATE: *This project has been rescheduled to the 2012/2025 timeframe.*

2009 UPDATE: This project will be updated as part of the 2011 Long Term System Development Plan.

(d) Telecommunications for Business Systems

This project provides for the use of the FortisBC telecommunications system for future applications that may be developed for company operations in the period 2010/25. In each case, use of the FortisBC telecommunications system will be dependent on its ability to improve the performance of the application, and lower the operating and maintenance costs for the telecom portion of the systems (displacing common carrier costs). The 2005 SDP scheduled this project for the 2011/25 timeframe.

2007 UPDATE: *This project has been rescheduled to the 2012/2025 timeframe.*

2009 UPDATE: This project will be updated as part of the 2011 Long Term System Development Plan.

2.5.2 Telecommunications, SCADA and Protection (Sustaining)

This is a multiyear project consisting of a number of items, necessary to maintain the integrity of the Company's telecommunication, SCADA and protection network in order to supply safe, reliable electrical service. It includes items such as harmonic remediation, protection upgrades, and fault locating for inaccessible lines and communication upgrades.

Appendix 3 shows the schedule and estimate as contained in the 2005 SDP as well as the current schedule and estimate.

Appendix 1 Load Forecast

- Substations are listed under the area in which they are physically located, although some feeders connected to certain substations may serve a small portion of load in an adjacent area.

North Okanagan (Kelowna) (summer)

North Okanagan					Summer Historical						Summer Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2013/14 Year 5	2028/29 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
NOK	W302S	Glenmore	T2	S	26168	23484	18799	16645	17155	16345	17392	17937	19112	20287	21462	21933	26231
NOK	W302S	Glenmore	T3	S	19800	22475	25172	28665	30638	30806	34175	34147	34965	35783	36601	37892	49884
NOK	W304S	Hollywood	T1	S	17712	18312	19536	17760	20047	20750	22089	23023	23744	24465	25186	26857	33577
NOK	W304S	Hollywood	T3	S	15432	17904	23736	23832	25972	27342	28179	29972	30756	30522	31281	32134	40175
NOK	W305S	Okanagan Mission	T1	S	19135	18488	20142	19527	23362	22407	23226	27603	28326	30662	31424	32533	43146
NOK	W305S	Okanagan Mission	T2	S	9540	12444	12949	12774	13574	13108	17080	17527	17975	18422	18870	19498	25293
NOK	W306S	Recreation	T1	S	20208	22200	22200	19560	21864	24681	28105	28895	29685	30475	31265	32652	46247
NOK	W308S	Sexsmith	T1	S	22488	25992	27696	25944	28704	28704	28836	22420	26137	29853	34200	36494	53633
NOK	W313S	Saucier	T1	S	20832	18168	18240	16824	18047	19944	18675	20416	23057	23448	23840	24316	28652
NOK	W315S	Joe Rich	T1	S			4702	5000	5339	4170	1671	1776	1881	1986	2091	2117	2351
NOK	W316S	Duck Lake	T1	S	4143	4496	4469	7744	9058	12631	13988	10508	11382	12255	13128	13565	17596
NOK	W371S	D.G. Bell	T1	S	11095	12188	13510	14203	17424	19774	15767	18872	20652	22433	24213	26000	47505
NOK	W372S	Lee	T tert	S	10808	12808	13129	11762	15072	14805	18420	6352	4057	5897	6354	0	0
NOK	W311S	Ellison	T1	S								15847	22493	25818	28242	29803	46771
NOK	W310S	Black Moutain	T1	S								16903	19828	22754	24825	28283	63141
NOK	W301S	Big White	T1	S							3299	8737	8774	8811	8849	8960	9948
		Sub-Total NOK			197361	208959	224280	220241	246256	255467	270901	300935	322822	343872	361831	373037	534151

South Okanagan – Similkameen (summer)

South Okanagan/Similkameen					Summer Historical						Summer Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2013/14 Year 5	2028/29 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
SOK	W320S	Huth	T7//T4-6	S	12144	12371	12371	10496	10496	11440	11594	11743	11892	12041	12190	12354	13820
SOK	W320S	Huth13kV(HUT1)	T8	S	13503	14213	13673	13775	18860	6690	12445	12699	12954	13208	13463	13645	15263
SOK	W321S	Kaleden(KAL1)	T1	S	3281	3441	2793	2738	3509	3727	3777	4075	4372	4669	4967	5034	5631
SOK	W322S	Naramata	T1	S	2938	3526	3526	3086	3527	4032	3923	4018	4113	4208	4304	4420	5526
SOK	W323S	Okanagan Falls	T1	S	10948	11643	11384	8639	11657	11400	12837	13175	13512	13850	14187	14570	18216
SOK	W324S	Summerland	T2	S	10222	11255	11330	11203	12849	12744	13092	13335	13578	13820	14063	14329	16636
SOK	W325S	Waterford	T1	S	8272	9088	8608	8752	13014	18373	18621	18797	18972	19148	19324	19585	21907
SOK	W326S	West Bench	T1	S	3358	5090	5293	5283	5455	18373	18621	18797	18972	19148	19324	19585	21907
SOK	W327S	Westminster	T1/T2	S	17024	17968	17056	16864	16992	17824	18148	18327	18506	18686	18865	19054	20534
SOK	W329S	Trout Creek	T1	S	6530	5714	5224	4949	5356	5326	5826	5925	6024	6123	6221	6319	7336
SOK	W333S	Pine Street(PIN2)	T1	S	7079	6838	5820	7771	7935	8045	8154	8261	8368	8475	8582	8698	9730
SOK	W333S	Pine Street	T2	S	9860	9747	10268	10404	10584	10104	11185	11334	11482	11631	11779	11938	13354
SOK	W338S	Osoyoos	T1	S	11639	12360	12554	12760	13662	13200	7428	8158	8889	9619	10349	10908	16994
SOK	W338S	Osoyoos(OSO3)	T2	S	4967	6623	7523	7234	7500	9130	9469	9807	10146	10484	10823	11310	11310
SOK	W345S	Keremeos	T1	S	9492	9694	9953	9857	10981	10691	11201	11395	11590	11785	11980	12195	17662
SOK	W347S	Hedley	T1	S	1542	1724	1414	1231	1703	2100	2128	2157	2186	2216	2247	2277	2547
SOK	W380S	Anderson	T3	S	13212	17124	14028	16368	22531	14244	18944	19148	19356	19568	19784	20051	22429
SOK	W386S	Oliver	T1	S	6141	6544	6616	6660	9158	6890	8155	8320	8489	8660	8833	9531	18183
SOK	W390S	Princeton	T3	S	11368	11621	11755	11755	12490	13000	13585	13726	13869	14015	14162	14800	19918
SOK		Nk'Mip	T	S							7598	8908	10289	11745	13279	13996	21805
SOK	138kV	BC Gas (Terasen)	T	S	2826	1630	86	60	0	0	350	350	350	350	350	350	350
SOK	138kV	Mascot	T	S	0	0	1623	0	0	0	0	0	0	0	0	0	0
		Sub-Total SOK			166346	178214	172898	169885	198259	197333	217079	222454	227909	233448	239076	244948	301059

Kootenay (summer)

Kootenay					Summer Historical						Summer Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2013/14 Year 5	2028/29 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
KT	W102S	Kaslo	T1	S	6200	5257	5500	6133	5514	4860	5583	5660	5737	5814	5891	5968	7250
KT	W103S	Coffee Creek	T3	S	3853	2730	3140	4313	3643	4399	4439	4478	4518	4557	4597	4638	5258
KT	W110S	Crawford Bay	T2	S	1429	1820	1367	2062	2430	2466	2501	2535	2570	2604	2639	2676	3250
KT	W110S	Crawford Bay	T3	S	2024	2337	1738	3016	0	0	0	0	0	0	0	0	0
KT	W120S	Wynndel	T1	S	3085	2938	3036	2939	0	0	0	0	0	0	0	0	0
KT	W121S	Creston	T1	S	10000	10274	10307	7495	8164	7762	8072	8144	8216	8288	8360	8435	9563
KT	W121S	Creston	T2	S	6779	6514	6700	7313	8973	5301	6054	6108	6162	6216	6270	6326	7172
KT	W124S	Lambert	T1	S			1400	1442	8277	9021	9102	9183	9265	9346	9427	9512	10783
KT	W129S	Valhalla (VAL1)	T1	S	2300	3004	2508	2709	1730	1853	2018	2036	2054	2072	2090	2109	2391
KT	W130S	Passmore	T1	S	2160	1910	2351	2000	1763	2736	2774	2813	2851	2889	2928	2969	3606
KT	W131S	Playmor	T1	S	5267	7160	5733	5992	7312	8340	8457	8574	8690	8807	8924	9049	10993
KT	W132S	Slocan City (SLO1)	T1	S	4900	4117	3853	4025	3952	4057	4057	4057	4057	4057	4057	4057	4057
KT	W135S	Tarry's	T1	S	2400	2880	2880	2400	2609	2880	2880	2880	2880	2880	2880	2880	2880
KT	W200S	Whitewater (WHI1)	T1	S	115	112	112	73	78	0	0	0	0	0	0	0	0
KT	W201S	Cottonwood (COT1)	T1	S	0	0	0	0	0	116	116	117	118	119	120	121	137
KT	W202S	Salmo	T1	S	3456	3564	4104	4320	4896	4854	4940	4984	5028	5072	5116	5162	5852
KT	W204S	Hearns	T1	S	1119	192	178	133	133	1216	1225	1233	1242	1250	1259	1267	1397
KT	W205S	Fruitvale	T1	S	4224	4244	4244	3648	4042	5175	5222	5268	5315	5361	5408	5457	6186
KT	W206S	Ymir (YMR1)	T1	S	590	569	583	563	685	768	775	782	789	796	803	810	918
KT	W221S	Castlegar	T1	S	10702	11888	11888	9806	12481	12963	9291	9464	9638	9811	9984	10174	13241
KT	W222S	Blueberry	T1	S	4408	5289	5583	5437	6098	6542	6214	6330	6446	6561	6677	6804	8856
KT	W220S	Ootischenia	T1	S	0	0	0	0	0	0	5706	5813	5919	6026	6132	6249	8132
KT	W244S	Trail	T1	S	2800	2900	0	0	0	0	0	0	0	0	0	0	0
KT	W246S	Beaver Park	T1	S	6480	6408	6500	6500	7568	8174	8329	8485	8640	8795	8951	9121	11870
KT	W247S	Glenmerry	T1	S	8617	8799	8400	8500	8500	8619	8619	8738	8857	8976	9095	9222	11204
KT	W248S	Stoney Creek	T1	S	3594	3631	5838	3045	5320	5400	5476	5551	5627	5702	5778	5859	7118
KT	W256S	Paterson (PAT1)	T1	S	612	661	575	600	526	0	0	0	0	0	0	0	0
KT	W258S	Cascade	T1	S	6500	6792	4204	4799	4640	5200	5299	5398	5496	5595	5694	5802	7551
KT	63 kV	Celgar	T	S	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000
KT	63 kV	P&T - Castlegar	T	S	8022	7308	7644	7455	7539	7640	8022	8022	8022	8022	8022	8022	8022
KT	63 kV	City of Nelson	T	S		19620	17424	19459	10152	11230	15210	15420	15630	15840	16050	16275	19772
		Sub-Total Kootenay			127636	148918	143790	142177	143025	147572	156380	158072	159765	161458	163150	164963	193461
		Growth															

Boundary (summer)

Boundary					Summer Historical						Summer Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2013/14 Year 5	2028/29 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
BND	W270S	Christina(CHR1)	T1	S	3709	3798	3515	3596	4077	4061	4179	4281	4383	4485	4587	4701	6643
BND	W271S	Ruckles	T1 -13 kV	S	8231	8492	9244	8791	7920	8074	8628	8787	8949	9113	9280	9419	11602
BND	W271S	Ruckles	T2	S	7966	7966	7986	8310	7650	8306	8451	8593	8734	8875	9016	9170	11610
BND	W275S	Grand Forks Termin	T3	S	1948	2911	2768	3591	4587	5056	5157	5258	5359	5460	5562	5673	7485
BND	W290S	Kettle Valley	T1	S	0	0	0	0	0	0	10542	10581	10621	10662	10703	10821	12612
BND	W290S	Kettle Valley	T2	S	0	0	0	0	0	0	0	0	0	0	0	0	0
BND	W291S	Midway	T1	S	4902	6302	6302	6050	5707	5815	0	0	0	0	0	0	0
BND	W292S	Rock Creek(ROC1)	T1	S	1729	1632	1507	1680	1680	1728	0	0	0	0	0	0	0
BND	W292S	Rock Creek(ROC2)	T2	S	928	989	846	1022	1102	1176	0	0	0	0	0	0	0
BND	W294S	Baldy(BAL1)	T1	S	184	152	152			0	0	0	0	0	0	0	0
BND	W296S	Greenwood	T1	S	1594	1428	1428	1457	1562	1648	0	0	0	0	0	0	0
BND	63 kV	Roxul	T	S	7403	8127	8001	8022	8135	8259	8259	8259	8259	8259	8259	8259	8259
		Sub-Total Boundary Growth			38593	41797	41749	42518	42420	44123	45216	45759	46305	46854	47407	48043	58211

North Okanagan (Kelowna) (winter)

North Okanagan					Winter Historical						Winter Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2013/14 Year 5	2028/29 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
NOK	W302S	Glenmore	T2	W	16623	19792	13396	13404	14830	14485	17690	19043	20082	21120	22159	22646	27083
NOK	W302S	Glenmore	T3	W	22828	23860	27325	23079	31796	29166	33148	31153	31973	32792	33612	34798	45811
NOK	W304S	Hollywood	T1	W	23064	25224	24552	21792	24667	27900	27144	28905	29766	30627	31488	33326	41665
NOK	W304S	Hollywood	T3	W	15144	18120	22272	22056	23484	26470	28771	30353	31054	31755	32455	33341	41684
NOK	W305S	Okanagan Mission	T1	W	22342	22953	23296	22537	25927	25414	26300	30370	31189	33787	34651	35874	47576
NOK	W305S	Okanagan Mission	T2	W	12527	14958	15085	13339	17283	11874	19333	19892	20450	21008	21567	22284	28908
NOK	W306S	Recreation	T1	W	20280	23304	23136	21864	24528	25732	30354	31352	32351	33349	34348	35872	50807
NOK	W308S	Sexsmith	T1	W	24648	29520	29232	28464	20101	29145	33973	27500	31468	35435	40033	42598	62603
NOK	W313S	Saucier	T1	W	21024	22944	20808	20184	22944	20784	20639	22407	25075	25493	25911	26428	31141
NOK	W315S	Joe Rich	T1	W	13760	16067	15829	17849	16802	17820	2899	3117	3334	3552	3769	3817	4238
NOK	W316S	Duck Lake	T1	W	3716	4713	4929	8514	8960	9072	11944	8138	9012	9887	10761	11119	14424
NOK	W371S	D.G. Bell	T1	W	13337	16829	16780	17357	19774	19637	18565	21672	23416	25161	26905	28891	52786
NOK	W372S	Lee	T tert	W	15100	18912	17622	18712	20512	19129	23348	8373	5189	7124	7232	0	0
NOK	W311S	Ellison	T1	W						0	0	17415	24331	27782	30333	32009	50233
NOK	W310S	Black Moutain	T1	W						0	0	20012	23310	26608	29050	32926	73507
NOK	W301S	Big White	T1	W						0	14130	20705	21880	23055	24231	26651	59498
		Sub-Total NOK			224393	257196	254262	249151	271608	276628	308237	340408	363881	388535	408504	422579	631965

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. and Feb. 2004 data.

South Okanagan - Similkameen (winter)

South Okanagan/Similkameen					Winter Historical						Winter Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2013/14 Year 5	2028/29 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
SOK	W320S	Huth	T7//T4-6	W	11664	16051	16051	13136	13136	13488	15097	15298	15499	15700	15901	16116	18028
SOK	W320S	Huth13kV(HUT1)	T8	W	11221	13313	12621	12621	13714	6477	12157	12336	12516	12696	12876	13049	14597
SOK	W321S	Kaleden(KAL1)	T1	W	4706	4489	6317	4726	6481	6268	6568	6906	7243	7581	7918	8025	8977
SOK	W322S	Naramata	T1	W	5142	7200	6465	7347	6759	6048	7545	7744	7942	8140	8339	8564	10707
SOK	W323S	Okanagan Falls	T1	W	11600	13941	13419	13338	14600	14000	15107	14683	15054	15425	15796	16222	20282
SOK	W324S	Summerland	T2	W	12343	17647	15343	15266	16885	15744	17204	17538	17871	18205	18538	18889	21929
SOK	W325S	Waterford	T1	W	8144	11072	10496	8752	14980	17189	17421	17623	17826	18028	18230	18476	20667
SOK	W326S	West Bench	T1	W	6170	5942	7192	6802	7093	7454	8953	9188	9424	9659	9894	10161	12704
SOK	W327S	Westminster	T1/T2	W	17392	23872	21328	20064	22848	21088	24110	24349	24587	24825	25064	25314	27280
SOK	W329S	Trout Creek	T1	W	6122	7346	6556	6252	7033	6696	8004	8139	8274	8408	8543	8690	10089
SOK	W333S	Pine Street(PIN2)	T1	W	4619	5542	5755	5876	7559	6177	7661	7763	7865	7967	8069	8178	9148
SOK	W333S	Pine Street	T2	W	9168	11583	11090	10904	10980	11270	11380	11530	11681	11832	11983	12145	13585
SOK	W338S	Osoyoos	T1	W	8885	10841	10879	10721	10211	10960	5771	6229	6687	7144	7602	7924	10664
SOK	W338S	Osoyoos(OSO3)	T2	W	3600	6419	7050	6424	9261	8160	8368	8577	8785	8993	9202	9409	9409
SOK	W345S	Keremeos	T1	W	8387	11409	11390	10416	11862	11585	12490	14299	14548	14796	15045	15315	22181
SOK	W347S	Hedley	T1	W	3681	4905	4859	2709	4800	4640	4971	4988	5006	5023	5041	5109	5715
SOK	W380S	Anderson	T3	W	13320	14220	16332	20520	19971	14364	19066	19273	19482	19696	19914	20182	22576
SOK	W386S	Oliver	T1	W	5781	5277	7631	7336	10281	6170	10173	10380	10590	10804	11021	11894	22689
SOK	W390S	Princeton	T3	W	13895	18519	17388	16653	19700	17300	20587	20826	21069	21316	21568	22538	30334
SOK		Nk'Mip	T	W	0	0	0	0	0	0	5822	7036	8316	9666	11087	11686	18207
SOK	138kV	BC Gas (Terasen)	T	W	2347	2347	2347	105	0	0	500	500	500	500	500	500	500
SOK	138kV	Mascot	T	W	1623	1623	1623	0	0	0	0	0	0	0	0	0	0
		Sub-Total SOK			169810	213558	212132	199969	228154	205078	238957	245206	250766	256406	262131	268388	330269

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. and Feb. 2004 data.

Kootenay (winter)

Kootenay					Winter Historical						Winter Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2012/13 Year 5	2027/28 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
KT	W102S	Kaslo	T1	W	9256	10620	9232	8702	9085	7395	8112	8224	8336	8448	8560	8672	10535
KT	W103S	Coffee Creek	T3	W	5997	7817	6853	5450	5040	5615	5666	5716	5767	5817	5868	5920	6712
KT	W110S	Crawford Bay	T2	W	1992	2312	2200	5488	5303	5337	5476	5551	5627	5702	5778	5859	7118
KT	W110S	Crawford Bay	T3	W	2657	3500	3300	0	0	0	0	0	0	0	0	0	0
KT	W120S	Wynndel	T1	W	4016	4114	3428	3552	0	0	0	0	0	0	0	0	0
KT	W121S	Creston	T1	W	13268	16116	14719	11850	11528	12880	12996	13112	13228	13344	13460	13581	15396
KT	W121S	Creston	T2	W	9953	12420	11371	11500	9346	9128	9333	9417	9500	9583	9666	9753	11057
KT	W124S	Lambert	T1	W			1800	3850	11589	12599	12712	12826	12939	13053	13166	13284	15060
KT	W129S	Valhalla (VAL1)	T1	W	2936	3925	3413	3278	3400	3610	3642	3675	3707	3740	3772	3806	4315
KT	W130S	Passmore	T1	W	2808	4100	3820	3549	3673	3528	3733	3767	3800	3833	3867	3901	4423
KT	W131S	Playmor	T1	W	8916	11610	12242	11398	12074	10455	11604	11707	11811	11914	12018	12126	13746
KT	W132S	Slocan City (SLO1)	T1	W	5635	4519	5186	4400	4260	4453	4453	4453	4453	4453	4453	4453	4453
KT	W135S	Tarry's	T1	W	2880	3360	3360	2880	2826	3152	3152	3152	3152	3152	3152	3152	3152
KT	W200S	Whitewater (WHI1)	T1	W	365	345	323	350	337	0	0	0	0	0	0	0	0
KT	W201S	Cottonwood (COT1)	T1	W	0	0	0	0	0	357	357	363	370	377	383	391	508
KT	W202S	Salmo	T1	W	5616	6984	7056	6912	6371	6763	6962	7024	7086	7148	7211	7275	8248
KT	W204S	Hearns	T1	W	1367	263	160	200	1520	1576	1587	1598	1609	1620	1631	1643	1811
KT	W205S	Fruitvale	T1	W	5760	7445	6465	6432	6563	7409	7476	7542	7609	7676	7742	7812	8856
KT	W206S	Ymir (YMR1)	T1	W	972	1224	1187	1075	1102	960	1059	1069	1078	1088	1097	1107	1255
KT	W221S	Castlegar	T1	W	14733	17250	16644	17064	17700	16690	10700	10899	11099	11298	11498	11716	15248
KT	W222S	Blueberry	T1	W	7640	8375	7640	8330	7768	8543	7643	7785	7928	8070	8213	8369	10892
KT	W220S	Ootischenia	T1	W	0	0	0	0	0	0	7948	8096	8245	8393	8541	8703	11327
KT	W244S	Trail	T1	W	3000	2700	0	0	0	0	0	0	0	0	0	0	0
KT	W246S	Beaver Park	T1	W	6826	8263	7870	8082	8035	7556	7859	7967	8076	8184	8293	8409	10215
KT	W247S	Glenmerry	T1	W	8015	10559	10388	9977	9974	10254	10398	10541	10685	10828	10972	11125	13516
KT	W248S	Stoney Creek	T1	W	4805	6232	7367	6783	7315	7477	7582	7686	7791	7896	8000	8112	9856
KT	W256S	Paterson (PAT1)	T1	W	942	857	673	790	857	0	0	0	0	0	0	0	0
KT	W258S	Cascade	T1	W	7087	8000	8112	7336	8418	9300	9477	9653	9830	10007	10184	10377	13505
KT	63 kV	Celgar	T	W	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000	16000
KT	63 kV	P&T - Castlegar	T	W	7949	7298	7560	7870	7770	7830	7949	7949	7949	7949	7949	7949	7949
KT	63 kV	City of Nelson	T	W	22680	24228	22140	24263	25517	21380	25874	26231	26589	26946	27303	27685	33634
		Sub-Total Kootenay			184071	210436	200509	197361	203371	200246	209748	212005	214261	216518	218775	221181	258787
		Growth															

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. and Feb. 2004 data.

Boundary (winter)

Boundary					Winter Historical						Winter Projected Loading						
					2002/3	2003/4	2004/5	2005/6	2006/7	2007/8	2008/9 Year 0	2009/10 Year 1	2010/11 Year 2	2011/12 Year 3	2012/13 Year 4	2013/14 Year 5	2027/28 Year 20
Region	Sub No	Name	Trans		kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA	kVA
BND	W270S	Christina(CHR1)	T1	W	4583	4437	4275	4116	4572	4277	4636	4700	4764	4828	4892	4961	6026
BND	W271S	Ruckles	T1 -13 kV	W	9209	11532	11278	10076	10289	10502	10649	10859	11073	11289	11509	11670	14178
BND	W271S	Ruckles	T2	W	7310	9775	9040	9815	8820	7820	8128	8256	8384	8512	8640	8778	10963
BND	W275S	Grand Forks Terminal(GFT1)	T3	W	3141	4384	4221	6392	6485	6827	6957	7086	7216	7346	7476	7618	9914
BND	W290S	Kettle Valley	T1	W	0	0	0	0	0	0	14932	14992	15052	15113	15175	15342	17881
BND	W290S	Kettle Valley	T2	W	0	0	0	0	0	0	0	0	0	0	0	0	0
BND	W291S	Midway	T1	W	6552	7100	7100	7227	7159	7159	0	0	0	0	0	0	0
BND	W292S	Rock Creek(ROC1)	T1	W	2024	1983	2468	2448	3840	2760	0	0	0	0	0	0	0
BND	W292S	Rock Creek(ROC2)	T2	W	1114	1243	1440	2253	1689	2160	0	0	0	0	0	0	0
BND	W294S	Baldy(BAL1)	T1	W	592	592	1299	0		0	0	0	0	0	0	0	0
BND	W296S	Greenwood	T1	W	2086	2160	2160	2411	2556	2534	0	0	0	0	0	0	0
BND	63 kV	Roxul	T	W	8148	8211	8190	8043	8227	8463	8463	8463	8463	8463	8463	8463	8463
		Sub-Total Boundary Growth			44759	51417	51471	52781	53637	52502	53765	54357	54952	55551	56154	56831	67425

Footnote: Load forecasts are based on winter and/or summer peaks. Winter peaks span 2 years and include Nov. and Dec. of calendar year and Jan. and Feb. of the following year. i.e. 2003 data includes Jan. and Feb. 2004 data.

Appendix 2 Project Schedule and Estimate

Summary

CATEGORY	2009		2010	
	Update/07	Update/09	Update/07	Update/09
TRANSMISSION	58,083	96,123	41,174	88,675
Transmission Growth	51,907	84,396	33,458	76,178
Transmission Line Sustaining	3,439	7,024	3,864	7,109
Stations Sustaining	2,737	4,703	3,852	5,388
DISTRIBUTION	23,319	28,207	22,203	33,750
Distribution Growth	13,631	12,158	12,161	15,433
Distribution Sustaininng	9,688	16,049	10,042	18,317
TELECOM, SCADA, P&C	4,635	2,202	932	2,176
Telecom Growth	3,400	1,338	0	1,438
Telecom Sustaining	1,235	864	932	738
TOTAL T&D CAPITAL FORECAST	**86,037**	**126,532**	**64,309**	**124,601**

Transmission

TRANSMISSION PROJECT DESCRIPTION	Complete	2009 ($000s)		2010 ($000s)		Scheduled	Cancelled
	<2009	Update/07	Update/09	Update/07	Update/09	>2010	
TRANSMISSION GROWTH							
BULK SYSTEM							
DOUBLE CIRCUIT 230 kV VASEUX TO RG ANDERSON		20,000	28,512		23,519		
230/161/138 kV BENTLEY TERMINAL		15,000	16,241	3,934	13,703		
230 KV VASEUX TO BENTLEY		5,000	3,021		3,127		
KELOWNA SHUNTS & SVC				2,930		x	
VASEUX TRANSFORMER 3 (500/230 kV)			4,430		4,254		
CONVERT EXISTING OLIVER TO 138/63/13 kV DISTRIBUTION SOURCE STATION		500	3,590	4,216	3,582		
RG ANDERSON TERMINAL UPGRADE			5,995		5,506		
LEE TERMINAL AND BELL TERMINAL 138 kV UPGRADE			2,394		2,626		
63 kV and 138 kV CIRCUITS BENTLEY TO OLIVER			1,082		1,576		
TOTAL OTR		**40,500**	**65,265**	**11,080**	**57,893**		
KELOWNA AREA							
BIG WHITE 138 KV LINE AND SUBSTATION	x						
ELLISON DISTRIBUTION SOURCE			1,734				
ELLISON TRANSMISSION LOOP				3,489		x	
BLACK MOUNTAIIN DISTRIBUTION SOURCE			4,517				
FAULT LEVEL REDUCTION				1,634			x
CLOSE 138 kV LOOPS KELOWNA						x	
RECREATION CAPACITY INCREASE			178	2,749	3,401		
HOLLYWOOD (BENVOULIN DISTRIBUTION SOURCE) CAPACITY INCREASE		6,307	2,930		13,554		
BRAELOCH (SW) DISTRIBUTION SOURCE				1,582		x	
OK MISSION CAPACITY INCREASE							x
NORTH KELOWNA TRANSFORMER ADDITION							
KELOWNA DISTRIBUTION CAPACITY REQUIREMENTS			518		517		
STATIC VAR COMPENSATOR KELOWNA					400		
DUCK LAKE REGULATOR BANK	x						
PENTICTON/SUMMERLAND AREA							
NARAMATA REHABILITATION			3,962				
HUTH REBUILD AS 63 kV RING BUS				6,333	413		
SUMMERLAND 63 kV BACKUP						x	
WEST BENCH SUBSTATION REGULATOR BANK	x						
OSOYOOS/OLIVER AREA							
NEW EAST OSOYOOS SOURCE	x						
PRINCETON/KEREMEOS AREA							
PRINCETON TRANSFORMER 1 REPLACEMENT	x						
PRINCETON TRANSFORMER 2 REPLACEMENT						x	
HEDLEY STEP UP 5 MVA TRANSFORMER	x						
KEREMEOS NEW FEEDER				263			
BOUNDARY/GRAND FORKS AREA							
KETTLE VALLEY DISTRIBUTION SOURCE	x						
KETTLE VALLEY VOLTAGE CONVERSION	x						
BOUNDARY AREA STATION CONVERSIONS	x						
GRAND FORKS AREA VOLTAGE CONVERSIONS				2,532		x	
GRAND FORKS DISTRIBUTION SOURCE				3,796		x	

Transmission cont'd

TRANSMISSION PROJECT DESCRIPTION	Complete	2009 ($000s)		2010 ($000s)		Scheduled	Cancelled
	<2009	Update/07	Update/09	Update/07	Update/09	>2010	
CASTLEGAR AREA							
TARRYS SUBSTATION UPGRADE			403				
CASTLEGAR CAPACITY INCREASE (OOTISCHENIA SUBSTATION)			389				
COFFEE CREEK - KASLO AREA							
COFFEE CREEK TRANSFORMER 3 REPLACEMENT		2,600				x	
30 LINE CONVERT TO 63 kV		2,500	4,500				
CRAWFORD BAY AREA							
CRAWFORD BAY CAPACITY INCREASE	x						
CRESTON/WYNDELL AREA							
LAMBERT SUBSTATION UPGRADE	x						
NEW LAMBERT 230\63 KV TRANSFORMER	x						
NEW LAMBERT 230 kV RING BUS						x	
SOUTH SLOCAN AREA							
SLOCAN - NEW DENVER 63 KV LOOP							x
TRAIL/SALMO AREA							
YMIR FEEDER CONVERSION	x						
NEW 18 LINE BREAKER AT WANETA	x						
SUBTOTAL - TRANSMISSION GROWTH		**51,907**	**84,396**	**33,458**	**76,178**		

Transmission cont'd

TRANSMISSION PROJECT DESCRIPTION	Complete	2009 ($000s)		2010 ($000s)		Scheduled	Cancelled
	<2009	Update/07	Update/09	Update/07	Update/09	>2010	
TRANSMISSION LINE SUSTAINING							
TRANSMISSION LINE URGENT REPAIRS		326	288	331	293		
RIGHT OF WAY ENHANCEMENTS		347	311	384	345		
PINE BEETLE KILL HAZARD TREES			1,218		821		
RIGHT-OF-WAY RECLAMATIONS		326	550	383	602		
TRANSMISSION CONDITION ASSESSMENTS		680	427	760	496		
SWITCH ADDITIONS					132		
FUTURE YEAR REHABILITATION		1,760	1,639	2,006	1,888		
20 LINE REBUILD			1,943		1,540		
27 LINE REBUILD			648		642		
30 LINE REHABILTATION					350		
6A LINE REHABILITATION	x						
26 LINE REHABILITATION	x						
28 LINE REHABILATION	x						
SUBTOTAL - TRANSMISSION LINE SUSTAINING		**3,439**	**7,024**	**3,864**	**7,109**		
STATION SUSTAINING							
STATION ASSESSMENT AND MINOR PROJECTS		1,210	620	1,298	680		
STATION UNFORESEEN REPAIRS		447	473	445	448		
CMMS	x						
BULK OIL BREAKER REPLACEMENT		780			292		
WARFIELD TERMINAL CONNECTOR REPLACMENT AND DEFICIENCY CORRECTION	x						
GROUND GRID UPGRADES		300	572	322			
TRANSFORMER OIL FILTRATION/REPLACEMENT				264			
LTC OIL FILTRATION			32	258	64		
KASLO SUB UPGRADE				1,265		x	
PINE STREET BREAKER REPLACEMENT			345				
SLOCAN CITY - VALHALLA SUBSTATION UPGRADE			2,173				
PASSMORE SUBSTATION UPGRADE					1,987		
PRINCETON RECLOSER REPLACEMENT					1,513		
JOE RICH BREAKER					404		
CRESTON SUBSTATION PROTECTION			488				
WEST OSOYOOS TRANSFORMER REHABILITATION	x						
GRANDFORKS TERMINAL NOISE REDUCTION	x						
WESTMINSTER TRANSFORMER 1 REPLACMENT	x						
TROUT CREEK TRANSFORMER 1 REHABILITATION	x						
REPLACE COFFEE CREEK T2							x
REPLACE CRAWFORD BAY TRANFORMER 1							x
TAP CHANGER LEAK REPAIR AND UPGRADE	x						
SUBTOTAL - STATIONS SUSTAINING		**2,737**	**4,703**	**3,852**	**5,388**		
TOTAL - TRANSMISSION		**58,083**	**96,123**	**41,174**	**88,675**		

Distribution

DISTRIBUTION PROJECT DESCRIPTION	Complete	2009 ($000s)		2010 ($000s)		Scheduled	Cancelled
	<2009	Update/07	Update/09	Update/07	Update/09	>2010	
DISTRIBUTION GROWTH							
NEW CONNECTS SYSTEM-WIDE		8,401	9,788	9,291	10,670		
CIAC (credit amount)							
KELOWNA AREA							
KELOWNA GENERAL FEEDER PROTECTION	x						
MCKINLEY LANDING CAPACITY UPGRADE(#2 TO 477) FED SEXSMITH 3	x						
NEW GLENMORE FEEDER (50 LINE UNDERBUILD HIGH RD-CLIFTON)	x						
HOLLYWOOD 1 - DG BELL 3 / FA LEE 2 TIE	x	1,500					
HOLLYWOOD 1 - OK MISSION 1 TIE ALONG KLO RD	x						
MCKINLEY TO CLIFTON TIE				633		x	
FA LEE 2 - HOLLYWOOD 5 TIE, ADD N.O.	x						
GLENMORE 1 AND 2 / HOLLYWOOD 4 U/G CABLES	x						
HOLLYWOOD 1 AND 2 TIE	x						
FA LEE 2 REGULATOR	x						
SEXSMITH 4 REGULATOR							x
FEEDER EGRESS CABLES							x
NEW GLENMORE FEEDER			788				
FUTURE KELOWNA DISTRIBUTION UPGRADES		1,200		1,292		x	
HOLLYWOOD 3 - SEXSMITH 4 TIE		250			365		
AIRPORT WAY UPGRADE					1,551		
PENTICTON							
PRINCETON 4 CAPACITY UPGRADE		1,350				x	
OK FALLS 3 CAPACITY UPGRADE	x						
OSOYOOS/OLIVER							
25 KV TIE TO ANARCHIST/BRIDESVILLE						x	
OLIVER 01 REGULATOR					137		
SIMILKAMEEN							
KEREMEOS FEEDER				158		x	
KEREMEOS 1 CAPACITY UPGRADE	x	200					
KEREMEOS 2 CAPACITY UPGRADE	x						
BOUNDARY/GRAND FORKS AREA							
CHRISTINA LAKE FEEDER 1 CAPACITY UPGRADE			608		489		
TRAIL/ROSSLAND AREA							
W. TRAIL VOLTAGE CONVERSION	x						
PATERSON 25 KV FEED	x						
BEAVER PARK FEEDER 2 TO FRUITVALE FEEDER 1 TIE\UPGRADE					1,227		
SOUTH SLOCAN							
VALHALLA 1 CAPACITY UPGRADE	x						
CRESTON AREA							
CRAWFORD BAY 2 CAPACITY UPGRADE	x						
GENERAL							
SMALL CAPACITY IMPROVEMENTS, UNFORSEEN PRIMARY & SECONDARY VOLTAGE PROBLEMS, RELIABILITY IMPROVEMENTS, SWITCHING IMPROVEMENTS		730	974	787	994		
SUBTOTAL - DISTRIBUTION GROWTH		**13,631**	**12,158**	**12,161**	**15,433**		

Distribution cont'd

DISTRIBUTION PROJECT DESCRIPTION	Complete	2009 ($000s)		2010 ($000s)		Scheduled	Cancelled
	<2009	Update/07	Update/09	Update/07	Update/09	>2010	
DISTRIBUTION SUSTAINING							
DISTRIBUTION CONDITION ASSESSMENTS		710	599	760	667		
DISTRIBUTION REHABILITATION		2,060	3,124	1,974	3,470		
PINE BEETLE KILL HAZARD TREES			722		551		
RIGHT-OF-WAY RECLAMATION		639	621	686	646		
DISTRIBUTION LINE REBUILDS		1,931	1,178	2,143	1,167		
SMALL PLANNED CAPITAL		410	668	419	747		
PCB PROGRAM		870	1,073	919	1,117		
FORCED UPGRADES AND LINE MOVES		1,396	1,255	1,472	1,461		
DISTRIBUTION URGENT REPAIRS		1,572	1,911	1,564	1,805		
AESTHETIC AND ENVIRONMENTAL UPGRADES		100	100	105	100		
COPPER CONDUCTOR REPLACEMENT			4,798		6,586		
SUBTOTAL - DISTRIBUTION SUSTAINING		**9,688**	**16,049**	**10,042**	**18,317**		
TOTAL - DISTRIBUTION		**23,319**	**28,207**	**22,203**	**33,750**		

Telecommunications, SCADA and Protection and Control

TELECOM, SCADA, P&C PROJECT DESCRIPTION	Complete	2009 ($000s)		2010 ($000s)		Scheduled	Cancelled
	<2009	Update/07	Update/09	Update/07	Update/09	>2010	
TELECOM, SCADA, P&C GROWTH							
DISTRIBUTION SUBSTATION AUTOMATION, METERING AND COMMUNICATIONS		1,000	1,338		1,438		
TRAIL-OLIVER PHASE 1 HIGH CAPACITY COMMUNICATIONS	x	2,400					
TRAIL-OLIVER PHASE 2 HIGH CAPACITY COMMUNICATIONS						x	
TELECOMMUNCIATIONS BACKBONE LOOP CLOSE						x	
TELECOMMUNICATIONS FOR BUSINESS SYSTEMS						x	
SUBTOTAL - TELECOM, SCADA, P&C GROWTH		**3,400**	**1,338**		**1,438**		
TELECOM, SCADA, P&C SUSTAINING							
NARROW SPECTRUM CONVERSION	x						
HARMONIC REMEDIATION		105	117	114	119		
RELAY TEST/MAINTENANCE PROCESS	x						
COMM EQUIPMENT TEST/MAINTENANCE PROCESS	x						
PROTECTION UPGRADES		651	448	697	508		
FAULT LOCATING INACCESSIBLE LINES		158	0		0		
COMMUNICATIONS UPGRADES		321	299	121	111		
SUBTOTAL - TELECOM, SCADA, P&C SUSTAINING		**1,235**	**864**	**932**	**738**		
TOTAL - TELECOM, SCADA, P&C		**4,635**	**2,202**	**932**	**2,176**		