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Editing sample from writer/editor Stephen Arthur 2008 — WHITE PAPERS

This document is a sample of editing BC Transmission Corporation’s *2007 State of the Transmission System Report* for re-use in 2008 (when new developments were added). This sample shows excerpts of the edited draft, followed by the original document for comparison. The full STSR documents for both 2007 and 2008 have been made public by BCTC.

Objectives for editing were:

- Provide only the context for evaluating the Capital Plan. The Utilities Commission wants to see how the current state of the system matches BCTC’s strategies for growing and sustaining the system—where we are compared to where we’re going. The Capital Plan then addresses how we’re going to get there.
- Be shorter and more readable. It should be about 50 pages long, instead of 115.
- Be easier to update.

The text was condensed by:

- eliminating all project details while retaining all strategic issues
- summarizing where appropriate
- copy-editing to make it concise and to remove redundancy within the document and with respect to the Capital Plan

(A) EDITED DRAFT (EXCERPTS)

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4.0 WECC INITIATIVES OF INTEREST TO BCTC

Several proposed interconnections and initiatives in neighbouring jurisdictions could have impacts on the existing transmission system or on proposed projects in BC. A general requirement of member systems in the WECC is that projects are coordinated between companies or system operators to avoid negative impacts on neighbouring systems. BCTC monitors and participates in WECC processes to ensure that BCTC's interests, and those of its customers, are protected and advanced.

BCTC also studies these initiatives in terms of the objectives of the new BC Energy Plan for self sufficiency and renewable energy. To enable BC Hydro to optimize the economic value of its generation assets, BCTC will likely need to expand the capacity of both internal transmission facilities and intertie facilities, to allow selling surplus energy.

The federal governments and legislatures in Canada and the US are exploring ways to introduce new national standards on clean, renewable sources of electricity, commonly referred to as "green energy". California has set the most aggressive targets for green energy on the Pacific coast, mandating a 20% Renewable Portfolio Standard by 2010 with potential for a 33% target by 2020.

California has diminishing potential to meet these targets in-state and is interested in partnering with BC to source green energy. Premier Campbell supports the joint initiative and signed a Memorandum of Understanding in June 2007 with Governor Schwarzenegger to work with California on this. New transmission infrastructure would likely be needed to enable BC Hydro and BC IPPs to pursue these opportunities.

4.1 Transmission Expansion Initiatives in Alberta

4.1.1 New BC-Alberta Intertie

Section 2.2.6.1 discusses the recommendations for an expanded intertie. The study by BCTC and the AESO considered two routing options: a new 500 kV connection in the north, and a second 500 kV connection in the south, roughly paralleling the existing 500 kV connection. The working group will next consider mechanisms for sharing costs and benefits.

4.1.2 Edmonton-Calgary 500 kV Line

In 2005, an application was made to the AEUB to build two parallel 500 kV circuits between Edmonton and Calgary. This line would restore the Alberta export capacity on the AB-BC Intertie. When this intertie limit is restored, the constraints on electricity trade with Alberta will likely be on internal paths in the BC system.

This project was originally due for completion in 2009. In 2007, the regulatory processes for this project ran into landholder resistance and AEUB ended its proceedings. The project proponent is revising the original project concept and is re-examining a number of design and route alternatives.

4.1.3 Wind Power in Southwest Alberta

In September 2007, the AESO lifted a 900 MW limit that it had imposed on the integration of wind power generation. This change should result in the integration of more wind power generation, which by some estimates would be over 3000 MW. The first circuit is scheduled for completion in 2008.

The addition of wind power in Alberta will increase the AESO's need for generation reserves and dynamic scheduling. As a result, there could be opportunities for BC Hydro and others to provide these services.

Additional intermittent, renewable generation in Alberta could also provide BC with a source of lower cost imports when Alberta has surplus energy.

Alberta wind power could also result in AESO building a new 500/240 kV substation near Pincher Creek, which would provide a close interconnection point to expand the intertie capacity between BC and Alberta.

The addition of wind power in southwest Alberta has caused overloading on BCTC's 138 kV ties from Natal into Alberta. A study is underway with Alberta to determine the best solution.

4.1.4 Northwest Alberta

In August 2006, the AESO received regulatory approval to reinforce the regional transmission system throughout Northwest Alberta. The first phase of this project, planned to come in service in 2009, is a reinforcement of the Rainbow Lake system into which the Fort Nelson area is integrated. For BCTC this might be an opportunity to reinforce the supply to the Fort Nelson region through the Alberta system.

4.1.5 Alberta/Montana

Montana Alberta Tie Ltd. (MATL) is building a merchant transmission project between Lethbridge and Great Falls in northern Montana. The MATL project has been granted an Accepted WECC Rating of 300 MW. This tie would complicate the operation of the existing BC-AB intertie, increase the competition for electricity trade with Alberta, and impact the electric system in BC when the Montana-Alberta transmission path has contingency events.

BCTC participates in the Project Review Group for the WECC rating of the MATL project to ensure there are sufficient operating procedures and remedies to address impacts of this new line to the BCTC system. The MATL project is planned to come into service in December 2008.

4.1.6 "Northern Lights" Initiative

TransCanada Pipelines proposes a High Voltage DC transmission path from Alberta to the US through the southeastern corner of BC, to be completed by 2015 or later. This route would give BCTC an opportunity to expand intertie capacity with both Alberta and the US within one project.

4.2 Transmission Expansion Initiatives in the US

4.2.1 Pacific Gas & Electric

Pacific Gas and Electric (PG&E) concluded a WECC Regional Planning Review to investigate the feasibility of delivering renewable energy from the WECC Region to Northern California. This project is driven by California's Renewable Portfolio Standard (RPS). The preferred alternative includes a 1500 MW 500 kV line extending from Selkirk in BC to Oregon.

By participating in the Steering Committee of the current WECC Project Rating Review, BCTC will focus on the required upgrades to BCTC's internal bulk system for this proposed project. The target in-service date for the PG&E project is Q4 of 2015.

There could be synergies between this project and the Northern Lights project because there is potential to develop co-generation projects in the Alberta oil sands to feed into a potential northern segment of the proposed PG&E Canada-California project.

4.2.1.1 Competition from the "Frontier Line"

The Frontier Line is a major project proposed by Western US state governors to deliver clean coal and wind energy from Montana, Wyoming, and Colorado to major load centers in Utah, Nevada, and California. The significance to BC is that it competes with the potential PG&E project from BC to California by delivering renewable energy from Montana and Wyoming to Northern California.

4.2.1.2 Synergy with PacifiCorp

PacifiCorp announced plans to build more than 1,200 miles of new 500 kV lines originating in Wyoming and connecting into Utah, Idaho, Oregon, and the desert southwest. The two lines are set for completion in 2014. The lines would likely connect with the lines from the PG&E project. This connection between two high capacity transmission projects would improve the use of existing regional resources and transmission, and the economic viability of both projects.

4.2.2 Juan de Fuca Cable (JDF)

Sea Breeze Power proposes to build a 49-km HVDC Light submarine cable transmission interconnection across the Strait of Juan de Fuca, connecting Port Angeles substation on the Olympic Peninsula in Washington State with Pike Lake Substation near Victoria, BC. The JDF project has achieved WECC Phase 2 status, with a planned rating of 550 MW. The project also includes upgrades to the transmission networks west of Puget Sound on the Olympic Peninsula.

BCTC has started work on a commissioned study of the interconnection.

4.2.3 Portland General Electric Southern Crossing

In 2007, Portland General Electric initiated a WECC Regional Planning Review for a proposed project that would improve service to loads in the BPA system, and would enable integration of significant renewable resources located in central Oregon. The proposed project would significantly increase the east-to-west transfer capacity to the

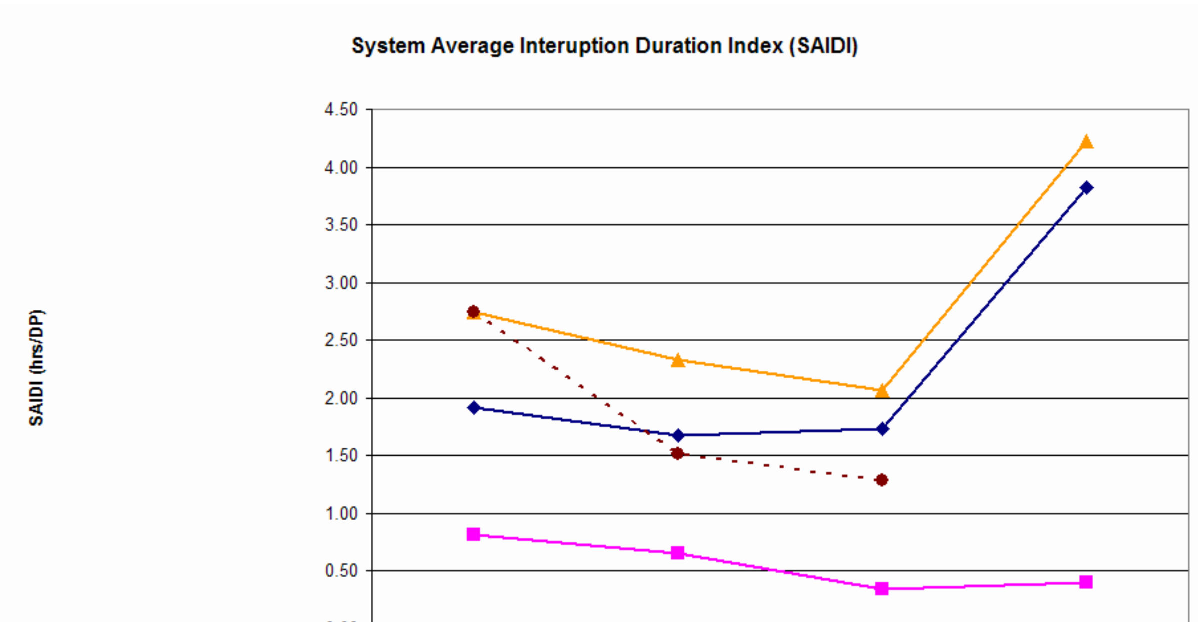
California intertie. Portland General Electric is examining synergies with other regional projects.

8.0 SYSTEM PERFORMANCE MEASURES

8.1 System Average Interruption Duration Index (SAIDI)

SAIDI is a measure of the reliability of the transmission system. It is calculated as the average amount of time in hours, across all transmission delivery points, that service is interrupted in a year because of forced or planned outages. Figure 8-1 compares BCTC's SAIDI—both forced and planned—with the industry composite SAIDI for forced outages only, taken from the Canadian Electrical Association (CEA) benchmarking study.

Figure 8-1. SAIDI F2004 to F2007



	F2004	F2005	F2006	F2007
SAIDI Forced	1.92	1.68	1.73	3.82
SAIDI Planned	0.82	0.65	0.34	0.41
SAIDI Total	2.74	2.33	2.07	4.23
CEA Composite (with 2003 Fire)	2.74	1.51	1.29	

BCTC's total SAIDI is the result of six categories of causes. These are Planned Outages, Operations, Defective Equipment, Trees & Animals, Third Party, and Environment & Weather. Figure 8-2 shows the historical contribution of these six categories of causes to BCTC's total SAIDI over the past five years. This high level view of SAIDI is useful for monitoring the impact of asset-management programs on these contributors.

Figure 8-2. SAIDI Breakdown by Cause Category

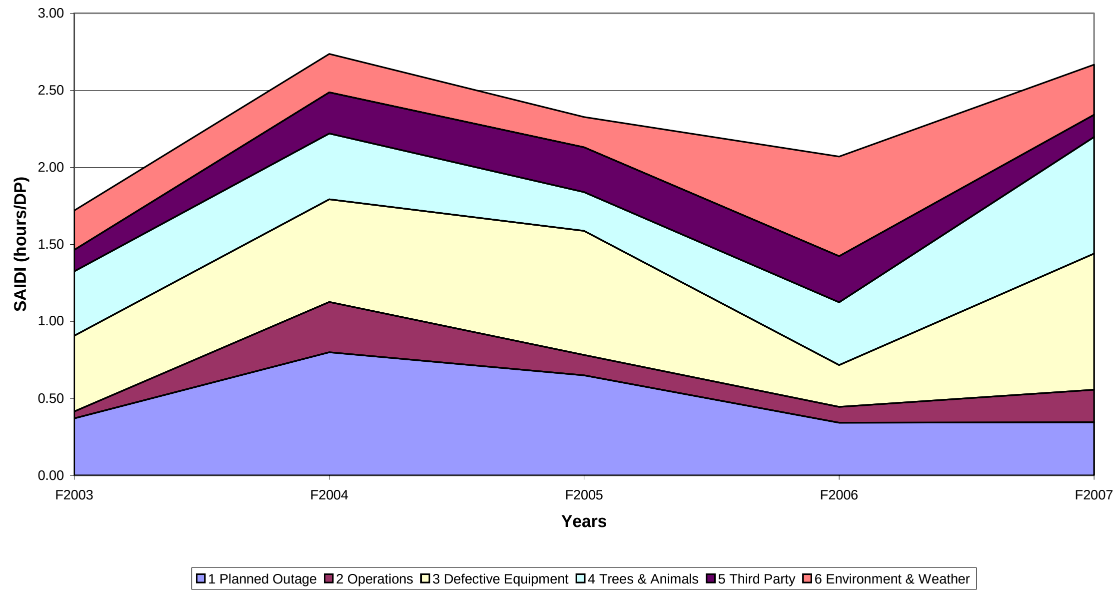
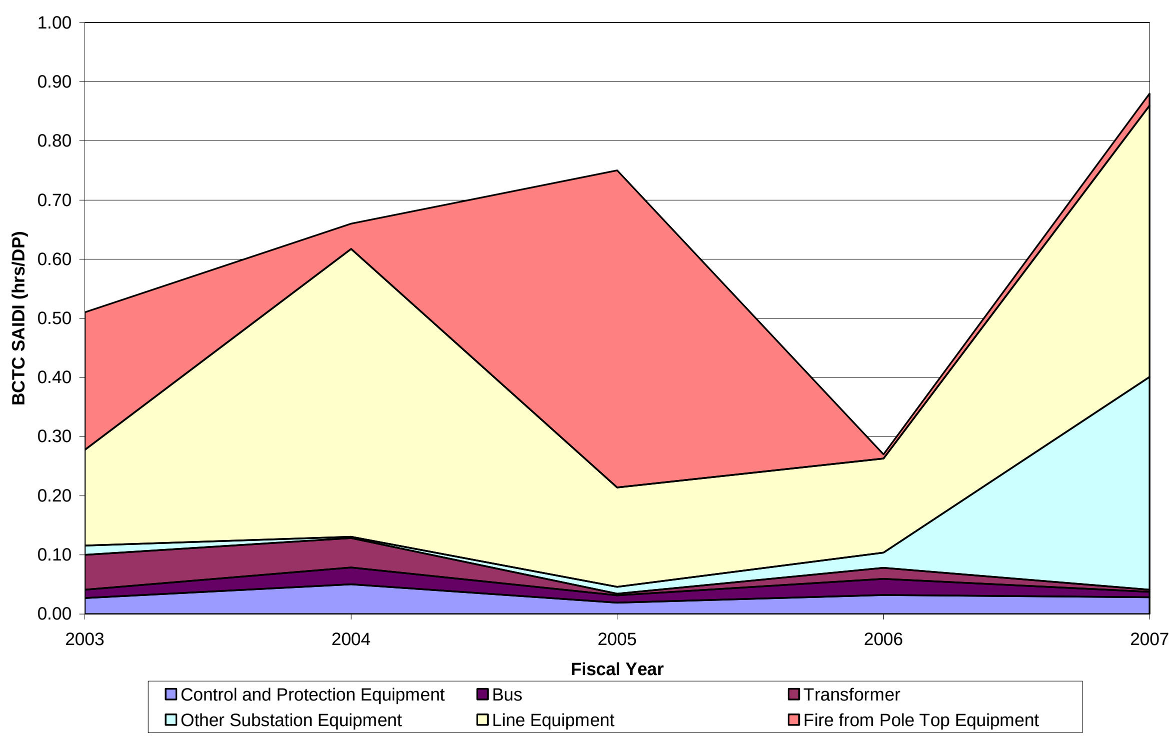


Figure 8-3 presents a breakdown, by equipment type, of the "Defective Equipment" Cause Category. Pole Top Equipment and Line Equipment are the main contributors.

Figure 8-3. SAIDI Breakdown by Equipment Type – Defective Equipment



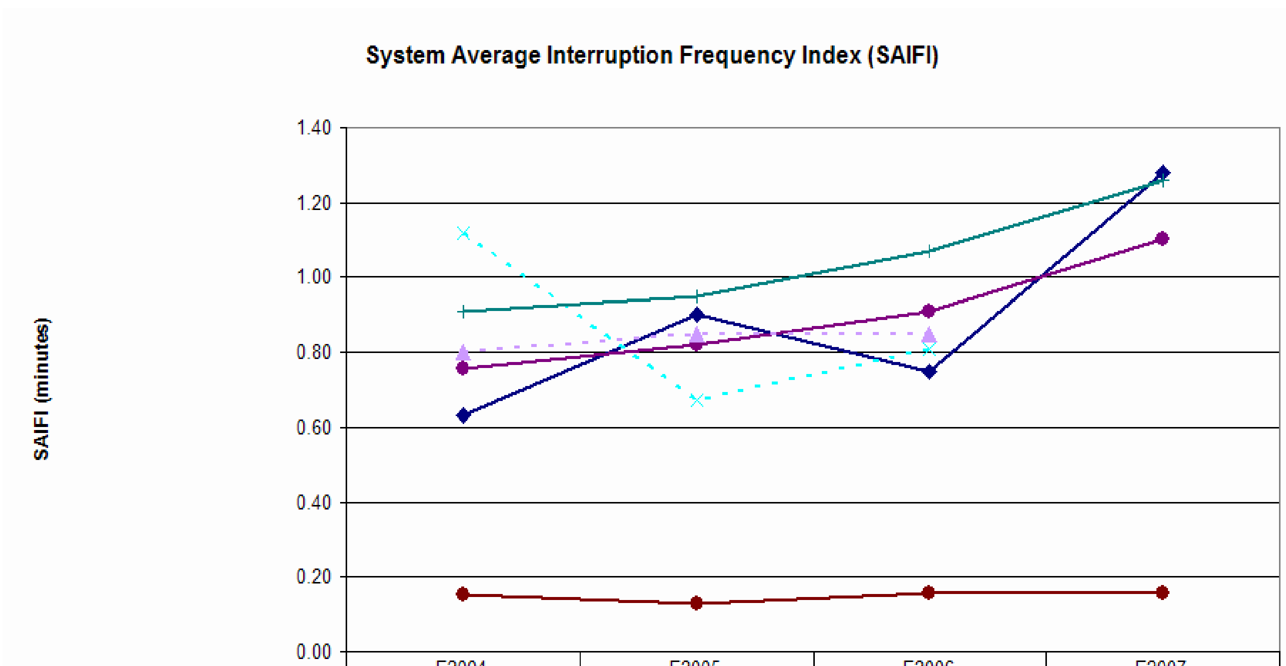
In F2006, BCTC undertook a bonding program to reduce the number of pole top fires. BCTC expects to complete the bonding program in F2010. BCTC has also focused its efforts on reducing delivery-point outages caused by line equipment.

8.2 System Average Interruption Frequency Index (SAIFI)

System Average Interruption Frequency Index (SAIFI) is a measure of the reliability of the transmission system. It is calculated as the total number of interruptions across all delivery points in a year. It includes all forced and planned outages except interruptions attributed to generators. BCTC does not have a target for SAIFI.

Figure 8-4 provides historic SAIFI results for the period F2004 to F2007 for BCTC and the CEA composite for forced outages only. Interruptions less than one minute in duration are categorized as Momentary (SAIFI-MI). Interruptions one minute or greater are categorized as Sustained (SAIFI-SI).

Figure 8-4. SAIFI F2004 to F2007



	F2004	F2005	F2006	F2007
SAIFI-MI Forced	0.63	0.90	0.75	1.28
SAIFI-MI CEA Composite	1.12	0.67	0.81	
SAIFI-SI Forced	0.76	0.82	0.91	1.10
SAIFI-SI Planned	0.15	0.13	0.16	0.16
SAIFI-SI Total	0.91	0.95	1.07	1.26
SAIFI-SI CEA Composite	0.80	0.85	0.85	

Note 1: BCTC's SAIDI excludes the impact of the F2004 wildfires.

Note 2: The Eastern Blackout has been excluded from the F04 CEA Composite.

The programs that BCTC is undertaking to improve SAIDI, discussed in Section 8.1, are also expected to improve BCTC's SAIFI. These programs address certain types of equipment outages, so they reduce the frequency of the outages as well.

8.3 Delivery Point Unreliability Index (DPUI)

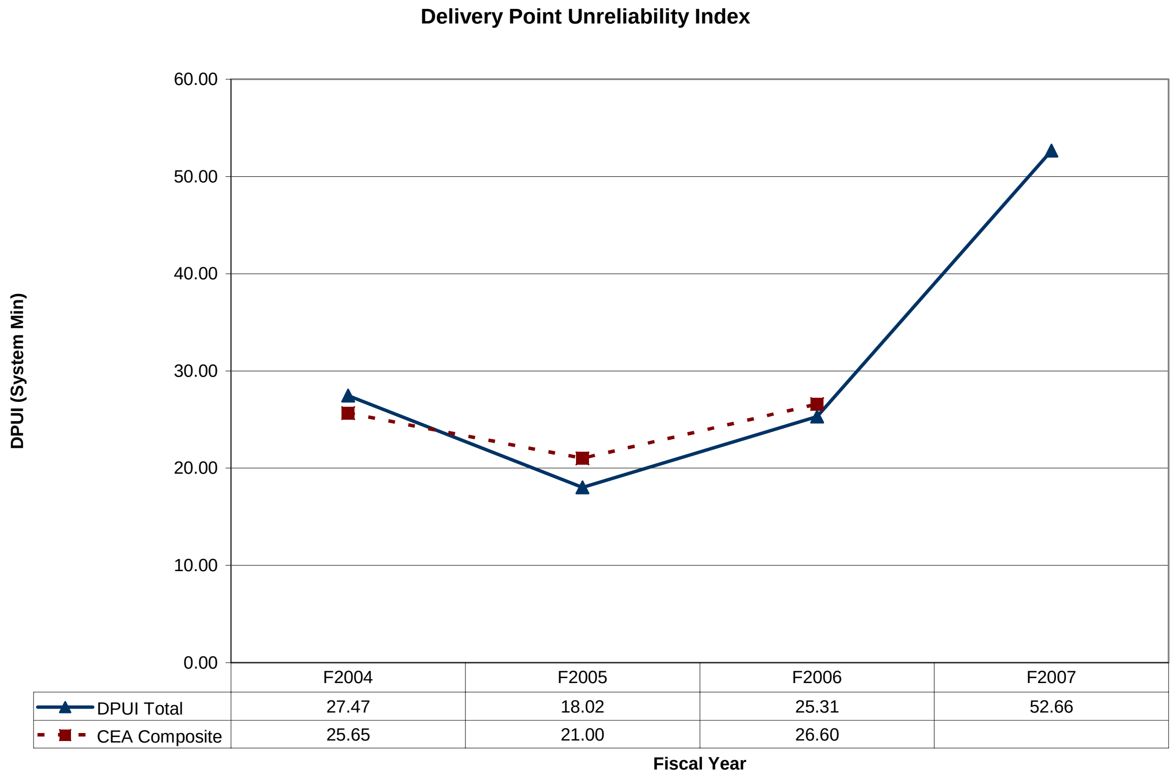
The Delivery Point Unreliability Index (DPUI) is a composite index of reliability in terms of System Minutes. It includes all forced and planned outages except interruptions attributed to generators. DPUI is calculated as follows:

$$DPUI = \frac{\text{Total Unsupplied Energy (MW Minutes)}}{\text{System Peak Load (MW)}}$$

If the total energy not supplied because of all outages was produced by a single outage event that caused whole system blackout during the peak time, DPUI indicates how long this equivalent outage would last.

Figure 8-5 provides historic results of the DPUI measurement from F2004 to F2007.

Figure 8-5. DPUI F2004 to F2007



	F2004	F2005	F2006	F2007
DPUI Total	27.47	18.02	25.31	52.66
CEA Composite	25.65	21.00	26.60	

8.4 Outage Indices by Voltage and Equipment Class

The following are examples of the types of data BCTC currently collects for external reporting on equipment reliability. BCTC maintains a database on forced outages of major system components. BCTC reports that information annually to the CEA. Tables 8-1 and 8-2 provide BCTC-specific calendar-year data collected on forced outages compared to the CEA average reported from all Canadian electric utilities.

8.5 Operational Response to Intertie Congestion

Managing congestion is a complex challenge because congestion has causes beyond BCTC's control, such as market conditions that encourage electricity trading, and limits and transfer loadings on neighbouring systems.

This performance measure considers BCTC's operation of the interties with Alberta and the US. These interties are significant for trade. There is abundant data available on their use.

The measure is defined as the percent of congested hours caused by BCTC when less than 90% of the maximum theoretical capacity of the intertie was available. "Maximum theoretical capacity" is the transmission capacity on a path if all transmission circuits and equipment were in service.

Performance for each hour is determined as shown in Figure 8-6. A determination is made for every hour of the month for each of the four intertie paths, inbound and outbound with Alberta and the US.

Figure 8-6. Calculating Operational Response to Intertie Congestion

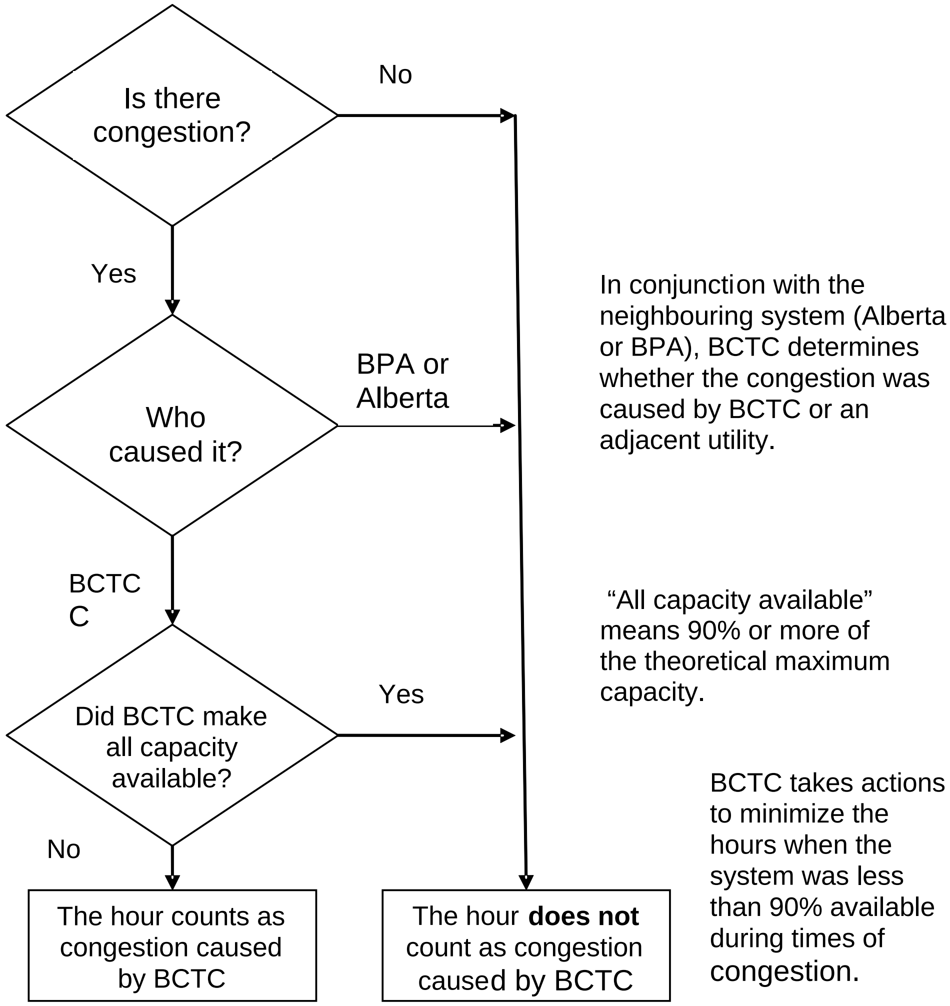
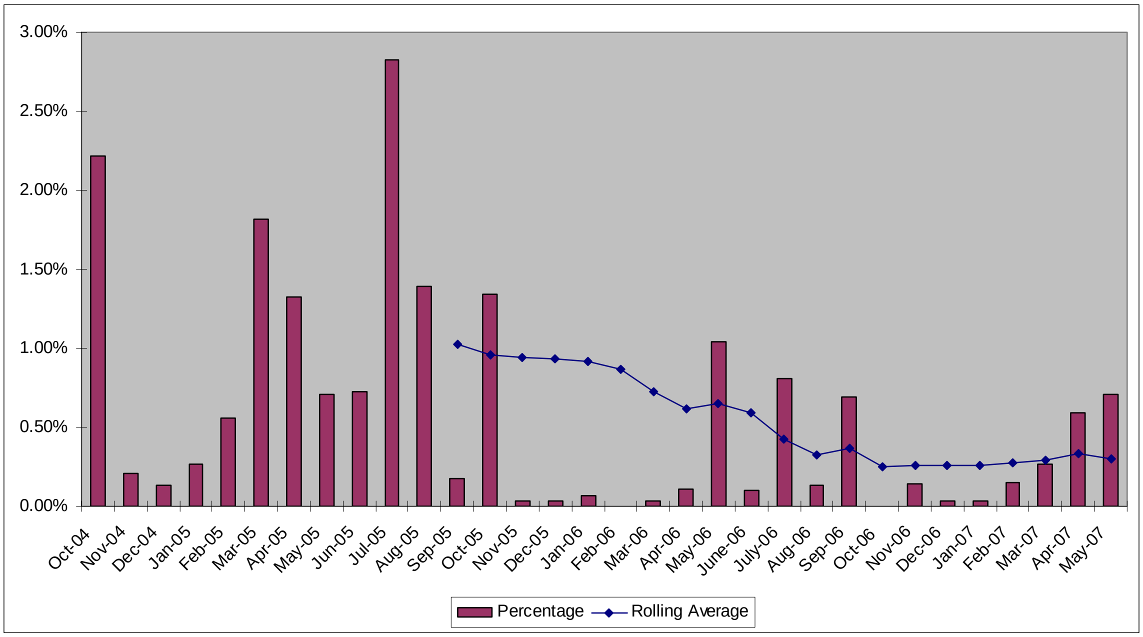


Figure 8-7 presents results of this measure for the period October 2004 through May 2007. As shown by the twelve-month rolling average line, BCTC's performance improved since the establishment of this measure in early 2006.

Figure 8-7. Operational Response to Intertie Congestion Oct 2004 to May 2007



(B) ORIGINAL DOCUMENT (EXCERPTS)

4.0 WECC INITIATIVES OF INTEREST TO BCTC

The following section provides an updated report on the initiatives captured in the 2006 STSR, and describes new developments within the WECC region.

There are proposed projects in neighbouring jurisdictions and proposed new interconnections that could have impacts on the existing transmission system or on proposed projects in BC. It is a general requirement of member systems in the WECC that projects are coordinated between companies and/or system operators to avoid negative impacts on neighbouring systems. BCTC monitors and, where necessary, participates in WECC processes to ensure that BCTC's interests and those of its customers are protected and advanced.

BCTC also studies these initiatives to understand how they may impact the self sufficiency and renewable energy objectives of the new Energy Plan.

The new Energy Plan directs BC Hydro to acquire sufficient electricity supply from sources within BC by 2016 to meet its domestic demand under critical water year conditions, and to provide a surplus of 3000 GWh by 2026. To enable BC Hydro to optimize the economic value of its generation assets, including the value of its regional electricity trade, it will likely be necessary for BCTC to expand the capacity of both its internal transmission facilities and of its inter-tie facilities with neighbouring jurisdictions to allow for the sale of surplus energy when not needed internally.

Federal governments and legislatures in Canada and the US are actively exploring ways to introduce new national standards on clean renewable sources of electricity, commonly referred to as "green energy". California has set the most aggressive targets for green energy supply on the Pacific coast, mandating a 20% Renewable Portfolio Standard by 2010 with potential for a 33% target by 2020. California has diminishing potential to meet these targets with in-state renewable generation and is interested in partnering with BC to source green energy. Premier Campbell supports the joint initiative and signed a Memorandum of Understanding in June 2007 with Governor Schwarzenegger to work with California on this. Consequently, BCTC anticipates an expansion of US market demand for clean and renewable generation in BC. New transmission infrastructure would likely be required to enable BC Hydro and BC IPPs to pursue these opportunities.

4.1 Transmission Expansion Initiatives in Alberta

4.1.1 New BC-Alberta Intertie

In 2006, BCTC and the AESO started a high level study to assess the economic viability of a new Alberta-BC intertie circuit. The study considered two routing options: a new 500 kV connection in the north; and a second 500 kV connection in the south, roughly paralleling the existing 500 kV connection.

The study was completed in mid-2007 and concluded that, for both BC and Alberta, an expanded intertie would provide a number of benefits, such as greater future supply adequacy; improved integration and operation of intermittent generation; greater utilization of generation resources on a regional basis; and lower electricity price volatility. There was broad recognition of a number of non-monetized benefits such as system reliability and market liquidity. The working group will next consider mechanisms for sharing costs and benefits.

4.1.2 Edmonton-Calgary 500 kV Transmission Line

In 2005, an application was made to the AEUB to build a 500 kV circuit between Edmonton and Calgary. This line would supply energy to fast-growing Southern Alberta and would partially restore the Alberta export capacity on the AB-BC Intertie, by relieving the limitations in the Alberta system that occur when BC is importing energy from Alberta during heavy load periods. The second phase of the project would add a parallel line between Edmonton and Calgary that would fully restore the AB-BC inter-tie to its rated capacity. When this inter-tie limit is restored, the constraints which limit increases to electricity trade with Alberta will likely be on internal paths in the BC transmission system.

This project was originally due for completion in 2009. In 2007, the regulatory processes for this project ran into significant landholder resistance and AEUB ended its proceedings.

The project proponent is revising the original project concept and is re-examining a number of design and route alternatives.

4.1.3 Southwest Alberta

In 2005, the AEUB approved a need application for a transmission project to build two 240 kV circuits south of Calgary to enable the integration of up to 600 MW of wind generation in southwest Alberta. The first circuit was scheduled for completion in 2007 but has been delayed until late 2008.

In September 2007, the AESO lifted a 900 MW limit, which it had imposed on the integration of wind power generation due to uncertainties related to the amount of generation reserves required to compensate for the intermittent nature of wind power. This is expected to result in the ultimate integration of more wind power generation resources, which by some estimates will provide well over 3000 MW.

The addition of wind in Alberta will increase the AESO's need for generation reserves and dynamic scheduling. As a result, there may be opportunities for BC Hydro and others to provide these services. Additional intermittent, renewable generation could also provide BC with a source of lower cost imports when Alberta has surplus energy. In the long term, it may also result in AESO building a new 500/240 kV substation near Pincher Creek to integrate the wind power generation, which would also provide a close interconnection point to expand the inter-tie capacity between BC and Alberta.

The addition of wind in southwest Alberta has caused overloading at times on BCTC's 138 kV ties from Natal into Alberta. A study is underway with Alberta to determine the best solution to this issue.

4.1.4 Northwest Alberta

In August 2006, the AESO received regulatory approval to reinforce the regional transmission system throughout the northwest Alberta region between the areas of Wabasca and Peace River. This region has reached capacity on many circuits and a number of many must-run generation contracts costing about $40 million a year are being relied upon to serve the load.

The first phase of this project, planned to come in service in 2009, is a reinforcement of the existing Rainbow Lake area transmission system into which the Fort Nelson area is integrated. The planned second phase of the project is a second 240 kV supply line to Wesley Creek, scheduled to be completed by 2014.

These reinforcements are designed to serve the load growth in Alberta and may not meet the load growth in BC. However, given the expected load growth in the Fort Nelson region, there may be an opportunity to reinforce the supply to the Fort Nelson region through the Alberta system.

4.1.5 Alberta/Montana

Montana Alberta Tie Ltd. (MATL) is seeking approval to build a merchant transmission project between Lethbridge in southern Alberta and Great Falls in northern Montana. The 300 km, 240 kV transmission line would provide 300 MW of capacity.

This tie would complicate the operation of the existing BC-AB intertie, increase the competition for electricity trade with Alberta, and impact the electric system in BC when the Montana-Alberta transmission path has contingency events.

It appears that the funding for this project is not yet fully secured, but despite this, regulatory applications in various jurisdictions have progressed. In April 2007, the National Energy Board (NEB) granted MATL a Permit to construct this transmission project. In August 2007, the MATL project achieved Phase III status of the WECC rating review process, and was granted an Accepted Rating of 300 MW.

BCTC participates in the Project Review Group of the WECC rating review process for the MATL project, to ensure there are sufficient operating procedures and remedies to address any potential impacts of this new line to the BCTC system. The MATL project is planned to come into service in December 2008.

4.1.6 Northern Lights

TransCanada Pipelines is proposing a transmission path from Alberta to the U.S. through the southeastern corner of BC. This route would provide BCTC with an interconnection opportunity to expand inter-tie capacity with both Alberta and the US within one project.

This proposed project could transmit over 2000 MW of Alberta oil sands or Montana/Wyoming wind and coal generation to Washington or to California markets. A Direct Current (DC) transmission line is the preferred option due to lower overall costs (including transmission losses over this long path).

There could be synergies between this project and the proposed PG&E BC-California project discussed in Section 4.2.1, as there is potential to develop cogeneration projects in the Alberta oil sands to feed into a potential northern segment of the proposed PG&E Canada-California project.

The project cost was estimated in the $2 billion range over a year ago, but general cost escalations suggest the costs would be higher today. TransCanada held a WECC Regional Review Group meeting in September 2006 but there has been little public consultation since then. This project has an earliest completion date of 2015.

4.2 Transmission Expansion Initiatives in the United States

4.2.1 Pacific Gas & Electric

Pacific Gas and Electric (PG&E) initiated a WECC Regional Planning Review process in 2006 to investigate the feasibility of delivering either 1500 MW or 3000 MW of renewable energy from the WECC Region (including the Pacific Northwest) to Northern California. This project is driven by California's Renewable Portfolio Standard (RPS) target of 20 percent by 2010, which, pending legislation, may increase to 33% by 2020.

Three study groups reviewed resource availability, transmission requirements and economic feasibility. The regional planning process studied a variety of resource options, including Canadian (BC and Alberta) renewable resources. As well, a variety of transmission route alternatives, involving both overhead and underwater cable solutions were identified and studied. BCTC participated in each of the study groups, and sits on the Steering Committee.

The WECC Regional Planning Review process for the PG&E project concluded in October 2007. The preferred alternative that emerged from this process is a hybrid transmission project consisting of a 1500 MW 500 kV AC line extending from Selkirk in BC to McNary or Grizzly in Oregon, at which point the line would convert to a 500 kV DC line capable of transmitting 3000 MW south to Tesla in northern California.

The next phase of the WECC planning process for the PG&E project is the WECC Project Rating Review process. This phase is expected to commence in November of 2007 and last approximately one year. Through Steering Committee participation, BCTC will place particular focus on the required upgrades to BCTC's internal bulk transmission system for this proposed project. The target in-service date for the PG&E project is Q4 of 2015.

4.2.2 PacifiCorp and Idaho Power Expansion

This potential project would consist of new 500 kV lines between Utah/Wyoming and Oregon and is synergistic with PG&E's potential 3000 MW transmission project for the "Canada Resources" option described above.

PacifiCorp announced plans to build more than 1,200 miles of new 500 kV lines originating in Wyoming and connecting into Utah, Idaho, Oregon and the desert southwest. The two lines are set for completion in 2014. The $4 billion-plus project includes plans to deliver wind and other renewable energy resources to more customers throughout PacifiCorp's six-state service area and the western region. The lines would likely connect with the 500 kV transmission lines from the PG&E project described above, near the existing Burns substation in Eastern Oregon. This connection between two high capacity transmission projects would enable improved utilization of existing regional resources and transmission, improving the economic viability of both projects.

4.2.3 Juan de Fuca Cable (JDF)

Sea Breeze Power proposes to build a 49-km HVDC Light submarine cable transmission interconnection across the Strait of Juan de Fuca, connecting Port Angeles substation on the Olympic Peninsula in Washington State with Pike Lake Substation near Victoria, BC. The project also includes upgrades to the transmission networks west of Puget Sound on the Olympic Peninsula.

In 2006, the National Energy Board (NEB) granted Sea Breeze approval of the JDF Project. The JDF project has also undergone Phase 1 of the WECC Rating Review process, and has achieved Phase 2 status, with a planned rating of 550 MW.

Sea Breeze made an interconnection application to BCTC and was provided with study proposals in 2007. BCTC will commence work on the requested interconnection study as soon as Sea Breeze signs the study agreement.

The target in-service date of this project is December 2008.

4.2.4 Frontier Line

The Frontier Line is a major project proposed by Western US state governors to deliver clean coal and wind energy from Montana, Wyoming and Colorado to major load centers in Utah, Nevada and California. It is distinct from the Northern Lights project. A partnership of Pacific Gas & Electric (PG&E), San Diego Gas & Electric, Southern California Edison, Sierra Pacific Power Company, Nevada Power Company, and MidAmerican Energy Holdings Company is advancing this project. The proponents have done preliminary scoping and set a proposed in-service date of 2015. The project may integrate up to 12,000 MW of new wind and coal generation throughout a broad region, with transmission costs estimated between $3.5 and $5 billion.

The Frontier Line project is geographically remote from and unlikely to have much impact on the BC transmission system. However, its significant size would alter regional power flows throughout the U.S. regions of the WECC. Of significance to BC is that it competes with the potential PG&E project from BC to California by delivering renewable energy from Montana and Wyoming to Northern California.

4.2.5 Portland General Electric Southern Crossing

In 2007, Portland General Electric initiated a WECC Regional Planning Review process for a proposed project that would improve service to loads west of McNary in the BPA system and would enable integration of significant renewable resources located in central Oregon. The proposed project consists of rebuilding the existing 230 kV Cross-Cascade South line to 500 kV, and would significantly increase the east-to-west transfer capability to the California intertie. Portland General Electric is studying alternatives and examining synergies with other regional projects.

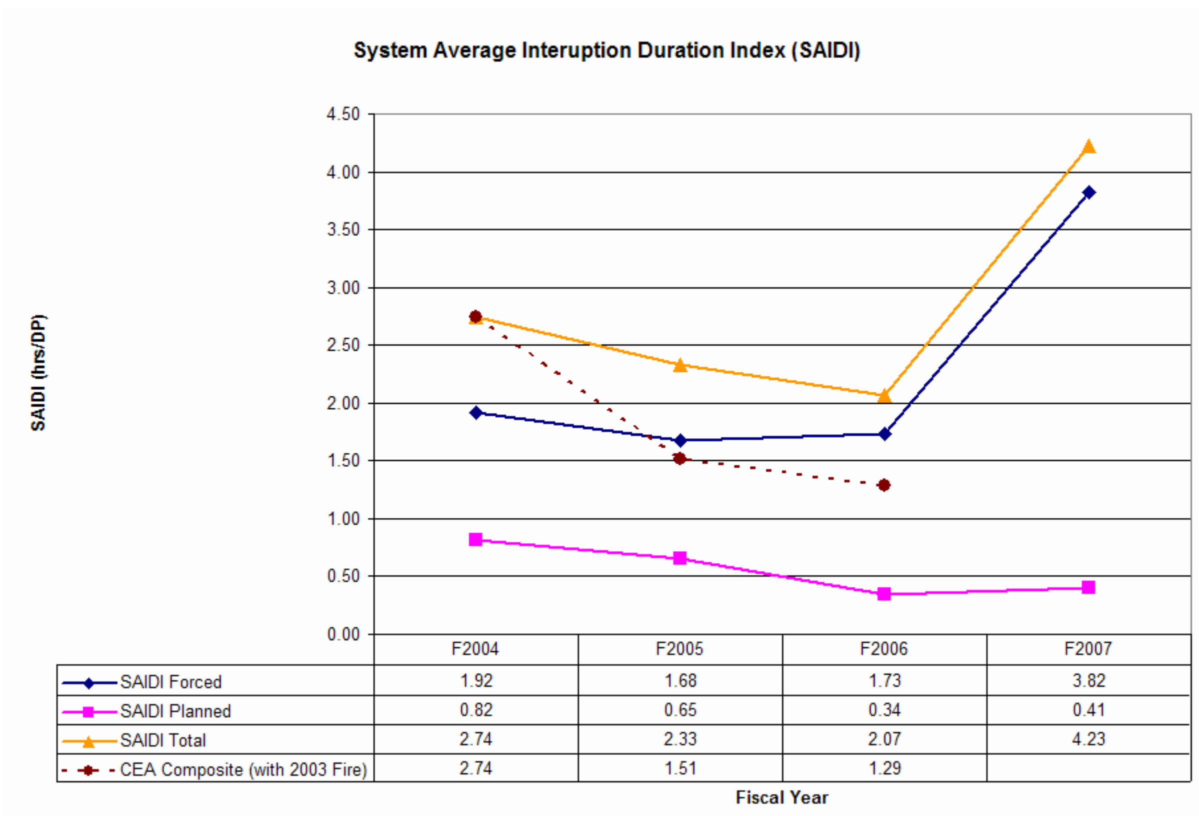
8.0 SYSTEM PERFORMANCE MEASURES

8.1 System Average Interruption Duration Index (SAIDI)

SAIDI is a measure of the reliability of the transmission system. It is calculated as the average amount of time in hours across all transmission delivery points that service is interrupted in a year due to planned or unplanned outages. The measure takes the total service interruption time during the fiscal year from all planned and unplanned outages at all delivery points and divides it by the total number of points.

Figure 8-1 shows BCTC's SAIDI and the industry composite SAIDI from the Canadian Electrical Association (CEA), Bulk Electricity benchmarking study. It should be noted that the CEA measure does not include the effect of planned outages. To allow a better comparison to CEA averages, BCTC has separated the forced and planned outages as per Directive 10 from the F2008 Capital Plan Decision.

Figure 8-1. SAIDI F2004 to F2007



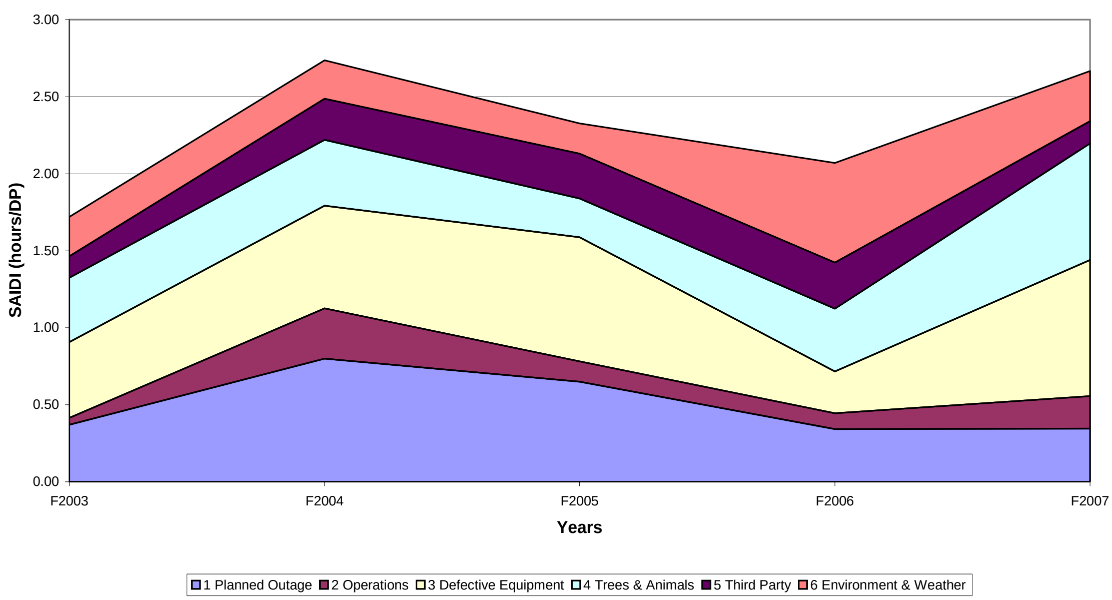
	F2004	F2005	F2006	F2007
SAIDI Forced	1.92	1.68	1.73	3.82
SAIDI Planned	0.82	0.65	0.34	0.41
SAIDI Total	2.74	2.33	2.07	4.23
CEA Composite (with 2003 Fire)	2.74	1.51	1.29	

Reliability data provided to the CEA by members is confidential, thus direct comparisons between companies are not possible. The SAIDI values vary from utility to utility, and the causes of these differences include network configuration, climate and terrain, and possible inconsistency in the collection and submission of data. Through CEA initiatives, member utilities are continually working to ensure consistency in definitions and data quality.

At the highest level, BCTC's total SAIDI is the result of six categories of causes. These are Planned Outages, Operations, Defective Equipment, Trees & Animals, Third Party, and Environment & Weather. Figure 8-2 shows the historical contribution of these six categories of causes to BCTC's total SAIDI over the past five years.

This high level view of SAIDI is useful for monitoring the major SAIDI contributors and the impact of asset management programs on these contributors. For instance, the effectiveness over time of maintenance initiatives, such as major vegetation clearing work or co-ordination can be reflected in changes seen in the cause category breakdown.

Figure 8-2. SAIDI Breakdown by Cause Category[35]



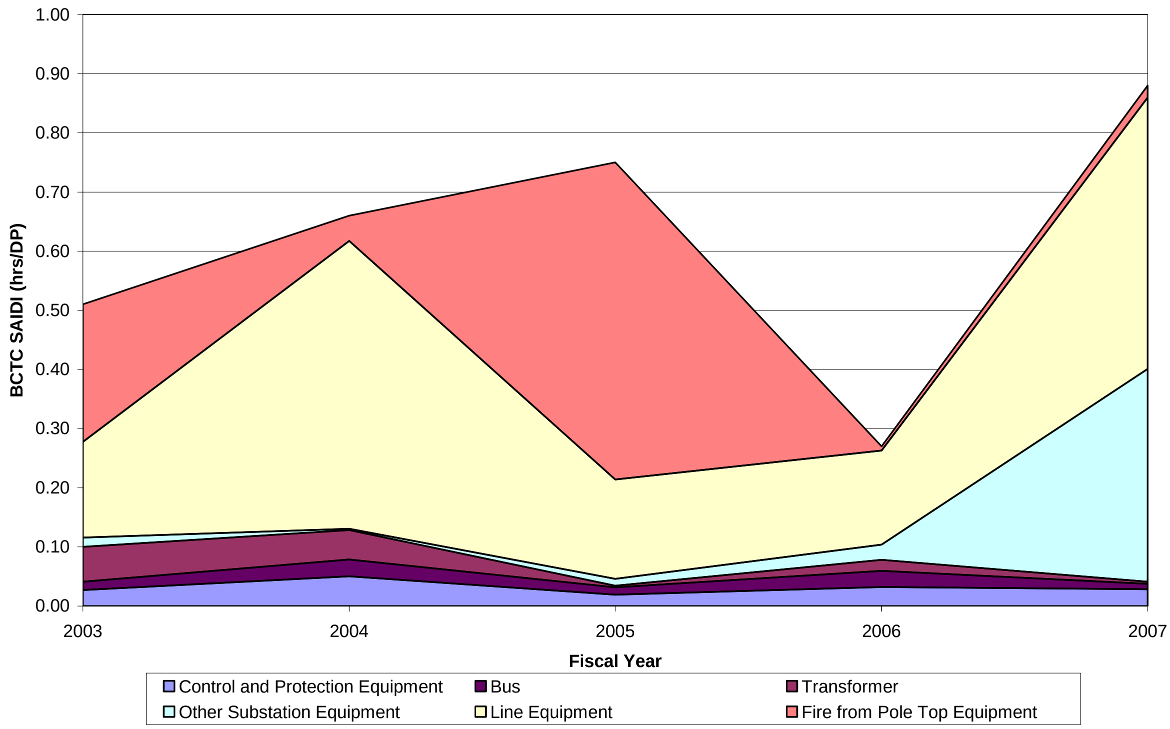
[35] SAIDI values used for Cause analysis exclude the summer of 2003 (F2004) fire storm and November and December 2006 (F2007) major wind and snow storms.

Environment and weather, shown in pink in Figure 8-2, plays a significant role in BCTC's SAIDI. While BCTC cannot directly control this category, in some cases BCTC can reduce the impact that the environment and weather have on system reliability. For instance, as discussed above, BCTC has begun performance improvement initiatives to reduce the contribution of lightning to BCTC's SAIDI by installing surge arrestors and arcing horns on lightning prone circuits (see section 6.5.2.3.1 in the F2009 Capital Plan).

More generally, BCTC has recently initiated a major project to improve SAIDI through the addition of single pole reclosing on transmission lines. Approximately 60 to 80 percent of faults are single phase to ground faults which presently result in complete interruption of the circuit and can adversely impact generation, transmission capacity, and end-use customers. Single-pole Trip and Reclose installations allow a single phase of a three-phase circuit to be interrupted and re-energized, as opposed to the interruption of all three phases, thereby improving reliability (see section 6.5.1.5.3 in the F2009 Capital Plan).

Figure 8-3 presents a breakdown, by equipment type, of the "Defective Equipment" Cause Category.

Figure 8-3. SAIDI Breakdown by Equipment Type – Defective Equipment



As shown in Figure 8-3, Pole Top Equipment and Line Equipment are the main contributors to the Defective Equipment Cause Category.

In F2006, BCTC undertook a bonding program to reduce the number of pole top fires. BCTC expects to complete the bonding program in F2010 (see section 6.5.2.4.1 in the F2009 Capital Plan).

BCTC has also focused its efforts on reducing delivery point outages due to line equipment. For example a two year Sustaining Capital program to upgrade circuit 60L129[36] commenced in F2007. In F2008, an investment of $1,900k will complete the upgrade, adding approximately 100 new full-length CCA treated wood poles,

[36] 60L129 is 79 km long and is the radial supply to Long Beach Substation which has the worst record of Transmission Reliability Index of all the Delivery Points in the system. Long Beach Substation has the highest (i.e. worst) number of Customer Hours Lost during the last 5 years, measuring 321,071. Rough terrain, age, and the oceanside environment (with salt corrosion & high winds) all contribute to the poor reliability of 60L129. The main outage causes are defective equipment, adverse weather and trees. In F2006 a comprehensive condition assessment confirmed the overall state of the assets is poor. No maintenance solution can completely resolve the health state of this circuit and greatly improve the reliability performance. BCTC will replace all poorly performing sections of the circuit over this 2 year program and will improve reliability performance somewhat but the approach of "replacements by sections" has shown that is will not cause significant reliability performance improvements.

hardware, insulators, timbers and approximately 45 circuit kilometers of new conductor. It includes some design modifications in places where this was necessary to improve the reliability.

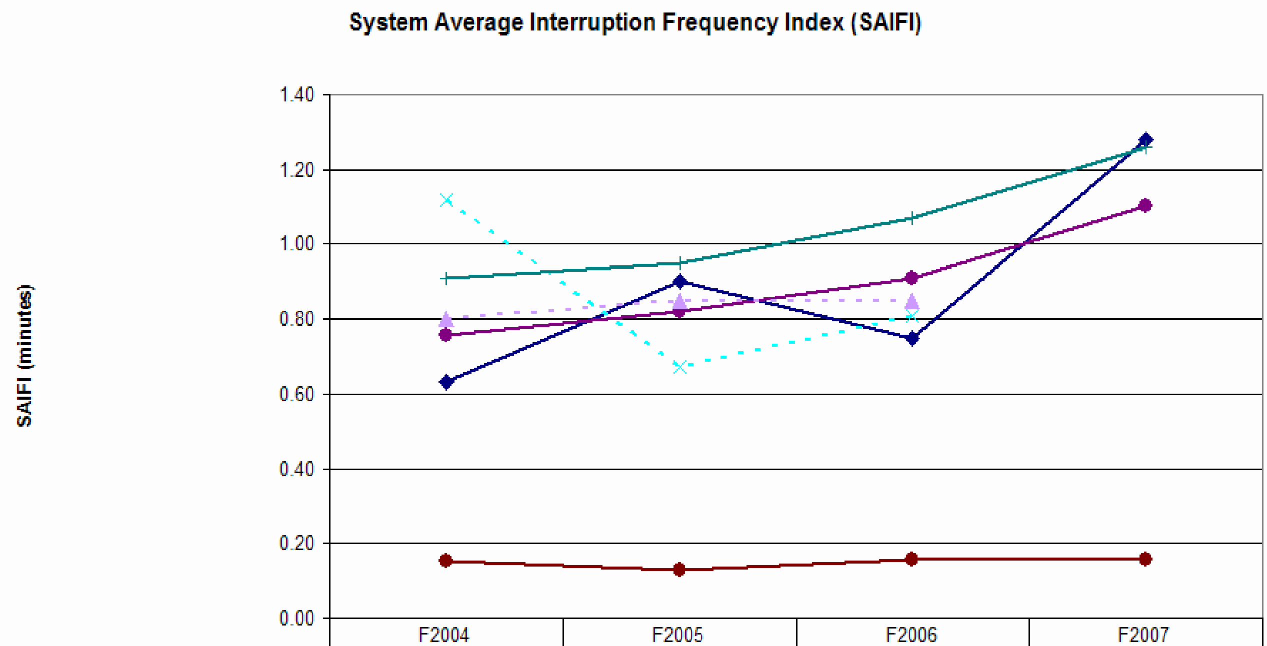
8.2 System Average Interruption Frequency Index (SAIFI)

System Average Interruption Frequency Index (SAIFI) is a measure of the reliability of the transmission system. It is calculated as the total number of interruptions across all transmission delivery points in a year due to planned or unplanned outages, excluding interruptions due to outages attributed to generators.

Interruptions can be categorized as Momentary (less than one minute in duration) or Sustained (one minute or greater in duration). Thus, SAIFI can be broken down into SAIFI-MI, the number of momentary interruptions across all transmission delivery points in a year, and SAIFI-SI, the number of sustained interruptions across all transmission delivery points in a year.

Figure 8-4 provides historic SAIFI results for the period F2004 to F2007 for BCTC and CEA. It should be noted that the CEA measure does not include the effect of planned outages. To allow a better comparison, BCTC has separated the forced and planned outages as per Directive 10 from the F2008 Capital Plan Decision. BCTC does not have a target for SAIFI.

Figure 8-4. SAIFI F2004 to F2007



	F2004	F2005	F2006	F2007
SAIFI-MI Forced	0.63	0.90	0.75	1.28
SAIFI-MI CEA Composite	1.12	0.67	0.81	
SAIFI-SI Forced	0.76	0.82	0.91	1.10
SAIFI-SI Planned	0.15	0.13	0.16	0.16
SAIFI-SI Total	0.91	0.95	1.07	1.26
SAIFI-SI CEA Composite	0.80	0.85	0.85	

Note 1: BCTC's SAIDI excludes the impact of the F2004 wildfires.

Note 2: the Eastern Blackout has been excluded from the F04 CEA Composite.

Similar to the SAIDI results, the CEA SAIFI values vary from utility to utility, and the causes of these differences include network configuration, climate and terrain, and possible inconsistency in the collection and submission of data. Through CEA initiatives, it is hoped that there will be more consistency in definitions and data quality in the future.

The programs that BCTC is undertaking to improve SAIDI, discussed in Section 8.1, are also expected to improve BCTC's SAIFI since these programs address certain types of equipment outages, hence reducing the frequency of the outages as well.

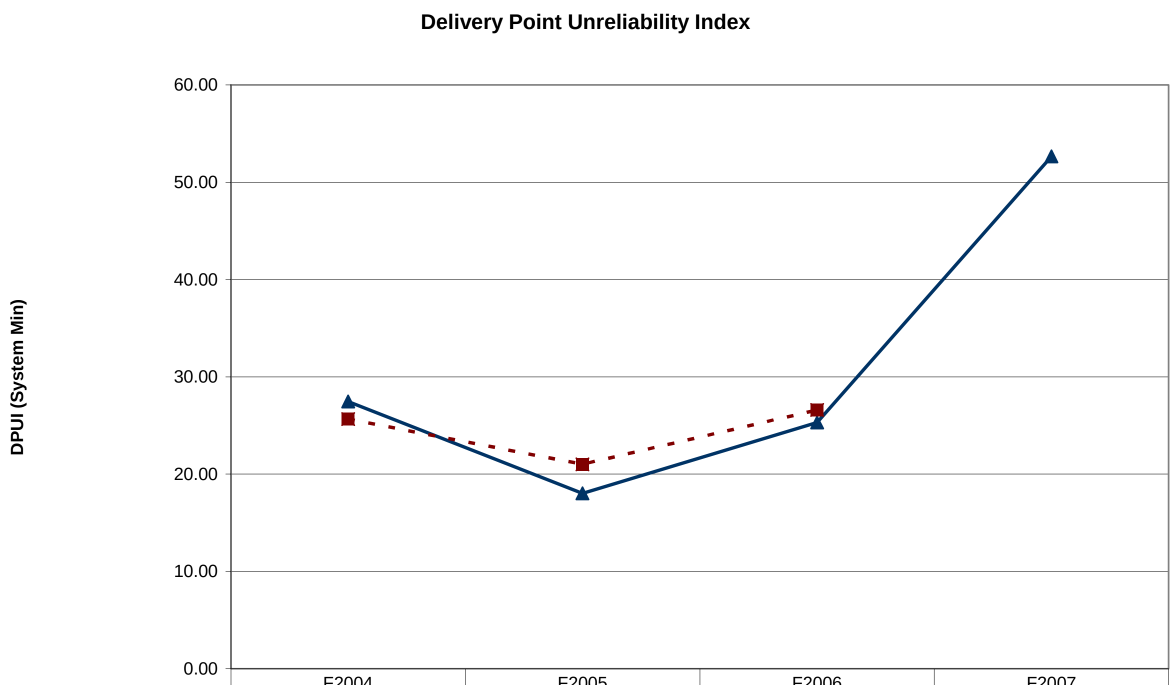
8.3 Delivery Point Unreliability Index (DPUI)

The Delivery Point Unreliability Index (DPUI) is a composite index of reliability in terms of System Minutes. It includes all planned and unplanned outages, excludes interruptions due to outages attributed to generators, and is calculated as follows:

$$DPUI = \frac{\text{Total Unsupplied Energy (MW Minutes)}}{\text{System Peak Load (MW)}}$$

If the total energy not supplied due to all outages was produced by a single outage event causing whole system blackout during the peak time, DPUI indicates how long this equivalent outage would last. Figure 8-5 provides historic results of the DPUI measurement from F2004 to F2007.

Figure 8-5. DPUI F2004 to F2007



	F2004	F2005	F2006	F2007
DPUI Total	27.47	18.02	25.31	52.66
CEA Composite	25.65	21.00	26.60	

8.4 Summary of Outage Indices by Voltage and Equipment Class

The following are examples of the types of data BCTC currently collects for the purpose of external reporting on equipment reliability, BCTC maintains a database on forced outages[37] of major system components and reports that data annually to the CEA. Tables 8-1 and 8-2 provide BCTC-specific calendar-year data collected on forced outages compared to the CEA average reported from all Canadian electric utilities for Line-Related Sustained Forced outages, Cable-Related Sustained Forced outages, Transformer-Related Sustained Forced outages, and Circuit Breaker-Related Sustained Forced outages.

[37] Definition of forced outages is consistent with the definition in the CEA ERIS – Forced Outage Performance of Transmission Equipment Report.

8.5 Operational Response to Intertie Congestion[38]

This performance measure considers BCTC's operation of the transmission interties with Alberta and the US. These interties are significant for trade and there is abundant data available on their use.

The measure is defined as the percent of congested hours when less than 90% of the maximum theoretical capacity of the transmission intertie was available and the operating limit on the intertie was a limit caused by the operating state of the BC transmission system, where:

(a) "Congested hours" are hours in which 90% or more of transmission path's TTC for that hour was actually used,

(b) "Limit caused by the operating state of the BC transmission system" means that limitations on the BC side of the intertie were responsible for establishing the transmission capacity limit of the intertie for that hour. In practice the lower of the BC and adjoining system limits will establish the operating limit for the hour, and

(c) "Maximum theoretical capacity" is the transmission capacity on a path if all transmission circuits and equipment were in service.

A determination is made for every hour of the month for each of the four intertie paths (inbound and outbound with Alberta and the US). Performance for each hour is determined as shown in Figure 8-6.

[38] Managing congestion is a complex challenge because congestion has causes beyond BCTC's control, such as market conditions that encourage electricity trading as well as limits and actual transfer loadings on neighbouring systems.

Figure 8-6. Calculating Operational Response to Intertie Congestion

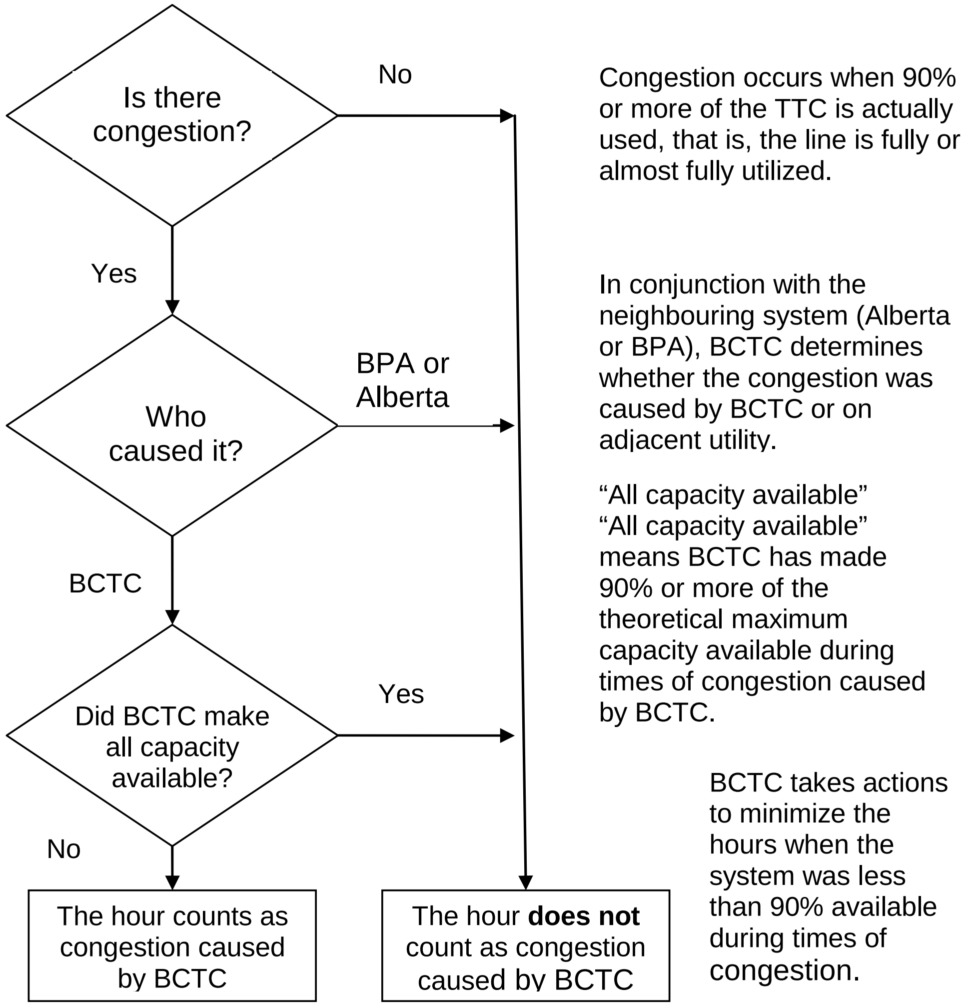


Figure 8-7 presents results of this measure for the period October 2004 through May 2007. As evidenced by the twelve-month rolling average line, BCTC's performance has improved since the establishment of this measure in early calendar 2006.

Figure 8-7. Operational Response to Intertie Congestion Oct 2004 to May 2007