BC hydro

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March 1, 2005

Mr. Robert J. Pellatt
Commission Secretary
British Columbia Utilities Commission
Sixth Floor – 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Pellatt:

RE: British Columbia Hydro and Power Authority ("BC Hydro")
2004/05 to 2005/06 Revenue Requirements Application
British Columbia Utilities Commission ("Commission")
Decision – 29 October 2004
Directive 72 (page 212), Directive 73 (page 213)

Further to BC Hydro's letter January 10, 2005 letter and the Commission's response of February 10, 2005 BC Hydro encloses the first of a two-stage submission regarding the provision of engineering services within BC Hydro.

BC Hydro considers both submissions to be part of a broader management strategy to continuously strive for improvements in the way we conduct all aspects of our business to deliver reliable, low cost power to our customers. This first submission describes BC Hydro's plan for the delivery of engineering services for F06 and the method for deciding on a plan for subsequent years. BC Hydro will respond to any questions the Commission may have regarding this submission, bearing in mind that the costs associated with the provision of these services have already been reviewed and approved in the recent Revenue Requirements proceeding.

Yours sincerely,

Richard Stout
Chief Regulatory Officer

Enclosure (1)

BC hydro

PROVISION OF

ENGINEERING SERVICES

FOR BC HYDRO

March 1, 2005
Submission to the British Columbia Utilities Commission

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Executive Summary

BC Hydro is undertaking an evaluation of the provision and use of engineering services. This evaluation will ensure that the provision and use of engineering within BC Hydro continues to be aligned with BC Hydro's purpose of providing reliable power, at low cost, for generations. This evaluation will be made carefully and with the benefit of a thorough consideration of the options available to the company. The results of the evaluation will be communicated to the Commission in a two-stage submission, one on March 1, 2005 outlining options and a second submission on September 1, 2005 giving results of the evaluation. The Commission accepted this approach in their letter of February 10, 2005.

BC Hydro believes that a comprehensive strategic review of engineering is appropriate at this time. Developments that make this review timely include the separation of BCTC from BC Hydro, the evolution of the line of business structure within BC Hydro, and definition of BC Hydro long-term goals. This review is aligned with ongoing work in BC Hydro to improve practices to ensure cost effective work delivery while meeting BC Hydro's needs for reliability, safety and security.

BC Hydro owns and operates a hydroelectric and thermal generation system, and delivers electricity through an extensive interconnected transmission and distribution system. These assets are technically complex and have high potential impacts on public safety, communities and the environment. Due to the complexity of the electricity system and BC Hydro's responsibility for service and reliability, a strong set of strategic relationships are required with engineering service providers to ensure that appropriate engineering resources are available when required. Strong technical and system expertise is required to effectively maintain and extend the life of BC Hydro's assets.

The purpose of the review of engineering services will be to determine the right balance of internal core engineering resources with the use of external engineering resources in a set of arrangements that will ensure the BC Hydro assets are maintained in an efficient, cost effective, safe and environmentally sound manner.

BC Hydro operates under a "line of business" (LoB) model. Within this model BC Hydro is the asset owner and the Generation LoB and Distribution LoB act as asset managers with the responsibility to make asset owner decisions on behalf of BC Hydro. The Field

Services LoB and Engineering LoB provide services to Generation and Distribution. This model provides clear separation between the accountabilities of the asset manager and the service provider. Common BC Hydro goals ensure alignment and cooperation amongst the LoBs.

For the transmission system, BC Hydro owns the assets and BCTC manages the assets and makes asset owner decisions. Field Services and Engineering provide services to BCTC through Master and Support Services agreements.

BC Hydro has established policies and practices for portfolio management and project delivery by the asset managers. Generation and Distribution are responsible for development of annual plans for capital, maintenance and other programs and preparation of project justifications to support these plans. Generation and Distribution are responsible for defining and approving project objectives, and Engineering is responsible for achieving approved objectives. Generation and Distribution seek input from Engineering on options for technical solutions and, with an understanding of the tradeoffs between the various technical options; Generation and Distribution select the solutions that best meet business requirements.

Engineering is a highly respected hydroelectric utility engineering organization currently made up of approximately 600 regular and temporary employees. Engineering practices are consistent with industry best practice. As a service provider to BC Hydro LoBs and BCTC, Engineering has assisted Generation, Distribution and BCTC in achieving their business objectives and met its principal F05 performance goals relating to delivery schedule, utilization, billing rates, safety and environmental incidents. Engineering operates on a cost recovery basis. Positive net income achieved through above-target performance on work volume, rates, utilization or administrative costs are returned to the client LoBs and BCTC. Engineering continues to improve cost management and client relationships.

Generation and Distribution have F06 business plans that are consistent with their accountabilities as asset managers. Engineering has developed delivery plans for work assigned to them by Generation and Distribution, and will utilize a mix of in-house, temporary and external resources to deliver the assigned work. The F06 target for work

procured from external resources is 20% of the total Engineering workload. These external work packages will vary from commodity-type work to high-value work.

BC Hydro has established key considerations and fundamental principles that will be used in the evaluation of the provision of engineering services to BC Hydro. Using these considerations and principles, along with benchmarking information and case studies, BC Hydro will evaluate a series of options for the delivery of engineering and related services. The evaluation of these options will assess the impact on reliability, safety, security, financial performance, operations, employees and external stakeholders. The results will form the basis for BC Hydro's long-term plans (F07 and beyond) for the provision of engineering services, and will be submitted for the information of the Commission on September 1, 2005. These long-term plans will also be reflected in BC Hydro's 2006/07 and 2007/08 Revenue Requirements Application.

Section 1- Introduction

This submission represents the first of a two-stage submission to the British Columbia Utilities Commission ("the Commission") regarding the provision and use of engineering services within BC Hydro. This work is in response to Directives 72 and 73 in the Commission's decision regarding BC Hydro's 2004/05 and 2005/06 Revenue Requirements Application. These directives request BC Hydro to reassess its delivery plan for engineering services and directs the company to submit an action plan that considers alternative means of providing these services, and for Generation and Distribution to provide business plans that will focus on Engineering in the role of service provider.

BC Hydro believes that a comprehensive strategic review of the provision and use of engineering is appropriate at this time. Several events make this review timely, including:

- Separation of BCTC from BC Hydro and initiation of the commercial relationship between Engineering and BCTC.
- Evolution of the BC Hydro LoB structure.
- Definition of BC Hydro's purpose and long-term goals.

A comprehensive review will ensure that the provision and use of engineering within BC Hydro continues to be aligned with BC Hydro's purpose of providing reliable power, at low cost, for generations.

BC Hydro has adopted a two-stage approach to responding to these directives. Engineering activities are critical to all electric utilities and can have significant short and long-term impacts on performance and value to customers and shareholders. Consequently, a thorough consideration of the options available to the company is necessary for BC Hydro to reach appropriate decisions related to the provision of engineering services. The two-stage submission is designed to accomplish this goal. The first stage submission will be provided to the BCUC on March 1, 2005 and the second stage submission on September 1, 2005.

This first submission is organized as follows:

- Section 2 briefly describes the framework within which BC Hydro operates its business.
- Section 3 summarizes the fundamental principles related to the provision of engineering services to companies like BC Hydro. Building on these principles and the key items identified in other sections of this submission, Section 3 provides descriptions of the spectrum of options and evaluation criteria that will be applied to the evaluation for the provision of engineering services within BC Hydro.
- Section 4 describes, in summary form, key Generation, Distribution and BCTC portfolio management practices that separate asset management and service delivery functions, and provides information on how those practices rely on engineering services to meet business requirements.
- Section 5 provides a brief summary description of key engineering project and service management practices.
- Section 6 provides a summary of Fiscal 2006 business, work and resource plans, including targets for the percentage of work performed by external resources.
- Section 7 identifies next steps that will form the basis for the second stage submission to be filed with the Commission by September 1, 2005.

This first stage response is an interim step that addresses key points in the BCUC directives in the context of F06 business plans. The second stage response will articulate BC Hydro's long term plans for the provision of engineering services, and will provide a full response to the BCUC directives.

Section 2 - BC Hydro

2.1 Nature of Business

BC Hydro's purpose is to supply reliable power, at low cost, for generations. BC Hydro is one of the largest electric utilities in Canada serving more than 1.6 million customers in an area containing 94 percent of British Columbia's population. BC Hydro endeavours to provide energy solutions to its customers in an environmentally and socially responsible way by balancing British Columbians' energy needs with the concerns of the environment and communities in which it operates. It has developed a hydroelectric and thermal generation system of approximately 10,730 megawatts of generating capacity. Electricity is delivered safely and dependably to customers through an interconnected system of over 73,000 km of publicly owned transmission and distribution lines. The transmission assets continue to be owned by BC Hydro; however the management and operation of the transmission system is now the responsibility of the publicly owned British Columbia Transmission Corporation (BCTC). Due to this efficient and reliable generation, transmission and distribution system, BC Hydro is able to offer customers some of the lowest electricity rates in North America.

2.2 Internal Organization

BC Hydro operates under a "line of business" (LoB) model, consisting of the Generation and Distribution LoBs, and the Engineering and Field Services LoBs, which provide services to Generation and Distribution. BC Hydro as a corporation determines its strategic objectives and each line of business is charged with achieving those corporate objectives that fall within its mandate. The line of business model allows BC Hydro to set clear accountabilities and provide focus. Generation and Distribution are accountable for management of their assigned assets and for making asset owner decisions on behalf of BC Hydro. Engineering and Field Services are accountable to support the business objectives of Generation and Distribution through provision of services.

2.3 Relationship with BCTC

BCTC is a provincial crown corporation that manages, maintains and operates BC Hydro's transmission assets and provides open and non-discriminatory access to the transmission system for all electricity producers. The transmission assets are owned by BC Hydro, and BC Hydro Engineering and Field Services support the business objectives of BCTC through the provision of services.

2.4 Corporate Goals

BC Hydro has a number of long-term goals aligned to its purpose of providing reliable power, at low cost, for generations. The goals include specific customer, employee, social, environmental and financial targets. The lines of business, through their operations and strategic objectives, are accountable for supporting these goals individually and collectively. In particular, Engineering and Field Services directly support long term goals related to reliability, financial performance, environmental impact reduction, electricity intensity reduction, safety, and innovation and technology.

Section 3 - Options to be considered

3.1 Key Considerations

BC Hydro considers the following to be essential when making determinations of engineering services to BC Hydro:

1. The provision of electricity is a critical infrastructure industry that demands reliability, safety and security.
2. BC Hydro is an integral part of an extensive integrated electricity system, and has influence and impact throughout western North America.
3. BC Hydro has significant responsibility for system reliability. Medium to long-term management of reliability risk necessitates corporate technical memory and capability.
4. BC Hydro has extensive, technically complex assets including dams, powerhouses, substations, transmission lines and distribution lines.
5. BC Hydro has complex technical requirements resulting from the location of its facilities relative to the population it serves, and the geographic setting of the province.
6. The electric industry has evolved to provide open and non-discriminatory access to independent power producers and marketers. This has added a greater complexity to the management of BC Hydro's assets to ensure that acceptable levels of reliability are maintained.
7. BC Hydro's technical assets have high potential impacts on public safety, communities and the environment, particularly its dams and high voltage components.
8. BC Hydro has large and ongoing capital programs for developing and maintaining its technical assets, which are ageing.
9. The planning, development, operation and maintenance of its technically complex, integrated and non-integrated electricity systems requires high quality engineering resources.

10. The electric utility industry is a long cycle business: new technical assets can require a long lead-time to be brought into service (1 to 12 years) and have a long life cycle (20 to 100 years).

11. Over the next 10 years, the electric utility industry will be facing a significant loss of knowledge with almost one third of the workforce eligible to retire.

12. Significant time in direct job experience is required to train a fully competent engineer capable of supporting the key areas of the BC Hydro electric system in an effective manner. This training is not readily available through consultants or suppliers.

BC Hydro considers the following to be fundamental principles for any evaluation of its required engineering services.

Fundamental principles:

1. All decisions regarding the provision of engineering services to BC Hydro will take a long-term view aligned to BC Hydro's purpose of providing reliable power, at low cost, for generations.

2. Achievement of BC Hydro's long term goals, particularly the goals for reliability, safety, low costs, energy efficiency and environmental impact, drive the need for core engineering work to be performed by BC Hydro employees.

3. Core engineering work is defined by the risks to BC Hydro. The majority of core engineering work will be performed by BC Hydro employees to ensure the quality and availability of resources, continuity of knowledge and approach, and to build and maintain a corporate technical memory.

4. Non-core engineering work will be performed by either internal (BC Hydro) resources or external (non-BC Hydro) resources such as equipment manufacturers and suppliers, contractors, other utilities and external engineering consulting firms.

5. Some amount of non-core engineering work needs to be performed by internal resources to provide training and development of core engineering capacity, and to manage variable core workload.

6. Evaluation of engineering performance will include both short-term costs (project costs and engineering costs) and long-term value (life-cycle costs, reliability, environmental/social impacts and safety).

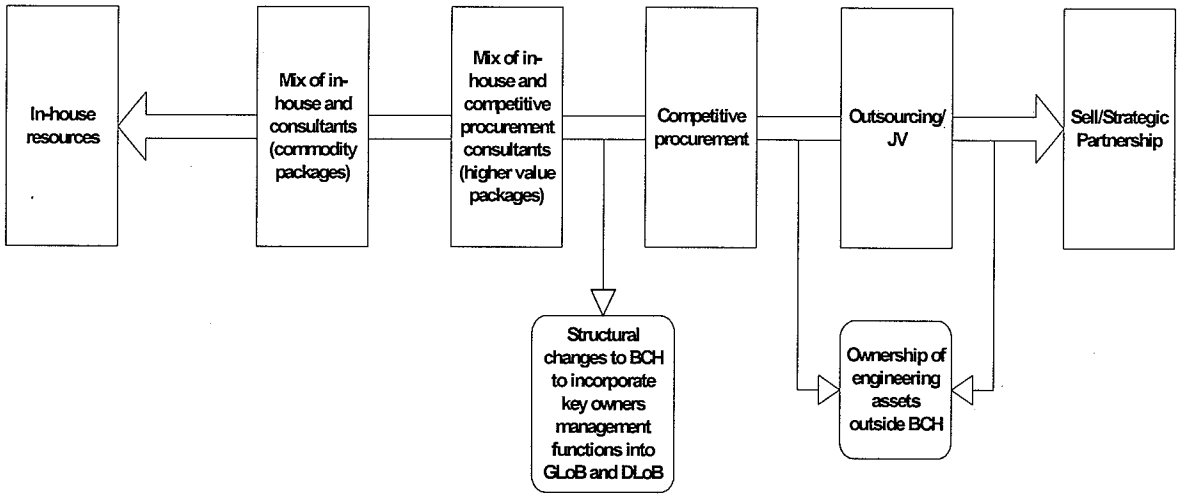
7. Decisions related to the procurement of non-core engineering resources will be made with appropriate consultation of all BC Hydro parties impacted by the decisions.

3.2 Options and Criteria

BC Hydro will examine a wide spectrum of options for the provision of engineering. Specific options will be defined for detailed evaluation, and will address the current BC Hydro situation, the long-term goals of the organization, and the particular needs of Distribution, Generation and BCTC. In addition, the specific options will be based in part on industry practices and experiences.

The following diagram illustrates the spectrum of options for provision of engineering services.

FIGURE 3-1
Spectrum of Options for Provision of Engineering Services



The following issues will be considered when defining the specific options:

- Definition of core engineering work, applicable to each option.
- Consideration of appropriate location for core resources within BC Hydro (i.e. within asset manager or service provider organizational unit)
- Mix of internal and external resources required to carry out engineering work.
- Method of assigning work to internal resources (e.g. direct assignment, competitive procurement).
- Method of procuring external resources.
- Management of external resources.
- Type of contractual arrangement with engineering service provider (e.g. joint venture, strategic partnership).
- Commitment to engineering service provider (e.g. project-by-project, long-term).
- Service provision to BCTC.
- Other issues that arise during option definition.

Option evaluation will assess the benefits to the ratepayer, benefits to the shareholder and alignment with BC Hydro's long-term goals. The assessment of each option will evaluate the impact on the following:

- Reliability
- Safety
- Security
- Financial performance
- Operations
- Employees
- External stakeholders

3.3 Engineering project and service benchmarking

BC Hydro is currently undertaking a benchmarking study to obtain information on the approach to delivery of engineering services in other electric utility organizations. This information will be used as input to the options definition described in Section 3.2, as will the results of previous benchmarking initiatives presented in BC Hydro's 2004/05 and 2005/06 Revenue Requirements Application.

The project and service benchmarking study will:

- Compare BC Hydro with benchmarking participants on key performance indicators.
- Summarize trends and best practices for provision of engineering services.

Section 4 - Portfolio Management Practices

4.1 Generation Portfolio Management Practices

The Generation line of business is accountable for the safe operation, maintenance, financial performance and sustainability of BC Hydro's Heritage Resources. As those assets age and some approach their end-of-life, maintenance cost and risk of failure increase and asset replacement must be considered. In developing its annual capital and maintenance plans and project justifications, Generation makes trade-offs between maintenance and capital work to optimize long term facility operating costs. For proposed capital projects, the impact upon financial statements due to increased finance charges and depreciation is compared to the costs of increased maintenance and forced outages if the project is deferred.

Total Generation estimates for F05 and F06 are shown in Table 4-1.

TABLE 4-1

Generation Estimates for F05 and F06

($ millions)	F05 Forecast	F06 Plan
Total Capital	130	176
Capital Assigned to Engineering	94	129
Total Maintenance	54	54
Maintenance Assigned to Engineering	8	9

Generation requires engineering related resources to implement a significant portion of its annual capital plan and a small portion of its maintenance plan. Capital and maintenance work assigned to Engineering is described in Section 6.1.

4.1.1 Generation functions requiring engineering support

Engineering staff work closely with and provide support to Generation business development and commercial management staff.

The primary requirements for engineering support to Generation are in the areas of:

- **Generating equipment maintenance and replacement**: many Generation assets are reaching an age when major components are at or approaching end-of-life. Continuing safe and reliable operation can only be assured by repair or replacement of generating equipment, ancillary components and civil structures. Engineering provides a centralized source of technical expertise with facility and equipment-specific knowledge that is available to support all Generation regions with maintenance, repair, design, testing, commissioning and emergency response services. Major generating equipment components are being replaced at a number of older facilities, Generation is working with Engineering to increase reliability and reduce capital and maintenance costs and outage times by replacing multiple manufacturers and models with standard components.

- **Operations support**: efficient and optimized operation of Generation's reservoirs requires ongoing updates of short and long term inflow forecasts and detailed information about generating plant characteristics. Engineering provides support in surface water hydrology modelling, statistical analysis and development of turbine efficiency and facility rating curves.

- **Dam safety**: surveillance to evaluate the performance of dams is an ongoing process. Ageing of the dams can reduce their ability to perform in a safe and acceptable manner. In addition, understanding of the seismic performance of dams has improved and design seismic and flood standards for dams have increased over time. As a result, physical dam safety improvements and other risk reduction measures are required to meet evolving scientific, engineering, regulatory and societal expectations. Engineering provides dam safety instrumentation services, dam safety studies and investigations, and design and implementation of dam safety improvements.

- **Resource Smart**: strategic upgrade or replacement of turbine runners, installation of additional generating units or redevelopment of power plants can provide energy efficiency gains and installed capacity gains from

existing assets. Engineering provides a full range of services to design and implement these projects.

Engineering support requirements for Generation include:

- Project management capability to implement capital and maintenance programs.
- Multi-disciplinary technical capability.
- Expertise in risk identification and analysis.
- Expertise in contract development and management, procurement, construction management, environmental support, regulatory and licensing support.
- Management of drawing records.

Many Generation projects require highly specialized technical expertise and facility and equipment-specific knowledge is often valuable.

4.1.2 Project identification, prioritization and assignment

Generation identifies the projects for its annual capital and maintenance plans and prioritizes projects in terms of risks and net benefits. Implementation is scheduled with consideration of outage restrictions and other requirements. Generation's management team reviews the proposed Generation projects to confirm priorities and to ensure that the overall risks are being appropriately addressed.

Draft Generation plans are shared with Engineering as part of the annual planning cycle, and Generation identifies the relative priority of projects to Engineering. Engineering then assesses overall engineering resource requirements (internal and external) and advises Generation of proposed resourcing strategies and any potential difficulties. Identified difficulties are assessed prior to finalizing the plans.

Projects are assigned to Engineering on an individual basis, with scope, budget and schedule agreed to and documented in a form that depends on the scale of the project. Once accepted by Generation, the proposal from Engineering forms the basis for assignment and management of the work.

4.1.3 Project and program management

For each capital project, a Generation project initiator has the following responsibilities:

- Justifies the project through a business case that complies with BC Hydro and Generation financial requirements. Where applicable, Generation requests Engineering to identify alternative technical solutions along with estimated costs and risks for each option. Generation then selects a preferred solution that best meets its business needs.
- Specifies Generation schedule, budget and performance requirements, and identifies interim milestone decision points.
- Defines the project through a Statement of Objectives, or other work assignment document (determined by scale of project).
- Secures financial approvals.
- Receives regular progress reporting for the project.
- Periodically reviews the project justification to ensure that the original business case is still valid and that the scope, schedule and cost objectives are current.
- Approves, if appropriate, changes to the project objectives (scope, schedule and cost), as required.

Generation and Engineering staff hold regular update meetings, as appropriate to review and discuss the status of programs and projects.

Similar practices are employed for maintenance work, with work assigned on a project-by-project basis.

Generation maintains sufficient technical expertise within their LOB to carry out high-level review of internal engineering work to ensure appropriate decisions are made by Generation.

4.2 Distribution Portfolio Management Practices

The Distribution Line of Business is responsible for managing capital investments and operating expenditures associated with the BC Hydro distribution system and for the procurement and delivery of safe, dependable and reliable energy. This is achieved through management of both demand and supply side options, and distribution system

asset management, extension and connection services. On behalf of BC Hydro, Distribution is accountable for defining the overall customer experience, and meeting BC Hydro's customer service performance measures.

Distribution, through its annual planning and budgeting cycle, determines annual capital and maintenance expenditures required to meet its operational and strategic objectives. Total Distribution estimates for F05 and F06 are:

Table 4-2

Distribution Estimates for F05 and F06

($ millions)	F05 Forecast	F06 Plan
Total Capital (includes substation - distribution assets, excludes Powersmart)	258	313
Capital assigned to Engineering (excludes substation-distribution assets, which are managed by BCTC)	47	54
Total Operations and Maintenance	240	239
Operations and Maintenance assigned to Engineering	2	3

Work assigned to Engineering is described in Section 6.1.

4.2.1 Distribution functions requiring engineering support

The primary requirements for engineering related support to Distribution are in the areas of:

- **Asset management**: strategic studies, additions, upgrades and extensions to the distribution system are required to support anticipated load growth.
- **Maintenance and revenue metering programs**: efficient and optimized operation of the existing Distribution assets requires ongoing maintenance and replacement of system components.
- **Customer projects and operations**: customer and operational projects and requests for expert advice are initiated when adding new customer load to the distribution system.

- **Distribution projects**: projects to support extensions for the non-integrated system are initiated as needed. In addition, analytical studies and environmental services of the overall distribution system are required to support Distribution.
- **Power planning and portfolio management**: assistance in ensuring prudent and cost effective long-term energy planning, purchasing, delivery and contract management.

Engineering support requirements for Distribution include:

- Monitoring and interpreting the distribution system operating parameters and criteria.
- In-depth familiarity with and access to BC Hydro systems, customer facilities, people, processes, and historical engineering practices to ensure continuity and expedient optimised solutions.
- Unrestricted access to secure and real-time BC Hydro computer systems to efficiently and promptly implement system design and maintenance improvements.
- Availability for emergency response to quickly respond to urgent situations or incidents to ensure public safety, service reliability and environmental compliance.
- Strong technical capability to support the identification, risk analysis, management and delivery of system improvement, maintenance, environmental and customer programs.
- Environmental expertise with high professional credibility, continuity, and specific knowledge of the history and present status of the distribution system, individual assets, and work practices sufficient to represent Distribution's interests with enforcement and regulatory agencies.
- Project management capability and strong multi-discipline technical expertise to provide expert technical advice and to support specific initiatives, diesel generation, distribution system and customer driven projects.

4.2.2 Program and project identification, prioritization and assignment

Distribution has established processes for identifying and prioritizing projects that become part of its annual capital and operating plans.

- **Asset management**: Distribution manages and prioritizes the system improvement capital program. Engineering proposes the identification, risk analysis and technical study of improvement projects for review and approval by Distribution. Formal project review meetings are held between Distribution and Engineering to discuss scope, cost and assessment of priority. The final scope, priority and budget are determined by Distribution and the approved system improvement projects are assigned to Engineering on a program basis.
- **Maintenance and revenue metering programs**: Distribution identifies and prioritizes the annual portfolio of projects, with support from Engineering. Distribution assigns the final approved maintenance and metering projects to Engineering on a program basis.
- **Customer projects and operations:** Distribution identifies the annual portfolio of projects. Technical support, project management and requests for expert advice when adding new customer loads to the distribution system and for unique design situations are assigned to Engineering on an ongoing basis.
- **Distribution projects**: Distribution identifies and prioritizes non-integrated system projects and environmental programs and assigns the technical analysis, project management and delivery to Engineering on a program basis.
- **Power Planning and Portfolio Management**: Distribution is responsible for the development of the resource plans, energy acquisition, acquiring transmission services for delivery and managing energy contracts such as the Heritage Contract and Energy Purchase Agreements with independent power producers. Distribution assigns specific projects to Engineering for support and evaluation of the technical requirements.

4.2.3 Project and program management

Distribution assigns work to Engineering primarily on a program basis (defined as a collection of small projects or initiatives). For each program, a program sponsor is identified in Distribution with the following responsibilities:

- Specifies client requirements, schedule and interim milestone decision.
- Secures financial approvals.
- Receives regular progress reporting.
- Approves, as appropriate, changes to the program objectives (scope, schedule and cost), as required.

For large Distribution projects, a project initiator is identified within Distribution with responsibilities as described previously in Section 4.1.3.

Appropriate Distribution and Engineering staff hold regular update meetings to review and discuss the status of programs and projects.

Distribution maintains sufficient technical expertise within their LOB to carry out high-level review of internal engineering work to ensure appropriate decisions are made by Distribution.

4.3 BCTC Portfolio Management Practices

BCTC is responsible for management, maintenance and operation of BC Hydro's transmission system.

Key BCTC business objectives for investment portfolios and investment portfolio governance are described in section 2.0 of the BCTC Capital Plan Application to the BCUC – May 31, 2004.

Projects for both capital and maintenance work managed by BCTC are assigned to Engineering based upon commercial practice and the Master and Support Services agreements between BCTC and BC Hydro. Projects assigned to Engineering by BCTC are part of a larger portfolio of BCTC capital and maintenance projects.

The BCTC – Engineering service level agreement describes a process for performance assessment and improvement, including performance measures and targets. Performance measure reporting is to be put in place per the agreement along with

assessment and continuous improvement processes that are managed by contract representatives for both BCTC and Engineering.

Section 5 - Key Engineering Management Practices

5.1 Accountabilities for project and service delivery

As a service provider, Engineering's work practices comply with BC Hydro's Corporate and LoB requirements and ensure appropriate accountability and controls are in place to effectively deliver projects and services. Each project or program has an initiator in the client line of business and a project manager in Engineering.

Responsibilities and accountabilities of the project manager are as follows:

- Proposes scope objectives, cost objectives, decision points and schedule objectives to fulfil the clients' requirements.
- Accountable to the project initiator for achieving approved objectives.
- Prepares a project plan setting out the strategy and plan for achieving the approved objectives.
- Achieves the client requirements with designs, drawings and specifications, manufactured and construction works and tests against approved requirements and specifications.
- Develops resourcing strategy to execute the assigned work, including use of external resources.
- Reports regularly, and by exception, to the project initiator.

During the course of the work there is frequent interaction between the project initiator and project manager and their respective organizations to review status and decisions required. If during the course of delivering the project, the project manager forecasts that the approved objectives cannot be achieved then the direction of the project initiator must be sought. Changes to the project objectives require project initiator approval, and acceptance by the project manager.

Engineering's project management practices and costs are consistent with industry best practices.

5.2 Estimate and schedule controls

The project initiator specifies schedule requirements to meet their business objectives, such as required in-service date or scheduled maintenance outage. Engineering prepares project schedules to meet these schedule requirements and verifies the schedules through discussions with the project initiator. Engineering tracks project milestones continuously, and notifies the project initiator of any potential variation from the project objectives. When required, the project manager implements a recovery plan to ensure the project objectives can still be met, or in the event this is not possible the project initiator provides further direction on required actions.

Engineering prepares project cost estimates that are verified through detailed reviews, comparison with internal and external cost databases, benchmarking, and client review. In 2003 BC Hydro adopted a probabilistic methodology for high-value and high-risk projects that require Board of Director approval. Such funding authorizations are approved at the expected cost. This reduces project contingencies, establishes tighter budgets and encourages greater innovation in project results.

Engineering ensures that practices and standards for cost estimation and scheduling are consistent with industry best practice through participation in external professional organizations, such as the Association for Advancement of Cost Engineering, and benchmarking.

5.3 Cost and schedule performance management within Engineering

Engineering prioritizes project and service delivery and client satisfaction in its strategic objectives and day-to-day operations. Project schedule and cost performance are monitored through regular management review and are communicated to all staff through regular reporting to reinforce a delivery-focused culture. In addition, employee annual performance assessment and variable (incentive) pay are strongly linked to project and service delivery, as described in Section 6.5.3.

Section 6 - Fiscal 2006 Engineering Work and Resource Plans

6.1 Summary of F06 Work Program

A summary of Capital Programs assigned to Engineering for the period F04 to F06 is as follows:

TABLE 6-1

Assignment of Capital Programs to Engineering, F04 to F06

($ millions)	F04 Actual	F05 Forecast	F06 Plan
BC Hydro Generation	109	94	129
BCTC/BC Hydro Transmission	152	112	140
BC Hydro Distribution	45	47	54
Total	**306**	**253**	**323**

A summary of operations, maintenance and administration programs assigned to Engineering for the period F04 to F06 are as follows:

TABLE 6-2

Assignment of Operations, Maintenance and Administration Programs to Engineering, F04 to F06

($ millions)	F04 Actual	F05 Forecast	F06 Plan
BC Hydro Generation	8	8	9
BCTC/BC Hydro Transmission	14	14	14
BC Hydro Distribution	3	2	3
Total	**25**	**24**	**26**

6.2 Engineering Cost of Providing Services

The average billing rate forecast to recover all Engineering operating costs for F06 is $97 per hour. The average billing rate has remained at $97 or less since F03. Increases in costs over the four-year period are less than inflation due to offsetting cost reductions. The average billing rate includes benefits and concessions, non-billable labour, office support, corporate shared services and excludes non-current pension costs.

Cost reductions have been achieved mainly through the reduction of IT costs, change in labour mix and lower non-billable administrative costs.

Billings made to deliver the work programs are as follows:

TABLE 6-3
Recovery of Engineering Costs Through Billing Rates, F04 to F06

	F04 Actual	F05 Forecast	F06 Plan
Costs Recovered Through Billing Rates ($ millions)	**79.9**	**76.3**	**80.7**

Costs for external consultants, suppliers and contractors managed by Engineering are not shown. These costs are charged directly to clients with no markup.

6.3 Resourcing Strategy

Engineering's F06 workforce strategy is based on:

- Maintaining a central complement of regular employees to maintain base level technical expertise and to meet base workloads. Additional work is assigned to temporary employees and to external engineering consultants, suppliers and contractors.
- Maintaining in-house technical specialist expertise in core areas, as defined by risk, frequency of need and availability from external sources.
- Acquiring external technical specialist expertise required for non-core areas.

- Acquiring and maintaining core skills while utilizing external resources available in the market to meet the fluctuating workload.
- Recruiting and developing at all experience levels to ensure a balanced distribution in the workforce to offset loss of technical staff due to retirement.
- Continuing to hire individuals into the Engineer in Training (EIT) and Graduate Technologist in Training (GTT) programs.
- Developing and maintaining links with external technical resources such as professional organizations, suppliers and equipment manufacturers to maintain up-to-date industry knowledge.

Engineering delivers their client work programs by utilizing a mix of in-house and external resources. The skill sets required from external resources include the full spectrum from commodity services to highly specialized technical experts. Where practicable, independent work packages (a project or portion of a project) are defined and assigned to external resources. In addition, external resources are utilized to supplement internal teams when required by resource constraints or need for technical skills that are not available internally.

Decisions to carry out significant work packages through external resources are made in consultation with the client.

Engineering procures external engineering services using sole sourcing or competitive procurement and a proposal process for defined packages of work. Through an annual public request for qualification process, Engineering maintains a preferred consultant database and standard form contracts in order to:

- Promote uniform approaches in dealing with consultants
- Reduce costs for contracts preparation
- Reduce costs by allocating risk equitably between the consultant and BC Hydro
- Maintain up-to-date information on available consultant expertise and services

Guidelines have been developed with involvement from the consultant community for procuring services from the preferred consultant database to ensure fair access to procurement packages. For work packages requiring expertise not available from

consultants in the database, competitively procured packages are issued via a public tender process in accordance with BC Hydro corporate policy.

6.4 F06 Work Plans

As described in Section 6.1, Generation, Distribution and BCTC have provided F06 work program estimates to Engineering. Based on these, Engineering estimates the required internal and external resources to deliver the planned work activities by discipline and service type. The planned distribution of engineering work for F06 is shown below.

TABLE 6-4
Breakdown of F06 Engineering Work Program by Client and Group

Distribution		10%
Generation		
Generation	20%	
Dam Safety	10%	
Contracts Construction & Environment	10%	40%
BCTC/Transmission		
Planning, P&C & Telecomm	14%	
Transmission	10%	
Stations	13%	
Contracts Construction & Environment	9%	46%
BCH Other & External		4%
Total		100%

Engineering is planning to procure 20% of its F06 work program from external consultants. This does not include work assigned to suppliers and contractors. The planned work to be procured ranges from commodity work to specialized, higher value packages.

6.5 Supporting Engineering F06 management plans

6.5.1 Demographics and knowledge transfer

Engineering has recognized the risks and opportunity presented by the anticipated retirement of a significant number of technical staff and has undertaken the following activities to ensure key technical knowledge is retained by BC Hydro:

- Implementation of electronic document management system to capture, retain, and improve access to information across BC Hydro and BCTC (2004).
- Development of streamlined, web-based operating practices to capture best practices, standards, and lessons learned (Initiated 2004).
- Recruitment of graduate engineers (EIT) and technologists (GTT) and support of their training and development through mentoring, junior-senior partnerships and cross-BC Hydro rotational assignments (Ongoing).

6.5.2 Culture change

Engineering has taken action to address the culture change issues associated with their role as a service provider to BC Hydro and BCTC, including the following:

- Identification, communication and reinforcement of 4 key strategic priorities for Engineering: client relationships, project and service delivery, technical leadership and people development.
- Streamlining the Engineering organization by reducing the number of senior managers, providing single point of accountability for clients, and adopting a delivery-team based structure to reinforce accountability for project delivery.
- Aligning Engineering performance measures and individual performance measures with the key BC Hydro and client priorities, goals and objectives.
- Initiation of employee performance management based on performance against key strategic priorities and BC Hydro values.

- "Service Excellence" training for employees to develop and enhance service-provider culture.
- Focus on employee and client communication to highlight service offerings and profile project delivery successes. Appendix A contains a document that was recently created for employee and client communication. It is included for information only to provide an overview of services and of a sample of projects recently completed by Engineering.

6.5.3 Performance Management

BC Hydro and Engineering have formal performance management and variable (incentive) pay practices for all management and professional employees. These practices ensure Engineering staff are aligned with BC Hydro goals and incent, measure and drive behaviors that support Engineering's role as a service provider.

Annual targets are set for all staff and performance is measured throughout the year against these targets. Client input is used to develop goals that are aligned with client priorities. Variable pay is based on BC Hydro performance, and on individual and team performance for:

- Project schedule and cost performance
- Client satisfaction
- Technical development

6.5.4 External Work

Engineering undertakes a limited amount of work for external clients. The primary purpose for undertaking external work is to increase the knowledge and experience for Engineering staff, in particular in the areas of commercial practices and innovative technical solutions. This knowledge and experience provides direct benefits to BC Hydro.

An evaluation and risk screening is undertaken for all potential external work prior to acceptance. The following guidelines are used when considering external work:

- External work does not impact project delivery for Generation, Distribution and BCTC.
- Risks of the work are identified, understood, and properly managed to acceptable levels.
- Preference for sole sourcing arrangements.
- Billing rates set to contribute positive net income.
- The execution of external work is consistent with Engineering's policy not to compete with consultants for external work in British Columbia.

In F05 Engineering completed approximately $5 million in external work, approximately 5% of total revenues. Engineering has a long-term strategy to increase its external work to a maximum of 10% of total revenues. This target level of external work is judged to provide maximum benefits to staff and BC Hydro without impacting the delivery of work for internal clients.

Section 7 - Summary and Next Steps

This submission provides an interim response to the BCUC 29 October 2004 directives regarding the provision and use of engineering services within BC Hydro. The following issues have been addressed in this submission:

Directive 72

- Section 6.3 describes current practices for procuring external resources with a range from commodity to specialized, high value services.
- Section 6.4 describes the F06 target for competitive procurement of external resources from subconsultants of 20%.

Directive 73

- Sections 2 and 4 describe BC Hydro practices that ensure appropriate responsibilities and accountabilities for the Generation and Distribution asset managers.
- Section 5 describes BC Hydro practices that ensure appropriate responsibility and accountability for the Engineering service provider.
- Section 6 provides business plans for the provision of engineering resources for F06, as well as supporting action plans that address demographics, knowledge transfer and culture change within Engineering.

The planned two-stage response will fully address the issues raised in BCUC directives 72 and 73. The second stage submission will include the following:

1. BC Hydro's final assessment of the options and selection of the preferred option for the ongoing provision of engineering services for BC Hydro.
2. Action plans for the provisions of engineering services to Generation and Distribution for F07 and beyond.

These action plans will also be reflected in BC Hydro's 2006/07 and 2007/08 Revenue Requirements Application.

APPENDIX A

About us

Our Expertise

Drawing on over 80 years of experience, BC Hydro Engineering provides the full range of utility engineering and project management services to support reliable energy, at low cost, for generations. Engineering Services, and its predecessor organizations, helped to build the third-largest electric utility system in Canada.

Technical Services: design, construction and maintenance, preliminary and final design, risk analysis, preparation of drawings and specifications, risk management, quality assurance, commissioning and testing, maintenance, survey and photogrammetry

Project Management: project scope definition, feasibility studies, preparing schedules and plans, assisting with obtaining project funding approval, coordinating public consultation, preparing permit applications, leading project-related regulatory processes, preparing project documentation and project completion reports

Contract Management: procurement, estimating and scheduling, contract preparation, quality control inspection and testing, equipment and construction management, field testing and diagnostic services

Environmental Management Services: stream, plant and wildlife interactions, land use, heritage and recreation, environmental education, utility pole management, vegetation management and waste management and air quality consultation

Engineering also provides project management leadership for BC Hydro business and strategic projects.

Our Technical Leadership

BC Hydro's Engineering Services leaders contribute to creating standards and sharing lessons learned through a variety of international industry associations, including:

- International Council on Large Electric Systems
- Institute of Electrical and Electronics Engineers
- Western Electricity Coordinating Council
- Canadian Association for Earthquake Engineering
- Canadian Standards Association
- American Society of Civil Engineers
- Association of Edison Illuminating Companies
- Electric Power Research Institute
- Canadian Dam Association
- Project Management Institute
- Public Construction Council of B.C.

Our technical leaders participate in advancing the industry in the areas of dam safety, risk management, rotary equipment, water management and transmission standards.

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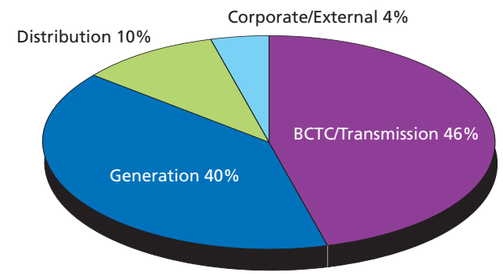
Engineering Services

People and technology, making a difference

Who We Are

F06 Revenue Forecast by Client



Transmission Engineering

Transmission Engineering delivers stations and transmission capital projects, maintenance services, protection and control (P&C), telecommunications, and survey and photogrammetry services. Transmission Engineering's client is primarily BCTC. Key projects include increasing downtown Vancouver's reliable power by placing underground cable 2L33 in service in spring 2004, strategically replacing end-of-life electromechanical line protections with state-of-the-art digital relays such as the 500 kV and under 500 kV equipment, remote terminal units (RTUs) involved in supervisory control and data acquisition (SCADA), and supporting BC Hydro's key independent networks including microwave, radio, fibre-optic and telephones by replacing the obsolete analog microwave facilities with contemporary digital equipment in the Lower Mainland, on Vancouver Island and along the Peace-Skeena.

Generation Engineering

Generation Engineering provides project management and design services for BC Hydro's Generation Line of Business capital and maintenance projects, including dam safety. The project delivery teams have been established to align with the client areas: water resources and energy projects, Coastal, Peace and Columbia region facilities, maintenance services, dam safety and other major projects such as Coquitlam Dam, Mica and Peace Canyon stators. Services include civil, electrical, protection and control, and mechanical technical support, in addition to instrumentation and automatic data acquisition.

Distribution Engineering

Distribution Engineering delivers full-service engineering services for both capital projects and services for infrastructure ranging up to 35 kV for BC Hydro's Distribution Line of Business. Services include load forecasting and one-year feeder capacity planning support, standards, design and construction guides, commodities support, distribution automation, power quality complaint investigation and Independent Power Producer (IPP) interconnection. Projects include distribution overhead, underground and submarine lines and feeders and equipment such as pole-top switches and reclosers.

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Recent ***Successes***

2L33 Underground Cable – **Client**: BCTC

Background: Downtown Vancouver's 2L46 cable circuit was nearing its end of life. BC Hydro and B.C. Transmission Corporation (BCTC) assessed potential solutions and elected to build a new line rather than replace a failing cable.

Results: This $42M project delivered the cable in service on April 29, 2004, ahead of schedule.

Value: This project restored the supply and seismic security to downtown Vancouver (over 900 customers) by adding a new cable circuit between Horne Payne Substation in Burnaby and Cathedral Square Substation. This meant a secure supply that impacted over 900 customers. It also provided mutual support between the downtown and Richmond supply area and deferred transmission reinforcement to the Richmond area.

Technical Leadership: The project route was surveyed using orthophotos and LiDAR (light detection and ranging). This enabled quick preparation of the civil plan and profile drawings for an early cable tender issue. Creative trenching was undertaken beneath the Burlington Northern and Santa Fe railway, along with pipejacking under Highway 1 to minimize disruption. Transmission capacity was optimized for 2L33 using distributed fibre optic temperature sensing, which determines the temperature profile along the entire nine-kilometre cable and helps manage hot spots.

Seven Mile Dam Safety Improvements – **Client**: Generation Line of Business

Background: This project implemented improvements to the dam, spillway and site systems necessary to provide an acceptable level of dam safety risk at the facility.

Results: This $64M, three-year project ensured that dam anchoring and spillway improvements were in service by December 2004 – lower than the approved budget.

Value: These dam safety efforts addressed the seismic upgrading of the dam stability, the spillway and dam drainage systems to restore normal use of the reservoir for power generation.

Technical Leadership: Financial savings were achieved through innovative design and construction techniques for the post-tensioned anchors; minimizing tender pricing risks by use of a trial contract for the first three anchors; simplifying the spillway control systems; innovative construction techniques for the spillway tower removal; packaging the work phases to maximize competitive tendering; and designing and building a highly reliable spillway operation and control system that avoids the cost of additional back-up such as a fuse gate.

Seven Mile Generating Station Unit 4 – **Client**: Generation Line of Business

Background: The Seven Mile Dam and power plant came into service in 1979 and consisted of a concrete gravity dam, a spillway, and a four-bay powerhouse. Three generating units with a total nameplate capacity of 607.5 MW were initially installed. The installation of Unit 4 in 2003 completed the project and increased the capacity by approximately 204 MW. Average energy production of the generating facility was increased by 302 GWh per year.

Results: This $86M, two-year project was placed in commercial service on April 25, 2003, 11 months ahead of the originally planned schedule and $11M under budget. This is close to the shortest schedule achieved in the industry for implementation of a large Francis turbine generator project.

Value: An increase in maximum output was achieved with the success of this project, and the overall efficiency of the other three units combined was increased by almost two per cent. The client revised the project objectives based on the commercial benefits that could be derived by completing the project before the spring freshet. Due to the the 11-month project acceleration period it is estimated that Unit 4 produced $15M in generation revenue for the client. The project payback period is expected to be less than 10 years.

Technical Leadership: By optimizing the flow and hydraulic turbine designs, an output of 210 MW was achieved from Unit 4 for the same inflow and head conditions as the other three 198 MW units. The use of three-dimensional computer modelling, combined with computational fluid dynamics flow analysis, ensured that the best turbine efficiency and performance characteristics were achieved. These studies were validated by a joint team of GE Hydro and BC Hydro Engineering. In addition, special arrangements were made to transport the turbine from eastern Canada in one piece, rather than assembling two pieces on site. This saved four months of time on the schedule and required two separate barge legs and special trucking permits from La Chine, Quebec, up the St. Lawrence, down through the Atlantic, and up to Portland, Oregon, via the Panama Canal.

Guichon Capacitor Station – **Client**: BCTC

Background: The project provided a new 50% series compensation capacitor station in the Cariboo region. The station increased the transmission capacity to the Lower Mainland by 500 firm megawatts to meet load growth.

Results: This $15M, two-year project energized the 500 kV series capacitor station on schedule on October 14, 2003.

Value: The project increased the capacity of transmission line 5L87 to the Lower Mainland. BC Hydro saved $1M by proactively selecting a suitable property. This project was completed in partnership with Nokia Capacitors of Finland, where the capacitor station site preparation and transmission line work was performed by BC Hydro and the design, supply and installation of the equipment and facilities was completed by Nokia.

Technical Leadership: Seismic calculations were verified by field test on the fully assembled and loaded platform. The natural frequency of the structure was determined through high-speed camera and supplementary measuring devices to ensure the accuracy of the study. To verify its performance, 500 kV staged fault tests were performed on the completed station to verify its performance. BC Hydro was able to obtain data on secondary arc activity, and Next-Phase, a local manufacturer, tested its newly developed fibre optic measuring instruments. In addition, radio interference measurements were done to ensure compliance with federal regulations.

Recent ***Successes***

Saltspring to North Pender Submarine Cable Replacement – **Client**: Distribution Line of Business

Background: This project improved the reliability and load capacity of the three submarine cables across the Swanson Channel between Saltspring and North Pender Island by replacing them with four new five-kilometre 25 kV cables.

Results: This $2M project was completed to coincide with optimum tide and current conditions, allowing energization before the 2003 winter peak.

Value: The project team reduced overall job costs by scheduling two projects to be completed in succession at a centralized marshalling point.

Technical Leadership: A sidescan sonar evaluation of the proposed route was conducted to ensure a secure placement location for the cable. The project team used specialized differential GPS position monitoring to control the laying vessel track as well as the continuous cable payout tension monitoring and control to ensure the correct cable location in the right-of-way and eliminating any cable suspensions. Environmental impacts were mitigated by using specialized slope stabilization measures at the Ruckle Park terminal end on Saltspring Island to minimize surface erosion, and an eelgrass credits scheme was negotiated with the DFO by conducting habitat improvement work at another nearby location.

Wild Fire Risk Reduction – **Client**: Distribution Line of Business

Background: In 2003 and 2004 a disproportionate number of forest fires struck the Southern Interior of B.C. Engineering supported the development of a contingency plan for the distribution substations at high risk of loss of transmission in northern B.C., the South Interior and North Vancouver Island.

Results: This $25,000 project had completed the fire emergency plans before the fire season of 2004.

Value: The project resulted in the creation of planning maps for affected regions that show entire circuits, an optimization plan for the number of diesel generators required, and a working contract with local diesel suppliers to prepare for emergency situations.

GMS Unit 6 – 8 Turbine Upgrade – **Client**: Generation Line of Business

Background: G.M. Shrum G6 to G8 turbine runners were manufactured by Toshiba and installed in 1971 and 1972. A model test completed by GE Canada, BC Hydro's turbine partner, confirmed that a potential increase in efficiency of about five per cent could be achieved by replacing the runners and modifying some water passage components.

Results: This $30M project is ongoing.

Value: The demonstrated efficiency benefits of 242 GWh have a present value of $120M. All turbine components will be replaced or refurbished to a better-than-new condition. The turbines are also capable of increased power output, which will support a future unit capability of 305 MW. As well, the upgraded turbines will have enhanced operating flexibility due to better cavitation performance, smaller rough load zone and increased output at lower reservoir levels.

Technical Leadership: Determinating of the scope of work involved close collaboration of BC Hydro and GE engineers as part of a joint design team.

GMS Unit 7 Emergency Repair – **Client**: Generation Line of Business

Background: On October 15, 2003, an electrical fault led to phase-to-phase failures that damaged 34 stator winding bars, sections of the core, the circuit ring bus and some other rotor pole insulation. Tests showed that a temporary repair was impractical and the G7 stator rewind was initiated.

Results: This $6M project returned the G7 unit back to service on July 1, 2004.

Value: BC Hydro Engineering responded quickly to the fault and negotiated the provision of the new winding with GE.

Technical Leadership: Lessons from the 1998 GMS Unit 8 rewind were applied to ensure that the emergency received efficient, effective attention. GE worked on site to replace the winding and completed the work two weeks ahead of schedule.

IPP Integration (Vancouver Island Cogen IPP Integration)

– **Client**: Transmission Line of Business (pre-BCTC)

Background: This project connected the 240 MW Island Cogen combined-cycle gas turbine generating station to the 138 kV transmission system in Campbell River. This included the installation of a new teleprotection system from John Hart Generating Station to the Elk Falls Pulp Mill, a transmission tap connection of the new generating station and the replacement of nine 138 kV circuit breakers at Ladore, Puntledge, and Comox Stations.

Results: This $5M project went into service in September 2000 in time to receive the first output from the IPP.

Value: The Island Cogen plan is the largest Independent Power Producer connected to the B.C. transmission system.

Technical Leadership: The generating station was located with BC Hydro's largest load, so it was important to ensure that the power quality met BC Hydro's requirements. VI Cogen installed a point on wave circuit breaker closing to minimize the impact of power transformer energization on the adjacent pulp mill. Engineering kept the interconnection costs down by installing three-terminal line protection over the fibre optic cable and developed new procedures for commissioning IPPs into the transmisison system.