THE BOARD OF COMMISSIONERS OF PUBLIC UTILITIES

IN THE MATTER OF
the *Electrical Power Control Act, 1994*, SNL 1994, Chapter E-5.1 (the "EPCA") and the *Public Utilities Act*, RSNL 1990, Chapter P-47 (the "Act"), as amended;

AND

IN THE MATTER OF
the Board's Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System.

EVIDENCE
OF
C. DOUGLAS BOWMAN

October 14, 2016

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Evidence Outline

List of Exhibits

Exhibit CDB-1 – C. Douglas Bowman Background and Qualifications

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EVIDENCE OF C. DOUGLAS BOWMAN

My name is Doug Bowman. This document was prepared by myself, and is correct to the best of my knowledge and belief. I have been retained by the Government appointed Consumer Advocate to provide expert advice and evidence to the Consumer Advocate in relation to the Board's *Investigation and Hearing into Supply Issues and Power Outages on the Island Interconnected System*.

A summary of my background and qualifications is provided in ***Exhibit CDB-1***. I have both a B.S. and an M.S. in Electrical Engineering from the State University of New York at Buffalo and 39 years of experience in the electricity services and consulting industry. My primary expertise includes electricity services costing and pricing and power sector restructuring, regulation and markets. I am an independent Energy Consultant working out of my office located in Warrenton, Virginia.

Prior to becoming an independent consultant, I was employed by KEMA Consulting, Nexant Inc., Pace Global Energy Services, International Resources Group, CSA Energy Consultants and Ontario Hydro. I have taken part in the regulatory process in the Province of Newfoundland and Labrador on behalf of the Consumer Advocate since 1996, and have submitted testimony before this Board nine times previously as an expert witness on cost of service and rate design at Newfoundland Power's 1996 *Application by Petition for Approval of Certain Revisions to its Rates, Charges and Regulations*, at Newfoundland and Labrador Hydro's 2001 *General Rate Proceeding*, at Newfoundland Power's 2003 *General Rate Application*, at Newfoundland and Labrador Hydro's *2003 General Rate Application*, at Newfoundland and Labrador Hydro's *2006 General Rate Application*, at Newfoundland Power's *2007 General Rate Application*, at Newfoundland and Labrador Hydro's *2009 Application concerning the Rate Stabilization Plan components of the rates to be charged Industrial Customers*, at Newfoundland and Labrador Hydro's *2013 General Rate Application*, and at Newfoundland and Labrador Hydro's *Amended 2013 General Rate Application*. While at Ontario Hydro, I was involved with the regulatory process in the areas of generation and transmission planning, demand/supply integration, operations, rate design and customer service.

In January, 2014 electricity customers on the Island Interconnected System ("IIS") were subjected to widespread power outages with as many as 200,000 customers without power, often for several hours at a time. The Board initiated an investigation into the circumstances leading up to and surrounding the outages and retained The Liberty Consulting Group ("Liberty") to assist with the investigation. The Board structured its investigation into two phases with Phase One focused on immediate reliability issues on the Island Interconnected

System. The issue of adequacy and reliability of supply continued to be a concern of the Board, so Phase Two is focused on the adequacy and reliability of the IIS to meet customer load both up to and after the interconnection with Muskrat Falls. The Board issued an Interim Report on Phase One dated May 15, 2014 and a final Phase One Report on September 29, 2016. Liberty issued its Final Report on Phase Two entitled *Review of Newfoundland and Labrador Hydro Power Supply Adequacy and Reliability Prior to and Post Muskrat Falls* on August 19, 2016.

I have been asked by the Consumer Advocate to review the Liberty Final Report on Phase Two including Requests for Information ("RFIs") on the report, and other information filed as part of the investigation and proceedings related to the Muskrat Falls project. My review focusses on system planning and regulatory issues pre- and post-Muskrat Falls.

Section 1 of my Evidence summarizes my recommendations, **Section 2** addresses my review of system planning and regulatory issues post-Muskrat Falls and **Section 3** addresses my review of system planning and regulatory issues pre-Muskrat Falls.

1. Summary of Recommendations

A summary of the recommendations relating to my review follows. My recommendations are provided within the context of IIS supply adequacy and reliability and its impact on the electricity consumers in the Province of Newfoundland and Labrador ("NL").

a) The Muskrat Falls project has been delayed until the winter of 2020-21. Hydro has an acceptable contingency plan in place if the project falters or unforeseen

reliability issues surface. The contingency plan includes keeping Holyrood in service for as long as needed and making emergency capacity purchases over the Maritime Link from Nova Scotia, New Brunswick and/or points south in the United States. Nalcor and Hydro have now received numerous recommendations to take into consideration as they construct, commission and initiate operations on the Muskrat Falls project. I recommend that the Board bring this investigation to a close and direct its attention to high priority items including the reliability and adequacy of supply pre-Muskrat Falls, the regulatory requirements associated with sales and purchases of capacity and energy over the Maritime Link, and the rates and regulatory treatment of costs associated with Muskrat Falls and its associated transmission. The investigation is not necessary to address these high priority issues – they can all be adequately addressed through the normal regulatory process.

b) In its Phase One Final Report (page iii), the Board directed Hydro to undertake a demand/supply analysis and risk assessment with the updated load forecast and realistic outage statistics for Holyrood TGS, and the Stephenville and Hardwoods combustion turbines. As Liberty points out, these are significant inputs to the pre-Muskrat Falls demand/supply balance and the Board and the parties need to understand the impact on supply risks faced by consumers. I support this undertaking and recommend that the analysis and risk assessment be undertaken at least annually ahead of each winter period.

c) As stated by Liberty, it may be necessary to add supply to the Island Interconnected System pre-Muskrat Falls. The Maritime Link is expected to be operational in 2017, so it may be possible to procure capacity over the Maritime Link to meet any supply needs in a cost effective and low risk manner. However, technical and regulatory risks must first be mitigated. It is not clear that Nova Scotia or New Brunswick have capacity available when there is a need on the IIS, and capacity from points farther south in the United States may require FERC approval of reciprocity provisions such as opening the NL electricity market to competition and establishing a third party transmission access regime. Gaining FERC approval of an open access transmission tariff could be a lengthy process, particularly if it also requires that Hydro unbundle its transmission function as a separate subsidiary, or separate entity altogether. I recommend that the Board direct Hydro to give this undertaking high priority with results and recommendations included as part of the 2017 General Rate Application ("GRA") which Hydro proposes to submit to the Board by March 31, 2017, less than six months from now.

d) The Muskrat Falls project and sales and purchases of electric capacity and energy over the Labrador-Island and Maritime Links will have a significant impact on electricity rates in the Province both pre- and post-Muskrat Falls. The funds that must be recovered for the Muskrat Falls project could potentially impact Hydro's ability to supply customers at adequate levels of quality and reliability. As Liberty states (Liberty's Final Phase Two Report, page 88): *the high construction costs of*

Muskrat Falls and its associated transmission will influence Hydro's financial structure for decades, with the large increase in rate base causing a substantial impact on what customers pay. This factor also has the potential to limit Hydro's financial flexibility in the future to an as-yet undetermined extent. These questions are crucial to future operation and of paramount interest to stakeholders. I recommend that the Board direct Hydro to file as part of its 2017 GRA, a rate transition plan covering the next five years that will provide Hydro the opportunity to operate as a financially viable concern while managing the rate impacts on the Province's electricity consumers.

2. Post-Muskrat Falls Reliability and Adequacy of Supply

With regard to power supply adequacy and reliability post-Muskrat Falls, Liberty makes the following recommendations:

Liberty Recommendation V-1. Hydro should expedite efforts to determine (a) the availability of dependable reserves from Nova Scotia or elsewhere and (b) the competitiveness of those reserves versus new IIS generation.

Liberty Recommendation V-2. Hydro should evaluate the degree to which new capacity, via dependable Maritime Link supply and/or new CTs, is required to assure that customer outages due to loss of the bipole are limited to those caused by UFLS and those circuits are promptly (hours) restored.

Liberty Recommendation V-3. Hydro should prepare a new resource plan that, as necessary, includes new CTs and the dependable portion of any Maritime Link imports, and addresses all of the supply-related risks currently confronting Hydro.

Liberty also makes 14 recommendations for transitioning to operations, 11 recommendations relating to the reliability of Muskrat Falls, and three recommendations relating to the Labrador-Island Link ("LIL") and Maritime Link.

I agree with the three recommendations relating to supply adequacy and reliability post-Muskrat Falls, and point out that all three recommendations are also applicable to the pre-Muskrat Falls era, and owing to timing considerations, are high priority. In particular, for the period pre-Muskrat Falls, the following recommendations are relevant:

a) Hydro should expedite efforts to determine: (a) the availability of dependable reserves from Nova Scotia or elsewhere, and (b) the competitiveness of those reserves versus new and existing IIS generation, if needed.

b) Hydro should evaluate the degree to which new capacity, via the Maritime Link and/or new CTs, is required to assure that customers receive adequate and reliable supply.

c) Hydro should prepare a new resource plan that, as necessary, includes new CTs and the dependable portion of any Maritime Link imports, and addresses all of the supply-related risks currently confronting Hydro.

The Muskrat Falls project is delayed until the winter of 2020-21 (see Liberty Final Phase Two Report, page ES-2), meaning there is time to assess if additional demand and supply options are required beyond 2020. Liberty states (page ES-1): "*Our review concludes that the interconnection of the IIS with Muskrat Falls and the Maritime Link can represent a state-of-the-art electrical system whose reliability is improved over today's circumstances*." The expectation is that the system will be improved over present-day. While it is true that there are risks that must be managed, that is the responsibility of the project manager (Nalcor) and following commissioning, the project operator (Hydro). Further, Hydro has a contingency plan, namely, keeping Holyrood available for operation beyond Muskrat Falls commissioning until such time it is decided that it no longer benefits consumers. Hydro will also have access to emergency capacity over the Maritime Link provided the technical and regulatory issues are addressed as discussed later in this report. Liberty has provided numerous recommendations with respect to project implementation, as will, I expect, various experts on behalf of the parties participating in this investigation. Now it is up to Nalcor and Hydro to execute the project. Project implementation and operation is their responsibility. I believe it is appropriate to bring this investigation to a close and to let Nalcor and Hydro concentrate on project implementation, while the resources of the Board and the Parties are directed to higher priority issues, including:

- The reliability and adequacy of supply and analysis of supply risks pre-Muskrat Falls;
- The technical feasibility of purchases of capacity and energy over the Maritime Link;
- The scope of potential reciprocity requirements related to the sale and purchase of power to/from points south; and
- The upcoming 2017 GRA expected to be filed in less than 6 months, by the end of the first quarter of 2017, including:
    - The treatment and impact of Muskrat Falls and associated transmission on rates;
    - The treatment and impact of Muskrat Falls commissioning power on rates;
    - The treatment and impact on rates of potential purchases and sales of capacity and energy over the Maritime Link.

I point out that none of these high priority issues require a continuation of the Board's investigation – they can all be adequately addressed through the normal regulatory process. As recommended later in this report, the pre-Muskrat Falls reliability and adequacy of supply and risk analysis should be considered now as directed by the Board in its Final Phase One Report, and also at least annually ahead of each winter period until Muskrat Falls is fully operational and the Board is satisfied that less frequent reviews are warranted. There is no need to continue the Board's investigation in order to impose this requirement on Hydro.

In summary, I recommend that the Board now bring this investigation to a close and direct its attention to these high priority issues.

3. Pre-Muskrat Falls Adequacy and Reliability of Supply

3.1 Demand/Supply Review and Risk Assessment

Liberty makes one recommendation relating to pre-Muskrat Falls adequacy and reliability of supply, as follows:

Liberty Recommendation II-1. Hydro should conduct a new supply review that considers all risks, including the thermal assets and the planned reductions in the load forecast, and provide a risk-based recommendation on the need, timing and amount, if any, for new pre-Muskrat Falls supply.

I agree with Liberty that Hydro should conduct a supply review and risk assessment taking into consideration the latest load forecast and outage statistics for hydro and thermal generation, considering in particular, recent performance at Holyrood TGS and the Stephenville and Hardwoods combustion turbines. As Liberty points out, the Board and the Parties need to understand the supply risks faced by electricity consumers in the Province. In fact, the Board has directed Hydro to undertake such a review in its Phase One Final Report (page iii).

Such assessments should be undertaken at least annually until Muskrat Falls is commissioned and operational. In fact, if events warrant, more regular assessments should be undertaken; i.e., failure of a unit at Holyrood. These assessments should continue beyond Muskrat Falls commissioning as well. Hydro had major system outages in January 2014 – the driver of this investigation that is now into its third year. I would expect Hydro to make such supply reviews and risk assessments common practice without the need for a specific order from the Board. Otherwise, Hydro would not be acting in the best interests of its customers.

3.2 Technical and Regulatory Requirements Relating to Capacity and Energy Sales and Purchases over the Maritime Link

Liberty makes the following recommendations relating to capacity and energy purchases and support over the Maritime Link:

Liberty Recommendation VI-12. A recommended plan for the completion of all activities, both internal and external, required to support NERC compliance and open access should be provided.

Liberty Recommendation VI-14. Hydro should promptly secure agreements with Nova Scotia Power and New Brunswick Power or, in the inability to do so, provide for other methods of addressing relevant contingencies.

As Liberty states, the Maritime Link will be in service in about one year, yet there does not appear to be suitable progress in resolving issues relating to market transactions, such as responsibility, rate treatment, open access, and avoidance of conflicts between marketing and operations (Liberty Conclusion VI-12). Liberty states (Conclusion II-5): "*a more detailed pre-Muskrat Falls supply assessment, including adequate consideration of the risks, is likely to conclude that new supply is required in the near future*". One would expect that capacity procured over the Maritime Link would meet such needs in a cost effective and low risk manner since it could be procured only as needed; i.e., as opposed to adding new combustion turbines that must be paid for whether or not they are actually needed to operate. However, as Liberty points out, there are technical and regulatory risks associated with this option. For example, it is not clear that Nova Scotia or New Brunswick will have additional capacity during periods of need on the Island Interconnected System. Hydro currently has no formal agreements in place with these Provinces to provide backup supply when needed (see Liberty Conclusion VI-16).

Further, if the capacity can be obtained from points farther south in the United States, as one might expect given that there are competitive wholesale electricity markets in place, it is not clear that such purchases are technically feasible or will be allowed if the Province has not established reciprocity. It is not clear what reciprocity might entail. For example, is the Province required to unbundle its electricity market into generation, transmission, distribution and supply components and establish full wholesale and retail competition via a third party transmission access regime? Liberty states on pages 101 and 102 of its Phase Two Final report "*Hydro's desire to engage in market transactions with*

others in North America brings the requirement of granting others access to the IIS. These needs have been known for some time, and Hydro has been taking steps to address them." In its response to CA-PUB-047, Liberty states "*if Newfoundland and Labrador or Nalcor wishes to have open access to any other electric markets, including its neighbors in New England, it is required to provide reciprocity*." Liberty goes on to say "*we understand that the provincial government has been working with Hydro to determine the actions it must take and to establish a strategy and plan for Newfoundland and Labrador's place in a North American electric grid and market.*"

What is the strategy and plan for establishing Newfoundland and Labrador's place in the North American electricity market? Establishing an open access transmission regime will significantly impact the electricity consumers, the electricity supply entities and the Board, and should have broad stakeholder review. To what extent does FERC jurisdiction extend to Canada, and in particular, to this Province? Even if the Government decides not to open the electricity market to competition, gaining FERC approval for an open access transmission tariff could be a lengthy process, particularly if it requires Hydro to unbundle its transmission function as a separate subsidiary, or separate entity altogether. Even if reciprocity is not required, it could be a lengthy process gaining FERC acknowledgement that reciprocity is not a requirement for the Province to buy and sell power in the United States.

Resolution of these issues must be given high priority if electricity consumers are to gain maximum value from the Maritime Link. I recommend that the Board direct Hydro to

address these issues as part of Hydro's 2017 General Rate Application. In fact, it would be helpful if Hydro presented its plan to the Board and the Parties prior to submission of its 2017 GRA in an effort to streamline the review process.

3.3 Rates and Regulatory Treatment of Muskrat Falls and Transactions Over the Maritime Link

Liberty makes the following recommendation relating to rates and regulatory treatment of transactions over the LIL and Maritime interconnections:

Liberty Recommendation VI-10. A complete plan for how interconnection transactions will be managed, including definition of roles and responsibilities, rate treatment, and how all regulatory requirements will be satisfied, should be developed.

The Muskrat Falls project and sales and purchases of capacity and energy over the Maritime and Labrador-Island transmission links will significantly impact electricity rates in the Province. As Liberty states (see Liberty Final Phase Two Report, page 89): "*A central question here is how the interconnection transactions will be managed and to whom the benefits (and risks) of such transactions accrue. Specifically, it is critical for Hydro and its customers to understand the degree to which such transactions contribute to the revenue requirement, if at all, and therefore whether or not they influence rates*."

With the completion of the Maritime Link expected only a year from now in 2017, a number of opportunities will arise through the sales and purchases of capacity and energy

with Nova Scotia, New Brunswick and points south in the United States both pre- and post-Muskrat Falls. For example, in the pre-Muskrat Falls period:

- Spare capacity on the Island Interconnected System in the summer months might be sold to entities in the South;
- Surplus hydro energy on the Island Interconnected System during wet periods might be sold to entities in the South;
- Other ancillary services such as reserves and/or balancing energy when available might be sold to entities in the South;
- Emergency capacity might be purchased during times of need from entities in the South;
- Low-cost energy might be purchased from entities in the South to offset higher-cost production from Holyrood TGS; and
- Lower cost ancillary services such as reserves and/or balancing energy might be purchased from entities in the South to offset higher cost services on the Island Interconnected System.

Opportunities will arise post-Muskrat Falls as well, and of course, the rates and regulatory treatment of the Muskrat Fall project itself and the revenues generated from its sales to points south must be resolved.

There are numerous questions relating to the rate and regulatory treatment of revenues and costs related to Muskrat Falls and sales and purchases over the Maritime and Labrador-Island Links, as follows:

- Will the revenues from sales of Muskrat Falls go toward reduction of Hydro's revenue requirement?
- If the rate impact owing to Muskrat Falls is large, how will it be implemented; i.e., will a transition plan be necessary?
- To what extent will Hydro utilize the Maritime Link for purchases to displace generation from other assets, and for sales of capacity and energy from other assets to points south, and how will the costs and revenues be recovered/refunded from/to electricity customers? The treatment of purchases over the Maritime Link to displace high-cost thermal generation at Holyrood is particularly relevant in the pre-Muskrat Falls era. Holyrood production costs were estimated at the Amended 2013 GRA to be Can$ 138/MWh (see CA-NLH-341 from Amended 2013 GRA). This is equivalent to US$ 105/MWh.[1] In comparison, New England and PJM locational marginal prices for energy were US$ 23.38/MWh and US$ 21.96/MWh, respectively, on October 4, 2016.[2] While these figures do not include transmission costs, and there are some discrepancies between fuel prices, they do

[1] Based on the Bank of Canada exchange rate for October 4, 2016 of 1.0 Can$ = 0.759 US$ (http://www.bankofcanada.ca/rates/exchange/).
[2] Prices relate to day-ahead electricity market. PJM price and New England price from http://www.nyiso.com/public/markets_operations/market_data/maps/index.jsp and https://www.iso-ne.com/isoexpress/web/charts# .

suggest that opportunities exist for purchases and sales that benefit NL electricity consumers.

This is just a sampling of the questions that require answers. It is important that electricity consumers in the Province be given the opportunity to fully vet the proposed regulatory regime. The funds that must be recovered for the Muskrat Falls project could potentially impact Hydro's ability to supply customers at adequate levels of quality and reliability. As Liberty states (Liberty's Final Phase Two Report, page 88): *the high construction costs of Muskrat Falls and its associated transmission will influence Hydro's financial structure for decades, with the large increase in rate base causing a substantial impact on what customers pay. This factor also has the potential to limit Hydro's financial flexibility in the future to an as-yet undetermined extent. These questions are crucial to future operation and of paramount interest to stakeholders.*

Resolution of these issues must be given high priority so that a transition plan can be developed to mitigate rate impacts on consumers. I recommend that the Board direct Hydro to file as part of its 2017 GRA, a rate transition plan covering the next five years that will provide Hydro the opportunity to operate as a financially viable concern while managing the rate impacts on the Province's electricity consumers.

This concludes my Evidence.

Exhibit CDB-1

C. Douglas Bowman

Background and Qualifications

Profession	***ENERGY CONSULTANT***
Nationality	Canadian Citizen U.S. Resident
Years of Experience	39
Education	M.S./1977/Electrical Engineering/State University of New York, Buffalo, NY B.S./1975/Electrical Engineering/State University of New York, Buffalo, NY
Key Qualifications	Mr. Bowman has 39 years of experience in the power industry both domestically and internationally. His primary areas of expertise include electricity services costing and pricing and power sector restructuring, regulation and markets. Mr. Bowman has played a leading role in consulting projects in Canada, Armenia, Australia, Central America, China, Colombia, Dutch Antilles, Egypt, Georgia, Ghana, India, Indonesia, Macao SAR, Macedonia, Mexico, the Middle East, Mongolia, Pakistan, the Philippines, Russia, Saudi Arabia, Serbia, South Korea, Taiwan, Thailand, United States and Vietnam. **Expert Testimony at Newfoundland and Labrador Hydro's Rates Submission** Provided expert oral and written testimony on issues related to cost of service, rate design and regulation at Hydro's Amended 2013 General Rate Proceeding. **Expert Testimony at Newfoundland and Labrador Hydro's Rates Submission** Provided expert written testimony on issues related to cost of service, rate design and regulation at Hydro's 2013 General Rate Proceeding. **Expert Testimony at Newfoundland and Labrador Hydro's Application Concerning the Rate Stabilization Plan** Provided expert written testimony on issues related to Hydro's 2009 Application on the rate stabilization plan components of the rates to be charged Industrial Customers. **Expert Testimony at Newfoundland Power Inc.'s Rates Submission** Provided expert written and oral testimony on issues related to cost of service, rate design and distribution quality and reliability of service standards at Newfoundland Power's 2008 General Rate Application.

Expert Testimony at Newfoundland and Labrador Hydro's Rates Submission
Provided expert oral and written testimony and participated in negotiation sessions on issues related to cost of service, rate design and regulation at Hydro's 2006 General Rate Proceeding.

Expert Testimony at Newfoundland and Labrador Hydro's Rates Submission
Provided expert oral and written testimony and participated in mediation sessions on issues related to cost of service, rate design and regulation at Hydro's 2003 General Rate Proceeding.

Expert Testimony at Newfoundland Light & Power's Rates Submission
Provided expert written testimony and participated in mediation/technical sessions on issues related to cost of service and rate design at Newfoundland Light & Power's 2003 General Rate Application.

Expert Testimony at Newfoundland and Labrador Hydro's Rates Submission
Provided expert oral and written testimony related to cost of service and rate design issues at Hydro's 2001 General Rate Proceeding.

Expert Testimony at Newfoundland Light & Power's Rates Submission
Provided expert oral and written testimony related to cost of service and rate design issues at Newfoundland Light & Power's 1996 General Rate Proceeding.

Expert Testimony at Nova Scotia Power's Rates Submission
Provided expert oral and written testimony related to cost of service and rate design issues. Recommended and designed time-of-day rates for all customer classes and designed an alternative interruptible rate design for large industrial customers.

Expert Testimony at Nova Scotia Power's Rates Submission
Provided expert oral and written testimony regarding an Industrial Expansion rate design. Recommended approval of rate with modifications and submitted two alternative rate designs for approval including a real-time surplus power rate and a time-of-day expansion rate.

Cost of Service and Cost Reducing Rate Design Study
On behalf of the Nova Scotia Utility and Review Board, reviewed Nova Scotia's cost of service study and developed rate designs consistent with Nova Scotia Power's integrated resource plan for all customer classes. Report was filed with Board, and reviewed as part of hearing on utility's subsequent rate submission.

Secondary Legislation Development in Georgia
For Georgia's electricity and gas regulatory, GNERC, provided advisory services on Rules Governing Retail Electricity Market, Supplier of Last Resort, Customer Switching and Distribution Grid Code. Legislation drafted in conjunction with GNERC based on industry best practices and requirements of the European Union. Final versions of rules governing each area submitted to GNERC for adoption as it makes the transition to a fully competitive electricity market.

Economic Policy Reform and Competitiveness Project – Mongolia
Assisted with the setup and training of the new regulatory commission in Mongolia. Developed tariff reform plan that was accepted by the regulatory commission for implementation. Developed incentive based power purchase agreement for sales of generating company capacity and energy to the transmission company. Developed market rules for governing competitive electricity market.

Electricity Market Reform in Macedonia
Participated in development of competitive electricity market design for Macedonia consistent with European Union market design. Assisted with development of Market Rules to govern operation of the competitive electricity market.

Competitive Electricity Market Design – Taiwan
Developed competitive market design for electricity sector in Taiwan. Drafted market governance documents including Market Rules and Grid Code. Managed market modeling component of project which simulated market operation under wide range of scenarios.

Alberta RTO Evaluation Project
Developed strategy related to preferred business relationship between the Alberta Regional Transmission Organization and RTO West to ensure Alberta's electricity needs are met by a competitive market. The project participants included the Alberta Department of Energy, ESBI Alberta Limited, and the Power Pool of Alberta.

Detailed Market Design and Market Rules Development, Western Australia
Served as project manager providing advice to the Government of Western Australia with regard to detailed market design, market rules development, and market power mitigation. Assisted with the stakeholder process, drafted position papers on various design topics, drafted market rules consistent with a bilateral contracts market, and designed a market power mitigation program.

Market Assessment of Generating Company in Korea
Provided advisory services to a client interested in submitting a bid for the purchase of a large generating company in Korea. Served as Project Manager for the market valuation component of the project.

Expert Testimony in Kansas Civil Case Concerning IPP Development
Provided expert testimony concerning the independent power producer (IPP) programs in India and Colombia. The testimony related to the difficulties and hurdles that must be overcome in order to successfully develop an independent power project in a developing country.

Market Power Mitigation Strategy for Generating Company in Korea
Provided advisory services to a large generating company in Korea relating to a market power mitigation strategy. Served as project manager. The project included market simulation to determine if the generating company would have market power in the new competitive market, and if so, if its market power were any greater than other generating companies participating in the market.

Advisory Services to World Bank on Regional Market Design among Arab Countries: Conducted a review of the status of market reform in the Arab countries and designed a competitive regional electricity market and road map for implementation of the market and ultimately gain access to markets in the surrounding region. Developed governance documentation for the regional electricity market including a General Agreement, Market/Commercial Rules and a Grid Code.

Advisory Services on Transmission Tariff Development in Georgia: Provided advice to Government of Georgia on behalf of USAID on transmission tariff development. The project included a comparison of current practice in Georgia to best practice in the European Union and provided recommendations for bringing current practice up to EU standards.

Advisory Services to World Bank on Regional Energy Integration in Middle East and Surrounding Area: Provided advice to Government of Saudi Arabia on behalf of World Bank on regional energy integration of GCC countries (Saudi Arabia, Kuwait, Bahrain, Qatar, UAE and Oman), as well as a select number of other countries offering trade opportunities for Saudi Arabia including Egypt, Iraq, Jordan, Syria, Lebanon, Iran, Turkey and the EU. Advice included assessments of legal, regulatory and policy relating to international energy trade, energy demand and supply balance, electric transmission interconnection including HVAC and HVDC, and pipeline capacity to support trade.

Advisory Services to World Bank on Potential Egypt – Saudi Electrical Interconnection: On behalf of Government of Saudi Arabia, conducted evaluation of potential HVDC electrical interconnection between Saudi Arabia and Egypt.

Advisory Services on Electricity Market Design in Serbia
Developed a high-level, phased design for the internal Serbian electricity market consistent with the EU Directive. The project intent was to provide institutional support to the Ministry of Mining and Energy to facilitate the phased development of the internal electricity market with

competitive bilateral contracts taking into account Serbian Energy Policy, the draft Energy Law, European Union requirements and the Athens Memorandum 2002.

Expert Testimony in California Civil Case Concerning Breach of Contract
Provided expert testimony concerning the value of a company based on revenues generated less costs to manage and operate the business. Revenues were derived from a contract for energy services covering steam and electricity sales to an industrial client and its power purchase agreement covering electricity sales to a utility.

Workshop on Transmission Planning in a Competitive Power Market
Conducted workshop on transmission planning for proposed RTO West in Portland, Oregon. Workshop covered transmission planning responsibilities of Regional Transmission Organizations under FERC Order No. 2000 and experience with domestic independent system operators and international transmission organizations. Reliance on market mechanisms for transmission expansion was emphasized at workshop.

Workshop on Transmission Pricing in a Competitive Power Market
Conducted workshop on transmission pricing for proposed RTO West in Portland, Oregon. Workshop covered transmission pricing in Regional Transmission Organizations under FERC Order 2000 and experience with domestic Independent System Operators and international transmission organizations. Workshop addressed transmission services such as network, connection, import, export, and point-to-point service, and cost recovery such as postage stamp, zonal and nodal pricing.

Development of Terms and Conditions for Transmission Tariff
Assisted Ontario Hydro Services Company with development of terms and conditions for its new transmission tariff. The terms and conditions were filed with the regulatory authority as part of the utility's application for approval of the new tariff. Also assisted with preparation of responses to various discovery questions related to the tariff.

International Survey of Transmission Rates and Services
Conducted a survey of transmission rates and services provided in various domestic and international jurisdictions. Survey conducted in support of submission by Ontario Hydro Services Company to Ontario Energy Board on its new transmission tariff. Survey topics included: services offered such as network, point-to-point, connection, import and export service; cost recovery such as postage stamp, zonal and nodal pricing; treatment of generation; and transmission planning.

Feasibility Study of Merchant Co-generation Project
Participated with a team of consultants on a feasibility study for development of a merchant co-generation facility to sell power into the wholesale market and steam to the industrial plant. Directed market studies including analyses of forecasts for electricity demand, new

generating plant construction, generation costs, market bid strategies, fuel costs, utility avoided costs, etc.

Advice to Mid-west Cooperative Concerning Role in Deregulated Power Market
Provided advice to a mid-west cooperative on positioning itself for a deregulated power market. Advice included the cooperative's future power purchasing strategy, transmission and distribution construction and operations and maintenance strategy and how it should position itself to compete in the future deregulated power market.

Experience

Independent Consultant, Warrenton, VA 2005 to Present

Nexant, Inc., Washington, DC 2004
Executive Consultant

KEMA Consulting, Fairfax, VA 1999 to 2004
Executive Consultant

Pace Global Energy Services, Fairfax, VA 1998 to 1999
Director, Power Services

International Resources Group, Ltd. (IRG), Washington, DC 1995 to 1998
Senior Manager, Energy Group

CSA Energy Consultants, Arlington, VA 1994 to 1995
Vice President (1995); Senior Manager, Power Supply Analysis (1994)

Ontario Hydro, Toronto, Ontario, Canada 1977 to 1993
Industrial Service Advisor, Field Support Services Department, 1992-1993

Senior Rate Economist, Rate Structures Department, 1990-1992

Planning Engineer, Demand/Supply Integration, System Planning Division, 1988-1990

Senior Engineer, Resource Utilization, Power System Operations Division, 1987-1988

Planning Engineer, BES-Resources Planning, System Planning Division, 1981-1987

Assistant Planning Engineer, Transmission System Planning Department, 1979-1981

Engineer-in-Training, 1977-1979