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August 1, 2008

Ms Kirsten Walli
Board Secretary
Ontario Energy Board
27th floor
2300 Yonge Street
Toronto, ON
M4P 1E4

RE: EB-2007-0707 Prefiled evidence Report # 4 of GEC-Pembina-OSEA

Dear Ms Walli,

I enclose three copies of the prefiled evidence prepared by Mr Jim Harding on behalf of the Green Energy Coalition, Pembina and OSEA. It has been uploaded to the Board's RESS site and sent to all the parties by email as well.

Sincerely,

(Mr.) Kai Millyard
Case Manager for the
Green Energy Coalition
Pembina Institute
Ontario Sustainable Energy Association

encls.
EC: All participants

Green Energy Coalition

David Suzuki Foundation

EB-2007-0707
Exhibit L
Tab 8
Schedule 4

BEFORE THE ONTARIO ENERGY BOARD

IN THE MATTER OF sections 25.30 and 25.31 of the Electricity Act, 1998;

AND IN THE MATTER OF an application by the Ontario Power Authority for review and approval of the Integrated Power System Plan and proposed procurement processes.

Overnight Costs of New Nuclear Reactors

by Jim Harding

Filed August 1, 2008

prepared for:
Green Energy Coalition
(David Suzuki Foundation, Eneract, Greenpeace Canada, Sierra Club of Canada, World Wildlife Fund Canada)
Pembina Institute
Ontario Sustainable Energy Association

Pre-Filed Testimony of Jim Harding
Overnight Costs of New Nuclear Reactors
July 2008

Witness Background

My name is Jim Harding, and I am the sole proprietor of Harding Consulting, based in Olympia, Washington. I currently serve as a consultant to the nuclear subgroup of a National Academy of Sciences panel on America's Energy Future, and as a consultant to the Natural Resources Defense Council, also on generation economics. Most recently, I served as director of power planning and forecasting and director of external affairs for Seattle City Light. I have also worked as assistant director and acting director for the Washington State Energy Office, Washington staff director of the Northwest Power Planning Council, senior associate for MHB Technical Associates, and special advisor to two members of the California Energy Commission. I have published a variety of papers on reactor economics; most recently for The Electricity Journal (January 2008) and UC Berkeley's Ecology Law Quarterly (spring 2008). I have recently testified on reactor economics before the California and Florida Energy Commissions.

Recent past clients include the Council on Foreign Relations, Nonproliferation Policy Education Center, Rio Tinto PLC, Burbank Public Utilities, the Large Public Power Council, and the Snohomish Public Utility District. I conducted most of the economic analysis – on a pro-bono basis – for an expert panel convened by the Keystone Center, with extensive representation from the electric utility industry and other sectors and interests.

I hold a BS in economics from University of San Francisco, and attended the MBA program at the University of California's Haas Business School before relocating to the Pacific Northwest.

Introduction and Summary

Cost estimates for new reactors have been rising at an extremely rapid rate in the US and Europe. There are many reasons for real cost increases, including sketchy or poor estimates from 2000-2003, rising raw and finished materials costs, and supply chain imbalances for skilled labor, forging capacity, and sub-suppliers with nuclear quality assurance programs. All of these issues affect reactor designs and building costs in all nations.

In 2007, a reasonable range of overnight (i.e., without interest or real escalation during construction) costs for a new reactor was in the range of $3000-4000/kW. In 2008, it is more reasonable to assume $5000/kW in overnight costs. This testimony describes the reasons for real cost escalation. I do not predict whether costs will continue to grow at

recent historical rates, but substantial contingency allowances should be built into any prudent estimate.

Capital Cost

For a number of years in the early to mid 2000s, the prevailing view in the US was that reactor costs were roughly $2000-2500/kW. For the most part, these "estimates" were goals. Natural gas and wind power were the resources of choice; few, if any, utilities and vendors made substantial investment of time and money to verify probable costs. This situation changed in 2006 and 2007, when rising gas prices and near certain controls on carbon forced a number of utilities and vendors to examine nuclear costs in earnest.

In developing this testimony, I have relied on a variety of recent overnight cost estimates and escalation indices. The cost estimates include estimates by Florida Power & Light for Turkey Point, Southern Nuclear for two additional units at the Alvin Vogtle site, and Progress Energy for two units in Levy County. A number of investment firms have also made concurrent estimates, including Standard & Poor's, Moody's, and Lazard Freres. In most cases, the estimates do not include highly desirable information, such as annual cash flows or whether the vendor is willing to assume any risks of real escalation or schedule delay during construction. In some cases, key information is redacted as commercially sensitive information. I have also orally discussed the costs and terms of conditions for a plant that was contemplated by MidAmerican Energy Holdings for southern Idaho. In this case, the owners halted further consideration based on the unwillingness of vendors to assume much, if any, cost or schedule risk.

The Florida Power & Light estimate is the most complete of the utility estimates described above.[1] FP&L developed its estimates in conversations with vendors and by using a TVA study for the Bellefonte nuclear project. FP&L's low, medium, and high overnight cost estimates, in 2007 dollars, are shown below:

Estimate	2004 TVA	FP&L Low	FP&L Medium	FP&L High
Overnight cost	$1661/kW	$3108/kW	$3596/kW	$4540/kW
Escalation	NA	18.8%/year	30.6%/year	41.2%/year
Real escalation	NA	16.3%/year	28.1%/year	38.7%/year

It is not entirely clear how comparable the TVA and FP&L cost estimates are. The TVA cost estimate was for EPC (engineering, procurement, and construction) costs. In 2004, remaining "owner's costs" were usually estimated at about 20 percent of EPC costs, but if we assume that the TVA estimate entirely excluded owner's costs, the escalation from 2004-2007 has been extraordinary. FP&L's cost estimates incorporate contingency (rather than real escalation) going forward, but the values used imply about 1.5-2.5

[1] Testimony of Steven D. Scroggs, In re: Florida Light & Power Company's Petition to Determine Need for Turkey Point Nuclear Units 6 and 7 Electrical Power Plant, October 16, 2007, pg. 247.

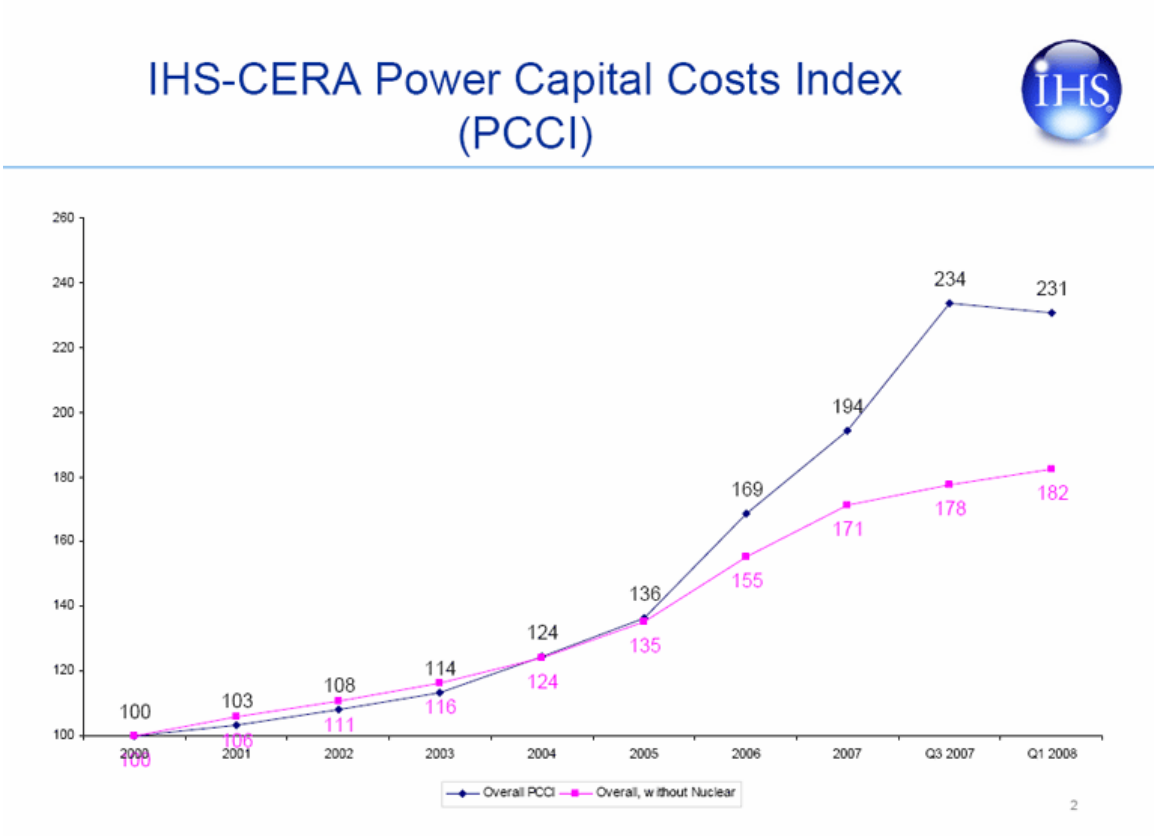
percent real escalation per year through commercial operation – far below recent historical averages.

American Electric Power recently presented analysis on one of the key reasons for cost escalation – rising commodity costs.

Commodity	Escalation 86-03	Escalation 03-07	Ratio vs. History
Nickel	3.8% per year	60.3% per year	15.9x
Copper	3.3% per year	69.2% per year	21x
Cement	2.7% per year	11.6% per year	4.3x
Iron/steel	1.2% per year	19.6% per year	16.3x
Heavy construction	2.2% per year	10.5% per year	4.8x

The estimated value (8 percent real, assuming 2.5 percent inflation) for "heavy construction" is significantly below the rate implied by the FP&L, but nevertheless quite high.

Cambridge Energy Research Associates has introduced a new index for power plant construction that tracks vendor bids worldwide. Their index shows nearly a three fold increase in estimated reactor construction costs over the last 6.8 years (14 percent real.)



It is very difficult to determine whether real cost escalation will continue into the future, and it clearly affects all generating options (in greater or lesser degree), and is most acute for capital intensive and longer lead time resources – nuclear in particular. As described earlier, nuclear power faces some specific supply-chain challenges that argue against a low number. Twenty years ago, the U.S. had about 400 suppliers and 900 nuclear or N-stamp certificate holders (sub-suppliers) licensed by the American Society of Mechanical Engineers. The numbers today are 80 and 200.[2] I have not reviewed equivalent numbers for the Canadian industry.[3] It is notable that the Ontario RFP process was recently extended for an additional three months at the request of bidders. This likely reflects the design, supply chain and cost uncertainty challenges facing the bidders.[4]

Worldwide forging capacity for pressure vessels, steam generators, and pressurizers is limited to two qualified companies - Japan Steel Works and, shortly, Creusot Forge – and the reactors builders will be competing with each other as well as with simultaneous demand for new refinery equipment. Japan Steel Works prices have increased by 12% in 6 months, with a new 30% down payment requirement.[5]

Other long lead-time nuclear qualified components, including reactor cooling pumps, diesel generators, and control and instrumentation equipment have six year manufacturing and procurement requirements. In the near term, reliance on foreign manufacturing capacity could complicate construction and licensing. NRC Chairman Dale Klein recently indicated that reliance on foreign suppliers would require more time for quality control inspections, to ensure that substandard materials are not incorporated in U.S. plants.[6] Two of the three reactor designs under consideration in Ontario are non-Canadian designs. The Canadian (AECL) design is a new design that moves away from the previous non-enriched fuel CANDU approach. All of these designs would thus entail new challenges for the local Canadian supply industry and would likely involve substantial reliance on imported components.

Skilled labor and experienced contractors present another problem. A recent study by GE-Toshiba identified a potential shortage of craft labor within a 400-mile radius of the

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[2] "Supply Chain Could Slow the Path to Construction, Officials Say," *Nucleonics Week*, February 15, 2007. Comments of Ray Ganthner, Areva.

[3] The current RFP process in Ontario is reviewing Canadian, American and French designs by AECL, Westinghouse/Toshiba, and Areva respectively. All are new 'generation III' designs. The FP&L project discussed herein utilitizes the Westinghouse AP1000 design. The Olkiluoto 3 project utilities the Areva design. None of the projects described here use the AECL design.

[4] http://www.infrastructureontario.ca/en/news/io_news/2008/july2508/NPP%20new%20timeline%20NR%20-%20FINAL.pdf?fuseaction=english.news&body=yes&news_id=173

[5] *Ibid*.

[6] *Ibid*.

Bellefonte site, forcing the adoption of a longer construction schedule.[7] Other sources have pointed to the potential for skilled labor shortages if nuclear construction expands.[8]

Several of these problems have clearly surfaced at the Olkiluoto 3 site, where the French vendor Areva is building a 1600 megawatt advanced European pressurized reactor (EPR). Areva originally estimated a four year construction period, but the plant has fallen 18 months behind schedule, and is substantially over budget. Analysts estimate that Areva's share of the loss on the "turnkey" contract will be between $700-900 million. Concrete poured for the foundation of the nuclear island was found to be more porous than the Finnish regulator would accept. Hot and cold legs of the reactor cooling system required reforging. The design drawings must be redone to accommodate the longstanding requirement that the containment be able to withstand the impact of a commercial airliner.

At a recent conference in Nice, Areva NP President Luc Oursel indicated that the company had underestimated what it would take to reactivate the global supply chain for a new nuclear plant. In particular, they were not "100 percent assured to have a good quality of supply," were not sufficiently familiar with the "specific regulatory context" in Finland, and began building without a complete design. Some 1,360 workers from 28 different nations are now at work at the site. The project manager for STUK, the Finnish regulator, added that "a complete design would be the ideal. But I don't think there's a vendor in the world who would do that before knowing whether they would get a contract. That's real life."[9]

The industry believes that standardization and "learning curves," coupled with clearing supply chain imbalances will drive costs lower over time. But there are chicken-and-egg problems with this conclusion. Utilities may not order new plants and equipment if capacity is limited and costs are uncertain. Suppliers may not expand production capacity if orders are not immediately forthcoming. As suggested in the comment above, vendors may not be willing to complete engineering designs before contracts are awarded. Moreover, given the structure of the US utility industry, learning curves may be hard to achieve, with different utilities, in different parts of the country, considering standardized but different reactor designs. Using the FP&L overnight cost estimates, a range of real escalation rates, and reasonable assumptions for fuel cost, capacity factor, decommissioning, and operations and maintenance, one can get more than a factor of two difference in levelized life cycle cost.

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[7] "GE/ Toshiba, Advanced Boiling Water Reactor Cost and Schedule at TVA's Bellefonte Site," Aug. 2005, pp. 4.1-2 and 4.1-23.

[8] "A Missing Generation of Nuclear Energy Workers," NPR Marketplace, April 26, 2007. "Vendors Relative Risk Rising in New Nuclear Power Markets," *Nucleonics Week*, January 18, 2007. http://marketplace.publicradio.org/shows/2007/04/26/PM200704265.html.

[9] Lack of Complete Design Blamed for Problems at Olkiluoto 3, *Nucleonics Week*, May 17, 2007. Areva Official Says Olkiluoto 3 Provides Lessons for Future Work, *Nucleonics Week*, May 3, 2007.

Case	0% Real	4% Real	8% Real	14% Real
Med overnight	$4050/kW	$5400/kW	$7100/kW	$9050/kW
High overnight	$4540/kW	$6050/kW	$8000/kW	$10150/kW
Med overnight	$0.11/kWh	$0.13/kWh	$0.17/kWh	$0.21/kWh
High overnight	$0.12/kWh	$0.15/kWh	$0.19/kWh	$0.23/kWh

The French experience most strongly suggests that rapid construction is best achieved with one utility ordering one basic design at a steady rate, keeping vendors, sub-suppliers, and construction crews operating near capacity and able to move smoothly from one project to the next.[10] That model of single government vendor, coordinated procurement, and single government utility is rare, if not unique and unavailable, in today's world. Even in France, later reactors were substantially more expensive than earlier units.

Investment firms have also released a variety of reports on new reactor construction and operating costs. In May 2007, Standard & Poor's released a report on coal, gas, nuclear, and wind costs, and how competitiveness would be affected by carbon taxes. The nuclear capital cost estimate was $4000/kW.[11] Moody's followed in October 2007 with a range of $5000-6000/kW, which the investor's[12] service called "only marginally better than a guess." In May of this year, Moody's released a new report with estimated capital costs of $7500/kW.[13]

Moody's and Standard & Poor's do not spend a great deal of time explaining their methodology. One can infer that that these values are not strictly "overnight costs," but probably include real escalation and real interest during construction, based on the use of fixed charge rates to convert capital cost to capital charges. They would be expressed in real 2007 or 2008 dollars.

US utilities typically report estimates of new reactor construction costs in mixed current dollars at the date of commercial operation. Thus, Florida Power & Light estimates $5500-8090/kW for two AP1000 units or $5430-7995/kW for two EPRs in mixed current dollars at commercial operation (2018-2020). It is not completely straightforward to convert these estimates to either overnight costs, or real construction costs in 2007 or 2008 dollars, as one must discount both nominal escalation and interest during construction based on annual cash flows. I have approximated final construction cost estimates for both FP&L's Turkey Point project and Progress Energy's Levy 1 and 2 project and believe them to be generally consistent with an overnight cost estimate of

[10] Jim Harding, *Caro Nucleare,* published by Amici della Terra, 1984.
[11] Which Power Generation Technologies Will Take the Lead in Response to Carbon Controls?" Standard & Poor's Viewpoint, May 11, 2007.
[12] Moody's Investors Service, "New Nuclear Generation in the United States: Keeping Options Open versus Addressing an Inevitable Necessity," October 10, 2007.
[13] Moody/s Investors Service, "New Nuclear Generating Capacity: Potential Credit Implications for US Investor Owned Utilities, May 2008.

$5000/kW. E.On's chairman has reportedly estimated that a single reactor in the UK would cost roughly $10,000/kW in US dollars, but the details are not available.

In light of the recent rapid cost escalation, I believe that it is prudent to assume an overnight cost of $5000/kW in 2008 dollars. I treat this as inclusive of contingency for both potential delays and cost increases, though it would be desirable to treat these factors separately.

OPA, in response to interrogatory 87, tab 22, argues that real escalation of nuclear construction costs is a far different problem in Canada than in the US, primarily based on the fact that the Canadian dollar has appreciated against the US dollar since 2002 and many commodities used in reactors are priced in US dollars. There are essentially four issues associated with this argument.

First, trend is not destiny. The commodities "bubble" could reverse itself and redouble the cost in Canadian dollars of reactor construction. The rise of Canadian dollars versus the US dollar clearly does not explain the E.On estimate, as the UK pound has also increased in value compared with the dollar from 2002-2008. This testimony addresses overnight costs, which is simply today's cost. Past changes in the US-Canadian exchange rate should not affect overnight cost.

Second, rising commodity prices, albeit troublesome for new power plant costs, explain very little of the rise in estimated completion costs. Per Peterson (Department of Nuclear Engineering, University of California Berkeley) calculates that high commodity prices for raw materials in March 2008 add only $36/kW to a 1 GW PWR. While I have not examined this analysis in detail, I am reminded of the current debate over the cost of wheat in a loaf of bread. Rising raw commodity prices force buyers to buy in advance, pay interest, hedge, and include contingency or indexed adjustments in contracts, potentially adding a significant multiple to Dr. Peterson's estimate. Raw materials are also not the best choice of ingredients in a calculation; nuclear grade concrete and steel are substantially scarcer than ordinary concrete and steel.

Third, the rapid estimated increase in construction costs probably has a great deal to do with bad estimates in the 2002-2005 period. During that time, virtually no utilities worldwide were seriously considering reactor construction. The estimates were primarily done by governments and academic institutions, and were usually R&D targets rather than genuine estimates. It was only when utilities and vendors invested serious time and money (e.g., 1 year and $10-15 million) that significantly larger numbers emerged.

Fourth, if raw commodity price escalation is not the problem, what is? I would infer that the most difficult problem, which Canada cannot escape against currency changes, is supply-chain imbalances. EPC contractors, N-stamp sub-suppliers, skilled crews, large forgers, and other steps in the supply-chain are in short supply. One cannot rule out

monopoly pricing for many of these steps, and that may be reflected in current US estimates.

Summary

In conclusion, I believe that $5000/kW is a reasonable overnight cost, including a modest contingency. I have not attempted to estimate escalation or schedule delay risks, or interest during construction going forward. In light of current experience, I believe it is prudent to treat these factors explicitly, and I do not believe it would be prudent to assume zero escalation in the future. This estimate is in line with recent US utility estimates, but is also below some utility and investment firm estimates.

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Experience:

Harding Consulting (4/2005-present)

Wide range of consulting on energy and environmental issues. Current clients include the National Academy of Sciences and the Natural Resources Defense Council Recent past clients include the Union of Concerned Scientists, Council on Foreign Relations, Burbank Water and Power, the Public Power Council, Snohomish Public Utility District, and the Rocky Mountain Institute.

Director of External Affairs Seattle City Light (3/1998-4/2005)
Director, Power Planning and Forecasting Seattle City Light (11/95-3/98)

Member of executive team responsible for developing and presenting utility policy before state and federal legislators, regional bodies, and regulatory and licensing agencies. Extensive involvement with the Bonneville Power Administration, Federal Energy Regulatory Commission, Northwest Governors and state utility commissions, and City officials (Mayor, Council, Advisory Board, City Attorney). Regular presentations to bond rating agencies (S&P and Moody's). Major role with trade associations, such as Large Public Power Council, Energy Northwest Board, and Pacific Northwest Utilities Conference Committee. Played major role in overall utility strategic planning.

As Power Planning division director, supervised development of least cost plan, including service and sub-area load forecasting, portfolio analysis, power and transmission contract analysis, and assessments of impacts from California market restructuring. Worked with key customers on special contracts for wholesale market access, with potential hedges and demand response. Evaluated demand response as an alternative to distribution system expansion.

Director, Washington staff Northwest Power Planning Council (2/1995-11/95)

Provided lead staff support to Washington's two members on the Northwest Power Planning Council. Extensive coordination with Washington state agencies, including Energy Office, Department of Fisheries, Department of Wildlife, Governor's Office, Ecology, Tribes, and Utilities and Transportation Commission.

Assistant and Acting Director Washington State Energy Office (3/1990-9/1994)

Served as assistant director for policy, program research, facility siting, and resources. Supervised staff of twenty seven. Served as Acting Director of agency (185 FTE) for six months, following transition from Governor Gardner to Governor Lowry. Extensive involvement with State Legislature, cabinet agencies, Governor's Office, and members of the Congressional delegation. Member, Natural Resources Cabinet and Subcabinet. Provided lead staff support for development of Washington State Energy Strategy. Responsible for merging Energy Facilities Site Evaluation Council (EFSEC) into State Energy Office. Chaired task force on environmentally sound power exchanges for the Western Governors Association's Committee on Regional Electric Power Cooperation (CREPC).

Senior Associate MHB Technical Associates (10/1985-3/1990)

Lead economist for consulting firm providing expert testimony and litigation support, mainly involving prudence of utility power supply planning and investment decisions. Provided extensive expert testimony in regulatory proceedings throughout the US. Clients included Attorneys General for Texas, California, Michigan, New York; state regulatory agencies in Illinois, California, New Hampshire, Maine, and Vermont. Some work on reactor safety issues for organizations in California, France, Austria, Sweden, and Italy.

Executive Director International Project for Soft Energy Paths (8/1979-10/1985)
Energy Program Director Friends of the Earth

Founded and directed 501c3 (non-profit, tax deductible) organization that consulted, conducted research, sponsored conferences, and published extensively on new and emerging renewable resources and energy efficiency improvements. Editor of bi-monthly publication. Extensive fund-raising and contract management experience. Consulting clients included the states of Victoria (Australia) and Lower Saxony (Germany), Amici della Terra, Canadian International Development Agency, US Environmental Protection Agency, US Congressional Office of Technology Assessment, Solar Energy Research Institute, US Department of Energy, President's Council on Environmental Quality, Atlantic Richfield Company, and Pacific Gas & Electric Company. Board or panel member for National Academy of Sciences, California Governor's Solar Cal Council, US Department of Energy's Energy Research Advisory Board, and California Regulatory Reform Commission.

Special Advisor to Commissioner California Energy Commission (3/1976-8/1979)

Served as principal staff assistant to two members of the California Energy Commission, including the Chairman. Agency was responsible for developing a common approach to forecasting gas and electric demand, siting power plants, and setting efficiency standards

on buildings and appliances. Served as administrative law judge in place of commissioner in evidentiary hearings; extensive interaction with State Legislature, Governor's Office, and other state agencies. Member, US delegation, International Atomic Energy Agency Conference on Nuclear Power and Its Fuel Cycle (Salzburg, Austria.)

Energy Program Director Friends of the Earth (8/1972-3/1976)

Director of first national energy program in the environmental movement – focused on nuclear power, synthetic fuels from coal, and potential for renewables and conservation. Extensive public speaking, expert testimony, publications, and television appearances. Editor energy books series (Cry Crisis, World Energy Strategies, Non-Nuclear Futures, and Soft Energy Paths, published by Ballinger Press). Author, twice-monthly, energy report.

Education:

MBA Program — University of California, Berkeley
(did not complete, owing to relocation)

AB (economics) — University of San Francisco
Bowdoin College, Brunswick, Maine

Other:

Member, Keystone Center panel on potential for major nuclear energy revival; chair, economics subpanel. Final report released in early June 2007.

Former Board member, Northwest Energy Coalition.

Former Board member, Energy Northwest.

Mayor's Award for Exceptional Service, 1998, 2001, and 2003.

Bonneville Administrator's Award for Exceptional Public Service (co-recipient), 1995.

Committee member, National Academy of Sciences. (Radioactive waste, subcommittee on socioeconomic issues associated with repository siting.)

Expert panel member, US Congress Office of Technology Assessment. (Nuclear non-proliferation, solar energy research and development, and energy conservation.)

Member, US delegation, International Atomic Energy Agency conference on nuclear fuel cycle.

Former Board member, Keystone Center.

Selected Publications

Economics of Nuclear Power and Proliferation Risks in a Carbon Constrained World, The Electricity Journal, December 2007.

Seven Myths of the Nuclear Renaissance, Keynote Speech for Conference on the 50th Anniversary of the Euratom Treaty, European Parliament, March 2007.

Estimating Costs for New Nuclear Reactors, presented by request to the power subcommittee of the Northwest Power Planning Council, February 2007.

Solar Cells Change Electric Distribution, opinion-editoral for the Seattle Post Intelligencer, August 10, 2006 (with S. David Freeman and Roger Duncan).

Briefing Paper for Commissioner Suedeen Kelly (incoming FERC member) on unusual characteristics of the Northwest Hydro System, April 2003.

Changes in Western Power Markets, Law, Regulation, Methods of Analysis and Technology, analysis of strategic risks and opportunities for Seattle City Light, August 2004. Presented by request to full meeting of NW Power Planning Council, September 2004.

Nuclear Power - Not an Easy Solution to Global Warming, opinion-editorial for the Seattle Post Intelligencer, June 2005 (with Denis Hayes).

Pebble Bed Nuclear Reactors – Prospects and Challenges. Prepared for Parliamentary Summit Hearings in South Africa, March 2004. *Available at www.rmi.org.*

Rethinking Bonneville – What Role for Federal Hydro Resources in More Competitive Wholesale Markets? The Electricity Journal, March 2002.

Cost Effectiveness of Northwest Electricity Conservation Programs, (with Dick Byers), published in The Electricity Journal, February 1994.

Washington's Energy Strategy – An Invitation to Action. (Lead author on behalf of Governor's advisory committee), 1993.

The Use of Cost-Benefit Analysis in Evaluating Nuclear Safety Measures – Pitfalls and Surprises, published in Contemporary Economic Policy, September 1990.

Soviet Nuclear Energy, published in Transaction/Society Magazine (publication of Rutgers University, September 1986.

Plutonium Policy –1985 (with Walt Patterson), published by Brick House Press, 1985.

Renewable Energy Options for Africa, (with Dr. Florentin Krause) report commissioned by the Canadian International Development Agency and Dutch Environment Ministry, 1984.

Nuclear Electricity and Alternatives in the US and Europe, published by Island Press in US (foreword by David R. Brower) and in Italy as *Caro Nucleaire* (1984).

What if Argentina Gets the Bomb (with Leonard Ross), op-ed published by New York Times and International Herald Tribune, 1982.

Socioeconomic Impacts of Nuclear Repository Siting and Fuel Cycle Policies (with members of a National Academy of Sciences panel), National Research Council, 1982.

End Use Forecasting of Electricity Demand (California Energy Commission memo on reduction in estimated demand growth from 7 to 3 percent per year associated with shift from econometric to engineering models), published by the US Senate Small Business Committee, 1979.

Editor and principal author, *Soft Energy Notes*. Bi-monthly journal published from 1980-1985 on technical and economic potential of renewable resources and energy efficiency.

Toward a Global Renewable Energy Future, Brick House Press, 1984, foreword by Denis Hayes.