Update

Major Cogeneration Installation in Ottawa

A cogeneration installation to serve the Ottawa Health Sciences Centre is nearing completion. The Centre is a group of hospitals and other related facilities, including the Faculty of Medicine of the University of Ottawa, in the city's southeastern section. The new unit, which is to replace an aging conventional heating plant operated by the Federal Department of Public Works, will tie into the district heating system to provide steam for heating and cooling systems, and up to 68 MW of electricity. The plant will be owned and operated by TransAlta Resources Corporation, which is also installing a larger cogeneration facility (108 MW) on the grounds of McDonnell Douglas Canada Limited in the Toronto area.

The 'combined cycle' Ottawa plant uses a General Electric LM6000 gas turbine capable of generating up to 42 MW of electricity. Hot exhaust gases, after expansion in the gas turbine, proceed to a waste heat recovery boiler to produce high-pressure steam, which is then expanded in an Asea Brown Boveri steam turbine to generate an additional 26 MW of electricity. Process steam is extracted from this turbine at the necessary pressure to meet heating, hot water, and cooling requirements. A condensing system is provided for the remaining fraction of the steam which is fully expanded by passage through the turbine.

A portion of the electricity generated by the facility will be sold through a 115 kV interconnection with Ontario Hydro. The plant's 68 MW capacity represents about 8% of Ottawa's peak winter load (about 900 MW).

The Ottawa Health Sciences Centre and McDonnell Douglas plants will be the first to utilize General Electric's LM6000 gas turbine. The LM6000 aero-industrial engine is a two-shaft gas turbine which operates at 41% simple cycle efficiency. It is derived from the General Electric CF6-80C2 aircraft engine which has amassed over two million operating hours of experience. The mechanical load is coupled directly to the low pressure turbine shaft. There is no free power turbine and, in 60 cycle applications, no gearbox. The land-based unit uses the combustor and both high and low pressure turbine components of the aircraft engine with only minor modifications to allow coupling of the low pressure turbine to the electrical generator. Substantial savings in cost result from the use of existing designs.

The two cogeneration projects received a combined support of $800,000 from the Ontario Ministry of Energy for the purpose of demonstrating this technology. The Ministry will be assessing the potential for other such applications in the province. The capital cost of most such facilities is generally about $1/watt of installed electrical capacity. Such investments in energy conservation equipment may also be eligible for Capital Cost Allowance under Class 34 of the federal

Income Tax Act. If so, three-year, 25-50-25% straight-line depreciation may be applicable. In a typical case, up to 80% of the total capital invested may qualify for this favourable tax treatment. The present value of the tax deferral due to the accelerated depreciation is generally about 10% of the investment eligible for Class 34 treatment. However, to take full advantage of this tax concession, the company must have income from other energy-related activities against which to apply the write-offs.

It has also been the practice to strongly lever such investments with loans in the 80-90% range where possible. Lending institutions have, however, been reluctant to extend credit for other than the electrical part of the revenue stream. The rationale for this conservatism appears to be that the contract with Ontario Hydro is considered safe but that there is less certainty concerning the thermal load in many cases.

Ontario Hydro was surprised at the number of submissions it received when it first called for proposals for cogeneration facilities. If all were built, a substantial part of the load growth foreseen by Ontario Hydro in this decade could be met in this way. However, the current severe economic downturn has complicated this situation — Hydro's forecast has been changed and the electricity is not needed. For this reason a number of proposals have been put on hold until the situation is clarified. Fifty-three such proposals were terminated or deferred earlier this year alone. In effect, only those schemes which are in net balance with the grid or where the electricity is needed due to local system requirements are being approved now. This has led to a downsizing of some proposals, giving rise to some concern that turbines of less than the most economical size may be installed. If so, in the long run such actions may prove costly.

There are advantages attached to the continued development of cogeneration in Canada. System reliability should be enhanced by the deployment of many smaller, decentralized generators which will add robustness and resilience to the electrical grid.

From an environmental viewpoint, there are many advantages to using natural gas in cogeneration facilities. The high efficiency of cogeneration combined with the favourable emission qualities of natural gas will result in low emissions per unit of fuel consumed. It should be noted, however, that to the extent that cogeneration replaces either nuclear or hydro generation, emissions levels will increase.

Low-priced energy, particularly electricity, has been advantageous to Canadian industrial development. With the planned increase in exports of western Canadian natural gas to fuel the many planned cogeneration plants to be built in the US in the next few years, the long-run price of natural gas, which has recently rebounded somewhat from very low levels experienced last year, becomes a major question.

In a sense, Canada is competing with itself. Electricity generated in the US from Canadian natural gas will replace the direct purchase of electricity from Canada, particularly from Quebec. Also, since the cogenerated electricity produced by economically-sized units will replace current higher cost generation in the US, Ontario manufacturers will slowly lose their relative price advantage in electricity. Furthermore, some observers feel that Canadian gas consumers in Ontario and Quebec will be partly subsidizing the transportation of gas for export. The National Energy Board ruled that the extra costs of moving Alberta gas to eastern US markets through the newly-completed Iroquois line could be rolled into the common transportation rate base.

The cogeneration facility at the Ontario Health Sciences Centre is expected to begin operation in the fall of 1992. This is not the only large scale innovative heating installation in the Ottawa area. Carleton University obtains a large fraction of its heating and cooling needs by heat pumps which extract energy from water supplied from wells drilled on the campus.

MIES Conference

Energy Technology Options for the Twenty-First Century: Environment, Economy and Society, a workshop/conference series mounted this year by the McMaster Institute for Energy Studies, is nearing completion. Four one-day workshops on specific categories of technologies have now been completed. The first two focused on supply alternatives (see *ESR* 4:1, pp.78-80), the second two on end use options. Workshop 3: *End Use Options — Buildings, Processes and Appliances* was held on May 7th; Workshop 4: *End Use Options — Transportation* was on June 18th. The final event, a two-day conference to provide an overview and to deal with broad issues involved in technology choice, will be at McMaster University on October 1-2.

A report on the four workshops will be the starting point for a special session at the conference devoted to drawing together the discussions on specific technologies. (This report and a selection of papers given at the conference will be a special feature in a future issue of *ESR*.)

The opening speaker at the October conference will be Thomas Johansson, Professor of Energy Systems Analysis at Lund University in Sweden. He will report on a major new UN study of the prospects for renewable energy being prepared and edited jointly by him, Robert H. Williams of Princeton University, Henry Kelly of the Office of Technology Assessment in Washington and A.K.N. Reddy of the International Energy Initiative in Bangalore, India. The UN study is scheduled to be published as a book in November 1992, titled *RENEWABLE ENERGY: Sources for Fuels and Electricity* (Covelo, California: Island Press. ISBN 1-55963-139-2 (hardcover); ISBN 1-55963-138-4 (paperback)). It will be devoted to assessing a wide series of options for making fuels and electricity from renewable energy.

Other issues to be examined include energy efficiency gains in an international perspective (with a paper by Lee Schipper of the Lawrence Berkeley Laboratory), the use of modelling techniques to take account of global warming and other environmental impacts when choosing energy technologies, and institutional changes, such as the use of integrated resource planning in the regulated energy sector. Two sessions will be devoted to the outlook for established energy industries: oil, gas and nuclear power.

Papers on modelling include one on CO_2 control using MARKAL by Richard Loulou, Director of Groupe d'Etudes et de Recherche en Analyse de Décisions in Montreal, and a report on the application of the Energy 2020 Modelling Framework to Canada by George Backus of the Policy Assessment Corporation in Minnesota. Russell Lee of the Oak Ridge National Laboratory will report on an ambitious program of full-cycle analyses of the environmental impacts of energy technologies.

For more information and registration telephone the MIES office at (416) 525 9140 ext 4527, FAX at (416) 521 8232, or make contact by E-Mail at the address — MIES@MCMASTER.CA.

Two Parliamentary Reports of Interest to the Energy Field

Two Parliamentary Committees have recently released reports of interest to those concerned with energy matters in Canada.

The Standing Committee on the Environment, chaired by the Hon. David MacDonald, PC, MP for Rosedale, forwarded its Second Report, *Environment and the Constitution*, to the House of Commons in March. The report deals with the division of responsibility for the environment between the Provinces and the federal Government, an urgent issue in light of the continuing constitutional negotiations.

Many have argued that, for the sake of administrative efficiency and regulatory consistency, one level of government should be clearly responsible for environmen-

tal control and regulation. Which level that should be, however, is a matter of some disagreement. For example, TransCanada Pipelines Ltd. took the position in its testimony to the Committee that "Federal authority over the environment should be dominant to provide uniform regulation across the country in respect of environmental processes as well as pollution controls," while The Canadian Electrical Association, perhaps reflecting the nature of the ownership of many of its member utilities, took the view that the Provinces should have the primary responsibility. Most energy industry associations and individual companies saw a need for the present mixed control system to continue, but with better coordination, faster action, and more predictability.

Under existing constitutional arrangements, the federal Government is restricted in its ability to assign jurisdiction over environmental affairs. In recent decisions, the Courts ruled that the federal Government would have to prepare environmental impact assessments retroactively for two flood control dams in the prairies after construction was already well advanced. It appears that Ottawa, which was prepared to leave questions of environmental review to the provinces concerned, cannot freely abdicate its powers in this field.

The Environment Committee presented its findings in a series of 15 specific conclusions and recommendations. In Conclusion 3 the Committee stated: "Effective recognition and understanding of environmental problems, and cooperative and coordinated policies, actions and enforcement measures among all jurisdictions, are more necessary at present than a new division of environmental powers." Consequently Recommendation 4 stated: "The Committee recommends that the environment be regarded as an area of shared jurisdiction, in which concurrency and partnership are the appropriate bases for governmental action." It is interesting that Recommendation 15 stated: "The Committee recommends that, if any amendment were made to the Canadian Charter of Rights and Freedoms to guarantee property rights, it be clearly stated in the wording of the guarantee that maintenance and enhancement of the quality of the environment and the promotion of sustainable development shall take precedence."

The second report of interest was released on February 24, 1992, by the Parliamentary Standing Committee on Energy, Mines and Resources in preparation for UNCED '92 in Rio. The report, which dealt with global climate change, was given unanimous approval by the Committee, chaired by Al Johnson, MP for Calgary North.

Recommendations of the EMR Committee differed somewhat from those of the House Environment Committee, which a year ago had called upon the Government to adhere to the guidelines of the 1988 Toronto Conference advocating a 20% reduction in greenhouse gas emissions by the year 2000. The EMR Standing Committee heard many witnesses from the energy production and consuming industries, as well as from those specializing in environmental matters. Despite its concerns about adverse effects on the energy industries, the Committee agreed that the implementation of an effective greenhouse gas emission strategy "is of the utmost urgency." Nevertheless, the Committee believed that this country's high degree of intensity of energy use and heavy reliance on international trade must also be taken into account. Since each country may be in differing circumstances, the Committee called upon the Government to instruct the Canadian delegation at the UNCED '92 conference to "urge the adoption of a flexible global strategy." More specifically, the EMR Committee urged that:

- the federal Government set Canada on a new course of action regarding its greenhouse gas emission strategy by convening a series of meetings with all the major energy and environmental stakeholders to discuss the global climate change issue and the environmental and economic implications of various implementation

measures, and to decide on a detailed action plan;

- as soon as possible, the federal Government provide stakeholders with a discussion paper on the potential costs and benefits of alternative strategies geared to achieving reductions in greenhouse gas emissions;
- at UNCED '92, Canada reconfirm its stated commitment to stabilize greenhouse gas emissions not controlled by the Montreal Protocol at 1990 levels by the year 2000, and that it also seek a global commitment to reduce total global anthropogenic greenhouse gas emissions by 20% from 1990 levels by the year 2000; and
- to help meet any commitments reached as part of a global climate change convention, and mindful of the need to enhance the competitiveness of the Canadian energy and mineral sectors, the federal Government instruct the Canadian UNCED delegation to support proposals to facilitate Canada taking global action such as contributing, both financially and through technology transfer, to emissions reduction efforts in other countries.

Many independent observers were surprised by the strong tenor of the recommendations coming from this Committee, deeply concerned as it is with the health of the energy industries and chaired by a member of parliament from Calgary. The Committee intends to release a more comprehensive report later which will reflect "more broadly on the energy and mineral sectors as they continue to respond realistically to the challenges of sustainable development."

Copies of both Committee reports are available from the respective chairmen at the House of Commons, Ottawa, K1A 0A6.

The Federal Panel on Energy R&D

The Federal Government is a major funder and conductor of energy research in Canada (as it is in most fields of R&D). Nuclear research is carried out by Atomic Energy of Canada Ltd. (AECL), and activities related to regulation of the nuclear industry by the Atomic Energy Control Board (AECB). Nearly all other research in the energy field is coordinated through the Panel on Energy Research and Development (PERD).

At the time of the first oil crisis, when it became clear that energy R&D would have to be strengthened in Canada, it was decided to coordinate and enhance the effort of the existing agencies rather than establish a new organization especially for this purpose. In 1973 a committee comprised of members from about 20 departments was formed to determine the requirements for R&D in the context of that time. In 1975 this committee was formally established as the Panel on Energy Research and Development and four principle objectives for the ensuing activities were chosen: (1) using energy efficiently, particularly oil; (2) developing indigenous resources; (3) diversifying the energy economy to be less reliant upon oil; (4) and developing long-term alternative energy sources. These goals reflected the increased emphasis of the time on alternative transportation fuels and the development of offshore and arctic hydrocarbon resources. Now, and especially after the reduction of expenditure on energy R&D made in November 1984, the program has been rebalanced to increase efforts in energy efficiency and alternative energy, together with more emphasis on environmental considerations, particularly after the announcement of the *Green Plan* on December 11, 1990. The EMR Energy Diversification Laboratory was established in Varennes, Quebec, to focus on renewable energy and hybrid systems, energy management technologies, and techniques for enhancing the use of natural gas as a clean-burning fuel. (For more on this new laboratory see *ESR* 3:1 (1991), pp.82-3.)

The formal objective of the Panel is now to 'develop the science and technology for Canada to produce and utilize its energy resources in an environmentally responsible and cost-effect fashion.' Federal funds administered through the Panel were $89.5 million in 1991, and although

these expenditures were substantially less than the peak of $170 million expended in 1984, they still represent a significant component of Canada's research effort in energy. Other federal expenditures in energy R&D amounted to about $210 million, largely for AECL, but also for so-called Departmental 'A' base (or core) expenditures. The provincial governments spend some $75 million in this field, of which about two-thirds is by the Alberta Oil Sands Technology and Research Authority (AOSTRA). Expenditures by industry amount to about $525 million. The oil and gas companies and the electrical utilities together spend nearly three-quarters of this total, with the rest accounted for by a wide spectrum of industrial activities.

The expenditures administered through the Panel could be regarded as discretionary additional funds that may be shifted among departments and agencies relatively rapidly to reflect changes in priorities in the field. This program is administered through seven broad technology areas designated as 'Tasks.' The expenditures on each are shown in brackets (in millions) as follows: Task 1 — Energy Efficiency ($15.0); Task 2 — Coal ($10.5); Task 3 — Fusion ($8.4); Task 4 — Renewable Energy and Generic Environment ($10.9); Task 5 — Alternative Transportation Fuels ($21.1); Task 6 — Oil, Gas and Electricity ($18.1); and Task 7 — Coordination and International Participation (largely through the programs of the International Energy Agency) ($5.6). Within Task 5, the expenditure on methanol and hydrogen amounted to some $8.6 million. Coordination of the program is the responsibility of EMR's Office of Energy R&D (OERD).

The PERD program is well connected to both industrial and provincial activities. Strong linkages have been established with the Canadian Electrical Association and other industrial groupings such as the Canadian Petroleum Association, Canadian Gas Association, Petroleum Association for the Conservation of the Canadian Environment, Canadian Petroleum Products Institute, and the Coal Association of Canada. Memorandums of Understanding (MOUs) link the efforts of the main provinces in the energy field.

At the international level, OERD coordinates participation in the multilateral R&D activities of the International Energy Agency where there are many information exchange and actual research programs, the latter based either on cost-sharing or task-sharing principles. (For notes on the IEA R&D activities in the coal field, see *ESR* 3:2 (1991), pp.192-3, and 4:1 (1992), pp.81-2.) At the bilateral level, there are MOUs with the US Department of Energy which also involve the interested provinces.

In short, an extensive framework has been established for Canada's national effort in the energy R&D field which is reasonably flexible and may be modified relatively easily to meet changing priorities. One major objective is to minimize duplication among nations (through the IEA), provinces, and where possible, within industry.

As to the impact of the R&D activities supported by PERD, they influence the range of technologies available to consumers and producers of energy and increase the diversity and flexibility of energy supply systems. This is compatible with the Government's market-oriented energy policy in that the PERD programs ensure that medium- to longer-term R&D is undertaken and that concerns in the field of regulations, health and safety standards, and longer-term energy supply options are adequately addressed. Because of the many difficulties in establishing longer-term priorities (for a discussion of some of these issues see *ESR* 3:2 (1991) p.194), a strategic planning group has been established within OERD to better integrate policy considerations into the program activities and to develop long-term strategic and technical reviews for each Task as well as for PERD as a whole, including on-going assessments of the focus and balance of the various programs.

In the Canadian case, R&D priorities are not necessarily the same as current development priorities. This is be-

cause so much relevant work in this field is performed in other countries that R&D performed here must first of all deal with those fields of special interest to Canada. There is no need to duplicate the many activities underway elsewhere. This point is not always made clear in critiques of Canada's efforts (see *ESR* 4:1 (1992), pp.66-76).

At present, the Panel is Chaired by M.D. Everall, Assistant Deputy Minister of the Mineral and Energy Technology Sector, and B.D. Cook serves as Director-General of the Office of Energy Research and Development. Contracts and shared-cost research agreements conducted within the framework of the Panel's activities are reported regularly in the *Research and Development Bulletin,* produced monthly by the Department of Supply and Services. This publication provides a useful record of many of the major projects and is available without charge from that agency (ISSN 0707-8730; Fax: (819) 997-7352). The Office of Energy Research and Development also issues occasional reports on timely matters, and brochures are available that deal with the specific projects in the very wide field covered by PERD.

Energy Prices, Developing Countries and Global Warming

The adoption of measures to deal with global warming has been greatly complicated by two factors: the price of fossil fuels remains low, and the consumption of these fuels in some developing countries is increasing rapidly. Although oil prices have rebounded somewhat from their lows experienced after the conclusion of the Gulf War, most observers believe that they will remain in the low US$20/bbl range for some years to come. Most dissenters take the view that prices, if anything, will fall again as Kuwait resumes its full share of its OPEC quota production, as oil from Iraq re-enters world export markets, and as Russian (and other CIS) production recovers with the aid of technology and investment from the west. The recent 'farewell' lecture by the well-known oil expert Peter R. Odell ('Global and Regional Energy Supplies — Recent Fictions and Fallacies Revisited' in *Energy Policy,* Vol.20, No.4, April 1992) is representative of this school of thought. Natural gas prices remain at low levels in North America, though these too have increased somewhat in recent months.

The urgent need for hard currency in the former republics of the USSR, still the world's largest producing area, is frequently cited as the major motivation for their inviting the external investment needed to revitalize the oil and gas industry in that region. The recent agreement between the Chevron Company of the US and the new Republic of Kazakhstan is the most important example of this trend so far.

The Minister of Energy, Mines and Resources, the Hon. Jake Epp, visited Russia and Ukraine in May of this year partly to enhance cooperation with the Canada nuclear and petroleum sectors. Canadian companies already active include Canadian Fracmaster (the firm that pioneered the concept of production-sharing joint venture agreements in Russia and the leading western energy company operating there today), PanCanadian Petroleums, Norcen Energy Resources, Gulf Canada Resources, Canadian Foremost, Wega-D Geophysical, and Lacey International. The engineering firm of SNC-Lavalin is managing a large gas field in southern Russia and Hardy BBT has established a Moscow office to conduct environmental assessments of energy projects. All this activity suggests production will recover in the CIS, placing downward pressure on oil prices.

Nevertheless, recent moves by Saudi Arabia may have the opposite effect. The Saudis have recently signaled to their partners in OPEC that

they are no longer opposed to some increase in the price of oil. This change in policy is thought to be due to the recent trend, especially by countries of the European Community, of imposing or increasing carbon and other taxes on oil, capturing revenues which the Saudis would prefer to retain for themselves. Other factors influencing the Saudi position may be the low value of the US dollar in relation to European currencies (most oil prices are denominated in US dollars), the slow but steady recovery from recession in North America, the gradual break-up of the Gulf War coalition due to continuing stresses in the Islamic World, and reports of difficulties with the oil reservoirs in Kuwait arising from an overly hasty restoration of production. Only time will tell which position on the direction of energy prices will prove to be correct.

Meanwhile, the price of gasoline in the US has never been lower in inflation-adjusted terms. Partly as a result, the number of miles travelled on American roads has quadrupled in the last 40 years. Indeed, the number of cars around the world continues to rise faster than the human population, and this trend will no doubt continue, at least through this decade.

Despite this increased usage of oil, the prevailing view is that depletion effects are not expected to cause greatly increased prices in the near future. In fact, authors associated with the Electric Power Research Institute in the US (C. Starr, M.F. Searl and S. Alport) in a paper published in *Science* (May 15, 1992) claim "there is little likelihood that a serious shortage of fuels will develop during the next century on a global scale" even though, by 2060, global population will nearly double and the average economic output per capita will increase 2.8 times. Total energy consumption will increase more slowly than economic output because of gains in efficiency, but even so, energy usage will be in the range of 2.5 to 4.5 times what it is today. Despite this large increase, the resource base appears adequate, according to these authors.

The total US oil bill increased from about 2% of GNP in the 1960's to 9% at the time of the oil shock of 1979-80, but has now declined to about 2% again according to studies conducted by Conoco Oil Inc. Low prices for fossil fuels inhibit research and development into more environmentally-desirable substitutes, especially solar and wind power, and there appears to be no great enthusiasm to revitalize the nuclear option. Without a substantial drop in costs, which could only come about from such research, there is little prospect of new developments in alternative energy fields which would draw the world away from fossil fuels. Consequently, there is growing interest in the use of economic instruments, particularly a tax on contained carbon, as the best way of encouraging this transition. At present, only Finland, the Netherlands, Norway and Sweden impose such taxes, which are levied on the fossil fuel consumed (not on the carbon dioxide emitted) for administrative simplicity. The European Community, as a group, is also considering an equivalent tax on oil. Nevertheless, in the case of Sweden at least, exemptions have been necessary to two large fuel-consuming sectors in the economy — electrical generation and energy-intensive industries — to meet international competitive pressures.

The developing countries, perhaps best exemplified by China, present another difficult problem. The economy of the world's most populous country is growing rapidly. China's GDP grew at a remarkable 9.7% per year during the 1980s, though admittedly starting from a low base. The Stockholm Environment Institute estimates that if China's economy continues to grow at a more modest 8.5% per year for the next three decades, Chinese carbon dioxide emissions will then be three times the amount released by the US (currently the world's largest emitter of this greenhouse gas in both absolute and per capita terms). This is partly because of the heavy dependence on coal, of which, in 1990, China was the world's largest consumer on a energy-contained basis. In 1991,

the US released 24% of the world's emissions of carbon dioxide from the three fossil fuels, China 11% and Canada 2%. (Per capita emissions that year tell another story at 5.6, 0.5 and 4.5 tonnes of C/person for the three countries respectively.)

The Chinese argue that their share of the world's emissions over the last 200 years has been very small. Nevertheless, China intends to spend more on environmental matters, though the target allocation at the end of the current five year plan in 1995 is still small — about 0.9% of GNP as compared to the present level of about 2% of GNP in the US. The most important steps required are to raise the consciousness of a large, mainly indifferent population to the need for action, and to increase the efficiency with which energy is consumed. No matter how successful these efforts, however, there is little doubt emissions of carbon dioxide will increase in China; the only hope is to reduce the rate of increase to some manageable level. To decide to merely cap world emissions at their present level (which is probably too high in any case) is really to ask developed nations to reduce their share of emissions to accommodate inevitable increases in developing countries like China. Even so, the Chinese will no doubt call upon the developed nations for extensive technical and financial support to merely slow down their emissions. Both developing and developed countries will be watching these events unfold with interest.

Principal Source: *The New York Times*

Energy Forum '92 Meets in Victoria

This year's annual meeting of the Energy Council of Canada was held in conjunction with the fifth annual Electric Forum of BC Hydro in Victoria May 10-13. Over 400 attended these meetings whose unifying theme was "Efficiency, Trade and the Environment in the Energy Field." The growing emphasis on fully integrated systems analysis in the planning of energy activities was reflected in the discussion of the means of quantifying the economic, environmental, and social aspects of future competing energy systems. Special attention was also given to the problems involved in improving both the definition and measurement of the potential for energy efficiency.

In his review of the technical program, Dr. Stanley R. Hatcher, former President of Atomic Energy of Canada Limited, summarized the challenges raised at the Forum into four questions for the future: 1) How can energy policy contribute to developing integrated energy systems? 2) How can barriers to enhancing efficiency be removed? 3) How can the stakeholder input be focused on the architecture of the whole energy system? and 4) How can the trade in energy (both direct and embodied in goods) be balanced against environmental costs?

The Energy Ministers of British Columbia, Manitoba and Saskatchewan participated in a concluding panel discussion which considered the question: where do we go from here? The Ministers stressed the importance of involving the public at every stage in energy policy development. In their view, there would also have to be more consultations among provinces, less reliance on megaprojects as vehicles of energy policy, and improved means of reflecting environmental costs in the development of energy policy.

A special half-day session was devoted to Technology Transfer to Developing Countries, with special emphasis on the Pacific Rim and Latin America. Some 20 delegates from overseas had been partially sponsored by the Canadian International Development Agency (CIDA) first to participate in the forum and then to meet one-on-one with their individual industrial sponsors. The discussion at this session dealt with the needs as perceived by the developing countries themselves and the appropriate techniques for encouraging this transfer. Over 100 attended this session, reflecting the growing importance of this question.

The proceedings of Energy Forum '92 are available from

the Energy Council of Canada, 305-130 Albert Street, Ottawa, Ontario, K1P 5G4; Fax: (613) 993-7679.

Nuclear Waste Storage

The Atomic Energy Control Board (AECB) is currently considering a proposal from Ontario Hydro for storage of irradiated fuel. It is expected that Pickering's two spent fuel bays will be filled by 1995 and Ontario Hydro studies indicate that the best option for additional storage is in dry containers located on-site. A program to demonstrate this concept was undertaken by the utility at Pickering in 1989 and was concluded last year. The concrete containers were monitored regularly for radiation levels, surface contamination and seal integrity with no unusual results being recorded. A similar system for storing irradiated fuel is being used successfully at Douglas Point and the Nuclear Power Demonstration Reactor in Ontario, at Gentilly 1 in Quebec, and at the Point Lepreau Generating Station in New Brunswick.

The first phase of the proposed facility would consist of 700 dry storage containers each with a capacity of 384 fuel bundles. The containers would be loaded with the spent fuel only after it has been allowed to cool in the irradiated fuel bays for at least six years following discharge from the reactor. When completed in two phases, the dry storage facility would hold enough fuel to allow the station to operate to the end of its life expectancy, estimated to be 2025. The AECB will probably render its decision on the proposal for this dry storage facility by mid-1992. To date, Canada's total volume of used fuel is relatively small: stacked as cordwood, it would cover a hockey rink about two metres deep.

In the meantime studies continue on a longer-term means of storage of radioactive materials at the Underground Research Laboratory (URL) located near the Whiteshell Laboratories operated by Atomic Energy of Canada (AECL) in Manitoba, about 100 km northeast of Winnipeg. A chamber has been carved 443 metres below the surface in grey granite which is some two billion years old. Site investigation to choose the location of the URL started in 1980 and construction began in 1982. AECB criteria require that anyone proposing to dispose of high-level nuclear waste must show that there will be 'minimal risk' to people living nearby for 10,000 years. 'Minimal risk' is defined as a radiation dose no more than about 2% of background radiation, or the exposure a person would receive from living in a brick or stone building for three months of the year arising from naturally occurring radioactive substances in the building materials. The storage concept under study is a multi-barrier configuration, utilizing a highly resistant ceramic that surrounds used fuel with a container, and which is in turn surrounded with buffer material in hard granite. The URL is located below the water table in previously undisturbed granite, and experiments are carried out on many aspects of the disposal system, including water movement, chemistry of the rocks, and rock stress. Mining tests are also conducted to develop excavation techniques that minimize damage to the surrounding rock.

The overall plan for disposal of high-level nuclear wastes in Canada includes concept development and assessment, site screening and characterization, design, construction, operation, and all aspects of reactor decommissioning, such as closure and monitoring in the post closure period.

NEB Annual Report

The National Energy Board (NEB) released its report for 1991 on April 8, 1992. As usual this annual report gives an overview of matters before the Board in the previous year. The Appendices are especially useful, covering such matters as a list of the companies operating under NEB jurisdiction, licences and long-term orders to export natural gas, and finan-

cial regulation of the major oil and gas pipelines. Subject to Parliamentary approval, the Board has now acquired new responsibilities for oil and gas operations on a portion of Canada's frontier lands resulting from the disbandment of the Canada Oil and Gas Lands Administration (COGLA). These are distinctly different from the Board's traditional regulatory responsibilities and encompass the regulation of exploration for oil and gas, and the development and production of oil and gas resources in a manner that promotes worker safety, protects the environment and conserves hydrocarbon resources. Presently, the federal Government has joint responsibility with Newfoundland and Nova Scotia for oil and gas activities offshore of much of the east coast which is exercised through the respective Offshore Petroleum Boards. A similar joint management regime is contemplated for the north, but not until a Northern Accord is negotiated. Thus, for the time being, the federal Government retains sole responsibility for oil and gas activities in areas not subject to accords in the region north of 60°, in Hudson Bay, parts of the Gulf of St. Lawrence, and for west coast waters beyond provincial jurisdiction.

In the meantime, the expansion of Canada's natural gas transmission system continues. In May the Board announced its approval of most of TransCanada Pipelines Ltd.'s new facilities planned for 1992-3. Approximately 278.2 km of pipeline will be installed along the system in western and central Canada to meet both domestic and export markets. The total cost of these additional facilities is estimated to be $357 million. This expansion will permit the pipeline company to provide 3.29 million cubic metres (116.1 mcf) per day of new firm service east from Empress, Alberta. Of this, 31% will go to Canadian markets and 69% to customers in the US. In a hearing held on August 4, 1992, the NEB considered an application for further facilities which includes 366.1 km of pipeline loop and 42.8 MW of new compression to provide still more capacity totalling about 6.4 million cubic metres (227 mcf) per day. A start on this stage of the expansion is planned for the winter of 1992/3 at a cost of about $499.5 million. The Board has also approved an expansion by Alberta Natural Gas Company Ltd. New compressor equipment costing $82 million is being installed. These facilities, together with a planned expansion by Foothills Pipe Lines (South B.C.) Ltd., is designed to increase the capacity at the border export point of Kingsgate by 24.7 million cubic metres (872 mcf) per day to serve new markets in California and the Pacific northwest of the US. The current scale of investment in the Canadian natural gas pipeline system, taken as a whole, can only be classed as a megaproject.

Unlike other years, no statistical information on energy production is provided in the Annual Report which is unfortunate as the NEB data were usually the first available for the previous year. Copies of this report (ISBN 0-662-19372-5) may be obtained on request without charge from the National Energy Board, 311 - 6th Avenue S.W., Calgary, Alberta T2P 3H2. (Fax: (403) 292-5503).

Short Notes

• In Calgary on March 25, 1992, the Hon. Jake Epp, Minister of Energy, Mines and Resources, announced the liberalization of foreign investment regulations pertaining to the petroleum industry. The Government's objective is no longer 50% Canadian ownership of the upstream oil and gas industry, but the Minister made it clear that Investment Canada would still ascertain whether external investment will lead to a positive net gain to the country. According to the latest federal statistics, Canadian controlled companies accounted for 38% of industry revenues and Canadians owned 45% of industry shares. Though officially denied, some observers speculated that this unilateral change came about because of the need to attract new partners to the Hibernia project off the coast of New-

foundland, despite the fact that petroleum investment and trade were contentious issues in the trilateral negotiations for a free trade agreement with Mexico and the US. The withdrawal of the Gulf interests led to Hibernia being put on hold.

• At the United Nations Conference on Environment and Development (UNCED) held in Brazil in June, Canada adhered to international agreements concerned with global climate change, and reiterated its commitment to the stabilization of carbon dioxide and other greenhouse gas emissions at their 1990 levels by the year 2000. This decision makes it important to establish the level of emissions accurately in the 1990 base year. Consequently, the Department of the Environment has given wide circulation to a draft report entitled *Canada's Greenhouse Gas Emissions-Estimates for 1990* by A.P. Jacques of the Conservation and Protection Group, on which comments are invited. This report may be obtained from Environment Canada, Ottawa, Ontario, K1A 0H3 (Fax: (819) 953-9542).

• The World Energy Council (WEC) will hold its 15th Congress in Madrid September 20-25, 1992. As part of this activity, the Energy Council of Canada (ECC), the Canadian corresponding member of the WEC, prepared the *National Energy Data Profile* for Canada (NED). This document contains useful statistical information and may be obtained from the ECC, Suite 305, 130 Albert Street, Ottawa, Ontario, K1P 5G4 (Fax: (613) 993-7679).

• A ceremony was held in Halifax on June 6, 1992, to announce the beginning of oil production some 250 km off the coast of Nova Scotia. On that day 14,000 barrels of oil were produced from the Panuke field. The project is managed by LASMO Nova Scotia, a subsidiary of the British firm LASMO plc., which shares ownership with the provincial crown corporation Nova Scotia Resources Ltd. Next year, with both the Panuke and Cohasset fields operating, production should reach 40,000 bbl/day in the summer months. The crude is of high quality and will earn premium prices in petrochemical applications. Though the immediate resources are limited — production from these two fields will likely last only six years — there are other nearby fields which may be brought into production. While the quantity of oil is not yet large, the importance of this event was the launching of production off the eastern coast of Canada which will go a long way to offset the disappointment at the delay to the larger Hibernia project off Newfoundland.

• On the occasion of the visit to Ottawa in June, 1992, of the President of the Russian Federation, Boris N. Yeltsin, it was announced that $30 million will be provided by Canada to help improve safety in Russian nuclear facilities.

• Statistics Canada has announced a new energy publication. The *Energy Statistics Handbook* provides timely information on the Canadian energy scene together with relevant economic indicators and international world oil production data. A 240-page loose-leaf binder will be supplied which will be updated with about 200 pages monthly. The *Handbook* may be obtained for a yearly cost of $300 + $21 GST from Statistics Canada, Ottawa, Ontario, K1A 0T6, or by phoning 1-(800) 267-6677.

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