

c l e a n   a i r



Annual Report 1998-1999

Atomic Energy of Canada Limited



c l e a n   e n e r g y



## TABLE OF CONTENTS

1	Corporate Profile
2	Letter of Transmittal
5	President's Message
8	Corporate Governance
10	Marketing and Sales
14	Commercial Operations
18	Research and Product Development
23	Waste Management and Nuclear Sciences
26	Environmental Management
28	Site Refurbishment
29	Year 2000 Program
30	Financial Review and Analysis
33	Management Responsibility
34	Auditors' Report
35	Consolidated Financial Statements
39	Notes to the Consolidated Financial Statements
47	Five-Year Consolidated Financial Summary
48	Board of Directors and Officers

# Corporate Profile

ATOMIC ENERGY OF CANADA LIMITED (AECL) WAS ESTABLISHED IN 1952  
AS A CROWN CORPORATION AND REPORTS TO PARLIAMENT THROUGH  
THE MINISTER OF NATURAL RESOURCES.

AECL develops, designs and markets CANDU® power reactors, MAPLE research reactors and MACSTOR™ waste storage facilities and manages the construction of nuclear reactor projects worldwide.

AECL's accomplishments include the development of a variety of products and services that are now in use around the world. The flagship product, the CANDU reactor, supplies about 15 per cent of Canada's electricity and is an important component of energy programs on four continents.

The corporation continues to build upon these achievements by advancing the research and engineering that underlie the reactor products and by supplying R&D and engineering services to CANDU plants at home and abroad. The science and technology that support the reactor business have made significant contributions that are recognized internationally. They have also enhanced national science and energy objectives and contributed to the evolution of Canada's nuclear policies.

AECL's product development strategy continues to consolidate the corporation's position as a leading supplier of full-scope nuclear power capabilities. This gives it the capacity, in collaboration with Canadian and international partners, to capture a substantial share of the emerging global nuclear power market with a competitive and superior product.

AECL is dedicated to meeting its customers' needs, and to continuous improvement and sustainable development. The CANDU success is a result of close collaboration with utilities and the private sector, and continues to make an important contribution to job and wealth creation.

As of March 31, 1999, the corporation employed 3,384 people full-time at sites in Canada and overseas.



Chalk River Laboratories



Sheridan Park,  
Mississauga



# Letter of Transmittal

The Honourable Ralph Goodale, P.C., M.P.  
Minister of Natural Resources  
House of Commons  
Ottawa, Canada

Dear Mr. Goodale:

In accordance with subsection 150(1) of *The Financial Administration Act*, I am pleased to submit the Annual Report of Atomic Energy of Canada Limited (AECL) for the fiscal year ended March 31, 1999.

The benefits associated with the Canadian nuclear industry and, in particular, with AECL's CANDU technology, are substantial and well documented. They include important environmental benefits to Canada and its export customers and the creation and maintenance of high-quality jobs for Canadians.

As we look ahead, it is clear that nuclear power remains the only proven technology that is both greenhouse gas-free and capable of meeting the large-scale electricity generation demands of the coming millennium. In Canada alone, the use of AECL's CANDU technology to generate nuclear power has averted the release of over one billion tonnes of carbon dioxide into the atmosphere. This past year, AECL continued in its efforts

to make an important contribution to reducing greenhouse gas emissions worldwide.

By embracing CANDU technology, China, the Republic of Korea and other nations will experience the same environmental benefits in the 21<sup>st</sup> century that Canadians now enjoy. In Qinshan, China excellent progress continues to be made on two 700 MWe-class CANDU reactors that will help meet China's growing energy requirements when they go into service in 2003. In the Republic of Korea, the Wolsong project is nearing completion. Wolsong Unit 3 has performed exceedingly well since entering commercial operation in July 1998 and the fourth CANDU unit at the Wolsong site has achieved criticality and will go into commercial service before the new millennium, in September 1999.

AECL's CANDU technology continues to make a major contribution to the economic growth of Canada. Over the past three decades, Canada's nuclear technology has generated



over 25,000 direct, high-technology jobs in over 150 private sector companies across Canada; and has contributed \$6 billion annually to Canada's gross domestic product, as well as \$700 million annually in federal income and sales taxes. About \$1 billion (Cdn.) returned to the Canadian economy from the Wolsong 2, 3 and 4 project.



A calandria destined for one of two CANDU nuclear reactors being built in Qinshan, China leaves the manufacturer in Tracy, Québec.

The Qinshan CANDU project, with \$1.5 billion (Cdn.) in Canadian contracts, is supporting 27,000 person-years of employment for Canadians.

In anticipation of the new millennium, we reflect on AECL's accomplishments, with a view to planning for the future. Looking back, the theme of change predominates.

AECL has undergone tremendous changes over the years since being incorporated as a Crown corporation in 1952 with its initial broad mandate: the peaceful uses of nuclear energy. At one time, AECL functioned as Canada's "National Lab" for activities in the nuclear field and research was dominant. This changed with the evolution to

equal, but separate research and product divisions within the company and was reflected in a large corporate structure with over 10,000 employees. Today AECL is focused on the CANDU business in which the market, the product and R&D are fully integrated.

The importance of AECL's contributions throughout the years is undeniable. Canadians can be proud. Through Canadian nuclear science and engineering research, AECL has contributed to sophisticated technology that supports a wide range of products that touch the lives of Canadians every day. Canada is a world leader in the production and supply of medical, industrial and food processing isotopes thanks to the pioneering work that was undertaken at AECL.

In pharmaceutical science, the application of isotopes to the study of molecular biology makes the design of effective new drugs possible. This technology is key to the research programs of Canadian pharmaceutical firms.

In cancer care, the cobalt-60 cancer therapy unit, developed in Canada, is still widely used around the world. Canada supplies about 80 per cent of the cobalt sources used in these units. It also supplies two thirds of the world's reactor-produced radioisotopes for nuclear medicine with which 20 million diagnostic tests are performed each year worldwide. Cobalt-60 sources are also widely used in the sterilization of medical devices.

***“Canada’s nuclear technology has generated over 25,000 direct, high-technology jobs in over 150 private sector companies across Canada.”***

In the food industry, the technology used in the irradiation of meats and fruits to sterilize, prolong shelf lives and prevent potential food poisoning, was developed by AECL. It is now being used to reduce the number of illnesses that are attributable to microbial contamination of food.

Applications of nuclear science also extend to agriculture, and the mining, oil and manufacturing industries. In agriculture, the sterile male technique, in which Canada played a leading developmental role, has controlled the Coddling Moth in British Columbia's apple orchards. Cobalt-60 irradiators are also used for such diverse agricultural applications as the sterilization of infected bee-keeping equipment and the destruction of parasites in wool.

In the mining industry, neutron activation analysis is used to obtain inexpensive and rapid analysis of ore samples. In the oil industry, well-logging by radioisotopes and pipeline radiography are important

tools. In many manufacturing industries, from fine paper to regional jet aircraft, nuclear technology is used for radiography, process control and quality assurance purposes.

AECL spun off its electron processing technology to an employee group, ACSIon Industries, in 1998. While the technology has important industrial materials applications, it was not part of AECL's core business. ACSIon is primarily involved in the aerospace industry, but other

applications for the technology, including viscose production, are on the horizon.

Despite the wide-ranging applications of AECL's nuclear science and engineering research throughout its history, AECL's core focus on the CANDU product has persisted. We recognize that the key to AECL's future success is a clear understanding of the core CANDU business and a concentration on being the world's best in that business. AECL's evolution as a corporation that is increasingly funded by commercial revenues will continue.

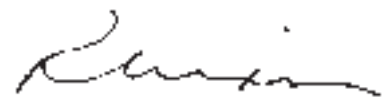
In 1995, the Government of Canada commissioned a program review that, while confirming continued support for AECL's leadership of the CANDU business, also proposed a reduction in the parliamentary appropriation supporting AECL's R&D program. The drop in government funding levels from \$174 million to \$100 million per year has led to the

preparation of a comprehensive management plan that addresses key strategic elements to the CANDU business and completes the unfinished business of Program Review. These include the need to fund the Canadian Neutron Facility (CNF) to replace the National Research Universal (NRU) research reactor, the need for funds to extensively refurbish facilities at Chalk River Laboratories, and support for a coherent funding and management framework for discharging historical liabilities for decommissioning and remediation of the corporation's facilities. This plan will be moving forward to the Government in the coming months.

This year, I was pleased to welcome Karen Pitre as a new member of AECL's Board of Directors. I wish to thank outgoing members George L. Cooke and Ralph E. Lean for their valuable contributions.

On the threshold of the new millennium, the Board of Directors is committed to continuing its work with the shareholder to ensure that AECL and CANDU technology continue to provide substantial, long-lasting benefits to Canada and other nation members of the CANDU family.

Respectfully,



Robert F. Nixon  
*Chairman of the Board*





# President's Message

AS WE ENTER THE NEW MILLENNIUM, THE GLOBAL DEMAND FOR ENERGY IS PROJECTED TO INCREASE BY 50 PER CENT, FROM 1990 TO 2010, AS BOTH DEVELOPED AND DEVELOPING COUNTRIES SATISFY THEIR DESIRE TO MAINTAIN ECONOMIC GROWTH.

Only by maximizing the expansion of greenhouse gas-free nuclear energy, will the demand for economic growth in an environmentally sustainable manner be possible.

Under the 1997 Kyoto Protocol, industrialized nations must reduce their collective emissions of heat-trapping gases by six per cent below 1990 levels. This is a daunting task. Canada alone must cut back its emissions by 21 per cent from projected 2010 levels. Nuclear energy, therefore, must inevitably be part of Canada's and the world's solution.

AECL and its colleagues in the Canadian nuclear industry fully support the federal-provincial process for developing Canada's plans for meeting the Kyoto targets. We are encouraged by the support of other member companies of the Canadian Nuclear Association in showing that nuclear energy is part of the climate change solution.

Canada's ability to control its domestic greenhouse gas emissions benefits all Canadians and is key to

meeting our country's global commitments. AECL's commitment to the environment is applied to its products and services and the assistance that it provides to Canadian utilities in maintaining the performance of their reactors. This is important, for without Ontario's nuclear reactors Canada's annual carbon dioxide emissions would increase by 15 to 20 per cent.

Pickering A nuclear reactors. It is expected that good support to the operation and maintenance of these CANDU reactors will assist the utility in extending their operating life for years to come.

The excellent performance of the seven non-OH CANDU 6 plants operating worldwide (Wolsong Units 1, 2 and 3; Republic of Korea, Embalse,

***“Without Ontario's nuclear reactors, Canada's annual carbon dioxide emissions would increase by 15 to 20 per cent.”***

AECL is one of many suppliers from within and outside Canada helping Ontario Hydro (OH) – now Ontario Power Generation – in its program to return the performance of all of its 20 CANDU nuclear reactors to world-class levels. Over the past year, AECL has been assisting OH in the planning and preparatory work for the potential return to service of

Argentina; Gentilly 2, Québec; Point Lepreau, New Brunswick and Cernavoda Unit 1, Romania) is clearly demonstrated by an average lifetime capacity factor of 82 per cent, to the end of 1998.

Through the export of CANDU reactors, Canada is contributing to the global reduction of greenhouse gases. Countries investing in nuclear

power are those that will have the advantage in effectively controlling greenhouse gas emissions in the new millennium.

China is among the countries in the 21<sup>st</sup> century that will benefit from the safe, clean and economical electricity that CANDU technology provides. In fiscal 1998-1999, tremendous progress was made on the construction of two 700 MWe-class CANDU reactors in Qinshan, China. The reactor buildings' containment walls were slipformed and following year-end, in April 1999, the calandria for Unit 1 was shipped from Canada. The two reactors in Qinshan will go into commercial service in 2003.

In the Republic of Korea, Wolsong Unit 3 entered into commercial operation on July 1, 1998 and Wolsong Unit 4 achieved its first sustained nuclear reaction following year-end, on April 10, 1999. Through their participation in the Wolsong project, Korean companies have built on their pressurized heavy water reactor design, manufacturing and construction experience, thereby contributing to their country's drive to self-sufficiency in nuclear technology. AECL continues to work towards having CANDU 9 units included in Korea's construction plans.

In Romania, Cernavoda Unit 1 continued to operate well during the past year. The Government of Romania has renewed its interest in completing Cernavoda Unit 2. AECL and its partner Ansaldo of Italy continued negotiations to secure financing to complete the second CANDU unit at the Cernavoda site.

AECL submitted a competitive bid in October 1997 to supply two CANDU reactors to Turkey. TEAS, the Turkish utility, completed its evaluation during 1998-1999 of three bids that were submitted. AECL is awaiting a decision from the

Government of Turkey.

Countries implementing and considering the CANDU option are aware of the fact that AECL considers the environment and safety in every phase of the design, manufacturing, construction and commissioning of



Two CANDU nuclear reactors are under construction in Qinshan, China.



each CANDU reactor. In 1998-1999, AECL continued to build on the demonstrated strengths of its CANDU technology, through its ongoing development of products that will compete with other nuclear plants, as well as with fossil-fueled plants well into the next millennium.

AECL's advanced CANFLEX® fuel bundle, the latest design in the evolution of CANDU fuel, was developed to increase fuel performance and cost efficiency, and to allow for advanced fuel cycle options. This past year, a demonstration irradiation of CANFLEX fuel bundles in New Brunswick Power's Point Lepreau Nuclear Generating Station was begun, to show acceptability of completed CANFLEX product. Full commercial use of CANFLEX in CANDU 6 reactors could begin as early as 2001.

AECL's commitment to the environment and safety is reflected in the management of its sites. Implementation of AECL's Environmental Protection Program, issued in 1996 and generally based on the draft of ISO-14000 international standards, continued in 1998. Operation of AECL's Canadian sites and facilities continued to be carefully controlled and monitored, so as to comply with regulations governing protection of the environment and health and safety.

In December 1997, the Atomic Energy Control Board granted construction approval for two MAPLE reactors and a new isotope processing facility for the MDS Nordion Medical Isotopes Reactor (MMIR) Project. The MMIR project at Chalk River Laboratories is dedicated to producing radioisotopes used for medical diagnostics and treatment. Start-up of the first reactor is scheduled for 1999;

the second reactor for 2000. The project will be operated to meet requirements that ensure the health and safety of AECL staff and the public and that adequately protect the environment. Additional detail on the project is contained in the Commercial Operations section of this report.

Production of medical isotopes will continue in the National Research Universal (NRU) reactor until operations are transferred to the new MAPLE facilities. The Canadian Neutron Facility (CNF) is proposed as a replacement for the NRU reactor to develop CANDU fuels and materials, and to support advanced materials research on behalf the National Research Council of Canada and the private sector. In 1998-1999, AECL's Board of Directors approved the conceptual design of the CNF. Initiatives are under way to gain government approval for the project.

In 1997, the Government of Australia authorized \$286 million (Australian) for the construction of a research reactor to replace their aging HIFAR reactor. AECL is one of the four companies pre-qualified to submit a turnkey bid in 1999. The reactor that AECL will propose is in the same "family of technology" as the proven HANARO reactor in Korea and the two MAPLE reactors under construction at Chalk River Laboratories.

On December 15, 1998 the Government of Canada announced the closure of the Whiteshell Laboratories site within a five-year period. The process of decommissioning the site has begun. Over the past year, AECL renewed its relationship with the Economic Development Authority of Whiteshell to actively support its efforts to develop commercial opportunities for the Whiteshell area.

To continue demonstrating the importance that the corporation places on the role of Canadian industry in safeguarding the environment, in 1998-1999 AECL sponsored one of the *Financial Post Awards for Business*. The *Education Award* recognizes an educational or awareness program designed for students or consumers about specific environmental issues. AECL also provided a scholarship to a graduate student in environmental health sciences at the University of Alberta.

The Program Review that the federal government commissioned in 1995 was aimed at determining how AECL can maintain a viable CANDU business, while reducing the cost to the shareholder. The resulting drop in government funding levels from \$174 million to \$100 million per year, dictates that only research and development vital to the CANDU business be supported. AECL is preparing a comprehensive management plan that addresses key strategic elements to the CANDU business as we enter the new millennium and outstanding issues of Program Review. This plan is under discussion with the shareholder and the issues identified will be addressed in the months ahead.

The efforts of AECL's skilled and talented staff are pushing the frontiers of knowledge, innovation and productivity in furthering the CANDU business. On the threshold of the new millennium, AECL's staff remain its greatest asset – one on which the promise of a bright, successful future for CANDU depends.



R. Allen Kilpatrick  
President and Chief Executive Officer



# Corporate Governance

THE BOARD OF DIRECTORS OF ATOMIC ENERGY OF CANADA LIMITED IS  
COMMITTED TO ENSURING THAT THE CORPORATION HAS AN EFFECTIVE  
CORPORATE GOVERNANCE SYSTEM WHICH ADDS VALUE AND ASSISTS THE  
CORPORATION IN ACHIEVING ITS PUBLIC POLICY AND COMMERCIAL OBJECTIVES.

The Committee on Corporate Governance was established by the Board of Directors in 1997, and approved the following guidelines, which are the foundation of AECL's corporate governance procedures and policies.

**1.** The Board of Directors of AECL shall explicitly assume responsibility for the stewardship of the Corporation.

**2.** The Board of Directors of AECL shall examine its public policy objectives and periodically the legislated mandate to ensure their continuing relevance.

**3.** The Board of Directors of AECL shall ensure that the Corporation communicates effectively with the Crown, other stakeholders and the public.

**4.** The Board of Directors and management shall develop an effective working relationship.

**5.** The Board of Directors shall ensure that the Board can function independently.

**6.** In recognition of the importance of the position of the President and Chief Executive Officer, the Board of Directors of AECL shall periodically assess the President and Chief Executive Officer's position and evaluate the President and Chief Executive Officer's performance.

**7.** The Board of Directors of AECL shall assess its effectiveness and initiate renewal of the Board.

**8.** Directors of AECL shall receive orientation and education programs appropriate to their needs.

**9.** The Board of Directors shall review the adequacy and form of compensation for directors.

**10.** The Board of Directors shall assume responsibility for developing AECL's approach to governance issues.

The Board has undertaken to report on its governance activities each year in the Corporation's Annual Report.

Integral to the Board's responsibility for stewardship of the Corporation is the development and approval of the Corporate Plan. The Corporate Plan was approved at the meeting of the Board held in January of this year, and subsequently forwarded to the Minister of Natural Resources. The Corporate Plan sets out the business horizon for the Corporation for the

Additionally, the Board conducted the first of what are intended to be annual workshops, where major issues facing the Corporation were discussed and addressed, with a view to advising the Shareholder of the strategic direction recommended to be taken for the Corporation.

As part of the Board's commitment to continuous development, an orientation session was held for new members, accompanied by a site tour of the Sheridan Park Engineering Laboratory. New recurring agenda

Committee recommending to the Board that its mandate be expanded to include areas of Health and Safety.

The Governance Committee reviewed the adequacy of compensation for Directors, and forwarded statistical information to the Shareholder. Additionally, the skills profile of current members was reviewed, and recommendations as to the skills profile for future directors were made to the Shareholder.

Activities planned for the next fiscal year include further examination of the Board's effectiveness and functioning through a Board survey, as well as meeting with a major customer of the Corporation.

The governance activities of the Board this fiscal year were aimed at fulfilling the Board's obligations with respect to stewardship of the Corporation, maintaining an effective relationship with management, assessing its effectiveness and ensuring its independence, and initiating its renewal, all with a view to enhancing Shareholder value. The Board will continuously seek to improve its governance activities in the context of its adopted Guidelines.

### ***“The Corporate Plan was approved at the meeting of the Board held in January of this year.”***

ensuing five-year period, and also, during the course of its development, directly and indirectly ties the commercial objectives for the Corporation to its public policy objectives, and its legislated mandate. It also serves as an important communications vehicle between the Board and its shareholder, the Crown.

items for the Board meetings include Technology Updates, where members are apprised as to new developments in the Corporation's research and product development areas.

Each of the Committees of the Board, as well as the Board itself, reviewed, as regularly scheduled agenda items, their respective Terms of Reference, with the Environment





# Marketing and Sales

NUCLEAR GENERATION HAS BEEN PROVEN TO BE A MAJOR FACTOR IN  
 RESTRAINING GREENHOUSE GAS EMISSIONS AROUND THE WORLD.  
 NUCLEAR POWER WORLDWIDE HAS AVERTED THE RELEASE OF 22 BILLION  
 TONNES OF CARBON DIOXIDE INTO THE ATMOSPHERE SINCE 1973.

In Canada alone, the use of CANDU technology to generate nuclear power has avoided over one billion tonnes of carbon dioxide emissions.

As we enter the new millennium, increased use of nuclear energy will have to be an important part of the solution to reducing global carbon dioxide emission levels. Consider the relative impacts of various energy options. Coal produces approximately 867,000 tonnes of carbon dioxide per Tera Watt-hour (TWh) of electricity generated. Oil produces approximately 750,000 tonnes/TWh, and natural gas produces about 550,000 tonnes/TWh, whereas nuclear energy produces no carbon dioxide.

Nuclear energy has already been demonstrated to be one of the best methods of avoiding carbon dioxide emissions in Canada. Canada's CANDU technology will play a larger and growing role in the 21<sup>st</sup> century in the global reduction of greenhouse gases, with its remarkable on-power refuelling capability and proven, safe,

economical and reliable power production. Since the first CANDU 6 plants went into service in the early 1980s as leading-edge technology, the CANDU design has continuously advanced to maintain superior technology and performance.

A growing number of nations recognize the benefits of CANDU technology and are joining the CANDU family. In 1998-1999,

office in Shanghai to develop and broaden the technical support base for CANDU in China. The office will offer courses on issues of interest to Chinese engineers on nuclear energy in general and on various technical issues related to CANDU design, licensing and operation. Chinese technical writers will receive assistance in developing CANDU documentation for the operation, design and analysis

***“Canada’s CANDU technology will play a larger  
 and growing role in the 21<sup>st</sup> century.”***

construction of the two 700 MWe-class CANDU units in Qinshan, China has made excellent progress, as detailed in the Commercial Operations section of this report. Both units will enter commercial operation in 2003.

On November 24, 1998, AECL officially opened a new representative

of CANDU power plants. An extensive library of CANDU educational and training materials is available for review and for developing cooperative training programs. The office will also offer computer simulation models to demonstrate the details of CANDU design and operation.

The Republic of Korea is another important market that is realizing the benefits of CANDU technology.

Three CANDU reactors are operating successfully in Wolsong, Korea and the fourth CANDU reactor is due to enter into commercial service there in September 1999. Detail on the Wolsong project is outlined in the Commercial Operations section of this report.

Nuclear reactors now supply the Republic of Korea with nearly 40 per cent of its electrical energy. Building upon the success of the Wolsong project, AECL is continuing to work towards having CANDU 9 units included in Korea's construction plans. The CANDU 9 design retains all the proven strengths and features of CANDU,

as well as featuring evolutionary enhancements.

During 1998-1999, AECL opened a new office in Bangkok, Thailand. This office will act as the regional office for Asia-Pacific, with the Jakarta, Indonesia office as a satellite.

In November 1998, AECL, Daewoo and Vietnam's Ministry of Industry signed a Memorandum of Understanding to undertake a Pre-Feasibility Study on the construction of CANDU nuclear power plants in Vietnam. Vietnam is expected to be a net importer of electrical energy by 2010 and nuclear power is one of the options being considered.

AECL continues to sponsor a major program in nuclear engineering

and cooperation with the university's Nuclear Engineering Department.

Several engineers and scientists from Indonesia and Vietnam were attached to AECL's product development groups at its head office in Mississauga, Ontario to build a better understanding of the CANDU reactor and provide market feedback in developing the product.

In conjunction with, and in addition to, the human resource development initiatives, AECL was active in the Asia-Pacific region during the year on the public education front. Public acceptance and the restructuring and privatization of the electric utility sector are challenges to the introduction of nuclear power to some countries in the region.



Two CANDU reactors have been proposed for the Akkuyu Bay area of Turkey seen [here](#).

at Chulalongkorn University in Bangkok to strengthen existing graduate programs. During the year, AECL and the Center for Energy Studies, University of Gadjah Mada in Yogyakarta, Indonesia, signed a Technical Cooperation Agreement to facilitate exchange of information

In 1997, the Australian Government approved \$286 million (Australian) for the Replacement Research Reactor Project (RRRP) at Lucas Heights, a suburb of Sydney. A multi-purpose nuclear research reactor is to replace the country's HI-FLUX Australian



At the Akkuyu site in Turkey, AECL engineering staff and a site geologist (far right) from the Turkish utility TEAS examine a core sample taken to determine the underlying rock structure.



Reactor that will be shut down and decommissioned by 2003. Following 18 months of environmental studies and community consultations, Australian Ministers of Environment and Industry, Science and Tourism have given clearance to the RRRP's construction. AECL is one of the four pre-qualified bidders for the project. The invitation to bid is expected in July 1999, with the bid due in December. The project is scheduled for operation in 2005.

AECL submitted a competitive bid in October 1997 to supply two CANDU reactors to Turkey. TEAS, the Turkish utility, completed its evaluation during 1998-1999 of three bids that were submitted for the project. AECL is awaiting a decision from the Government of Turkey.

AECL and its partner Ansaldo of Italy continued negotiations with the customer, as well as efforts to secure financing to complete the second CANDU unit at the Cernavoda site in Romania. Completion of Cernavoda Unit 2 continues to be a priority for

the Government of Romania. The excellent performance of Cernavoda Unit 1, in commercial operation since December 2, 1996, has contributed significantly to Romania's decision to include the second Cernavoda unit in its near-term energy strategy.

AECL continues to evolve its *Energy for the Next Millennium* campaign to provide information about AECL and its products and services to customers and potential customers worldwide. Korean, Chinese and Turkish versions of the 62-page *Energy for the Next Millennium* book were distributed during the year.

A new international newsletter, *NEXUS*, was initiated to provide information to key markets. Other materials produced in 1998-1999 included a new AECL brochure, *Excellence, Technology, Partnerships*; a new CANDU 9 brochure in four languages, and a video to support MAPLE research reactor marketing efforts in Australia. A new 20-page brochure and a video were produced to provide information on AECL's

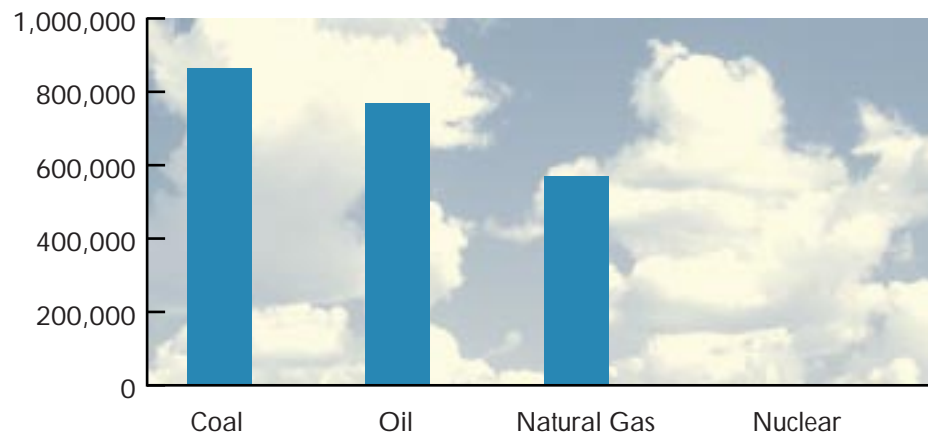
CANDU and Technical Services to utilities and others.

A five-minute television program about the Qinshan CANDU project was produced and shown several times throughout the year on STAR TV's *Asian Business Profile*. The program showed the need for energy and the reasons for choosing nuclear electricity.

Improving the science culture in Canada is key to public understanding and acceptance of the important role that nuclear energy plays in meeting domestic and world energy needs in an environmentally sustainable and responsible manner. In the past year, AECL undertook public education initiatives, with the goal of enhancing science literacy. These initiatives include AECL's launch of the *Science Net* Web site, sponsorship of the YTV Youth Achievement Awards for Innovation, Science and Technology, a workshop for journalists on reporting on scientific issues and a new Web site [www.aecl.ca](http://www.aecl.ca).

In October 1998, AECL, in partnership with the Toronto Public



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Library, launched *Science Net*, a Canadian Web site to benefit science education, at Toronto's Marc Garneau Collegiate Institute. *Science Net* provides students, educators and the general public with easy and thorough access to Internet resources on specific areas of pure and applied sciences. *Science Net's* series of subject-specific "gateways" is tied to the science curriculum of schools across Canada. The first in the series, dedicated to the study of physics, was demonstrated at the launch.

In 1998, AECL sponsored the YTV *Youth Achievement Award for Innovation, Science and Technology*. The annual awards program, broadcast in April, celebrates individual accomplishments of Canadian youth and encourages and inspires other young people to make their own personal difference.

In October 1998, practicing journalists from the print and electronic media gathered with scientists for a two-day workshop on reporting on scientific issues. AECL, along

with other organizations, sponsored the workshop to provide an opportunity for journalists and scientists to meet, exchange ideas and open new lines of communication.

#### PARTNERSHIPS

Over many years, AECL has built a resource base of partners from among the world's best-known companies in engineering, manufacturing, construction and R&D. To secure major projects and service contracts, AECL has the flexibility to choose the partners that can bring specific expertise, local knowledge and financing.

AECL's largest current project is Qinshan Phase III, two 700 MWe-class CANDU reactors for the Peoples' Republic of China. With AECL holding overall project leadership, other key partners are ALSTOM, Canatom NPM, HANJUNG, an Hitachi-Bechtel consortium, Hydro Québec, Korea Electric Power Company (KEPCO), and a number of Chinese construction companies. In the outstandingly successful Wolsong Units 2, 3 and 4

project nearing completion, again there has been a team of well-respected partners: Babcock & Wilcox, Canatom NPM, Daewoo, HANJUNG, Hyundai, Korea Atomic Energy Research Institute (KAERI) and Korea Power Engineering Company (KOPEC). In Turkey, as well as the local companies Bayindir, GAMA and GURIS, AECL also has Korean partners in Daewoo, HANJUNG and KEPCO. In Romania, AECL has had a long association with Ansaldo of Italy. For the replacement research reactor for the Australian Nuclear Science and Technology Organization, AECL has signed a teaming agreement with Thiess Contractors Proprietary Limited, one of Australia's largest and most well-regarded construction/engineering companies.

On the nuclear services side, AECL has partnered with companies as diverse as AEA Technology, Babcock & Wilcox, Duke Engineering and Services, Hitachi and Siemens AG. In R&D, AECL has teamed with BNFL, COGEMA, Japan Atomic Energy Research Institute and KAERI, in projects of mutual interest.

# Commercial Operations

THE FAMILY OF OPERATING CANDU PLANTS AROUND THE WORLD CONTINUED TO GROW WITH THE REPUBLIC OF KOREA'S WOLSONG UNIT 3 ENTERING COMMERCIAL OPERATION ON JULY 1, 1998.

## SUPPORT TO OPERATING CANDU PLANTS

The list of products and services which AECL provided on a commercial basis to both CANDU owners and non-CANDU customers also continued to expand. During the past year, AECL developed several new products and services to meet the changing and challenging needs of its customers.

- AECL's advanced inflatable door seals provide greater reliability and durability while significantly reducing maintenance costs. These seals were purchased by the Korea Electric Power Corporation (KEPCO) for use at the Wolsong station and will also be used in the Qinshan reactors in China.
- Following the decision of Ontario Power Generation (OPG) – formerly Ontario Hydro – to no longer offer fuel channel inspection services to non-OPG reactors, but instead to focus its resources and energies on its Nuclear Optimization Plan,

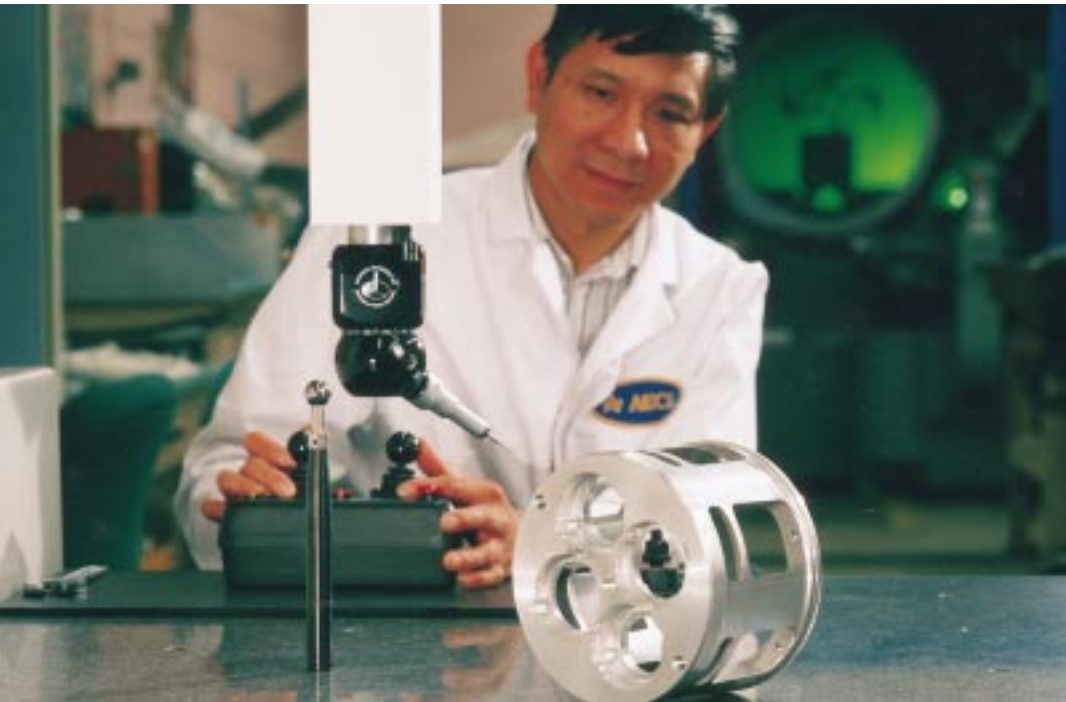
AECL developed its own capability in this area to ensure a secure source of inspection services for the operating CANDU 6 units, over the long term. AECL received a contract for inspection services at Cernavoda Unit 1 in Romania and negotiations continue for similar services for the Embalse unit in Argentina.

Ontario Power Generation proceeded with planning activities aimed at returning the Pickering A units to service and retained AECL for design and engineering to support these activities. AECL rapidly mobilized significant engineering resources to support OPG's demanding schedule requirements.

AECL continued to provide traditional engineering services in safety, reactor engineering and environmental qualification and on-site services such as SLARette and fuel channel installation, replacement and maintenance assistance to the CANDU 6 owners



In February 1999, fuel was loaded into Wolsong Unit 4 in Korea.



A member of AECL's Commercial Products and Field Services division checks the dimensions of a manufactured component using a Coordinate Measuring Machine. This activity is part of a quality assurance program to ensure the component meets design specifications.

around the world. New services provided to these customers included Year 2000 support, plant life management studies and steam generator cleaning.

Continuing with the direction set the previous year, AECL is now fabricating a number of components for the Qinshan CANDU project, in keeping with its core services business. This equipment fabrication/assembly is building on the contracts from KEPCO for spare fuelling machines and ram assemblies for Wolsong Units 2, 3, and 4. The first ram assembly will be ready for shipment, on schedule, early in the next fiscal year.

AECL has continued to look for opportunities in other, non-CANDU markets to apply its unique capabilities and products. AECL's fabrication facilities for research reactor fuel assemblies successfully delivered fuel to the HANARO research reactor in Korea and continued to secure additional contracts.

## CANDU PROJECTS

### China

Construction of the two 700 MWe-class CANDU units at Qinshan, in Zhejiang Province, China is on schedule. The reactor buildings' containment walls for both Units 1 and 2 have been slipformed, with Unit 2 being done in a world record time of 14 days. Major equipment is starting to arrive at the Qinshan site. Much of the piping and fittings have been delivered and prefabrication work is continuing. The calandria for Unit 1 has been shipped from Canada and will arrive at the Qinshan site in June 1999; the condenser in July 1999. Civil work is well advanced and mechanical installation is starting. Engineering and procurement are on schedule to support the construction program, which will see both units in service in 2003.

The Qinshan CANDU project has already awarded over \$1 billion in purchase orders to over 150 mainly high-tech Canadian supplier



Inspection of elastomer seal products is a service provided by AECL.





Wolsong, Korea is the site of four CANDU nuclear reactors.

companies which, in turn, purchase raw materials and finished goods from over 3,000 other Canadian companies. The project is generating about 27,000 person-years of direct, indirect and induced employment all across Canada. The number of expatriates performing construction, engineering, material management, quality

### **Korea**

AECL continued to make significant progress on the Wolsong Units 2, 3 and 4 project.

Wolsong Unit 2, which entered into commercial operation, on schedule, on July 1, 1997, performed reliably, recording a 90.2 per cent capacity factor to the end of March, 1999.

The commissioning phase of Wolsong Unit 4 continued, with the reactor achieving its first sustained nuclear reaction just after the fiscal year-end, on April 10, 1999. The unit is expected to complete its full power performance tests, on schedule, by July 1, 1999, and to be declared in commercial operation in September 1999.

AECL continued to work toward having CANDU 9 units included in Korea's construction plans.

***“Wolsong Unit 3 entered into commercial operation, also on schedule, on July 1, 1998.”***

assurance and project management at the Qinshan site in China continues to grow and will reach about 100 at the end of 1999, and about 175 at the peak of construction activities.

Wolsong Unit 3 completed its commissioning phase successfully, and entered into commercial operation, also on schedule, on July 1, 1998. It achieved an almost perfect performance record to the end of March, 1999, of 99.9 per cent.

A fuelling machine magazine is assembled for the Qinshan CANDU project.



Civil construction of the MAPLE reactors and the new processing facility buildings was completed in February 1999.



## Romania

Cernavoda Unit 1 has been in commercial operation since December 2, 1996, with the operation since July 1, 1997 under Romanian control. The unit provides approximately 10 per cent of Romania's electricity and contributes to district heating. AECL is providing advisors to assist SNN (the Romanian utility formerly known as RENEL) in key areas of operation, maintenance and technical support. To the end of March 1999, the unit had achieved a capacity factor of 88.8 per cent since going into service.

AECL, with its Balance of Plant partner Ansaldo, continues to perform limited work on Cernavoda Unit 2, under direct contract from SNN. The work has concentrated on inspection and repair, preparation of the unit for the

completion activities and engineering, but has included some major activities such as installation of feeders and fuel channels. Negotiations for a contract to complete Unit 2 are under way.

## MDS NORDION MEDICAL ISOTOPES REACTOR (MMIR) PROJECT

AECL is the main producer of medical isotopes for the global market. The National Research Universal reactor at Chalk River Laboratories produces approximately two thirds of the world's market demand for molybdenum-99 – the isotope most widely used in hospitals and clinics in the care of patients suffering from cancer, heart diseases and other illnesses. AECL produces isotopes exclusively for MDS Nordion, which purifies the product and distributes the isotopes worldwide from its facilities in Kanata, Ontario.

In August 1996, AECL undertook the construction of two new MAPLE reactors and a new processing facility at its Chalk River Laboratories. MDS Nordion will own the facilities and manage the commercial supply of isotopes. AECL will operate the facilities for MDS Nordion.

In April 1997, following public consultation on the project, the Atomic Energy Control Board (AECB) approved the environmental assessment for the MMIR project. The AECB granted construction approvals for the facilities in December 1997. Civil construction of the MAPLE reactors and the new processing facility buildings was completed in February 1999. Equipment installation and commissioning are continuing.

Start-up of the first MAPLE reactor is scheduled for 1999 and start-up of the second reactor for 2000.

# Research and Product Development

AECL HAS CONTINUED TO FOCUS ON FURTHER  
INCREASING THE COMPETITIVENESS OF ITS  
REACTOR PRODUCTS.

## CANDU TECHNOLOGY FOR THE NEXT CENTURY

Additional shortening of project schedules, enhanced resistance to seismic events, improvements to components, and features for enhancing environmental performance were defined during the year.

## CANDU REACTORS

During the year, a study to enhance CANDU 6 economics was successfully completed. In addition, the product's competitiveness was increased in the areas of enhanced safety, reduced emissions, and shorter schedules.

The CANDU 9 is an evolutionary design that is based on currently operating CANDU plants. During 1998-1999, the product was advanced in the areas of safety, licensing and detailed design. Attention was given to implementation of the first CANDU 9 project – in particular, the establishment of advanced engineering and project management tools.

## RESEARCH REACTORS

The Canadian Neutron Facility (CNF) is proposed as a replacement for the National Research Universal (NRU) reactor to develop CANDU fuels and materials, and to support advanced materials research. In 1998-1999, AECL's Board of Directors approved the conceptual design of the CNF. Initiatives are under way to gain approval for the project.

## FUEL CHANNELS

During the fiscal year, modifications to the standard fuel channel design for CANDU 6 and CANDU 9 based on results from the R&D program have been recommended and accepted. These changes will further extend the operating life of the fuel channels for new CANDU projects.

Development of a Long-Life Pressure Tube (LLPT) is under way. This pressure tube incorporates a number of modifications to the





standard tube and has an expected life of 40 years in a new CANDU 6 or CANDU 9 reactor. Alternatively, the use of the LLPT would allow higher primary coolant circuit temperatures and pressures with a resultant increase in the power output of the reactor. In 1998-1999, four prototype LLPTs were produced, demonstrating manufacturing feasibility. Among the important features of the LLPT is a treatment to the inside surface that was demonstrated during the past year to improve the in-reactor corrosion resistance.

### REACTOR SAFETY

The AECL Code Centre was established in 1998-1999 as the central repository for all of

AECL's analytical and scientific codes that the corporation is making available for transfer, under appropriate conditions, to interested organizations around the world. These codes embody much of the knowledge that is built into AECL's reactor products, and can be used to educate and



The main cooling pump CAN 8 seal is designed and supplied by AECL for CANDU plants and other customers.

train people on CANDU technology, particularly at universities and research institutes in both Canada and CANDU client countries. The mandate of the Code Centre is to serve as the central point of contact between AECL and potential recipients of AECL's codes and to arrange initial training and ongoing user support for codes transferred to such organizations. Within a few months of its inception, the Code Centre is already addressing about a dozen requests, representing universities within Canada and organizations from around the world.

With the increased interest in CANDU technology in the international market, the demand for Level 2 Probabilistic Safety Analysis for existing and potential customers has become an important area of activity. To support these activities, AECL has acquired the MAAP4 CANDU code and implemented CANDU 6 models to conduct severe accident consequence analysis for a generic CANDU 6 station. The station

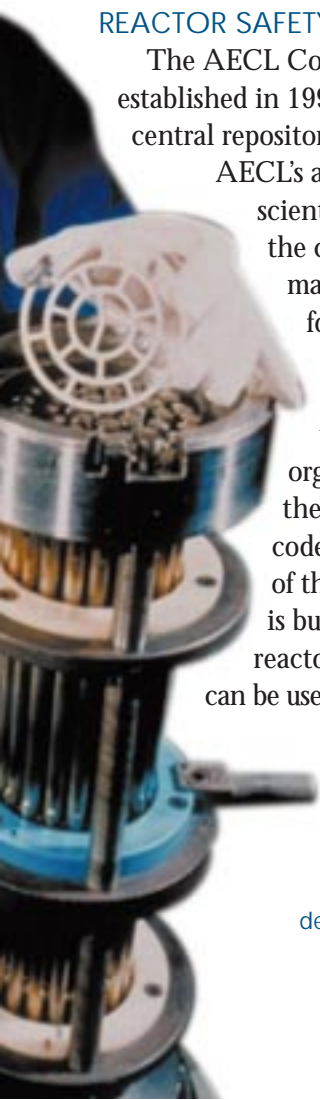
data and additional parameters required for the analysis were assembled and preliminary analysis was completed for selected accident sequences. The preliminary results show, as expected, the ability of the CANDU 6 plant to mitigate severe accidents.

### CODE VALIDATION

With AECL's growing reliance on computer code simulations of reactor performance in the design and safety analysis of CANDU and MAPLE reactors, it is becoming increasingly necessary to ensure that these computer codes perform reliably and with known accuracy. Therefore, AECL is implementing a company-wide software quality assurance program for analytical, scientific and design computer programs that is in compliance with the Canadian Standard N286.7: *"Quality Assurance of Analytical, Scientific and Design Computer Programs for Nuclear Power Plants."* This company-wide program requires that our codes be validated for safety and licensing applications, with statements of accuracy and uncertainty.

The AECL Safety Code Validation Project was initiated in 1998-1999 to ensure that our codes are fully qualified for our applications. AECL has also made commitments to the Atomic Energy Control Board as to the level of validation it will achieve for its codes for power plant applications. AECL's efforts are the corporation's portion of an industry effort, which is actively supported by Hydro Québec and New Brunswick Power, and which

The CANFLEX fuel bundle is the latest design in the evolution of CANDU fuel.



is parallel to, and coordinated with, a similar effort by Ontario Hydro (now Ontario Power Generation).

The end products of the Safety Code Validation Project are quality assured codes under configuration management and change control and

### CONTROL CENTRE DESIGN

Operators of the CANDU 6 plants in China will benefit from a major upgrade in the control room. Control centre designs have been evolving along a path of continuous improvement in both the CANDU 9

- support for predictive maintenance;
- improved control room layout and ergonomics; and a
- formalized human factors program.

The CANDU control centre design evolution is founded on proven systems, components and technology. The control centre design retains all the elements demonstrated to be successful in operating CANDU units. CANDU control centre improvements are performance tested, as an integrated whole, in AECL's mock-up at Sheridan Park and in various applications implemented in operating CANDU plants.

The CANDU 9 control centre has additional advanced features to further reduce plant operating costs and enhance operator performance. A new distributed control system and expansion of the capability of the plant display system will ensure that the CANDU 9 is highly competitive in the international marketplace.

The evolution of the control centre design continues to proceed

## ***“The CANFLEX fuel bundle will enable CANDU utilities to maintain operating margins.”***

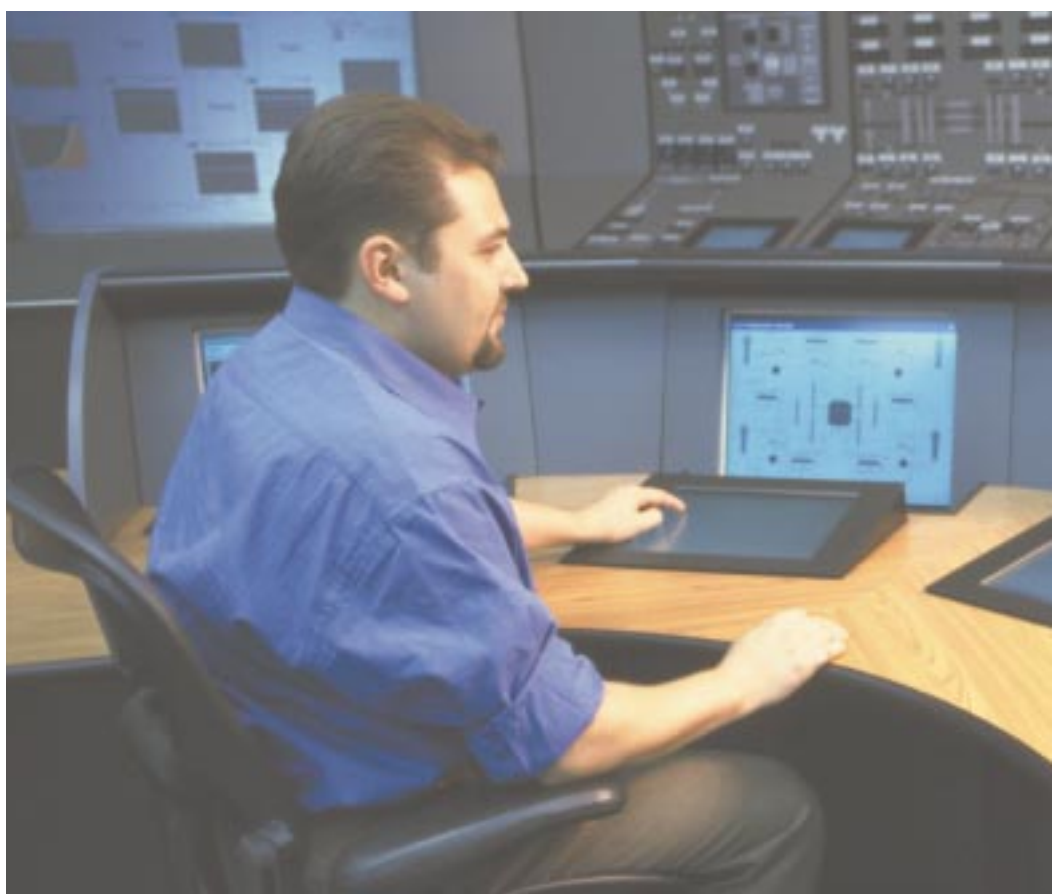
which carry statements of accuracy and uncertainty in calculating the safety-significant analysis parameters required by the applications.

### FUEL AND FUEL CYCLES

The CANFLEX fuel bundle will enable CANDU utilities to maintain operating margins that could be eroded by plant aging, and thereby avoid derating, in addition to ensuring fuel-cycle flexibility. CANFLEX, fully compatible with existing stations, can be implemented as part of normal on-power refueling. In a demonstration irradiation of CANFLEX at Point Lepreau, 16 bundles were inserted into high and low-power channels and four bundles have completed a normal fuel cycle. This confirms the compatibility of the new design to existing station hardware. The enhanced thermalhydraulic performance of CANFLEX was confirmed in freon and water critical heat flux testing. The economic analysis of CANFLEX full-core implementation at Point Lepreau shows that the enhanced performance with CANFLEX will result in considerable savings to the station from sustained reactor power levels over the next eight years.

and Qinshan Control Room Upgrade projects. The significant advanced features of both the Qinshan CANDU 6 and the CANDU 9 control centres include:

- advanced alarm management;
- large overview displays;
- advanced computerized process monitoring and supervisory control displays;
- advanced plant display system technology;



towards a single design for all CANDU products. The design is superior to that used in competing products, is operationally focused, and contributes to lowering both capital and operating costs.

### COMPONENTS AND SYSTEMS

One of the keys to the long-term success of future CANDU reactors is to maintain a high capacity factor over a 40-year operating period. Considerable R&D is under way in the components and systems area to mitigate the effects of plant aging and to develop new technologies to improve plant performance. To achieve longer service life from CANDU stations, AECL is carrying out R&D aimed at improving heat transport system chemistry and materials, feedwater chemistry, steam generator and balance-of-plant reliability, and station components and materials.

To ensure high capacity factors over the target life of 40 years will also

require a strong focus on surveillance and diagnostics. Effective management of plant systems throughout their lifetime requires much more than data acquisition and display – it requires that system health be continually monitored and managed. AECL has developed a System Health Monitor called ChemAND for CANDU plant chemistry. ChemAND, a Chemistry ANALysis and Diagnostic system, monitors key chemistry parameters in the heat transport system, moderator/cover gas, annulus gas, and the steam cycle during full-power operation and feeds these parameters to models that calculate the effect of current plant operating conditions on the present and future health of the system.

Chemistry data from each of the systems are extracted on a regular basis from the plant historical data server and are sorted according to functionality, to allow for automatic monitoring, alarming (when chemistry is out of specification), diagnostics

and prediction. ChemAND is an integral part of the “Smart” CANDU that will be used with on-line *in-situ* probes to optimize chemistry control for the whole reactor (new CANDU reactors and retrofitted to existing CANDU plants). ChemAND is presently undergoing a field trial at the Gentilly-2 nuclear power plant, and a commercial version is planned to be available within a year.

The Components and Systems program continues to develop new products and services, for both existing and new CANDU reactors. Some examples of new or enhanced products in the short term (one to three years) include: pump seals, airlock seals, hydrogen probes, ChemAND, corrosion probes, CHECWORKS applications, and steam generator cleaning and fouling control additives. There is an additional need to ensure more products/services will be added in the medium term (three to six years). Some examples of these include: containment penetration seals, on-line and dilute chemical clean of steam generators, and on-line chemistry control of primary and secondary heat transport systems.

### ADVANCED ENGINEERING TOOLS

Applying advanced electronic engineering, AECL continues to position the CANDU product for major cost reductions across engineering, procurement and construction.

The CANDU 9 control centre has advanced features to further reduce plant operating costs and enhance operator performance.





A state-of-the-art engineering, project management and project control system is now in place for the Qinshan CANDU Project. The system allows for integrated electronic data management and communication among all major participants on the project.

A key aspect of the system is its comprehensive materials management functionality via the CANDU Material Management System (CMMS). Installed in both the Sheridan Park engineering office and at the Qinshan construction site, it allows identification and tracking of all material across all phases of the project; engineering, procurement and construction. Furthermore, the CMMS system has been fully integrated with the 3-D CADDs model resulting in accurate material demand.

A state-of-the-art electronic document and drawing storage and management system, based on Intergraph's AIM system, has also been fully implemented at both Sheridan Park and the Qinshan site. Complementing AIM is an information control management system that AECL developed called TRAK. Among other cost savings features, these systems have eliminated the need to ship large quantities of paper drawings and documents back and forth between the engineering office and site. The transfer process has become fully electronic.

#### QINSHAN (CHINA) 3-D CADDs MODEL

The tools in use on the Qinshan CANDU project will serve as a basis for the next CANDU project. Work is currently under way to complement

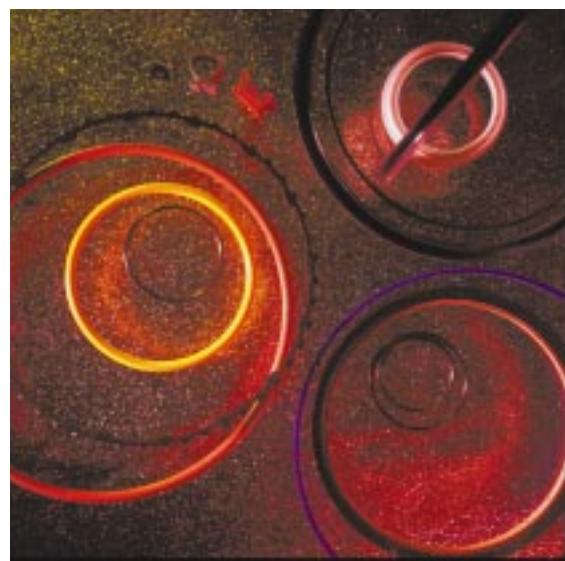
them with additional tools aimed at further increasing productivity and lowering overall project costs. In particular, significant progress has been made over the last year in developing and preparing for the next CANDU project an integrated piping support design, stress analysis and 3-D modeling system. This functionality will result in significant savings in engineering and construction of future plants.

#### HEAVY WATER

AECL and Air Liquide Canada (ALC) are cooperating to demonstrate the Combined Industrial Reforming and Catalytic Exchange (CIRCE) process for heavy water production. ALC has brought on line a new steam methane reformer (SMR) hydrogen production plant in Hamilton, at which the CIRCE process will be demonstrated. To this end, modifications to the basic SMR plant have been designed, constructed and commissioned, while a prototype CIRCE plant that will be connected to the SMR is currently under construction. Start-up of the prototype plant is expected to take place in the next fiscal year.

The combined electrolysis-catalytic exchange heavy water upgrading and detritiation (CECE-UD) demonstration facility is now in operation in the upgrading mode.

To date, over two megagrams of water have been processed; our understanding of the basic CECE technology and the performance of AECL's proprietary wetproofed catalyst have been confirmed; and valuable insight



A variety of nuclear seal products is supplied by AECL.

regarding the nuances of operational control applicable to the full-scale plant has been gained. A project is under way to evaluate application of the technology for the upgrading needs of the next CANDU project.

Upgrading and detritiation of used heavy water has emerged as a timely source of low-cost heavy water in the medium term. A project has been started to define the conceptual design of a heavy water processing system for this application.

# Waste Management and Nuclear Sciences

IN 1978, THE FEDERAL AND ONTARIO GOVERNMENTS ESTABLISHED THE NUCLEAR FUEL WASTE MANAGEMENT PROGRAM TO DEVELOP A CONCEPT TO SAFELY AND PERMANENTLY DISPOSE OF CANADA'S NUCLEAR FUEL WASTE.



## NUCLEAR FUEL WASTE MANAGEMENT PROGRAM

AECL was tasked with carrying out the research and development of the concept of “disposal in a deep underground repository in intrusive igneous rock.” In 1989, an Environmental Assessment Panel was appointed by the Minister of the Environment to examine AECL’s disposal concept. AECL submitted an Environmental Impact Statement to the panel in October 1994, and on March 11, 1998 the panel submitted its report.

A water bay at the Embalse Nuclear Power Plant, in Argentina, where radioactive used fuel is safely stored.

With the end of the environmental review, AECL has completed the task given to it by the governments. The Panel's report concludes that, from a technical perspective, the safety of the concept has been adequately demonstrated and that it is likely that a significant number of technically suitable sites could be identified in

this work for Ontario Hydro on a contractual basis. The R&D included work on the geosciences, particularly as it relates to site characterization, engineered barriers, geotechnical studies including the operation of the Underground Research Laboratory, performance assessment, and disposal facility conceptual

***“The Panel’s report concludes that, from a technical perspective, the safety of the [disposal] concept has been adequately demonstrated.”***

the Canadian Shield. The report, however, recommends that siting of a disposal facility not proceed until broad public acceptance is demonstrated.

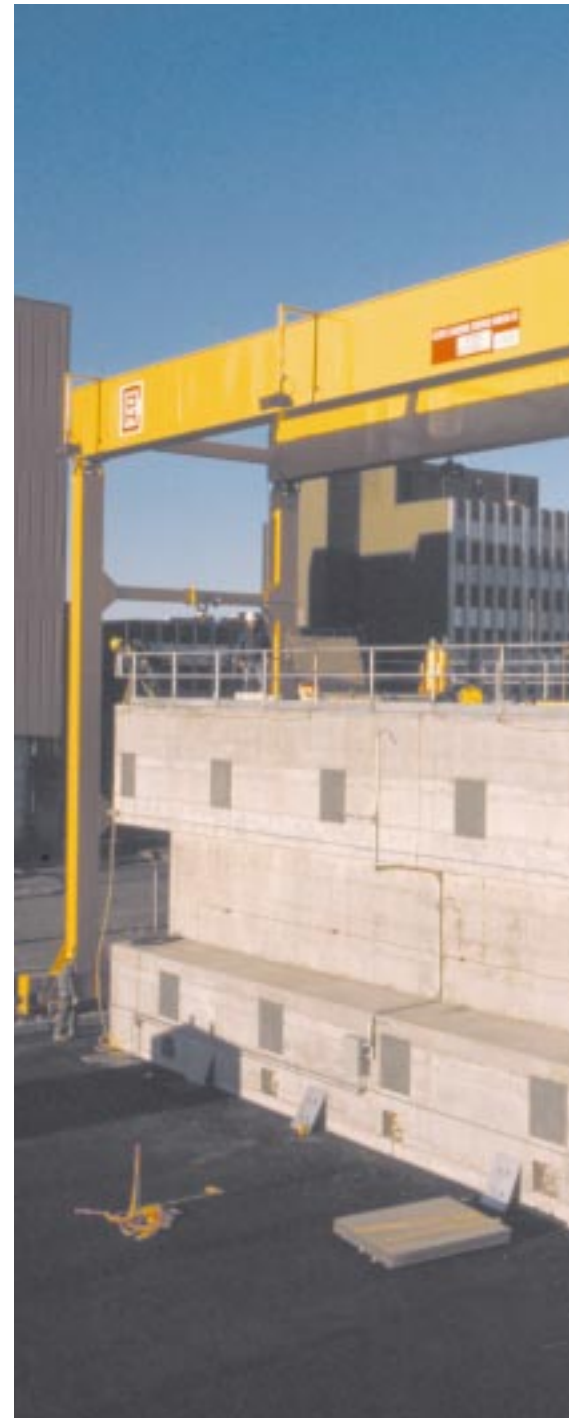
The response of the federal government to the Panel's report, issued in December 1998, agreed with the majority of the Panel's recommendations. A key outcome of the government response is the expectation that the producers and owners of nuclear fuel waste in Canada will establish a waste management organization (WMO) to manage and coordinate the full range of activities relating to the long-term management, including disposal, of nuclear fuel waste. The producers and owners of nuclear fuel waste have begun the process that will lead to establishing the WMO.

Ontario Hydro (now Ontario Power Generation) has continued to provide technical direction and financial support to develop further the disposal technology and to maintain key areas of technical expertise. During 1998, AECL worked in partnership with Ontario Hydro to develop the required R&D workscope, and AECL performed

engineering. Work was also carried out for clients in France, Hungary, Japan and the U.S.A.

#### LOW-LEVEL RADIOACTIVE WASTE MANAGEMENT

The Low-Level Radioactive Waste Management Office (LLRWMO), operated by AECL through a cost-recovery arrangement with Natural Resources Canada (NRCan), continued the clean-up and interim storage of historic wastes on behalf of the federal government. Monitoring and maintenance are carried out at all interim storage sites until a permanent disposal facility is available to the LLRWMO. Technical and administrative support were continued for the Surrey Siting Task Force, an independent task force established by the Minister of Natural Resources Canada to locate a permanent disposal site for two specific historic waste inventories located in Surrey, B.C. Technical support was also provided to NRCan in its discussions with communities willing to host a disposal facility/facilities for much of the historic wastes located in the Port Hope area of Ontario.



#### HEALTH, SAFETY AND ENVIRONMENT

Research in health and environmental sciences is directed to reducing radionuclide releases at the source, improving our ability to monitor and predict their dispersion in the environment, and assessing any biological effects.





AECL's MACSTOR dry storage system for spent nuclear fuel (foreground) at the Gentilly 2 Generating Station, Québec.

Radiation biology studies *in vitro* and *in vivo*, using the Biological Research Facility, focused on understanding the ability of cells to adapt to radiation, and the role of genetic factors in determining cancer risk. Biological methods to measure radiation dose, in the event of accidental exposure, have been developed and appropriate protocols have been established.

Development of better instruments and methods to monitor radiation within nuclear power reactors and in the environment included development of a method to identify alpha-emitting particulates on personal air sampler filters, evaluation of advanced methods for monitoring tritium and noble gases, and testing of dosimeters used by CANDU Owners Group utilities against more stringent regulatory requirements.

During the period under review, research led to the development of improved technologies and strategies for tritium and carbon-14 emission control. Environmental monitoring studies near CANDU nuclear power stations in Canada showed the presence of such radionuclides at near background levels, in

good agreement with our models. In fact, further tests of model predictions against laboratory and field data support lower exclusion area boundaries. More refined methods for calculating the radiation dose from exposure to tritium and carbon-14 have also been developed.



# Environmental Management

AECL'S COMMITMENT TO PROTECTION OF THE ENVIRONMENT IS EXPRESSED IN A CORPORATE POLICY, AND IMPLEMENTED IN ITS OPERATIONS AT CANADIAN SITES THROUGH AN ENVIRONMENTAL PROTECTION PROGRAM.

As in past years, AECL operations during calendar 1998 were in compliance with environmental regulations. In addition, there were measurable improvements in environmental performance that related to both radiological and non-radiological operations.

and to continually improve its environmental performance. In November 1998, an assessment of the AECL Environmental Protection Program, as implemented at Chalk River Laboratories (CRL), was commissioned. The assessment focused on identifying gaps between the

AECL continued to manage effectively the radioactive wastes generated by its own operations, and continued to provide a national service which manages low-level radioactive wastes generated by various Canadian institutions and industries such as hospitals, universities, and suppliers of medical radioisotopes.

AECL is undertaking the replacement of the active drain system at CRL. The new system will provide for further improved containment of the active liquid waste. Construction is planned to start in June 1999 and be completed by July 2000. The upgrading of the Waste Treatment Centre at CRL is continuing and construction is approximately 40 per cent completed. Both these projects reinforce AECL's commitment to the safe management of the CRL site, to continued protection of the environment, and to the health and safety of AECL's workers and neighbors.

***“Improvements in environmental performance related to both radiological and non-radiological operations.”***

Implementation of AECL's Environmental Protection Program, issued in 1996 and generally based on the draft ISO-14001 international standard, continued in 1998. The objectives of this program are to ensure AECL continues to meet or exceed all applicable environmental laws and regulations and, where appropriate, international standards,

Environmental Management System and the ISO-14001 standard. The assessment found that environmental protection is well managed.

Operation of AECL's Canadian sites and facilities continued to be carefully controlled and monitored, so as to comply with regulations governing protection of the environment and health and safety.





Members of AECL's Environmental Research Branch use tree rings to determine past carbon-14 emissions from CANDU reactors. This activity is part of AECL's ongoing program to demonstrate compliance with regulatory requirements.

AECL is committed to the principles of recycling and reuse where it can be done safely. For example, the Waste Segregation Program at CRL successfully redirected over 700 tonnes of metal in 1998 to an off-site recycling company.

AECL also continued to improve its environmental performance in non-nuclear aspects of its operations, including modifications to systems and operating procedures. For example, the two large industrial boilers used for site-wide building heating at CRL

have been replaced. This will increase fuel efficiency and reduce emissions of gases that cause global warming and acid rain.

During the year, AECL continued to undertake community relations and public information programs and activities designed to foster awareness and understanding of the company's activities at its various sites. The objective of these programs is to further the development of mutually effective working relationships with neighboring stakeholders, including elected and appointed officials, business

associations, service groups and the community-at-large. The programs include tours, briefing sessions, public education, partnership with local schools, distribution of information materials, and participation in open houses and many community events. Chalk River held its first Open House in 11 years and it was extremely well received. The activities are designed to provide information and to seek feedback in order to identify public issues related to AECL's operations, including environmental performance.

Public interest in AECL's operational activities continued throughout 1998 in the areas related to waste management, decommissioning, radioactivity releases and to projects which have high profile through media interest or perceived potential environmental impact. Public interest in Whiteshell Laboratories (WL) has come primarily from the Manitoba government and the Local Government District of Pinawa concerning the decommissioning of WL.





# Site Refurbishment

LAST YEAR, AECL CONTINUED IMPLEMENTING ITS  
10-YEAR INFRASTRUCTURE REFURBISHMENT PLAN.

Projects to receive funds are prioritized based on urgent business needs that focus on ensuring code and regulatory compliance, loss prevention, life safety and economic payback.

In 1998-1999, the following notable refurbishment projects were completed at CRL:

- replacement of the active area exit building to provide enhanced security access and personnel monitoring systems to meet regulatory requirements;
- major refurbishment of a large office building as part of a space consolidation program leading to space reductions;
- extensive piping replacement in its district heating steam distribution system and installation of two large boilers in the central heating plant to improve site steam supply reliability and cost effectiveness while reducing operating costs and environmental emissions.

In 1999-2000, refurbishment work will focus on replacing the site-wide, low-level active liquid collection system. Future refurbishment projects for CRL are being defined this year for consolidating materials storage/warehousing, site workshops, offices and laboratories, for improving radioactive hot cell facilities, and for further improving site energy efficiency and reliability.

The corporation continues implementing the strategy it endorsed in 1997 to replace and refurbish major facilities at CRL to meet business needs.



# Year 2000 Program

THE YEAR 2000 PROGRAM IS AN IMPORTANT  
INITIATIVE AND A HIGH PRIORITY CORPORATE  
OBJECTIVE FOR AECL.

A dedicated vice-president has been appointed, with a team of technical experts, specifically to address the Year 2000 issue. The comprehensive program includes Year 2000 compliance of digital products for both the infrastructure systems at AECL, and AECL's products and services supplied to external clients.

By the end of December 1998, AECL had completed all of its activities to meet the requirements of the Atomic Energy Control Board (AECB) for the highest priority ("Safety Systems" and "Safety Related Control Systems") systems and facilities. Work is on schedule to complete all other high priority systems by June 30, 1999. Key lower priority systems will be completed by September 30, 1999.

As of March 1999, the monthly report from the Treasury Board Secretariat's Year 2000 Project Office showed AECL as 86 per cent complete on our government-wide mission critical functions.

With some assistance from AECL, utilities that own CANDU reactors have conducted Year 2000 tests. Two of AECL's principal CANDU customers KEPCO, the Korean Utility, and Ontario Hydro (now Ontario Power Generation) have successfully completed Year 2000 tests on some of their units. Utilities are planning additional Large Scale Integrated Year 2000 tests of other CANDU reactors in 1999.

# Financial Review and Analysis

THE CORPORATION'S STRONG COMMERCIAL PERFORMANCE CONTINUED IN 1998-1999, WITH REVENUES REACHING A FIVE-YEAR HIGH AND OPERATING PROFIT FROM COMMERCIAL OPERATIONS INCREASING BY \$8.2 MILLION OVER THE PRIOR YEAR.

As announced by the government in March 1996, the second of the two scheduled reductions in parliamentary appropriations occurred this year. Nevertheless, the corporation continued to invest heavily in CANDU technology in support of its installed customer base, as well as product evolution for future sales. In addition, the corporation continued to operate the Whiteshell Laboratories, at a net cost, while exploration of privatization opportunities continues and the process for decommissioning has begun. The net research expense exceeded the profit from commercial operations and other parliamentary appropriations, resulting in a net loss of \$10.3 million.

## COMMERCIAL OPERATIONS

Revenue of \$544.4 million in 1998-1999 reflects CANDU reactor projects in China, Romania and

the Republic of Korea, each in various stages of completion, as well as the MAPLE project currently under construction which will supply medical isotopes to MDS Nordion. With services holding steady on a year over year basis, it is the strength of the CANDU and MAPLE projects which is the primary driver for the 11 per cent increase in revenue.

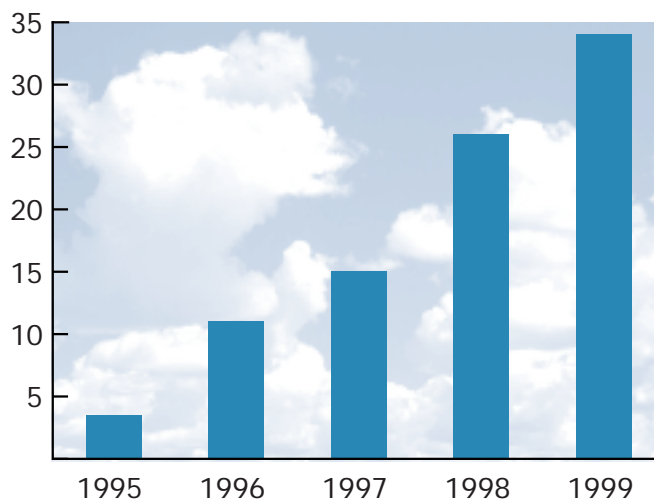
Margins on commercial activities remained relatively constant year over year. Both marketing and administration as well as product development expenditures decreased, resulting in operating profit from commercial operations of \$34.2 million increasing to 6.3 per cent of revenue from 5.3 per cent in the prior year.

## RESEARCH

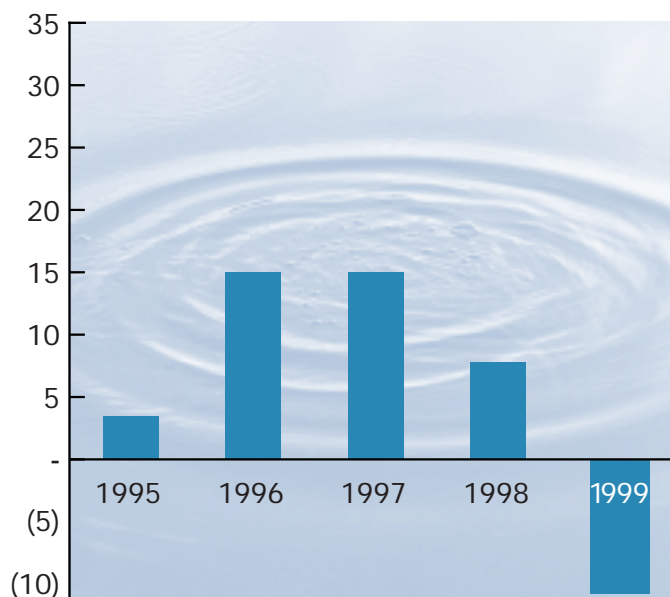
Funding at \$150.9 million for 1998-1999 reflected the government's commitment to CANDU technology, as well as contributions from



### OPERATING PROFIT FROM COMMERCIAL OPERATIONS (MILLIONS OF DOLLARS)



### INCOME/(LOSS) FROM OPERATIONS (MILLIONS OF DOLLARS)

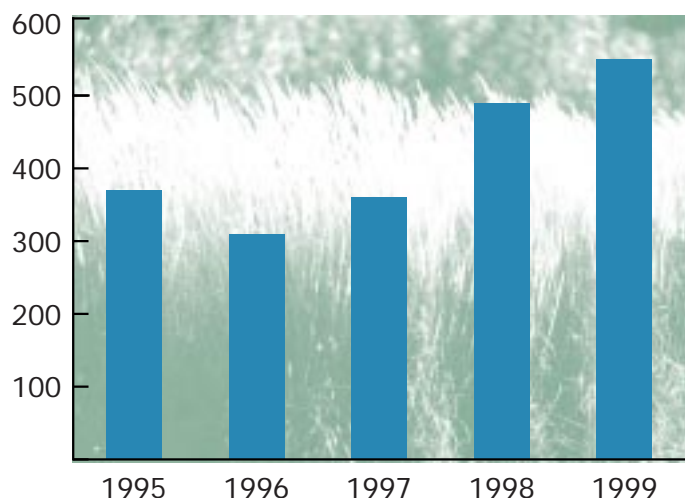


Canadian utilities. The major areas of focus for the \$203.6 million research programs included ongoing development of CANDU technology, technical support to the Canadian nuclear utilities, updating heavy water production methodologies and nuclear fuel waste management.

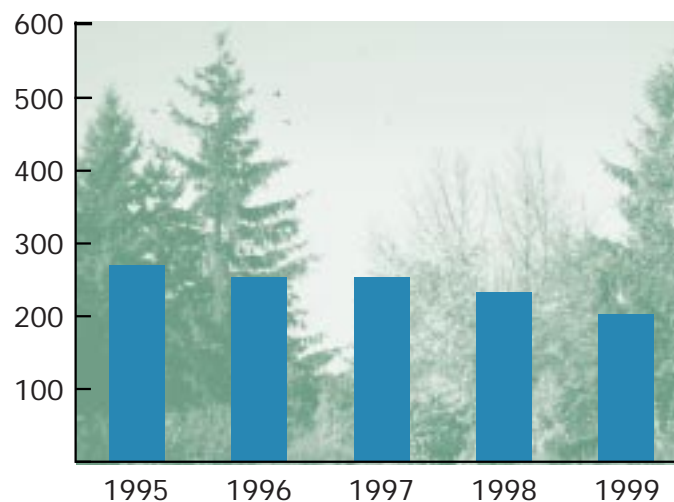
### DECOMMISSIONING ACTIVITIES

AECL has spent an average of \$13 million per year over the last five years on decommissioning activities in relation to facilities as they come off-line and waste management. In 1998-1999, \$16.3 million was incurred with the major areas including upgrading of Chalk River Laboratories Waste Treatment Centre (which is now 40 per cent complete), ongoing waste segregation, and the initial planning phase for the decommissioning of the Whiteshell Laboratories.

REVENUE  
(MILLIONS OF DOLLARS)



INVESTMENT IN RESEARCH  
(MILLIONS OF DOLLARS)



Funding for the decommissioning program is currently sourced from net proceeds received on the sale or lease of government funded heavy water inventory. The unused portion of these proceeds is included in segregated cash and reflected as deferred decommissioning funding on the balance sheet.

#### CASHFLOW

The corporation has adopted the direct cashflow statement this year in line with the Canadian Institute of Chartered Accountants' recommended presentation which replaced the statement of changes in financial position used in prior years.

The corporation's cash position at March 1999 was \$101.0 million. Usage of \$47.3 million during the current fiscal year included \$18.0 million for operations, \$22.3 million in capital acquisitions, the net transfer of \$6.1 million of heavy water proceeds to the decommissioning segregated fund and \$1.1 million for the reduction of long-term debt.

#### IMPACT OF THE YEAR 2000

Last year, the corporation's Annual Report commented on the Year 2000 issue (which is a general term used to refer to certain technological and business implications of the arrival of the new millennium that could result in a system failure or miscalculations

causing disruptions of operations, including, among other things, a temporary inability to process transactions, send invoices or engage in other normal business activities). Management expects to achieve its Year 2000 Plan and the Board of Directors is monitoring progress closely. However, there can be no assurance that the products or systems of other companies which AECL or its customers utilize or on which they rely will be converted in a timely and effective manner, or that a failure to convert by another company, or a conversion that is incompatible with AECL's systems, would not have material adverse effects on AECL or its customers.



# Management Responsibility

THE CONSOLIDATED FINANCIAL STATEMENTS, ALL OTHER INFORMATION PRESENTED IN THIS ANNUAL REPORT AND THE FINANCIAL REPORTING PROCESS ARE THE RESPONSIBILITY OF THE MANAGEMENT AND THE BOARD OF DIRECTORS OF THE CORPORATION.

Except for the non-recognition of future decommissioning costs, which is explained in the notes to the consolidated financial statements, these statements have been prepared in accordance with generally accepted accounting principles and include estimates based on the experience and judgment of management. When alternate accounting methods exist, management has chosen those it deems most appropriate in the circumstances. In the case of decommissioning costs, the corporation has chosen to continue its established policy of expensing such costs as decommissioning activities take place.

The corporation and its subsidiaries maintain books of account, financial and management control, and information systems, together with management practices designed to

provide reasonable assurance that reliable and accurate financial information is available on a timely basis, that assets are safeguarded and controlled, that resources are managed economically and efficiently in the attainment of corporate objectives, and that operations are carried out effectively. These systems and practices are also designed to provide reasonable assurance that transactions are in accordance with Part X of the *Financial Administration Act* and its regulations, as well as the *Canada Business Corporations Act*, the articles, and the by-laws and policies of the corporation and its subsidiaries. The corporation has met all reporting requirements established by the *Financial Administration Act*, including submission of a corporate plan, an operating budget, a capital budget and this Annual Report.

The corporation's internal auditor has the responsibility for assessing the management systems and practices of the corporation and its subsidiaries. AECL's external auditors conduct an independent audit of the consolidated financial statements of the corporation and report on their audit to the Minister of Natural Resources.

The Board of Directors' Audit Committee, composed of directors who are not employees of the corporation or its subsidiaries, reviews and advises the Board on the consolidated financial statements, AECL's auditors' report thereto and the plans and reports related to special examinations, and oversees the activities of internal audit. The Audit Committee meets with management, the internal auditor and AECL's external auditors on a regular basis.



R. Allen Kilpatrick  
President and Chief Executive Officer



Raymond E. Grisold  
Vice-President Finance,  
Treasurer and Chief Financial Officer



# Auditors' Report

## TO THE MINISTER OF NATURAL RESOURCES

We have audited the consolidated balance sheet of Atomic Energy of Canada Limited as at March 31, 1999 and the consolidated statements of operations, contributed capital, deficit and cash flows for the year then ended. These financial statements are the responsibility of the Corporation's management. Our responsibility is to express an opinion on these financial statements based on our audit.

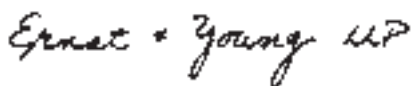
We conducted our audit in accordance with generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation.

There are significant costs associated with decommissioning the Corporation's facilities and remediating its sites, including costs of residual waste storage and disposal. Generally accepted accounting principles require that these costs be recognized in a rational and systematic manner over the estimated useful lives of the corresponding facilities. However, the Corporation expenses these costs as the activities take place and has not recorded a liability for them. Government funding of these costs is similarly recorded. Failure to record a liability for these costs is not in accordance with generally accepted accounting principles. The estimated net present value of this unrecorded liability, together with information on related assumptions and management plans, is disclosed in Note 10 to the consolidated financial statements.

In our opinion, except for the failure to record the liability for decommissioning and site remediation as described in the preceding paragraph, these consolidated financial statements present fairly, in all material respects, the financial position of the Corporation as at March 31, 1999 and the results of its operations and its cash flows for the year then ended in accordance with generally accepted accounting principles. As required by the *Financial Administration Act*, we report that, in our opinion, these principles have been applied on a basis consistent with that of the preceding year.

Further, in our opinion, the transactions of the Corporation and of its wholly-owned subsidiaries that have come to our notice during our audit of the consolidated financial statements have, in all significant respects, been in accordance with Part X of the *Financial Administration Act* and regulations, the *Canada Business Corporations Act*, and the articles and by-laws of the Corporation and its wholly-owned subsidiaries.

We wish to draw your attention to Note 1 to the consolidated financial statements which indicates the Governor in Council has not approved the Corporation's five-year Corporate Plans since 1994-95, and the Corporation continues to work with the government to address budget and policy issues affecting the Corporation.



Ernst & Young LLP  
Chartered Accountants

Ottawa, Canada  
May 14, 1999



John Wiersema, CA  
Assistant Auditor General  
for the Auditor General of Canada

# Consolidated Balance Sheet

AS AT MARCH 31

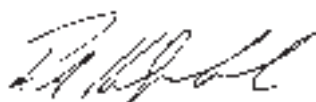
(thousands of dollars)	1999	1998
<b>ASSETS</b>		
Current		
Cash, advances and short-term investments (Note 3)	\$ 101,007	\$ 148,325
Segregated cash (Notes 3 and 4)	32,722	26,637
Accounts receivable (Note 3)	92,798	111,613
Due from Receiver General	-	10,400
Inventory	10,966	11,171
	237,493	308,146
Heavy water inventory (Note 5)	566,431	589,570
Capital assets (Note 6)	112,585	107,806
	\$ 916,509	\$ 1,005,522
<b>LIABILITIES</b>		
Current		
Accounts payable, advances and accrued liabilities	\$ 274,847	\$ 305,519
Current portion of restructuring and other provisions (Note 12)	20,500	30,483
Current portion of deferred decommissioning funding (Note 7)	23,300	22,800
Current portion of long-term debt (Note 8)	1,256	1,283
	319,903	360,085
Restructuring and other provisions (Note 12)	56,465	61,133
Deferred decommissioning funding (Note 7)	9,187	3,543
Deferred revenue	6,471	9,148
Deferred capital funding (Note 6)	64,504	71,922
Accrued employee termination benefits	47,544	53,395
Long-term debt (Note 8)	8,588	9,650
	512,662	568,876
<b>COMMITMENTS AND CONTINGENCIES (Notes 10 and 13)</b>		
<b>SHAREHOLDER'S EQUITY</b>		
Capital stock		
Authorized - 75,000 common shares		
Issued - 54,000 common shares	15,000	15,000
Contributed capital (Note 7)	535,015	557,508
Deficit	(146,168)	(135,862)
	403,847	436,646
	\$ 916,509	\$ 1,005,522

See accompanying notes to the consolidated financial statements

Approved by the Board:



Mary C. Arnold, Director



R. Allen Kilpatrick, Director

# Consolidated Statement of Operations

FOR THE YEAR ENDED MARCH 31

(thousands of dollars)	1999	1998
<b>COMMERCIAL OPERATIONS</b>		
Revenue	\$ 544,413	\$ 489,701
Expenses		
Cost of sales	466,356	409,263
Marketing and administration	24,059	26,404
Product development	19,798	28,022
	510,213	463,689
Operating profit from commercial operations	34,200	26,012
<b>RESEARCH</b>		
Funding		
Parliamentary appropriations (Note 9)	102,400	142,386
Cost recovery from third parties	41,315	52,175
Amortization of deferred capital funding	7,178	8,492
	150,893	203,053
Expenses	203,568	232,244
Net research expense	(52,675)	(29,191)
<b>DECOMMISSIONING ACTIVITIES (Note 10)</b>		
Decommissioning funding	16,349	15,384
Expenses	16,349	15,384
Net decommissioning	-	-
<b>OTHER PARLIAMENTARY APPROPRIATIONS (Note 9)</b>	<b>8,000</b>	<b>10,400</b>
<b>INTEREST INCOME AND OTHER (EXPENSE)</b>	<b>169</b>	<b>(217)</b>
<b>NET INCOME (LOSS)</b>	<b>\$ (10,306)</b>	<b>\$ 7,004</b>

Amortization disclosure (Note 6)

See accompanying notes to the consolidated financial statements



# Consolidated Statement of Contributed Capital

FOR THE YEAR ENDED MARCH 31

(thousands of dollars)	1999	1998
Balance at beginning of the year	\$ 557,508	\$ 585,819
Transfer to deferred decommissioning funding (Note 7)	(22,493)	(28,311)
Balance at end of the year	\$ 535,015	\$ 557,508

# Consolidated Statement of Deficit

FOR THE YEAR ENDED MARCH 31

(thousands of dollars)	1999	1998
Balance at beginning of the year	\$ (135,862)	\$ (142,866)
Net income (loss)	(10,306)	7,004
Balance at end of the year	\$ (146,168)	\$ (135,862)

See accompanying notes to the consolidated financial statements

# Consolidated Cash Flow Statement

FOR THE YEAR ENDED MARCH 31

(thousands of dollars)	1999	1998
<b>OPERATING ACTIVITIES</b>		
Cash receipts from customers	\$ 580,660	\$ 553,261
Cash receipts from parliamentary appropriations	120,800	155,615
Cash paid to suppliers and employees	(728,577)	(674,265)
Interest received (net)	9,072	6,985
Cash from (used in) operating activities	(18,045)	41,596
<b>INVESTING ACTIVITIES</b>		
Funds provided to segregated cash	(6,085)	(1,991)
Proceeds on disposal of capital assets	182	396
Acquisition of capital assets	(22,281)	(19,840)
Cash used in investing activities	(28,184)	(21,435)
<b>FINANCING ACTIVITIES</b>		
Reduction in long-term debt	(1,089)	(4,700)
Cash used in financing activities	(1,089)	(4,700)
<b>CASH, ADVANCES AND SHORT-TERM INVESTMENTS:</b>		
CHANGE	(47,318)	15,461
BALANCE AT BEGINNING OF THE YEAR	148,325	132,864
BALANCE AT END OF THE YEAR	\$ 101,007	\$ 148,325

See accompanying notes to the consolidated financial statements

# Notes to the Consolidated Financial Statements

FOR THE YEAR ENDED MARCH 31, 1999

## 1. THE CORPORATION

Atomic Energy of Canada Limited (AECL) was incorporated in 1952 under the provisions of the *Canada Corporations Act* (and continued in 1977 under the provisions of the *Canada Business Corporations Act*) pursuant to the authority and powers of the Minister of Natural Resources under the *Atomic Energy Control Act*.

The corporation is a Schedule III Part I Crown corporation under the *Financial Administration Act* (FAA) and an agent of Her Majesty the Queen in right of Canada. The corporation is exempt from income taxes in Canada. As required by the FAA the corporation submits annually its Corporate Plan, and operating and capital budgets to the government for its review and approval. The Treasury Board has approved an annual operating and capital budget for the corporation each year up to, and including, the 1998-1999 fiscal year.

The Governor in Council has not approved the corporation's five-year Corporate Plan in its entirety since 1994-1995 and, as a result, the related five-year Corporate Plan Summaries have not been tabled in Parliament as contemplated by the FAA. The government and the corporation continue to consider budget and policy issues affecting the corporation.

These financial statements include the accounts of the corporation's wholly-owned subsidiaries, AECL Technologies Inc., incorporated in the state of Delaware, U.S.A. in 1988, and AECL Technologies B.V., incorporated in the Netherlands in 1995.



## 2. SIGNIFICANT ACCOUNTING POLICIES

### a) *Use of Estimates*

The corporation's financial statements include estimates and assumptions that affect the amounts reported in the financial statements and accompanying notes. The more significant areas requiring the use of estimates are in relation to estimation of future contract costs; establishing restructuring and other provisions; and assessments of future decommissioning costs. The corporation reviews these estimates annually and does not expect the current assumptions to vary significantly in the near term.

### b) *Cash, Advances and Short-Term Investments*

Short-term investments are carried at the lower of cost or market.

### c) *Foreign Currency Translation*

Transactions denominated in a foreign currency are translated into Canadian dollars at the exchange rate in effect at the date of the transaction, except those covered by foreign exchange contracts, where the rate established by the terms of the contract is used. Monetary assets and liabilities outstanding at the balance sheet date are adjusted to reflect the exchange

rate in effect at that date, except those covered by foreign exchange contracts, where the exchange rate established by the terms of the contract is used.

Exchange gains and losses arising from the translation of foreign currencies are included in income.

### d) *Inventory*

Heavy water is valued at the lower of average cost and net realizable value. Supplies are valued at cost.

### e) *Capital Assets*

Capital assets are recorded at cost and this cost is amortized on a straight-line basis over the estimated useful life of the asset as follows:

- Machinery and equipment - 3 to 20 years
- Buildings, reactors and land improvements - 20 to 40 years

### f) *Decommissioning Activities*

As further explained in Note 10, costs of decommissioning nuclear facilities and site remediation are expensed as the activities take place.

### g) *Long-term Contracts*

Revenue and costs on long-term contracts are accounted for by the percentage of completion method based on expenses incurred and applied on a conservative basis to

recognize the absence of certainty on these contracts. Full provision is made for estimated losses, if any, to completion of contracts in progress.

### h) *Parliamentary Appropriations*

The Government of Canada, through parliamentary appropriations, funds certain operations of the corporation as described in Notes 7, 9 and 10. Except as noted below, parliamentary appropriations are recorded separately in the consolidated statement of operations as used.

Parliamentary appropriations specified for the acquisition of capital assets are recorded as deferred capital funding on the consolidated balance sheet and are amortized on the same basis as the related capital assets.

Effective in 1996-1997, and pursuant to the 10-year arrangement for funding decommissioning activities, the corporation retains net proceeds from the sale or lease of certain heavy water and these proceeds are recorded in the consolidated statement of operations as deferred decommissioning funding as related expenditures are made.

**i) Cost Recoveries from Third Parties**

The corporation and the Canadian nuclear utilities (Ontario Power Generation, New Brunswick Power and Hydro Québec) have a common interest in the safe, efficient and economical use of power utilizing CANDU technology. Research programs aligned with these objectives are undertaken by the corporation and cost-shared with the utilities. Funding under these arrangements is included in cost recovery from third parties and is recognized as the related expenses are incurred.

**j) Pension Plan**

Employees are covered by the Public Service Superannuation Plan administered by the Government of Canada. The corporation's contributions to the Plan are limited to contributions made by both the employees and the corporation on account of current service. These contributions represent the total pension obligations of the corporation and are charged to income on a current basis. The corporation is not required under present legislation to make contributions with respect to actuarial deficiencies of the Public Service Superannuation Account.

**k) Employee Termination Benefits**

Employees are entitled to specific termination benefits as provided for under collective agreements and conditions of employment. The liability for these benefits is recognized as benefits accrue to the employees. The accumulated liability is based on an actuarial determination and reviewed on a periodic basis.

**l) Workers' Compensation**

In accordance with the *Government Employees' Compensation Act*, the corporation reimburses Human Resources Development Canada for current payments for workers' compensation claims and pensions billed by the provincial compensation boards. The benefit payments are recognized as an expense in the year paid to the provincial compensation boards.

**m) Post-Retirement Benefits**

The corporation provides supplemental life insurance benefits to its retired employees. A small group of retirees or spouses of deceased retirees are paid an allowance each year to cover their cost for medical benefits under a grandfathering arrangement. The cost of post-retirement benefits is recognized as an expense in the year paid.

**3. FINANCIAL INSTRUMENTS**

Unless otherwise specified, the fair value of the corporation's financial instruments approximates cost.

**a) Cash, Advances and Short-term Investments**

Bank deposits are maintained at levels required to meet daily operating needs. Any surplus deposits are invested in the short-term money market. The investing strategy is based on a conservative risk assessment. All instruments are rated R1 Low or higher by the Dominion Bond Rating Service and the portfolio is diversified by limiting investments in any one issuer and balancing the fund among Canadian federal and provincial

government guaranteed, financial and commercial paper issuers. The instruments in the portfolio mature within one year.

**b) Foreign Exchange Contracts**

The corporation enters into foreign exchange forwards to reduce the risk associated with the purchase and sale of goods in foreign currencies. Forward contracts in effect as at March 31, 1999 amount to \$10.5 million (1998 - \$28.8 million). The majority of these contracts are for the sale of \$US at rates which do not vary significantly from market and which will be settled upon completion of the underlying transaction. Contract expiry dates range from one month to two years, with the majority maturing in 1999-2000. All forwards are offset by contracts with third parties for payment in foreign currencies.

**c) Accounts Receivable**

Accounts receivable represent normal trade instruments. Three customers (1998 - three), each representing greater than 10 per cent of the total accounts receivable, comprise an aggregate 65 per cent (1998 - 54 per cent) of total accounts receivable. No substantial amounts are due in foreign currency. The corporation does not believe it is subject to any significant credit risk.

#### 4. SEGREGATED CASH

Segregated cash is the unused portion of proceeds available for future decommissioning activities (Note 10).

#### 5. HEAVY WATER INVENTORY

Heavy water inventory includes leased amounts with expiry occurring in 2000-2001, as well as 1,100 megagrams which have been provided to the Sudbury Neutrino Observatory Institute at no cost, the majority of which is scheduled for return in 2000-2001. In addition, the corporation has contractual commitments to sell heavy water in support of ongoing reactor projects.

#### 6. CAPITAL ASSETS

(thousands of dollars)	1999		1998	
	Cost	Accumulated Amortization	Cost	Accumulated Amortization
Commercial operations				
Land and improvements	\$ 949	\$ 245	\$ 949	\$ 245
Buildings	11,431	8,901	10,339	8,248
Machinery and equipment	12,597	8,443	12,969	8,730
	24,977	17,589	24,257	17,223
Research				
Land and improvements	22,173	17,050	16,287	11,758
Buildings	88,782	47,661	79,436	44,772
Reactors and equipment	220,563	172,364	217,199	173,450
Construction in progress	10,754	-	17,830	-
	342,272	237,075	330,752	229,980
	\$ 367,249	\$ 254,664	\$ 355,009	\$ 247,203
Net book value		\$ 112,585		\$ 107,806

Amortization of capital assets for the year ended March 31, 1999 amounted to \$17.1 million (1998 - \$11.0 million) in part offset by amortization of deferred capital funding of \$7.2 million (1998 - \$8.5 million).



## 7. CONTRIBUTED CAPITAL AND DEFERRED DECOMMISSIONING FUNDING

Included in contributed capital is approximately \$345 million (1998 - \$367 million) related to parliamentary appropriations received for the production of heavy water inventory. Up to and including 1995-1996, the corporation was required to repay the government, by way of a dividend, the net proceeds from the sale of government funded heavy water. A 1997 Decision of the Treasury Board directs the corporation to hold the proceeds received over the 10-year period following the sale or lease of government funded heavy water in a segregated fund for use in decommissioning activities.

Commencing in 1996-1997, as government funded heavy water is sold or leased, the net proceeds are transferred from contributed capital to deferred decommissioning funding which is used to fund ongoing decommissioning activities. The corporation continues to account for these transactions as a reversal of the originally established contributed capital. Subsequent to 2005-2006, unless renewed, the prior arrangement will apply whereby net proceeds would be repayable to the government and decommissioning activities would be funded through parliamentary appropriations. The balance of the contributed capital remaining related to the parliamentary appropriations received for heavy water production remains in contributed capital.

## 8. LONG-TERM DEBT

(thousands of dollars)	1999	1998
Loans from Government of Canada		
To finance leased heavy water and other assets, maturing through 2008 at interest rates varying from 4.00% to 8.84%	\$ 9,844	\$ 10,933
Current Portion	1,256	1,283
	<b>\$ 8,588</b>	<b>\$ 9,650</b>

Repayments of loan principal amounts required over succeeding years are as follows (millions of dollars): 2000 - \$1.0; 2001 - \$1.0; 2002 - \$1.0; 2003 - \$1.0; 2004 - \$1.0 and subsequent to 2004 - \$4.5.

## 9. PARLIAMENTARY APPROPRIATIONS AND OTHER GOVERNMENT FUNDING

The use of government funding by the corporation is as follows:

(thousands of dollars)	1999	1998
Research operating costs	<b>\$ 102,400</b>	\$ 132,215
Year 2000	<b>8,000</b>	-
Whiteshell commercialization	-	10,171
Termination costs (Note 12)	-	10,400
	<b>\$ 110,400</b>	<b>\$ 152,786</b>

Parliamentary appropriations include \$8.0 million which was received as part of the government's program to assist crowns and departments in defraying Year 2000 costs. The government considers this appropriation to be an advance which it intends to recover from reductions of appropriations over the next three years. The prior year includes support for continued operations of the Whiteshell Laboratories while the government explored commercialization opportunities.

## 10. DECOMMISSIONING ACTIVITIES

When prototype reactors, heavy water plants, nuclear research, development and other facilities have no further commercial or research value to the corporation, they are retired and subsequently decommissioned in accordance with Atomic Energy Control Board regulations. Due to the variety of facilities, the decommissioning process may differ in each case. In some situations decommissioning activities are carried out in stages with intervals of several decades between them to allow radioactivity to decay before moving on to the next stage. Activities include dismantling, decontamination, residual waste storage and disposal.

The corporation has not recorded the liability for these future costs because, historically, the government has funded decommissioning activities on an annual basis through parliamentary appropriations. Starting in 1996-1997, and for a period of 10 years, the government has requested the corporation to use the proceeds from

government funded heavy water, which was previously refundable to the government, to fund decommissioning activities (Note 7). The corporation is in the third year of the 10-year funding arrangement over which an expenditure of \$200 million over the 10-year period was projected. The government is currently reviewing its overall environmental policy, which will include the decommissioning activities of the corporation's facilities and waste storage on its property. As part of this policy review, the government has proposed that the corporation and the government work jointly on a comprehensive management strategy. The corporation expects that this strategy will include determination of a financial framework to address funding of future decommissioning activities. Accordingly, the corporation expects that the government will continue to finance these activities and has continued its policy of expensing decommissioning costs as they take place.

The estimated future decommissioning and site remediation costs require that judgments be made

about the regulatory environment, health and safety considerations, the desired end-state, technology to be employed and, in some cases, research and development for these activities that extend well into the future. The corporation has prepared a broad plan of activities to be carried out over the next 100 years. This time-frame recognizes that its major nuclear facilities at Chalk River will remain a managed and active site for a minimum of 75 years into the future. The current estimated discounted cost of these activities, based on management's best estimate, is approximately \$400 million (1998 - \$400 million). A conservative discount rate has been used reflecting long-term borrowing rates.



## 11. RELATED PARTY TRANSACTIONS

In addition to the transactions disclosed elsewhere in these financial statements, the corporation had the following transactions with the Government of Canada:

(thousands of dollars)	1999	1998
Repayment of loans		
Principal	\$ 1,109	\$ 1,163
Interest	501	195
	<hr/> \$ 1,610	<hr/> \$ 1,358
Payments to the Public Service Superannuation Plan	\$ 11,073	\$ 13,349

In the normal course of business, the corporation also enters into various transactions with the Government of Canada, its agencies and other Crown corporations.

## 12. RESTRUCTURING AND OTHER PROVISIONS

The corporation carries provisions for restructuring as well as other commercial activities. The charge to earnings for the estimated cost of undertaking actions pursuant to the government's 1996 Program Review was made in 1995-1996 and the unused portion continues to be held for ongoing actions.

## 13. UNCERTAINTY DUE TO THE YEAR 2000 ISSUE

The Year 2000 issue arises because many computerized systems use two digits rather than four to identify a year. Date-sensitive systems may recognize the year 2000 as 1900 or some other date, resulting in errors when information using year 2000 dates is processed. In addition, similar problems may arise in some systems which use certain dates in 1999 to represent something other than a date. The effects of the Year 2000 issue may be experienced before, on, or after January 1, 2000, and if not addressed, the impact on

operations and financial reporting may range from minor errors to significant systems failure which could affect a corporation's ability to conduct normal business operations. It is not possible to be certain that all aspects of the Year 2000 issue affecting the corporation, including those related to the efforts of customers, suppliers, or third parties, will be fully resolved.

## 14. COMPARATIVE FIGURES

Certain 1997-1998 amounts have been reclassified to conform with the current year's presentation.

# Five-Year Consolidated Financial Summary

(millions of dollars)	1999	1998	1997	1996	1995
<b>OPERATIONS</b>					
Revenue	544	490	362	312	366
Income from operations	(10)	7	15	15	3
Net income (loss)	(10)	7	15	(10)	7
Research expenses	204	232	256	254	272
Cost recovery from third parties	41	52	73	81	87
<b>FINANCIAL POSITION</b>					
Cash, advances and short-term investments	101	148	133	146	141
Heavy water inventory	566	590	622	584	584
Capital expenditures	22	20	17	10	8
Capital assets	113	108	100	109	113
Total assets	917	1,006	1,032	993	980
Long-term debt (excludes current portion)	9	10	11	15	19
Shareholder's equity	404	437	458	464	474
<b>OTHER</b>					
Parliamentary appropriations for research operations	102	142	167	164	170
Export revenues	415	396	285	235	291
<b>NUMBER OF FULL-TIME EMPLOYEES</b>	<b>3,384</b>	<b>3,652</b>	<b>3,675</b>	<b>3,881</b>	<b>3,943</b>

## BOARD OF DIRECTORS

Robert F. Nixon ■●★▼▲◆  
Chairman of the Board

R. Allen Kilpatrick ★▼▲◆  
President and Chief Executive Officer

Mary C. Arnold ■●★  
Senior Partner  
Arnold Consulting Group Ltd.

George L. Cooke\* ■▲  
President and Chief Executive Officer  
The Dominion of Canada General  
Insurance Company

Pierre Fortier ■★◆  
Senior Advisor to Chairman  
of the Board, Innovitech Inc.

J. Raymond Frenette ■▼  
Director

Ralph E. Lean\* ■★▼  
Partner  
Cassels, Brock and Blackwell

James S. McKee ▼◆  
Professor Emeritus  
University of Manitoba

Louis-Paul Nolet ■●★▲  
Senior Partner  
L.P. Nolet & Associates Inc.

Marnie Paikin ●▲  
Director

Karen J. Pitre\*\* ▼◆  
President  
Lonsdale Group

Jean-Pierre Soublière ★▲  
President and Chief Executive Officer  
Anderson Soublière Inc.

Hugh Wynne-Edwards ▼◆  
Chairman of the Board  
B.C. Research Inc.

\*Ralph E. Lean  
retired November 27, 1998

\*George L. Cooke  
retired March 31, 1999

\*\*Karen Pitre  
appointed November 27, 1998

## OFFICERS

R. Allen Kilpatrick  
President and Chief Executive Officer

Raymond E. Grisold  
Vice-President Finance, Treasurer  
and Chief Financial Officer

William T. Hancox  
Vice-President, Marketing and Sales

Allan A. Hawryluk  
General Counsel  
and Corporate Secretary

A. Douglas Hink  
Vice-President,  
Strategic Development

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