ASSESS AND ADVISE: A DECADE OF EVALUATION OF THE CANADIAN NUCLEAR FUEL WASTE MANAGEMENT PROGRAM

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ABSTRACT

The research program conducted by Atomic Energy of Canada Limited (AECL) into the concept of geologic disposal of high-level radioactive waste has been the subject of independent review on a continuing basis for the past twelve years. The organization and role of the Technical Advisory Committee (TAC) instituted as this review and advisory body are examined with an emphasis on its public reporting. Based on annual reports, a summary is given of a decade of specific recommendations and general judgments that have been made. The multi-disciplinary requirement for such evaluations is noted in regard to the system components of engineered barriers, the geological medium and the biosphere. The assessment methodology being used for evaluation of the performance of the complete system relative to its long-term safety is also examined. The advantages and disadvantages of a continuing Advisory Committee are considered. The role of TAC in the public environmental assessment process recently announced and the responsibility of scientific and professional organizations to be involved in such a public process are noted.

INTRODUCTION

The nuclear power program in Canada is based on the heavy water moderated and cooled, natural uranium fuelled CANDU (CANadian Deuterium Uranium) reactor which operates on a once-through cycle. About 16 Gg of irradiated fuel have been accumulated to date in the water-filled storage bays at nuclear power stations, largely in the Province of Ontario where over 60% of its electrical energy is now produced in such stations. Additional development, planned or under construction in Ontario and in other provinces, would result in as much as 50 Gg uranium in storage in Canada at the turn of the century. The use of high-density storage arrangements in existing water-filled bays at reactor sites will provide storage capacity until at least 1993, and with some extension, for at least another decade. It is recognized, however, that this type of storage is only a temporary measure and that a permanent means of waste disposal must be found.

A major study(1), commissioned by Energy, Mines and Resources Canada in 1977, emphasized the need for a national plan and research program for safe disposal of the used fuel wastes, and supported the concept of underground disposal in geological formations such as igneous intrusions of crystalline rock, known as plutons, found in the Canadian Shield. Following the recommendations from this report, the Canadian Nuclear Fuel Waste Management Program (NFWMP) was formally established in June 1978 by a Federal Government-Ontario Agreement which designated Atomic Energy of Canada Limited (AECL) as the lead agency for carrying out the research with participation from the provincial utility Ontario Hydro (OH) as well as from various governmental departments. The present program is described in a public document(2) "Managing Canada's Nuclear Wastes".

Unlike the programs of some other countries where political decisions to build and operate an actual vault according to an existing schedule (i.e. Sweden and the USA) have been made, the actual implementation of the disposal concept in Canada is not subject to a firm deadline. Instead, the process of actual disposal is seen as proceeding through three distinct phases. The first phase involves the assessment of the concept that the disposal of immobilized fuel or wastes in deep, stable, terrestrial geologic formations can be achieved with the stated objective of safety and permanence. This "generic research and development phase" spans the period 1981-1992 at the end of which time, a rigorous regulatory and scientific review will be conducted to determine the acceptability and feasibility of the concept. This review is already in its initial stages under Federal Government environmental assessment rules and is the subject of the preceding paper(3). The second phase, that of site selection involving the actual process of locating a potential site, may only begin if the concept is deemed acceptable. The final phase would be the construction and operation of an actual vault after successful location of a suitable site.

Canada is presently approaching the end of the first "generic R&D" phase. The research program that comprises it has included research on interim storage and on transportation of nuclear fuel wastes as the responsibility of Ontario Hydro. AECL has the responsibility for conducting research studies on the immobilization of wastes, and the disposal or burial of wastes. The studies include the assessment of possible safety and environmental impacts from the disposal vault, both in the time period during its operation and also far into the future after its closure. Assessment during the operational phase (pre-closure assessment) will be generally comparable to that for any operational nuclear facility. However, the post-closure assessment, based on forecasting into the future, becomes a much more complex

endeavor. It remains, however, as central to the idea of safe permanent disposal.

In mid 1979 a Technical Advisory Committee to AECL on the Nuclear Fuel Waste Management Program was established. Its membership was selected entirely from a list of nominees submitted by major scientific and engineering societies in Canada. The purpose of TAC is to act as an independent review committee, advising AECL on the extent and quality of the Canadian NFWMP. The annual reports of TAC(4) provide publicly available documentation of its assessment of the progress and performance within the program.

The next section elaborates on the Canadian waste disposal concept and the research program in place. The section which then follows provides details of TAC's organization and role. Succeeding sections give summaries of TAC's evaluations and judgments over the years, and finally a statement of potential advantages and disadvantages of this form of external review of a national research program on nuclear waste disposal.

THE CANADIAN WASTE DISPOSAL CONCEPT

The Multi-Barrier System

The overall objective of the NFWMP is "to ensure that there will be no significant adverse effect on man or the environment from nuclear fuel waste at any time"(5). Nuclear fuel waste is defined as either used or irradiated fuel, or high-level radioactive material separated from used fuel through reprocessing (should Canada adopt this option in future). Similar to efforts in several other nations, the Canadian program of research on deep geological disposal of nuclear waste is based on the concept of isolating wastes with a series of barriers situated in a deep (500 m -1000 m) underground vault, built in a stable, terrestrial geological formation such as the Canadian Shield.

Waste Form and Containers

The bundles of used fuel would be encased in containers with an anticipated minimum lifetime of several hundred years corresponding to the period of high fission-product activity. The containers would be designed to withstand vault pressures and be resistant to corrosion under the pressure, temperature, groundwater exposure and radiation fields that could potentially exist. A supported shell packed with particulate matter has been selected as the reference container design, with candidate container materials identified as ASTM Grades 2 and 12 titanium(6). Research has also been conducted on immobilizing high-level wastes from fuel reprocessing (if adopted) whereby the waste would be incorporated into a water-insoluble, leach-resistant material, such as glass or ceramic.

The Vault

Following waste immobilization or containment, the containers would be emplaced in the vault and packed with a compacted buffer material such as bentonite clay. The reference buffer material(7), a 50-50 mixture of silica sand and a Canadian bentonite, swells upon contact with water, thus acting as a seal against leaching and corrosive agents. It also has a high capacity to absorb chemical species, including most of the significant radionuclides. The vault and the shafts would then be backfilled, probably with a mixture containing bentonite and crushed granite, and along with borehole sealing thus close any openings to the surface.

Geological Medium

The geologic medium in which the underground vault is built acts as yet another barrier to the migration of radionuclides should they escape the vault. Retardation occurs as a result of a number of natural processes taking place at depth, including chemical absorption of radionuclides onto rock surfaces, ion exchange, diffusion into the body of the rock, and the long path lengths to the surface due to the relatively small size and frequency of fractures in the chosen rock. The effectiveness of this natural barrier depends on careful selection of a site which exhibits favorable geochemical, geological and hydrogeological conditions.

The Biosphere

Finally, although the biosphere is not generally regarded as a "barrier" in the same sense as those described above, the surface environment, with its large volume of soil and water, has a great capacity to disperse and dilute whatever material which, no matter how unlikely, may reach the surface.

Research Program

The Canadian research program can be conveniently considered as encompassing four general areas: geosciences, engineered barriers, bioscience and systems analysis or performance assessment. The geoscience area includes hydrogeology, geology, geophysics, geomechanics and geochemistry. Engineered barriers include studies on immobilization of wastes with the use of glass or ceramics; containers (composition and design); buffers and backfill; and vault sealing. In these two areas, the role of groundwater is a primary feature through its potential for penetration to the source of radionculides and their subsequent transport through the engineered barriers and the geosphere into the biosphere. The bioscience areas include studies on radiologic effects, dosimetry, ecological succession, limnology, hydrology, plant uptake, and food chain models. The objective of system analysis or performance assessment is to

process and integrate the results from all of these disparate studies and present a comprehensive and comprehensible statement about the safety and acceptability of the disposal concept. Most performance assessments involve a probabilistic approach. Canada has adopted it in the form of Systems Variability Analysis (SVA) through a computer code, SYVAC(8). A general description of this approach and TAC's current evaluation was presented recently(9).

Safety and Performance Criteria

The criteria for judging system safety and performance have been established by the Atomic Energy Control Board (AECB), the regulatory body in Canada which has responsibility for matters dealing with radioactive substances. Three regulatory documents directly relevant to nuclear waste disposal have been issued. Their contents include specific radiological and risk criteria and the requirement that (a) burdens placed on future generations be minimized; (b) the environment be protected, and (c) human health be protected, for which a risk criterion of less than 10^{-6} serious health effects per year is imposed. This figure corresponds to a dose of 0.50 mSv/yr.

TECHNICAL ADVISORY COMMITTEE

Organizational Role

As noted, the Technical Advisory Committee was formed in 1979. The terms of reference for such a committee had been agreed to by AECL in consultation with the presidents of seven major scientific and engineering associations in Canada. The agreed terms were simple and straightforward, and, while subject to triennial review, have not been changed. In summary they read as follows:

Purpose

- To advise on extent and quality of the program (CNFWMP).
- To serve as an independent peer-review committee.

Membership

- To have suitable technical or scientific background.
- To be recommended by appropriate professional bodies.
- To be appointed by AECL for three years.
- Reappointment can be made by recommendation of the appropriate bodies.

Responsibilities

- Review proposed research programs within the CNFWMP.
- Suggest alternatives and additions as deemed appropriate.
- Review scientific methodology.
- Note if best available technology is being applied.
- Review results and conclusions.
- Identify expertise for contracts.
- Recommend areas for research.
- Advise on research proposals.
- Other as agreed.

Procedure

- To be responsible for its own internal organization.
- To meet as deemed appropriate.
- To appoint a secretary to keep minutes of all meetings.
- To recommend other resource personnel as deemed desirable.

Reporting

- To AECL Program Director.
- Annual report required which will be published.

Other

- AECL pays all reasonable expenses and honorarium for members' time at meetings.
- Terms of Reference reviewed every three years or as mutually agreed.

The Technical Advisory Committee initially had a membership of ten, which is now extended to a current membership of sixteen. It meets regularly as a full committee, and some sixty meetings have been held since its inception almost twelve years ago. TAC also utilizes a subcommittee structure correlated with major elements of the research program. The four subcommittees (Geosciences, Engineered Barriers, Bioscience and Systems Analysis) have some overlap of membership to maintain continuity and invoke expertise in required aspects of the program. Continuity is also maintained by the allowance of renominations for additional terms. The overlap in successive appointees from a specific association or society has also been used to augment knowledgeable input to our reviewing process. The nominating societies and the number of such nominees currently on TAC are as follows:

- Biological Council of Canada and Canadian Federation of Biological Sciences (4).
- Canadian Association of Physicists (2).
- Canadian Geoscience Council (3).
- Canadian Information Processing Society (1).
- Canadian Institute of Mining and Metallurgy (2).
- Chemical Institute of Canada (2).

- Engineering Institute of Canada (2).

The distinction of such peer nomination is further evidenced by the fact that nine of the current members are Fellows of the Royal Society of Canada, and the two engineers are both Fellows of the Canadian Academy of Engineering.

TAC Operations

The review procedures remain in the tradition of peer review and include a critical examination of information directly available from a large number of research projects within the program. Such information comes in three main formats: published documents, laboratory and field visits, and meetings and discussions. Documentation includes an AECL Technical Record (TR) series of reports, initiated primarily for this program, and a large number of contributions in the AECL report series. Both series are publicly available, and both were subjected to internal review before publication. In many instances the report contents were also published, in part or in whole, in the open scientific literature. Other AECL reports available to TAC include a series of quarterly progress reports (for the first few years) which were succeeded about 1986 with semi-annual status reports published in the TR series. Inputs for TAC's evaluation have also been provided by scientific papers presented at national and international conferences, and publications, now numbering over 300, in scientific periodicals and conference proceedings as authored by participants in the research program. The vast open literature available in the field of high-level radioactive waste provides an invaluable context for evaluation of all components of the Canadian program, especially those closely related to work in other jurisdictions and countries.

TAC arranges for site and laboratory visits, and in the last few years combining those with informal presentations by program staff on an organized basis. For many years, so-called information meetings, which involved progress report presentations by research staff, were a paramount source of direct and current information to TAC. In the early years of the program such meetings were held three to four times a year, then on a bi-annual basis for several years, and now only occasionally as needs demand. These 2-3 day assemblies were an ongoing part of program activities assisting in the integration of projects and developing coherence for the overall program. Simultaneously they provided TAC with an opportunity to hear and to enter into discussion with research personnel, as well as to follow current progress in many of the specific research projects. Latterly the proceedings from such meetings were published in the TR series. Occasional special workshops and meetings on specific program areas or topics have been held, sometimes following suggestions made by TAC. These occasions provided for participation by scientists who are not otherwise involved in the program. The direct involvement, as reviewers or discussants, of several outside expert scientists provided valuable and direct evaluation of specific program components. The convening of review panels, again on specific topics, has occurred. These also allowed for TAC participation. The total flavor of openness and full freedom of information has been noted in annual TAC reports as a most commendable feature of the Canadian program. Presentations and contributions to the proceedings of national and international conferences, workshops, and special working groups by program personnel are also noted by TAC. Whenever feasible, attendance by one or more TAC members provides means for direct evaluation. Through these, as well as other meetings noted above, direct, informal communication between members of TAC and program research personnel continues to be frequent and valuable, facilitating the exchange of information, suggestions and advice, and assisting in our endeavors to fulfil our mandated role.

Utilization of the above sources of information, including the monitoring of related work elsewhere, provides the basis for the review and advisory activities of TAC. These continue to center on a scientific evaluation of methods, technology and results achieved within the program both as related to objectives, and with regard to such limiting problems as time, manpower and resources. Efforts to determine missing or neglected areas of research, and to suggest potential sources of expertise or special facilities that might become involved in the program are part of the evaluation mode. Judgments on scientific methodology, accuracy and significance of results are made. Publications in refereed proceedings and journals are an important aspect of external recognition that can significantly augment our evaluations. Extensive subcommittee and committee discussion assists in judging degrees of relevancy and levels of priority. The existence and adequacy of research plans, of experimental design and specificity of data and experiment needs are all categories entering into the judgment areas employed by TAC as it assesses and advises.

Primarily because of the continuing nature of the overall task assigned to TAC, some of its advice and assessment is communicated informally and directly to research personnel in the program facilitated through meetings, site visits, etc. as described above. However, the major focus for presentation of TAC's evaluation and advice remains its annual report. Although directed to AECL, and formally communicated to the Director of the AECL program, the annual report is designed with a two-fold purpose. Firstly, it addresses the program managers and investigators with evaluations and judgments in each of the program areas being investigated. Degree of detail will vary depending on the perceived need or the depth of review that has been made, but it is basically a medium for transmitting advice with respect to the current status and recent research re-

sults. For the second objective of informing the public and, in particular, the general scientific community, the annual report provides an overall general view of the program, a brief cumulative status of research accomplishments, and summary assessments of research performance within each program area. It also strives to review, in great brevity, the national context within which the program is operating, including regulatory and external environmental assessment plans, program funding and organization, and public information and participation.

Annual reports, available in both official languages, are widely distributed and have a current circulation of some 800. They are provided to all investigators involved in the program, to the presidents and, when opportune, to the councils of all scientific societies which nominated members to TAC, to AECB, to a wide range of groups of individuals in government and in federal and provincial legislatures and to the public at large. The report and summaries of it are also sent to the various scientific and professional society journals in Canada, to the Deans of Science and Engineering at Canadian universities and to the Chairmen of the Science Departments in all universities.

Occasionally special matters of concern to TAC have arisen which warrant more rapid communication. These become the subject of Technical Communications to the Program Director. The topics will then be covered, updated for currency, in the ensuing annual report. They have only averaged about two per year but even at that frequency have been found to be useful.

In the public arena, additional to annual report distribution, members of TAC have made presentations to public hearings, to select committees (both federal and provincial level), to councils of several scientific and professional bodies, and at many national and international conferences. Members have also been involved in occasional media interviews.

Responses to TAC reports or to its statements or conference presentations have always been welcomed. Our main response from AECL is provided in written form which, for the last two years, has been bound with the succeeding year's TAC report. The response is presented with sufficient context that areas of agreement and disagreement, as well as items under continuing discussion, can be noted.

TAC's operations are supported by a small staff consisting of an administrative-office secretary, a computer analyst and a science secretary, the latter two with professional scientific qualifications.

RECOMMENDATIONS AND JUDGMENTS

With the broad objectives of our task and reporting thereon, it is not unexpected that our recommendations in each annual report are often wide-ranging as well as very specific. In addition, since each report purports to review the entire program and to reflect its current status, there will be much overlap and repetition among the 645 recommendations or evaluative judgments made in the eleven TAC reports now issued. Additional to those specifically enumerated as recommendations, the accompanying text frequently includes suggestions or comments that are designed to assist the progress of the various investigations. Since this paper is designed to present the process by which the Canadian program is reviewed by TAC and not the specific substance of its review, we now present, but for illustrative purposes only, selected recommendations and judgments. Those include affirmations, matters of commendation, items of criticism, suggestions and the raising of questions.

Throughout the eleven reports there is noticeable a steady pattern for certain recommendations or affirmations which are presented each year, reflecting either a continuing or a consistent view by TAC for a number of years or throughout the decade under review. A sampling of these is given here in an abbreviated format to illustrate.

TAC Recommendations/Conclusions – Steady Pattern

- Support wide participation in the program (government, industry, university).
- Know international framework -- cooperate internationally.
- Thorough evaluation of simulation models required.
- Awareness of alternative geologic media included.
- Support free access for field research studies.
- Support construction and operation of an Underground Research Laboratory (URL).
- Concentrate on used fuel as waste form.
- Support system variability analysis for performance (safety) assessment.
- Commend for making research information freely available.
- Commend availability of full public information/participation.
- Range of tools/techniques for software reliability should be used.
- Publication in scientific literature strongly supported.
- Construction of hydrostatic test facility commended.

The main categories for TAC recommendations correspond logically to the main organizational groupings in the Canadian NFWMP, i.e. engineered barriers, geosciences, biosphere and systems analysis. The pattern for most comments has been a changing one over the years as they address developing aspects of the many investigations and

research tasks being undertaken. Examples for each of these categories which illustrate the dynamics of the development of a mission-oriented program appear below. Each example is a greatly abbreviated statement, and its full implication can only be accurately and fully understood if its original context with basis and rationale is taken into account. The numbers following each statement refer to the pertinent annual report, e.g. TAC-1 is the First Annual Report published in 1980.

TAC Recommendations/Conclusions -- Geology and Geophysics

- Develop borehole geophysics instrumentation (TAC-1).
- Maintain concentration on granitic plutons (TAC-1).
- Program document with current research plans required (TAC-1, 2, 4, 5).
- Close coordination among geoscience groups needed (TAC-1, 2, 4, 5).
- Expand research areas with more reconnaissance work (TAC-2).
- Suggest critical review and selection of geophysical methods (TAC-2, 3, 4, 6).
- Consider studies on gneissic rocks (TAC-4).
- Commend advances in characterization and correlation of fracture systems (TAC-4).
- High quality structural lithological mapping commended (TAC-5).
- A site specific geosphere model is a reasonable approach (TAC-8).
- Subsurface geophysical methods valuable (TAC-10).
- High quality of instrumentation development noted (TAC-10).
- Maintain emphasis on underground geophysical methods (TAC-

TAC Recommendations/Conclusions -- Hydrogeology

- Research plan document needed (TAC-1).
- Expand hydrogeologic resources/personnel (TAC-1, 2).
- Explore groundwater flow patterns on both local/regional scales (TAC-1).
- Obtain data pre-construction of the URL (TAC-2).
- Good research plans (TAC-2).
- Expanded flow system studies needed (TAC-2).
- Instrumentation development proceeding well (TAC-3).
- Flow system study well conceived (TAC-3).
- Pursue simulations of URL Field Results (TAC-4).
- Location change for regional flow study supported (TAC-7).
- Quality of hydrogeology program noted (TAC-7, 8, 9).
- Excavation response modelling needs development (TAC-9).
- Suggest emphasis on regional recharge areas (TAC-10, 11).

TAC Recommendations/Conclusions -- Geotechnical

- Expand data base (TAC-1).
- Expand instrumentation capabilities (TAC-1).
- Large scale rock mass properties needed (TAC-2).
- Expand rock mass modelling approaches (TAC-3).
- URL Pre-construction experiments well conceived (TAC-3).
- Continued development of methods to model URL rock mass response (TAC-4).
- Plan for URL construction phase experiments needed (TAC-5).
- Suggest extension of studies to large scale and jointed rock (TAC-6).
- Investigate microcracking potential (TAC-6).
- Geomechanical instrumentation development evaluated (TAC-7).
- URL Extension advantageous (TAC-7).
- Extend research on time effects of rock response (TAC-11).

TAC Recommendations/Conclusions -- Geochemical

- Expand studies on groundwater - mineral interactions (TAC-1).
- Suggest sorption studies more realistic (TAC-1).
- Maintain studies on effect of colloids (TAC-2).
- Sorption studies on alteration products commended (TAC-3).
- Continue work on modelling complex sorption processes (TAC-4).
- Rock matrix diffusion studies noted (TAC-4).
- Support development of international data bases (TAC-4, 5, 11).
- Continue large scale migration experiment (TAC-5, 10).
- Support natural analog studies, interpret cautiously (TAC-5, 9).

- Commend geochemical research quality (TAC-10).

TAC Recommendations/Conclusions -- Hydrogeology

- Research plan document needed (TAC-1).
- Expand hydrogeologic resources/personnel (TAC-1, 2).
- Explore groundwater flow patterns on both local/regional scales (TAC-1).
- Obtain data pre-construction of the URL (TAC-2).
- Good research plans (TAC-2).
- Expanded flow system studies needed (TAC-2).
- Instrumentation development proceeding well (TAC-3).
- Flow system study well conceived (TAC-3).
- Pursue simulations of URL field results (TAC-4).
- Location change for regional flow study supported (TAC-7).
- Quality of Hydrogeology program noted (TAC-7, 8, 9).
- Excavation response modelling needs development (TAC-9).
- Suggest emphasis on regional recharge areas (TAC-10, 11).

TAC Recommendations/Conclusions -- Waste Immobilization/Engineered Barriers

- Suggest more corrosion studies and special workshops (TAC-1, 2, 4).
- Seek alternatives to glasses (TAC-1).
- Reassess casting technology (TAC-1).
- Emphasize experiments with realistic vault conditions (TAC-2).
- Noted good coordination between process and product development (TAC-2).
- Radiolysis effects require study (TAC-3, 5).
- Expanded work on buffers, rock sealing needed (TAC-3, 5, 6).
- Support integrated cask development (TAC-4).
- Suggest overall review of used fuel characterization (TAC-4).
- Multi-component tests commended (TAC-4, 5).
- Suggest full data compilation on container fabrication, testing, closure, inspection (TAC-5).
- Consider immobilized fuel test facility essential (TAC-6).
- Localized corrosion effects important (TAC-7).
- Suggest emphasis on buffer-rock interface studies (TAC-7).
- Commend progress in used fuel characterization (TAC-8).
- Document basis for parameter values in vault model (TAC-8).
- Termination of waste form development acceptable (TAC-9).
- Maintain copper and titanium corrosion studies (TAC-7, 8, 9, 10, 11).
- Commend grouting and sealing research progress (TAC-10).
- Suggest re-examination aspects of (fuel) solubility model (TAC-11).

TAC Recommendations/Conclusions -- Biosphere

- Consolidate/coordinate biological research (TAC-2).
- Support doing field work at existing sites (TAC-2).
- Emphasize deep groundwater age determination (TAC-2).
- Not all potential pathways included (TAC-3).
- Vegetation - radionuclide studies needed (TAC-3).
- Atmospheric pathways analysis commended (TAC-4, 5).
- Commend development of generic food chain model (TAC-4).
- Canadian Shield conditions need emphasis (TAC-4, 5).
- Biosphere model developing satisfactorily (TAC-6, 9).
- Radionuclide transport in soil important (TAC-7).

TAC Recommendations/Conclusions -- Safety (Performance) Assessment

- Approach setting regulatory criteria cautiously (TAC-1).
- Iterative studies on assessment methodology commended (TAC-3, 5).
- Ensure model and software reliability (TAC-2 to TAC-11).
- Facilitate process of examining algorithm--code translation (TAC-4, 5).
- Need to apply sensitivity analysis (TAC-4, 8).
- Transitional processes considered (TAC-5).
- International code comparisons useful (TAC-6).

- Suggest greater emphasis on software quality assurance (TAC-7, 10, 11).
- Risk criteria exposition needed (TAC-7, 8).
- Suggest carrying out uncertainty analysis (TAC-11).

A special feature of TAC's evaluation in the area of performance or safety assessment has been its effort to provide independent detailed investigation of the computer code SYVAC and its application. As noted above, details of some of our views and results in this aspect have been recently reported(9).

AN EVALUATION OF THE TAC REVIEW PROCESS

The establishment and organization of the Technical Advisory Committee as described above has certain unique factors as an independent review body. These primarily center on its autonomy in operation and its continuity over now almost twelve years in advising on a major national research program. There are resultant advantages and disadvantages in its operations due to such organizational features and from TAC's own decisions on operating modes. An enunciation of these is now in order.

As a potential disadvantage note that any attempt on a year-by-year basis to review and assess all aspects of a wide-ranging program is likely to lack the intensity and depth of examination that can be given by ad hoc specific, one-time reviews of a defined problem or area. It is important to try to guard against that form of superficiality, and at the same time not drift into the issuing of obvious and belated advice. An ongoing committee such as TAC, with much information accruing informally through site visits and progress reports, faces the constraints established by trying to base observations and conclusions on unpublished and often preliminary data. The very make-up of the committee with renewals of membership brings in the danger of having inadequate fresh views. We consider this to have been countered through the addition of at least one new member almost every year. Even then the wide range of topics for review could mean calling to hand an inordinate number of consultants (a move we have strenuously resisted) or being more generalistic in our approach--the emphasis we have selected. This has been bolstered by the interdisciplinary and teaching/learning efforts of the committee members. A further matter, different from some peer review approaches, is the lack of anonymity. Finally there is the possible perception from outside that the committee is not independent, despite its method of nomination and appointment and its making reports public. An aspect of this arises when the very nature of continuing review is considered. If changes in research program, in experimental detail or in conceptual analysis are made as a result of TAC recommendations, then the continuing review of that changed program is also being done by TAC--assessing a program which it had possibly in part formulated or suggested. A counter-balance here arises through other external evaluations, such as refereeing of publications and the convening of special review panels or workshops. More importantly, objectivity can be maintained through the ability of committee members to discuss and question thoroughly in group or full committee format. Critical perceptions can hold sway in such a situation. While TAC's own operating rules permit issuing a minority report, if supported by more than one individual, consensus and unanimity has always been reached.

On the positive side there are also advantages arising from the very acquisition over time of full program information and its assimilation to a point of understanding and of willingness to assess. Despite aperiodic involvement of committee members, over adequate time a good breadth of appreciation of the intricacies of the research tasks being evaluated can be achieved. The opportunity to know the individual working scientist or engineer and to see them operate in their home laboratory or on the field site adds both clarity and perspective especially when it is viewed over years and not just months. Possibly most important of all, the opportunity to have a mix of those whose experience with the program extends over some years and those who are looking at it with a fresh and questioning viewpoint strengthens the possibility of adopting a fundamental and basic perspective rather than a concentration on detail. The committee organization and method of operation allows it to maintain an overall integrated view of the entire program, offers continuity in approach, and provides a type of cumulative awareness of issues, needs and difficulties in the research being assessed.

Further advantage to the TAC process accrues through the well-founded assurance of independence by public reporting, and now, for several years by the publication in the TAC reports of the AECL responses. Pursuant to the nomination procedure for TAC members and its reporting mechanisms, there is a relatively broad acquaintance with the Canadian program on the part of the membership of scientific and engineering associations. This marshalling of scientific societies' involvement has an important public connotation when ultimate decisions on the nuclear waste disposal concept will be made at the governmental level. With such a research program as that on nuclear waste, there are major social, environmental and political aspects, as well as the direct scientific and technical elements. The members of TAC continue to feel a responsibility to provide evaluation of the NFWMP to the scientific and technical community in Canada as well as to those participating in the program and to those accountable for it at the political level. We also continue to be most willing to provide interpretation and evaluation as broadly as possible to the general public.

We have agreed to assess and advise--and we are privileged to be able to perform this role openly and publicly.

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