AECL-6813

ATOMIC ENERGY OF CANADA LIMITED

L'ENERGIE ATOMIQUE DU CANADA LIMITEE

A STUDY OF THE HEALTH OF THE EMPLOYEES OF ATOMIC ENERGY OF CANADA LIMITED

I. SETTING UP THE STUDY

ETUDE DE LA SANTE DU PERSONNEL DE L'ENERGIE ATOMIQUE DU CANADA LIMITEE

I. ORGANISATION DE L'ETUDE

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September 1981 septembre

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I. ORGANISATION DE L'ETUDE

par

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RESUME

Ce rapport résume l'état présent de l'Etude de la santé du personnel de l'Energie Atomique du Canada Limitée; il est rédigé sous forme de source de référence pour les personnes travaillant à cette étude. Il contient, sous une forme révisée, quelques extraits d'une publication précédente (J.L. Weeks, Un Registre pour l'Etude de la santé des travailleurs sous rayonnement employés par l'Energie Atomique du Canada Limitée, AECL-6194 (1979), de même que des renseignements sur les méthodes employées lors de l'organisation de l'étude. Les différences entre ce rapport et AECL-6194 découlent des développements du concept de l'étude intervenus au cours d'une période de deux ans.

Certains détails de ce rapport pourraient intéresser les personnes travaillant à des programmes similaires.

L'Energie Atomique du Canada Limitée
Etablissement de Recherches Nucléaires de Whiteshell
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J.L. Weeks

ABSTRACT

This report summarises the present status of the Study of the Health of the Employees of Atomic Energy of Canada Limited and is written as a reference source for those who are working on the study. It contains, in revised form, some excerpts from a previous publication (J.L. Weeks, A Registry for the Study of the Health of Radiation Workers Employed by Atomic Energy of Canada Limited, AECL-6194 (1979)), with information on the methods used in setting up the study. The differences that exist between this report and AECL-6194 represent developments of the study concept over a two-year period.

Some aspects of the report may be of interest to those working on similar programs.

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CONTENTS

1. INTRODUCTION

The development of nuclear power programs in many countries has led to increased interest in the long-term biological effects of low doses of ionising radiation, delivered at low dose rates over a prolonged period of time. Information is available on long- and short-term effects in humans and experimental animals after relatively high-dose, high-dose-rate exposures. There is little information on long-term effects on human populations following exposure to radiation delivered in low doses and at low dose rates. The identification of such effects, if they exist, is relevant to the preparation of risk estimates for nuclear power programs, and for other scientific or industrial activities that may entail population exposure.

The information presently available on the long-term effects of high-dose, high-dose-rate irradiation provides the basis for current concepts of long-term biological effects. From such information is derived the working hypothesis that a linear relationship between dose and effect represents an upper limit of hazard for an exposed person. This hypothesis, involving extrapolation from high to low doses, is generally held to be conservative. It excludes the possibility that a threshold may exist for the induction of cancer by radiation.

The linear hypothesis has been widely discussed, and the current view is that it may be pessimistic to calculate the biological costs of nuclear power programs in terms of such an hypothesis. However, it has also been suggested that the linear hypothesis may <u>not</u> be conservative and that the biological effects of radiation, in particular the late effects, may be enhanced at low doses and low dose rates. It is in the context of these two viewpoints that epidemiological studies of radiation workers are considered.

The primary purpose of the Atomic Energy of Canada Limited (AECL) Health Study described in this report is to define the causes of death in a group of workers, some of whom have been occupationally exposed to low doses of radiation delivered at low dose rates. This knowledge, together with information derived from similar studies, may eventually provide the basis for an assessment of the long-term biological effects of such exposures.

2. EPIDEMIOLOGICAL AND THEORETICAL ASPECTS

In 1970, Duncan and Howell[1] published the results of their study of the health of radiation workers in the United Kingdom Atomic Energy Authority (UKAEA). They found no evidence of work-related illness, but the study did not extend to ex-employees. While it provides much useful information, this paper has been questioned on the grounds that it is a painstaking demonstration of the so-called "well worker" effect. Mancuso, Stewart and Kneale (MSK), at a Health Physics symposium in 1976[2], presented a preliminary paper dealing with their study of Hanford radiation workers. In this paper and its developments[3,4], the authors concluded that the effects of prolonged low-dose, low-dose-rate exposure were greater than had been believed.

The arguments against such a conclusion have been convincingly marshalled by Anderson[5], who based his criticism on several factors. These include: the use by MSK of cumulative mean radiation doses in which a high dose to one individual can distort the mean of a series of doses; the use of proportional mortality; the selection of a single year (1960) as the control point for an unexposed population; and the fact that a change in the international classification of diseases (ICD) was not reflected in the treatment of data by MSK. Nonetheless, Anderson points out that the Hanford data do indicate that, among those radiation workers, there has been increased incidence of deaths from myeloma, car-

cinoma of the pancreas and possibly lung cancer. There is also an apparent deficit of leukaemia deaths. Similar conclusions have been reached by Marks and Gilbert[6] and by Hutchinson et al.[7]. It is possible that there is no causal relationship between these disease patterns and radiation exposure, and that occupational and non-occupational exposures to other carcinogens should be considered as possible confounding factors. The rising incidence of pancreatic carcinoma in Europe has been commented upon[8] and, for this disease, the Hanford figures may be simply a reflection of a general trend.

Dolphin published a report[9], in 1976, on the incidence of cancers of the haematopoietic and lymphatic systems among employees of the British Nuclear Fuels Limited (BNFL) plant at Windscale. This first report has subsequently undergone revision and, in particular, the confidence limits on the incidence of leukaemia (ICD 204-207), myeloma (203) and lymphosarcoma (200) have been reviewed, with the result that the excess incidence of myeloma is now considered to be significant. It is interesting that this rare disease figures in reports from two similar but widely separated plants, Hanford and Windscale. In his report, Dolphin referred to the need to follow up ex-employees, and pointed out that the National Registry for Radiation Workers would meet this need in the United Kingdom.

A report of a survey of the health of employees at the Lucas Heights Research Establishment of the Australian Atomic Energy Commission (AAEC)[10] describes the prevalence of disease among those employees. The study was done because of concern about the incidence of sarcoidosis at this site; four known cases have occurred among some 1200 employees over a 19-year period. This first report of a continuing study brings to light no other unusual disease-occupation relationships.

In a paper unrelated to occupational exposure, Boice and Stone[11] have described their study of 1764 women repeatedly fluorographed during the course of collapse therapy for pulmonary tuberculo-

sis. The authors conclude that multiple-radiation doses may carry the same breast-cancer risk as a single exposure of the same total dose, and point out the apparently increased sensitivity of the pubertal and prepubertal breast to radiation. The significance of age at exposure to radiation was also mentioned in the MSK study[3].

During recent years, papers have been published dealing with the methodology of studies of the health of radiation workers. Reissland and his colleagues[12] drew attention to the large amount of data necessary before it can be concluded with confidence that an excess incidence of a relatively uncommon disease, such as leukaemia, does or does not exist. In a subsequent paper, Reissland[13] described the conceptual basis of the National Radiation Registry in the United Kingdom, and concluded that, provided such a registry is maintained over several decades, it will contribute usefully to the determination of upper limits for risk coefficients. Newcombe[14] considered the methods by which dose records may be integrated with relevant cancer and death registrations in Canada. He emphasized the need for adequate identification of individual entrants to such a registry, and noted that considerable economy could be effected in the operation of a registry if use were made of data that are already being collected for other purposes. The importance of Newcombe's concepts to the present study is particularly emphasized.

A major purpose of epidemiological studies is to determine the incidence of disease in a population and to relate this to factors that may have a bearing on observed variations in disease patterns. It has been noted that one of the factors of interest in a study of radiation workers is the relationship of dose and dose rate to the incidence of cancer. The theoretical aspects of this factor have been reviewed by Mole[15] and Brown[16], who suggested that an enhanced radiation effect at low dose rates could not be excluded on the basis of information then available. The experimental studies reported by Petkau[17], moreover, demonstrated such an enhanced effect in an isolated system: a model

cell membrane prepared from cattle-brain phospholipid material. Petkau emphasized that his observations applied only to this particular system, and in his continuing studies identified mechanisms that, in the intact animal, protect against radiation[18]. Lafuma[19] has reported findings that lend some support to the concept of an inverse dose-effect relationship.

It is important to relate these concepts to the study being undertaken by AECL. Land[20], in a thoughtful analysis of the estimation of cancer risks from low doses of radiation, has pointed out that the statistical power of a study, i.e., the probability of obtaining a statistically significant result, varies with δ/σ, where δ is the true excess risk and σ is the standard deviation. In terms of the AECL Health Study, the relationship of mortality to occupational radiation exposure is a factor of interest. It must, however, be emphasized that the comments made by Land are particularly applicable to this type of study. It is a study in which the population size is relatively small, the accumulated radiation exposure is not high and the available data suggest that the overall effect may be low. Consequently, it would be unrealistic to expect that the study, by itself, will provide conclusive information on the size and dose relationships of an effect, if indeed such an effect exists in the population studied.

Cuzick[21] has reviewed the incidence of myelomatosis in populations exposed to ionising radiation and suggests factors that may account for the apparent deficit of this disease in two large cohorts of women who received intense irradiation for the treatment of uterine cancer. The effect may parallel the decreased leukaemogenicity of radiation at high dose in animals. Of similar interest is an increase in the incidence of myelomatosis among Atomic Bomb Survivors. By 1976, five cases had occurred, giving a lower level risk ratio of 1.3, at the 90% confidence level.

3. PARTICIPANTS IN THE STUDY

At an early stage in the design of the study it was recognized that the participation of agencies outside of AECL would be essential for its implementation. Many members of the staff of these agencies have given extensively of their time to bring the program to its present stage of development (see Section 8).

In January 1980 an AECL Health Study Steering Committee was formed to coordinate the work of participating groups within and outside of AECL. The membership of this committee is listed in Appendix A.

4. INTENTION

Mortality experience is to be determined for a group that consists at present of some 7400 employees (Table 1), of whom more than half are classified as Atomic Radiation Workers, using the definition that appears in Regulations made under the Atomic Energy Control Act (Appendix B). In addition, the records of more than 11 000 previous employees at the Chalk River Nuclear Laboratories (CRNL) and the Whiteshell Nuclear Research Establishment (WNRE) are available to the study. In the current employee population, those who are not "atomic radiation workers" are engaged in a wide range of occupations. Some are involved with what can be described as "light engineering", many are office or laboratory workers and an important subgroup is employed in heavy water plants. For the last named, a potential hazard is exposure to hydrogen sulphide (H_2S).

Attention is also directed to the possibility of determining whether occupational exposure to low-level radiation influences the cause of death. For reasons already referred to (see Section 2 and reference

TABLE 1

ATOMIC ENERGY OF CANADA LIMITED - DISTRIBUTION OF EMPLOYEES

(April 1981)

	Atomic Radiation Workers	Total Employees
AECL Corporate Head Office	0	160
AECL Research Company		
- Head Office	0	40
- CRNL	2286	2286
- WNRE	892	892
AECL Radiochemical Company	291	912
AECL Engineering Company	316	2268
AECL International Company	0	21
AECL Chemical Company		
- Head Office	0	76
- Port Hawkesbury HWP	0	329
- Glace Bay HWP	0	385
TOTALS	3785	7369

20), it is unlikely that the AECL study will possess sufficient statistical power to permit a conclusive determination of the influence of radiation on mortality. This does not detract from the purpose of the program, but given the availability of radiation exposure data, it is prudent to include this with the information accessible to the program, recognising that a number of other factors, such as exposure to chemical carcinogens, may similarly affect mortality statistics.

To summarise — the purpose of the AECL study is to determine, by follow-up, the causes of death among its employees, to compare this information with the statistics of a suitable control group from the general population and to test any apparent relationship between these statistics and occupational exposure to ionising radiation.

5. METHODS

5.1 GROUPING OF RADIATION WORKERS

There are four groups of radiation workers in Canada:

1. Atomic Radiation Workers employed by AECL.
2. Atomic Radiation Workers employed by utilities — Ontario Hydro, Hydro-Quebec and New Brunswick Electric Power Commission.
3. Radiation workers (X-ray technicians, etc.) employed by hospitals, universities and industry.
4. Workers in mines and related industries who are occupationally exposed to radiation.

The AECL Study includes radiation workers in Group 1, together with those employed by AECL who are not classifed as atomic radiation

workers. In Group 2, Ontario Hydro has, since 1972, been undertaking a health study of all its employees, including those classified as radiation workers. The data for the very large Group 3 are kept by the National Dose Registry and provisions are being, or have been, made by federal and provincial governments for the follow-up of workers in Group 4 (see Appendix C).

5.2 PERSONS INCLUDED IN THE STUDY

The main cohort for the study will include:

(a) All past employees at CRNL and WNRE, i.e., those whose service began and ended during the period 1944-1980, ∿ 11 000 entrants.

(b) All current employees at all AECL sites (see Table 1) in June 1980*, ∿ 7000 entrants.

Data entries will also be prepared for those employees who subsequently enter the service of AECL at any of its sites and who consent to participate in the study. This information will be maintained in the form of a Health Study Register of AECL employees. The entrants to this register will not in the first instance be joined to the cohort described above, but this option may be exercised in the future.

5.3 PROCEDURE FOR HANDLING DATA

5.3.1 Past Employees

i) The identifying data for past employees at the two sites, CRNL and WNRE, are entered from personnel files into the Employee Identity Summary (E.I.S.) forms prepared specifically for Past Employees (Appendix D). These differ slightly from the E.I.S. forms used for current employees (Appendix E), in that provision is made for the entry of death data where this is known.

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* Excluding ∿ 500 current employees who have indicated that they do not wish to participate in the study.

ii) On completion of the E.I.S. forms, the identifying data which they contain are entered on tape in machine-readable form, in accordance with the Data Entry Instructions (Appendix F). This tape will be prepared in such a way that information on occupational radiation exposure while in the service of AECL can be entered (Appendix G). (See also Section 5.7.)

iii) A small sample of the entries used to prepare the tape is reviewed to ensure that entry is being satisfactorily made.

iv) The final tape for past employees is then sent to Statistics Canada, Ottawa, for linkage with the Mortality Data Base (Appendix H).

v) The data from this linkage are in turn transmitted to the Epidemiology Unit of the National Cancer Institute of Canada (NCIC) for analysis.

5.3.2 Current Employees

i) The procedure to be followed for current employees at all sites differs in some respects from the foregoing. Compliance with the provisions of the Canadian Human Rights Act, and with the Protection of Personal Information Regulations, is not a problem in the context of past employees, as information from the study could not be used for adminstrative purposes that might affect a past employee. However, this is not necessarily the case for a current employee who could conceivably be affected, i.e., by changes made in working practices as a result of the study. A consent form (Appendix I) has therefore been included with the E.I.S. form. Only the information concerning those people who have consented to its use is included in the study (at October 1980, approximately 7% of current employees had indicated that they did not wish to participate in the study).

ii) The completed E.I.S. forms, together with consent forms, are then sent from the sites to WNRE (Dr. J.L. Weeks) where the Consent Forms are separated and filed.

iii) The data from the completed E.I.S. forms are then entered on a master tape, a small sample of which is reviewed to ensure the accuracy of the key-punching procedure. If this is satisfactory, preparation of the master tape continues, provision being made for the subsequent inclusion of occupational radiation exposure.

iv) The completed master tape is then compared with the Payroll File to ensure that it contains the names of all employees other than those who have declined to participate.

v) In due course, this tape will be sent to Statistics Canada for linkage with the Mortality Data Base and the resulting statistical data are transmitted to NCIC for analysis, as described above (Section 5.3.1 (v)).

At this point the study consists of two primary tapes that may be described as Phase I and Phase II. The Phase I tape includes the names of all past employees at CRNL and WNRE and provides the initial instrument for linkage with the Mortality Data Base. The Phase II tape contains the names of employees who were on strength in 1980. In time, a number of these will become past employees and some of them will die. Until that time arrives, little purpose is served by linking this tape to the Mortality Data Base. Eventually, however, it will be useful to merge the tapes, thus providing one tape containing the entries of the cohort as a whole.

5.4 PILOT STUDY OF PAST EMPLOYEES

In addition to the main cohort study, a separate analysis is being undertaken of the causes of death of past employees at CRNL and

WNRE who are known to have died during employment or while on pension. This sub-group contains some 500 names.

5.5 FUTURE EMPLOYEES

A cohort designed in the way described will not be extinct for a long period of time, perhaps more than 50 years. Nonetheless, it will be possible to make increasingly valid assessments of mortality as the data accumulate. There are some disadvantages in the concept of an 'open-ended' cohort and, for this reason, it has been decided, in conjunction with NCIC, that the names of future (i.e., post-1980) employees will not be included initially in the cohort study. Instead, the E.I.S. forms for employees joining after 1980 will be retained at WNRE as a Health Registry of AECL Employees. The data included in these forms will be periodically entered on tape, as described in Appendix F. This approach will provide a continuing record of AECL employees and will ensure flexibility in deciding how the use of the data contained in the Registry will be related to the cohort study.

5.6 MEDICAL AND LIFESTYLE QUESTIONNAIRE

It is desirable that some background information on the participants should be available to the study. For this reason, the use of a questionnaire (Appendix J) related to medical and lifestyle histories is being considered. This questionnaire would probably be self-administered by current staff and completed by new employees at the time of the employment medical examination. All questionnaires for current staff would be distributed by personal mailing and the completed questionnaires returned in a confidential envelope to the local plant physician and retained in the personal medical file of the employee. This type of information could also be obtained for a small number of past employees.

The questionnaire would be coded for linkage to the Phase II tape and to the Registry. After names were deleted, it would be sent to the Epidemiology Unit (NCIC) for this linkage to be performed.

The problems inherent in the use of questionnaires of this type are well recognized. It is, however, important to identify factors other than radiation that may have a bearing on carcinogenesis in the population being studied. The role played by occupational carcinogens may be relatively small[22], but the difficulty of obtaining a precise history of occupational exposure to potential carcinogens in the diverse environment of a research establishment makes it virtually impossible to verify such a statement in the context of the present study. Nonetheless, the use of a questionnaire may produce data that will help to minimize, to some extent, the potential bias that could be introduced by concurrent exposure to chemical carcinogens and to ionising radiation.

A decision on the use of such questionnaires has yet to be made.

5.7 SECURITY

The need to ensure the confidentiality of data related to the study is an important part of the program, necessary not only to ensure fulfillment of a commitment to employees, but also to satisfy the requirements of the Provincial Registrars of Vital Statistics, who are the custodians of the basic mortality data.

Provisions are made to ensure that the work of the study is handled in such a way that names of participants will not be included in the information emerging from the linkage with the Mortality Data Base, and the eventual conclusions will be of a statistical nature only. The linkage of information, such as that which would be contained in the Medical and Lifestyle questionnaire, would be carried out using coded identification numbers.

All documents relating to participants in the study will be kept in the manner prescribed for documents such as personnel files. Access to these documents will be confined to those people individually authorised by the study coordinator or his designates.

5.8 OCCUPATIONAL EXPOSURE TO IONISING RADIATION OTHER THAN WHILE IN THE EMPLOY OF AECL

It is probable that many participants in the study will be occupationally exposed to ionizing radiation other than while in the employ of AECL. Consequently, the dosimetry information available to AECL may not, in some cases, constitute a full lifetime history of occupational exposure. It is hoped that the National Dose Registry in Ottawa will be able to collaborate with the AECL Health Study to complete, where necessary, the dosimetry data available to the study. The National Dose Registry does not, of course, contain information about individuals who are not radiation workers and who form a large part of the AECL study population.

6. ADMINISTRATION AND ADMINISTRATIVE PROBLEMS

The administrative sequence that was followed may be of interest to those involved with the setting up of similar programs.

The formation of a Steering Committee (Appendix A), in January 1980, brought together those who had helped to design the study. The actions listed below were subsequently taken.

1. Formal approval of the study by Atomic Energy of Canada Research Company in March 1980.

2. Finalisation of design and preparation of French language versions of the E.I.S. and Consent forms.

3. Identification at each site of personnel office contacts to whom the E.I.S. forms would be sent for distribution at the various sites (Appendix K).

4. Preparation of an adminstrative instruction (Appendix L) to inform site personnel staff of the methods for handling the form.

5. Preparation and approval of a General Notice (Appendix M) to be distributed at all sites.

6. Preparation of Data Entry Instructions for the transfer of data from E.I.S. forms (Appendix F).

7. Discussion of collaborative agreement with staff of the Epidemiology Unit, National Cancer Institute of Canada.

8. Entry to E.I.S. forms of data from the personnel files of past employees at CRNL and WNRE, and preparation of magnetic tape (WNRE).

9. Distribution to all sites and completion of E.I.S. and Consent forms (current employees) for return to WNRE.

10. Preparation of magnetic tape for current employees (WNRE).

The issue of the General Notice to all sites in April 1980 marked the formal commencement of the Study. This action had been preceded by visits by two members of the Steering Committee, to all of the major sites, to explain to employees why the program was being undertaken and how it would be put into effect.

During the summer of 1980, the distribution, completion and collection of E.I.S. forms continued and the major task of data gathering was well established. The number of problems encountered in reaching this stage has been few, but it may be interesting to review them.

In terms of number of employees, AECL is not a large organisation. It is, however, spread widely across Canada and although at first this posed no problem, communication became more difficult as the number

of people involved grew larger and the tasks encountered became practical rather than conceptual. The formation of a Steering Committee in January 1980 was of immediate assistance in resolving this problem, and such a committee could usefully have been established a year earlier than it was.

The Committee, as it is now constituted, deals with both technical and adminstrative aspects of the Health Study. In retrospect, it is clear that the existence of a separate adminstrative sub-committee would have resulted in better communication with site personnel staff and a speedier turn-around of E.I.S. forms.

Although AECL is not bound by the specific legislation that safeguards personal information in Canada, it was decided that, as a matter of courtesy, all current employees should be asked to consent to use of their personal data for the purpose of the study. This approach appears to have caused some concern and, although in the long run, fewer than 10% of employees refused their consent, it is clear that the study aroused some misgivings. It is perhaps curious that this should have been so, for many groups of employees were strongly supportive of the program. However, mistrust of computerised systems is widespread and the information given out at site meetings and in the General Notice did not diffuse sufficiently far through the employee structure to allay this mistrust. Faced with a similar situation in the future, it would, as a minimum, be advisable to increase by a factor of two the amount of time spent talking to employees about the program, to ensure personal mailings of all E.I.S. forms and to enclose a brief, individually addressed, information sheet with each E.I.S. form.

7. SUMMARY AND CONCLUSIONS

This report has summarised the present status of the AECL Health Study and is a description of the steps by which the present position has been reached. Included in the appendices are documents that may be of interest to those engaged in the preparation of similar programs.

During the design phase, which is now drawing to its close, there has been a shift in the emphasis of the study. What was originally proposed as a study of mortality in a population of radiation workers, and related specifically to radiation exposure, has now been extended to become a study of mortality data for all AECL employees, whether or not they are classifed as "atomic radiation workers". The interest in mortality as a function of occupational radiation exposure remains, but it is recognised that the data available to the study will probably be inadequate for the definition of a dose-effect relationship. Nevertheless, the availability of the mortality data to be produced by the study is, in conjunction with information derived from similar studies, fundamental to the eventual resolution of the low dose-effect problem. In this context, the importance of cancer incidence as opposed to mortality is recognised, and the possibility of linking the AECL data to that contained in the National Cancer Incidence Reporting System is being followed up.

With design nearing completion and the gathering of data well established, the study now moves into a new phase during which the data will be prepared for linkage with the Mortality Data Base, and the information derived from the linkage will be analysed. The form of analysis has not been referred to in this document and will be the subject of a separate report. Its formulation and implementation will mark the commencement of the third and longest phase of the study. During this period, extending over many years, the accumulating data will be the

subject of periodic reports, but it is anticipated that only towards the end of the period of analysis will the data be sufficient to justify conclusions as to the mortality experience of the AECL cohort relative to that of the general population.

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Department of Preventative Medicine and Biostatistics - University of Toronto

Eldorado Nuclear Limited - Ottawa

The International Agency for Research on Cancer - Lyon, France

The International Atomic Energy Agency - Vienna, Austria

The Laboratory Centre for Disease Control - Ottawa

National Cancer Institute of Canada (Epidemiology Unit) - Toronto

The National Dose Registry - Ottawa

The National Radiation Protection Board - Harwell, U.K.

Dr. H.B. Newcombe - AECL (retired)

Ontario Hydro - Toronto

Statistics Canada - Ottawa

Dr. C.G. Stewart - AECL (retired)

In addition, I express my appreciation of the large amount of work contributed to the study by my colleagues in many departments of AECL. Without their efforts the program would not have come into being.

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APPENDIX A

HEALTH STUDY STEERING COMMITTEE

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(L. Johnston, Secretary to J.L. Weeks, provides liaison with site representatives)

APPENDIX B

ATOMIC ENERGY CONTROL ACT.
REGULATIONS: DEFINITION OF AN "ATOMIC RADIATION WORKER"

Registration SOR/78-53, 16 January 1978
Atomic Energy Control Act
Atomic Energy Control Regulations, Amendment
P.C. 1978-10, 12 January 1978

In these Regulations "atomic radiation worker" means

(a) any person who, in the course of his work, business or occupation, is likely to receive a dose of ionising radiation in excess of any dose specified in column IV of Table 1 to Schedule II (attached) or an exposure to radon daughters in excess of an exposure specified in column II of Table 2 to Schedule II and

(b) any person specified as an atomic radiation worker pursuant to subsection 17(4) (of the Regulations) which reads:

17(4) The Board may specify in writing any person as an atomic radiation worker who in the course of his work, business or occupation is likely to receive a dose of ionising radiation in excess of any dose specified in Schedule II for persons other than atomic radiation workers.

17. Schedule II to the said Regulations is revoked and the following substituted therefor:

17. L'annexe II est ainsi remplacée:

SCHEDULE II

Maximum Permissible Doses and Exposures (1,2)

Table 1

Maximum Permissible Doses (3)

Column I	Column II Atomic Radiation Workers		Column III Female Atomic Radiation Workers of Reproductive Capacity		Column IV Any Other Person
	Rems per Quarter of a year	Rems per year	Rems per quarter of a year	Rems per year	Rems per year
Whole body, gonads, bone marrow	3	5	1.3(4)	5(4)	0.5
Bone, skin, thyroid	15	30	15	30	3(5)
Any tissue of hands, forearms, feet and ankles	38	75	38	75	7.5
Lungs (6) and other single organs or tissues	8	15	8	15	1.5

ANNEXE II

Doses et expositions maximales admissibles (1,2)

Tableau 1

Doses (3)

Collone I	Colonne II Travailleurs sous rayonnements		Colonne III Femmes affectées à des travaux sous rayonnements et en état de procréer		Colonne IV Toutes autres personnes
	Rems par trimestre	Rems par année	Rems par trimestre	Rems par année	Rems par année
Tout le corps, gonades, moëlle des os	3	5	1.3(4)	5(4)	0.5
Os, peau, thyroïde	15	30	15	30	3(5)
Tout tissu des mains, avant-bras, pieds et chevilles	38	75	38	75	7.5
Poumons (6) et autres organes ou tissu pris isolèment	8	15	8	15	1.5

25/1/78 Canada Gazette Part II, Vol. 112, No. 2 | Gazette du Canada Partie II, Vol. 112 No. 2 SOR/DORS/78-58

Table 2

Maximum Permissible Exposures to Radon Daughters (6)

Column I Atomic Radiation Workers		Column II Any Other Person
WLM per quarter of a year	WLM per year	WLM per year (7)
2	4	0.4

Tableau 2

Exposition aux produits de filiation du radon (6)

Colonne I Travailleurs sous rayonnements		Colonne II Toutes autres personnes
WLM par trimestre	WLM par année	WLM per année (7)
2	4	0.4

NOTES TO SCHEDULE II

(1) The maximum permissible doses and exposures specified in this Table do not apply to ionizing radiation

a) received by a patient in the course of medical diagnosis or treatment by a qualified medical practitioner, or

b) received by a person carrying out emergency procedures undertaken to avert danger to human life.

(2) The Board may, under extraordinary circumstances, permit single or accumulated doses or exposures up to twice the annual maximum permissible doses or exposures for atomic radiation workers. Such variance will not be granted

a) if appropriate alternatives are available

b) for irradiation of the whole body or abdomen of women of reproductive capacity or

c) for irradiation of the whole body, gonads or bone marrow if the average dose received from age 18 years up to and including the current year exceeds 5 rems per year.

(3) In determining the dose, the contribution from sources of ionizing radiation both inside and outside the body shall be included.

(4) The dose to the abdomen shall not exceed 0.2 rem per two weeks, and if the person is known to be pregnant, the dose to the abdomen shall not exceed 1 rem during the remaining period of pregnancy.

NOTES À L'ANNEXE II

(1) Les doses et les expositions maximales admissibles iniquées dans ce tableau ne s'appliquent pas aux rayonnements ionisants

a) recus par un patient lors d'un examen médical ou de soins donnés par un médecin compétent ou

b) recus par une personne exécutant des mesures d'urgence pour prévenir un danger pour la vie humaine.

(2) La Commission peut, en des circonstances exceptionnelles, permettre qu'une dose ou une exposition atteigne le double du taux admissible par année pour les travailleurs sous rayonnements. Cette dérogation n'est pas accordée

a) s'il existe d'autres solutions

b) pour l'irradiation de tout le corps ou de l'abdomen de femmes fécondes ou

c) pour l'irradiation de tout le corps, des gonades ou de la moëlle des os, si la dose moyenne recue depuis l'âge de 18 ans, jusqu'à et compromis l'année en cours, dépasse 5 rems par année.

(3) En déterminant cette dose, il faut tenir compte de l'apport des sources de rayonnements ionisants tant a l'intérieur qu'à l'extérieur du corps.

(4) La dose recue au niveau de l'abdomen ne peut dépasser 0.2 rem par période de deux semaines, toutefois, pour les femmes enceintes, cette dose ne peut dépasser 1 rem du moment de la connaissance de leur état jusqu'au terme de leur grossesse.

(5) The dose to the thyroid of a person under the age of 16 years shall not exceed 1.5 rems per year.

(6) For exposures to radon daughters, the maximum permissible exposures (in working level months) apply instead of the maximum permissible doses for the lungs (in rems).

(7) The WLM unit is not appropriate for exposures in the home or in other non-occupational situations. In such situations, the maximum permissible annual average concentration of radon daughters attibutable to the operation of a nuclear facility shall be 0.02 WL.

(5) La dose recue au niveau de la thyroïde d'une personne âgée de moins de 16 ans ne peut dépasser 1.5 rem par année.

(6) Le taux d'exposition de poumons aux produits de filiation du radon est calculé selon l'exposition maximale admissible (calculée en WLM) plutôt que selon les doses maximales admissibles (calculées en rems).

(7) Le tableau 2 ne s'applique pas aux expositions au foyer ou à l'extérieur du lieu du travail. Afin de limiter l'exposition qui pourrait exister, il faut se baser sur la concentration moyenne annuelle maximale de produits de filiation du radon attribuable à un etablissement nucléaire. Cette concentration est alors d'au plus 0.02 WL.

APPENDIX C

EPIDEMIOLOGICAL STUDIES OF RADIATION WORKERS IN CANADA (1980)

AGENCY	STUDY	COORDINATORS
Ontario Hydro	Mortality Study	Dr. T. Hamilton Ontario Hydro 700 University Avenue TORONTO, Ontario M5G 1Z5
Eldorado Nuclear Limited	Health Follow-up of Eldorado Uranium Workers	Dr. J. Abbatt Eldorado Nuclear Limited Suite 400 255 Albert Street OTTAWA, Ontario K1P 6A9
Province of Ontario	Study of the Health of Miners	Dr. J. Muller Ministry of Labour Occupational Health and Safety Division Special Studies and Services Branch 8th Floor 400 University Avenue TORONTO, Ontario M7A 1T7
St. Lawrence, Newfoundland	Fluorospar Miners Study	Dr. D. Wigle Laboratory Centre for Disease Control Room 230A Health and Welfare Canada Tunney's Pasture OTTAWA, Ontario K1A 0L2
Atomic Energy of Canada Limited	AECL Employee Health Study	Dr. J.L. Weeks Atomic Energy of Canada Limited Whiteshell Nuclear Research Establishment PINAWA, Manitoba ROE 1LO Dr. D.K. Myers Atomic Energy of Canada Limited Chalk River Nuclear Laboratories CHALK RIVER, Ontario K0J 1J0
National Dose Registry	Records of Life-time Occupational Radiation Exposure	Dr. E. Letourneau Radiation Protection Division Health and Welfare Canada Brookfield Road OTTAWA, Ontario K1A 1C1

APPENDIX D

EMPLOYMENT IDENTITY SUMMARY FORM FOR PAST EMPLOYEES

CRNL-3150 (Rev. 11/79)

EMPLOYEE IDENTITY SUMMARY

RESTRICTED STAFF INFORMATION

SITE ..... DATE .....

PLEASE PRINT

1. Surname	
2. Any other surname(s) you may have had	
3. First given name	
4. Second given name	
5. Third given name (if any)	
6. Usual name or nickname	
7. Sex	☐ Male ☐ Female
8. Marital status	
9. Birth date	Year / Month (spell out) / Day
10. Birth country	
11. Birth place	Village/Town/City / County / Province
12. Father's surname	
13. Father's first name	
14. Father's second name	
15. Father's birth place	Province / Country
16. Mother's maiden surname	
17. Mother's first name	
18. Mother's second name	
19. Mother's birth place	Province / Country
20. Spouse's birth surname	
21. Spouse's first name	
22. Spouse's second name	

FOR OFFICE USE ONLY

23. Badge Number	
24. Employee Number	
25. Social Insurance Number	
26. Provincial Health Insurance Number	Province / Number
27. Superannuation Number	
28. Starting date	Year / Month (spell out) / Day
29. Termination date	Year / Month (spell out) / Day
30. Date of death	Year / Month (spell out) / Day
31. Place of death	City / Province / Country
32. Last known year alive	

APPENDIX E

EMPLOYMENT IDENTITY SUMMARY FORM FOR PRESENT AND FUTURE EMPLOYEES

Atomic Energy of Canada Limited

EMPLOYEE IDENTITY SUMMARY

(ORIGINAL)

RESTRICTED STAFF INFORMATION

SITE -

The following information is required in the interest of Atomic Energy of Canada Limited employees for a health study to help insure that our safety standards are soundly derived.

	PLEASE PRINT
1. SURNAME	
2. ANY OTHER SURNAME(S) YOU MAY HAVE HAD	
3. FIRST GIVEN NAME	
4. SECOND GIVEN NAME	
5. THIRD GIVEN NAME	
6. USUAL NAME OR NICKNAME	
7. SEX	☐ MALE ☐ FEMALE
8. MARITAL STATUS	☐ -SINGLE/WIDOW/WIDOWER ☐ -MARRIED ☐ -OTHER
9. BIRTH DATE	YEAR MONTH (Spell Out) DAY
10. BIRTH PLACE	CITY OR PLACE PROV (or country if not Canada)
11. FATHER'S SURNAME	
12. FATHER'S FIRST NAME	
13. FATHER'S SECOND NAME	
14. FATHER'S BIRTH PLACE	*PROVINCE (or country if not Canada)*
15. MOTHER'S MAIDEN NAME	
16. MOTHER'S FIRST NAME	
17. MOTHER'S SECOND NAME	
18. MOTHER'S BIRTH PLACE	PROVINCE (or country if not Canada)
19. SPOUSE'S BIRTH SURNAME	
20. SPOUSE'S FIRST NAME	
21. SPOUSE'S SECOND NAME	
22. EMPLOYEE NUMBER	
23. SOCIAL INSURANCE NUMBER	
24. PROVINCIAL HEALTH INSURANCE NUMBER	PROVINCE NUMBER
25. SUPERANNUATION NUMBER	
26. STARTING DATE	YEAR MONTH (Spell Out) DAY
27. EMPLOYEE'S ADDRESS	CITY OR PLACE PROV (or country if not Canada)

DIVISION -
BRANCH -

DATE _____ (YEAR / MONTH / DAY) **SIGNATURE** _____

APPENDIX F

DATA ENTRY INSTRUCTIONS

It should be noted that the birth-place coding shown in Appendix F is taken directly from that incorporated in the Mortality Data Base of Statistics Canada because of the need to link the Statistics Canada data base and the AECL Health Study data base.

The Statistics Canada coding system, naturally enough, allows for both how things were, geopolitically, as well as how they are now.

RADIATION HEALTH STUDY

EMPLOYEE IDENTITY SUMMARY

DATA ENTRY INSTRUCTIONS

I Form Handling

A. Data Entry for all past employees of CRNL and WNRE will be undertaken at CRNL under the direction of Dr. D.K. Myers.

B. Data Entry for all 'current' AECL employees and for those who join AECL in the future will be undertaken at WNRE. E.I.S. forms for all such employees when completed at sites will therefore be sent to Dr. J.L. Weeks at WNRE for processing. This applies both to the E.I.S. forms for those who have consented to participate in the study and also to the E.I.S. forms for those employees who have not so consented.

II Field Encoding

Before the employee updates can be entered into the computer, there is some encoding that must be done. A line-by-line description follows, with a list of Province and Country codes, and rules for spelling place names.

Field Encoding Rules

1 Surname

Do not enter special characters or intervening blanks.

e.g.	O'Neill	ONeill
	La France	LaFrance
	Smith-Jones	SMITHJONES

In the case of double barrelled surnames, enter the complete name, as in the example, and the separate components, e.g. Smith and Jones, under "Other" surnames.

2 Other Surnames

See 1

3-5 Given Names

See 1

For double-barrelled given names, e.g. Jean-Paul, enter as two separate given names, Jean and Paul

6 Usual Name

See 1

7 Sex

M or F

8 Marital Status

S Single/Widow/Widower
M Married
O Other

9 Birth Date

Enter an eight digit date in the format CCYYMMDD*

10 Birth Place (City or Place) See Attached Rules

Birth Place (Province or Country)
See attached list
Enter two digit code

11 Father's Surname

See 1

12 Father's First Name

See 1

13 Father's Second Name

See 1

14 Father's Birthplace

See Attached List

* CC = century of birth, 19, 20

15 Mother's Maiden Name

See 1

16 Mother's First Name

See 1

17 Mother's Second Name

See 1

18 *Mother's Birth Place* (Province or Country)

See Attached List

19 Spouse's Birth Surname

See 1

20 Spouse's First Name

See 1

21 Spouse's Second Name

See 1

22 Employee Number

Enter the four digit employee number e.g. 9304

23 Social Insurance Number

Enter a nine digit number, with no dashes

24 Provincial Health Insurance Number

Enter a two digit province code (See Attached) plus
a nine digit hospital number (Left Zeroed.

25 Superannuation Number

Enter a six digit date in the format YYMMDD.

26 Starting Date

Enter a six digit date in the format YYMMDD.

27 Employee's Address

(City or Place) See Attached Rules
(Province or Country) See attached list, enter two-digit code.

CODE	BIRTHPLACE
	Canada
01	Prince Edward Island
02	Nova Scotia
03	New Brunswick
04	Quebec
05	Ontario
06	Manitoba
07	Saskatchewan
08	Alberta
09	British Columbia
10	Yukon
11	Northwest Territories
12	Newfoundland
17	Canada - Province no stated
18	Other British Possessions in America
	British Isles
21	England
22	Northern Ireland
23	Irish Free State
24	Scotland
25	Wales
26	Lesser Isles
	British Possessions
31	Australia and Mandates
32	New Zealand and Mandates
33	South and South West Africa
34	Other British Possessions - Africa
35	India
36	Other British Posssessions in Asia
37	Other British Possessions
	American Countries
41	United States of America
42	Mexico
43	Other North American Countries
44	Central American Countries
45	South American Countries

CODE	BIRTHPLACE
	EUROPEAN COUNTRIES
51	Albania
52	Austria
53	Belgium
54	Bulgaria
55	Czechoslovakia
56	Denmark
57	Estonia
58	Finland
59	France
60	Germany
61	Greece
62	Holland (Netherlands)
63	Hungary
64	Iceland
65	Italy
66	Latvia
67	Lithuania
68	Norway
69	Poland
70	Portugal
71	Roumania
72	Spain
73	Sweden
74	Switzerland
75	Yugoslavia
76	Other European
77	Union of Soviet Socialist Republics (USSR)
	Asiatic Countries
82	China
83	Japan
84	Syria
85	Turkey
86	Other Asiatic
	Africa, Other Countries, etc.
91	African Countries (Not British)
93	Other Countries
96	Palestine, Israel
98	At Sea
	Birthplace not stated

II Field Encoding

Place Name Rules

When entering city or place names use the abbreviations for two-word names.

ST	Saint
STE	Sainte
N	North
S	South
E	East
W	West
O	Ouest
ND	Notre Dame
FT	Fort
PT	Port
GR	Grand
T	Township

For instance: Notre Dame de Prescott will be entered as ND De Prescott

III Using EISUPD

Dial into the Chalk River CDC computer as normally done for CPRS updates.

ENTER PROC,EISUPD, "PASSWORD"

The system will respond "EISUPD READY". Enter each line being changed as prompted. With the exception of surname and employee number which must always be entered, key in only data that must be updated. Press carriage return after each line.

To exit EISUPD, enter a blank surname, i.e. carriage return. This will cause the updates to be copied to a disk file, and a proof listing generated.

When all the EIS forms have been entered, notify Dr. J.L. Weeks at WNRE.

NOTE: The magnetic tape when produced should include spaces for the following information for each individual entry recorded.

i The unique EIS form number, a unique 5-digit number which appears on the top right hand corner of the EIS form.

ii AECL site
iii Provision for inclusion of radiation dose
iv Provision for the inclusion of data related to non-AECL personnel involved in CRNL clean-ups in 1952 and 1958.

APPENDIX G

RADIATION EXPOSURE RECORDS IN AECL

G.1. EXTERNAL RADIATION

G. Cowper, Chalk River Nuclear Laboratories

G.1.1 DOSE LIMITS FOR RADIATION WORKERS*

During the period from the beginning of atomic energy research in Canada until the present time, the dose limits for radiation workers have been as follows:

1. Until 1949

   1. Exposure of the whole body, blood-forming organs, eyes, gonads - 100 mrem/working day

   - This limit, which was established in the 1930's in North America as 0.1 R per working day, corresponded to a European limit of 0.2 R per working day. However, the doses incurred in meeting these limits were, in effect, about the same since the American limit was based on measurements of exposure made in free air whereas the European limit was based on measurements made at the surface of a body in the radiation field. Since, with the principal radiation sources of those days

---

* With the evolution of radiation dosimetry, the quantities and units have changed during the period of review. For convenience, in these notes, radiation exposures will be expressed as the quantity known as dose equivalent and the unit is the rem. With the introduction of the International System of Units (SI), the unit for dose equivalent for future use will be the sievert (Sv). In the case of radiation exposure from X-rays, γ-rays and fast electrons the following are to be accepted as equivalent:

1 R (exposure) = 1 rad (absorbed dose) = 1 rem (dose equivalent) = 0.01 Sv (dose equivalent) = 0.01 $J \cdot kg^{-1}$.

(250 kV X-rays) there was substantial backscattering, the actual doses received under both jurisdictions were similar.

2. From 1949-1956

1.	Exposure of the whole body, blood-forming organs, gonads and lenses of the eyes	- 300 mrem/week
2.	Skin (in the basal layer of the epidermis in a significant area)	- 600 mrem/week
3.	Extremities (hands and forearms, feet and ankles)	- 1.5 rem/week

- These dose limits introduced a distinction between dose to the surface of the body and dose to the whole body, which contained particular critical organs, and reflected the substantial change which had taken place in the preceding years concerning the availability of high-energy sources. In effect, the earlier limit of 0.1 R/working day applied to low-voltage X-ray exposure corresponded to a surface dose of about 600 mrem/week and a penetrating, or mid-line, dose of appreciably less than this. The 1949 recommendations only provided a numerical reflection of the changing circumstances of radiation work.

- The special dose limits to the extremities were a reflection of the reality that some radiation work could be carried out, in effect, at arm's length thereby involving tissues where the risks of radiation exposure were substantially less than if the whole body had been uniformly exposed.

3. From 1956* - Present Time**

1. Exposure of the whole body, blood-forming organs, gonads, and lenses of the eyes.

   - Maximum accumulated dose, D = 5(N-18)
     where D is the dose in rems, N is age in years
   - Maximum rate of dose accumulation not to exceed 3 rems in 13 consecutive weeks.

2. Skin

   - Maximum dose not to exceed 8 rems in 13 consecutive weeks
   - Annual limit for 50-week year = 30 rems

3. Extremities (hands and forearms, feet and ankles)

   - Maximum dose not to exceed 20 rems in 13 weeks
   - Annual limit for 50-week year = 75 rems

- These dose limits were both more restrictive and more liberal than those they replaced. Weekly dose limits were discarded and thus the change allowed special radiation work to be carried out occasionally without exceeding the limits, i.e., a 13-week dose limit.

- The accumulated whole body dose limit was reduced to an average dose rate of 100 mrem/week, a factor of three smaller, but the age-dependent formula permitted exposure to continue at essentially the same rate as before (3000/13 mrem vs. 300 mrem) provided the age and previous radiation history of the worker

---

* The new dose limits were adopted by the International Commission on Radiological Protection (ICRP) in September 1958 but, in anticipation of this change, most organizations brought the new limits into practice at an earlier date.

** In 1977 the ICRP further modified its recommendations. The changes, which were not substantial (and which will be noted later), have not yet come into use in Canada.

allowed it. In fact, since the adoption of these dose limits in AECL, the relaxations provided by the age formula have never been used.

4. The 1977 Recommendations of ICRP

1.	Exposure of the whole body	- 5 rem/a
2.	Exposure of all tissues except the eye lens	- 50 rem/a
3.	Eye lens*	- 30 rem/a

- For application of external radiation exposure, the principal change in the 1977 Recommendations was the elimination of limits within a year of rates of dose accumulation and the removal of the special allowance for body extremities. The 1977 Recommendation for dose limit to the eye lens, since changed*, represented a substantial increase over the previous dose limit.

- The flexibility introduced by the quarterly dose limits in the 1958 ICRP recommendations and by the elimination of rate of accumulation factors in the 1977 Recommendations has not been used indiscriminately. Within AECL administrative dose limits of 600 mrem in two weeks for whole body exposures and 1600 mrem for skin exposure are established and are the criteria upon which the need to institute a formal investigation of the circumstances of the exposure is judged.

G.1.2 RADIATION MONITORING METHODS

An accounting of the radiation exposure history of workers to external radiation exposure is based upon the doses received by an individual dosimeter worn by each worker on the trunk of the body. The characteristics of the dosimeters that have been used in AECL are as follows.

---

* In 1980 the ICRP further modified the dose limit to the lens of the eye to 15 rem/a.

1. Up to 1963

A single-dosimeter film package containing two films of high and low sensitivity held in an identity badge with 50% of the film package covered with 0.38 mm cadmium.

Minimum detectable dose:

∿ 20 mrem hard gamma-ray radiation
Extreme energy dependence amounting to seven-fold overestimation of low-energy (70 kV) X-ray exposures

No capability for detection of skin dose from beta emitters

- The energy-dependence characteristic resulted from the use of a metal filter having insufficient thickness, which had been chosen to give optimum sensitivity for detection of exposures from thermal neutrons.

- From 1960, workers who were known to receive larger radiation exposures were provided with a modified dosimeter containing a 1-mm thick cadmium filter. This modification provided temporary relief from the problems resulting from overestimation of radiation exposures.

- Film dosimeters were replaced and processed every week until 1958, thereafter every two weeks.

2. 1964-1973

A single-dosimeter package containing initially two films as before and later a single film with emulsions of different sensitivity on opposite faces (Kodak Type II), held in a moulded plastic case with a multiplicity of filters: 2 mm aluminum, open window, 1 mm tin, 1 mm cadmium, 0.62 mm lead.

Minimum detectable doses:

γ 20 mrem

β 50 mrem

Thermal neutrons $\sim$ 10 mrem

3. 1973-1977

A dosimeter plaque holding two thermoluminescent dosimeter (TLD) chips. One chip (0.87 mm thick) was located behind an aluminum filter and one chip (0.38 mm thick) was located behind an open window in the existing film-dosimeter plastic case. The reading obtained from the thick chip was recorded as whole body penetrating radiation dose; the reading from the thin chip was recorded as the total body surface radiation dose.

Minimum detectable doses:

Penetrating radiation from thick chip	1 mrem
Surface radiation from thin chip	60 mrem

(For surface doses < 60 mrem, the recorded surface dose was that measured by the thick chip.)

The TLD mounting plaque contained, in punch-code form, the identification of the wearer, thus permitting processing in an automatic reader.

4. 1977-1980

The adapted film-badge holder used for TLD dosimeters was found to admit thermoluminescent dust, which could produce spurious high-dose readings. To overcome this difficulty, a new holder was developed which is dustproof and contains an "open window" sealed with 7 mg/cm^2 black plastic and an aluminum filter (2 mm thick), corresponding to the dosimeter chip positions, to provide whole body penetrating and surface dose information.

G.1.3 METHODS OF DATA STORAGE AND REPORTING

Prior to 1960 dosimeter data were entered by hand in "Kardex" file cards and running totals were accumulated. Overexposures, i.e., above 300 mrem in one week, were reported to supervisors and individuals by letter. From 1956 reports of exposures exceeding 100 mrem per week were also reported to encourage workers to keep within the prorated limit of 5 rem/a.

From 1960, data were also entered into a simple machine-accounting system using IBM cards and, henceforth, all exposures exceeding 20 mrem per monitoring period (now two weeks) were reported to individuals and supervisors. The "Kardex" system was retained for ready access to answer follow-up inquiries, etc. The machine-accounting system was used primarily to provide running reports and to allow analyses of group patterns to be made, showing distributions of radiation exposures throughout the work force. Following the introduction of the automatic TLD monitoring system, the Kardex file system was retired and detailed reports of exposure records are now obtained directly from the computer.

G.1.4 RECOVERY OF LOST RADIATION DATA

In 1956 a fire destroyed the building containing all the radiation dose records. Subsequently, an attempt was made to recover some of these lost records from notices of overexposures during the period December 1952 to June 1954 (during the rebuilding of the NRX reactor), as obtained from the files of the recipient branches. The data recovered were not complete, but are believed to include the significant exposures received during a period when the greatest exposure to radiation had occurred at the Chalk River Nuclear Laboratories (CRNL).

Because of this loss of data, it is not possible to obtain an accurate statement of the entire collective dose of AECL employees since the beginning of operations at Chalk River. Even if such an accounting

were possible, it would have limited value since, for reasons noted earlier, the dosimeters generally used until 1962 were capable of seriously overestimating radiation doses and, until the introduction of TL dosimeters in 1973, the very smallest doses (less than 20 mrem per week until 1958 and less than 20 mrem in two weeks) were undetectable with the film dosimetry method used.

G.1.5 COLLECTIVE WHOLE BODY RADIATION DOSE

The collective whole body radiation doses for AECL employees from 1959 to 1978 are listed below.

1959	2010 rem	1966	928 rem	1973	1014 rem
1960	1527 rem	1967	1008 rem	1974	1122 rem
1961	1363 rem	1968	876 rem	1975	1098 rem
1962	1278 rem	1969	895 rem	1976	1158 rem
1963	1136 rem	1970	1471 rem	1977	1264 rem
1964	952 rem	1971	1178 rem	1978	1333 rem
1965	888 rem	1972	1341 rem		

- The decrease in collective dose in 1964 corresponds to the introduction of the improved film badge for all workers, and the reduction from 1959-61 reflects improvements made to the dosimeters of the most exposed workers.

- The high value for 1970 is connected with additional radiation work associated with the replacement of the NRX reactor vessel and special work carried out at nuclear power stations by AECL workers.

- The introduction of TLD in 1973 does not show a significant effect upon collective dose. The reduction in dose readings due to improved energy dependence is balanced by the increased capability to measure very small doses.

G.1.6 IDENTIFICATION OF INDIVIDUAL WORKERS

For convenience in the operation of the dosimetry service, employees are identified on a day-to-day basis by the serial number of the dosimeter issued to them. In the event of the retirement of an employee, this number will eventually be reissued to a new employee so that for permanent identification of workers, both past and present, use is also made of the nine-digit ~~Social~~ Insurance Number. The computer file contains both these identification codes for every worker so that unique identification of all radiation workers will always be achievable.

G.2. INTERNAL RADIATION

J.R. Johnson, Chalk River Nuclear Laboratories

G.2.1 BIOASSAY

The records of bioassay measurements made at CRNL go back to 1949, and by 1951 routine measurements of "plutonium" and "β fission products" were being performed. ("Plutonium" was actually total alpha-emitting actinides and "β fission products" would include the alkaline earths and the lanthanides.) Sporadic tests for such radionuclides as ^{60}Co, ^{106}Ru and ^{131}I were done in the early fifties, but it wasn't until 1958 that these "gamma emitters" were measured routinely. Tritium measurements were also done sporadically in the early fifties, and fairly routinely by 1956. Doses from tritium were calculated and added to the external dose estimates from 1963 onwards.

Records of the above-mentioned measurements are in three forms. First are the Bioassay Laboratory work-books, which are archived in fire-proof safes in the basement of Building 513. These books contain data such as size of sample, counting time, etc. Next are the "bioassay cards", which contain the results of the measurements. These form the

most accessible records as there is at least one card per individual. These cards are kept in the Bioassay Laboratory Office, Building 464. Last are copies of the reports to supervision on the results of the measurements. These are also archived in the fire-proof safes in Building 513. The Biomedical Research Branch also has records of lifetime tritium doses, many of them in computer-readable form.

G.2.2 IN-VIVO MONITORING

The first in-vivo monitors at CRNL were set up in the "Townsite Lab" by the (now) Health Physics Branch and were operational by late 1958. In 1961 the entire in-vivo monitoring program became the responsibility of the Medical Division. Monitoring during the period 1958 to 1972 was done only after known incidences, and routine monitoring was not instituted until 1972. From 1972 to 1975 routine whole body monitoring was done with a "shadow shield" monitor in Building 600, and from 1961-1975, non-routine thyroid monitoring was done in Building 464, by the Bioassay Laboratory. In 1975, the Low Background Building (Building 560) was completed, and since that time all in-vivo monitoring, which includes (since 1975) "lung" monitoring, has been done there.

Records of all in-vivo monitoring, except the thyroid monitoring done in Building 464, are retained in Building 560. The thyroid monitoring results are recorded on the bioassay cards kept by the Bioassay Laboratory. From 1972, the results of whole body monitoring have been summarized and reported approximately monthly.

In addition to the tritium doses mentioned, there have been occasional instances of significant doses from other internal contaminants. These incidents have been recorded in "Radiation Exposure Results", filed with the Health Sciences Division (CRNL).

In the near future it is planned that all monitoring results will be computerized. Past records will not be incorporated into the

computer file, but a code appended to an individual entry will indicate whether records of previous exposure exist.

G.3 EXTERNAL CONTAMINATION

J.R. Johnson, Chalk River Nuclear Laboratories

When a contamination of the external surface of the body by radioactive materials has resulted in a radiation exposure exceeding local control levels, this fact has been recorded in the diaries maintained by the Radiation and Industrial Safety Branch. If the persistence of contamination entailed referral to the Plant Clinic, the Bioassay Laboratory or the in-vivo monitoring unit, individual records would be maintained by these groups. These records could not be integrated as a whole into the Health Study, but would be useful in the construction of individual work histories.

The custody of personnel contamination data at WNRE is similar to that described for CRNL.

APPENDIX H

STATISTICS CANADA - MORTALITY DATA BASE

The Mortality Data Base (MDB) maintained by Statistics Canada contains information on the causes of all notified deaths occurring in Canada since 1950. As such, it provides the epidemiologist with an unusually effective instrument. The AECL Health Study has been designed with the potentialities of the Mortality Data Base in mind and, in particular, the Employee Identity Summary (E.I.S.) form contains information which will permit accurate linkage with the data base.

While the Mortality Data Base is the repository of a vast amount of information on the causes of death in Canada, access to this information for epidemiological purposes is subject to the severe constraints imposed by the Statistics Act of 1918 and by subsequent legislation. While this legislation is at times frustrating to the would-be epidemiologist, it fulfills its purpose in maintaining that degree of individual confidentiality without which Statistics Canada would be unable to perform its tasks effectively.

The original Statistics Act of 1918 remained unchanged for more than 50 years until, in 1971, it was amended to permit (among other things) the agency to make available to users unidentifiable individual person data. It is this provision that makes possible undertakings such as the AECL Employee Health Study. However, within the less restrictive structure of current legislation, it is still necessary to appreciate that the output of any linkage operation involving the Mortality Data Base can only be of a statistical nature. Other approaches must be taken if, for example, it is necessary to identify the dependents of a person who has died of an occupationally induced cancer.

The Mortality Data Base operated by Statistics Canada is, in a well defined sense, the custodian of vital event data, which is the property of the province supplying the information. The Registrar of Vital Statistics for the province concerned may be requested to approve the use of such data for epidemiological studies.

Thus, the Mortality Data Base is an unusual, perhaps unique, instrument which is a most useful source of information on the causes of death in Canada. It is also safeguarded by stringent provisions designed to ensure the continuing confidentiality of this information and to prevent its use for inappropriate purposes.

APPENDIX I

PERSONAL INFORMATION CONSENT FORM

PERSONAL INFORMATION CONSENT FORM

Atomic Energy of Canada Limited is undertaking a long-term study of the health of its employees at all sites. This study has been described in an AECL General Notice issued by Corporate Office, dated 1980 April, a copy of which is available in your Personnel Department office. For the study to be successful, it is important that we be able to precisely identify each employee, and for this reason you are being asked to complete the attached Employee Identity Summary Form. You will note that much of the information required on the Form is information which you were previously required to provide to AECL upon commencing your employment.

For those employees who wish to participate in the study, we would ask that you check the appropriate box on the Consent Form below, complete the Employee Identity Summary and return both documents to your Personnel Department office as soon as possible.

Although AECL is not legally required to comply with the privacy rules outlined in the Canadian Human Rights Act and the Protection of Personal Information Regulations, we believe that protection should be granted to those employees who do not wish any personal information provided by them to be used for the purposes of the study. For these employees, we would ask that you check the appropriate box on the Consent Form below and return the form to the undersigned within 45 days of receipt of this notice. If no response is received from these employees within this time period, it will be assumed that they do not object to the use of their personal information already on file for the purposes of the study.

Please be reminded that none of the information collected and used in the study will be published in a form that could in any way identify any individual employee. Furthermore, all reports issued as a result of the study will be of a statistical nature only. In this way the privacy of each and every employee will be strictly preserved.

J.L. Weeks, M.D., D.I.H.
Director
Health and Safety Division
WNRE,
Pinawa, Manitoba, ROE 1LO

I, _____ consent ☐
do not consent ☐

to the use of personal information provided by me to AECL for the purposes of the study of the health of AECL employees.

Signed _____

Dated _____

FORMULE DE CONSENTEMENT RELATIVE A

L'UTILISATION DE RENSEIGNEMENTS PERSONNELS

L'EACL a décidé d'entreprendre une étude à long terme concernant la santé de ses employés dans tous les établissements de son ressort. Cette étude a été annoncée dans un avis général de l'EACL publié par le Bureau central en avril 1980. Vous pouvez vous procurer une copie de cet avis général auprès de votre service du personnel. Pour que l'étude porte des fruits, il est important que nous puissions identifier chaque employé(e) avec précision. C'est pourquoi nous vous demandons de bien vouloir remplir la formule ci-jointe qui est un sommaire d'identification. Veuillez noter qu'une grande partie des renseignements demandés dans la formule sont les mêmes que ceux fournis lorsque vous êtes entré(e) à l'EACL.

Les employés désirant participer à l'étude sont priés de cocher la case appropriée de la formule de consentement ci-dessous et de renvoyer cette formule ainsi que le sommaire d'identification dûment rempli à leur service du personnel et, ce, le plus tôt possible.

Bien que l'EACL ne soit pas juridiquement obligée de se conformer aux clauses touchant la vie privée que l'on trouve dans la Loi canadienne sur les droits de la personne et dans les règlements touchant la protection des informations personnelles, nous pensons qu'il y a lieu de protéger les employés qui ne désirent pas que les renseignements personnels fournis par eux servent aux fins de cette étude. Nous demandons donc à ces employés de cocher la case négative de la formule de consentement ci-dessous et de renvoyer cette formule au soussigné dans les 45 jours qui suivront la réception du présent avis. Si ces employés ne nous font pas connaître leur refus dans le laps de temps requis, nous considérerons qu'ils ne voient pas d'inconvénient à ce que l'on utilise les renseignements personnels déjà dans les dossiers aux fins de notre étude sur la santé des employés.

Soyez certains qu'aucun renseignement recueilli et utilisé dans cette étude ne sera publié sous une forme qui pourrait identifier la personne l'ayant fourni. De plus, tous les rapports publiés à la suite de cette étude seront exclusivement de nature statistique. De cette façon, la vie privée de chaque employé(e) sera strictement respectée.

J.L. Weeks, M.D., D.I.H.
Directeur
Division Santé et Sécurité
Établissement de Whiteshell
Pinawa, Manitoba, ROE 1LO

Je, _____ consens ☐
ne consens pas ☐

à ce que les renseignements personnels fournis par moi à l'EACL servent aux fins de l'étude sur la santé des employés de l'EACL

Signature _____

Date _____

APPENDIX J

MEDICAL AND LIFESTYLE QUESTIONNAIRE

CONFIDENTIAL

AECL EMPLOYEE HEALTH STUDY

PROPOSED DRAFT OF

Personal Medical Questionnaire

February 1981

Note: No decision has been made on the use of the draft at the time of publishing this report.

SURNAME:

GIVEN NAMES:

FIRST

SECOND

EMPLOYEE BADGE NUMBER:

LOCATION OR SITE:

CODING NUMBER
OFFICE USE ONLY

/WE WOULD LIKE TO KNOW ABOUT YOUR HEALTH AND THAT OF YOUR FAMILY/

1. We would like to ask you about some common diseases and medical conditions that you may have had during your life.

   Please look at the list below and put a ✓ mark opposite any condition that you have been diagnosed as having had. Also, please give us your approximate age when you were first diagnosed with the condition.

	Check if had	Age
1. HYPERTENSION (HIGH BLOOD PRESSURE)	☐	☐☐
2. DIABETES	☐	☐☐
3. TUBERCULOSIS	☐	☐☐
4. STOMACH ULCER	☐	☐☐
5. STROKE	☐	☐☐
6. LEUKEMIA (CANCER OF THE BLOOD)	☐	☐☐
7. THYROID PROBLEMS	☐	☐☐
8. CIRCULATORY AILMENTS	☐	☐☐
9. RHEUMATISM/ARTHRITIS	☐	☐☐
10. GALL BLADDER PROBLEMS	☐	☐☐
11. ANEMIA	☐	☐☐

12. HEART DISEASE

(If you have had heart disease, please tell us what type of heart disease you have had:

13. CANCER

(If you have had cancer, please tell us what type of cancer you have had:

2. Have any of your blood relatives ever been diagnosed with cancer? (This would include your mother, father, brothers, sisters, grandparents, aunts, uncles, cousins, etc.)

Please check the appropriate box: NO YES

If any of your blood relatives have ever been diagnosed with cancer please tell us which of your relatives this was and what type of cancer it was:

Relative	Type of Cancer

3. Please look at the list below and put a ✓ mark opposite any of the types of x-ray examinations you may have had during your life.

For each type of x-ray examination you may have had please tell us approximately how many you have had during your life.

	Check if had	Approximate Number
1. DENTAL X-RAYS	☐	☐☐☐
2. CHEST X-RAYS	☐	☐☐☐
3. SKULL X-RAYS	☐	☐☐☐
4. ABDOMEN: UPPER G.I. SERIES (BARIUM MEAL)	☐	☐☐☐
5. ABDOMEN (BARIUM ENEMA)	☐	☐☐☐
6. *ABDOMEN INTRAVENOUS* PYELOGRAM (X-RAY OF KIDNEYS)	☐	☐☐☐
7. ABDOMEN GALLBLADDER SERIES	☐	☐☐☐
8. ARMS/HANDS	☐	☐☐☐
9. LEGS/FEET	☐	☐☐☐
10. BACK/SPINE	☐	☐☐☐

4. Have you ever received radiation <u>treatment</u> for any disease? Check the appropriate box.

NO ☐ YES ☐

If you have ever received radiation <u>treatment</u> for any disease please tell us what the disease was and your age when you first were given this treatment:

Disease	Age
	☐☐
	☐☐
	☐☐

/WE WOULD LIKE TO KNOW ABOUT SOME JOBS YOU MAY HAVE WORKED AT DURING YOUR LIFE/

5. We would like to ask you about some substances that you may have come in contact with while working in some of the jobs you may have had.

Please look at the list below and put a ✓ mark opposite any substance you have been in contact with while at work. If you have had contact with the substance please tell us the type of job or jobs involved, the year you first worked in that job, and the year you last worked in that job.

	Yes	Jobs	Year Started	Year Ended
1. BENZENE	☐	1.	19	19
		2.	19	19
2. ASPHALT	☐	1.	19	19
		2.	19	19
3. CHLORINATED COMPOUNDS SUCH AS CARBON TETRACHLORIDE, CHLOROFORM	☐	1.	19	19
		2.	19	19
4. ASBESTOS	☐	1.	19	19
		2.	19	19

5. *COKE FUMES*		1.	19	19
		2.	19	19
6. HERBICIDES, FUNGICIDES, AND PESTICIDES		1.	19	19
		2.	19	19
7. *METALS AND METALLIC* COMPOUNDS SUCH AS ARSENIC OXIDES, LEAD COMPOUNDS, ZINC CHROMATE COBALT		1.	19	19
		2.	19	19
8. URANIUM (EG. MINING OR PROCESSING)		1.	19	19
		2.	19	19
9. RADIATION SUCH AS INDUSTRIAL X-RAYS		1.	19	19
		2.	19	19

/WE WOULD LIKE TO KNOW ABOUT SOME GENERAL LIFESTYLE HABITS/

Have you ever smoked cigarettes regularly? That is, have you ever smoked at least 1 cigarette per day for a period of at least six months. Please check the appropriate box:

NO ☐ YES ☐

(If you have never smoked cigarettes regularly please go on to Question 7)

At what age did you start smoking cigarettes regularly? AGE

On average how many cigarettes a day do/did you smoke. NUMBER

If you have quit smoking cigarettes, how many years has it been since you last smoked regularly? NUMBER OF YEARS

When you smoke (or smoked) cigarettes regularly, what kind of cigarettes did/do you usually smoke? Please check the appropriate box below:

Usually Filter ☐

Usually Plain ☐

About the same filter and plain ☐

When smoking cigarettes, to what extent do you/did you usually inhale? Please check the appropriate box below:

Deeply ☐

Somewhat ☐

Not At All ☐

7. Have you smoked pipes regularly? That is, have you ever smoked at least 1 pipeful per day for a period of at least six months. Please check the appropriate box. NO ☐ YES ☐

(It you have never smoked pipes regularly please go on to Question 8)

At what age did you start smoking pipes regularly? AGE

On average, how many pipefuls do you/did you smoke per day? smoked regularly in a day? NUMBER

If you have quit smoking pipes, how many years has it been since you last smoked regularly? NUMBER OF YEARS

When you smoke (or smoked) pipes regularly, to what extent do you/did you inhale? Please check the appropriate box below:

Deeply ☐

Somewhat ☐

Not At All ☐

8. Have you ever smoked cigars regularly? That is, have you ever smoked at least one cigar a day for a period of at least six months. Please check the appropriate box:

NO ☐ YES ☐

9. Have you ever consumed alcoholic beverages regularly? That is, have you ever drank beer, wine, or liquor at least once a day for a period of at least six months. Please check the appropriate box opposite.

NO ☐ YES ☐

(If you have never drank alcoholic beverages regularly please go the last question)

On average, how many drinks do you/did you consume per day of the following.

WINE: NUMBER OF GLASSES ☐☐

BEER: NUMBER OF BOTTLES/CANS ☐☐

LIQUOR (RYE, GIN, RUM, ETC.) NUMBER OF DRINKS ☐☐

10. Please fill in the date on which you completed this questionnaire:

DAY ☐☐ MONTH ☐☐ YEAR ☐☐

Thank you for taking part in the study.

APPENDIX K

SITE PERSONNEL OFFICE CONTACTS

Whiteshell Nuclear Research Establishment	- H.M. Johnson
Chalk River Nuclear Laboratories	- R.W. Christie
Chemical Company Head Office and LaPrade	- M.M. Labelle
Glace Bay Heavy Water Plant	- G. Roy
Port Hawkesbury Heavy Water Plant	- J.D. King
Corporate Head Office	- G.P. Lefebvre
Radiochemical Company	- B. Harper
Engineering Company	- E.G. Philip
Research Company Head Office	- E.A. Provick

L. Johnston, Secretary to Dr. J.L. Weeks (WNRE) provides liaison with site representatives.

APPENDIX L

ADMINISTRATIVE INSTRUCTION

Atomic Energy of Canada Limited
Corporate Office

L'Energie Atomique du Canada, Limitée
Bureau central

MEMORANDUM

May 20, 1980

TO: Site Personnel Heads
(See Distribution)

FROM: P. F. Goddard
Corporate Information Systems

RE: AECL Health Study - Employee Identity Summary Forms

You will find attached a note regarding the use of the E.I.S. form. Under separate cover you will be receiving:

- personalized "update" EIS forms to add or change information pertaining to employees on strength at 1 January 1980
- blank "original" EIS forms for new employees, and
- consent forms pertaining to the data being used in the study

Please arrange to have the EIS and consent forms distributed to all the employees at your site, and provide for their collection and retention. Data entry instructions will be issued from this office in the near future. If I can be of any use to you, please get in touch with me.

PFG/pl
Attach.

P. F. Goddard

ADMINISTRATIVE INSTRUCTION FOR THE USE OF THE EMPLOYEE IDENTITY SUMMARY FORM BY SITES

The Employee Identity summary form will be used for creating and updating the Health Study Employee Data Base. The data base will identify all past employees at CRNL and WNRE, and present and future employees at all sites. For the purpose of the study, contractor's staff who are employed for more than one year are considered permanent and must have EIS forms filled out, with "CONTRA" entered for employee number.

To assist site administration, and reduce data entry the EIS forms for employees on strength as of 1 January, 1980 have been partially filled out, with information from CPRS. Employees hired since then must have their EIS forms filled by hand.

For the retrospective study, form CRNL 3150 (REV 11/79) will be completed at CRNL and WNRE for all past employees and the forms sent to D.K. Myers for data entry and safekeeping.

For the prospective study, form CIS-HS01 (02/80) and a consent form will be filled out by present and future employees at all sites and returned to Dr. J.L. Weeks at WNRE for data entry and safekeeping. Permanent employees on staff (i.e., on CPRS) as of 1 January, 1980, will have a preprinted EIS form identified as an "Update" form, enabling them to correct and add to the preprinted information. A blank form CIS-HS01 (02/80), identified as "Original", will be filled out by those employees hired after 1 January 1980, and should also form part of the pre-employment documentation of all new employees, for an indefinite period of time.

When all the EIS corrections and updates have been entered, the data will be accumulated on the Corporate Computer, and a copy sent to Dr. J.L. Weeks for storage at WNRE.

New Employee EIS forms should be sent to Dr. J.L. Weeks by sites on a quarterly basis as of 1 January 1981.

The study for which these forms are an essential beginning will continue for at least twenty years, however, it is hoped that no further administrative work will be required of sites other than the documentation of new employees. It must be emphasized that the success of the program will, in a very large part, depend upon the completeness of the data base and, in particular, this is the case with the documentation of past employees.

Sites should institute a follow-up system to ensure that completed forms are received from all employees who have not declined to participate in the study,

APPENDIX M

HEALTH STUDY, CORPORATE GENERAL NOTICE

ATOMIC ENERGY OF CANADA LIMITED

Corporate Office

AECL GENERAL NOTICE

A Study of the Health of AECL Radiation Workers

A study of the health of past and current AECL employees has been approved in order to determine by follow-up whether there is evidence of a difference in the causes of and age at death of workers exposed to different levels of ionizing radiation. This will be a long-term project taking many years to complete and will include those whose work does not involve exposure to radiation, as well as those who are classified as atomic radiation workers.

Those who work with radiation know that precautions are necessary and that strict regulations are enforced to protect their health. There is no reason to believe that these measures have been inadequate. However statistically accurate information on the health of our employees will provide additional evidence on which this adequacy can be demonstrated and as a scientific organization AECL should attempt to obtain such information. For the results to be statistically accurate the study must involve a large number of people and be done over several decades.

The study will involve the collection of identifying information for past and current employees which will be matched where appropriate with records of lifetime occupational exposure to radiation. This information will be transferred to Statistics Canada who will compare it with their records of vital statistics. It will then be possible to determine whether there is a relationship between life expectancy and exposure to

L'ENERGIE ATOMIQUE DU CANADA, LIMITEE

Bureau central

AVIS GENERAL DE L'EACL

Projet d'étude sur la santé des travailleurs sous rayonnements de l'EACL

Un projet d'étude de la santé des employés anciens et actuels de l'EACL a été approuvé afin de déterminer, en y donnant suite, s'il y a l'évidence d'une différence dans l'âge et les causes, du décès des travailleurs exposés à différents niveaux de radiation ionisante. Il s'agit d'un projet à long terme qui nécessitera plusieurs années pour le compléter et qui incluera les employés dont le travail ne les expose pas aux rayonnements et ceux qui sont classifiés comme des travailleurs sous rayonnements.

Ceux qui travaillent avec les rayonnements savent qu'il est nécessaire de prendre des précautions et que l'on impose des règlements très sévères afin de protéger leur santé. Il n'y a aucune raison de croire que ces mesures ont été inefficaces. Bien qu'ils soient exacts du point de vue de la statistique, les renseignements portant sur la santé des employés fourniront des preuves supplémentaires au moyen desquelles cette efficacité peut être démontrée; et en tant qu'organisation scientifique, l'EACL devrait essayer d'obtenir de tels renseignements. Afin que les résultats soient exacts du point de vue de la statistique, l'étude devrait être faite sur un grand nombre de personnes et avoir lieu pendant plusieurs dizaines d'années.

Le projet d'étude comprendra la collection des données d'identification sur les employés anciens et actuels, qui seront assorties lorsqu'elles seront appropriées aux records d'exposition occupationnelle à vie aux rayonnements. Ces données seront transmises à Statistique Canada, qui les comparera avec ses records de statistiques de l'état civil. Il sera donc ensuite possible de déterminer s'il existe une relation entre les

.../2

radiation or other environmental factors. This is the usual method for studying the health effects of an industry. There will be no medical examinations or personal interviews and the information requested will be kept to the minimum necessary to carry out the study. No data will be published in a form in any way identifiable with any individual and reports issued as a result of the study will be of a statistical nature only. In this way the privacy of the individual will be strictly preserved.

As a first step in setting up this program, employees will be asked to complete an Employee Identity Summary Form. Any employee who does not wish to participate will be excluded on so indicating to the Personnel Department at his or her location. However, for the study to be a success, it is important that as many as possible past and current employees be included in it, and I request all staff to cooperate in the work to be undertaken by this important program.

probabilités de la vie et l'exposition aux rayonnements ou à d'autres facteurs de l'environnement. C'est la façon usuelle d'étudier les effets d'une industrie sur la santé. Il n'y aura aucun examen médical ni d'entrevue personnelle, et les renseignements demandés seront réduits au minimum nécessaire pour mener à bien cette étude. Aucune donnée ne sera publiée sous une forme pouvant l'identifier à un individu et les rapports soumis à la suite de cette étude, le seront uniquement à des fins de statistiques. De cette façon, la nature discrète de l'individu sera strictement respectée.

Comme première étape, dans la mise sur pied de ce programme, l'on demandera aux employés de compléter un sommaire d'identité d'employé(e). Tout(e) employé(e) ne désirant pas participer sera exclus, en l'indiquant au bureau du Personnel de son établissement. Toutefois, pour que l'étude soit un succès, il est important que le plus grand nombre d'employés possible anciens et actuels, en soient inclus, et je demande à tous les employés de bien vouloir coopérer au travail que veut accomplir cet important programme.

Le président-directeur général

James Donnelly
President and Chief Executive Officer

1980 April

1980 avril

APPENDIX N

HISTORY OF THE AECL EMPLOYEE HEALTH STUDY

The work done during the past 20 years by Dr. Howard B. Newcombe in the development of methods for the linkage of vital records has received international recognition and it is appropriate to acknowledge the importance of this work to the methodology of the AECL Health Study. A report by Dr. Newcombe[N.1] related record linkage to the follow-up of radiation workers and the Employee Identity Summary (E.I.S.) forms (Appendices D and E) were designed by him in 1979.

1976		- Program discussions begin
	September	- Meetings with staff of National Radiological Protection Board (NRPB), Harwell, U.K. and International Agency for Research on Cancer (IARC), Lyon, France
1977		- Program development continues. Meetings with staff at Chalk River Nuclear Laboratories (CRNL) and International Atomic Energy Agency (IAEA)
1978	February	- First CRNL meeting
	March	- Panel meeting at IAEA
	August	- Exploratory meeting with staff of Statistics Canada
	October	- Meeting of Canadian consultants at Whiteshell Nuclear Research Establishment
	November	- Meeting at NRPB, U.K.
1979	May	- AECL-6194 published[N.2]
		- Meeting with Provincial Registrars of Vital Statistics, Winnipeg
	August	- Second CRNL meeting
		- Design of Employee Identity Summary (E.I.S.) form

	November	- First meeting on operational aspects of study, AECL Corporate Head Office, Ottawa
1980	January	- Formation of AECL Health Study Steering Committee and first meeting, Ottawa
	March	- Approval of study proposal: AECL Research Company
	April	- Issue of General Notice describing the study
		- Information visits to AECL sites
	June	- E.I.S. forms distributed
	October (continuing)	- Assembly of completed E.I.S. forms
	November	- Finalization of study concept
		- Preparation of collaborative agreement
1981	February	- Manual linkage examination of records for ex-employees known to be dead
	February (continuing)	- Completion of E.I.S. forms for past employees at CRNL and WNRE
	April	- Finalization of Draft Cooperative agreement between AECL and NCIC
	May (continuing)	- Retrieval of data for current employees who did not complete E.I.S. forms
	June (continuing)	- Data Entry for current employees

REFERENCES

N.1 H. Newcombe, "A Plan for a Continuing Follow-up of Persons Exposed to Radiation in the Canadian Nuclear Power Industry", Atomic Energy of Canada Limited Report, AECL-5538 (1976).

N.2 J.L. Weeks, "A Registry for the Study of the Health of Radiation Workers Employed by Atomic Energy of Canada Limited", Atomic Energy of Canada Limited Report, AECL-6194 (1979).

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