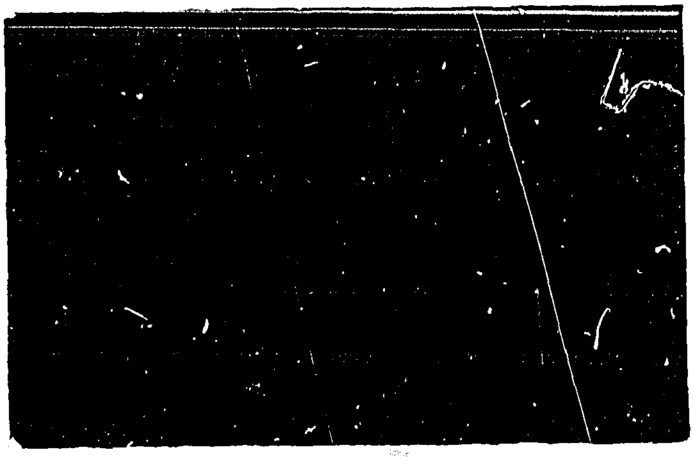
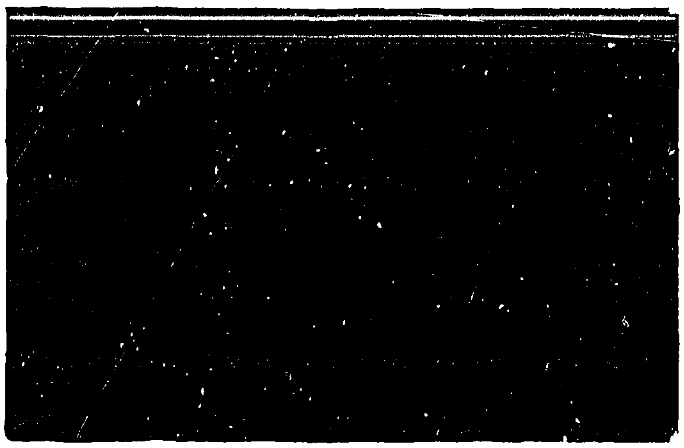
Canadian Fusion Fuel Technology Project





THE CANADIAN FUSION FUEL TECHNOLOGY PROJECT REPRESENTS PART OF CANADA'S OVERALL EFFORT IN FUSION DEVELOPMENT. THE FOCUS FOR CFFTP IS TRITIUM AND TRITIUM TECHNOLOGY. THE PROJECT IS FUNDED BY THE GOVERNMENTS OF CANADA AND ONTARIO, AND BY THE UTILITY ONTARIO HYDRO; AND IS MANAGED BY ONTARIO HYDRO.

CFFTP WILL SPONSOR RESEARCH, DEVELOPMENT, DESIGN AND ANALYSIS TO EXTEND EXISTING EXPERIENCE AND CAPABILITY GAINED IN HANDLING TRITIUM AS PART OF THE CANDU FISSION PROGRAM. IT IS PLANNED THAT THIS WORK WILL BE IN FULL COLLABORATION AND SERVE THE NEEDS OF INTERNATIONAL FUSION PROGRAMS.

Health, Safety and
Environmental Research Program

Report #F82008

January 1983

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SUMMARY

CANADIAN FUSION FUELS TECHNOLOGY PROJECT
HEALTH, SAFETY AND ENVIRONMENTAL RESEARCH PROGRAM

This report outlines the Health, Safety and Environmental Research (HSER) Program being undertaken by the CFFTP. The Program objectives, relationship to other CFFTP programs, implementation plans and expected outputs are stated.

Opportunities to build upon the knowledge and experience gained in safely managing tritium in the CANDU program, by addressing generic questions pertinent to tritium safety for fusion facilities, are identified. These opportunities exist across a broad spectrum of issues covering the anticipated behaviour of tritium in fusion facilities, the surrounding environment and in man.

TABLE OF CONTENTS

CANADIAN FUSION FUELS TECHNOLOGY PROJECT
HEALTH SAFETY AND ENVIRONMENTAL RESEARCH PROGRAM

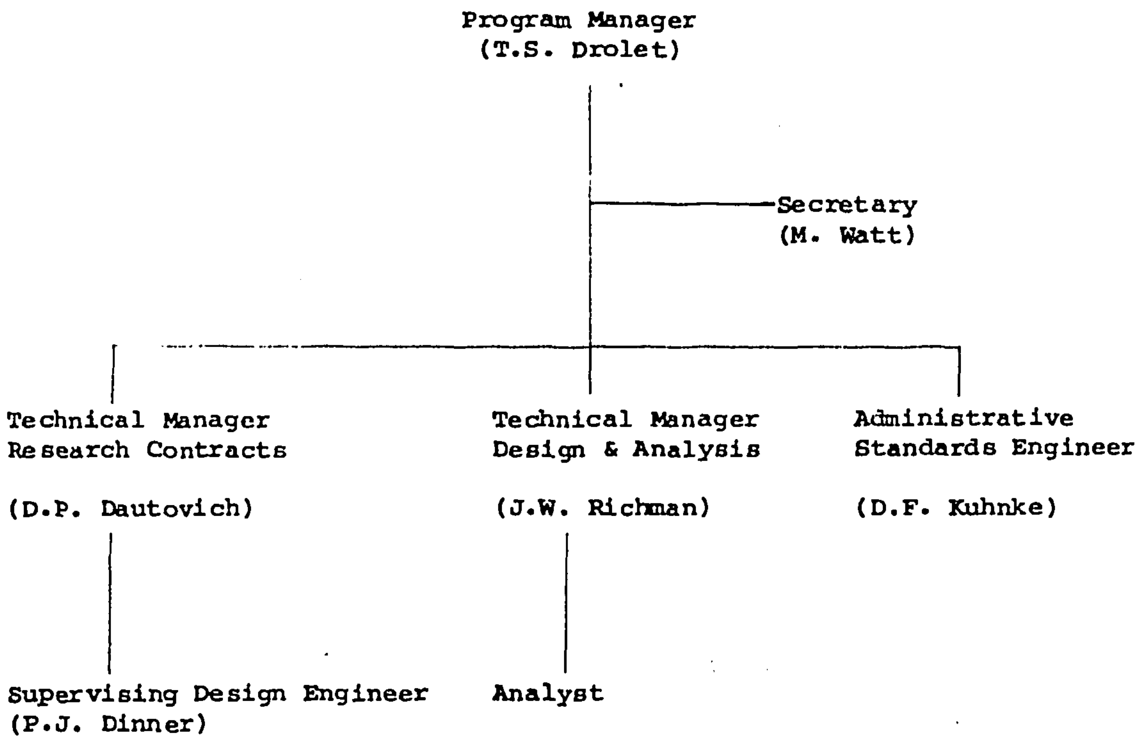
1.0 INTRODUCTION

The purpose of this document is to describe the goals, priorities and organization of a Health, Safety and Environmental Research (HSER) program within the context of the Canadian Fusion Fuels Technology Project (CFFTP). The HSER program will be carried out by selective funding or co-funding of research and development activities in Canadian institutions relevant to the health, safety and environmental needs of the international fusion community. Information in this report will assist potential participants to identify opportunities within the HSER program. In place of defining specific projects, this document describes issues, priorities and objectives and invites potential contributers to define R&D projects to meet the stated objectives and submit proposals for these projects.

The CFFTP is part of the national fusion program. It is funded by the Federal Government - National Research Council (50 percent), Ontario Provincial Government - BILD Program (25 percent) and by Ontario Hydro (25 percent). The project focuses on tritium and tritium-related technology, with a mandate to extend and adapt current Canadian tritium handling capability to fusion needs. The project is managed by Ontario Hydro (refer to Figure 1-1) and plans expenditures of $21M over five years. Contracts will be placed with national laboratories, utility laboratories, industry and universities. The CFFTP supports the development and international commercialization of Canadian capability and resources in the tritium related areas of fusion fuel systems, materials technology, equipment development and health safety and environment.

Figure 1-1

Canadian Fusion Fuels Technology Project
Management Centre Staff Organization



Attached Staff: S.P. Nickerson
I. Woolgar
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* As of 83-01-17

7964G

Table 1-1 lists issues of potential HSER interest. In line with the overall CFFTP mandate, initial focus of the CFFTP-HSER program will be on (a), and on (a1) in particular. Elements of (c), (e), (f) and (h) may also be explored where these pertain to tritium. A conceptual scheme for visualizing the pathways for tritium from reactor source to man is given in Figure 1-2. Appendix A consists of a checklist of topical areas corresponding to the steps in Figure 1-2. The principal difference between the application of this scheme to fusion facilities, and its more familiar application to fission, lies in the nature and magnitude of source terms. Tritium compounds other than oxide are expected in the occupational environment and in facility releases to air and water. In both cases, the emphasis is on man as the receptor. The behaviour of tritium in the natural environment will be studied insofar as this behaviour affects estimating of tritium intakes by man.

These research activities will interface with two other activities (already underway) within the CFFTP Health, Safety and Environment program. These are:

(a) Tritium monitoring R&D. This activity aims at the development of commercial instrumentation suited to the needs of concentrated tritium handling facilities. The CFFTP has assisted this development from its inception in April 1982.

(b) A tritium information compilation and applications study to make available to the international community, existing Canadian health, safety and environmental experience with tritium from CANDU reactors. In particular, emission data, dosimetry programs, effluent monitoring, occupational dose monitoring, and protective equipment capabilities will be documented.

Table 1-1

Health Safety and Environmental Research Issues In the Fusion Fuel Cycle

(a) Tritium in relation to:

1) Fusion Reactor Systems;
2) Large Scale Tritium Storage and Transportation.

(b) Neutron activation of reactor structures, corrosion products in coolant, reactor hall environment.

(c) Lithium handling (releases and effects).

(d) Magnetic fields.

(e) Radioactive waste disposal.

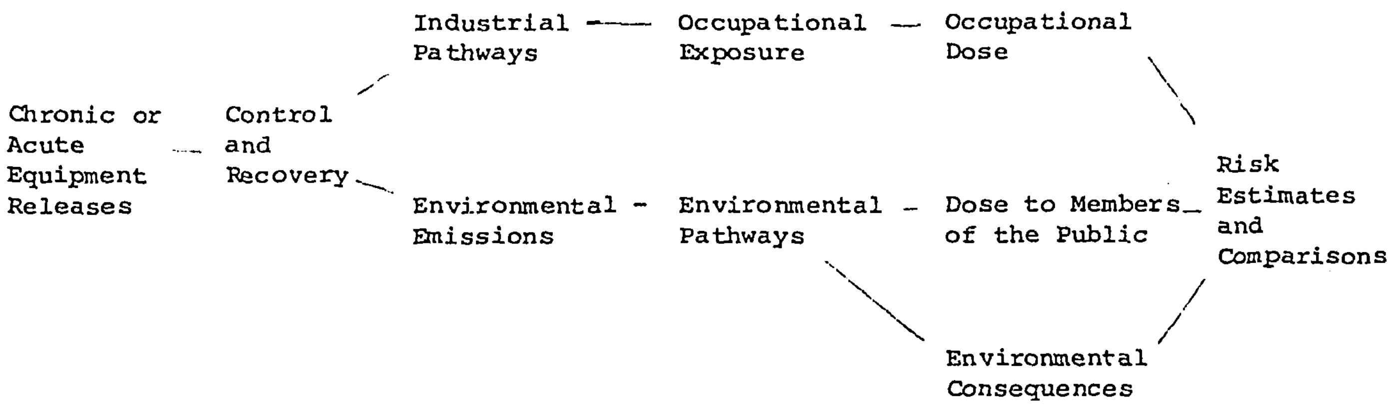
(f) Resource use, decommissioning and resource recycle.

(g) Non-radioactive material occupational impacts (e.g., chemicals, thermal discharges, particular in air or water emissions).

(h) Public perception of technical issues (a) - (g), the associated health risks and other non-technical issues.

Figure 1-2

Tritium in the Fusion Reactor



2.0 HSER PROGRAM OBJECTIVES

The present image of hydrogen fusion is that it can provide a relatively benign source of power. In order to substantiate this image and to ensure the public acceptability of the fusion power option when it is available, continued attention must be paid to the comparative risks of fusion with other energy options. Canadian health and safety experience with tritium, refocussed in the fusion context, can contribute significantly to its acceptability. Therefore, the primary objective of the HSER program is to gain acceptance for Canadian participation in other national and international fusion programs based on an area of established Canadian technical strength. This acceptance will facilitate involvement in other fusion- related technical activities, the exchange of technology, and may lead to commercial opportunities for Canadian engineering and industry. In the selection of research activities to be funded, the basic concepts in the proposed work should reflect this objective of the CFFTP-HSER program.

The following factors will be used in evaluating proposals. These factors are listed approximately in descending order of importance. Proposals submitted for funding under the HSER program should:

- Significantly reduce uncertainties in public or occupational dose estimation from fusion reactors;
- Produce marketable technology, information or equipment to reduce or control occupational exposures and environmental emissions from fusion facilities;
- Involve a high 'payoff', for example, the application of existing technology or resources, in new ways, to fusion problems may be provided at little additional cost.
- Produce reliable results within near (one to three year) term;
- Demonstrate commitment of CFFTP and capability of Canadian expertise in health, safety and environmental issues related to tritium;
- Address issues of <u>perceived</u> public or worker safety with respect to tritium (e.g., DNA, oocyte incorporation). Address potential regulatory issues;
- Mesh with other national, international or specific needs where collaborative ventures are desirable;

- Provide 'spin-off' benefits in the form of developmental information relevant to CANDU program, commercial and medical applications of tritium, design and operation of Canadian tritium removal systems or other Canadian non-nuclear technologies;

- Contribute to general scientific knowledge.

3.0 PROGRAM IMPLEMENTATION

The Health, Safety and Environmental Research program will be conducted as a contract research program involving national labs, utilities, industry and universities, as is the intent for other CFFTP programs. The funding process will normally involve competition between research groups on the basis of a request for proposal (RFP) issued to qualified bidders. Additionally, where warranted by pressing need or unique qualifications of a proponent, a direct award will be considered. Since individuals or groups conducting research in the field will frequently be in the best position to identify critical elements missing from available tritium knowledge, unsolicited proposals to fund work to fill these gaps will be welcomed. On a periodic basis, a general RFP may be released summarizing a number of key issues requiring further work and inviting proposals which address these needs.

In many cases, only parts of proposed programs may be selected for CFFTP funding. In other cases, proponents may be asked to collaborate with each other to produce a stronger joint effort. In all cases, proposals involving co-funding with the sponsoring agency or a third party will be viewed as preferrable to sole-funding by the CFFTP. General information of interest to program participants is provided in Appendix B.

4.0 PROGRAM OUTPUTS

While initial emphasis in assessment studies is directed to supplying key missing data, development of models to permit risk analysis to be quantified and integrated across the entire HSE spectrum will be sponsored to use new results as they become available. Modelling requirements may be determined using assessment techniques such as System Safety Analysis or the Management Oversight and Risk Tree (MORT) approach. Both systems analysis and quantitative modelling will assist in identifying major information gaps, most sensitive data, and providing a basis for cost-benefit analysis applied both to further studies and to safety related engineering developments and equipment studies for fusion facilities.

In addition to providing detailed written reports of completed work, to the CFFTP, investigators are expected to participate in international fora to present research results or summaries of work in progress. Limited travel assistance may be provided where appropriate. If sufficient details are known in advance an allowance for this should be included in the original proposal costs under "Travel".

Publishable papers should be prepared for submission to internationally recognized journals accessed by the fusion community. Credit for CFFTP funding support should be accorded where appropriate.

Since a major objective of the CFFTP program is to generate consulting or commercial opportunities for Canadian industry, and to identify technological spin-offs and patentable devices or processes, it is expected that investigators working under contract to the CFFTP will identify these developments to the CFFTP for discussion of means to take advantage of them.

An annotated literature data base on Health and Safety and Environmental issues will be established and made available to the Canadian Fusion Community. As a researcher's work requires him to review documents in the base he/she will be expected to contribute entries and annotations, and relate major papers to his/her own findings for the benefit of other researchers. Specific plans to implement this data base will be evolved early in 1983.

5.0 RESEARCH PRIORITIES FOR THE 1983 HSER PROGRAM

Specific opportunities to build upon the knowledge and experience gained in safely managing tritium in the CANDU program, by addressing generic questions pertinent to tritium safety for fusion facilities, are identified in this section. These opportunities exist across a broad spectrum of issues. The issues are grouped here and in Appendix A under three general headings:

A1.0 Tritium in Fusion Facilities

A2.0 Tritium in the Environment

A3.0 Tritium in Man

A detailed checklist of topics for each heading is provided in Appendix A, and priorities are identified below. The ideas presented are given as examples and are not intended as an exclusive list.

The research activities which have highest immediate priority are those which will contribute most significantly to the reduction in uncertainty in the estimation of occupational dose and environmental impacts of tritium in fusion facilities. These estimates assist in directing design activities for monitoring, protective equipment and engineered systems for fusion application.

Risk models will be developed as part of future CFFTP sponsored activities to integrate study results in each of areas A1, A2 and A3. However, the current need is for certain key tritium-related data which may be obtained from theoretical, laboratory or field studies.

5.1 Tritium in Fusion Facilities

The development of a comprehensive equipment data base to permit assessment of occupational doses and environmental releases from fusion facilities early in the planning stage is of high priority. This will require:

(a) identification of possible fusion facility components subject to tritium leakage;

(b) completion of component inventories and measurements on similar components in existing CANDU stations;

(c) acquisition of data on hydrogen gas leakage rates applicable to tritium handling equipment;

(d) establishment of industrial pathways and inter- conversion of various chemical species of tritium (e.g., gas, dusts and organic compounds. The role of tritide dust, as generated through storage in getters in particular, needs to be resolved. The factors affecting the rate of HT to HTO or organic conversion in anticipated fusion reactor environments and on engineered surfaces is required. Protective clothing must be evaluated for its effectiveness in controlling uptake of the various tritium forms and development needs, if any, identified;

(e) quantification of barrier and recovery system effectiveness for controlling tritium leakages from process equipment.

A longer term objective will be to construct a quantitative modelling package which may be applied to calculation of release and occupational doses for conceptual fusion reactor designs, and used to optimize these designs according to the ALARA principal.

Measurements of tritiated hydrocarbons emitted from existing nuclear facilities and, if present, relation of these to vegetation uptake is needed.

Studies of accident release probabilities, source terms, and impacts will be required for large scale tritium storage and transportation as the engineered systems for these operations become better defined. In the short term, emphasis will be on tritium in relation to other fusion reactor systems (issue aii of Table 2). This may include some "process upset" type releases.

5.2 Tritium in the Environment

Theoretical calculations and experimental data to confirm rates of environmental conversion of T_2 gas to oxide, or other environmentally available chemical forms in the vicinity of fusion reactor facilities is required as soon as possible to permit realistic assessments of the environmental impact of fusion facilities to be made. Many existing assessments assume instantaneous conversion of tritium gas to oxide, which leads to excessively conservative (and sometimes alarming) consequences. Studies of vegetation and soil properties which are instrumental in the conversions of tritium gas (or compounds) to oxide (or bound tritium compounds in plant tissues) are required to compliment atmospheric chemistry processes. Mechanisms for direct uptake of hydrogen gas or organic compounds in air through leafy plant tissues have not been studied extensively and may be important. Tritium gas to oxide conversion mechanisms and rates are perceived to have highest priority in this area. The ranges of turnover halftimes for major tritium (hydrogen) pools in regional ecosystems should be estimated and experimentally confirmed. Seasonal influences should be studied. Methods for analysis of bound tritium samples in plant and animal tissues must be further standardized.

5.3 Tritium in Man

Evaluation of tritium RBE experimental data should be performed. A review is required of important issues in tritium intake for various tritium compounds. This should focus on:

(a) the uncertainties in existing tritium dosimetry due for example to compartment size and tritium turnover assumptions, and functional sytem uptake (for HT);

(b) the specific molecular binding sites, for the organs and compartments in (i), for tritium taken in various chemical/physical forms; and

(c) the significance of the dose delivered at these sites (e.g., review of microdosimetry for tritium, key cell volumes and targets). Specific experimental needs should be identified by this review.

Several activities have been identified which should be carried out immediately based on an absence of key information in the literature. These include:

(a) a study of HT skin penetration rates and HT to HTO conversion rates "in vivo";

(b) a study of organic tritium binding sites for mono-gastric animals with metabolism similar to man;

(c) quantification of the effects of this binding for certain assumed high-risk sites;

(d) development of a model relating tritium intake, distribution, binding sites, and consequent risks; and

(e) confirmation via autopsy or epidemiological studies of the oocyte losses incurred by women who have incurred significant gonadal dose from cancer radiotherapy.

This model in (d) should lead ultimately to a set of dose-factors for individual tritium compounds taken into the body.

If tritide dusts are shown to persist in the occupational environment, tritide dust dosimetry should be pursued.

Development of public education strategies regarding risks from hydrogen fusion power is required. This should also build on the experience obtained in the fission power program.

APPENDIX A

TRITIUM IN RELATION TO FUSION REACTOR SYSTEMS

A1.0 TRITIUM IN FUSION FACILITIES

A1.1 Fusion Reactor Equipment Releases

Using information from fusion reactor design studies and CANDU operation, the following topics can be addressed:

- Accident/upset tritium spills
- Component leakage data base
    - By component type, size age and service conditions (T,P); for tritium oxide and gas:
        - component chronic leakage
        - component reliability, maintenance frequency
        - component failure releases, frequency of failure
- Leakage targets, (nominal values, expected ranges)
- Generalized model of Heat Transport System or Moderator System tritium buildup, leakage recovery, air cleanup, efficiency, environmental releases:

A1.2 Tritium Control and Recovery

Mitigation of occupational tritium exposures and environmental releases is possible by controlling releases close to source. Tritium would be present in air, water, and on building or equipment surfaces.

Methods for tritium inventory measurement must be evolved.

- Tritium in air:
    - Oxidation of HT or organic molecules
    - Drying of HTO
    - Gettering of HT
    - Ventilation and air mixing efficiencies
- Tritium in water:
    - Collection rates and tritium concentrations
    - areas wetted by spills or leakage
    - systems for collection and collection efficiencies
    - water - lithium interaction prevention

- Tritium in Surfaces:

  - gas and oxide penetration, permeation, T_2 conversion
  - effects of surface coatings on penetration, T_2 conversion to oxide/organic forms
  - decontamination feasibility and efficiency
  - transfer of tritium compounds to unprotected skin
  - re-mobilization in building atmosphere
  - reaction of elemental tritium to form organic molecules

- Tritium Inventory Measurement and Safeguards.

A1.3 Environmental Emissions

- Emissions Data Base (gas, oxide, tritide)

  - Relation to leakage, cleanup, buildup, recovery
  - Based on CANDU (oxide) experience, and world-wide experience in concentrated tritium handling

- Modelling environmental emissions due to equipment releases as mitigated by recovery and cleaunp systems

- Develop emissions targets; rationale

- Monitoring of gas, oxide, tritide emissions to air, oxide emissions to water

- Accident/upset release calculations, accident frequency and magnitude spectra

- Emission system design (stack, vent, discharge channel, dilution mechanism) for chronic and accident/upset releases.

A2.0 TRITIUM IN THE ENVIRONMENT

The following elements are important in determining eventual dose to man.

- Atmospheric Dispersion (local, regional, global)

- Dispersion and buildup of tritium in rivers and lakes

- Deposition

  - wet and dry
  - for HT, HTO, CH_3T
  - to snow, soil and vegetation

- HT, CH_3T interaction and conversion to HTO in air, soil, water

- Organic binding in micro-organism and soil

- Tritium movement in groundwater and soil

- Transfer of tritium to plants from air, soil and water

- Conversion to organic tritium in plants

- Conversion to organic tritium in animals (e.g. ruminants)

- Modelling pathways and processes quantitatively, i.e. determining local, regional, global cycling; inter-compartmental transfer rates and compartment sizes.

- Environmental tritium measurement devices/methods

- Effect of tritium on organism other than man.

A3.0 TRITIUM IN MAN

A3.1 Tritium Dosimetry and Bioeffects (Public and Worker - Dose Topics)

- Metabolic modelling of organically bound (OB) fractions and elimination rates in man under pulsed and steady state conditions for tritium following:

    - ingestion (HTO, OB)
    - inhalation (HTO stritides fractional systemic uptake of HT)
    - skin uptake (HTO, OB, HT)

- Percent of OB fraction reaching genetic material (RNA, DNA Oocytes. Turnover times and biological implications of this OB fraction. Confirmation of animal studies with human populaton (epidemiological studies, tissue analysis of workers).

- Low dose/dose rate aspects of tritium exposure

    - possible synergistic effects
    - Relative Biological Effectiveness (RB) of low dose/dose rates
    - Dose-response linearity
    - administrative "de-minimus" values for dose and dose rate

- Topics related to public or worker acceptance of scientific findings e.g.,:

    - "Tritium and Fusion - A strategy for public acceptance"

- Risk Comparisons between various accepted life risks and anticipated tritium exposures from fusion reactors
- Refinement of human dosimetry models
  - analysis of critical uncertainties
- Quality factor:
  - Development of arguments in support of ICRP recommended value

A3.2 <u>Occupational Exposure</u>

- Occupational exposure control philosophies and application to tritium exposure in fusion facilities:
  - Experimental laboratory vs power generation "ALARA"
  - $/Rem, Rem/MWE targets, rationale
- Internal dosimetry:
  - Methods for HT, HTO, Organics, Tritide bioassay
  - Administration : costs, reliability, accuracy, worker cooperation (CANDU experience represents the only large scale commercial tritium dosimetry program in the world to date)
  - Empirical confirmation of dose calculations in the dosimetry program for:
    - Tissue Free Water Tritium (TFWT)
    - Tightly bound/labile organic tritium compounds
- Administrative Standards for Air Concentrations of HT, HTO, tritides, tritiated organics
  - Effect of conversion on surfaces on practical air concentration limits in fusion facilities
  - Tritide dusts: filtration efficiency, size distribution lung retention, persistence of finely divided tritide in oxygen atmosphere.
- Personal Protective Equipment (respirators, hoods, gloves, suits, etc).
  - Experience, verification of protection factors (PFs)
  - Design, operational history. Factors in optimization for fusion facilities.

- Fixed and Portable instrumentation (air water surface)
  - Requirements (sensitivity, discrimination, response time)
  - Experience to date

APPENDIX B

INFORMATION FOR RESEARCH PROPONENTS

B1.0 GENERAL

Under normal circumstances, the CFFTP will award a cost-plus-fee type contract to successful bidders. The award of the contract will require the signing of an agreement by the successful organization with the CFFTP. The agreement will reflect the CFFTP position concerning: the scope of work; cost and payment; the use of data, inventions and patents; schedule and cost performance.

The proposal should identify critical review positions at major milestones, at which an assessment is to be made as to whether the activity continues to be technically and financially viable. The organization will be required, if requested, to provide evidence that the work retains a high ranking with respect to the factors upon which it was originally assumed.

In addition to major milestones, numerous milestones, indicating interim achievements, should be identified to enable the organization to report and the CFFTP to monitor progress and performance in an orderly fashion. Failure of the organization to meet milestones within time and budget may be reason for termination of the project. Termination will be accompanied by a wind-down period determined by CFFTP (nominally 30 days) during which all equipment and data will be passed over to CFFTP.

Brief reports shall accompany monthly billing. Quarterly reports shall be provided to review progress for the preceeding quarter and major reports are required on completion of major phases of the project and of the overall project. Further directions are provided in a Report Guide to be issued shortly. It will be CFFTP practice to withhold 15 percent of monthly progress payments pending submission of a satisfactory final report on completion of the project.

The formation of joint ventures by the organization is strongly encouraged to bring complete and adequate resources to bear on the project.

Six copies of the proposal are required and should be submitted directly to:

Dr. D.P. Dautovich
Technical Manager - Research Contracts
Fusion Fuel Technology Project
U11
c/o 700 University Avenue
Toronto, Ontario
M5G 1X6

When responding to a request for proposal, the outside of the proposal package should reference the RFP number and title. The RFP number should appear in the upper right hand corner of each proposal document and the copies should be numbered 1 through 6.

The selected organization will receive written notification of the decision of the CFFTP after evaluation is complete. Contract negotiations based on the CFFTP standard contract terms and conditions will be initiated with the selected organization soon after the notification of proposal selection. The start of work or incurrence of costs are not authorized prior to the execution of a formal contract with the selected organization. Where competitive bids are involved, unsuccessful organizations will be advised of the decision after execution of the formal contract with the selected organization.

B2.0 REQUIREMENTS FOR PROPOSAL CONTENT

Proposals must contain information as listed below.

1. TITLE

2. IDENTITY OF PROPOSER

   The Corporate name and address of the organization submitting the proposal.

3. AUTHORITY

   The name, title and telephone number of the responsible authority under whose general direction the project would be carried out.

4. STATEMENT OF WORK

   This is to include the following items.

   a) A discussion of the requirements as understood by the proposer.

   b) An explanation of the technical approaches to be taken. This may be supported by sketches, diagrams, calculations or any other data required for the presentation, substantiation and justification of the proposed approaches.

   c) Statement and discussion of major problem areas together with potential or recommended approaches for their resolution.

   d) A statement of any interpretation, qualification or assumptions made to the technical scope.

   e) Statement of the extent to which the proposed approach and program can be expected to meet or exceed the requirements and specifications of the contract as outlined in the RFP.

      A differentiation shall be made between the areas of assured compliance and noncompliance. If, in the opinion of the proposer, a requirement or specification cannot be satisfied, the proposer shall so state, shall indicate his reasons for the conclusions and may suggest or recommend an alternative or compromise for consideration.

5. TASK IDENTIFICATION

The program shall be broken down into the component tasks and subtasks with milestones identified for interim results. Each task shall have a clearly defined objective. Critical review points shall be identified at major task or phase completion points. These shall be used by FFTP to assess performance and continued funding. Form No. 100 shall be used to list the tasks and task objectives, Form No. 200 shall be used to list the milestones and completion dates.

6. SCHEDULE

A schedule for the completion of work shall be prepared on a monthly basis identifying interim results, milestones, critical review and approval points, task cost and cash flow. Form No. 26607 shall be used for this purpose. A logic diagram shall be used to show activity precedence and task inter-dependence.

7. PERSONNEL

The names and resumes giving pertinent qualifications are required of the Project Leader and other key personnel who would be assigned to the project, including an indication of the role each would play. Key personnel will not be replaced without approval of FFTP-MC. The approximate percentage of time each key person is expected to assign should be stated.

8. DETAILS OF SUBCONTRACTS

Proposers are encouraged to arrange subcontracts with others. If such arrangements are proposed, the areas of investigation and role of the subcontractors shall be identified.

9. ORGANIZATIONAL QUALIFICATIONS

An indication is required of similar work experience to demonstrate the suitability of the organization to undertake this project. If subcontracts are undertaken, information relevant to qualifications is to be provided for the organization undertaking the subcontract.

10. COST

The following cost data shall be provided.

a) Chargeable rates for key personnel and technical staff.

b) Overheads including all markup, profit, etc., applicable to the above rates.

c) Methods for charging for materials, equipment, space rental or other identifiable charges not included in the overhead.

d) An estimate of the total hours chargeable for each task identified to personnel involved and for the total program including materials, subcontracts, computer time, rentals, travel, etc. and including a total amount thereby arriving at a contract cost limitation.

e) The proposer shall indicate if he intends to undertake any cost sharing or if there is to be cost sharing by other sponsor. The name(s) of any sponsor and any conditions imposed by them shall be divulged.

11. ANNUAL REPORT

Two copies of your organization's most recent annual report are required.

12. INSURANCE

A statement of insurance (public liability, fire, nuclear hazards, etc.) which the contractor proposes to carry for the purposes of carrying out the work.

13. OWNERSHIP

Proposers will indicate the percentage Canadian Ownership of their organization or company and identify the percentage and country of origin of any non-Canadian ownership.

FORM # 26607

RFP ____________ PROJECT TITLE: ____

TASK		TIME FROM START (Months)																								TASK COST $K
#	DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
QUARTERLY ACCUMULATED CASH FLOW $K																										

◯ Milestone ☐ Review & Approval

COMPLETED BY: ____________ DATE:

FORM #100

NO	TASK DESCRIPTION	OBJECTIVE

FORM #200

Task No	Milestone Description	Period to Accomplish	Resulting Milestone No