AECL EACL

Licensing Package

Information in Support of Site Licence Renewal for Chalk River Laboratories

Licensing

CRL-00521-LP-001
Revision 1

2007 March

UNRESTRICTED

2251 Speakman Drive
Mississauga, Ontario
Canada L5K 1B2

Mars 2007

ILLIMITÉ

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1. INTRODUCTION

1.1 General

Atomic Energy of Canada Limited (AECL) originally provided Revision 0 of this document to support the 2006 application to the Canadian Nuclear Safety Commission (CNSC) for renewal of the Chalk River Laboratories (CRL) operating licence. The purpose of the document was to assist CNSC staff in their review of the application to renew the licence, which had previously been submitted to CNSC staff during 2005 November. Also provided at that time was the, *Licensing Basis Document for Chalk River Laboratories*, CRL-00521-LBD-001, (see Section 3.5.4).

Following consideration, including the CNSC two-day public hearing process, the operating licence was renewed for a period of 63 months, with a start date of 2006 August 01. The renewed licence for CRL was issued as NRTEOL-01.00/2011.

Revision 1 of this document has been prepared to incorporate two additional appendices for the Dedicated Isotope Facilities (DIF) located within the CRL site, comprising the MAPLE 1 and MAPLE 2 Reactors (Appendix T) and the New Processing Facility (NPF) (Appendix U). Currently, these facilities each have their own respective operating licences issued by the CNSC; NPROL-62.00/2007 for the MAPLE reactors and NSPFOL-03.00/2007 for the NPF, and both of these licences will expire on 2007 November 30. Accordingly, AECL has submitted an application to the CNSC for licence renewal whereby the existing NPROL and NSPFOL licences would be replaced by a single new licence to cover both DIF facilities. This new combined licence would become effective 2007 December 01, and the proposed duration of 47 months would coincide with the same expiry date of 2011 October 31 as for the CRL site operating licence. This arrangement will enable the merging of renewal activities (and associated application processes, public hearings etc.) for both the CRL site and DIF licences in the months leading up to the 2011 expiry date. Furthermore, with both licences (CRL and DIF) expiring simultaneously, this arrangement would simplify any possible future decision by AECL regarding an application to add the MAPLE reactors and NPF to the list of operating nuclear facilities on the CRL site licence (Appendix B of NRTEOL-01.00/2011).

1.2 Background and Structure

Revision 0 of this document was originally prepared to replace the *Documentation in Support of Site Licence Renewal for Chalk River Laboratories*, RC-693-CRL, Revision 5, which was referred to in the prior CRL operating licence which expired on 2006 July 31. While broadly similar in structure to the former RC-693-CRL document, the detailed content and layout was simplified to better reflect the compliance program and facility documentation now in place at CRL.

The main text is followed by 21 facility-specific appendices. The text presents information applicable to the whole of the CRL site, or is applicable Company-wide, whereas the individual appendices present facility-specific information.

There are currently 14 nuclear facilities at CRL listed in Appendix B of the CRL site licence, and which are the subject of a separate appendix to this document, as indicated in the List of Appendices on the Table of Contents (i.e., Appendices A to N inclusive). Each appendix has the prefix label "OF" to indicate operating facility, and is further labelled by means of the Facility Authorization numbering system.

Additionally, there are a further five facilities at CRL that are permanently shutdown nuclear facilities at various stages of decommissioning. These facilities are listed in Appendix C of the CRL site licence, and are the subject of a separate appendix to this document, as indicated in the Table of Contents (i.e., Appendices O to S inclusive). These appendices each have the prefix label "PSD" and are further labelled by a letter code.

As explained in Section 1.1 above, two new appendices have been included for the MAPLE reactors and NPF. Each of these facilities is the subject of a separate appendix to this document, as indicated in the Table of Contents (i.e., Appendices T and U respectively).

The remainder of the document comprises the following:

- Section 2: Compliance programs (e.g., Radiation Protection Program, Environmental Protection Program) applicable to the CRL site (and hence are not specific to any one facility).
- Section 3: Auxiliary programs that provide support to those compliance programs documented in Section 2.
- Section 4: A summary of the nuclear operations at the CRL site.
- Section 5: A summary of the decommissioning process at the CRL site.
- Section 6: Public Communications Program

1.3 Acronyms

AECL Atomic Energy of Canada Limited

AIMS Actions/Issues Management System

ALARA As Low As Reasonably Achievable (economic and social factors being taken into account).

CANDU CANada Deuterium Uranium, registered trademark of AECL.

CECEUD Combined Electrolysis Catalytic Exchange Upgrading/Detritiation (Test Facility)

CIP Continuous Improvement Plan

CNSC Canadian Nuclear Safety Commission

CRL Chalk River Laboratories

CSD Criticality Safety Document

DIF	Dedicated Isotope Facilities
EmP	Emergency Preparedness (Program)
GSS	Guaranteed Shutdown State
HAZOP	HAZard and OPerability Study
HEPA	High-Efficiency Particulate Air (Filter)
HSE	Health Safety and the Environment
IAEA	International Atomic Energy Agency
MAPLE	Multi-purpose Applied Physics Lattice Experimental (Reactor)
MIPF	MAPLE Iodine-125 Production Facility
MMIR	MDS Nordion Medical Isotope Reactor
MPF	Molybdenum-99 (Mo-99) Production Facility
NFFF	Nuclear Fuel Fabrication Facility
NFPA	National Fire Protection Association
NMMT	Nuclear Materials Management and Radioactive Materials Transportation
NPF	New Processing Facility
NRU	National Research Universal (Reactor)
NRU LE	NRU Licensability Extension (Project)
NRX	National Research Experimental (Reactor)
OHS	Occupational Health and Safety (Program)
OPEX	Operating Experience (Program)
OTP	Operator Test Procedures
PCR	Power Coefficient of Reactivity
PIP	Project Improvement Plan
PLiM	Plant Life Management Program
PSD	Permanently Shut Down
PTR	Pool Test Reactor
RAM	Radioactive Materials
RFFL	Recycle Fuel Fabrication Laboratories

SRC	Safety Review Committee
TSSA	Technical Standards & Safety Authority
WHMIS	Workplace Hazardous Materials Information System
WMA	Waste Management Area(s)
WTC	Waste Treatment Centre

2. COMPLIANCE PROGRAMS

AECL compliance program documentation listed and described in the following sub-sections fulfils the applicant submission requirements stemming out of the Nuclear Safety and Control Act and associated regulations, as part of the licensing process. The final sub-section in each of the following program descriptions lists the specific documents.

2.1 Environmental Protection Program

2.1.1 General

The objectives of the AECL Environmental Protection Program are to establish and maintain the overall processes and procedures that implement AECL's environmental policy within AECL owned or operated sites in Canada, and to ensure compliance with legal and policy requirements with respect to protection of the environment.

The AECL Environmental Protection Program applies to operations and activities with sites in Canada owned or operated by AECL insofar as they may affect the environment in and around those sites.

The primary legal requirements related to protection of the environment applicable to operations and activities at AECL sites in Canada, including the CRL site, are:

- Nuclear Safety and Control Act,
- Canadian Environmental Protection Act,
- Canadian Environmental Assessment Act,
- Fisheries Act,
- Transportation of Dangerous Goods Act, and
- Species at Risk Act.

The Environmental Protection Program is defined and described in tiered series of documents:

- A first tier document, *Environmental Management System for AECL Sites in Canada*, CW-509200-OV-113, provides an overview of the program, the key processes, organizational structure and responsibilities for the management and implementation of the program.
- A second tier consists of two series of documents. The Level 2A series (RC-2000-021-1.x) addresses requirements related to ISO-14001 for environmental management. The Level 2B series (RC-2000-021-2.x) defines the key requirements, processes and responsibilities related to environmental performance and compliance to applicable regulations.
- A third tier of company-wide or site-wide documents provide guidelines, procedures, standards and specifications at the working level. At this level are specific procedures related to the control and management of the facility or operations as they relate to environmental protection. Monitoring and measurement processes used to characterize any release of radioactive and non-radioactive substances to the environment exist at the third tier.

The program and documentation meet the ISO-14001 international standard for Environmental Management Systems. Chalk River Laboratories was first registered to ISO 14001: 1996 in 2004, and as a result of a CRL surveillance audit in 2005 June, CRL was re-registered to ISO-14001: 2004.

2.1.2 Program Management

AECL's Management Manual describes distribution of responsibility and authority in the implementation of the environmental policy. The Executive Authority for the Environmental Protection Program is the Vice-President, Nuclear Laboratories. The Program Authority is the Director, Environmental Division.

The Program Manager and staff are responsible for identifying legal and other requirements, developing and maintaining program documents, advising and assisting managers and facility staff to implement environmental protection requirements, preparation and reporting progress of AECL's environmental plan, coordinating environmental compliance monitoring programs and reporting on environmental performance.

2.1.3 Management of Environmental Aspects

Some of the significant environmental aspects of AECL's operations and services that are addressed by the Environmental Protection Program, and are of particular relevance to the CRL licence, are summarized in the following sections.

2.1.3.1 Environmental Aspect Assessment of Existing Facilities and Activities, and Review of Proposed Modifications

The program requires that the environmental aspects of existing operations, activities, products and services be identified and the significance of potential impacts of those aspects be evaluated according to *Environmental Protection Program Manual*, Element 1.3: *Environmental Aspects, Objectives, Targets and Plans*, RC-2000-021-1.3. A review of the environmental aspects of proposed new or modified facilities, operations and activities must be conducted according to *Environmental Protection Program Manual*, Element 2.2: *Environmental Evaluation of Proposed New and Modified Facilities and Activities*, RC-2000-021-2.2. Where required, formal environmental assessments of proposed new facilities or activities are conducted in accordance with the requirements of the Canadian Environmental Assessment Act.

2.1.3.2 Management of Radioactive Emissions

Key requirements and responsibilities for management and control of radioactive emissions from facilities at the CRL site are defined in *Environmental Protection Program Manual*, Element 2.3: *Management of Radioactive Emissions*, RC-2000-021-2.3. The requirements are intended to ensure that emissions are below regulatory limits and are as low as reasonably achievable (ALARA).

Derived Release Limits, calculated following the general methodology of the CSA N288.1 standard, and approved by CNSC staff, serve as the licence limits for emissions of radioactive materials in air and liquid effluents from the site. Current Derived Release Limits for the CRL site are contained in Addendum 1 (see Section 2.1.4) to RC-1731.

AECL has established Action Levels for radioactive emissions from nuclear facilities at the CRL site (see Section 2.1.4), for the purposes of Section 6 (Action Levels) of the Radiation Protection Regulations. Action Levels applicable to CRL were approved by CNSC staff and came into effect in 2003 May as a condition in the CNSC, Nuclear Research and Test Establishment Operating Licence – Chalk River Laboratories, Licence No. NRTEOL-01.00/2006. Exceedances of Action Levels trigger a requirement for specific actions to be taken including reporting to CNSC staff.

In addition, Administrative Levels for radioactive emissions have been established by the Environmental Protection Program staff at levels well below Derived Release Limits and close to "normal" emission levels, and to serve as internal early warning levels to aid in the application of the ALARA principle.

Key requirements and responsibilities for monitoring of radioactive emissions from the CRL facilities and site, and for monitoring of radioactivity and radioactive materials in the environment in and around these sites are defined in *Environmental Protection Program Manual,* Element 2.7: *Radiological Effluent and Environmental Monitoring,* RC-2000-021-2.7. Site-wide programs for quantitative verification monitoring of airborne and liquid effluents from CRL facilities to the environment, and for monitoring radioactivity in the environment in and around the CRL site, are specified and coordinated by Environmental Protection Program staff. The actual monitoring is conducted by groups independent of the direct management of the nuclear facilities on site. The CRL air effluent verification monitoring program is conducted by the Technical Support Section of Safety and Environment Division. Additional measurement support is provided by the CRL Dosimetry Service[1]. The CRL liquid effluent and environmental monitoring programs are conducted by Environmental Technologies Branch. These programs are documented in tier three Environmental Protection Program documents.

Where appropriate, individual facilities maintain separate operational control monitoring programs to provide timely feedback to operating staff on the control of emissions from their facilities or operations. Such programs may range from qualitative to quantitative in nature, and typically are applied upstream of final effluent verification monitoring locations. Documentation and reporting related to facility specific operational control monitoring programs are the responsibility of the individual facilities.

Annual reports of the results of the monitoring programs are submitted to the CNSC as a site licence requirement.

[1] Category II dosimetry service licensed by the CNSC.

2.1.3.3 Management of Non-Radioactive Emissions

Key requirements, responsibilities, and criteria for the management of emissions of non-radioactive materials from AECL sites and facilities are defined in *Environmental Protection Program Manual*, Element 2.4: *Management of Non-Radioactive Emissions*, RC-2000-021-2.4. The nature and emissions routes of non-radioactive contaminants are required to be identified and controlled.

Guidelines and objectives for the quality of emissions are identified in this document or in related tier three level documents.

In particular, company-wide guidelines for effluent concentrations of parameters in discharges from processes are provided in document ENV-2.4-R-01. These guidelines are based on previously existing federal and provincial criteria for industrial discharges, and are applied to process-type discharges from AECL's CRL facilities.

Key requirements and responsibilities for monitoring of emissions of non-radioactive hazardous substances from AECL sites and facilities to the environment are defined in *Environmental Protection Program Manual*, Element 2.8: *Non-Radiological Monitoring*, RC-2000-021-2.8 (CW-509200-REQ-148).

The Environmental Protection Program coordinates a CRL site-wide monitoring program for non-radiological contaminants in liquid effluents. The monitoring program is conducted primarily by the Environmental Technologies Branch, with some other laboratories (AECL and external) performing specific analyses. Annual reports of the results of this monitoring program are submitted to the CNSC as a licence requirement.

There has been no identified need for routine monitoring of non-radioactive hazardous substances to the atmosphere. Emissions of some airborne contaminants from the CRL site are estimated to track performance, typically using emission factor methodology recommended by Environment Canada, and where required are reported to Environment Canada under provisions of the Canadian Environmental Protection Act (e.g., National Pollutant Release Inventory reports, reporting of halocarbon releases under the Federal Halocarbon Regulations).

2.1.3.4 Management of Radioactive Waste

Key environmental requirements and responsibilities for the generation and management of radioactive wastes at AECL sites and facilities are defined in *Environmental Protection Program Manual*, Element 2.5: *Management of Radioactive Waste*, RC-2000-021-2.5. Managers of facilities generating radioactive wastes are responsible for developing waste management plans, minimizing the quantity and degree of hazard of the wastes generated, ensuring that wastes are appropriately characterized and segregated, and ensuring safe interim storage until the waste is transferred to an approved waste receiver. Managers of waste management systems or facilities intended for the collection, transfer, processing, storage or disposal of radioactive wastes on AECL sites are responsible for establishing appropriate waste acceptance criteria, verifying that wastes received meet the acceptance criteria, maintaining records of wastes received, and ensuring the waste management systems or facilities are designed and operated in a manner that minimizes current and future environmental impacts and liability.

2.1.3.5 Management of Non-Radioactive Waste

Key environmental requirements and responsibilities for the generation and management of non-radioactive hazardous and non-hazardous wastes at AECL sites and facilities are defined in *Environmental Protection Program Manual*, Element 2.6: *Management of Non-Radioactive Wastes*, RC-2000-021-2.6. A "3 R's" (reduce, reuse, recycle) philosophy is applied to minimize the quantities and hazard of wastes generated.

Recycling programs are maintained at AECL sites to reduce the amounts of non-radioactive wastes requiring disposal. At CRL the program is operated by Waste Management Operations.

Site-wide programs for collection and management of non-radioactive hazardous wastes are maintained at AECL sites. Hazardous wastes are shipped off-site, in accordance with applicable Provincial regulations, to authorized receivers of hazardous wastes for disposal. The CRL hazardous waste program is operated by Waste Management Operations. The CRL site is registered as a hazardous waste generator with the Province of Ontario.

2.1.3.6 Management of Land and Habitat

Key environmental requirements and responsibilities for the management of land and habitat at AECL sites are defined in *Environmental Protection Program Manual,* Element 2.9: *Management of Land and Habitat*, RC-2000-021-2.9.

Proposed new or changes in land use are to be reviewed through a siting selection and approval process, which includes a review of potential environmental impacts including archaeological considerations.

Proposals to conduct physical works within AECL sites are to be reviewed for potential impacts on the environment. Where proposed works may potentially affect fish habitat in surface waters on or off site, the proposal is to be reviewed in consultation with the Department of Fisheries and Oceans to ensure compliance with the fish habitat protection provisions of the Fisheries Act.

Contaminated sites within AECL sites are to be identified, assessed for significance, and, where appropriate, mitigation or remediation plans developed. At CRL, responsibility for assessing, prioritizing and developing remediation plans for contaminated sites lies with the Liability Management Unit, a division of Decommissioning, Waste Management & Site Projects.

Programs for energy conservation are maintained at AECL sites. At CRL the primary responsibility for the energy conservation program lies with the Infrastructure and Site Services Division within.

2.1.4 Environmental Protection Program Documentation

1. *Environmental Management System for AECL Sites in Canada*, including:
   - Level 1 Overview Document: *Environmental Management System for AECL Sites in Canada*, CW-509200-OV-113, Revision 0, 2006 November.
   - Level 2A Requirements Documents: *Requirements for the Environmental Management System*, RC-2000-021-1.X (series).
   - Level 2B Requirements Documents: *Requirements of the EMS for Environmental Performance and Compliance*, RC-2000-021-2.X (series).
2. *Chalk River Laboratories – Action Levels for CRL Air and Liquid Radioactive Effluents*, RC-2000-021-ENV-2.3-SC-02, Revision 0, 2004 April.
3. *Derived Release Limits for Airborne and Liquid Effluents from Chalk River Laboratories During Normal Operations*, RC-1731, Addendum 1, Revision 0, 1998 November.

2.2 Overall Quality Assurance Program

2.2.1 Quality Assurance Program

The Quality Assurance Program at Chalk River Laboratories applies to all staff and external contractors who participate in, or support, projects or activities at these sites.

AECL has evolved into a fully integrated organization. The organizational structure, roles and responsibilities at the executive and senior management levels, delegation of authority for key aspects of the management system and interfaces with other organizational units within AECL, are described in Revision 1 of the *AECL Management Manual* issued in 2005 April (CW-514000-MAN-002), and this document is currently under revision. The *AECL Management Manual* also covers high-level processes and AECL policies for managing the work carried out within AECL.

The AECL quality assurance documentation structure consists of a series of top-tier and sub-tier manuals, procedures, site and facility specific procedures, and operating instructions that document an integrated approach that is compliant with the CSA-N286 series of standards. All activities are carried out under quality assurance programs meeting these documented requirements. All AECL participants are required to comply with these requirements, and to ensure that activities performed by their contractors and attached staff also meet these requirements.

2.2.1.1 Overall Quality Assurance Manual

The Overall Quality Assurance Manual (00-01913-QAM-010, Revision 3), is AECL's top-tier quality assurance document. It is compliant with CAN/CSA-N286.0-92, *Overall Quality Assurance Program Requirements for Nuclear Power Plants*. The manual defines the policy, scope, applicability, responsibility, and authority for the N286 Program at AECL including functional programs addressing the CAN3-N286.1, CAN3-N286.2, CAN3-N286.3, CAN3-N286.4, CAN3-N286.5, N286.6, N286.7, CAN/CSA-N285.0, ISO 9001:2000, and CSA B51 standards.

2.2.1.2 Nuclear Laboratories, Nuclear Operations Quality Assurance Manual

The *Nuclear Laboratories, Nuclear Operations Quality Assurance Manual* (CW-508200-QAM-112, Rev. 0), is a sub-tier quality assurance manual issued in 2007 January, and supplements the Overall Quality Assurance Manual. This sub-tier manual defines the Nuclear Operations Quality Assurance Program for the operation of nuclear facilities owned and operated by AECL, along with the defined supporting facilities and services. This manual and associated procedures satisfy the requirements of the CSA standards CAN/CSA-N286.0-92, *Overall Quality Assurance Program Requirements for Nuclear Power Plants* and N285.5-95, *Operations Quality Assurance for Nuclear Power Plants*.

2.2.1.3 Facility Documentation

Licence-listed facilities are required to have either an operations Quality Assurance Plan or a Conduct of Operations Procedures Manual that complies with the requirements of the sub-tier Nuclear Laboratories, Nuclear Operations Quality Assurance Manual listed above. These plans or procedures identify how the individual facilities maintain compliance with the applicable requirements.

These facility-specific Conduct of Operations manuals are listed within each facility appendix of this document.

Working level documents consist of working level procedures and documents that identify how the work must be done, on a daily basis, within the work unit. Process-based working instructions provide detailed guidance on how specific tasks are to be conducted and ensure consistency of work practices.

2.2.2 Overall Quality Assurance Program Documentation

1. *Overall Quality Assurance Manual*, 00-01913-QAM-010, Revision 3, 2003 July.
2. Company-Wide Procurement Quality Assurance Manual, 00-01913-QAM-011, Revision 2, 2004 September.
3. Company-Wide Design Quality Assurance Manual, 00-01913-QAM-005, Revision 2, 2003 August.
4. Company-Wide Construction Quality Assurance Manual, 00-01913-QAM-013, Revision 0, 2004 April.
5. Research and Development Quality Assurance Manual, 00-01913-QAM-018, Revision 2, 2005 May.
6. Nuclear Laboratories, Nuclear Operations Quality Assurance Manual, CW-508200-QAM-112, Revision 0, 2007 January.
7. Company-Wide Decommissioning Quality Assurance Manual, 00-01913-QAM-016, Revision 0, 2002 November.
8. Company-Wide Quality Assurance Manual for Analytical, Scientific and Design Computer Programs - Requirements, CW-507230-QAM-102, Volume 1 and Volume 2, Revision 0, 2005 April.

9. Quality Control Manual for the Manufacture, Installation, Repair, Alteration, Replacement and Modification of Pressure Retaining Components to the Latest Edition of CSA B51 and ASME Section VIII Division 1, B31.1 and B31.3 Codes, CRL-508200-QAM-111, Revision 0, 2006 November.
10. Quality Control Manual for the Repair/Service of Pressure Relief Valves to ASME Sections I, IV, VIII -Division 1 and CSA B51 at AECL, Chalk River Laboratories, Chalk River, Ontario, Canada K0J 1J0, FM-01913-QAM-002, Revision 2, 2006 March.
11. Quality Assurance Manual for the Construction of Class 1/2/3 Nuclear Piping Systems, Non-Standard Fittings & NF Piping Supports to CSA N285.0 Standard at Chalk River Laboratories, CRL-508200-QAM-109, Revision 0, 2005 September.

2.3 Security and Fire Protection Program

2.3.1 General

Emergency & Protective Services at CRL organizes and manages the Physical Security program in accordance with the needs of the organization, regulators and key stakeholders. The Emergency & Protective Services group is accountable for Physical Security and the program reports to the Director, Emergency & Protective Services, who reports to the Senior Director, Nuclear Programs.

Corporate Security reports to the Chief Security Officer under Compliance and Corporate Oversight, and supports the Emergency & Protective Services operations.

The Fire Chief, who reports to the Senior Director, Nuclear Programs, manages the fire protection program at CRL.

2.3.2 Physical Security

CRL Protective Services, within Emergency & Protective Services, is structured to provide continuous security coverage of the site. A dedicated crew of personnel is assigned to augment a five-shift rotation during normal company workdays. This ensures adequate staffing levels to meet customer requirements. The Emergency and Protective Services Director oversees the Protective Services Branch comprised of security systems support/personnel, security supervisors, administrative staff, Nuclear Security Officers, and Nuclear Response Force Officers.

CRL Protective Services provides physical protection against unauthorized access and malicious damage to nuclear and non-nuclear facilities, and to specified nuclear materials that are used, processed, stored or possessed by the Company. AECL maintains processes to prevent unauthorized disclosure, destruction, removal, modification or loss of classified, sensitive, designated or valuable assets, whether in physical or electronic form.

AECL remains bound to the provision of security services as described in the Nuclear Safety and Control Act, Nuclear Security Regulations and the Government of Canada Governmental Security Policy. AECL updates security-related documents accordingly, when there are policy changes and government directives.

Regulatory performance is measured by our adherence to applicable policies and procedures in a timely manner. CNSC staff conducts visits and audits of the Physical Security Program to ensure compliance with the Nuclear Security Regulations and the CNSC Nuclear Response Force Standard (S-298).

The Director, Emergency and Protective Services within Nuclear Laboratories also ensures the provision of Physical security at Whiteshell, Douglas Point, Gentilly 1 and Laprade.

2.3.3 Corporate Security

AECL's Corporate Security Program is such that single point accountability is in place for all AECL requirements. To this effect, a Chief Security Officer was appointed. This position is accountable for setting the framework and overall direction, organization and coordination of all aspects of AECL corporate security. The Chief Security Officer also provides oversight of the Physical Security program to ensure that the requirements are properly identified and implemented.

The Chief Security Officer's mandate is structured to administer programs under Personnel Security Screening, Access Control, Security Awareness, Investigative Services, Threat and Risk Assessments, Identification of Assets, and oversight of Regulatory Compliance.

AECL is mandated to comply with Treasury Board and Privy Council guidelines and policies for security at federal facilities and as such is required to ensure appropriate safeguarding of all sensitive information and assets of the Government of Canada.

The Chief Security Officer and Corporate Security liaise with local, provincial, and national police forces as required.

2.3.4 Fire Protection

CRL Fire & Emergency Services is organized into two sections: Fire Prevention and Operations. This structure enables a higher level of fire prevention services and a more comprehensive maintenance and training program. The Fire Chief manages both sections, supported by Deputy Chiefs, Assistant Chief, Fire Prevention Officers, Fire Systems/Protection Engineers and Fire Administration Officers. Four rotating shifts provide continuous on-site fire protection, each shift being comprised of a Fire Lieutenant and Fire Fighters.

Fire and Emergency Services provides services in fire prevention, investigation, fire safety inspection, fire advisory, fire suppression, emergency rescue, hazardous materials response, and medical first aid. Various educational and training programs are continually being developed, improved and delivered to satisfy the needs of AECL.

Applicable requirements for CRL Fire & Emergency Services are the National Building Code of Canada, the National Fire Code of Canada, Fire Protection for Facilities Handling Radioactive Material (NFPA 801) and Canadian Standard Association CSA N293: Fire protection for CANDU Nuclear Power Plants, where applicable at CRL.

The Fire Department is committed to developing Fire Fighter safety, education and training, and priority objectives. A training officer has been hired to lead the emergency response training. Essential training will continue to be delivered and monitored, integrating the International Fire Service Training Association, Ministry of Natural Resources, and Ontario Fire College

programs. Courses taken by Fire Fighters include confined space rescue, high angle rescue, automobile extraction, hazardous materials, fire cause and determination and officer training courses. On-shift training is also conducted at regular intervals.

2.3.5 Security and Fire Protection Program Documentation

1. *Security of Nuclear Materials Program Manual*, 119-508720-MAN-001, Revision 0, 2006 October.
2. *Fire Protection Program Chalk River Laboratories*, CRL-508720-MAN-001, Revision 0, 2005 June.
3. *Chalk River Laboratories Site Security Report*, EPS-14000-RPT-17, Revision 10, 2005 April.
4. Canadian Nuclear Safety Commission, *Nuclear Response Force Standard*, Regulatory Document S-298.
5. National Fire Protection Association, *Fire Protection for Facilities Handling Radioactive Materials*, Standard NFPA 801, 2003 Edition.
6. National Building Code of Canada, 2005.
7. National Fire Code of Canada, 2005.

2.4 Occupational Health and Safety Program

2.4.1 General

AECL places the health and safety of its employees and the public as its highest priority. The AECL Occupational Health and Safety (OHS)[2] Program provides a management framework and processes that, together with active employee involvement, can help to ensure the health and safety of people involved in all aspects of AECL's activities. The AECL OHS Program is applicable to all AECL organizational units, facilities and projects.

It is every employees responsibility to work safely. Management actions and procedures are designed and implemented to provide worker protection. All managers and supervisors are held accountable for the health and safety of persons who report to them. The effectiveness of this program depends on commitment of management to provide a safe and healthy work environment, and on active employee involvement.

The OHS Program addresses the legal requirements of:

- The Nuclear Safety and Control Act and Regulations.
- The terms of the CNSC licences issued to AECL.
- Human Resources and Skills Development Canada, as specified in the Canada Labour Code Part II, and the Regulations Respecting Occupational Health and Safety made under Part II of the Canada Labour Code, and the Safety and Health Committees and Representatives Regulations.

[2] Formerly known as Occupational Safety and Health.

The current AECL Occupational Safety and Health Program Manual establishes the framework for the OHS Program. Further documentation includes processes, procedures, supporting documents, records, forms and training packages to be used in achieving the objectives of the OHS Program. These allow for site-specific and project-specific needs, while still ensuring consistent application of the OHS Program requirements.

The revised OHS Program Manual is in final review and expected to be issued early 2007 April.

2.4.2 Occupational Health and Safety Program Documentation

1. *Occupational Safety and Health Program Manual*, 00-07010-MAN-001, Revision 1, 1999 November.

2.5 Operating Experience Program

2.5.1 General

The Operating Experience (OPEX) Program uses information from within AECL and from external sources to improve the safety of operations, improve operational performance, and reduce the significance and the occurrence of unplanned events at sites in Canada. The OPEX group provides the processes for the identification and investigation of unplanned events, determination of corrective actions, internal notification to stakeholders, and trending and information sharing, both internally and with the nuclear industry in general. The overall objective of the OPEX Program is to achieve higher levels of safety by providing the following processes:

- Internal events are identified, categorized according to their significance, and reported internally, and to regulatory agencies if required, pursuant to the Nuclear Safety and Control Act. Events are screened for applicability and shared with industry peers.
- External events are screened for applicability and significance, and communicated internally.
- A corrective action process is applied to significant events and follow-up is performed to ensure that the corrective actions taken have been effective.
- The causes of internal events are analysed for apparent cause or root cause, the choice of which is dependent on the significance of the event with concurrence from line management.
- Results of investigations are compiled and analysed for trends. Adverse trends are documented and communicated to the responsible line management for investigation as to the cause(s).
- Information gained from operating the facilities is used to improve facility and equipment performance, and operating requirements and practices.
- Information is made available for use in improving design, procurement, construction and commissioning requirements and practices.
- The OPEX Program promotes safety culture, safety awareness and lessons learned.

The program is described in the following documents:

- Nuclear Laboratories Operating Experience Program Manual (see Section 2.5.2),
- Operating Experience Feedback procedure,

- Root Cause Analysis Handbook, and
- Unplanned Event Reporting.

The OPEX group also performs an annual Program Management Review, in accordance with the *AECL Management Manual*, where the effectiveness of the program is assessed, and new objectives and actions are identified.

2.5.2 Operating Experience Program Documentation

1. *NLBU Operating Experience Program Manual*, OPEX-514000-MAN-001, Revision 1, 2005 August.
2. *Operating Experience Feedback*, GEN-CO-C7, Revision 3, 2004 August.
3. *Root Cause Analysis Handbook*, CW-514300-GL-112, Revision 0, 2005 December.
4. *Unplanned Event Reporting*, CRL-508760-PRO-343, Revision 0, 2006 November.
5. *Unplanned Event Reporting*, RC-2000-1132, Revision 2, 2004 July.

2.6 Radiation Protection Program

2.6.1 General

AECL's Radiation Protection Program covers all CRL activities involving ionizing radiation. The program is designed to ensure that AECL complies with, or exceeds, the level of radiation safety that is required by the relevant regulations pursuant to the Nuclear Safety and Control Act.

The objectives of AECL's Radiation Protection Program are to:

- limit doses to less than the regulatory limits;
- limit the risk of detrimental stochastic health effects in employees and members of the public to levels as low as reasonably achievable, social and economic factors being taken into account (ALARA principle); and
- prevent detrimental non-stochastic (deterministic) health effects caused in employees and members of the public by the AECL use of radiation.

At all CRL facilities, these objectives are achieved through facility design, internal and external dosimetry program, staff training, administrative exposure control procedures, contamination control requirements, and work planning and supervision.

An independent Radiation Protection Organization supports the radiation safety responsibilities of line management and employees. The structure of the Radiation Protection organization is provided in RC-2000-633-0, *AECL's Radiation Protection Requirements.* (This document is currently undergoing revision.)

The Radiation Protection Program is based on the following documentation:

- RC-2000-633-0, AECL's Radiation Protection Requirements, and
- RC-2000-633-1, Radiation Protection Manual.

At the lowest level are facility, branch-specific, or other working level documents. These include radiation work plans, procedure documents and Radioisotope Laboratory Protocols. All CRL employees and contractors receive formal initial and ongoing radiation protection training corresponding to their work and responsibilities in the use and handling of radioactive materials.

Program reviews are conducted annually and improvement initiatives arising from the review are tracked through the Actions/Issues Management System Program (see Section 3.5.3).

As part of the ALARA program, dose Action Levels, radiological hold points, and individual Dose Control Points have been established to trigger investigations and, if found appropriate, corrective actions when these levels are exceeded. These internal AECL limits are significantly below the dose limits defined in the CNSC *Radiation Protection Regulations*.

2.6.2 Dosimetry Services

Chalk River Laboratories maintains external and internal dosimetry programs that monitor, assess, record, and report doses of ionizing radiation received by AECL employees, visitors, and contractors as a result of AECL activities. The primary functions of the dosimetry program include demonstration of regulatory compliance, assessment of the effectiveness of the Radiation Protection Program, providing required information for work planning, dose control and ALARA programs, and providing personal dose information for employees. Radiation doses received either in Controlled or Supervised Areas are normally monitored individually. Individuals that regularly handle radioactive materials where there is the potential of intakes that could lead to a recordable Committed Effective Dose of 1 mSv participate in a routine bioassay program. The requirements and design of the internal and external dosimetry programs are described in RC-2000-633-0 and RC-2000-633-1.

The dosimetry services are provided by the Radiation Biology and Health Physics Branch and this activity is licensed directly by the CNSC. The CRL Dosimetry Service Licence was renewed in 2005 for the period 2005 June 1 to 2010 May 31. The *Dosimetry Services Quality Assurance Manual*, DSP-01913-QAM-001, is the Policy Level document for the Dosimetry Quality Assurance Program. This program covers planning, documenting, executing, and verifying dosimetry monitoring work carried out by AECL's Dosimetry Services. Processes that are used to implement the requirements of the Dosimetry Services Quality Assurance Manual and the requirements of CNSC document S-106, *Technical & Quality Assurance Requirements for Dosimetry Services in Canada* are given in DSP-01913-QAM-002, *Dosimetry Services Quality Assurance Administrative Procedures Manual.* Working-level procedures are used to conduct measurements, and the recording and reporting of dosimetry results.

2.6.3 Radiation Protection Program Documentation

1. *AECL Research's Radiation Protection Requirements*, RC-2000-633-0, Revision 2, 2000 October.
2. *AECL Radiation Protection Manual*, RC-2000-633-1 a collection of AECL's radiation protection procedures and requirements.
3. R.P. Lambert, Letter to W.G. Martin, *Action Levels,* SERP 02-053, 2002 March 19.

4. R.P. Lambert, Letter to W.G. Martin, *Actions Levels for AECL's Chalk River (CRL) and Whiteshell Laboratories (WL)*, SERP 02-245, 2002 July 12.
5. Dosimetry Service Licence, No. 20004-17-10.1. Expiry Date: 2010 May 31.
6. *Dosimetry Services Quality Assurance Manual*, DSP-01913-QAM-001, Revision 1, 2005 July.
7. *Dosimetry Services Quality Assurance Administrative Procedures Manual*, DSP-01913-QAM-002, Revision 0, 2003 November.

2.7 Emergency Preparedness Program

2.7.1 General

AECL's Emergency Preparedness (EmP) Program defines and describes the organizational structure, responsibilities, and processes, and reports on the implementation of the AECL *Health and Safety*, and *Environment* policies with respect to emergency preparedness within AECL sites. The EmP Program ensures that all of the components of emergency preparedness and response are effectively maintained.

The EmP Program comprises planning, exercises and training to ensure that the processes are in place to control and to mitigate the consequences of an emergency at CRL, as well as the emergencies related to the transportation of nuclear materials.

The program structure and requirements are documented in EMP-508000-MAN-001, *Emergency Preparedness Program Requirements Manual*. The Nuclear Laboratories organization is specified in AECL's Management Manual as being responsible for the compliance management of the emergency preparedness requirements for operation at AECL sites in Canada and the business processes related to Emergency Preparedness. As such, the Vice-President, Nuclear Laboratories is the designated Executive Authority for the Emergency Preparedness Program. In addition, the Senior Director, Nuclear Programs is the designated authority for the company-wide EmP program.

The EmP Program Authority is appointed by the Senior Director, Nuclear Programs and has the authority and is responsible for defining and implementing the EmP Program.

As required by the CRL site licence, the EmP Program carries out an annual program review that covers the organization, drills, exercises, training, documentation, interactions with outside agencies and status of emergency preparedness.

The EmP Program uses the following performance measures to assess site-wide compliance with program requirements:

- Emergency procedures are reviewed annually and revised as required.
- Designated personnel are trained in their emergency response duties.
- Facility/building personnel conduct and/or participate in drills and exercises as identified in the annual exercise schedule.
- Emergency equipment is maintained in a state of readiness and quarterly confirmation is reported to the EmP office.

AECL has in place, and is continuously improving general and specific plans to enable appropriate responses to be made on short notice to various emergency situations that might arise. These plans define the on- and off-site response procedures and the communications and organizational arrangements that would be brought into effect to deal with an emergency situation.

Lower-level procedures are prepared by building/facility/branch staff to ensure a planned, orderly, and timely response to a building or site-wide emergency condition, and to support off-site arrangements. The building procedures identify specific hazards and provide actions to be taken by the staff and by designated building emergency teams. The Building Emergency Procedures are reviewed annually and are revised as changes occur. The communication protocols and emergency response activities identified in these procedures are integrated with the CRL Site Emergency Plan and the EmP Program Requirements Manual.

The CRL Exercise and Drill Plan outlines the exercise program over five years. It is used to develop an annual schedule. Approximately 50 drills are conducted annually. The drills and exercises are used to train staff, test and validate plans and procedures for on-site and off-site response. Briefing sessions are held after every drill and exercise to discuss objectives, actions taken during the response, and lessons learned. The actions and recommendations are documented in final reports and lessons learned are used to improve future response and the EmP program.

Training of the emergency response personnel is in place to ensure that personnel have the required skills and knowledge to perform their assigned functions. The training program was developed in accordance with AECL's Systematic Approach to Training and supporting documents.

2.7.2 Emergency Preparedness Program Documentation

1. *Emergency Preparedness Program Requirements Manual*, EMP-508000-MAN-001, Revision 1, 2005 February.
2. *Chalk River Laboratories Site Emergency Plan*, CRL-508000-PLA-001, Revision 0, 2003 October.
3. *Chalk River Laboratories Site Emergency Plan*, CRL-508000-PLA-001, Addendum 1 to Revision 0, 2004 March.

2.8 Nuclear Materials and Safeguards Management Program

2.8.1 General

The overall objective of the Nuclear Materials and Safeguards Management Program is to ensure that processes and interfaces involved in the management and safeguards of nuclear materials adhere to the terms of the Treaty on the Nuclear Non-Proliferation of Nuclear Weapons, the Canadian Nuclear Safety and Control Act, as well as applicable international, federal and AECL company-wide requirements. The program oversees the procurement, transfer, accounting, safeguards and storage of nuclear materials to ensure that all requirements are met.

The controls of nuclear materials are discussed in the following sections.

2.8.2 Procurement

Procurement of fissionable materials, heavy water, radioisotopes, and radiation sources is the responsibility of Nuclear Programs - Nuclear Materials Management and Radioactive Materials Transportation (NMMT). When procuring nuclear materials, a written request is submitted from the requisitioner to the Procurement and Safeguards Policy Program Officer (at Chalk River Laboratories, NMMT). The Procurement and Safeguards Policy Program Officer determines the contractual parameters and any licensing aspects to import/export the nuclear materials, and to ensure that all necessary approvals are obtained from the CNSC, as required.

When necessary, the Procurement and Safeguards Policy Program Officer makes the arrangements for the transportation for the nuclear materials, ensuring that the transport/forwarding agent, acting on AECL's behalf, is qualified and adequate security is provided as required by Emergency and Protective Services and regulatory requirements. The Procurement and Safeguards Policy Program Officer, along with the Radioactive Materials Transportation and Storage Program Officer, will also determine and arrange for the appropriate packaging required to ship the materials in order to comply with applicable regulations.

2.8.3 Nuclear Material Control

Movement of nuclear materials is controlled by ensuring the material is radiologically safe to move, that is, free of contamination and radiation hazards as per RC-2000-633-0. Furthermore, the movement is made in accordance with the rules laid out for criticality control. An accountability control system is maintained for each of the Material Balance Areas to record the transaction and maintain the balance of nuclear materials within the Material Balance Areas. Emergency and Protective Services is involved, as required in the movement of materials.

2.8.4 Shipment of Nuclear Materials Off-Site

Control of transportation of nuclear materials to and from AECL sites is maintained by ensuring all shipments follow the requirements in 9200-01900-MAN-001, (Revision 0, 2004 July, *Radioactive Materials (RAM) Transportation Compliance Program)*.

2.8.5 Inventory Management Control

Heavy water, tritium, fissionable materials, and radioisotopes at Chalk River Laboratories are nuclear substances that are controlled in accordance with relevant sections of the Nuclear Safety and Control Act.

Separate accounting systems have been developed to satisfy the requirements of AECL management and the Nuclear Safety and Control Act relating to nuclear substances. Nuclear Programs-NMMT is responsible for the accounting and control of the various inventories at Chalk River. These accounting systems and inventories are open to inspection and audit by the CNSC and the International Atomic Energy Agency (IAEA).

To help achieve accurate and efficient accountability control of fissionable material, AECL has been sub-divided into a number of Material Balance Areas with well-defined physical boundaries, within which fissionable materials are held in inventory. The purpose of the accounting system is to document the transfer of fissionable material to, from, and within the

AECL sites and to ensure that accurate records are maintained. At least twice a year, each Material Balance Area must complete a physical inventory of its stock of fissionable material and submit a report in the form of a physical inventory listing to Nuclear Programs-NMMT. The physical inventory listing will document the amount of fissionable material by location, and physical and chemical form. All variances between inventory listings and ledgers maintained by the Material Balance Area and the fissionable material ledgers, maintained by Nuclear Programs-NMMT are investigated. Physical inventories and associated records are audited by the IAEA, as required under the Treaty on the Non-Proliferation of Nuclear Weapons.

Accountability control of heavy water and tritium inventories is maintained and adjusted by a series of signed nuclear material vouchers. Each transaction is uniquely identified, verified, and audited by Nuclear Programs-NMMT. All variances between inventory listings and ledgers are investigated and resolved.

2.8.6 Safeguards

To meet Canada's obligations under the Treaty on the Non-Proliferation of Nuclear Weapons, a mandatory Safeguards Program has been implemented at AECL. One component of the Safeguards Program is outlined in AECB-1049, *Reporting Requirements for Fissionable and Fertile Substances.* This document defines the national system of accounting for the control of nuclear materials within Canada. Nuclear Programs-NMMT ensures that the requirements of the CNSC are put in place and maintained. The program involves regular and unannounced inspection visits by IAEA Inspectors to carry out spot-checking of physical inventories of unirradiated and irradiated fissionable material, audit monthly inventory accounting records and compare records with actual quantities. Annually, AECL is also required to provide information about all areas, buildings and activities at each AECL site in Canada. The IAEA confirms the submitted information by performing random, unannounced inspections.

2.8.7 Nuclear Materials and Safeguards Management Compliance Program Documentation

1. *Nuclear Materials and Safeguards Management Compliance Program Manual*, 9100-01900-MAN-001, Revision 0, 2005 April.
2. *Radioactive Materials (RAM) Transportation Compliance Program*, 9200-01900-MAN-001, Revision 0, 2004 July.
3. *AECL's Radiation Protection Requirements*, RC-2000-633-0, Revision 2, 2000 October.

2.9 Radioactive Material Transportation Program

2.9.1 General

The program document, *Radioactive Materials (RAM) Transportation Compliance Program*, establishes and describes in detail the process to be used for the safe transport (both shipments sent off-site and receipt of shipments on-site) of radioactive materials.

This program is administered by Nuclear Materials Management and Radioactive Materials Transportation (NMMT), within Nuclear Programs. The Branch Manager of Nuclear Programs-NMMT is the RAM Program Authority.

2.9.2 Objectives

The overall objectives of the program are:

1. Protect persons, property and the environment from the effects of radiation during the transport of radioactive material by establishing and maintaining mandates necessary to facilitate the safe transport of RAM to and from AECL sites in accordance with regulatory requirements. Transport encompasses all operations associated with the movement of RAM, such as: security, emergency response, regulatory permits/licences/certifications, packaging, markings, and documentation as identified in applicable laws, standards and regulations.
2. To adhere to the quality assurance program as outlined in the CNSC regulations and Appendix IV of IAEA Safety Guide, *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material* and *AECL's Overall Quality Assurance Manual*. It is the aim of these regulations and internal policies to achieve, through the application of effective quality and compliance assurance, the safety of the public and workers in the transport of radioactive material.
3. Incorporate specific requirements identified by the CNSC, Transport Canada, International Air Transport Association, International Civil Aviation Organization, the International Maritime Organization and the IAEA, as set out in a number of provincial, federal and international regulations.
4. Incorporate requirements specified internally by the *AECL Management Manual* and the AECL Safety Review Committee.

This program applies to all AECL personnel at all AECL sites in Canada.

2.9.3 Emergency Response

The Nuclear Programs-NMMT, through the AECL Radioactive Material (RAM) Transportation Compliance Program Authority, ensures that an Emergency Response Plan for potentially dangerous occurrences involving radioactive material shipped from all AECL sites, as required by EMP-508000-PLA-001, ERP2-1456, *Response Plan for Off-Site Transportation Accidents Involving Radioactive Material*, is in place. The RAM Program Authority also ensures that all personnel involved in the transportation process are aware of the emergency response requirements.

The Emergency Response Plan is registered with Transport Canada. The RAM Program Authority ensures that all unplanned events pertaining to the transport of radioactive materials are investigated, documented, and reported to the regulatory authorities in accordance with regulatory requirements.

2.9.4 Transportation of Radioactive Materials Program Documentation

1. *Radioactive Materials (RAM) Transportation Compliance Program*, 9200-01900-MAN-001, Revision 0, 2004 July.
2. *Response Plan for Off-Site Transportation Accidents Involving Radioactive Material*, EMP-508000-PLA-001, ERP2-1456, Revision 0, 2004 March.

2.10 Nuclear Criticality Safety

2.10.1 General

The Nuclear Criticality Safety Program documents how AECL prevents criticality accidents through appropriate design, analysis, operations, and decommissioning of facilities involving fissionable materials. This Nuclear Program specifies the requirements to fulfill company business, regulatory, environment, health, safety and quality assurance responsibilities.

Nuclear Programs - NMMT administers this Program.

2.10.2 Objectives

The Nuclear Criticality Safety Program provides a framework for ensuring compliance with all applicable laws, regulations, company policies and procedures. It defines nuclear criticality safety practices consistent with international standards to control and minimize the potential for an out-of reactor criticality incident. This Program integrates the necessary principles and controls into all AECL Chalk River Laboratories activities that could affect the use, processing, transfer, storage and disposal of fissionable materials or the consequences of failures in the use, processing, transfer, storage and disposal of this material.

The Nuclear Criticality Safety Program requires that criticality safety analysis be conducted and that processes and procedures be established to provide assurance that a sufficient safety margin is established. The safety margin shall be maintained under normal and credible abnormal conditions.

2.10.3 Program Implementation

This Nuclear Program addresses Condition 14.2 of the Nuclear Research and Test Establishment Operating Licence for Chalk River Laboratories, CNSC licence NRTEOL-01.00/2011. This Program defines a new AECL Nuclear Program that demonstrates clear alignment with the ANSI/ANS-8 standards, and will be implemented beginning in 2007 January.

In 2007, AECL will begin to develop program procedures. Using initial versions of these procedures, AECL will update the Nuclear Criticality Safety Analyses and Criticality Safety Documents (CSDs) on a risk-graded basis. The procedures will be refined based on experience with updating the Nuclear Criticality Safety Analyses and CSDs for the five most significant facilities, and will result in a baseline set of program procedures.

In parallel with updating the Nuclear Criticality Safety Analyses and CSDs on a risk-graded basis beginning with the most significant facilities, CRL will continue to review, revise and approve CSDs at Chalk River Laboratories in accordance with past AECL nuclear criticality

safety practices. CSDs require approval to authorize changes (e.g., design or use) that could affect criticality safety, as well as periodic review and re-approval. To the extent possible, these CSDs will be updated to meet or move closer to meeting the requirements in this Program. This approach updates the CSDs on a risk-graded basis and takes advantage of necessary CSD re-approvals to complete the implementation of the Program as soon as possible.

2.10.4 Independent Review

The AECL Nuclear Criticality Safety Panel is a permanent subcommittee of the AECL Safety Review Committee (SRC), which performs oversight and independent review, reporting to the President through the Vice President for Compliance and Corporate Oversight. The SRC operates independently of the line organization, and acts for the Board of Directors, President and Chief Executive Officer in matters of health, safety and the environment. Members of the Nuclear Criticality Safety Panel are experts in the fields that are relevant to nuclear criticality safety.

The Nuclear Criticality Safety Panel is responsible for:

- reviewing, and if found satisfactory, approving all CSDs;
- reviewing and if found satisfactory, approving reports and other documents;
- Unplanned Event Reports, relating to criticality safety;
- reviewing and approving the removal of Balance After Processing burdens;
- reviewing and accepting criticality safety training material;
- reviewing and accepting Nuclear Criticality Control Officer appointments; and
- participating in independent audits of the Nuclear Criticality Safety Program, nuclear criticality training programs, safety practices and compliance with procedures relevant to criticality safety.

2.10.5 Nuclear Criticality Safety Documentation

1. *Nuclear Criticality Safety Program*, 190-123400-MAN-001, Revision 0, 2006 December.

3. AUXILIARY PROGRAMS

3.1 Maintenance Program

3.1.1 General

A comprehensive maintenance program complements and supports all facility operations and infrastructure at Chalk River Laboratories. The reliability and effectiveness of equipment, as described in the relevant safety reports and other submissions, are achieved through a balance of planned and controlled preventive and corrective maintenance. The Site Maintenance Division within Nuclear Operations is responsible for developing standards for maintenance planning, execution and related activities and these are described in a series of documents, Conduct of Operations for Maintenance. These are a sub-set of the *Conduct of Operations Manual*, FNO-01900-COP-001. The elements of these operations documents include:

- General Maintenance,
- Maintenance Procedures,
- Maintenance Planning,
- Corrective Maintenance,
- Preventive Maintenance,
- Calibration of System Instrumentation,
- Periodic Maintenance,
- Measuring and Test Equipment, and
- Replacement Item Management.

The Site Maintenance Division is responsible for the development of the facility maintenance programs that meet the design and operating requirements of the facility, on behalf of the Facility Authority. The maintenance programs are described in the Facility Maintenance Plans, which now exist for all licence-listed facilities at the CRL site. This contributes significantly to the achievement of quality targets and performance over the broad infrastructure that exists at the CRL site. The Site Maintenance Division is also responsible for the development of Maintenance Working Procedures and Instructions.

A Computerized Maintenance Management System, MP5, managed and operated by the Work Management Branch within Business Operations, forms the basis of scheduling and other management aspects of facility-by-facility maintenance on the CRL site. Management and staff of each facility listed in the Appendices are responsible for ensuring that maintenance is undertaken as required. At CRL, the Work Management Branch is responsible for prioritising, planning and scheduling of any required maintenance, and interfaces closely with the facilities and Site Maintenance Division who carry out the work, as required.

Maintenance facilities are provided at the CRL site under the management of the Site Maintenance Division to perform maintenance on all systems and components. The maintenance personnel receive training in the required skills and an aggressive use of apprenticeship programs ensures the long-term availability of specialized skilled trades personnel. Each Facility Manager is responsible for approving maintenance requests within the facility and approving necessary work permits.

The Site Maintenance Division, within Nuclear Operations, is responsible for the execution of all work and for:

- providing maintenance services for all nuclear facilities;
- landlord maintenance and maintenance services within research and development facilities at CRL;
- training and qualification of maintenance personnel;
- calibration and initial servicing of new safety relief valves, and the servicing of safety relief valves at CRL[3];
- providing calibration services for instrumentation and measurement of test equipment at CRL; and
- welded structures at CRL[4].

There is a full time maintenance team, dedicated to the National Research Universal (NRU) Reactor, under the supervision of the Director, Site Maintenance Division. They are also responsible for providing maintenance services on the safety systems of the ZED-2 Reactor.

3.1.2 Maintenance Program Documentation

1. *Nuclear Laboratories Nuclear Operations Quality Assurance Manual*, 145-01913-QAM-001, Revision 1, 2005 August.
2. *Conduct of Operations: Facilities and Nuclear Operations*, FNO-01900-COP-001 (Various issue dates for sections).

3.2 Radioactive Waste Management Program

3.2.1 General

The mandate of Waste Management Operations, at Chalk River Laboratories is the safe and reliable management of solid and liquid radioactive wastes. This organization is responsible for waste processing and storage operations and for operating a waste management service for CRL and external customers.

Waste Management Operations, operates the Waste Treatment Centre (per Facility Authorization document AECL-FA-16 – see Appendix I) and the Waste Management Areas (per AECL-FA-18 – see Appendix K).

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[3] The safety relief valve repair shops for Controlled Area 1 and Controlled Area 2 have been audited and certified by the Technical Standards & Safety Authority (TSSA).

[4] CRL has been certified by the Canadian Welding Bureau to the requirements of CSA W47.1 as a Division 1 Certificate Holder.

3.2.2 Solid Waste Management

All solid radioactive waste generated by AECL facilities is stored in designated areas at the CRL site – see Appendix K for details of the Waste Management Areas at CRL. Pending the availability of disposal facilities, wastes are managed using a variety of facilities, including concrete canisters, tile holes, bunkers and Modular Above Ground Storage.

Radioactive solid wastes generated in CRL consist of contaminated equipment, irradiated materials (including fuels), and a wide variety of wastes resulting from maintaining and operating the nuclear facilities at the sites.

3.2.3 Liquid Waste Management

Liquids containing a high-level of radioactivity are stored in stainless steel tanks pending the availability of future permanent disposal facilities. The storage tanks are monitored on a routine basis to ensure that leakage has not occurred.

Liquids containing low-levels of radioactivity are stored in tanks, and are monitored and processed as required.

Depending on the activity level of the liquid, processing may include:

- delay and decay,
- microfiltration and reverse osmosis, and
- evaporation.

One of the primary objectives in the processing of liquid radioactive wastes is to concentrate the radioactive contaminants and to subsequently immobilize those contaminants. The immobilized wastes are stored in the CRL Waste Management Areas.

The primary operation for the Waste Treatment Centre is the liquid waste evaporator, allowing liquid waste from the Decontamination Centre, the Chemical Active Drain System, and the NRU Reactor drains system to be routinely treated. The distillate produced from the liquid waste evaporator is monitored against acceptance criteria and, if acceptable, is discharged to the Ottawa River through the Process Sewer.

3.2.4 Gaseous Emissions, Environmental Control

The active ventilation systems of AECL facilities are used for cooling thermal columns in the reactors and removing radioactive species and other hazardous contaminants in the air from other areas, such as radioactive laboratories. In all areas where airborne contamination is reasonably expected, the radioactive species are removed by a filtration system. All active ventilation systems contain High-Efficiency Particulate Air (HEPA) filters, and – in areas where there is likelihood that radioiodines may be present – are combined with High-Efficiency Charcoal Adsorbers.

During normal operation, the NRU Reactor thermal column ventilation systems do not contain significant quantities of radioiodines, and are vented through roughing and HEPA filters located in a dedicated filter building associated with the main reactor stack. It is recognized that radioiodines could be released during some operations, and would be present in the event of a severe reactor accident. In order to reduce the radioiodine releases on these occasions, a separate

Emergency Filtration System, incorporating both charcoal adsorbers and HEPA filters, is placed on-line and bypasses the normal filters. The Emergency Filtration System serves the NRU Reactor and comes on-line automatically in the event of high radiation levels in the exhaust stream (accident conditions) or may be put on-line manually.

The effectiveness of the gaseous effluent management systems is continuously monitored and routinely tested to ensure that releases to the environment remain at small fractions of the site Derived Release Limits (see Section 2.1 of this document).

3.2.5 Radioactive Waste Management Program Documentation

1. *Management of Radioactive Waste,* RC-2000-021-2.5, Revision 1, 2001 October.
2. *Management of Non-Radioactive Waste,* RC-2000-021-2.6, Revision 1, 2001 October.
3. *Management of Radioactive Emissions,* RC-2000-021-2.3, Revision 3, 2005 June.
4. *Management of Non-Radioactive Emissions,* RC-2000-021-2.4, Revision 2, 2005 June.
5. *Radiological Effluent and Environmental Monitoring,* RC-2000-021-2.7, Revision 3, 2005 July.

3.3 Training Program

3.3.1 General

The fundamental goals of AECL's training programs are to:

- identify and design training targeting any specific need to increase knowledge, skills, and competencies;
- develop customized training programs for all job levels, with particular expertise in the technical areas;
- conduct training process and program evaluations and validations as required;
- assess, value and cost effectiveness of courses required to be offered internally; and
- ensure that the programs developed comply with regulations and meet with the requirements of internal as well as external regulatory bodies.

Specific information on the Organizational Development & Training group and the Radiation Protection Training is presented below.

3.3.2 Organizational and Technical Training

The Organizational Development & Training group supports managers and their work teams in their efforts to accomplish performance objectives, enhance their effectiveness, meet job competency/qualification requirements, and achieve the goals of AECL. Specifically, the group provides service in the following areas: facilitation and consulting, training design and development, coordination and conduct of training, and implementation of the systematic approach to training (as identified in *AECL Systematic Approach to Training*, CW-510000-MAN-001).

Numerous instructor-led and computer based courses are offered internally, targeted at knowledge and skills training generic to AECL in the following program areas:

- General and Safety Orientation/Contractor Safety and Orientation;
- Basic Skills Training (i.e., Writing, Effective Presentation, etc.);
- Computer Skills Training;
- Technical (i.e., Nuclear Theory, Equipment Principles, Waste Management, etc.);
- Compliance Programs (i.e., Emergency Preparedness, Environmental Protection, etc.);
- Safety (i.e., Fire, First Aid, WHMIS, etc.);
- Leadership/Management; and
- AECL Systems/Programs/Processes.

3.3.3 Radiation Protection Training Program

Radiation Safety and Emergency Preparedness Division, is responsible for the development and implementation of Radiation Protection Training at AECL. The Radiation Protection School, a section of Radiation Safety and Emergency Preparedness Division, is responsible for the development and maintenance of radiation protection training material consistent with the requirements of *AECL's Radiation Protection Requirements* document, RC-2000-633-0.

AECL continues to recognize that a good understanding and knowledge of the hazards associated with radiation work, correct use of protective measures against these hazards, and a high level of competence in one's trade are crucial in ensuring the safe operation of nuclear facilities. In order to determine responsibilities and required competence under *AECL's Radiation Protection Requirements* document, RC-2000-633-0, it is required that all AECL employees and contractors at licensed nuclear sites be designated into one of four groups. The degree of radiation work control exercised for AECL employees will be commensurate with the level of individual responsibility assigned to each of the four employee groups. An outline description of these group designations and the associated degree of training is given below:

- **Group 4** employees are those who do not normally handle radioactive materials and/or work with radiation-emitting devices. They are neither trained nor authorized to undertake radiation work except in unusual circumstances under the strict provisions of a Work Permit.

  The information imparted in Group 4 radiation protection training is sufficient to meet the CNSC regulatory requirements for Nuclear Energy Worker designation. Accordingly, the training addresses the following topics:

  (1) AECL commitment to a sound safety culture;
  (2) access and working restrictions;
  (3) Work Permit requirements for Group 4 employees;
  (4) recognition of radiation warning signs and alarms;
  (5) recognition of radiological controlled areas and zones;
  (6) risks associated with radiation to which the person may be exposed to during the course of their work;

(7) risks and hazards for embryo and foetus;

(8) applicable dose limits; and

(9) meaning of employment as a Nuclear Energy Worker.

- **Group 3** employees are those who only handle radioactive materials or work with radiation-emitting devices while under a valid Work Permit.

  In addition to receiving the Group 4 training, the training of Group 3 employees is augmented so as to provide the employee with the skills and knowledge required to perform radiation work safely, while under a valid Work Permit. The training is specific to those hazards to which the employee is exposed during routine operations, or to which the employee may be exposed while controlling unplanned events and emergencies.

- **Group 2** employees are those who normally work with radioactive materials and with radiation-emitting devices within a defined routine envelope, and in accordance with detailed procedures and protocols that have been reviewed and approved by a Group 1 employee in advance.

  In addition to receiving the Group 3 training, the training of Group 2 employees is augmented so as to provide the employee with the required skills and knowledge to perform radiation work independently while performing routine, authorized operations. The training is specific to hazards to which the employee is exposed during routine operations, or may be exposed to in order to control unplanned events and emergencies in the employee's normal area of work.

- **Group 1** employees are those who are trained and qualified as radiation protection specialists reporting to the Radiation Protection Program Manager designated by the Radiation Protection Program Authority for the site or facility. Group 1 employees are responsible for providing radiation safety assessments and advice on the appropriate protection for any radiation work.

  The training for Group 1 employees provides all individuals in any of the occupations within Group 1 with both the theoretical knowledge and skills necessary to routinely take care of the radiation protection of others, including conducting radiation safety assessments, and providing authoritative advice to other AECL and non-AECL employees.

3.3.4 Training Program Documentation

1. *AECL Research's Radiation Protection Requirements, Section 11.3: Radiation Protection Training and Qualifications*, RC-2000-633-0, Revision 2, 2000 October.
2. *AECL Radiation Protection Manual, Section 3: Qualifications and Training*, RC-2000-633-1. (Various dates of issue.)

3.4 Safety Review Committee

3.4.1 General

AECL's commitment to the health and safety of persons and to the protection of the environment (HSE) is expressed through AECL's *Health and Safety*, and *Environment* policies. As part of this commitment to HSE, the AECL Safety Review Committee was established to review operating activities at AECL sites to ensure that they are acceptable. This committee operates independently of the line organization, and act for the Board of Directors and the President and Chief Executive Officer in matters of health, safety, and environment.

The AECL SRC was established in 1991 to review operating activities at AECL sites. The SRC *Terms of Reference* defines the mandate of the committee, which is to review the activities of the line organization at all AECL sites in Canada to assure that these activities are conducted in accordance with HSE regulations, policies, procedures, and good practice.

The AECL SRC is not responsible for obtaining regulatory licences or approvals from the CNSC or any other regulatory or jurisdictional body. Responsibility for obtaining regulatory licences and approvals rests with the appropriate line management, as defined in the *AECL Management Manual*.

Reporting to the AECL SRC are a number of subcommittees, most notably the Nuclear Criticality Safety Panel, which is responsible for reviewing, evaluating and approving activities involving fissionable material on behalf of the SRC.

AECL's requirements for independent review are defined in the document listed below.

3.4.2 Safety Review Committee Documentation

1. *AECL Safety Review Committee,* 00-832.1, Revision 0, 1999 September.

3.5 Licensing

3.5.1 General

The Licensing Division within Regulatory Affairs and Safety Analysis was established to coordinate and manage AECL contact with CNSC staff and to interface, as required, with the CNSC Secretariat regarding AECL's attendance at Commission public hearings and public meetings. The Director of Licensing reports to the Chief Regulatory Officer, who is mandated to provide overall coordination of the various licensing activities related to AECL nuclear facilities and operations, including waste management and decommissioning.

Various processes and mechanisms have been established to fulfil the obligations of the Licensing Division, as summarized in the sections below.

3.5.2 External Correspondence Database

A system has been established whereby all correspondence between external regulatory agencies (e.g., CNSC staff, or Secretariat, Environment Canada, etc.) and AECL CRL is provided to the Licensing Division. This correspondence is logged within an External Correspondence Database, the substance of which provides input for action tracking as described in Section 3.5.3.

3.5.3 Actions/Issues Management System

The Actions/Issues Management System (AIMS), managed by the Licensing Division, is an application used for tracking the status and progress of actions that must be completed in order to resolve issues. In fiscal year 2005/2006, the AIMS database was upgraded to improve management oversight of issues and corrective action tracking as well as trending capability.

3.5.4 Licensing Documentation

1. *Licensing Basis Document for Chalk River Laboratories*, CRL-00521-LBD-001, Revision 0, 2005 November.

3.6 Pressure-Retaining Systems and Components Program

3.6.1 General

AECL operations are licensed under the federal Nuclear Safety and Control Act by the CNSC. AECL also comes under the jurisdiction of Human Resources Development Canada (formerly Labour Canada).

In the area of nuclear and non-nuclear pressure-retaining systems, it is a condition of the CRL site licence granted by the CNSC that AECL complies with the CSA National Standards: CAN/CSA-N285.0, *General Requirements for Pressure-Retaining Systems and Components in CANDU Nuclear Power Plants*, and CSA B51 (Boiler, Pressure Vessel & Pressure Piping Code), respectively.

In Ontario, and hence at CRL, the CNSC has contracted the Jurisdictional Authority duties to the TSSA, who act on behalf of the CNSC.

AECL designs, installs, operates, and maintains pressure-retaining systems and components at its Chalk River site ranging from nuclear systems to conventional service systems and test rigs. These activities are carried out under approved Quality Assurance programs.

The procedure listed in Section 3.6.2 describes the processes for code classification and design registration of these systems and components with the regulatory authorities. Shop fabrication of pressure-retaining components in the Building 412 machine shop is authorized under a Certificate of Authorization for B-51 work. Field installation and repairs are done under separate Certificate of Authorization approved for N-285.0 and B-51 work, respectively. The Quality Control Manuals associated with these programs have been approved and accepted by the TSSA acting on behalf of the CNSC.

For the Periodic Inspection Program for nuclear systems, N285.0 refers to CAN3-N285.4, *Periodic Inspection of CANDU Nuclear Power Plant Components*, which AECL follows.

For periodic inspection of non-nuclear systems, the Boiler & Pressure Vessels Act of Ontario and Human Resources Development Canada regulations are followed.

For all conventional or Class 6 pressure vessels at CRL, the Inspection Authority is AECL's insurance carrier, GCAN Insurance Company. Personnel from this insurance carrier are authorized by TSSA to undertake periodic inspection of CRL's boilers and pressure vessels. Nuclear pressure vessels at CRL, the Inspection Authority is the TSSA. Inspection Certificates for CRL, issued by the insurance carrier or the TSSA, are retained by each facility.

3.6.2 Pressure-Retaining Systems and Components Program Documentation

1. *Code Classification and Design Registration of Pressure Retaining Systems and Components*, Procedure 120-541.3, Revision 3, 2004 May.

4. NUCLEAR OPERATIONS

4.1 General

AECL is engaged in a broad range of nuclear-related activities at the CRL site and operates facilities that include nuclear reactors, nuclear fuel fabrication facilities, radioactive waste storage facilities as well as specialized radioisotope laboratories. AECL operates its facilities and conducts work in them under established quality management systems that meet the requirements of quality standards CAN/CSA N286 and ISO:9001: 2000.

All Class I and Class II facilities are listed on the CRL site licence and are operated in accordance with formal documentation, including a Safety Analysis Report and Facility Authorization. The boundaries within which a facility must be operated are presented in the individual Facility Authorizations for each facility. Facility staff are required to operate the facility in accordance with the approved Facility Authorizations, and to meet the requirements of safety set out in any listed Safety Analysis Report. Conduct of Operations manuals, or other facility-specific documentation, describe the processes used to achieve safety objectives. The *Nuclear Laboratories, Nuclear Operations Quality Assurance Manual* (CW-508200-QAM-112) is used in the quality management of all licence-listed facilities.

Safe and reliable performance objectives in nuclear facility operations exist from the time of the conceptual design, through to construction and operations. Assurance is required that components, systems and subsystems in AECL facilities are capable of performing their required functions in a reliable manner. The rigour of the various testing programs is dependent on the potential consequences of failure of the components, systems and subsystems. For example, the testing program for many facilities is included in standard operating procedures. However, in other facilities, such as reactors, a separate intensive program of trip-and-alarm and equipment tests is in place. Results of these tests are closely monitored and are subject to external (to the facility) review.

All testing is carried out according to approved procedures. Test frequencies are selected to satisfy regulatory and internal AECL requirements. For example, both internal and external reviews are carried out to ensure that the unavailability of reactor safety systems is less than 10^{-3} years/year. Less critical components such as ventilation system filters are routinely tested to ensure operational viability.

All uses of radioactive materials that occur outside licence-listed facilities are conducted in basic and intermediate-level radioisotope laboratories. These laboratories are classified on the International Atomic Energy Agency hazard-graded scale of A, B and C that take into account the nature of the operations performed and the relative toxicity of the radionuclides handled in the laboratories. Individual Radioisotope Laboratory Protocols for each laboratory document the design elements of the physical characteristics of the laboratories against CNSC Regulatory Guide R-92. In addition, the individual radioisotope laboratory protocol specifies the laboratory operating limits and identifies the basis for maintaining safe operations within each laboratory. Quality management processes follow the *Nuclear Laboratories, Nuclear Operations Quality Assurance Manual* (CW-508200-QAM-112) or the *Research and Development Quality Assurance Manual* (00-01913-QAM-018).

Nuclear operations also use site infrastructure components and the requirements of the *Nuclear Laboratories, Nuclear Operations Quality Assurance Manual* (CW-508200-QAM-112) are applied, not only to the operating facilities themselves, but the site infrastructures that support licence-listed facilities and other specialized radioisotope laboratories.

Annual safety reviews for each facility, are carried out and compiled into a report, as one of the requirements of the site operating licence, and to assist the AECL Safety Review Committee in its annual review of CRL nuclear facilities operations. Events, faults, and modifications significant to facility operation are reported, as are radiation doses to personnel and any radioactive releases to the environment. The most recent annual review provided to CNSC staff, for each facility listed on the CRL site licence, is identified in each of Appendices A to S of this document.

4.2 Class I Nuclear Facilities

4.2.1 Class 1 Nuclear Facilities Listed on CRL Site Operating Licence

The operation of all CRL Class I licence-listed facilities is summarized in the appendices shown below.

APPENDIX	FACILITY	No.
A	NRU Reactor	OF-FA-01
B	Nuclear Fuel Fabrication Facility (Buildings 429A and 429B)	OF-FA-02
C	Recycle Fuel Fabrication Laboratories	OF-FA-03
D	Heavy-Water Upgrading Plant	OF-FA-04
E	ZED-2 Reactor	OF-FA-05
F	Building 234 Universal Cells	OF-FA-06
G	Molybdenum-99 Production Facility	OF-FA-07
H	Tritium Laboratory (Building 250)	OF-FA-15
I	Waste Treatment Centre and Associated Facilities	OF-FA-16
J	Fuels & Materials Cells[5]	OF-FA-17
K	Waste Management Areas	OF-FA-18
L	Nuclear Fuel Fabrication Facility (Building 405)	OF-FA-19
M	CECEUD Test Facility	OF-FA-20

[5] Annual reporting to the CNSC also includes the operations of the Building 250 Hot Cells though they are not part of the Facility Authorization.

4.2.2 Class 1 Nuclear Facilities with Separate Licences

APPENDIX	FACILITY	No.
T	MAPLE 1 and MAPLE 2 Reactors	OF-MAPLE
U	New Processing Facility	OF-NPF

4.3 Class II Nuclear Facilities

The operation of the Class II licence-listed facility is summarized in the appendix shown below.

APPENDIX	FACILITY	No.
N	Health Physics Neutron Generator	OF-FA-14

4.4 Radioisotope Laboratories

4.4.1 Class A Radioisotope Laboratories

Building	Room	Classification	Name/Function
250	242, 244, 245, 248, 250, and 250A	A	Tritium Laboratory

4.4.2 Class B Radioisotope Laboratories

Building	Room	Classification	Name/Function
137	117	B	Molten-Fuel-Moderator-Interaction Laboratory
150	201B	B	Radiation Gross Laboratory
150	219, 322, and 326	B	Control/Loop Laboratory
226	113	B	Iodine Preparation Laboratory
320	317, 318/319, and 320	B	Chromatography Laboratory
320	324	B	Research Calorimetry Laboratory
320	333	B	Containment Chemistry Laboratory
330	316 and 318	B	ICP-MS Laboratory
330	319	B	NAA Laboratory
330	321	B	NAA Laboratory
330	325, 328	B	Radiochemistry Laboratory
330	326	B	Radiochemistry Laboratory
330	326A	B	H&D Analysis Laboratory
375	160	B	Imaging-XPS Laboratory

Building	Room	Classification	Name/Function
375	157 and 159	B	SIMS and Radioactive Specimen Preparation Laboratory
375	043	B	Ceramics Section
375	162, 38, 40, and 50	B	Material Fabrication - Class
375	257, 257A, and 257B	B	Coulometric Titration Laboratory
375	258 to 262	B	Advanced CANDU Fuel Development Laboratory
467, 467A	101, 102, 106, 106A, and 110	B	Waste Processing Technology Development Laboratory

4.4.3 Class C Radioisotope Laboratories

Building	Room	Classification	Name/Function
150	216	C	Irradiation Creep Laboratory
250	110	C	Coupons for Corrosion Test
250	112	C	Heat Exchange Technology Branch Laboratory
250	114	C	Shipping & Receiving Room/Laboratory
250	116	C	Geochemistry Laboratory
250	210	C	Corrosion & Activity Transports Test
250	212	C	Heat Exchange Technology Branch Laboratory
250	216	C	Waste Processing and Analysis Laboratory
250	221	C	CAN-DECON Decontamination Test Loops
250	111 and 111A	C	H3 Loop
250	213 and 215	C	Activity Transport Loop Facility
250	415 and 417	C	Chemical Cleaning Laboratory
300	222	C	Fuel Fabrication Development Laboratory
320	210	C	Waste Analysis Laboratory
320	220	C	Autoclave laboratory
320	223	C	Active Gas Rack Facility Laboratory
320	326	C	Solubility Studies Laboratory

Building	Room	Classification	Name/Function
320	309, 309A, and 312	C	ICP-AES Laboratory
375	117, 118A, 118B, and 120B	C	Heat Treatment and Homogenization Laboratory
375	125, 125A, 127, and 127A	C	Metallographic Services Laboratory
380	116, 117, and 120	C	Surface Science Laboratory
469	105	C	Fission Product Release Group Laboratory
469	124	C	In-Reactor Testing Group Laboratory
469	125	C	Fission Product Release Laboratory
513	259	C	Tritium Monitor/Technique Development Laboratory
513	267	C	Health Physics Experimental Laboratory
513	25 and 027	C	Carcinogen Handling (CH) Laboratory
513	115, 219, 219A, 263, 264, 265, and 266	C	Bioassay Laboratory
524	173 to 175, 177 to 179, and 101	C	Biological Research Facility Laboratory
610	103A, 103B, 105, and 121	C	Pressure Tube Sampling Tool Facility Laboratory
300B	133 and 134	C	Laser Laboratory (Lab 20)
513B	153	C	Environmental Technologies Branch Radiochemistry Laboratory

4.5 Fuel Fabrication Laboratories

The Fuel Development Branch, within the CANDU Technology Development organizational unit, is responsible for work performed in the Buildings 375 and 300 Fuel Development Laboratories. These laboratories are used to develop fuel fabrication processes, and to fabricate research reactor, CANDU, or other fuels (powders, elements, bundles). Customers are both internal and external to AECL. The use of the fuel fabricated in these laboratories includes characterization and properties measurements (within the Chalk River Laboratories or off-site); irradiation testing (in the NRU Reactor or other irradiation facilities); and measurement of reactor physics properties in the ZED-2 Reactor facility (see Appendix E).

CANDU fuel fabrication is performed in Building 375 Rooms 258 through 262, 43, and one half of Room 40. Research reactor fuel fabrication is performed in Building 375 Rooms 38, 48, 50, 162, and one half of Room 40. Fuel characterization studies are performed in Building 375 Room 257 and in the Surface Science Laboratory and other microscope laboratories. Fuel element and bundle assembly and welding development is performed in Building 300, Rooms 222 and 133.

4.6 Nuclear Operations Documentation

1. *Nuclear Laboratories, Nuclear Operations Quality Assurance Manual*, CW-508200-QAM-112, Revision 0, 2007 January.
2. *Research and Development Quality Assurance Manual*, 00-01913-QAM-018, Revision 2, 2005 May.
3. *AECLs Radiation Protection Requirements*, RC-2000-633-0, Revision 2, 2000 October.

5. DECOMMISSIONING PROGRAM

5.1 General

AECL's CRL site is large and diverse and contains many structures and features, some dating back to the beginning of the site's first establishment in 1944. The site is expected to continue in operation as a licensed facility for a wide range of nuclear research and development/industrial and production activities for many years to come. Several of the original structures have been decommissioned over the life of the site and the decommissioning of specific facilities is expected to continue in the future, as structures age or as business needs change. In addition to this, the site has seen new structures and facilities installed and this too is expected to continue for many years to come. Accordingly, the decommissioning model for the CRL site, including the Waste Management Areas, is one of individual decommissioning projects for its various components over time. At the end of the site's operational life, a single project for the site decommissioning, as a whole will occur. The Minister of Natural Resources Canada provided a proposal for a financial guarantee for the decommissioning of the CRL site to the CNSC in 2003 December.

5.2 Management and Planning

CRL decommissioning activities are managed by Waste Management and Decommissioning Operations, under the General Manager of Decommissioning and Waste Management. The General Manager reports to the Vice-President, Nuclear Laboratories. Waste Management and Decommissioning Operations has the responsibility for overall health, safety and environmental aspects along with maintenance, storage-with-surveillance and project activities within the decommissioning boundaries at CRL. The Waste Management and Decommissioning Operations group also assists in the planning, establishment of priorities and allocation of funds for decommissioning activities.

A Comprehensive Preliminary Decommissioning Plan for the CRL site, consistent with the contents and intent of the Canadian Nuclear Safety Commission Regulatory Guide G-219, has been developed (*Comprehensive Preliminary Decommissioning Plan for AECL's Chalk River Laboratories*, CPDP-01600-PDP-002, Revision 0). This plan takes into consideration both the current and projected availability of funds to conduct the Decommissioning Program, as reflected in the AECL Corporate Plan.

The decommissioning that has taken place over the past 5 to 10 years at CRL is consistent with the plan described in this document. The decommissioning has been performed in the context of an operating site with decommissioning activities focused on specific facilities that are declared redundant. Decommissioning Facilities Managers are appointed for all facilities/buildings or projects as they are transferred from the Nuclear Operations (see Section 4 of this document) to the Decommissioning Program.

Decommissioning work is performed based on the principles and intent of the Canadian Standards Association Standard CSA-N286.6-8, *Decommissioning Quality Assurance for Nuclear Power Plants;* CNSC regulatory Guide G-219, *Decommissioning Planning for Licensed Activities*; AECL SRC Requirements SRC-R-4/00-832.4, *AECL Requirements for Independent Review of the Decommissioning of Buildings, Facilities, and Sites*; and AECL DO-01913-QAP-001, *Decommissioning Operations Quality Assurance Plan*. Decommissioning projects are subject to compliance with all AECL Company-wide and site-specific documentation as they apply to that facility, and their own project-specific Quality Assurance Plan.

Individual decommissioning projects are grouped into seven "Planning Envelopes", as noted below, where each planning envelope is a grouping that has a degree of similarity, which lends itself to the application of common planning assumptions.

- Planning Envelope 1 – Licence-Listed Nuclear Facilities,
- Planning Envelope 2 – Radiochemical Laboratories,
- Planning Envelope 3 – Low Hazard Structures,
- Planning Envelope 4 – Non-Contaminated Structures,
- Planning Envelope 5 – Distributed Services,
- Planning Envelope 6 – Affected Lands, and
- Planning Envelope 7 – Waste Management Areas.

The individual projects will, in general, take each respective structure or feature to a documented end-state while the site as a whole continues in operation.

AECL's decommissioning strategy is based upon two fundamental principles. First, physical decommissioning will not be initiated until a facility, or a defined area, has been permanently retired from its current service and transferred to Waste Management and Decommissioning Operations. Second, decommissioning work on a facility or area can be phased, based on financial and radiological priorities (ALARA), and may be most efficiently executed through a series of projects that leaves the facility or area in a sequence of sustainable, stable interim end-states. Each interim end-state is maintained for a period of maintenance and surveillance when no physical decommissioning activities are conducted until the next project starts.

The sequence of intended decommissioning actions for a facility is defined early in its life cycle, and is documented in a Preliminary Decommissioning Plan. The Preliminary Decommissioning Plan is updated, as required, through the operating phase, and is later expanded into a Detailed Decommissioning Plan at or near the end of the operating phase.

Once a licence-listed facility ceases operations, the following decommissioning steps are followed:

- The Facility Authority for the once operating facility is responsible for operations and places the facility in a Safe Shutdown State by, for example, reducing inventories, removing short-term risks and hazards, and augmenting monitoring and surveillance systems. These actions are taken under the provisions of the Facility Authorization.

- The shutdown condition of the facility, the facility boundaries and any monitoring requirements are documented in facility turnover documentation, which is submitted by the Facility Authority to the Decommissioning Facility Authority, for acceptance. Decommissioning documentation is prepared as appropriate including a Detailed Decommissioning Plan and associated environmental assessment report for review and approval by the AECL Safety Review Committee, and the CNSC. Upon approval of these documents, application is made to the CNSC to transfer the facility from the list of operating facilities on the site licence to the list of permanently shutdown facilities. Responsibility for managing the facility safely and in compliance with regulatory requirements is then transferred from the Facility Authority to the Decommissioning Facility Authority.
- Waste Management & Decommissioning Operations maintains and monitors the facility in its shutdown state under the licence conditions for the decommissioning facility and/or an approved Storage With Surveillance Plan until such time as a decision is made to proceed to a new phase of physical decommissioning.
- Physical decommissioning, to an agreed defined final end-state, can proceed through a series of phased projects or to prompt decommissioning, appropriate to each specific facility, that is designed to achieve a decreasing level of worker and public risk. The projects have been defined in the Detailed Decommissioning Plan and are described in a series of Decommissioning Work Packages approved by the AECL Safety Review Committee and the CNSC. Each project may be followed by a period of storage-with-surveillance, and where a surveillance period is applied; appropriate end-state documentation is incorporated into each site licence. Decisions on the scope and timing of each project are based upon an analysis of the relevant costs, benefits, risks and priorities. Waste Management & Decommissioning Operations remains responsible for the safety and regulatory compliance of all activities in the facility until physical decommissioning is complete and the site and any remaining structures are turned over to new management.

5.3 Decommissioning Projects

5.3.1 Planning Envelope 1 – Licence-Listed Nuclear Facilities

There are six licence-listed facilities that have been permanently shut down and have been transferred from the Nuclear Operations Program to the Decommissioning Program.

- PSD-NRX NRX Reactor,
- PSD-PRL Plutonium Recovery Laboratory,
- PSD-PT Plutonium Tower,
- PSD-PTR Pool Test Reactor
- PSD-WWR Waste Water Evaporator, and
- OF-FA-20 Combined Electrolysis Catalytic Exchange Upgrading/Detritiation Test Facility.

These facilities and associated documentation are summarized in the appendices of this document.

5.3.2 Planning Envelope 2 - Radiochemical Laboratories

Planning Envelope 2 consists of buildings that contain, currently or previously, one or more Radiochemical Laboratories or facilities for storage of radioactive materials. The following is such a decommissioning project: Class C, Building 107-Chemistry Laboratory.

5.3.3 Planning Envelope 3 - Low Hazard Structures

Planning Envelope 3 consists of buildings that are used for service and support for Radiochemical Laboratories and Licence-Listed Nuclear Facilities: there are currently no projects in this category.

5.3.4 Planning Envelope 4 - Non-Contaminated Structures

Planning Envelope 4 consists of buildings in Controlled Area 1 and the Supervised Area that are used for research and development not involving radioactive materials. There are currently no projects in this category.

5.3.5 Planning Envelope 5 - Distributed Services

Services distributed around the CRL site total approximately 90 km of civil services (process, service and firewater, storm drains, sanitary sewers, active drain system, steam and condensate lines, etc.) and approximately 270 km of electrical cables (power, communications, data, etc.). Except for the active drain system, the distribution is divided roughly equally between Controlled Area 2 and Controlled Area 1. The active drain system is located in Controlled Area 2 exclusively. Approximately 95% of all services (civil plus electrical) are buried.

5.3.6 Planning Envelope 6 - Affected Lands

The term, affected lands, captures those areas of the CRL site, not included as part of an identified structure or building that have been modified, changed or otherwise “affected” by the construction and operation of the CRL site. Although affected lands primarily pertain to the CRL Supervised Area, there are also items considered to be affected lands within the CRL Inner Area (CA-1 and CA-2). At the same time that affected lands are defined or identified, unaffected lands are, in turn, delineated. While the CRL site remains a licensed site with operating nuclear facilities, the decommissioning related activities are those of remediation that serve to mitigate impacts associated with past practices. The following are remediation projects that fall under this category:

- Waste Management Area “B” Spring B and the Chemical Pit Groundwater Remediation, and
- Nitrate Plant Groundwater Remediation.

5.3.7 Planning Envelope 7 - Waste Management Areas

The waste management areas at CRL remain operational (Appendix K, OF-FA-18). There are currently no projects in this category.

5.4 Decommissioning Program Documentation

1. *Comprehensive Preliminary Decommissioning Plan for AECL's Chalk River Laboratories*, CPDP-01600-PDP-002, Revision R0, 2005 March.
2. *Decommissioning Planning & Operations Quality Assurance Plan*, 3600-01913-QAP-001, Revision 1, 2004 November.
3. *Company-Wide Decommissioning Quality Assurance Manual*, 00-01913-QAM-016, Revision 0, 2002 November.
4. Hon. H. Dhaliwal, P.C., M.P., Minister of Natural Resources Canada, letter to L. Keen, President and Chief Executive Officer, Canadian Nuclear Safety Commission, 2003 December.

6. PUBLIC COMMUNICATION PROGRAM

AECL's Public Information Program continues to evolve and make steady progress. Proactive and transparent actions taken during the current licensing period are enhancing the program and further activities are planned for operations moving forward.

A major improvement to the program resulted from comments made by the Commission and interveners at the Day Two Public Hearing in 2003 April with respect to AECL being more open in its communications (reference was to redacted reports and timely delivery of information). As a result, AECL implemented a Disclosure Policy which is posted on the external website. The introduction of the Disclosure Policy was shared with the communities and public interest groups prior to being launched and since its launch in 2005 September, AECL has responded to about 1,100 requests for information. Furthermore, AECL is posting copies of annual environmental monitoring reports, the Ecological Effect Review of Chalk River Laboratories, the Comprehensive Preliminary Decommissioning Plan for Chalk River Laboratories, the associated Framework for a Communications and Public Consultation Plan and other key reports of interest on the external website as they become available. While all of these reports can be accessed on the website, copies are also provided to all stakeholders (this includes local and regional public interest groups) to ensure they are kept apprised in a timely manner.

As public tours of the site are no longer possible due to enhanced security post 9/11, it is important to find other ways to keep the public informed. During this period, regular briefings and discussions with regard to all aspects of our business continued with federal, provincial, county and municipal elected officials and councils on both sides of the Ottawa River. Members of the Dedicated Isotope Facilities are actively participating in these meetings are providing regular updates on the project. These meetings provide the opportunity for AECL to share information on the current status of our operations and projects and to listen to the concerns that councils or their constituents may have. Participants complete a survey at the end of each meeting to measure effectiveness and value. Collaborative efforts are made to promptly resolve issues. While no major issues have been raised, AECL continues to support the Municipalité régionale de comté de Pontiac in their efforts to develop an emergency response plan. AECL was invited to make a presentation on its emergency preparedness program to the Fort Williams' Cottagers' Association in 2003 July and AECL's Emergency Preparedness management met with representatives from Québec ministries 2005 October 11 to 2005 October 12 to tour the NRU Reactor and discuss the NRU planning basis. AECL also sits on the Chalk River Regional Nuclear Emergency Preparedness Committee and is currently working with the group to revise their plans to coincide with a new exclusion zone of 9 km. Information on emergency exercises, testing of the new site siren system as well as reportable events classified as Significance Level 1 or 2 is provided to community stakeholders and the Emergency Management Ontario Duty Officer.

Where business cases support tours of the site, they are arranged. AECL is proud of the work done at Chalk River and has been pleased to host the visit of our Minister, the Honourable Gary Lunn, our Deputy Minister, our MP and MPP for Renfrew-Nipissing-Pembroke, Renfrew County Warden and other Mayors and Reeves. Other members of the federal and provincial governments such as the Environment Critic, Natural Resources Canada Critic, and the Auditor General have also visited Chalk River. Visits for local contractors and business development officers in

Renfrew and Pontiac Counties have taken place so that contractors understand the standards that AECL requires in order for them to carry out work for us. Standing invitations are open to all community stakeholders including local and regional public interest groups. Interested members of the public who participated in the public information sessions associated with the Environmental Assessment for the ongoing operation of the NRU Reactor beyond 2005 December 31 also took part in tours of the reactor in 2005 August. This resulted in positive interventions being made in support of the seven-month licence extension for NRU operation. AECL also met with an intervener in Pontiac to discuss AECL's environmental monitoring program. A tour of monitoring locations was provided and additional passive air monitors for tritium and C-14 have been installed in Demers Centre. Follow-up communication is planned with the community once sufficient monitoring data is retrieved for comparative and contextual discussion. The installation and proposed follow up communication meeting was to the intervener's satisfaction.

Decommissioning and waste remediation projects continue to be a major component of Chalk River's programs. The footprint of the Chalk River Laboratories is constantly being reviewed in order to reduce costs and environmental impacts. Details of these projects are shared with community stakeholders through activities such as, but not restricted to letters, briefings, and advertisements seeking public comment, brochures, information sessions, and media interviews. AECL is at various stages of executing long-term projects such as the Liquid Wastes Transfer and Storage Project, the Fuel Packaging and Storage Project, decommissioning of the Pool Test Reactor and the Building 204 Storage Bays and the Shielded Modular Above Ground Storage Project. Information has been distributed and input sought on all of these projects. Communications are forthcoming on AECL's proposal for managing sewage sludge and on the activities associated with the Comprehensive Preliminary Decommissioning Plan. In 2006, AECL became a Responsible Authority under the Canadian Environmental Assessment Act resulting in increased communication on other projects such as the demolition of old bus garages in Deep River, construction of a new salt shed and the clean up of an embankment area near the Ottawa River. One of the mechanisms that will assist AECL in its distribution of information on matters of mutual interest will be a new Environmental Stewardship Council comprised of members of AECL as well as interested members of the public and environment-focussed organizations. This new Council will discuss all matters associated with site operations, not exclusively those related to decommissioning and waste remediation. As of 2007 March, three meetings had been held with two more scheduled for June and October.

As the second largest employer in the Ottawa Valley, AECL maintains a key relationship with the business and education community. Staff members sit on Boards of Directors for Chambers of Commerce, Physicians' Recruitment, tourist associations, and school co-op and apprenticeship programs. Employees participate in summer festivals, winter carnivals, and special events such as the annual Renfrew-County skilled trades fair "Options" and act as judges at local and Renfrew County Science Fairs. AECL was recognized for its efforts in promoting skilled trades and providing co-op placements and apprenticeships with the Upper Ottawa Valley Chamber of Commerce 2006 Passport to Prosperity Award. AECL has revised its Speakers' Bureau and requests for presentations to schools and service groups are increasing. Furthermore, AECL continues to support the grade nine program, "Take Your Kid to Work Day", which allows students to grasp a better understanding of the work done at Chalk River. AECL has

completed its twentieth year as a major partner with the Deep River Science Academy, winner of the Michael Smith Award, by providing opportunities for high school students to obtain science credits by working with researchers on real projects for six weeks each summer. Communities are supportive of AECL, and so AECL is involved in helping the community as well. Support was recently given to citizens who were successful in their efforts to keep local schools open through a letter defining recruitment initiatives and expectations that solid academic programs for current and future employees will be available. Chalk River employees also give back financially to their communities through annual support of the United Way, which have averaged $81,500/year over the past three years. A new display is also being used to promote awareness of AECL in the community and for recruitment purposes.

AECL released *Contact*, its quarterly bilingual community newsletter in the fall of 2006. Mailed to more than 33,000 residents, businesses, and interested members of the public, it features a note from the Vice-President of AECL Nuclear Laboratories, profiles of the people and the work done on site, environmental monitoring results, and an opportunity for community input with a question and answer section. *Contact* is also posted on the external website.

AECL's external website continues to improve. Recent changes include the addition of sections on the MAPLE reactors, the New Processing Facility, and the importance of medical isotopes and the posting of documents of public interest. Information on decommissioning and waste remediation projects is available and includes details on projects, dates and locations of public information sessions, letters to officials and public interest groups, and contact information. Information is updated as warranted. A new section on Community and Stakeholder Relations was added during 2006.

Supportive media is helpful when it comes to sharing information with the public. Local media are kept informed of activities through informal press conferences, submitted stories, profiles of employees and/or programs and through opportunities to visit the site, for example, editorial board meetings with the Daily Observer have resulted in a number of stories on the economic impact of CRL and the future of nuclear and a two-part series on work done at CRL was produced by the New RO (now A-Channel). Radio, print and television contacts are appreciative of the information we share.

A new display featuring AECL's accomplishments and business profile is available to the public at the Petawawa Research Forest Visitors' Centre. Letters of welcome to the Ottawa Valley are included in community Welcome Wagon packages and new residents have followed up for information. All feature our toll-free number and website address.

Finally, the highlight for AECL's public information program is undoubtedly the successful transfer of Canada's first nuclear reactor, ZEEP, to the Canada Museum of Science and Technology in Ottawa during 2005 October. This was a collaborative effort between AECL and the Museum, with tremendous care and attention being paid at all times to ensuring public safety. CNSC staff were kept informed throughout the transfer process, and provided the necessary approvals.

Appendix A: OF-FA-01 NRU Reactor

A.1 General

The NRU Reactor at Chalk River Laboratories is operated on behalf of AECL by NRU Operations, within Reactor Operations. The reactor facility comprises several buildings, the most significant of which is Building 150, which houses the reactor, rod bays, and experimental facilities.

The NRU Reactor is one of the largest and most versatile research reactors in the world and can be used for a wide variety of irradiations. The applications include:

- fuels and materials testing,
- fuel testing under accident conditions,
- testing of fusion blanket materials,
- small-sample irradiations,
- experiments in neutron scattering, and
- isotope production.

The NRU Reactor operates at power levels up to 130 megawatts thermal and it is heavy-water moderated, light-water reflected, and heavy-water cooled. The reactor is designed to be fuelled at power. The core consists of an aluminum cylinder approximately 3.7 m in diameter and 3.5 m high. It is made up of 227 vertical lattice sites arranged in a hexagonal array with a pitch of 19.7 cm. Control rods and enriched uranium fuel rods occupy about half of the lattice sites; most of the remaining sites are used for low-temperature/low-pressure experiments and irradiations. Two-high-pressure/high-temperature loops supply coolant to three reactor test sections. A number of beam hole facilities are also available.

A.2 Facility Changes

A.2.1 Facility Changes During the 2003 to 2006 Licensing Period

During the 2003 to 2006 licensing period various initiatives and pre-existing programs and projects have been pursued with the objective of achieving the continued safe operation of the NRU Reactor, as described in the sub-sections below.

A.2.1.1 NRU Upgrades Project

A systematic engineering and safety assessment of the NRU Reactor was completed in the early 1990s on all systems and components critical to safety. Particular emphasis was placed on aging, obsolescence and vulnerability to external hazards. The initial study concluded that the overall condition of systems was good and continued operation of the reactor posed no undue risk to the public or the environment. In addition, seven major safety upgrades were identified to enhance the level of safety consistent with modern safety requirements.

The NRU Reactor safety upgrades are listed below:

- Qualified Emergency Response Centre,
- Second Trip System,
- Liquid Confinement/Vented Confinement,
- Main Pump Flood Protection,
- Qualified Emergency Water Supply,
- New Emergency Core Cooling System, and
- Emergency Power Supply.

The new upgrades are designed and installed to modern standards and will significantly reduce the reactor vulnerability to common mode failures and external hazards. The fundamental purpose of the new systems was to ensure that the reactor could be safely shutdown, cooled and monitored in any credible accident scenario. All of the above listed Upgrades are fully operational. Enhancements to the confinement envelope were also undertaken to mitigate the consequences of serious accidents.

A.2.1.2 NRU Reactor Safety Evaluation Project

The NRU Reactor Safety Evaluation Project was formed in 1996 to respond to actions raised by the CNSC as a requirement to justify the continued safe operation of the NRU Reactor beyond the year 2000. The actions were:

- demonstrate that the current operating programs provide assurance that the condition of the existing shutdown system is adequate;
- assess the vulnerability of the reactor to external events;
- provide justification for not having a second fast-acting shutdown system;
- consolidate, update, and revise the safety report (IOI-260) to reflect the current reactor status, including the upgrades being installed by the NRU Upgrades Project; and
- revise and update the safety analysis for NRU using modern assessment methods and up-to-date analytical tools.

A.2.1.3 NRU Licensability Extension Project

The NRU Licensability Extension (NRU LE) Project was formed in 2003 to provide justification for the operation of the NRU Reactor beyond the previously indicated shutdown date of 2005. As part of this mandate the NRU LE performed an independent periodic safety review gap analysis of the reactor and a comparison of the revised *NRU Reactor Safety Analysis Report* (AECL-MISC-300) and the NRU safety upgrades documentation with:

- The requirements of the International Atomic Energy Safety Guide for Periodic Safety Review.
- The requirements of CNSC Documents C-6, R-7, R-8, R-9 and R-10 as applied to research reactors.
- The International Atomic Energy Safety Document on the Safety Requirements of Research Reactors.

The review concluded that the issues identified were independent of reactor operating lifetime and that there was no technical reason why these issues, if addressed, should present a barrier to the continued operation the NRU Reactor beyond 2005. The main potential impediment to continued operation can only be the material condition of the reactor and associated facilities.

An action plan was formulated to dispose of the gaps identified by the review and formalized into an NRU LE Safety and Licensing Plan. Completion of the action items is through a series of reports, which are being provided to CNSC staff.

A.2.1.4 Plant Life Management Program

A Plant Life Management Program (PLiM) has been developed for the NRU Reactor to address the current material condition of NRU, and to provide assurance that aging effects are adequately addressed in the plant maintenance, surveillance and inspection programs and within the current operating context.

The PLiM provides for the systematic assessment, timely detection, mitigation, recording and reporting of significant aging effects in systems, structures and components. Phase 1 of the PLiM Program consisted of a screening of all NRU systems to rank them based on their safety function and the impact of their failure on facility, public or worker safety and on production. The resultant ranking was then used to formulate and prioritise the PLiM plan and schedule for NRU (Phase 2). The plan and schedule for Phase 2 listed the general procedures to be prepared for the performance of Systematic Assessment of Maintenance, Life Assessments, and Condition Assessments to systems, structures and components, as well as the sequence and priority which systems, structures and components would be subjected to Systematic Assessment of Maintenance, Life Assessments, and/or Condition Assessments. All Phase 2a Condition Assessments have been completed and Phase 2b Condition Assessments are nearing completion.

A.2.1.5 NRU Improvement Initiative Program

The Improvement Initiative Program is designed to achieve rapid implementation for short-term measures that will improve safety at NRU, and ensure that both short-term and long-term improvements are sustainable. A mandate of the program is to achieve industry best practices in operations and maintenance in these areas within three years, while continuing to operate NRU safely. A detailed Improvement Action Plan was prepared and over half of the short term actions have been completed.

A.2.2 Facility Changes Since 2006 August 01

The above mentioned initiatives described in Section A.2.1 are continuing to be implemented.

A.3 Performance to Requirements

A.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-01) outlines the envelope within which the NRU Reactor is required to operate to maintain the standard of safety represented in the safety analysis reports and other related documents specified in the safety analysis reports. A Conduct of Operations manual describes the detailed processes that are used in the management and operation of the facility to meet the Facility Authorization requirements as well as the requirements of compliance and business-related programs that are integrated into the nuclear operations at the Chalk River site.

A.3.2 Environmental Protection

A.3.2.1 Solid Wastes

Radioactive solid wastes generated in the NRU Reactor consist of contaminated equipment, irradiated materials, contaminated cleaning materials (i.e., mop heads and wipers), and spent ion-exchange column resins. These represent the by-products of operation or maintenance activities. Spent nuclear fuels are stored in a fuel storage bay.

A.3.2.2 Liquid Wastes

There are two release routes for liquid wastes resulting from the operation of the NRU Reactor: the Process Sewer, and the Active Drain System. The process sewer discharges the cooling water required by various systems of the NRU Reactor, roof drainage, floor drainage in inactive areas, and any water leakage that has been collected by the inactive sumps, to the Ottawa River. These discharges are expected to be inactive or contain short-lived activation species only. Effluents from the main heat exchangers are continuously monitored to give warning of a heavy-water leak.

The active drain system is for the collection of radioactive-contaminated water, from sources such as the active sumps and spent-fuel bays. Water collected from areas of the building where heavy-water leakage is anticipated, is sampled for heavy-water content prior to pumping, and if necessary, the discharge is diverted to storage drums for eventual heavy-water recovery. These discharges are collected in a holding tank prior to being pumped to the Waste Treatment Centre (see Appendix I, OF-FA-16) for processing.

Releases were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

A.3.2.3 Gaseous Effluents

Routine gaseous effluents from the NRU Reactor are released from building roof vents and the reactor ventilation system stack; the stack is located approximately 1 km from NRU.

Releases from the building roof vents include air discharges from the main reactor hall ventilation and process equipment room ventilation systems. These effluents, which may contain contamination, are monitored continuously, and the samples are analyzed for tritium, gross alpha and beta-emitters, carbon-14, tritium oxide and radioiodine (I-131 and I-125). Releases from the reactor ventilation system include air discharges from the graphite thermal column cooling system, air from the spaces around the reactor structure, and other systems that are exhausted by the reactor ventilation system. In addition to loose contamination that may be released into the air stream, it also contains Ar-41, formed by thermal neutron bombardment of naturally occurring Ar-40, and the off-gases from the helium cover-gas system purification system. Prior to discharge, the air is passed through a bank of filters to remove particulates. These effluents are also monitored.

The Ar-41 release data is based on continuous measurement by the Ambient Radiation Monitoring System, Station 5, on the stack duct. The Ar-41 concentrations in the stack are calculated from the weekly average Ambient Radiation Monitoring System readings using empirical correlation values, which are based on periodic grab samples of stack gases analyzed. Calculation of releases based on the method of correlation with reactor power and total power out continue to be done, and provide similar results.

Releases were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

A.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

A.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, nine lost-time injuries were associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

A.4 Facility Documentation

[A-1] *Facility Authorization for the Operation of the NRU Reactor at the Chalk River Laboratories*, AECL-FA-01, Revision 4, 2000 August.

[A-2] *Conduct of Operations*, NRU-01900-COP-001, (Individual sections with various dates of issue).

[A-3] *NRU Reactor Annual Safety Review 2005 plus Addendum*, NRU-01320-ASR-2005 (AECL-MISC-300-05) (plus addendum), Revision 0, 2006 March.

[A-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix B: OF-FA-02 Nuclear Fuel Fabrication Facility, Building 429A&B

B.1 General

Building 429A of the Nuclear Fuel Fabrication Facility (NFFF) is issued to receive, store, and process low enriched uranium based cores and to manufacture Molybdenum-99 (Mo-99) targets from uranium-aluminum based billets.

Building 429B of the NFFF is used to cast uranium-aluminum based billets.

The facility is operated by Site Nuclear Operations.

B.2 Facility Changes

B.2.1 Facility Changes During the 2003 to 2006 Licensing Period

No changes have occurred to the facility in the 2003 to 2006 licensing period.

B.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

B.3 Performance to Requirements

B.3.1 Authorization to Operate

The Facility Authorization outlines the envelope within which the NFFF Building 429 must be operated. Staff are required to operate the NFFF Building 429 in accordance with the approved Facility Authorization to maintain the standard of safety represented in the safety analysis reports. The NFFF Building 429 is operated in accordance with the NFFF Conduct of Operations Manual, a compilation of procedures that describe the organization, responsibilities, processes and controls used to satisfy the requirements of the Nuclear Laboratories, Nuclear Operations Quality Assurance Program.

B.3.2 Environmental Protection

B.3.2.1 Solid Wastes

Only suspect and low-level radioactive wastes are generated in the operation of the facility. These consist of alpha-contaminated items associated with the handling and production of the fuel materials, such as personal protective equipments, as well as components of engineered safety systems, such as air filtration devices and scrap from casting.

B.3.2.2 Liquid Wastes

Some soluble oil waste is generated from various process operations and is managed according to applicable waste handling practices.

B.3.2.3 Gaseous Effluents

Gaseous effluents from the NFFF are released to the environment via a roof stack. During operations carried out in the facility some fine particles may be released to the facility ventilation system. Airborne releases from the filtered ventilation system are monitored continuously. Releases of radionuclides to the environment resulting from operations were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

B.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

B.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injury was associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

B.4 Facility Documentation

[B-1] *Facility Authorization for the Operation of the Nuclear Fuel Fabrication Facility Building 429A and 429B at the Chalk River Laboratories*, AECL-FA-02, Revision 3, 1998 September.

[B-2] *Conduct of Operations, Nuclear Fuel Fabrication Facility Conduct of Operations Manual*, NFFF-01900-COP-001, (Individual sections with various dates of issue).

[B-3] *Nuclear Fuel Fabrication NFFF Building 429A and 429B Annual Safety Review 2005*, B429-01320-ASR-2005 (AECL-MISC-308-05), Revision 0, 2006 March.

[B-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix C: OF-FA-03 Recycle Fuel Fabrication Laboratories

C.1 General

The Recycle Fuel Fabrication Laboratories (RFFL) at CRL is operated, on behalf of AECL, by the Fuel Development Branch of the Reactor Core Technology Division, CANDU Technology Development.

The RFFL was constructed as an annex to the south end of Building 375 during the 1970s. The purpose of the facility was the fabrication of experimental quantities of alpha-active ceramic fuels, typically: uranium-plutonium, thorium-plutonium, and thorium-uranium-233.

The facility consists of several laboratories. The main fuel fabrication laboratory houses three interconnected lines of negative-pressure ventilated gloveboxes and fumehoods, to allow the fabrication of sintered pellets of mixed-oxide fuel, which are then clad and sealed into CANDU-type fuel elements.

C.2 Facility Changes

C.2.1 Facility Changes During the 2003 to 2006 Licensing Period

No changes have occurred to the facility in the 2003 to 2006 licensing period.

C.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

C.3 Performance to Requirements

C.3.1 Authorization to Operate

The Facility Authorization outlines the envelope within which the RFFL must be operated. Staff are required to operate the RFFL in accordance with the approved Facility Authorization, and to maintain the standard of safety represented in the Safety Analysis Reports. The current Facility Authorization is AECL-FA-03, Revision 2, 1998 September. The RFFL is operated in accordance with the RFFL Conduct of Operations Manual, a compilation of procedures that describe the organization, responsibilities, processes and controls used to satisfy the requirements of the Nuclear Laboratories, Nuclear Operations Quality Assurance Program.

C.3.2 Environmental Protection

C.3.2.1 Solid Wastes

Small quantities of low-level alpha-contaminated waste are produced by the routine operations of the RFFL. They are handled as required, by a comprehensive program to assure the protection of staff, the public and the environment.

C.3.2.2 Liquid Wastes

No liquid wastes are generated in the operation of the RFFL.

C.3.2.3 Gaseous Effluents

Gaseous effluents from the RFFL are released to the environment via a roof vent, after first passing through high-efficiency particulate air (HEPA) filters. These gaseous effluents are continuously monitored.

Releases of radionuclides to the environment, resulting from the operation of the RFFL, were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

C.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

C.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, one lost-time injury was associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

C.4 Facility Documentation

[C-1] *Facility Authorization for the Operation of the Recycle Fuel Fabrication Laboratories at the Chalk River Laboratories*, AECL-FA-03, Revision 2, 1998 September.

[C-2] *RFFL Conduct of Operations Manual*, RFFL-01900-COP-001, (Individual sections with various dates of issue).

[C-3] *Recycle Fuel Fabrication Laboratories Annual Safety Review for 2005*, RFFL-01320-ASR-2005 (AECL-MISC-266-05), Revision 0, 2006 March.

[C-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix D: OF-FA-04 Heavy Water Upgrading Plant

D.1 General

The Heavy Water Upgrading Plant is operated, on behalf of AECL, by Nuclear Facilities Operations within the Nuclear Laboratories organization. Upgrading operations in the Heavy Water Upgrading Plant ceased permanently in 1998 August. As of 1999 September 01, the facility ceased to be occupied on a regular basis; it was placed in a Safe Shutdown State and is now secured against unauthorized entry. It is currently being monitored by security and radiation protection personnel, or by facility supervision on a daily basis. Periodic drum shipments of downgraded heavy water are made from the shipping dock area.

D.2 Facility Changes

D.2.1 Facility Changes During the 2003 to 2006 Licensing Period

No changes have occurred to the facility during the 2003 to 2006 licensing period.

D.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

D.3 Performance to Requirements

D.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-04) outlines the envelope within which the Heavy Water Upgrading Plant is required to operate to maintain the standard of safety represented in the Safety Analysis Reports. A Conduct of Operations manual describes the detailed processes that are used in the management and operation of the facility to meet the Facility Authorization requirements as well as the requirements of compliance and business-related programs that are integrated into the nuclear operations at the Chalk River site.

D.3.2 Environmental Protection

D.3.2.1 Solid Wastes

Only suspect and low-level radioactive wastes are generated in the operation of the facility. These are characterized, segregated, handled and transferred to the Waste Management Areas according to the applicable requirements for storage.

D.3.2.2 Liquid Wastes

There are no liquid effluents generated in the facility. Daily sampling of the three facility process sewer sample stations was discontinued on 1999 June 23 because all cells and storage tanks had been emptied and flushed when facility operations ceased. (The site Process Sewer is sampled before it discharges into the Ottawa River.)

D.3.2.3 Gaseous Effluents

Gaseous effluents from the Heavy Water Upgrading Plant are those from tritiated heavy water vapour exhausted through the roof vents from exhaust fans. Even in the "Safe Shutdown State", these releases are sampled continuously and analyzed for tritium. The readings of the tritium samplers mounted on the two roof vents are recorded three times each week.

Releases of tritiated heavy water vapour to the environment, resulting from the operation of the Heavy Water Upgrading Plant, were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

D.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

D.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injury was associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

D.4 Facility Documentation

[D-1] *Facility Authorization for the Operation of the Heavy Water Upgrading Plant at the Chalk River Laboratories*, AECL-FA-04, Revision 3, 1998 September.

[D-2] *Nuclear Facilities Operations Conduct of Operations*, NFO-01900-COP-001, (Individual sections with various dates of issue).

[D-3] *Heavy Water Upgrading Plant Annual Safety Review 2005*, HWUP-01320-ASR-2005 (AECL-MISC-311-05), Revision 0, 2006 March.

[D-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix E: OF-FA-05 ZED-2 Reactor

E.1 General

The ZED-2 Reactor, located in Building 145 at CRL, is operated by staff of the Reactor & Radiation Physics Branch of the Reactor Core Technology Division, CANDU Technology Development. It is a versatile, heavy-water moderated, zero energy (less than 200 watts) critical facility that can be used for a variety of experiments. It is used mainly for reactor physics measurements on various fuel types with several coolants over a range of lattice pitches. The reactor can also be used for measurements on mockups of reactivity control devices and fuel channels of both power and research reactors. A heavy-water region in which neutrons are well thermalized can be assembled and used for neutron detector calibration and thermal neutron cross-section measurement.

The reactor is operated for short periods (generally less than an hour) at a power of less than 200 watts, on an average of about 70 days per year.

An estimate of the total amount of fission products that have been produced in ZED-2 since the reactor was first commissioned in 1960 can be made by assuming that the reactor was operated for less than 100 hours per year at an average power of less than 50 watts. The total energy thus produced would be less than 10,000 watt-days and the total mass of fission products produced would be less than 12 mg. These fission products are contained within the 5,000 kg of fuel. All of the fuels used in ZED-2 are contained within sealed sheaths. The average tritium production rate in the reactor is generally less than the natural decay rate of the isotope.

E.2 Facility Changes

E.2.1 Facility Changes During the 2003 to 2006 Licensing Period

During the 2003 to 2006 licensing period, permission was received from CNSC staff to operate ZED-2 with a full core of slightly enriched uranium fuel assemblies.

E.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

E.3 Performance to Requirements

E.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-05) outlines the envelope within which the ZED-2 Reactor is required to operate to maintain the standard of safety represented in the Safety Analysis Reports. A Conduct of Operations manual describes the detailed processes that are used in the management and operation of the facility to meet the Facility Authorization requirements as well as the requirements of compliance and business-related programs that are integrated into the nuclear operations at the Chalk River site.

E.3.2 Environmental Protection

E.3.2.1 Solid Wastes

A small quantity of low-activity solid waste (generally less than 1 cubic meter per annum) is produced.

E.3.2.2 Liquid Wastes

No liquid radioactive wastes are generated.

E.3.2.3 Gaseous Effluents

The release of radioactive material from the reactor during normal operation is essentially limited to the tritium in the heavy-water moderator (less than 40 MBq/l) that escapes by evaporation. Thus, the operation of the ZED-2 Reactor does not present a significant risk to either the public or the environment, as emissions are negligible.

E.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

E.3.4 Industrial Safety Highlights

No loss-time injuries have occurred in ZED-2 during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

E.4 Facility Documentation

[E-1] *Facility Authorization for the Operation of the ZED-2 Reactor at the Chalk River Laboratories*, AECL-FA-05, Revision 7, 2005 March.

[E-2] *ZED-2 Conduct of Operations Manual*, ZED2-01900-COP-001, (Individual sections with various dates of issue).

[E-3] *ZED-2 Reactor Annual Safety Review 2005*, ZED2-01320-ASR-2005 (AECL-MISC-226-05), Revision 0, 2006 March.

[E-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix F: OF-FA-06 Universal Cells

F.1 General

The Universal Cells are operated, on behalf of AECL, by Nuclear Facilities Operations within the Nuclear Laboratories organization. The Universal Cells are located in Building 234 at the CRL site. The Cell 1 ventilation exhaust is connected to Building 203/206 exhaust. (Building 203/206 is not under control of the Universal Cells; it is included in the Facility Safety Analysis Report documentation as part of the ventilation system.)

The Universal Cells – Building 234 contains three cells. Cell 1 is used for the processing of Co-60 from the NRU Reactor and the examination of highly radioactive materials. Cells 2 and 3 are used for the examination of irradiated fuel and metallurgical samples and some approved experiments.

F.2 Facility Changes

F.2.1 Facility Changes During the 2003 to 2006 Licensing Period

Facility changes are documented in the facility Annual Safety Reviews. No significant changes occurred in the 2003 to 2006 licensing period.

F.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

F.3 Performance to Requirements

F.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-06) outlines the envelope within which the Universal Cells facility is required to operate to maintain the standard of safety represented in the Safety Analysis Reports. A Conduct of Operations manual describes the detailed processes that are used in the management and operation of the facility to meet the Facility Authorization requirements as well as the requirements of compliance and business-related programs that are integrated into the nuclear operations at the Chalk River site.

F.3.2 Environmental Protection

F.3.2.1 Solid Wastes

Solid wastes are generated in the facility that ranges from non-radioactive and low-level wastes to irradiated fuel material. These are characterized, segregated, handled and transferred to the Waste Management Areas according to the applicable requirements for storage.

F.3.2.2 Liquid Wastes

All high-level liquid wastes are transferred to a storage tank. Low-level liquid wastes are collected in the Universal Cell Delay Tank. The contents of this tank are transferred to a holding tank outside the facility where the wastes are mixed with discharges from various other facilities

prior to being transferred to the Waste Treatment Centre for treatment. Transfers from the Delay Tank are infrequent.

F.3.2.3 Gaseous Effluents

The Cell 1 ventilation exhaust is combined with the Molybdenum-99 Production Facility effluent (see Appendix G, OF-FA-07), and is released via the Building 203 stack. Cells 2 and 3 are exhausted to roof stacks on Building 234. The ventilation systems for all cells incorporate High Efficiency Particulate Air (HEPA) filters and charcoal adsorbers.

Airborne releases from the filtered ventilation system are monitored continuously for I-131, gross beta particulate and gross alpha particulate.

Releases of radionuclides to the environment, resulting from the operation of the Universal Cells, were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

F.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers were generally well below the regulatory limits. During 2005 there was one radiation exposure to personnel that resulted in an equivalent dose of 56 mSv, exceeding the Action Level of 50 mSv for a localized area of the skin. Up to and including the most recent report for calendar year 2005, no other Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

F.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injury was associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

F.4 Facility Documentation

[F-1] *Facility Authorization for the Operation of the Building 234 Universal Cells at the Chalk River Laboratories*, AECL-FA-06, Revision 2, 1998 September.

[F-2] *Nuclear Facilities Operations Conduct of Operations*, NFO-01900-COP-001, (Individual sections with various dates of issue).

[F-3] *The Universal Cells in Building 234 Annual Safety Review 2005*, 9410-01320-ASR-2005 (AECL-MISC-302-05), Revision 0, 2006 March.

[F-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix G: OF-FA-07 Molybdenum-99 Production Facility

G.1 General

The Molybdenum-99 (Mo-99) Production Facility (MPF) is operated by Reactor Operations within Nuclear Laboratories, and is comprised of a portion of Buildings 225, 225A, 229, 206 and 203. The Mo-99 Cell is located in Building 225, and the off-gas delay system components are housed in Building 225A. The Fissile Solution Storage Tank and associated equipment are located in Building 229. Building 206 is the Mo-99 Cell ventilation fan house and Building 203 is the 61 m stack.

In the Mo-99 production process, irradiated uranium targets are dissolved in nitric acid and the Mo-99 is recovered from the fission-product solution. Xenon-133 is recovered as a by-product of this process. The fission-product solution is a waste product that is transferred to Fissile Solution Storage Tank for storage as liquid waste, or mixed with cement and stored as solid waste in tile holes in Waste Management Area "B".

G.2 Facility Changes

G.2.1 Facility Changes During the 2003 to 2006 Licensing Period

Approval to increase the concentration of uranium in the Fissile Solution Storage Tank was granted by the Canadian Nuclear Safety Commission in 2005.

G.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

G.3 Performance to Requirements

G.3.1 Authorization to Operate

The Facility Authorization outlines the envelope within which the MPF must be operated. Staff are required to operate MPF in accordance with the approved Facility Authorization, and to maintain the standard of safety represented in the Safety Analysis Reports. The current Facility Authorization is AECL-FA-07 (Revision 9, 2004 May). The MPF is operated in accordance with the MPF Conduct of Operations Manual, a compilation of procedures that describe the organization, responsibilities, processes and controls used to satisfy the requirements of the Nuclear Laboratories, Nuclear Operations Quality Assurance Program.

G.3.2 Environmental Protection

G.3.2.1 Solid Wastes

Solid radioactive wastes are generated in the facility as part of routine operations. These wastes range from suspect and low-level radioactive wastes to high-level wastes associated with dissolved irradiated uranium targets. Low-level solid wastes generated outside the cells are sent to the Waste Treatment Centre for processing. All other radioactive solid wastes originating from inside the Mo-99 facility cell, are sent directly to the Waste Management Areas for storage. Annual volumes are presented in annual safety reviews.

G.3.2.2 Liquid Wastes

Three types of radioactive liquid wastes are produced: low-level non-fissile, high-level non-fissile, and high-level fissile. Low-level non-fissile liquid wastes in the Mo-99 cell are stored in holding tanks and after a prescribed decay period are transferred to the Waste Treatment Centre (Building 570) for treatment. High-level non-fissile liquid wastes are converted to a solid form in cement and transferred to the Waste Management Areas for storage. High-level fissile liquid wastes are either stored in the Fissile Solution Storage Tank or mixed with cement and sent to Waste Management Areas.

Releases of radionuclides to the environment resulting from the operation of the facility were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

G.3.2.3 Gaseous Effluents

The MPF is equipped with high-efficiency particulate air (HEPA) filter and charcoal adsorbers in the air-cleaning systems to minimize discharges to the environment from the operation of the facility. Releases were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

G.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, one Action Level was exceeded in the facility during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

G.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, one lost-time injury was associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

G.4 Facility Documentation

[G-1] *Facility Authorization for the Operation of the Molybdenum-99 Production Facility at the Chalk River Laboratories*, AECL-FA-07, Revision 9, 2004 May.

[G-2] *Mo-99 Production Facility Conduct of Operations Manual*, MPF-01900-COP-001, (Individual sections with various dates of issue).

[G-3] *Molybdenum-99 Production Facility Annual Safety Review 2005*, MPF-01320-ASR-2005 (AECL-MISC-303-05), Revision 0, 2006 March.

[G-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix H: OF-FA-15 Tritium Laboratory

H.1 General

The Tritium Laboratory (also referred to as the Tritium Facility) is a Class A Radioisotope Laboratory operated, on behalf of AECL, by the Hydrogen Isotopes Technology Branch, Components & Systems Division of CANDU® Technology Development Unit. It is located in Rooms 242, 244, 245, 248, 250 and 250A in Building 250 at the CRL site. Facility management is responsible for the monitoring and access to Room 45 of Building 250, for the temporary storage of small quantities of tritium in compressed gas cylinders.

The laboratory is used almost exclusively for work with tritium in various chemical forms; the most common are tritium gas, usually stored as a metal tritide, and tritiated water. A key component of the laboratory is the inert-atmosphere, positive-pressure glovebox located in Room 245, which is used for handling very large quantities of elemental tritium.

The Tritium Laboratory serves as the primary facility for conducting research and development activities associated with heavy-water management and tritium control in CANDU reactors. In addition, tritium is dispensed under contract to Ontario Power Generation for their customers.

H.2 Facility Changes

H.2.1 Facility Changes During the 2003 to 2006 Licensing Period

To enhance the safety of Tritium Laboratory personnel, the Ventilation Failure Warning System was installed and commissioned for service in the fall of 2004. This alarm system is intended to provide a local audible alarm and visual indication (red LED) of a failure of any ventilation system exhaust fan servicing the Tritium laboratories, Room 45 and Lab 325, which is located on the third floor of Building 250.

H.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

H.3 Performance to Requirements

H.3.1 Authorization to Operate

The Facility Authorization outlines the envelope within which the Tritium Laboratory must be operated. Staff are required to operate the Tritium Laboratory in accordance with the approved Facility Authorization, and to maintain the standard of safety represented in the Safety Analysis Reports. The current Facility Authorization is AECL-FA-15, Revision 1, 1999 May. The Tritium Laboratory is operated in accordance with the Tritium Facility Conduct of Operations Manual, a compilation of procedures that describe the organization, responsibilities, processes and controls used to satisfy the requirements of the Nuclear Laboratories, Nuclear Operations Quality Assurance Program.

H.3.2 Environmental Protection

H.3.2.1 Solid Wastes

Low-level solid wastes containing tritium are generated in the Tritium Laboratory as part of routine operations. These are transferred to the Waste Management Areas for storage.

H.3.2.2 Liquid Wastes

Some liquid-form tritium waste is quantified for their tritium content prior to being released to the Active Drain System and subsequent transfer to the Waste Treatment Centre (see Appendix I, OF-FA-16).

Other small quantities of low-activity tritiated water used for various experiments are stored in bottles in fumehoods in Room 245. When the samples are no longer needed, they are stored by the Waste Management Areas (see Appendix K, OF-FA-18).

Small volumes of tritiated pump oil; oil/toluene mixtures and ethylene glycol and liquid-scintillation cocktails generated in the Tritium Laboratory are stored by the Waste Management Areas.

Releases of radionuclides to the environment, resulting from the operation of the Tritium Laboratory, were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

H.3.2.3 Gaseous Effluents

The Tritium Laboratory ventilation system is part of the overall Building 250 system and is discharged to roof stacks. Gaseous effluents from Rooms 244 and 245 through Fans E-2 and E-3 are monitored for both tritiated water and tritium gas. Releases of radionuclides to the environment, resulting from the operation of the Tritium Laboratory, were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

H.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

H.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injuries were associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

H.4 Facility Documentation

[H-1] *Facility Authorization for the Operation of the Tritium Laboratory at the Chalk River Laboratories*, AECL-FA-15, Revision 1, 1999 May.

[H-2] *Tritium Facility Conduct of Operations Manual*, TF-01900-COP-001, (Individual sections with various dates of issue).

[H-3] *CRL Tritium Laboratory Annual Safety Review 2005*, TF-01320-ASR-2005 (AECL-MISC-384-05) (plus addendum), Revision 0, 2006 March.

[H-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix I: OF-FA-16 Waste Treatment Centre and Associated Facilities

I.1 General

The Waste Treatment Centre (WTC) is operated and managed, on behalf of AECL, by Waste Management Operations within Nuclear Laboratories. The WTC is located in Building 570 and receives radioactive liquids and solids from Controlled Area 2 of CRL. The WTC also manages liquids containing high levels of radioactivity stored in stainless steel tanks.

The low-level radioactive solids are transported in covered trailers from the laboratories and reactors on a routine basis. Upon their arrival at the WTC, the wastes are off-loaded, monitored, weighed, and placed in transfer bins. Currently, the waste is volume reduced by compaction. Once the solid waste has been compacted into bales, with a typical volume reduction of about five to one, the bales are transported to Waste Management Areas (see Appendix K, OF-FA-18) for storage.

The facility routinely processes liquid waste generated by the NRU Reactor Drains, Dedicated Isotope Facility, the Decontamination Centre, and liquid wastes collected by the site Active Drain System. A large liquid waste evaporator is used for primary evaporation; the concentrate is further reduced in two Thin Film Evaporators before being solidified and transported to Waste Management Areas for storage. The distillate from the liquid waste evaporator is monitored and, when suitable, discharged to the site Process Sewer.

The Decontamination Centre supplies the WTC with a liquid waste volume of about 1,100 to 1,600 m^3/a; the Active Drain System supplies a volume of about 500 to 1,000 m^3/a and the NRU Reactor Drains system with a volume of 1,200 to 4,000 m^3/a. A new source (started in 2000) is the Dedicated Isotope Facilities, currently with a volume of about 10 to 20 m^3/a.

I.2 Facility Changes

I.2.1 Facility Changes During the 2003 to 2006 Licensing Period

No significant changes were made to the facility during the 2003 to 2006 licensing period

I.2.2 Facility Changes Since 2006 August 01

The upgrade of the Active Drain System will continue in the upcoming licensing period. On completion, the improved Active Drain System will be comprised of coaxial piping (secondary containment) for transfer lines, low point leak-detection capabilities, a holding tank facility as well as other improvements to instrumentation and processes.

I.3 Performance to Requirements

I.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-16) outlines the envelope within which the Waste Treatment Centre is required to operate to maintain the standard of safety represented in the safety analysis reports. A Conduct of Operations manual describes the detailed processes that are used in the management and operation of the facility to meet the Facility Authorization requirements as well as the requirements of compliance and business-related programs that are integrated into the nuclear operations at the Chalk River site.

I.3.2 Environmental Protection

I.3.2.1 Solid Wastes

Small amounts of radioactive wastes are generated in the facility as part of routine operations.

I.3.2.2 Liquid Wastes

Liquid effluent exists as the distillate from the liquid waste evaporator. It is monitored and, when suitable, discharged to the site Process Sewer on a controlled basis. The Process Sewer discharges to the Ottawa River. The effluent is sampled and analyzed before release from holding tanks in the WTC. The CRL Environmental Protection group monitors the Process Sewer outfall, and reports results to the Site Environmental Protection Officer.

Releases of radionuclides to the environment, resulting from the operation of the Waste Treatment Centre, were well below limits prescribed by regulation, and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

I.3.2.3 Gaseous Effluents

Ventilation systems for waste handling and processing are equipped with high-efficiency particulate filters. Releases of radionuclides to the environment, resulting from the operation of the Waste Treatment Centre, were well below limits prescribed by regulation, and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

I.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

I.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injuries were associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

I.4 Facility Documentation

[I-1] *Facility Authorization for the Operation of the Waste Treatment Centre and Associated Facilities at the Chalk River Laboratories*, AECL-FA-16, Revision 5, 1999 November.

[I-2] *Waste Management Operations Conduct of Operations Manual*, WMO-01900-COP-001, (Individual sections with various dates of issue).

[I-3] *Waste Treatment Centre Annual Safety Review 2005*, WTC-01320-ASR-2005 (AECL-MISC-304-05), Revision 0, 2006 March.

[I-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix J: OF-FA-17 Fuels and Materials Cells

J.1 General

The Fuels & Materials Cells facility is operated on behalf of AECL by Nuclear Facilities Operations within the Nuclear Laboratories organization. The Fuels & Materials Cells, located in Building 375 at CRL, is used primarily for the destructive examination or thermal-mechanical testing of irradiated fuels and materials. It comprises the following:

- two general purpose cells (C-1 and C-2);
- a metallographic sample preparation cell (C-3);
- four small, lead blister cells, which house three remote optical microscopes and an in-cell storage block (C-4 to C-7);
- a shielded Scanning Electron Microscope with built-in x-ray micro-analyzers;
- two low-radioactivity cells (C-10 and C-11);
- three mechanical test cells (MT-1 to MT-3);
- a shielded cell to accommodate thermal-mechanical testing (Delayed Hydride Cracking Test Facility - Room 4B); and
- three fumehoods where low activity work is done.

Also included in the facility are a horizontal storage facility for the temporary storage of irradiated material (particularly fissile) a vertical in-ground storage facility limited to non-fissile material, a storage block for temporary storage of low-level irradiated non-fissile material, an active waste drainage system, a ventilation system, a shipping/receiving area, manipulator, and active equipment storage rooms.

The general-purpose cells (C-1 and C-2) are situated back-to-back with a shielded isolation room between them. A variety of operations are performed in these cells, from visual examination and fuel-element leak testing, to sectioning of irradiated components.

The Sample Preparation Cell (C-3) is equipped with a high- and low-speed cut-off saw and grinder/polishers to prepare metallographic and ceramographic samples for examination on the optical microscopes.

A suite of self-contained blister cells (C-4 to C-7) constructed of 12.5 cm thick lead walls, are used for metallographic and ceramographic examination of irradiated materials. The blister cells are interconnected by a lead-shielded conveyor system that extends into C-3 for rapid and efficient sample transfer.

Cell 10 is dedicated to special projects requiring sensitive instruments and low-background activity. Cell 11 is dedicated to other special projects, identity engraving of samples and production of tensile mechanical test specimens from irradiated fuel channel component material.

The Mechanical Test Cells consist of three cells (MT-1, MT-2, and MT-3) used for testing and examining irradiated non-fissile materials.

A high-resolution Scanning Electron Microscope is installed in Room 116 above the sample preparation cell (C-3) for surface morphological examination of active samples. A steel-and-lead enclosure houses the microscope and analyzers, and protects the operator and main console. Active samples are prepared for examination in C-3 and transferred to the Scanning Electron Microscope through the roof of the cell with a shielded, cable-driven elevator.

The Delayed Hydride Cracking test facility located in Room 4B is used for thermal mechanical testing of cantilever-beam specimens fabricated from zirconium alloy fuel channel component material.

J.2 Facility Changes

J.2.1 Facility Changes During the 2003 to 2006 Licensing Period

Facility changes are documented in the facility annual safety reviews. No significant changes have occurred during the 2003 to 2006 licensing period.

J.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

J.3 Performance to Requirements

J.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-17) outlines the envelope within which the Fuels and Materials Cells facility is required to operate to maintain the standard of safety represented in the safety analysis reports. A Conduct of Operations manual describes the detailed processes that are used in the management and operation of the facility to meet the Facility Authorization requirements as well as the requirements of compliance and business-related programs that are integrated into the nuclear operations at the Chalk River site.

J.3.2 Environmental Protection

J.3.2.1 Solid Wastes

Solid wastes are generated in the facility and they range from low-level wastes to irradiated fuel material. These are characterized, segregated, handled, and transferred to the Waste Management Areas according to the applicable requirements for storage.

J.3.2.2 Liquid Wastes

Liquid wastes are generated in Cells 1, 2, and 3, and have historically drained to the Active Drain System. The Active Drain System is undergoing upgrades and during this period any collected waste is evaporated in-cell and handled as solid waste.

J.3.2.3 Gaseous Effluents

During operations carried out in the cells, such as cutting of irradiated fuel elements, some gaseous fission products are released to the cell atmosphere. Also, some fine particles may be released to the cell atmosphere during grinding or polishing operations. The ventilation systems for all the cells incorporate High Efficiency Particulate Air (HEPA) filters to prevent the release of such particles to the environment.

Small amounts of radioiodines may also be released to the cell atmosphere. If the release of radioiodines is anticipated, the work is carried out only in those cells where the ventilation system for those cells incorporates activated charcoal adsorbers.

Airborne releases from the filtered ventilation system are monitored continuously.

Releases of radionuclides to the environment, resulting from the operation of the Fuels & Materials Cells were well below limits prescribed by regulation, and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

J.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

J.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injuries were associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

J.4 Facility Documentation

[J-1] *Facility Authorization for the Operation of the Fuels and Material Cells at the Chalk River Laboratories*, AECL-FA-17, Revision 2, 1998 September.

[J-2] *Nuclear Facilities Operations Conduct of Operations Manual*, NFO-01900-COP-001, (Individual sections with various dates of issue).

[J-3] *Fuels and Material Cells Annual Safety Review 2005*, 9420-01320-ASR-2005 (AECL-MISC-305-05), Revision 0, 2006 March.

[J-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix K: OF-FA-18 Waste Management Areas

K.1 General

The Waste Management Areas (WMAs) comprise a number of fenced-in areas used for storage of a variety of solid radioactive wastes ranging in activity from very low levels up to that of irradiated nuclear fuel. These wastes originate from the operation of CRL and from off-site Canadian generators, such as isotope manufacturers, hospitals, and universities.

Some areas of the WMAs continue to accept wastes (WMAs "B", "C", "D", and "H"), others are no longer operational (WMAs "A", "E", and "F"), and WMA "G" is in the process of being reactivated. The Liquid Dispersal Areas are on standby status, pending completion of the Waste Treatment Centre Upgrades (see Appendix I, OF-FA-16).

Waste Management Area "B" is equipped with near-surface, in-ground cylindrical concrete structures of varying diameters. The smaller diameter (20 to 100 cm) facilities, which consist of lined and unlined precast concrete tiles (and therefore known as tile holes), are designed to accept high-level active wastes that require flasks or other shielding during transport and emplacement. The larger diameter (6 m) structures, known as bunkers, are used for wastes containing significant levels of gamma radioactivity and/or radionuclides of long half-life (greater than a few years), but do not generally require shielding during transport and emplacement.

Waste Management Area "B" also contains a variety of other storage structures (e.g., trenches, which were used until the late 1970s). Also located in the area is the Waste Reception Centre, Building 591), an insulated building equipped with gamma monitoring instrumentation and a glovebox for compliance monitoring of radioactive waste packages. The Waste Reception Centre has three operational objectives:

- receive and inspect radioactive wastes from CRL and from off-site waste generators;
- select wastes for compliance monitoring to determine whether they meet the waste acceptance criteria for different waste storage structures; and
- route wastes for storage.

The Waste Handling Building, an extension of the Waste Reception Centre houses a box compactor that volume-reduces low-level radioactive waste for storage in WMA "H".

Waste Management Area "B" is nearing capacity for low-level "bunker" type wastes. As a result, AECL is pursuing the use of shielded, above ground storage structures in WMA "H", similar in design to those in use at Ontario Power Generation's Western Waste Management Facility. Bunker use is expected to continue for a very restricted set of waste streams.

Waste Management Area "C" is a deep, free draining sand deposit used for storage of low-level radioactive waste, which are buried above the water table. Although in past years, long separated sand trenches were the configuration, current practice favours a continuous landfill arrangement to improve land-use efficiency.

With the introduction of WMA "H" in 2002, WMA "C" was relegated to receiving only wastes requiring landfilling – animal carcasses in sealed drums, and sewage sludge from the CRL Sewage Treatment Plant. In late 2004 November, sewage sludge emplacements ceased upon Canadian Nuclear Safety Commission request, and by 2006 July 31, all animal carcass waste emplacements ceased. Waste Management Area "C" is now used only for the above ground storage of a limited range of materials.

The WMA "C" extension was used for the storage of low-level radioactive waste similar to those stored in WMA "C". It has been approved for the storage of 5,000 m^3 of waste. With the introduction of WMA "H" in 2002, waste emplacements have ended.

Waste Management Area "D" is an area used for the temporary surface storage of re-usable but potentially contaminated surplus equipment. It has also become the location of:

- two metal-clad buildings erected for storage of drummed radium-contaminated wastes from cleanup projects undertaken by the AECL Low-Level Radioactive Waste Management Office on behalf of the Canadian government; and
- marine shipping containers with drums of contaminated and suspect contaminated liquids, and scintillation cocktails that are temporarily stored prior to processing.

Waste Management Area "G" was established in 1988 to provide concrete canister storage for used fuel from the Nuclear Power Demonstration Generating Station, which had been permanently shut down in 1987, and for a small number of irradiated fuel bundles from other power reactors. It currently contains 12 canisters, 11 with fuel and 1 empty. Waste Management Area "G" has been classified non-operational since the transfer of fuel to the canisters was completed in 1989. The area is monitored and inspected periodically by WMA staff.

Waste Management Area "G" is in the process of re-activation, following the Dedicated Isotope Facility schedule to accommodate calcine waste from the production of radioisotopes at the MDS Nordion New Processing Facility located at CRL. The calcine waste canisters will be emplaced in new concrete storage canisters. The current estimated storage requirements for this calcine waste over the expected production life of the MDS facilities is 7 to 16 canisters.

Waste Management Area "H" is a new 3.4-hectare area located east of and adjacent to WMA "D", which became operational in 2002. This storage area comprises several storage buildings for both compacted and non-compacted low-level radioactive waste, and the outdoor gravel pads to accommodate luggers with bulk materials such as low-level contaminated sand, soil, and concrete.

Two storage buildings have been erected; the first is full and the second receiving wastes since mid-2004.

AECL is pursuing the replacement of the Modular Above Ground Storage type buildings with more substantial concrete structure, as is used at Ontario Power Generation's Western Waste Management Facility. These structures are intended to provide storage for radioactive wastes streams currently being sent to Modular Above Ground Storage and WMA "B" circular concrete bunkers. The first structure, referred to as Shielded Modular Above Ground Storage, is expected to be built and in service by late 2007.

The Liquid Dispersal Area is not normally operational:

- Reactor Pit 2 is operational in the stand-by status only and has received no additional liquid wastes (from the Active Drain System) since 2000, and
- the Chemical Pit is operational in the stand-by status only and has received no additional liquid wastes (from the Active Drain System) since 1995.

Waste Management Area "A" and recently added WMA "E" are non-operational. Waste Management Area staff inspect and monitor these areas on a regular basis.

K.2 Facility Changes

K.2.1 Facility Changes During the 2003 to 2006 Licensing Period

In 2004, construction of a new administration building, Building 596 was completed. Building 596 became operational in 2004 December.

In late 2004 November, sewage sludge emplacements in WMA "C" ceased upon Canadian Nuclear Safety Commission request.

The first WMA "H" Modular Above Ground Storage Building 599A, was filled in 2004. The second WMA "H" storage building, Building 599B, was completed and turned over to Waste Management Operations in 2003 September. It began receiving waste in 2004 September.

Waste Management Area "G" is in the process of re-activation, following the Dedicated Isotope Facility schedule to accommodate calcine waste from the production of radioisotopes at the MDS Nordion New Processing Facility located at CRL.

On 2006 July 31, Waste Management Area "C" operation was restricted to surface storage only.

K.2.2 Facility Changes Since 2006 August 01

In 2006 September, permission was received from CNSC staff to utilize a sprung-tent type structure to augment the second Modular Above Ground Storage building, to provide low-level waste storage until the first Shielded Modular Above Ground Storage building is available in 2007.

K.3 Performance to Requirements

K.3.1 Authorization to Operate

The Facility Authorization outlines the envelope within which the Waste Management Areas must be operated. Staff are required to operate the Waste Management Areas in accordance with the approved Facility Authorization, and to maintain the standard of safety represented in the safety analysis reports. The current Facility Authorization is AECL-FA-18, Revision 4[6], 2001 October. The Waste Management Areas are operated in accordance with the Waste Management Operations Conduct of Operations Manual, a compilation of procedures that describe the organization, responsibilities, processes and controls used to satisfy the requirements of the Nuclear Laboratories, Nuclear Operations Quality Assurance Program.

[6] AECL-FA-18, Revision 8, 2006 January – CNSC staff "have no objections" to its use [K-5].

K.3.2 Environmental Protection

K.3.2.1 Solid Wastes

Suspect and low-level radioactive wastes are generated in the WMAs as part of routine operations through materials contact with wastes transferred to the WMAs or through the processing and compaction of wastes in the Waste Handling Building.

K.3.2.2 Liquid Wastes

No liquid wastes are directly generated through WMA operations. A comprehensive ground water monitoring program at the boundaries of all WMA storage areas is conducted and reported in the WMAs annual safety reviews.

K.3.2.3 Gaseous Effluents

Effluents for the waste management areas are mainly tritiated water vapour. Releases were well below limits prescribed by regulation and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

K.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

K.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, one lost-time injury was associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

K.4 Facility Documentation

[K-1] *Facility Authorization for the Operation of the Waste Management Areas at the Chalk River Laboratories*, AECL-FA-18, Revision 4, 2001 October.

[K-2] *Waste Management Operations Conduct of Operations Manual*, WMO-01900-COP-001, (Individual sections with various dates of issue).

[K-3] *CRL Waste Management Areas Annual Safety Review 2005*, WMA-01320-ASR-2005 (AECL-MISC-306-05) (plus addendum), Revision 0, 2006 March.

[K-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

[K-5] F. Taylor, Letter to J.E. Chilton, *Waste Management Areas Facility Authorization AECL-FA-18, Revision 8*, 2006 December 15.

Appendix L: OF-FA-19 Nuclear Fuel Fabrication Facility, Building 405

L.1 General

The Nuclear Fuel Fabrication Facility (NFFF), Building 405, operated by Site Nuclear Operations, produces nuclear fuel products for internal and external customers.

L.2 Facility Changes

L.2.1 Facility Changes During the 2003 to 2006 Licensing Period

No significant changes were made to the facility during the 2003 to 2006 licensing period.

L.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

L.3 Performance To Requirements

L.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-19) outlines the envelope within which the NFFF Building 405 must be operated. Staff are required to operate the NFFF Building 405 in accordance with the approved Facility Authorization to maintain the standard of safety represented in the safety analysis reports. The NFFF Building 405 is operated in accordance with the NFFF Conduct of Operations Manual, a compilation of procedures that describe the organization, responsibilities, processes and controls used to satisfy the requirements of the Nuclear Laboratories, Nuclear Operations Quality Assurance Program.

L.3.2 Environmental Protection

L.3.2.1 Solid Wastes

Only suspect and low-level radioactive wastes are generated in the operation of the facility. Nuclear materials contained in solid wastes are diligently tracked and accounted for in accordance with applicable safeguards requirements. Solid wastes are characterized, segregated and sent to Waste Management Areas (see Appendix K, OF-FA-18) for storage, or processed for recovery.

L.3.2.2 Liquid Wastes

Small quantities of liquid wastes are generated in NFFF Building 405. Wastewater, potentially containing radiological contamination, is disposed of in the active drain system. Other liquid waste (solvent and lubricant) is drummed and sent to Waste Management Areas for storage and/or disposal.

L.3.2.3 Gaseous Effluents

Low-level gaseous effluents may be generated by fuel processing operations in Building 405. Emissions are high-efficiency particulate air (HEPA)-filtered and retroactively monitored. No action levels have been exceeded in the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

L.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was typically well below the regulatory limits. Up to and including the most recent report for calendar year 2005, one Action Level was exceeded in the facility during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

L.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, one lost-time injury was associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

L.4 Facility Documentation

[L-1] *Facility Authorization for the Operation of the Nuclear Fuel Fabrication Facility Building 405 at the Chalk River Laboratories*, AECL-FA-19, Revision 3, 1998 September.

[L-2] *Nuclear Fuel Fabrication Facility Conduct of Operations Manual*, NFFF-01900-COP-001, (Individual sections with various dates of issue).

[L-3] *Nuclear Fuel Fabrication Facility Bldg. 405 Annual Safety Review 2005*, B405-01320-ASR-2005 (AECL-MISC-308-05), Revision 0, 2006 March.

[L-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix M: OF-FA-20 Combined Electrolysis Catalytic and Exchange Upgrading/Detritiation Test Facility

M.1 General

The Combined Electrolysis Catalytic & Exchange Upgrading/Detritiation (CECEUD) Test Facility is located in Building 215 in the northwest extension to the Chalk River Laboratories Controlled Area 2. The building was initially designed to contain the Tritium Extraction Plant, and construction was completed when the Tritium Extraction Plant Project was stopped in 1990. The CECEUD Test Facility demonstrated the combined electrolysis and catalytic exchange process for both heavy-water upgrading and detritiation. This was done in two operational phases: upgrading, which was completed in 1999 December; and detritiation, completed in 2001 April. Facility operations have ceased and the facility is now in a Safe Shutdown State and is unoccupied.

The facility consists of a process building and a service building, joined by a link building, and includes the combined electrolysis and catalytic exchange process and associated equipment and services. Some of the original, unused Tritium Extraction Plant equipment is incorporated into the combined electrolysis and catalytic exchange process.

The heavy-water upgrading and detritiation processes involve the electrolytic separation of water into oxygen and the hydrogen isotopes, and the catalytic transfer of hydrogen isotopes between heavy-water feedstock and the deuterium/tritium gas produced by the electrolytic cell.

M.2 Facility Changes

M.2.1 Facility Changes During the 2003 to 2006 Licensing Period

No changes have occurred to the facility during the 2003 to 2006 licensing period.

M.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

M.3 Performance to Requirements

M.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-20) outlines the envelope within which the CECEUD is required to operate to maintain the standard of safety represented in the safety analysis reports and other related documents specified in the safety analysis report. A Conduct of Operations manual describes the detailed processes that are used in the management and operation of the facility to meet the Facility Authorization requirements as well as the requirements of compliance and business-related programs that are integrated into the nuclear operations at the Chalk River site.

M.3.2 Environmental Protection

M.3.2.1 Solid Wastes

Only non-radioactive, or suspect and low-level radioactive wastes are generated in the operation of the facility. These are characterized, segregated, handled and transferred to the Waste Management Areas according to the applicable requirements for storage.

M.3.2.2 Liquid Wastes

Potentially active CECEUD facility liquid effluent is collected and stored within the facility until it is transferred by drums to the Waste Treatment Centre for processing.

Process cooling water discharged from the CECEUD Test Facility into the Process Sewer is sampled and analyzed daily for tritium content.

M.3.2.3 Gaseous Effluents

Gaseous effluents (tritium) from the CECEUD Test Facility are released from a roof vent.

Releases of tritium to the environment, resulting from the Safe Shutdown State of the CECEUD were well below limits prescribed by regulation, and approved Derived Release Limits. No Action Levels were exceeded during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

M.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

M.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injuries were associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

M.4 Facility Documentation

[M-1] *Facility Authorization for the Operation of the Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation (CECEUD) Test Facility at the Chalk River Laboratories*, AECL-FA-20, Revision 6, 2005 June.

[M-2] *CECEUD Facility Conduct of Operations Manual*, CECEUD-01900-COP-001, (Individual sections with various dates of issue).

[M-3] *Combined Electrolysis and Catalytic Exchange Upgrading and Detritiation (CECEUD) Test Facility Annual Safety Review 2005*, CECEUD-01320-ASR-2005 (AECL-MISC-312-05) (plus addendum), Revision 0, 2006 March.

[M-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix N: OF-FA-14 Health Physics Neutron Generator

N.1 General

The Radiation Biology & Health Physics Branch of the Radiological and Analytical Sciences Division within CANDU® Technology Development operates the Health Physics Neutron Generator, on behalf of AECL.

The Health Physics Neutron Generator is a high-voltage accelerator, designed to accelerate 1 mA of deuterium ions through a maximum potential drop of 150 kV. It produces nominal 14 MeV or 2.7 MeV neutrons, by the $^{2}H(t,n)\,^{4}He$ or $^{2}H(d,n)^{3}He$ reactions, when the deuteron beam strikes a target containing either tritium or deuterium. It was put into service in 1961. The designed maximum outputs are about 5×10^{10} 14 MeV neutrons and 5×10^{8} 2.7 MeV neutrons.

The accelerator is installed in a heavily shielded, underground room in the radiation facility wing of Building 513 at CRL. The shielding reduces the effective dose rate in the control room to well below 2.5 µSv/h for maximum neutron output. People working at this facility are not expected to receive any measurable dose from accelerator-produced neutrons. Over the last 10 years, the annual whole-body dose equivalents for the two people who most frequently work in this area have averaged 0.7 mSv, and much of this dose has probably been received in other areas.

N.2 Facility Changes

N.2.1 Facility Changes During the 2003 to 2006 Licensing Period

No changes have occurred to the facility in the 2003 to 2006 licensing period.

N.2.2 Facility Changes Since 2006 August 01

No significant changes to report.

N.3 Performance to Requirements

N.3.1 Authorization to Operate

The Facility Authorization (AECL-FA-14) outlines the envelope within which the Health Physics Neutron Generator must be operated. Staff are required to operate the Health Physics Neutron Generator in accordance with the approved Facility Authorization, and to maintain the standard of safety represented in the safety analysis reports.

N.3.2 Environmental Protection

N.3.2.1 Solid Wastes

The only solid waste produced is old targets and vacuum system components, all of which contain tritium. Over the past 10 years, targets containing tritium and two sets of ion pump electrodes have been stored in the CRL Waste Management Areas, along with vacuum system components replaced during maintenance.

N.3.2.2 Liquid Wastes

A minute amount of activity in liquid waste is produced by activation of the target cooling water, which is discharged to the Sanitary Sewer. Calculations of the radioactivity induced by 14 MeV neutrons show that this is many orders of magnitude lower than the permissible limit for drinking water, even before dilution. Pump oil, contaminated by low levels of tritium, is transferred to the CRL Waste Management Areas for storage.

N.3.2.3 Gaseous Effluents

During accelerator operation, most of the tritium that leaves the target is bound in the Ti-electrodes of the ion pumps. During this time, the accelerator is a closed system, but during pump-down, tritium enters the mechanical pump, which is vented to the outside air, and some tritium is released. Tritium also accumulates in the oil of the mechanical pump. Again, when the accelerator is opened, tritium is released to the room air from the target, ion pumps and interior walls of the accelerator. Much of this is removed to the outside air by room air circulation, but some accumulates on the room walls and may be released over a long period.

N.3.3 Radiation Safety Highlights

Radiation exposure to AECL workers was well below the regulatory limits. Up to and including the most recent report for calendar year 2005, no Action Levels were exceeded in association with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

N.3.4 Industrial Safety Highlights

Information regarding lost-time injuries or illnesses is reported in annual safety reports. Up to and including the most recent report for calendar year 2005, no lost-time injuries were associated with the facility operation during the 2003 to 2006 licensing period. Subsequent information is presented in the yearly safety reports.

N.4 Facility Documentation

[N-1] *Facility Authorization for the Operation of the Health Physics Neutron Generator at Chalk River Laboratories*, AECL-FA-14, Revision 2, 1998 August.

[N-2] *Quality Assurance Plan, Chalk River Laboratories Health Physics Neutron Generator*, Revision 1, 2005 June.

[N-3] *Annual Safety Review for the Health Physics Neutron Generator Facility, 2005*, HPNG-01320-ASR-2005 (AECL-MISC-228-05), Revision 0, 2006 March.

[N-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix O: PSD-NRX National Research Experimental Reactor

O.1 General

The National Research Experimental (NRX) Reactor at Chalk River Laboratories is listed in Appendix C of the CRL licence NRTEOL-01.00/2011. The monitoring and surveillance of the NRX Reactor is managed as part of CRL Facilities Decommissioning operations, within the Waste Management & Decommissioning Operations Division. This appendix includes information regarding the NRX Reactor facility and the NRX Fuel Storage and Handling Bays (Buildings 204A and B).

O.2 Facility Status

O.2.1 NRX Reactor

The NRX Reactor has not been operated since 1992. Phase 1 decommissioning, or shutdown operations work, aimed at bringing the facility to a safe storage state was completed in 1996. The reactor fuel and heavy water have been removed from the premises and major reactor process systems have been de-energized and isolated. Subsequent progress specific to 2005 and beyond is presented in the yearly safety reports (see Section O.3).

The facility is staffed during regular day-shift hours only. Outside of these hours, the alarm system is connected to the CRL plant-wide Supervisory Alarm System. The NRU staff (see Appendix A: OF-FA-01) is alerted to, and responds to, any alarm that occurs outside of normal day-shift working hours. The building is secured against unauthorized entry at all times.

O.2.2 Building 204A and B Bays

The NRX Reactor shutdown operations program included the removal of fuel and other irradiated stored materials from the bays. This work is now complete. A cleanup program to remove contaminated sludge and algae from the Building 204A bays under an approved Advanced Decommissioning Work Package was also completed.

In 2006/2007, after securing the required approval from CNSC staff, water was removed from the Building 204A bays, and work is currently underway to create a fire separation between the rod bays and the NRX Reactor.

The Building 204B bays have been separated from Building 204A bays since 1959, when the interconnecting trench was sealed off and sand-filled. It is intended that the bays be brought to a dry state with contamination removed or fixed. This work will be described in a detailed decommissioning plan.

O.3 Facility Documentation

[O-1] *CRL Facilities Decommissioning Annual Safety Review 2005*, GCMF-01320-ASR-2005 (AECL-MISC-458-05), Revision 0, 2006 March.

[O-2] *Preliminary Decommissioning Plan: NRX Reactor and Building 100 Decommissioning Plan,* 3611-01610-PDP-004, Revision 1, 2002 October.

[O-3] *Building 204 A/B Fuel Rod Storage and Handling Bays, Chalk River Laboratories: Detailed Decommissioning Plan*, RC-2593, Revision 1, 2002 March.

[O-4] *Environmental Assessment Study Report for the Decommissioning of Buildings 204A and 204B Fuel rod Storage and Handling Bays*, NSN-313/B204-03710-ENA-001, Revision 4, 2005 March.

[O-5] *NRX Reactor Facility Storage with Surveillance Plan (Buildings 100, 200X, 101, 101X, 103, 104, 122, 126, 133, 144, 157 and B204A/204B)*, NRX-06190-PLN-002, Revision 3, 2005 February.

[O-6] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix P: PSD-PTR Pool Test Reactor

P.1 General

The Pool Test Reactor (PTR) at Chalk River Laboratories is listed in Appendix C of the CRL Licence No. NRTEOL-01.00/2011. The monitoring and surveillance of the PTR is managed as part of CRL Facilities Decommissioning operations, within the Waste Management & Decommissioning Operations Division.

This appendix refers to the PTR facility located in Building 145 at CRL.

P.2 Facility Status

The PTR facility at Chalk River Laboratories has not been operated since 1990 October. All irradiated fuel elements have been removed from the core and are currently stored in the dry storage block in the reactor room. The four main control elements have been disconnected from their hydraulic actuators, and are also stored in the reactor room. In 1994, the single fine control absorber and its actuator, as well as the actuators of the four main control elements, were removed from the PTR pool. The water remains in the pool, and the water purification system is still maintained in an operating state.

AECL applied for authorization to decommission the Pool Test Reactor, and as part of the process prepared an Environmental Assessment Study Report (2006 April). CNSC staff subsequently prepared an EA Screening Report recommending that the CNSC Commission accept the recommendations of the screening report that, taking into account the appropriate mitigation measures, the project is not likely to cause significant adverse effects. A hearing on this matter was held on 2007 February 07.

P.3 Facility Documentation

[P-1] *CRL Facilities Decommissioning Annual Safety Review 2005*, GCMF-01320-ASR-2005 (AECL-MISC-458-05), Revision 0, 2006 March.

[P-2] *Pool Test Reactor Conceptual Decommissioning Plan*, RC-1861, Revision 0, 1996 June.

[P-3] *Pool Test Reactor Phase 1 Decommissioning Monitoring, Testing and Surveillance Program*, PTR-00422-06190-100, Revision 1, 1998 July.

[P-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

[P-5] *Environmental Assessment Study Report for the Pool Test Reactor Decommissioning Project*, NSN-508/PTR-3710-ENA-002, Revision 2, 2006 April.

Appendix Q: PSD-PRL Plutonium Recovery Laboratory

Q.1 General

The Plutonium Recovery Laboratory at Chalk River Laboratories is listed in Appendix C of the CRL Licence No. NRTEOL-01.00/2011. The facility includes the structure and contents of Building 220 at Chalk River Laboratories, which formed part of the Plutonium Fuel Processing Facilities. The building was erected in 1947, and the facilities commissioned in 1949 to extract plutonium isotopes from enriched fuels used in research reactors during the late 1940s and early 1950s. Research and operations in Building 220 were discontinued in 1957. The monitoring and surveillance of the Plutonium Recovery Laboratory is managed as part of CRL Facilities Decommissioning operations, within the Waste Management & Decommissioning Operations Division.

Q.2 Facility Status

The Plutonium Recovery Laboratory has remained in a static state since 1957, until the Treasury Board accepted it as a decommissioning project in 1990. During this period, some dismantling and cleanup work was performed. This facility is presently in a storage-with-surveillance state.

Q.3 Facility Documentation

[Q-1] *The Plutonium Recovery Laboratory, CRL Building 220: Preliminary Decommissioning Plan*, RC-2229, Revision 1, 2000 April.

[Q-2] *CRL Facilities Decommissioning Annual Safety Review 2005*, GCMF-01320-ASR-2005 (AECL-MISC-458-05), Revision 0, 2006 March.

[Q-3] *Plutonium Recovery Laboratory (Building 220) Storage with Surveillance Plan*, B220-06190-PLN-001, Revision 1, 2000 April.

[Q-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix R: PSD-PT Plutonium Tower

R.1 General

The Plutonium Tower at Chalk River Laboratories is listed in Appendix C of the CRL Licence No. NRTEOL-01.00/2011. The monitoring and surveillance of this permanently shut down nuclear facility is managed as part of CRL Facilities Decommissioning operations, within the Waste Management & Decommissioning Operations Division.

This appendix includes the structure and contents of Building 223 at Chalk River Laboratories known as the Plutonium Tower. This facility was built in 1948 as part of a joint research program between AECL and the United Kingdom Atomic Energy Authority, to develop methods of concurrent liquid aqueous extraction of plutonium from solutions of dissolved irradiated uranium. Research and operations in Building 223 were discontinued in 1954.

R.2 Facility Status

The Plutonium Recovery Laboratory has remained in a static state since 1957, until the Treasury Board accepted it as a decommissioning project in 1990. During this period, some dismantling and cleanup work was performed. This facility is presently in a storage-with-surveillance state.

R.3 Facility Documentation

[R-1] *The Plutonium Tower, CRL Building 223, Preliminary Decommissioning Plan*, RC-2392, Revision 0, 2002 April.

[R-2] *CRL Facilities Decommissioning Annual Safety Review 2005*, GCMF-01320-ASR-2005 (AECL-MISC-458-05), Revision 0, 2006 March.

[R-3] *The Plutonium Tower (Building 223) Storage with Surveillance Plan*, B223-06190-PLN-001, Revision 1, 2000 July.

[R-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix S: PSD-WWE Waste Water Evaporator

S.1 General

The Waste Water Evaporator at Chalk River Laboratories is listed in Appendix C of the CRL Licence No. NRTEOL-01.00/2011. The monitoring and surveillance of this permanently shutdown nuclear facility is managed as part of CRL Facilities Decommissioning operations, within the Waste Management & Decommissioning Operations Division.

This appendix includes the structure and contents of Building 228 at Chalk River Laboratories, known as the Waste Water Evaporator. This facility was built in 1952 to recover uranium, and to concentrate wastes from fuel processing by evaporation.

S.2 Facility Status

Fuel processing activities ceased at Chalk River Laboratories in 1958 and the uranium recovery equipment was removed from the Waste Water Evaporator. The facility was used for liquid waste evaporation with replacement evaporators fitted in 1959 and 1962. No processing activity has occurred since 1971. The facility is presently in a storage-with-surveillance state.

S.3 Facility Documentation

[S-1] *The Waste Water Evaporator CRL Building 228: Preliminary Decommissioning Plan*, RC-2395, Revision 0, 2000 April.

[S-2] *CRL Facilities Decommissioning Annual Safety Review 2005*, GCMF-01320-ASR-2005 (AECL-MISC-458-05), Revision 0, 2006 March.

[S-3] *The Waste Water Evaporator (Building 228) Storage with Surveillance Plan*, B228-06190-PLN-001, Revision 0, 2000 August.

[S-4] *CRL Annual Safety Review for 2006*, CRL-00583-ASR-2006, Revision 0, 2007 March.

Appendix T: Dedicated Isotope Facilities – Multipurpose Applied Physics Lattice Experimental 1 and 2 Reactors

T.1 General

The MAPLE 1 and 2 Reactors are located at CRL. The reactors are operated by Reactor Operations within Nuclear Laboratories.

The MAPLE 1 and 2 Reactors are constructed from the same design specifications. Each reactor is a 10 MW (thermal), pool type, light-water moderated and cooled, radioisotope production reactor. The reactor core consists of driver fuel assemblies and Mo-99 target assemblies arranged in a close-packed array. The core is surrounded by an annular reflector tank filled with heavy water that also contains a number of vertical tubes for isotope irradiation. The MAPLE 1 Reactor also contains the MAPLE Iodine Production Facility (MIPF), for the production of Iodine-125.

T.2 Facility Changes During the 2005 to 2007 Licensing Period

T.2.1 MAPLE 1 Reactor

During the 2005 to 2007 licensing period, a variety of initiatives were pursued with the objective of completing all prerequisites to exit the Guaranteed Shutdown State (GSS) in order to resume commissioning of the MAPLE 1 Reactor and to prepare the reactor to safely operate at 5 MW for Power Coefficient of Reactivity (PCR) testing purposes. Maintenance and testing of equipment were conducted as required based on the configuration of the facility. Inspection rounds and routines were completed as required. An implementation procedure was developed for the Dedicated Isotope Facilities (DIF) System Performance Monitoring Program, initiated to ensure that system, structures, and components perform within established criteria. Releases of airborne or liquid radioactive materials generated from the MAPLE 1 Reactor remain consistently well below regulatory Action Levels and the Derived Release Limits.

Some of the major changes to the facility, during the current licensing period, included the installation of an additional interlock trip for Safety System 2, the “Reflector Vent Line Level High” trip, the installation of the Reactor Computer Control System Baseline Release Software Version 4.6.1, and the installation of the Hilti Firestop Sealant in the floor penetrations of the control room.

During 2005-2006, staff from the Operational Safety Assessment/Performance Improvement and Nuclear Oversight group also conducted monthly safety inspection tours of the facility. The annual safety review for the MAPLE 1 Reactor was submitted to the CNSC during 2006 March.

T.2.2 Key Developments and Facility Performance

T.2.2.1 MAPLE 1 Reactor Out of Guaranteed Shutdown State

During 2005, and the beginning of 2006, plans to operate the reactor at power levels up to 2 kW and 5 MW were prepared, while development of test procedures continued, to re-measure the PCR. A safety case for the operation of the MAPLE 1 Reactor up to 2 kW was prepared and submitted to the CNSC for approval in 2005 October. AECL requested approval for limited operation of the reactor at 2 kW and under natural convection flow conditions. In its application, DIF provided a number of supporting documents to demonstrate that such limited operation was safe.

The MAPLE 1 Reactor restart checks for reactor power of 2 kW were initiated in 2005 August and a Completion Assurance Report for operation at this low-power level was submitted to the CNSC in 2005 December. The MAPLE reactors Operating Limits and Conditions document was updated as required ensuring trip functionality at powers up to 2 kW.

Following submission of the safety case, on 2006 January 12, AECL applied to CNSC staff for approval to exit the MAPLE 1 Reactor from GSS. Subsequently, following completion of operations readiness activities, DIF Operations declared readiness to remove GSS and operate the MAPLE 1 Reactor at powers up to 2 kW. The declarations were accepted by the Facility Authority on 2006 April 06 and the records documenting operations readiness were submitted to the CNSC on the same day. Upon successful completion of all licensing prerequisites, on 2006 April 28, approval to remove the MAPLE 1 Reactor from GSS was granted. As a result, the MAPLE 1 Reactor exited GSS on 2006 May 01.

T.2.2.2 MAPLE 1 Reactor Operations at 2 kW

On 2006 June 06, after completing the usual routines, readings, and surveillance, three target clusters were installed in CP-P21 followed by the completion of several Operator Test Procedures (OTP). Core refuelling was completed on 2006 June 14 and, on 2006 June 30, and the initial approach to critical was completed and the reactor reached criticality in “manual” mode. Operation at 2 kW allowed for continued improvements to operation and maintenance processes to support operational readiness for higher reactor power levels and completion of various OTPs.

T.2.2.3 MAPLE 1 Reactor Planned Outage and Preparation for Operation at 5 MW

The DIF planned outage commenced on 2006 September 11. It was scheduled to last 48 days. During this period, DIF Operations managed to complete Shut-Off Rod, Resistance Temperature Detector, Primary Cooling System testing, Safety System 1 and Safety System 2 Wire Remediation, commission verification testing (CP4s), installation and testing of the new Reactor Computer Control System Baseline Software Version, and continued executing more OTPs, as per the OTP schedule, in order to prepare for higher power operation. The planned 5 MW outage was completed on 2006 November 29 without an Event Free Day Reset.

On 2006 June 08, AECL formally requested approval from the CNSC to operate the MAPLE 1 Reactor at power levels up to 5 MW to conduct a series of tests to investigate and confirm the leading causes of the positive PCR issue. In its application, DIF submitted the following primary supporting documents:

- a safety analysis to support operation up to 5 MW;
- a 5 MW operating plan to describe the planned mode of operation at this power level;
- a test plan outlining the steps required to be taken to collect data to help resolve the positive PCR non-conformance; and
- a revised version of the MAPLE Operating Limits and Conditions to reflect the changes required for consistency with the 5 MW safety analysis.

On 2007 January 30, all the necessary approvals to operate the MAPLE 1 Reactor at 5 MW were granted by the CNSC.

T.2.2.4 Planned Activities for MAPLE 1 Reactor

In the upcoming months, AECL's plan for the MAPLE 1 Reactor is to re-measure the PCR, and complete further PCR testing, as appropriate.

T.2.3 MAPLE Iodine-125 Production Facility

The MAPLE Iodine-125 Production Facility (MIPF) is a stand-alone facility, currently undergoing inactive commissioning. An application to commence Active Commissioning of the MIPF will be made once the MAPLE 1 Reactor has been operated up to 5 MW.

T.2.4 MAPLE 2 Reactor

MAPLE 2 Reactor is currently in GSS. Maintenance and testing of equipment was conducted as required based on the configuration of the facility. Inspection rounds and routines were completed as required. As for the MAPLE 1 Reactor, an implementation procedure was developed for the DIF System Performance Monitoring Program, initiated to ensure that system, structures, and components perform within established criteria. Releases of airborne or liquid radioactive materials generated from the MAPLE 2 Reactor remain consistent well below regulatory Action Levels and the Derived Release Limits. During 2005-2006, staff from the Operational Safety Assessment/Performance Improvement and Nuclear Oversight group also conducted monthly safety inspection tours of the facility.

The SRC and the CNSC have approved engineering design of a modified target cluster holder and one modified target cluster holder is installed in the MAPLE 1 Reactor. AECL will make a separate request to install the modified cluster holder in the MAPLE 2 Reactor before it is ready to be removed from the approved GSS.

The annual safety review for the MAPLE 2 Reactor was submitted to the CNSC during 2006 March.

T.2.4.1 Planned Activities for MAPLE 2 Reactor

An application to remove the MAPLE 2 Reactor from GSS will be made to the CNSC after the PCR testing has been completed in the MAPLE 1 Reactor. During the remainder of the licensing period, the plan for the MAPLE 2 Reactor is to complete the pre-requisites to non-nuclear commissioning and licensing.

As in MAPLE 1 Reactor, some of the major changes to the MAPLE 2 Reactor facility, during the upcoming licensing period, will include the installation of an additional interlock trip for Safety System 2, the "Reflector Vent Line Level High" trip, the installation of the Reactor Computer Control System Baseline Release Software Version 4.6.1, and the installation of the Hilti Firestop Sealant in the floor penetrations of the control room.

T.3 Improvements to the Performance Assurance Program

T.3.1 Continuous Improvement Plan

Based on the review of an internal assessment in 2005 April, and a CNSC audit in 2005 June, observations from industry mentors, and findings and trends from Unplanned Event Reports, DIF developed a "Continuous Improvement Plan" (CIP). The initial CIP was implemented in DIF in 2005 September. Revision 1 of the plan, with additional actions, was subsequently released in 2006 January.

DIF management identified a set of actions and an implementation strategy to achieve improvement. These actions were grouped into four main areas of improvement:

- Leadership,
- Human Performance,
- Processes, and
- Equipment Performance Programs.

As the title implies, this is a continuous plan, and therefore the improvement actions are monitored. As implementation progresses, the plan is updated and modified as required to reflect operating experience and feedback from industrial peers and other independent assessments.

T.3.2 Project Improvement Plan

As part of AECL's effort to continuously improve its operations, recent management reviews of the MDS Nordion Medical Isotope Reactor (MMIR) Project performance have identified the need for a systematic improvement plan, the so-called Project Improvement Plan (PIP), which was introduced in 2006, and is organized into three broad areas of improvement: people, process, and plant.

The purpose of the plan is to improve the overall quality and schedule performance of the MMIR Project. This will be achieved by pursuing further opportunities for improvement by:

- strengthening the human performance,

- improving the implementation of engineering work processes and safety analysis, and
- incorporating feedback derived from operating experience on the MMIR Project.

The PIP is related to, and complements, the DIF Operation's CIP. Like the CIP, the PIP is a "living" document. Feedback and any additional opportunities for improvement identified during the implementation will be incorporated in future revisions of the plan.

T.4 Programs in Place Within the Dedicated Isotope Facilities

In addition to AECL company-wide and CRL site-wide programs, facility-specific programs are in use, as outlined in the Quality Assurance Manual and supporting procedures for the operation of MAPLE 1 and 2 Reactors and NPF, collectively referred to as DIF. Some site-wide programs require specific implementation in the context of DIF.

T.4.1 Quality Assurance Programs

T.4.1.1 Dedicated Isotope Facilities Quality Assurance Program

The *DIF Quality Assurance Manual* [T-1], applies to the operation of the MAPLE 1 and 2 Reactors and NPF, including all support activities in the areas of design, procurement, construction, and commissioning. Presently, the MAPLE reactors and NPF are in the commissioning phase, with the majority of systems turned over to DIF Operations control following inactive commissioning.

The Quality Assurance Program covers the Owner and Operator's responsibilities as per the requirements of the CSA N286.0 and N286.5-standards and the AECL Management System described in the *AECL Management Manual* [T-2] and the *Overall Quality Assurance Manual* [T-3].

T.4.1.2 MMIR Project Quality Assurance Program

The *MMIR Project Quality Assurance Manual*, [T-4], which complies with the requirements, specified in the Canadian Standards Association CSA-N286.1, CSA-N286.2, CSA-N286.3, CSA-N286.4, and CSA-N286.7 [T-5] describes the Quality Assurance Program for MMIR project.

The MMIR Quality Assurance Program includes verification activities, self-assessments, audits, and other actions to verify that activities are performed to obtain the assurance of quality and that non-compliance with specified requirements are identified, recorded, and corrected. Records are produced and retained as objective evidence of compliance with the specified requirements.

The *MMIR Project Quality Assurance Manual* was revised to highlight the requirements for all staff to use only defined terms, concepts, and processes. The development and use of analytical, scientific, and design software complies with the company-wide *Quality Assurance Manual for Analytical, Scientific, and Design Computer Programs* [T-6].

T.4.2 Operating Limits and Conditions for MAPLE Reactors/New Processing Facility

The MAPLE reactors are operated in accordance with Non-Power Reactor Operating Licence NPROL-62.00/2007 [T-7] and Nuclear Research and Test Establishment Operating Licence NRTEOL-01.00/2011 [T-8] for CRL for site wide programs. Operating Limits and Conditions, for MAPLE reactors [T-9], sets out the key requirements, limits, and conditions for the safe operation of MAPLE 1 and 2 Reactors and MAPLE 1 Iodine-125 Production Facility (MIPF).

The NPF is operated in accordance with NSPFOL-03.00/2007 [T-10] for the facility and NRTEOL-01.00/2011 [T-8] for CRL site-wide programs. New Processing Facility Operational Limits and Conditions [T-11], sets out the key requirements, limits, and conditions for the safe operation of the NPF.

T.4.3 Dedicated Isotope Facilities Maintenance Program

A comprehensive Maintenance Program at CRL supports DIF Maintenance Program. The objectives of the Maintenance Program are to detect and minimize deterioration in equipment and systems. The DIF Maintenance Manager ensures that the structures, systems, and equipment in DIF are maintained in good condition and good working order such that they can perform their design function.

Maintenance work is done in accordance with approved work orders and written maintenance procedures where the complexity or safety significance of the work warrants the latter. Maintenance procedures are prepared, reviewed, and approved in accordance with the *Maintenance Procedures* [T-12]. Initiation, Planning, Scheduling, Execution and closure of work is conducted with the *Work Management* procedure [T-13].

The DIF preventive maintenance requirement, which is to ensure that safety-related systems, structures, components and equipment in DIF function reliably, is defined in the *DIF Maintenance Program* [T-14]. This document defines the type and frequency of the preventive maintenance activities to be performed and the required frequency for these activities.

The DIF Operations Maintenance, Radiation Protection and Work Management is responsible for leading and managing the maintenance, radiation protection and work management groups with overall responsibility for ensuring that DIF is maintained in a safe condition in accordance with the operating licences and Operating Limits and Conditions.

The governing documents of the maintenance program are:

- *Work Management* [T-13];
- *DIF Maintenance Program* [T-14];
- Various maintenance procedures;
- *DIF Periodic and Inaugural Inspection Program* [T-15];
- Various facility-specific maintenance procedures; and
- Various CRL maintenance procedures, as applicable.

T.4.4 Dedicated Isotope Facilities Periodic Inspection Program

The DIF Periodic Inspection Program specifies the criteria used to develop the program, and then addresses the implementation of these criteria on a system-by-system basis to produce the resulting Periodic Inspection Program for DIF.

The Inaugural and Periodic Inspection Program, based on criteria to be embedded in the overall program document, was completed in 2000 October. The scope of the periodic inspection is to provide assurance of structural integrity of pressure retaining boundaries in compliance with the mandatory requirements identified by the stakeholders. It includes, but is not limited to, the mandatory inspections of key equipment and piping to confirm that there is no significant deterioration of the pressure boundary, and also the inspection of code-classified systems and components as per the approved Form 73 (Classification Approval Form), with additional requirements.

An Overall In-Service Inspection Program was issued in 2006 May. This program defines the requirements for mandatory and non-mandatory inspections of systems essential to safe shutdown, cooling, and confinement of the MAPLE 1 Reactor, MAPLE 2 Reactor and the NPF. The overall program elements and guidance described in this program include:

- definition of the Mandatory and Non-Mandatory categories of the In-Service Inspection Program;
- criteria established to differentiate the subprograms; and
- the CSA Standard requirements appropriate to the NPF.

The documents supporting the program objectives are:

- *Dedicated Isotope Facilities (DIF) Periodic and Inaugural Inspection Program* [T-15], and
- *DIF In-Service Inspection Program* [T-16].

T.4.5 Dedicated Isotope Facilities Training Program

The MAPLE and NPF Training Program are designed to provide and maintain the training, qualification, authorization, and certification of personnel in direct operating positions, namely, the MAPLE Manager of Operations, the MAPLE Reactor Operator, the Hot Cell Technicians, and NPF Supervisors.

The MAPLE and NPF Training Program:

- provides efficient and effective training for employees directly involved with the operation of the MAPLE reactors and NPF;
- provides training for employees involved in supporting the operation of the MAPLE reactors and NPF; and
- provides ongoing training for direct operating personnel to maintain qualification and certification.

The documents supporting the program objectives are:

- *AECL Systematic Approach to Training* [T-17] and supporting procedures;
- *DIF Training Plan* [T-18];
- System Task Analysis;
- System Training Manuals;
- Master Lesson Directives, On-Job-Training/Field Checkouts Guides; and
- Assessments (exams and answer guides).

Records of training, CNSC Certification exam development, conduct, and marking follow the operational procedure CNSC-ST1, Revision 2.2 (2002 July), *Written and Oral Examination for Certified Operating Personnel at Nuclear Reactor Facilities* [T-19].

T.4.6 Operating Experience Training for Dedicated Isotope Facilities Staff

Staff training and use of industry peers to mentor, participate in investigations and participate in peer review meetings have proven to be effective in improving DIF OPEX performance.

Eight DIF employees completed a three-day training for Event Investigation Training (ODT-100) (RCA) in 2005 October and five completed a follow up Event Investigation enhancement training (ODT-441) in 2006 February. This enhanced capability of DIF to help conduct investigations, thus, reducing the backlog of Unplanned Event Reports and Cause Analysis investigations in DIF.

T.4.7 Dedicated Isotope Facilities Safety Analysis Program

The objective of the safety analysis program is to demonstrate that the requirements for health and safety of persons and for protection of the environment are met for all accident scenarios in the Final Safety Analysis Reports.

The safety analysis program also includes the revision and update of the Final Safety Analysis Reports for both the MAPLE reactors and for the NPF. This will include updating on a regular basis of all Final Safety Analysis Report sections, with the exception of those sections containing safety analysis results. The safety cases will provide the safety analysis support for DIF.

T.4.8 Dedicated Isotope Facilities Safety-Related System Testing Program

The MAPLE Reliability Plan [T-20] and the *NPF Reliability Plan* [T-21] have been produced to guide DIF Operations in the development of a maintenance program for testing and inspection to demonstrate that the availability, reliability, and effectiveness of any structure, system, or component remain consistent with the Final Safety Analysis Reports. An Operating and Routine Maintenance Schedule was formulated based on the results of an activity base analysis conducted in DIF in accordance with operational and regulatory requirements.

T.4.9 Dedicated Isotope Facilities Environmental Program

Facility-specific environmental objectives and targets will be established, as required, to support applicable site-wide environmental objectives, targets and performances measures in accordance with RC-2000-021-1.3, *Environmental Objectives & Targets* [T-22]. Releases of radioactive liquids and gases to the environment will be controlled, monitored, and recorded, in accordance with this procedure.

Significant Environmental Aspects have been identified and documented. Significant Environmental Aspects are reviewed annually and updated as required. Ninety-eight percent of the training for Significant Environmental Aspects has been completed for DIF staff, and remaining staff will be completing their training by the end of 2007 March.

T.4.10 Occupational Health and Safety Program

The MAPLE reactors and NPF are operated in accordance with AECL Occupational Health and Safety program. All applicable elements of the program are implemented in DIF, such as control of hazardous material in the MAPLE reactors and NPF, confined space protocol, and personal respirators.

The identification of and the requirements (e.g., approved storage locations and allowable quantities) for controlling hazardous and combustible materials in DIF will be performed in accordance with the *Control of Hazardous Materials* [T-23]. Housekeeping monitoring, including confirmation that hazardous and combustible materials are controlled, will be performed in accordance with the *Routine Operations* procedure [T-24].

Procedure to minimize and control personnel radiation exposure and personnel protection are established, as per compliance programs documentation, *AECL's Radiation Protection Requirements* [T-25] and *AECL Occupational Safety and Health Program Manual* [T-26].

T.4.11 Dedicated Isotope Facilities Nuclear Materials and Safeguards Management Program

Management of nuclear materials (fissionable materials, heavy water and tritium) in the MAPLE 1 and 2 Reactors is in accordance with *Nuclear Materials and Safeguards Management Compliance Program* [T-27]. The material managed includes:

- uranium targets (unirradiated and irradiated);
- low enriched uranium and depleted uranium driver fuel bundles (unirradiated and irradiated);

- other wastes, samples, etc., containing uranium (unirradiated and irradiated); and
- heavy water (with and without tritium).

The documents supporting the program objectives are:

- *Accounting of Nuclear Material and Declaration of Nuclear Loss and Plutonium Generation in I-IEU Targets* [T-28];
- *Accounting of Nuclear Material and Declaration of Nuclear Loss and Plutonium Generation in LEU and DU Bundles* [T-29];
- *Fissionable Materials Management* [T-30];
- *Managing Heavy Water* [T-31];
- Design Information Questionnaire, CN-BM.

Fissionable materials in the form of fission chambers and fuel bundles have been received into DIF and also irradiated targets have been shipped out of DIF since 2005 December.

Heavy water continues to move in and out of DIF in the form of samples, used heavy water, and virgin heavy water.

Procurement of nuclear materials for DIF has taken place, specifically drums of virgin heavy water were purchased from on-site stock, an order was placed for fission chambers, and orders were placed and received for neutron sources for use in the MAPLE reactors.

T.4.12 Dedicated Isotope Facilities Criticality Control

Criticality Safety limits in specific facilities in DIF are defined in the following documents:

- CSD-55 - *Criticality Safety Document for the MAPLE Reactor Buildings 110 and 111* [T-32];
- CSD-56 - *Criticality Safety Document for the Irradiated Fuel Transfer Flask* [T-33];
- CSD-57 - *Criticality Safety Document for the NPF* [T-34]; and
- CSD-58 - *Criticality Safety Document for the Calicine Waste Transfer Flask* [T-35].

T.4.13 Dedicated Isotope Facilities Foreign Material Exclusion Program

This program defines how the foreign material exclusion methods are established and implemented for the commissioning, operation and maintenance of DIF.

It is applicable to facility systems or components that are normally open or opened for maintenance or operational activities where the potential introduction of foreign material could result in degraded performance. This program applies to all DIF personnel, Non-DIF AECL personnel, contractors and visitors who perform activities that may introduce foreign material into a system or component within DIF.

The document supporting this program objective is: *Foreign Material Exclusion Program in the Dedicated Isotope Facilities* [T-36].

T.4.14 Dedicated Isotope Facilities Procurement

The procurement of all essential equipment, materials, and services for DIF is performed in accordance with the *Company-Wide Procurement QA Manual* [T-37] and CSA Standard N286.1 [T-5].

The specific DIF procedure *MMIR/DIF Procurement Process* [T-38] ensures that the requirements stated by the *Company-Wide Procurement QA Manual* [T-37] will be implemented.

T.4.15 Dedicated Isotope Facilities Radiation Protection Program

DIF is operated in accordance with the AECL Radiation Protection Program.

All applicable elements of the AECL Radiation Protection Requirements are implemented in DIF to the extent required for current commissioning and operational status. Examples include the provision of dedicated Radiation Protection Group l-qualified staff (seven Radiation Surveyors and one Manager, Radiation & Industrial Safety), implementation of an internal dosimetry sampling program and supplementary external dosimetry program (personal electronic dosimeters), and the implementation of radiological zoning of DIF.

DIF Management ensures that radiation doses received by individuals are As Low As Reasonably Achievable (ALARA) through the implementation of AECL Radiation Protection Program. Access Control to areas of DIF considered to be high radiation areas will be established and maintained in accordance with the *Access Control* procedure [T-39].

T.4.16 Dedicated Isotope Facilities Radioactive Waste Management Program

The specific implementation of the program in DIF is done throughout procedures and operating manuals. DIF handling and storage of solid radioactive waste are performed in accordance with approved procedures, which include:

- *Operating Manual Calcination* [T-40];
- *Operating Manual Cementation* [T-41]; and
- *Management of Radioactive Waste* [T-42].

DIF handling, storage and transfer of radiological liquid waste are performed in accordance with approved procedures, which include:

- *Plumbing & Drainage System* [T-43 and T-44];
- *Plumbing & Drainage System* [T-45];
- *Liquid Waste Storage (Fissile HLLW)* [T-46];
- *Liquid Waste Storage (ALW)* [T-47]; and
- *Liquid Waste Storage (LLW)* [T-48].

T.4.17 Dedicated Isotope Facilities Emergency Preparedness

The DIF emergency procedure documents, *MAPLE Building Emergency Procedure* [T-49] and the *NPF Building Emergency Procedures* [T-50], are prepared based on the CRL site emergency response strategy.

The *Emergency Operating Procedure* [T-51] covers actions and checks to be executed following a fuel or target failure event, in the MAPLE 1 or MAPLE 2 Reactor core during reactor operation. This procedure covers the Entry Conditions for this event and ends with a stabilized situation and radioactive releases minimized.

T.5 Facility Documentation

[T-1] *DIF Quality Assurance Manual*, 6400-01913-QAM-004, Revision 10, 2006 October.

[T-2] *AECL Management Manual*, CW-514000-MAN-002, Revision 1, 2005 April.

[T-3] *Overall Quality Assurance Manual*, 00-01913-QAM-010, Revision 3, 2003 July.

[T-4] *MMIR Project Quality Assurance Manual*, 6400-01913-QAM-003, Revision 9, 2006 October.

[T-5] Canadian Standards Association, *Overall Quality Assurance Program Requirements for Nuclear Power Plants*, CSA N286 Series, 1998.

[T-6] *Quality Assurance Manual for Analytical, Scientific, and Design Computer Programs*, CW-507230-QAM-102, Revision 0, 2005 April.

[T-7] MAPLE Reactors Non-Power Reactor Operating Licence, NPROL-62.00/2007. Expiry Date: 2007 November 30.

[T-8] CRL Nuclear Research and Test Establishment Operating Licence, NRTEOL-01.00/2011. Expiry Date: 2011 October 31.

[T-9] *MAPLE Reactors Operational Limits and Conditions*, 6425-05410-OLC-001, Revision 18, 2007 March.

[T-10] Nuclear Substance Processing Facility Operating Licence, NSPFOL-03.00/2007. Expiry Date: 2007 November 30.

[T-11] *NPF Operational Limits and Conditions*, 6424-05410-OLC-001, Revision 4, 2003 February.

[T-12] *Maintenance Procedure*, 6423-485.1, Revision 2, 2007 February.

[T-13] *Work Management*, 423-650.1, Revision 15, 2006 July.

[T-14] *DIF Maintenance Program*, 6400-01500-MN-001, Revision 2, 2005 December.

[T-15] *Dedicated Isotope Facilities (DIF) Periodic and Inaugural Inspection Program*, 6423-01510-TF-001, Revision 2, 2006 February.

[T-16] *DIF In-Service Inspection Program*, 6423-01510-TD-002, Revision 0, 2000 May)

[T-17] *AECL Systematic Approach to Training*, CW-510000-MAN-001, Revision 1, 2005 June.

[T-18] *DIF Training Plan*, 6423-91000-TPL-001, Revision 1, 2006 May.

[T-19] CNSC, *Written and Oral Examination for Certified Operating Personnel at Nuclear Reactor Facilities*, Operational Procedure CNSC-ST1, Revision 2.2, 2002 July.

[T-20] *The MAPLE Reliability Plan*, 6425-01300-PLA-001, Revision 0, 1999 January.

[T-21] *NPF Reliability Plan*, 6424-01300-PLA-001, Revision 0, 2004 March.

[T-22] *Environmental Aspects, Objectives, Targets and Plans*, RC-2000-021-1.3, Revision 1, 2001 October.

[T-23] *Control of Hazardous Materials*, 6423-20000-ITS-004, Revision 1, 2007 February.

[T-24] *Routine Operations*, 6423-486.3, Revision 1, 1999 October.

[T-25] *AECL's Radiation Protection Requirements*, RC-2000-633-0, Revision 2, 2000 October.

[T-26] *AECL Occupational Health and Safety Program Manual*, CW-510400-MAN-001, Revision 3, 2007 March.

[T-27] *Nuclear Materials and Safeguards Management Compliance Program*, 9100-01900-MAN-001, Revision 0, 2005 April.

[T-28] *Accounting of Nuclear Material and Declaration of Nuclear Loss and Plutonium Generation in I-IEU Targets*, 6423-37000-PRO-001, Revision 0, 2004 December.

[T-29] *Accounting of Nuclear Materials and Declaration of Nuclear Loss and Plutonium Generation in LEU and DU Bundles*, 6423-37000-PRO-002, Revision 0, 2004 December.

[T-30] *Fissionable Materials Management*, 6423-37000-PRO-003, Revision 0, 2005 November.

[T-31] *Managing Heavy Water*, 6423-38000-PRO-001, Revision 0, 2006 January.

[T-32] CSD-55, *Criticality Safety Document for the MAPLE Reactor Buildings*, 6400-03200-AR-005, Revision 5, 2006 November.

[T-33] CSD-56, *Criticality Safety Document for the Irradiated Fuel Transfer Flask*, 6400-03200-AR-006, Revision 1, 2004 November.

[T-34] CSD-57, *Criticality Safety Document for the NPF*, 6403-03200-AR-002, Revision 4, 2004 October.

[T-35] CSD-58, *Criticality Safety Document for the Calcine Waste Tranfer Flask*, 6403-03200-AR-005, Revision 1, 2005 January.

[T-36] *Foreign Material Exclusion Program in the Dedicated Isotope Facilities*, 6423-05500-MAN-001, Revision 2, 2006 March.

[T-37] *Company-Wide Procurement QA Manual*, 00-01913-QAM-011, Revison 2, 2004 September.

[T-38] *MMRI/DIF Procurement Process*, 6400-850.1, Revision 2, 2006 September.

[T-39] *Access Control*, CW-508740-OV-109, Revision 0, 2005 September.

[T-40] *Operating Manual Calcination*, 6403-44240-OM-001, Revision 2, 2003 November.

[T-41] *Operating Manual Cementation*, 6403-44250-001 (being revised).

[T-42] *Management of Radioactive Waste*, RC-2000-021-2.5, Revision 1, 2001 October.

[T-43] *Operating Manual Plumbing and Drainage System MAPLE 1*, 6401-71700-OM-001, Revision 3, 2004 June.

[T-44] *Operating Manual Plumbing and Drainage System MAPLE 2*, 6402-71700-OM-001, Revision 0, 2004 December.

[T-45] *Operating Manual Plumbing & Drainage System NPF*, 6403-71700-OM-001, Revision 4, 2007 February.

[T-46] *Liquid Waste Storage (Fissile HLLW)*, 6403-46110-OM-001, Revision 2, 2006 December.

[T-47] *Liquid Waste Storage (ALW)*, 6403-46120-OM-001, Revision 2, 2006 December.

[T-48] *Liquid Waste Storage (LLW)*, 6403-46130-OM-001, Revision 1, 2007 March.

[T-49] *MAPLE Building Emergency Procedure*, 6425-01310-BEP-001, Revision 7, 2007 February.

[T-50] *NPF Building Emergency Procedure*, 6424-01310-BEP-001, Revision 6, 2006 September.

[T-51] *Emergency Operating Procedure*, 6425-01310-EOP-001, Revision 0, 2004 December.

Appendix U: Dedicated Isotope Facilities – New Processing Facility

U.1 General

NPF is located at Chalk River Laboratories. The facility is operated by Reactor Operations within Nuclear Laboratories.

The NPF is designed to extract radioisotopes (Mo-99, Xe-133, I-131) for use in medicine from targets irradiated in the MAPLE reactors (see Appendix T). All three isotopes along with other fission products are created by the irradiation of targets in the MAPLE reactors. After being irradiated for a prescribed period, the targets are transferred to the NPF for processing in the hot cells.

The initial stages of processing involve the recovery, purification, and separate packaging of isotope products. The remaining operations are focused on processing and packaging wastes created in the NPF into an environmentally secure form suitable for long-term storage.

U.2 Facility Changes

U.2.1 Key Developments and Facility Performance

Since Phase A Commissioning of the NPF was completed in 2000 July, activities in the facility have focused on identification and resolution of deficiencies found during the NPF Integrated Inactive Testing work, and training of operations and maintenance staff.

The most significant tasks currently ongoing are the redesign of two major waste handling systems: Calcination and Cementation. Work is also progressing on the modifications to the Closed Loop Cooling System (in part to fulfill the conditions of the approval to start active commissioning given on 2003 May 30, to resolve other operability issues with the system) and installation and commissioning of the small diesel generator added to supply certain NPF systems, as a back-up to the current diesel generator that provides Class 3 power to DIF.

Various maintenance and calibration activities were carried out during the 2005 to 2007 licensing period. In addition, field improvements, revisions to the operating manual, enhanced equipment readiness, and disposition of non-conformances were conducted to demonstrate the functionality and operability of systems in an integrated mode. The resolution of several issues was deemed to be essential prior to the start of Phase B Commissioning, since the work requires cell entry to complete.

The MMIR Project staff is resolving issues found during the non-nuclear commissioning work and the NPF Integrated Inactive Testing of the systems. DIF Operations staff continues to work on operational readiness for the start of active commissioning.

During 2005-2006, staff from the Operational Safety Assessment/Performance Improvement and Nuclear Oversight group conducted Monthly Safety Inspection tours of the facility. The annual safety review for the NPF was submitted to the CNSC on 2006 March.

U.2.2 New Processing Facility Current Status

AECL is currently resolving issues found during the non-nuclear commissioning work and the NPF Integrated Inactive Testing of the systems.

U.2.3 New Processing Facility Planned Activities

In the upcoming months, AECL's plan for the NPF is as follows:

- redesign, installation, and commissioning of two major waste handling systems, the Calcination and the Cementation systems;
- completion of the modified Closed Loop Cooling System;
- completion of the commissioning of the NPF Small Diesel Generator;
- complete resolution of issues found during the non-nuclear commissioning work and the NPF Integrated Inactive Testing of the systems; and
- make a licensing application to start Active Phase B Commissioning of the NPF.

U.3 Improvements to the New Processing Facility Commissioning Program

U.3.1 New Processing Facility Commissioning Program

The objective of the commissioning program is to perform testing within the NPF to verify that associated systems required to operate the facility perform in accordance with the design intent and safety requirements.

The documents supporting the program objectives are:

- *New Processing Facility Commissioning Plan* [U-1], and
- Commissioning Procedures prepared in accordance with, *Commissioning Documentation* [U-2].

Phase A Commissioning of the NPF was completed in 2000 July and the systems turned over to DIF Operations by 2000 November. Since Phase A Commissioning, operator training and testing of the systems have resulted in operability and maintainability issues, which have been documented in accordance with the applicable process. Work is currently in progress to resolve issues that are identified as prerequisites for starting Phase B Commissioning.

In addition to the completion of prerequisites, revision of the NPF Commissioning Plan [U-1] and Phase B Commissioning procedures will be completed prior to the start of Phase B Commissioning. The Commissioning chapter of the NPF Final Safety Analysis Report [U-3] has been revised and submitted to CNSC staff with revisions to the other chapters.

U.3.2 Hazard and Operability Study

HAZard and OPerability Study (HAZOP) is a structured technique used to identify and evaluate the potential hazardous events and operability issues for a process. The specific HAZOP approach used for the NPF attempts to generate possible deviations from the design intent of an operating step or the operating conditions in a process. The "What If" studies are similar to HAZOP studies, but for the NPF, they were applied to proposed conceptual system designs rather than the final system designs to which the HAZOP approach was applied.

U.4 Facility Documentation

[U-1] *New Processing Facility Commissioning Plan*, 6403-92000-CM-002, Revision 1, 2002 September.

[U-2] *Commissioning Documentation*, 6400-486.1, Revision 7, 2007 February.

[U-3] *Final Safety Analysis Report for the New Processing Facility*, 6403-05230-FSAR-001, Revision 1, 2006 April.