INFORMATION IN SUPPORT OF LICENCE RENEWAL FOR THE MAPLE REACTORS

Day 1 Hearing

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Acronyms

AECL	Atomic Energy of Canada Limited
AMMS	Advanced Maintenance Management System
CAR	Control Absorber Rod
CCA	Commissioning Completion Assurance
CDP	Conceptual Decommissioning Plan
CNSC	Canadian Nuclear Safety Commission
CR	Change Request
CRL	Chalk River Laboratories
CSA	Canadian Standards Association
DIF	Dedicated Isotope Facilities
DRL	Derived Release Limit
DU	Depleted Uranium
EAFS	Exhaust Air Filtration System
FCN	Field Change Notice
FME	Foreign Materials Exclusion
FSAR	Final Safety Analysis Report
GSS	Guaranteed Shutdown State
HEU	Highly Enriched Uranium
HF	Human Factors
HFEPP	Human Factors Engineering Program Plan
IPF	MAPLE 1 Iodine Production Facility
LEU	Low Enriched Uranium
MAPLE	Multipurpose Applied Physics Lattice Experimental (Reactor)
MCNP	Monte Carlo N-Particle Transport Code
MMIR	MDS Nordion Medical Isotopes Reactor
MRM	Management Review Meeting
NCR	Non-Conformance Report
NLBU	Nuclear Laboratories Business Unit
NPF	New Processing Facility
NRU	National Research Universal (Reactor)

OJT	On-the-Job Training
OLC	Operating Limits and Conditions
OPEX	Operating Experience
OSA	Operational Safety Assessment
OSH	Occupational Safety and Health
OTP	Operator Test Procedure
PCR	Power Coefficient of Reactivity
PDP	Preliminary Decommissioning Plan
PIRT	Phenomena Identification and Ranking Table
SERP	Safety, Environmental and Radiological Protection
SOR	Shut-Off Rod
SS1	Safety System 1
SS2	Safety System 2
SSHC	Site Safety and Health Committee
UER	Unplanned Event Report
UPS	Uninterruptible Power Supply
WAP	Work Activity Plan

1 INTRODUCTION

Atomic Energy of Canada Limited (AECL) is in the final stages of completing the MDS Nordion Medical Isotopes Reactor (MMIR) Project at the Chalk River Laboratories (CRL) to put into operation the MAPLE 1 and MAPLE 2 reactors and the New Processing Facility (NPF) for the sole purpose of producing medical isotopes for diagnostic and therapeutic purposes. The MAPLE 1 and MAPLE 2 reactors and the NPF are also referred to as the Dedicated Isotope Facilities (DIF).

The design and construction programs are completed and the completion assurance statements have been submitted to the Canadian Nuclear Safety Commission (CNSC) staff. Non-nuclear commissioning for MAPLE 1 and MAPLE 2 reactors has also been completed and the associated completion assurance statements submitted. Nuclear commissioning for the MAPLE 1 reactor up to 8 MW has been completed. The initial approach to critical for the MAPLE 2 reactor has been achieved.

MDS Nordion would take legal title of the MAPLE 1 reactor and the MAPLE 2 reactor after successful completion of their respective commissioning programs. Following transfer of legal title, AECL will continue to operate the MAPLE 1 and MAPLE 2 reactors. In addition, AECL will retain the Design Authority role and be the holder of the Operating Licence.

This report provides summary-level information to support the renewal of the Non-Power Reactor Operating Licence, MAPLE 1 and 2 Nuclear Reactors, NPROL-62.01/2005, which expires on November 30, 2005. AECL's application has requested a renewal for a period of 24 months on the basis that this is sufficient to allow the following:

- Resolution of the positive power coefficient of reactivity (PCR) issue to enable completion of the commissioning program for the MAPLE 1 and MAPLE 2 reactors;
- Resolution of the technical issues to enable completion of the commissioning program for the MAPLE 1 I-125 Production Facility (IPF); and
- Accumulation of representative operating experience in the MAPLE 1 and MAPLE 2 reactors and in the MAPLE 1 IPF.

Since the MAPLE 1 and MAPLE 2 reactors are at the CRL, operations are integrated with many of the CRL site-wide programs, which are covered under the Nuclear Research and Test Establishment Operating Licence, NRTEOL-01.02/2006.

As part of its continuous improvement program, including results of AECL's assessments, various audits, and root cause evaluations, AECL is putting in place improvement programs for the operation of the DIF in several areas. AECL is taking actions to develop and implement a comprehensive improvement plan for DIF to achieve the following:

- Clearly communicate accountabilities for program requirements and for the execution of work;
- Implement an Operation Score Card to continuously evaluate performance;

- Implement a Human Performance Improvement program for Operations and Maintenance;
- Incorporate lessons learned from major improvements in National Research Universal (NRU) reactor processes;
- Establish performance benchmarks against utilities and other research reactors;
- Improve the planning process by incorporating lessons learned from utilities and other AECL projects;
- Implement a plan for a transition from the MMIR Project to routine operations, maintenance, and technical support.

2 FACILITY PERFORMANCE

2.1 KEY DEVELOPMENTS DURING THE CURRENT LICENCE PERIOD (2003-2005)

The summary of key developments for the MAPLE 1 and MAPLE 2 reactors for 2003 and 2004 is prepared based on the MAPLE 1 and MAPLE 2 Annual Reports [1], [2], [3], and [4]. The summary of key developments for MAPLE 1 and MAPLE 2 reactors up to July 2005 is also provided.

During the current licence period, rounds and routine procedures were completed as required for both MAPLE reactors. Operational Safety Assessment (OSA) staff of the Facilities Safety and Licensing Branch conducted monthly safety inspection tours. In addition, the Facility was inspected twice in 2003 and 2004 and once in 2005 by an independent safety inspection team comprised of representatives from Safety, Environmental, and Radiological Protection (SERP), Occupational Safety and Health (OSH), Site Safety and Health Committee (SSHC), Security, the Fire Department, and OSA. MAPLE personnel addressed issues raised during these inspections.

2.1.1 Key Developments for 2003

2.1.1.1 MAPLE 1 Reactor

During 2003, commissioning and project work continued with ownership and responsibility for all systems residing with Facility Operations staff. The Phase C Commissioning Activities were completed with the reactor operating up to 8 MW. In June 2003, the reactor was shut down with the Safety System 1 (SS1) and the Control Absorber Rods (CARs) inserted fully in the core and de-energized during the investigation into a small positive Power Coefficient of Reactivity (PCR) measured during commissioning activities. A request for approval to operate the reactor up to 2 kW was made to the CNSC, with approval granted in December 2003. SS1 was re-poised in December. Throughout the year, the facility had been used for training of Operations and Maintenance staff. Various maintenance and calibration activities were also carried out.

During Phase C Commissioning, with only two exceptions both documented through Non-Conformances Reports (NCRs), system functional tests confirmed that the reactor systems functioned as expected. System responses to simulated accidents (Loss of Class IV Power and Loss of Regulation test) satisfied the acceptance criteria and expected results of the tests.

For MAPLE 1 and MAPLE 2, the collective whole-body dose equivalent was 6.2 person·mSv during 2003. The average individual dose for the year was 0.3 mSv and the maximum individual dose was 0.5 mSv. There were no exposures in excess of AECL Action Levels recorded in 2003. There were no fires in the Facility or lost-time accidents during the year.

Releases of airborne or liquid radioactive materials generated from the MAPLE 1 Reactor Facility were extremely small in 2003. An Effluent Verification Monitoring program,

initiated in 2000, continued throughout 2003 and included the measurement of emissions from MAPLE 1 roof vents and contributions from the MAPLE reactors to the NRU/DIF Stack in Building 158. The total of all releases measured throughout the year were well below the Action Levels for the Facility and the Derived Release Limits (DRLs) for the site.

During 2003, the reactor protective and regulating systems operated as required. The Operator Test Procedures (OTPs) for the Exhaust Air Filtration System (EAFS) and the 40-Day Periodic Tests to verify interlock and equipment functionality were conducted routinely throughout the year. All OTPs for both Safety System 1 and Safety System 2 (SS1 and SS2) were executed against a schedule instituted to ensure that all OTPs are conducted as required. An Operating and Routine Maintenance Schedule was formulated based on results of an activity base analysis conducted in the DIF in accordance with operational and regulatory requirements.

There were seven trips of the Safety Systems in 2003 as a result of Loss of Class IV Power events and three as a result of short duration power bumps. Other trips of the Safety Systems (58 in total) and Reactor Regulating System auto-shutdowns (14 in total) were initiated as a result of commissioning activities and maintenance/calibration procedures completed during the year.

There were four additional unplanned events reportable to the CNSC (with one common to both MAPLE reactors) and one minor event. Emergency response plans were tested, including the following Facility-specific drills: a fire drill in August, a Bomb Threat in December and a Stay-In exercise in June (in conjunction with a CRL site-wide exercise). Emergency procedures were reviewed and updated as necessary.

An annual third-party review of the Fire Protection Systems for MAPLE 1 and MAPLE 2 was carried out by an external independent agency in December to comply with Licence Condition 8.4 in the MAPLE Reactor Operating Licence, NPROL-62.01/2005. The three recommended actions made by the inspection team have been completed.

An audit of MMIR Commissioning Quality Assurance was conducted by the CNSC in July 2003. Seven directives were issued as a result of the audit. Signed-off audit forms with proposed resolutions were forwarded to the CNSC within the allotted time frame. Dispositions are completed.

2.1.1.2 MAPLE 1 Iodine Production Facility

Commissioning of the MAPLE 1 IPF commenced upon transfer of responsibility from construction and continued throughout the year. Class IV and Class III electrical supplies to the MAPLE 1 IPF panels were commissioned in September 2003.

The MAPLE 1 IPF Class II power was fed from Class IV under a jumper, pending installation of a dedicated UPS for Class II. Radiation shielding verification of the MAPLE 1 IPF, completed in June, confirmed that radiation dose rates met the requirements of the designated Radiological Safety Zone specific to each component of the MAPLE 1 IPF.

Liquid nitrogen control and monitoring instrumentation was commissioned. Commissioning of the MAPLE 1 IPF ventilation system was initiated in May 2003.

2.1.1.3 MAPLE 2 Reactor

During 2003 work activities focused on Phase B Commissioning of the MAPLE 2 Reactor. Commissioning work continued throughout 2003, with ownership and responsibility for all systems residing with Facility Operations staff. The reflector and shut-off rods were poised in June. Neutron sources were positioned in the centre of the core in order to calibrate the fission chambers for both the safety systems and the Reactor Regulating System (RRS). Regular execution of the OTPs for both safety systems was started. A monitoring program to measure the emissions from MAPLE 2 roof vents was initiated in June, with stack bubblers installed and samples routinely taken by Facility Radiation Protection Staff.

CNSC approval for loading fuel in the MAPLE 2 reactor for the first time and commissioning up to 2 kW was received in August. Initial loading of 18-element LEU driver-fuel bundles in the Shut-Off Rod (SOR) and Control Absorber Rod (CAR) sites commenced in September. Criticality was achieved in the MAPLE 2 core on October 9 following the addition of the fifth 36-element LEU driver-fuel bundle. The Reactor was operated as required for the execution of OTPs during the remainder of the year.

Releases of airborne or liquid radioactive materials generated from the MAPLE 2 Reactor were extremely small in 2003. Results from effluent monitoring indicate that emissions remain consistently well below Action Levels for the Facility and the DRLs for the site.

During 2003, there were no fires in the Facility. There was one lost-time accident in the Facility during the year, when an electrician twisted a knee.

The 40-Day Periodic Tests OTP, covering interlock and equipment functional testing as described in the Operating Limits and Conditions (OLC) document, was initiated in May 2003 in the MAPLE 2 reactor. All applicable OTPs for both Safety System 1 and Safety System 2 and the Emergency Filtration System (EFS) were executed on a schedule implemented to ensure that they are conducted as required, consistent with the reactor operating status.

During completion of OTPs, there was one failure of the test procedure to indicate the required SS1 channel trip and four failures of the test to indicate the expected SS2 channel trip. Upon investigation, it was found that the indicating instrumentation failed to register the expected result. All of these were addressed and resolved under separate work requests. One failure, during which one of the single valve dump timing tests exceeded the acceptance criterion, was subsequently covered in an Event Notification forwarded to Operating Experience at CRL. Trip functionality was not impaired during 2003.

There were five unplanned events reportable to the CNSC during the year associated with the MAPLE 2 reactor. In two instances, no further investigation was required. The third event was covered by the preparation of a Non-Conformance Report. For the fourth event, a Level 1 Unplanned Event Report (UER) was completed. In the last case, a Level 2 UER

investigation was completed, including corrective actions, in late October. Also during 2003, there was one reportable event associated with both MAPLE reactors wherein an inadvertent trip of SS2 in both facilities occurred during maintenance work on an electrical panel in the Remote Shutdown and Monitoring Centre. The cause was quickly determined and no further investigation initiated. There were four trips of the safety systems in 2003 as a result of a Loss of Class IV Power to the Facility. Other trips of the safety systems (28 in total) and RRS auto-shutdowns (two occurrences) were initiated as a result of commissioning activities and maintenance/calibration procedures completed during the year.

In addition, ten spurious safety system trips were reported to the CNSC. The reactor was shut down when these trips occurred.

2.1.2 Key Developments for 2004

2.1.2.1 MAPLE 1 Reactor

During 2004, the MAPLE 1 reactor remained shutdown throughout the year, with the Control Absorber Rods (CARs) inserted fully in the core and de-energized, as investigation into the positive PCR continued. However, routine maintenance and test procedures were conducted in accordance with the reactor operating status. The Facility continued to be used for training of Operations and Maintenance staff. Various maintenance and calibration activities were carried out during the year. Commissioning and project work continued throughout the year with ownership and responsibility for the Facility transferred to the Nuclear Laboratories Business Unit (NLBU) from the MMIR Project in 2004.

A Neutron Log Flux High trip was added to the trip relay logic, the time constants for the Neutron Log High Rate trip were reduced and the Gamma Linear High Rate trip setpoint was reduced under a Jumper, in preparation for re-measurement of the PCR. Commissioning of these new trips was about 50% complete by the end of 2004.

AECL has completed the work on the Mo-99 target critical heat flux correlation at low flows. CNSC staff has accepted the results of this work and concluded that the issue is now resolved.

The collective dose for MAPLE 1 and 2 reactors was 11.5 person·mSv during 2004. The average individual effective (whole-body) dose for the year was 0.4 mSv and the maximum individual dose was 0.6 mSv. There were no cases of internal or external radiation exposures from sources within the MAPLE 1 in 2004. There were no exposures in excess of dose Action Levels recorded in 2004. There were no fires in the Facility or lost-time accidents during the year.

Releases of airborne or liquid radioactive materials generated from the MAPLE 1 reactor were extremely small in 2004. An Effluent Verification Monitoring program continued throughout 2004 and included the measurement of emissions from MAPLE 1 roof vents and contributions from the MAPLE reactors to the NRU/DIF Stack in Building 158. The total of all releases measured throughout the year were well below the regulatory Action Levels and the DRLs.

An annual third-party review of the Fire Protection Systems for MAPLE 1 and MAPLE 2 was carried out by an external independent agency in December to comply with Licence Condition 8.4 in the MAPLE Reactor Operating Licence, NPROL-62.01/2005.

The reactor protective and regulating systems operated as required during the year. The OTPs for the Exhaust Air Filtration System (EAFS) and the 40-day Periodic Tests, to verify interlock and equipment functionality, were conducted routinely throughout the year. All OTPs for both SS1 and SS2 were executed against a schedule instituted to ensure that all OTPs were conducted as required. Maintenance was performed to demonstrate the continued reliability of equipment and components.

During completion of OTPs, there was one failure of the indicating instrumentation to register the expected result during a SS1 test, one failure of a Shut Off Rod (SOR) to rise during the execution of a test of SS1 that was found to be the result of a loose wire, and one failure of a limit switch for a damper to indicate correctly at the HVAC Operator workstation during testing of the EAFS box-up dampers. All of these were addressed and resolved under separate work requests. Trip functionality was not impaired during 2004.

There was one trip of both safety systems in 2004 as a result of a Loss of Class IV Power to the Facility. Other trips of the safety systems (18 in total) were primarily the result of spurious log rate trips due to low power signals from the core and the length of the reactor shutdown.

During 2004, there were 21 reportable unplanned events. Of these, 15 involved a trip of a safety system for which further investigation was not required, with 13 the result of a spurious log rate trip due to low power signals from the core and the extended length of the reactor shutdown. A Root Cause Assessment was conducted for two of the remaining six events. Non-Conformance Reports or Level 1 UERs were initiated to investigate the other four events.

In March, following completion of a trip relay logic wiring modification completed under an approved Work Plan, an attempt to poise SS1 was made. The attempt was unsuccessful due to the timing out of SOR 2 while poising. The safety system trip logic is designed such that when a time-out is encountered during an attempt to poise any one of the three SORs, the remaining poised SORs shall drop into the reactor core. However, in this instance, SOR 1 solenoid vent valves V-1220 and V-1121 remained closed after actuation of the 'Unintentional Drop of SOR 2' trip circuit; therefore SOR 1 remained poised. SOR 3 dropped into the reactor core as designed. A review of the wiring modifications, conducted by the DIF Technical Support Unit, found that one of the wires had been incorrectly terminated during the wiring modification work completed earlier. As a result of this, two relays remained energized rather than de-energized, as they should have been upon actuation of the unintentional SOR drop trip. This resulted in the SOR 1 drop solenoid valves remaining closed and SOR 1 poised. The wiring was corrected; the SOR 2 Unintentional Drop Logic was checked using an Operator Test Procedure, and the correct operation of the trip logic was confirmed. A root cause analysis was performed and corrective actions taken.

In July, SOR 2 and SOR 3 indicated 'Down,' whereas SOR 1 did not give the same 'Down' indication. There was no 'Unintentional Drop of SOR' indication on any of the three SS1 channels. On Panel 2 in the Control Room, the 'Raise SOR' light immediately began flashing on its own without having to push the button. SS1 was manually tripped from Panel 2 and the SOR 1 'Down' indication was achieved. An investigation found that this event was caused by two loose wiring connections in the SS1 cabinets. All wire terminations in the cabinet were examined and remediation work completed as required. In addition, an independent technical evaluation was commissioned to look at the control logic associated with the MAPLE SS1, SS2, and EAFS systems. The evaluation was extended to the control room and field wiring terminations, with re-termination work completed as required. This remediation work was conducted under approved Work Plans and continued in MAPLE 1 through to the end of the year.

Wiring re-termination work began on the SS1 and SS2 cabinets and the field junction boxes in September and October, with work completed in December. Wiring re-termination work began on the Reactor Regulating System cabinet in November. The re-termination work was completed by the end of the year, and all systems were returned to normal operation. Some work to remediate findings during the re-terminations remains outstanding; however, functionality of the systems is not affected. The engineering assessments showed that no single failure would prevent the safety systems from shutting down the reactor when required.

As part of the wire remediation activities initiated as a result of the root cause investigation into the 'SOR 2 and SOR 3 Indicate Down with Unintentional Drop Indication' event (UER2-MAPLE 1-04-04R), all wire terminations in Panel 37 in the MAPLE Control Room were also examined. Panel 37 includes wiring for both the Radiation Monitoring equipment and the EAFS ventilation. Ferrules were installed on all wire terminations and OTPs were performed in November following completion of the re-work to confirm functionality of the system. Some remediation work remains to be completed; however, functionality is not affected by these outstanding tasks. Wiring terminations were also inspected in Panel 102 associated with the EAFS located in Building 160. Once again there remains some outstanding remediation work to be done, mostly associated with updates to drawings and labelling.

During the re-termination work, the reactor was considered to be placed in a Guaranteed Shutdown State (GSS), with the transfer key placed under Facility Authority control and the neutron multiplication factor ≤ 0.75. OTPs were performed to confirm functionality of the systems after the rework was completed.

In October, based on a flooding alarm for Room 001 in MAPLE 2, the Process Water System piping in MAPLE 1 was inspected. The inspection found localized erosion in the Process Water System piping but no leakage. This event was reported to the CNSC within the prescribed time frame. An unplanned event investigation is in progress. An engineering evaluation was performed to establish inspection criteria and the allowable time to continue operating the system until the design changes are implemented.

A Quality Assurance Annual Program Review for the period March 2002 to November 2003 was conducted and completed in 2004.

2.1.2.2 MAPLE 1 Iodine Production Facility

Commissioning of the MAPLE 1 IPF continued throughout the year. Activities included installation of a new coupling mechanism in both Product Cells, commissioning of the coupling mechanism and product cylinder handling in both process streams, and installation of the liquid nitrogen supply in the facility. Responses of the MAPLE 1 IPF systems to loss of Class II, Class III, and Class IV power were confirmed in March. Shielding verification for the Process and Product Cells was completed in March. System volume for both streams was determined using carbon dioxide. In November, written notification was forwarded to the CNSC informing them of the absence of seismically qualified pressure indicators and pressure limiting valves in the MAPLE 1 IPF. The lack of seismic qualification of these components was identified during Phase A Commissioning activities and a Non-Conformance Report was initiated to investigate the cause of this discrepancy. An engineering evaluation was completed and work to acquire seismically qualified replacement components is in progress.

2.1.2.3 MAPLE 2 Reactor

The MAPLE 2 reactor did not operate during 2004 while an investigation into the reasons for a stuck cluster holder was conducted. While removing the cluster holders as part of commissioning activities to load flux wires, the cluster holder in core position N24 was found to be stuck in the fully down position and could not be removed. Several attempts using various techniques to try and release the cluster holder proved unsuccessful. A Non-Conformance Report was raised and a Root Cause Assessment investigation was initiated and completed. A decision was made to remove the flow tube and the cluster holder together so as to preserve the jamming mechanism for further inspection and investigation. The mechanical cause of the jamming identified during the investigation was attributed to interference between the welded tapered transition on the cluster holder central rod and the chamfered keyhole in the flow-type spider assembly. The failure mechanism was tested and repeated in the test facility, confirming the hypothesis proposed by the investigation team. Several issues related to the design process were identified and are being addressed.

Maintenance and testing of equipment was conducted as required based on the configuration of the Facility.

A Neutron Log Flux High trip was added to the trip relay logic, the time constants for the Neutron Log High Rate trip were reduced, and the Gamma Linear High Rate trip setpoint was reduced under a Jumper in preparation for re-measurement of the PCR. Commissioning of these new trips was about 50% complete by the end of 2004.

Releases of airborne or liquid radioactive materials generated from the MAPLE 2 reactor were extremely small in 2004. Results from effluent monitoring indicate that emissions

remain consistently well below regulatory Action Levels and the Derived Release Limits (DRLs).

During 2004, there were no fires in the Facility nor were there any lost-time accidents.

All applicable OTPs for both SS1 and SS2, the Exhaust Air Filtration System (EAFS), and the 40-Day Periodic Tests to verify interlock and equipment functionality were executed on a schedule implemented to ensure that they are conducted as required, consistent with the reactor operating status.

There were no trips of the safety systems in 2004 as a result of a Loss of Class IV Power to the Facility. There were five trips of the safety systems that occurred during execution of maintenance/calibration procedures completed during the year.

Following the incident with the stuck cluster holder, all remaining target clusters were removed from the core. In addition, four cluster holders were removed from the core and shipped to Sheridan Park for rework in May. They remained out of the core for the rest of the year while rework of the holders continued.

There were eight events reportable to the CNSC in 2004. All were reported to the CNSC within the prescribed time frame. Five of these were investigated using a Non-Conformance Report. Of these, four were related to failure of the UPS-2 supply and are being investigated under the Non-Conformance Reporting system. One of the SS1 trips was caused during troubleshooting of a faulty ammeter. The situation was quickly resolved and no further action was deemed necessary. A Root Cause Assessment was conducted for two of the remaining three unplanned reportable events.

In April, there was an inadvertent trip of Safety System 2 from the Standby Reactor Monitoring System in MAPLE 1 caused by a tapping of a pushbutton on Panel-38 by Operations staff in an attempt to clear a fault condition on the panel. This tapping caused an actuation of Channel A of SS2 in MAPLE 2 and, since Channel B was already manually rejected for safety system modification work, the result was a reflector dump on two-out-of-three channel trip logic. An unplanned event investigation (UER1) was performed.

In October, a flooding alarm for Room 001 in MAPLE 2 annunciated. The investigation found a pin hole leak in the Process Water System piping due to localized erosion of the pipe wall. This event was reported to the CNSC within the prescribed time frame. An unplanned event investigation is in progress. An engineering evaluation is being performed to identify design changes.

2.1.3 Current Status in 2005

A number of changes in the AECL organization have taken place over the last few months. The DIF organization, in its new constituency, manages all aspects of the DIF previously covered by the MMIR Project and DIF Operations. The DIF organization will ensure management oversight and operational risk review in an integrated manner. Further, this integrated team will ensure that safety and quality practices are enforced.

2.1.3.1 MAPLE 1 Reactor

Following the completion of the re-termination work on SS2, it was discovered that the MAPLE 1 reactor had departed from the GSS before a work activity plan covering operational readiness activities had been completed. It was then realized that during the re-termination work the MAPLE 1 reactor was not in the reference GSS configuration that had been previously accepted by the CNSC staff, although the reactor remained in a safe shutdown state. In February, actions were taken to put the MAPLE 1 reactor in the reference GSS configuration. An Unplanned Event Report with a Root Cause Analysis was submitted to the CNSC. Two corrective actions identified in the Root Cause Analysis have been completed. AECL has initiated a review of NRU operations by utility experts; the results of this review will be used to address the third corrective action. It is currently planned that the reactor will remain in GSS until the end of July.

In June 2005, AECL submitted a potentially reportable event to the CNSC that the FSAR does not fully account for the variation in the allowable manufacturing limits on the Mo-99 targets. When combined with the effect of the flux gradient across the target, the local element powers would exceed the FSAR maximum values. AECL intends to bound this effect in future safety cases submitted to the CNSC.

To support the request to change the operating status of the MAPLE 1 reactor from GSS to operating up to 2 kW, AECL submitted a safety case to demonstrate that there is no impact on health, safety, security, the environment, and Canada's international obligations. This safety case includes analyses to bound the effect of the flux gradient across the target and the worst-case manufacturing limits. AECL is preparing responses to the comments received from the CNSC staff. The prerequisites to exit from GSS and operate up to 2 kW have been identified and are currently being completed.

For MAPLE 1 and MAPLE 2, the training program for recertifying the Managers, Operations and Reactor Operators has been established, documented and implemented. All of the certified Managers, Operations and Reactor Operators, except the Facility Manager, have been recertified by the CNSC. There are sufficient certified Manager, Operations and Reactor Operators to cover the shift requirements for both MAPLE reactors. In addition, eight new Reactor Operators and one new Manager, Operations have also successfully completed the facility-specific AECL training, including a final AECL comprehensive examination, a Facility Performance program, and a Facility Manager Interview.

2.1.3.2 MAPLE 1 Iodine Production Facility

Phase A Commissioning of the MAPLE 1 IPF is currently on hold pending completion of residual Non-Conformance Reports and Change Requests.

2.1.3.3 MAPLE 2 Reactor

The MAPLE 2 reactor was placed in the reference GSS in April 2005.

3 MAPLE REACTORS PROGRAMS

3.1 SITE-WIDE PROGRAMS

Operation of the MAPLE 1 and MAPLE 2 reactors relies on many of the CRL site-wide programs, which are described in summary in Reference [5]. The site-wide programs used by the MAPLE 1 and MAPLE 2 reactors are:

1. Environmental Protection Program (Reference [5], section 2.1.l), which includes management of radioactive and non-radioactive emissions and waste management.
2. AECL's Overall Quality Assurance Program (Reference [5], section 2.1.2), which is supplemented by the MDS Nordion Medical Isotopes Reactor (MMIR) Project QA Manual (Reference [6]), for the remaining project activities, and the Dedicated Isotope Facilities (DIF) QA Manual (Reference [7]) that applies to the operation of the MAPLE 1 and 2 reactors and the NPF.
3. Emergency and Protective Services Program (Reference [5], section 2.1.3).
4. Occupational Safety & Health Program (Reference [5], section 2.1.4).
5. Operating Experience Program (Reference [5], section 2.1.5).
6. Radiation Protection Program (Reference [5], section 2.1.6).
7. Emergency Preparedness Program (Reference [5], section 2.1.7).
8. Nuclear Materials and Safeguards Management Compliance Program (Reference [5], section 2.1.8).
9. Radioactive Material (RAM) Transportation Compliance Program (Reference [5], section 2.1.9).
10. Radioactive Waste Management Program (Reference [5], section 2.2.2).
11. Training Program (Reference [5], section 2.2.7) that provides training for site-wide programs, organizational development, and radiation protection. Line managers define training requirements for staff. The Operations Training Manager in the DIF organizes facility-specific training and facilitates and tracks staff training. Training requirements for staff that are certified by the CNSC are specified in the current Operating Licence.
12. Independent Review and Approval (Reference [5], section 2.2.9).
13. Community Relations Program (Reference [5], section 4.6.6).

3.2 SPECIFIC PROGRAMS

In addition to AECL company-wide and CRL site-wide programs, facility specific programs are in use, as outlined in the QA Manuals and supporting procedures for the MMIR Project and the operation of the DIF (References [6] and [7]). Some site-wide programs require specific implementation in the context of the DIF. The following is a brief description of how key programs are implemented in the DIF.

3.2.1 QA Program

3.2.1.1 MMIR Project QA Program

The objective of the MMIR Project Quality Assurance (QA) program is to ensure that design and commissioning activities are properly planned and executed by competent individuals and that the results demonstrate system compliance with specified requirements.

The MMIR Project QA 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 documents supporting the program objectives are:

- AECL Overall Quality Assurance Manual, 00-01913-QAM-010;
- MMIR Project Quality Assurance Manual [6], 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.
- MMIR Project procedures to provide specific guidance on the QA program implementation.

The QA programs applicable to the MMIR Project activities are described as follows:

- Procurement is performed in accordance with the requirements described in the Company-Wide Procurement QA Manual, 00-01913-QAM-011, and the MMIR Project QA Manual [6].
- Design activities are performed in accordance with the requirements described in the Company-Wide Design QA Manual, 00-01913-QAM-005, and the MMIR Project QA Manual [6].
- Construction and fieldwork activities performed under direct MMIR Project control are conducted in accordance with the MMIR Project QA Manual [6] and the Company-Wide Construction QA Manual 00-01913-QAM-013, as applicable. Construction activities performed by Participants and /or Contractors are conducted in accordance with their quality program manual, which is accepted by the MMIR Project prior to the start of the activity. QA programs specified by MMIR Project and acceptable to jurisdictional authorities govern these activities, depending on the system classification.
- Commissioning activities are performed in compliance with the requirements of the MMIR Project QA Manual [6].
- The development and use of analytical, scientific, and design software complies with the Company-Wide QA Manual for Analytical, Scientific, and Design Computer Programs, CW-507230-QAM-102.

3.2.1.2 DIF Operations QA Program

DIF Operations has established and implemented an Operations QA Program to ensure that qualified individuals operate and maintain the MAPLE 1 and MAPLE 2 reactors safely and within the requirements defined in NPROL-62.01/2005 and detailed in "MAPLE Reactors Operational Limits and Conditions," 6425-05410-OLC-001.

The DIF QA 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 documents supporting the program objectives are:

- DIF Quality Assurance Manual [7], which covers both the Owner and Operator's responsibilities as per the requirements of the CSA-N286.0 and CSA-N286.5.
- Supporting documents to provide specific guidance on QA program implementation:
    - Company-wide procedures;
    - Chalk River procedures;
    - DIF-specific quality procedures;
    - MMIR Project quality procedures;
    - Conduct of Operations procedures;
    - Instructions to Staff documents; and
    - Compliance program manuals (e.g., radiation protection, emergency preparedness) and their referenced procedures.

Opportunities for improvement were identified from self-assessments, event investigations, root cause analyses, DIF Operations Oversight Assessment, and CNSC inspections and audits. Additional resources have been added to ensure prompt and effective resolution and implementation of these opportunities for improvement.

A comprehensive improvement plan for DIF is under development to achieve the following:

- Clearly communicate accountabilities for program requirements and for execution of work;
- Implement an Operation Score Card to continuously evaluate performance;
- Implement a Human Performance Improvement program for Operations and Maintenance;
- Incorporate lessons learned from major improvements in NRU processes;
- Establish performance benchmarks against utilities and other research reactors;

- Improve the planning process by incorporating lessons learned from utilities and other AECL projects;
- Implement a plan for a transition from the MMIR Project to routine operations, maintenance, and technical support.

An operational risk review and management oversight process has been implemented with 8 procedures produced. Operations and maintenance staff are being trained on the procedures.

Based on a review of best industry practices, utility peers have developed conduct of operations expectations for DIF Operations; training on the conduct of operations expectations has started. An observation and coaching program for operations and maintenance staff is being run by recognized experts in the field.

An extensive review of procedures, identification of gaps and improvements to the procedures are underway. Training on the revised and new procedures is being provided when they are issued for use.

3.2.2 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 for the environment are met for all accident scenarios in the Final Safety Analysis Report (FSAR). Currently, the Safety Analysis program is focused on providing safety cases to support operation of the MAPLE 1 and MAPLE 2 reactors at 2 kW, 500 kW, 5 MW, 8 MW, and 10 MW. These safety cases cover all activities to be performed at each level, including:

- Establishing a photo-neutron source;
- Commissioning tests;
- Tests to investigate the source of the positive PCR;
- Tests to support implementation of mitigation measures for the positive PCR; and
- Irradiation of Mo-99 targets for NPF active commissioning, acceptance testing, and production.

The documents supporting the program objectives are:

- "Safety Case to Support Operation of MAPLE Reactor to 2 kW," 6400-05600-ASD-019;
- Safety Case to Support Operation of MAPLE Reactor to 500 kW (to be issued);
- Safety Case to Support Operation of MAPLE Reactor to ~5 MW (to be issued);
- Safety Case to Support Operation of MAPLE Reactor to 8 MW (to be issued);
- Safety Case to Support Operation of MAPLE Reactor to 10 MW (to be issued);
- MAPLE Reactors FSAR;
- "Criticality Safety Document for the MAPLE Reactor Buildings," 6400-03200-AR-005 (CSD55);

- "Criticality Safety Document (CSD-56) for the Irradiated Fuel Transfer Flask," 6400-03200-AR-006.

The Safety Analysis program also includes the revision and update of the FSAR. This will include revision of all FSAR sections, with the exception of those sections containing safety analysis results. These safety analysis sections will be updated once the source of the positive PCR is identified, and the mitigation measures are known. In the meantime, the safety cases listed above provide or will provide the safety analysis support for reactor commissioning and operation.

3.2.3 Radiation Protection Program

The MAPLE 1 and MAPLE 2 reactors are operated in accordance with the AECL Radiation Protection Program. All applicable elements of the AECL Radiation Protection Requirements are implemented in the 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 the DIF.

The documents supporting the program objectives are:

- AECL's Radiation Protection Requirements, 00-872.1/RC-2000-633-0;
- Radiation Protection Manual, RC-2000-633-1;
- Radiation Protection training documents;
- Facility specific documents.

3.2.4 Operational Limits and Conditions

The MAPLE 1 and MAPLE 2 reactors and MAPLE Iodine-125 Production Facility are operated in accordance with NPROL-62.01/2005 for the MAPLE 1 and MAPLE 2 reactors and NRTEOL-01.02/2006 for the CRL site-wide programs.

"MAPLE Reactors Operational Limits and Conditions," 6425-05410-OLC-001, Revision 9, is the version currently approved by the CNSC Designated Officer [8]. Pursuant to Licence Condition 1.2 of Non-Power Reactor Operating Licence NPROL-62.01/2005, this replaces the version referenced in Appendix B of the NPROL-62.01/2005. The OLC document sets out the key requirements, limits, and conditions for the safe operation of the MAPLE 1 and MAPLE 2 reactors and MAPLE 1 IPF.

The CNSC Designated Officer's approval of Revision 9 of the OLC document does not construe approval of the various OLC limits (reactor power, safety system trip setpoints, etc.). Approval of these values will be given once the AECL safety case has been accepted by the CNSC staff.

3.2.5 Safety-Related Systems Testing Program

The MAPLE Reliability Plan, 6425-01300-PLA-001, has been produced to guide 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 Report for the MAPLE Reactors," 6400-05230-FSAR-001. The maintenance program and the supporting procedures, such as OTPs, have been developed. An Operating and Routine Maintenance Schedule was formulated based on the results of an activity base analysis conducted in the DIF in accordance with operational and regulatory requirements. A schedule has been instituted to ensure that all OTPs are conducted as required.

3.2.6 Commissioning Program

3.2.6.1 MAPLE 1 and MAPLE 2 Reactors

All MAPLE 1 & MAPLE 2 reactors commissioning work is conducted in accordance with the Commissioning Plan, 6401-92000-CM-001.

All systems in the MAPLE 1 and MAPLE 2 reactors have completed Phase A Commissioning and have been turned over to DIF Operations. The originally planned commissioning tests for the MAPLE 1 reactor have been completed up to the 8 MW hold point in NPROL-62.01/2005. The originally planned commissioning tests for the MAPLE 2 reactor have been completed up to the measurement of the reactivity worths of the control absorber rods and shut-off rods. The MAPLE 1 and MAPLE 2 reactors are currently in GSS.

The MAPLE 1 and MAPLE 2 Non-Nuclear Commissioning of safety system modifications described in Change Request 6400-68000-CR-007 is required to be completed prior to exiting the GSS for each reactor. A Work Activity Plan [9] has been prepared to describe in detail the design, procurement, installation and commissioning scope, processes and sequence of work.

CNSC staff has expressed its expectation that the Commissioning Completion Assurance (CCA) process should confirm that the design requirements for a system have been met. To close this issue, a process based on the AECL practices for Qinshan and Cernavoda 2 is being used to define tests required for demonstration of design intent and to assess whether objective evidence is available for the defined tests. A document describing the overall process, and defining the basis and methodology for an independent evaluation of the completeness of the MAPLE reactors commissioning program has been submitted to the CNSC [10]. An example of the commissioning specifications and the assessment of the objective evidence has also been submitted to the CNSC [11], [12]. The assessments for the remaining systems are being prepared.

3.2.6.2 MAPLE 1 Iodine Production Facility

The MAPLE 1 IPF Non-Nuclear Commissioning is being conducted and the Nuclear Commissioning will be conducted in accordance with Commissioning Manual - I-125 Production Facility, 6401-43000-CM-001.

The documents supporting the program objectives are as follows:

- A Work Activity Plan, 6401-43000-WAP-001, describes the residual engineering work remaining on the facility and the key commissioning objectives.
- Commissioning Manual - I-125 Production Facility, 6401-43000-CM-001, which outlines the whole commissioning program.
- Training Manual, On-job-training and Field Checkouts.
- Operating Manual for the operational validation.

3.2.7 Periodic Inspection Program

The Inaugural and Periodic Inspection Program, based on criteria to be embedded in the overall program document, was completed in October 2000. It includes, but is not limited to, the following:

- The mandatory inspections of key equipment and piping to confirm that there is no significant deterioration of the pressure boundary, which may result in failure of the pressure boundary.
- Inspection of code-classified systems and components per the approved Form 73, with additional requirements.
- Inspection of pressure vessels per the Boiler and Pressure Vessels Act.

An Overall In-Service Inspection Program is to be established to define the program requirements for mandatory and non-mandatory inspections of systems essential to safe shutdown, cooling, and confinement of the MAPLE reactors. The overall program elements and guidance will be described in a new program document to include:

- Definition of the Mandatory and Non-Mandatory categories of the In-Service Inspection Program;
- Criteria established to differentiate the subprograms;
- The CSA Standard requirements appropriate to the MAPLE reactors.

The documents supporting the program objectives are:

- "Dedicated Isotope Facilities (DIF) Periodic and Inaugural Inspection Program," 6423-01510-TD-001;
- DIF Overall In-Service Inspection Program.

The actions to be taken are identified in Section 5.1.5.2.

3.2.8 Maintenance Program

The objectives of the Maintenance Program are to detect and minimize deterioration in equipment and systems. The program is designed to maximize system availability and reliability and to ensure equipment and components perform their intended functions.

There are two types of maintenance:

- Preventive Maintenance (PM), which includes pre-planned routine testing, inspection, servicing, and overhaul of systems, equipment, and components. The PM program is made up of periodic inspection, periodic testing, in-service inspection, and predictive maintenance.
- Corrective Maintenance, which includes all actions taken to repair and/or restore equipment and components that have failed or are not performing their intended function.

The governing documents of the maintenance program are:

- Maintenance Manual, 6400-01500-MN-001;
- Maintenance procedures;
- DIF Periodic and Inaugural Inspection Program;
- Facility-specific maintenance procedures;
- CRL maintenance procedures, as applicable.

3.2.9 Qualification and Staff Training Program

The MAPLE Training Program is designed to provide and maintain the training, qualification, authorization, and certification of personnel in direct operating positions, namely, the MAPLE Manager Operations and the MAPLE Reactor Operator.

The MAPLE Training Program:

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

The documents supporting the program objectives are:

- The MAPLE Training Program is based on the guidelines and standards set out in the AECL Systematic Approach to Training and supporting procedures;
- MAPLE Staffing and Training Plan, 6400-05500-LS-002;
- System Task Analysis;
- System Training Manuals;

- Master Lesson Directives, On-Job-Training/Field Checkouts Guides;
- Assessments (exams and answer guides);
- Records of training;
- CNSC Certification exam development, conduct, and marking follow CNSC-ST1, "Written and Oral Examination for Certified Operating Personnel at Nuclear Reactor Facilities," Rev 2.2.

The description of the curricula has been updated and the staffing and training plan is under revision.

3.2.10 Nuclear Materials and Safeguards Management Compliance Program

Management of nuclear materials (fissionable materials, heavy water and tritium) in the MAPLE 1 and MAPLE 2 reactors is in accordance with Nuclear Materials and Safeguards Management Compliance Program, 9100-01900-MAN-001. The material managed includes:

- Highly Enriched Uranium (HEU) targets (unirradiated and irradiated);
- Low Enriched Uranium (LEU) and Depleted Uranium (DU) driver fuel bundles (unirradiated and irradiated);
- Other wastes, samples, etc., containing uranium (unirradiated and irradiated);
- 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 HEU Targets, 6423-37000-PRO-001;
- Accounting of Nuclear Material and Declaration of Nuclear Loss and Plutonium Generation in LEU and DU Bundles, 6423-37000-PRO-002;
- Fissionable Materials Management, 6423-37000-PRO-003;
- Managing Heavy Water, 6423-38000-PRO-001;
- Design Information Questionnaire, CN-BM.

3.2.11 Design

Design of the MAPLE 1 and MAPLE 2 reactors was completed with the issue of a Design Completion Assurance in 2001. Since that time, there has been a continuing need for design services to resolve non-conformances and design facility improvements and to provide design support to spares procurement, operations, and maintenance.

The documents supporting the program objectives are:

- The MMIR Project QA Manual [6] and the referenced procedures, particularly the change control procedures and instructions and the non-conformance procedure, which comply with CSA-N286.2;
- Change Requests to document design changes and approval of these changes;

- Change Request Closeout documents to demonstrate completion of change requests, including revision status of affected documents;
- The MMIR Project Design Verification Plan and associated design verification documents.

It has been identified in past audits that a better delineation between changes that can be approved by site staff and those that require design engineering review was required. Changes were made to procedures, and staff were trained to address these issues.

The following improvements have been made to the process for the procurement of items and services used during the design, construction, commissioning, and operation of the DIF:

- Issued the MMIR/DIF Procurement Process procedure, 6400-850.1, to provide a roadmap through the Corporate Procurement process, to identify roles and responsibilities for all aspects of the procurement process, and to include an independent verification before Engineering Manager approval.
- Issued the MMIR/DIF Technical Review of Procurement operating instruction, 6400-850.1.1, to provide technical verification in the procurement process.

3.2.12 Occupational Health and Safety Program

The MAPLE reactors are operated in accordance with the AECL Occupational Health and Safety Program. All applicable elements of the Program are implemented in the DIF. The prime objective of the program is to provide a safe and healthy work environment.

The documents supporting the program objectives are:

- AECL Occupational Safety and Health Program Manual, 00-07010-MAN-001;
- Detailed standards, guidelines, procedures and processes;
- Facility-specific documents, such as control of hazardous materials in the MAPLE reactors, confined space protocol, and personal respirators.

3.2.13 Decommissioning

In May 1999, AECL submitted a Conceptual Decommissioning Plan (CDP), as part of its application for construction approvals of the MAPLE reactors and the NPF. At that time, CNSC staff judged the CDP to be equivalent to a Preliminary Decommissioning Plan (PDP) and accepted it. Once AECL has produced a PDP for the CRL site that is acceptable to the CNSC staff, then the CNSC staff will review the CDP for the DIF against the requirements of CNSC Regulatory Guide G-219 and for the appropriate fit with the CRL site PDP.

3.2.14 System Performance Monitoring Program

A DIF System Performance Monitoring Program will be established to supplement operator surveillance, preventive maintenance, and system surveillance testing activities and will include the following elements:

- Systematic review of plant / equipment performance via system walkdowns, trending, and Operating Experience (OPEX) review;
- Review of system operational test and maintenance results for equipment deficiencies and compliance with design requirements;
- Preparation of formal Reports (Report Cards) on system performance, with improvement recommendations as appropriate.

The plan for the establishment of a DIF System Performance Monitoring Program is as follows:

- Development of a System Performance Monitoring Program;
- Implementation of the System Performance Monitoring Program;
- Self-assessment of the System Performance Monitoring Program within 12 to18 months of its implementation.

3.2.15 Environmental Qualification (EQ) Program

The design specifications for environmental qualification (EQ) of equipment in MAPLE 1 and MAPLE 2 reactors have been produced and reviewed against the EQ Design Guide.

For maintenance, an EQ program is to be established to define the program requirements for the provision of an assurance that selected equipment will perform its required safety function, taking into consideration the stresses of normal service and accident conditions. Elements of the program will include:

- Criteria for selection of EQ Program equipment;
- Establishment of master list of EQ equipment installed in the MAPLE 1 and MAPLE 2 reactors;
- Incorporation of EQ requirements of each component into the Advanced Maintenance Management System (AMMS) database;
- Development of maintenance procedures to take into consideration EQ requirements during maintenance.

The documents supporting the provisions of the EQ Program include:

- EQ Program document;
- Maintenance Procedure for EQ;
- Handling, Storage, Preservation, Packaging and Delivery, 116-660.1.1;
- DIF Maintenance Program, 6400-01500-MN-001.

The EQ Program evaluation will include the design specifications for potential exposure and susceptibility to stressors, such as, radiation, temperature, humidity, and pressure, on key safety related components.

The program requirements established are to be used for the preservation of qualification during maintenance or modification of equipment and systems, and are to be used as a consideration in the procurement process.

3.2.16 Human Factors Program

A Human Factors (HF) Program has been put in place to ensure that HF principles and design criteria are included in the design of MAPLE systems, equipment and facilities. The program is focussed on:

- New or changed areas including computerized displays, annunciation, target handling;
- Confirming the existing design was reviewed from an HF standpoint.

The document supporting the program objectives is:

- Human Factors Engineering Program Plan (HFEPP) for the MMIR Project, 6400-08000-IAD-001.

An assessment of HF work has been conducted on design changes that have occurred during the current licensing period.

3.2.17 Chemistry Control Program

A Chemistry Control Program has been put in place for the MAPLE 1 and MAPLE 2 reactors to:

- Prevent or minimize corrosion or other deterioration of components;
- Demonstrate compliance with all licence requirements as listed in the OLC document.

The documents supporting the program objectives are:

- MAPLE Chemistry Control, 6425-03080-OM-001;
- Rationale for Chemistry for Corrosion Control, 6400-03080-TD-001.

3.2.18 Configuration Management & Change Control Program

The MAPLE 1 and MAPLE 2 reactors design was completed with the issue of a Design Completion Assurance in 2001. Since that time, there has been a continuing need for changes to the facility to resolve non-conformances and make improvements. A change control process is in place to ensure that permanent equipment changes are reflected in revised documentation. In addition, temporary changes to the current status of equipment are managed by an Operations process.

The documents supporting the change control processes are:

- Change control procedures as identified in the MMIR Project QA Manual [6] and the DIF QA Manual [7], in compliance with CSA-N286.2, CSA-N286.4, and CSA-N286.5.
- Change Requests to document design changes and approval of these changes.
- Change Request Closeout documents to demonstrate completion of change requests, including revision status of affected documents.
- Jumper System procedure 6423-655.1 to identify temporary facility changes.
- Jumper Records to document temporary facility changes and approval of these changes.
- Control of Facility Equipment procedure 6423-311.1 for facility configuration management.

As noted in Section 5.1.5.2, the actions to be taken prior to In-Service are:

- Produce the reference document baseline for design, maintenance, and operation based on the current project and operations documents.
- Issue the Master Equipment List.

3.2.19 Foreign Materials Exclusion Program

The objectives of the Foreign Materials Exclusion (FME) Program are:

- To develop and instil a culture amongst all personnel that fosters the prevention of foreign material introduction into the DIF.
- To define the foreign material exclusion requirements for Operations, Maintenance, and all other staff when planning and implementing both routine and non-routine work activities in and around open systems in the DIF.
- To provide guidance and documentation requirements on recovery from intrusion of foreign material in a facility system.
- To evaluate and document the effects of unrecovered foreign material from facility systems and components.

The documents supporting the program objectives are:

- FME Program Manual, 6423-05500-MAN-001;
- Facility specific instruction on service pool and reactor pool foreign materials control areas;
- Work Plans/work packages.

4 PROJECT SCHEDULE

4.1 PLANNED ACTIVITIES UNTIL NOVEMBER 2005

Between June and November 2005, AECL plans to complete the following activities for MAPLE 1:

1. Complete the prerequisites, including submitting a request to the CNSC staff to obtain the approval to change the operating status, to exit GSS and operate up to 2 kW (2 kW Milestone).

2. Operate at 2 kW to do the following:
   - Allow various OTPs to be completed.
   - As far as possible, maintain the neutron source strength on scale for Reactor Regulating System and SS1. Following longer shutdowns for maintenance, the photoneutron source will likely be below scale and a neutron source will be inserted in such situations.
   - Continue to improve operating and maintenance processes to support operational readiness for higher reactor power level operation.

3. Identify and complete most prerequisites by November 2005 to allow the reactor to operate up to ~5 MW (~5 MW Milestone). The completion of the remaining prerequisites will follow after November 2005. To support the request to obtain CNSC staff approval to operate up to ~5 MW, AECL plans to submit:
   - A safety case to demonstrate that there is no impact on health, safety, security, the environment, and Canada's international obligations;
   - Documents to address the licensing issues associated with obtaining CNSC staff approval to resume nuclear commissioning, as described in "Outstanding Issues for the MDS Nordion Medical Isotopes Reactor Project," CMD 04-M28 [13];
   - A plan for the anticipated tests to re-measure the PCR, to aid in determining the cause of the positive PCR and to assess proposed changes for mitigating the positive PCR; and
   - A plan to operate the MAPLE 1 reactor to irradiate xenon gas for active commissioning of the MAPLE 1 IPF and to irradiate MAPLE Mo-99 targets for active commissioning of the NPF.

Between June and November 2005, AECL is evaluating the priorities for performing the wire re-termination work for MAPLE 2.

4.2 PLANNED ACTIVITIES DURING THE NEXT LICENCE PERIOD

4.2.1 MAPLE 1 Reactor

During the next licence period, AECL's plans for the MAPLE 1 reactor are as follows:

1. Identify and complete the remaining prerequisites to allow the reactor to operate up to ~5 MW and operate the MAPLE 1 reactor up to ~5 MW. AECL will also address CNSC staff comments on the safety case to operate up to ~5 MW and revise the OLC document. The MAPLE 1 operation at ~5 MW will allow to:
   - Complete the nuclear commissioning of the SS1 and SS2 additional trips.
   - Perform tests to re-measure the PCR.
   - Perform tests to aid in determining the cause of the positive PCR and to assess proposed changes for mitigating the positive PCR.
   - Confirm the effects of fuel burn up and the transition to an equilibrium core by re-measurements of the PCR.
   - Operate to irradiate targets for active commissioning of the NPF.
   - Irradiate xenon gas for nuclear commissioning of the MAPLE 1 IPF.

2. Identify and complete the prerequisites to allow the reactor to operate up to 8 MW. In particular, to support the request to obtain CNSC staff approval to operate up to 8 MW, AECL plans to submit:
   - A safety case to demonstrate that there is no impact on health, safety, security, the environment, and Canada's international obligations;
   - Request for approval of changes in the MAPLE OLCs required to support operation at 8 MW;
   - Documents to address the licensing issues associated with obtaining CNSC staff approval to operate MAPLE 1 up to 8 MW, as described in CMD 04-M28 [13];
   - A plan for the anticipated tests to re-measure the PCR, to aid in determining the cause of the positive PCR and to assess proposed changes for mitigating the positive PCR; and
   - A plan to operate the MAPLE 1 reactor to irradiate xenon gas for the MAPLE 1 IPF and to irradiate MAPLE Mo-99 targets for active commissioning of the NPF.

3. Operate the MAPLE 1 reactor up to 8 MW (8 MW Milestone) to:
   - Perform tests to re-measure the PCR.
   - If required, and depending on the results of the tests at ~5MW, perform tests to aid in determining the cause of the positive PCR and to assess and/or confirm proposed changes for mitigating the positive PCR.
   - Confirm the effects of fuel burn up and the transition to an equilibrium core by re-measurements of the PCR.
   - Implement measures for mitigating the positive PCR.

- Operate to irradiate targets for active commissioning of the NPF.
- Irradiate xenon gas for nuclear commissioning and in-service operation of the MAPLE 1 IPF.
- Operate to increase experience in the operating performance of the reactor.

4. Complete the prerequisites to allow the reactor to operate above 8 MW (10 MW Milestone). In particular, to support the request to obtain CNSC staff approval to operate above 8 MW, AECL plans to submit:
   - A safety case to demonstrate that there is no impact on health, safety, security, the environment, and Canada's international obligations;
   - Request for approval of changes in the MAPLE OLCs required to support operation at 10 MW;
   - Documents to address the licensing issues associated with obtaining CNSC staff approval to operate MAPLE 1 up to 10 MW, as described in CMD 04-M28 [13]; and
   - Revised MAPLE 1 reactor commissioning plan.

5. Operate the MAPLE 1 reactor above 8 MW to:
   - Complete the Phase C and D commissioning program.
   - Perform tests to demonstrate that the measures to mitigate the positive PCR are effective.

6. Complete the prerequisites to allow In-Service Operation (In-Service Milestone). In particular, to support the request to obtain CNSC staff approval to allow In-Service Operation, AECL plans to submit:
   - A safety case to demonstrate that there is no impact on health, safety, security, the environment, and Canada's international obligations;
   - Documents to address the licensing issues associated with obtaining CNSC staff acceptance for In-service for MAPLE 1, as described in CMD 04-M28 [13].

4.2.2 MAPLE 1 Iodine Production Facility

It is assumed that the active commissioning of the MAPLE 1 IPF will begin once the MAPLE 1 reactor has operated up to 5 MW. During the next licence period, AECL's plans for the MAPLE 1 IPF are as follows:

- Complete non-nuclear commissioning (Phase A CCA Milestone);
- Submit documents to address the licensing issues associated with obtaining CNSC staff approval for irradiating xenon gas for the first time in the MAPLE 1 reactor, as described in CMD 04-M28 [13];
- Complete nuclear commissioning (Phase B CCA Milestone); and

- Submit documents to address the licensing issues associated with obtaining CNSC staff acceptance of In-service for the MAPLE 1 IPF, as described in CMD 04-M28 [13].

4.2.3 MAPLE 2 Reactor

The MAPLE 2 reactor is currently in GSS. Resumption of MAPLE 2 Phase B Commissioning will depend upon an agreement between AECL and CNSC staff on a resolution of the positive PCR.

During the next licence period, AECL's plans for the MAPLE 2 reactor are as follows:

- Complete the prerequisites to exit GSS and complete the Phase B commissioning tests up to 2 kW (2 kW (M2) Milestone).
- Complete the prerequisites to operate above 2 kW and complete the Phase B commissioning tests up to 500 kW (500 kW (M2) Milestone).

If the schedule for Phase B commissioning for MAPLE 2 can be advanced, AECL plans to:

- Complete the prerequisites to operate above 500 kW and complete the Phase C commissioning tests up to 8 MW (8 MW (M2) Milestone).
- Complete the prerequisites to operate above 8 MW and complete the Phase C commissioning tests up to 10 MW (10 MW (M2) Milestone).

4.2.4 Reports to Be Revised During the Next Licence Period

The following documents, referred to in the current MAPLE 1 and MAPLE 2 licence (NPROL-62.01/2005) and that are specific to the MAPLE reactors, are planned to be revised during the next licence period:

1. "Final Safety Analysis Report for the MAPLE Reactors," Revision 0, 1998 August.
2. "MAPLE Reactors, Operational Limits and Conditions," 6425-05410-OLC-001, Revision 9, 2005 June.
3. "MAPLE Reactor Commissioning Plan," 6401-92000-CM-001, Revision 5, 2002 March.

As noted in Section 3.2.2, the safety analysis sections of the FSAR will be updated once the source of the positive PCR is identified, and the mitigation measures are known. In the meantime, the following safety cases will provide the safety analysis support for reactor commissioning and operation:

- Safety Case to Support Operation of MAPLE Reactor to 500 kW;
- Safety Case to Support Operation of MAPLE Reactor to ~5 MW;
- Safety Case to Support Operation of MAPLE Reactor to 8 MW;
- Safety Case to Support Operation of MAPLE Reactor to 10 MW.

Additional revisions to the OLC document will be produced to be consistent with the safety cases listed above.

As required, revisions to the MAPLE Reactor Commissioning Plan and additional operating and test plans will be produced based on the safety cases listed above. The operating and test plans will include procedures for investigating the positive PCR and potential remedies.

4.3 Key Project Milestones During The Next License Period

The following key project milestones for the MAPLE 1 and MAPLE 2 reactors and the MAPLE 1 IPF are included in the MMIR Project schedule for the next licence period:

Milestone	Description
MAPLE 1 and Iodine-125 Production Facility	
5 MW	CNSC Staff Approval to Operate Up to ~5 MW
M1 Operate @ 5 MW	MAPLE 1 Available Perform Additional PCR Re-measurements
IPF Phase B	MAPLE 1 IPF Available for Nuclear Commissioning
IPF In-Service	MAPLE 1 IPF Available for In-Service
8 MW	CNSC Staff Approval to Operate Up to 8 MW
M1 Operate @ 8 MW	MAPLE 1 Available to Irradiate Targets for NPF Active Commissioning and Irradiate Xenon Gas for MAPLE 1 IPF
10 MW	CNSC Staff Approval to Operate Above 8 MW
M1 In-Service	MAPLE 1 Available for In-Service
MAPLE 2	
M2 up to 2 kW	CNSC Staff Approval to Resume Commissioning up to 2 kW
M2 up to 500 kW	CNSC Staff Approval to Operate up to 500 kW

5 LICENSING ISSUES

A number of issues that need to be resolved as part of the ongoing licensing process have been identified in "Outstanding Issues for the MDS Nordion Medical Isotopes Reactor Project," CMD 04-M28 [13] and supplementary CNSC requests. The following sections present an overview of the outstanding licensing issues, along with an update on the current status and deliverables that AECL plans to produce to address the issues.

5.1 MAPLE 1 REACTOR

5.1.1 Agreement to Operate up to 2 kW

5.1.1.1 Positive Power Coefficient of Reactivity

Licensing Issues identified in CMD 04-M28 [13]:

AECL must demonstrate adequate trip coverage for the commissioning program for the MAPLE reactors in light of the positive PCR (relying on the rules in the FSAR).

AECL must demonstrate that the safety case continues to meet the acceptance criteria of no sheath failure and avoidance of superprompt criticality for all design basis events for all operating core states.

STATUS:

To address these issues and the CNSC request for a consolidated safety case to support MAPLE 1 reactor change in the operating state, AECL has submitted the following:

- "Safety Case to Support Operation of MAPLE Reactor to 2 kW," 6400-05600-ASD-019. This case is applicable for operation both with and without the Primary Cooling System (PCS) pump running. It also provides justification for the temporary reductions in trip setpoints to operate the reactor up to 2 kW. AECL's responses to CNSC staff comments are being prepared.

Licensing Issue identified in CMD 04-M28 [13]:

AECL must show that any newly proposed commissioning tests are appropriately planned and that such tests can be performed safely and are capable of meeting their intended objectives.

STATUS:

AECL has recently revised the Work Management procedure, 6423-650.1, and related procedures, to ensure that proposed reactor operation and any tests are appropriately planned, performed safely and capable of meeting their intended objectives. In addition, AECL is producing operating and test plans to support operation and testing at reactor power up to 2 kW.

5.1.1.2 Operational Readiness

Licensing Issue identified in CMD 04-M28 [13]:

AECL must demonstrate that adequate staff and systems and equipment are available for the resumption of commissioning.

STATUS:

To demonstrate that adequate staff, and systems and equipment are available for the resumption of operation and commissioning, the process and scope of activities for declaring the MAPLE 1 Reactor available for operation will be documented in "MAPLE 1 Reactor Availability for Operation following Wiring Re-terminations," 6425-01300-WAP-003.

The following actions identified in References [14], [15] need to be completed to obtain CNSC agreement to change the operating state of the MAPLE 1 reactor:

- *AECL to submit the CCA package for non-nuclear commissioning of the recent design modifications and the CCA meeting.*
- *AECL to submit the list of work that will remain outstanding at the time of restart, the proposed timing for completion and associated justification for timing of completion.*

STATUS:

The non-nuclear commissioning of the changes for SS1 has been completed and a CCA package for SS1 is in preparation. The non-nuclear commissioning of the changes for SS2 is in progress and a CCA package for SS2 is in preparation.

Management has reviewed all open items (i.e., all outstanding NCRs, FCNs, CRs, Corrective Actions from Root Cause Assessments, and UERs at the time of restart), and assessed them against the requirements for 2 kW Operation and other MMIR Project milestones. The

results of this review process have been submitted to the CNSC with the following documents:

- "MRM Process Description and the Results of Review Meetings for MAPLE 1 2 kW Operation," 6400-02700-025-154. This document provides the status of all NCRs, FCNs, CRs, and Corrective Actions from RCAs items that require completion prior to 2 kW operation for the MAPLE 1 reactor.
- "Outstanding UER Corrective Action Assessment – MRM Review Report," 6400-01300-690-100. This document provides the status of all UERs that require completion prior to 2 kW operation for the MAPLE 1 reactor.

Once AECL has approval to change the operating state, AECL will complete the operational readiness review process described in MAPLE 1 Reactor Availability for Operation following Wiring Re-terminations, 6425-01300-WAP-003.

The following actions identified in Reference [16] will be completed to obtain CNSC agreement to change the operating state of the MAPLE 1 reactor:

- *Assessment of the impact of the deficiencies noted in Reference* [16], *proposal for corrective actions and the dispositioning of the deficiencies.*

STATUS:

AECL has submitted responses on issues related to completion assurance certifications (CNSC action item 046201). As noted above, AECL has established a review process in the form of a MRM to review all deficiencies, corrective actions and the dispositioning of deficiencies. CNSC staff is reviewing AECL's responses.

5.1.1.3 SOR 1 Failure to Drop on Unintentional Drop of SORs

The following deliverables have been submitted to address the event on 2004 July 4, as a follow up to ENF-MAPLE1-04-04 [17]. These reports provide the assessment that the root cause of the failure to drop SOR 1 do not represent a common cause failure mode elsewhere in SS1, for SS2 or the logic for switching from EAFS to EFS:

- "MAPLE 1 SS1 Logic Circuit Incident – Root Cause Investigation," 6401-68100-RCA-001;
- "Review of MAPLE Wiring Terminations," 6400-57000-190-100 (which proposed the disposition of the Root Cause Assessment and implementation of the corrective actions related to safe operation of the facility);
- "Safety System #1 (SS1) Control Logic Design Verification," 6400-68100-ASD-001;
- "Safety System #2 (SS2) Control Logic Design Verification," 6400-68200-ASD-001;
- "EAFS Control Logic Design Verification," 6400-73200-ASD-002.

CNSC staff provided comments on the root cause analysis and the three verification reports listed above with Reference [18].

STATUS:

AECL's response and planned course of action to address the specific recommendations in Reference [18] has been submitted to the CNSC with:

- Letter D. Taylor to E. Langlois, *Root Cause Analysis of the July 4, 2004 MAPLE 1 Shut Off Rod 1 Failure to Drop*, 6400-ACNO-05-0084-L, 2005 June 2.

CNSC's specific comments regarding the root cause methodology used by AECL have been discussed at a meeting between the CNSC and AECL staff and AECL will be responding to the CNSC comments.

5.1.1.4 Safety System 1 Low Power Commissioning Completion Assurance

Licensing Issue identified in CMD 04-M28 [13]:

In order to close this issue AECL must demonstrate that three SORs deployment results in normal subcritical margin defined as keff<0.965 and that deployment of any two out of three SORs results in a stable subcritical margin defined as keff<0.99.

STATUS:

AECL has addressed this issue by submitting the following:

- "Measurement and Calculation of Subcritical k-Values in MAPLE," 6400-03100-AR-018.
- "Comparison of MAPLE 1 SOR and CAR Reactivity Worth Measurements to MCNP Calculations," 6400-03100-AR-015.

CNSC staff are reviewing AECL's documents.

5.1.1.5 GSS Compliance

An Unplanned Event Report (UER) was submitted by the AECL following the inadvertent departure from GSS in February 2005:

- Inadvertent Departure From Guaranteed Shutdown State, UER2-MAPLE1-05-05.

CNSC staff reviewed and provided comments on the UER with Reference [20].

Licensing Issue identified in Reference [20]:

AECL to address CNSC staff comments on the root cause assessment to determine how the compliance failures (i.e., failure to comply with way to achieve GSS and failure to place M1 in GSS) could have occurred.

STATUS:

AECL's response has been submitted to the CNSC with:

- Letter D. Taylor to E. Langlois, *Inadvertent Departure of MAPLE 1 from Guaranteed Shutdown State – AECL Root Cause Analysis*, 6400-ACNO-05-0071-L, 2005 May 17.
- Letter D. Taylor to B. Pearson, *Status of Actions Following the Guaranteed Shutdown State Neutron Multiplication Factor (k) Value Exceeded Event*, 6400-ACNO-05-0087-L, 2005 June 3.

AECL will address the CNSC staff comments on root cause analysis on GSS.

Licensing Issue identified in Reference [19]:

AECL to identify and implement measures to correct the failures and their impact and to prevent recurrence of the failures or any similar failures.

STATUS:

AECL's responses have been submitted to the CNSC with the following:

- Letter P. Fehrenbach to G. Lamarre, *GSS Requirements for MAPLE 1*, 6400-ACNO-05-0013-L, 2005 February 9.
- "Inadvertent Departure From Guaranteed Shutdown State," UER2-MAPLE1-05-05.

The UER2-MAPLE1-05-05 had raised 3 corrective actions required to be completed before raising power to 2 kW:

a) Strengthening the facility management oversight and operational risk review processes to provide a broad review of the planning and implementation of all work and operations.

STATUS: A number of changes in AECL organization have taken place over the last few months. The DIF organization, in its new constituency, manages all aspects of the DIF previously covered by the MMIR Project and DIF Operations. The DIF organization will ensure management oversight and operational risk review in an

integrated manner. Further, this integrated team will ensure that safety and quality practices are enforced. Changes in organizations have been communicated to the CNSC with:

- Letter K. Hedges to B. Howden, *Changes to NLBU, MMIR and DIF Organizations*, 6400-ACNO-05-0034-L, 2004 March 4.
- Letter D. Taylor to B. Pearson, *CNSC Verification of MAPLE 1 Completion Assurances – Supplementary Information*, 6400-ACNO-05-0049-L, 2005 April 14.

b) Provide operational documents, administrative controls and associated training to support a GSS.

STATUS: The following documents have been submitted to the CNSC:

- "MAPLE Reactors Operating Limits and Conditions," 6425-05410-OLC-001, Revision 9. This document has been approved by the CNSC Designated Officer, as noted in Section 3.2.4.
- "Assessment of Shutdown Conditions for MAPLE Reactors," 6425-05410-ASD-001. This document is currently under CNSC review.

c) Review expectations for the conduct of operations against best industry practices and disposition any gaps.

STATUS: AECL has initiated a review of NRU operations by utility experts; the results of this review will be used to assess, and as necessary enhance, DIF operations. An OPEX document has been produced along with a Field Observation and Coaching Card. These cards, with associated training, are being introduced into the facility, first use of the card by the Facility Authority occurred in May 2005.

Licensing Issue identified in Reference [19]:
AECL to address CNSC staff comments on Revision 7 of the Operational Limits and Conditions document.

STATUS:

To address this issue, AECL has submitted several revisions of the OLCs to the CNSC, in response to CNSC Staff comments on each. The most recent one is:

- "MAPLE Reactors Operating Limits and Conditions Document," 6425-05410-OLC-001, Revision 9. This document has been approved by the CNSC Designated Officer, as noted in Section 3.2.4.

Licensing Issue identified in Reference [19]:

AECL to expedite the completion of, and submission of, the Shutdown States document.

STATUS:

To address this issue, AECL has submitted the following:

- "Assessment of Shutdown Conditions for MAPLE Reactors," 6425-05410-ASD-001.

The report is currently under CNSC staff review.

Licensing Issue identified in Reference [21]:

AECL to prepare a specific procedure for approach to critical after a long shutdown (including a long maintenance outage).

STATUS:

To address this issue, AECL will submit the procedure for an orderly process to be followed when proceeding between any of the shutdown states defined in the "Assessment of Shutdown Conditions for the MAPLE Reactors," 6425-05410-ASD-001.

5.1.2 Agreement to Operate up to ~5 MW

5.1.2.1 Positive Power Coefficient of Reactivity

Licensing Issue identified in CMD 04-M28 [13]:

AECL must demonstrate adequate trip coverage for the commissioning program for the MAPLE reactors in light of the positive PCR (relying on the rules in the FSAR).

AECL must demonstrate that the safety case continues to meet the acceptance criteria of no sheath failure and avoidance of superprompt criticality for all design basis events for all operating core states.

STATUS:

To address these issues and the CNSC request for a consolidated safety case to support MAPLE 1 reactor change in the operating state, AECL is producing a safety case to support operation and testing at reactor power up to ~5 MW.

In addition, once additional data from a re-measurement of the PCR is available, AECL plans to produce the following:

- Technical Document for Developing the Analysis Value from Re-measured PCR Up To ~5 MW. A Technical Document will be produced to describe the analysis of the data from the commissioning tests to re-measure the PCR up to ~5 MW, and to discuss any differences between the data from the re-measurement and the PCR in the Technical Document, Power Coefficient of Reactivity, 6401-92400-TD-003. This document will include an analysis of the measurement uncertainties.

Licensing Issue identified in CMD 04-M28 [13]:

AECL must show that any newly proposed commissioning tests are appropriately planned and that such tests can be performed safely and are capable of meeting their intended objectives.

STATUS:

AECL has recently revised the Work Management procedure, 6423-650.1, and related procedures, to ensure that proposed operation and any tests are appropriately planned, performed safely and capable of meeting their intended objectives. In addition, AECL is producing operating and test plans to support operation and testing at reactor power up to ~ 5 MW.

To show that any newly proposed tests are appropriately planned and that such tests can be performed safely and are capable of meeting their intended objectives, AECL will submit detailed procedures for each planned test.

5.1.2.2 Commissioning Demonstration of Design Intent

Licensing Issues identified in CMD 04-M28 [13]:

AECL to provide the objective evidence obtained from routine operational tests and inspections (i.e., not from commissioning tests) to demonstrate that the systems and equipment perform according to their safety, functional, performance or control specifications.

STATUS:

To close this issue, a process based on the AECL practices for Qinshan and Cernavoda 2 is being used to define tests required for demonstration of design intent and to assess whether objective evidence is available for the defined tests. A document describing the overall

process, and defining the basis and methodology for an independent evaluation of the completeness of the MAPLE reactors commissioning program has been submitted to the CNSC [10]. An example of the commissioning specifications and the assessment of the objective evidence has also been submitted to the CNSC [11], [12]. The assessments for the remaining systems are being prepared.

5.1.2.3 Computer Code Validation

Licensing Issues identified in CMD 04-M28 [13]:

- *AECL to demonstrate that the validation work has not shown any deviations that would have a negative impact on the FSAR (based on commissioning results up to 8 MW).*
- *AECL to quantify the simulation error (systematic departure from reality) in key output parameters over the range of phenomena and parameters for reactor operating conditions and geometries prototypical of the intended application.*

STATUS:

To address these issues, AECL has submitted to the CNSC the following:

- "Verification of Thermal Power Calculation Algorithm," 6401-92400-TD-001;
- "CATHENA Validation of Natural Circulation at 580 kW for MAPLE 1 Reactor," 6400-03000-SVR-013;
- "CATHENA Validation of Loss of Regulation MAPLE 1 Reactor LOR Commissioning Test at 2 MW," 6400-03000-SVR-015;
- "Neutronic and Gamma Powers During Reactor Trip," 6401-92400-TD-002.

AECL will further address these issues by producing the following:

- Assessment of Code Validation Results from MAPLE 1 Commissioning for ~5 MW and impact on the safety cases. This assessment will summarize the results and identify their impact on the safety analysis in the FSAR.

5.1.3 Approval for Interim Operation of MAPLE 1 at 8 MW

5.1.3.1 Positive Power Coefficient of Reactivity

Licensing Issue identified in CMD 04-M28 [13]:

AECL must demonstrate adequate trip coverage for the commissioning program for the MAPLE reactors in light of the positive PCR (relying on the rules in the FSAR).

AECL must demonstrate that the safety case continues to meet the acceptance criteria of no sheath failure and avoidance of superprompt criticality for all design basis events for all operating core states.

STATUS:

To address these issues and the CNSC request for a consolidated safety case to support MAPLE 1 reactor change in the operating state, AECL is producing a safety case to support operation and testing at reactor power up to 8 MW. This safety case will demonstrate adequate trip coverage for the tests that being planned to investigate and remedy the positive PCR, and/or confirm the effectiveness of measures to mitigate the positive PCR.

Data from re-measurements of the PCR will be used to assess the impact of any differences in the value of the PCR on the safety case.

Licensing Issue identified in CMD 04-M28 [13]:

AECL must show that any newly proposed commissioning tests are appropriately planned and that such tests can be performed safely and are capable of meeting their intended objectives.

STATUS:

AECL has recently revised the Work Management procedure, 6423-650.1, and related procedures, to ensure that proposed operation and any tests are appropriately planned, performed safely and capable of meeting their intended objectives. In addition, AECL is producing operating and test plans to support operation and testing at reactor power up to 8 MW.

5.1.4 Approval to Operate Above 8 MW(th)

5.1.4.1 Positive Power Coefficient of Reactivity

Licensing Issues identified in CMD 04-M28 [13]:

- *AECL must demonstrate that all practical options of design and operation have been considered to remedy the positive PCR, and*
- *AECL must demonstrate that the safety case continues to meet the acceptance criteria of no sheath failure and avoidance of superprompt criticality for all design basis events for all operating core states.*

STATUS:

To demonstrate that all practical options of design and operation have been considered to remedy the positive PCR, AECL has taken the following steps:

Phase 1 Options Study:

[1] To provide a structured process for identifying possible causes for the positive PCR, a team was set up to do a Phenomena Identification and Ranking Table (PIRT). PIRT is a systematic formal review of all phenomena that could cause a positive PCR and a ranking in order of importance. The output was a ranked list of plausible phenomena that could cause the positive PCR, described in the report submitted to the CNSC:

- "PIRT for MAPLE Power Manoeuvre," 6400-03000-AR-001.

[2] AECL also issued and submitted to the CNSC:

- "Assessment Document with Options to Remedy Positive PCR Phase 1," 6400-05600-ASD-014.

This report identifies physically feasible (but not necessarily practical) options for mitigating the positive PCR. This is being done in parallel with the work identified in point [1] above. This first phase of the work identifies a set of options based on AECL's current understanding of the behaviour of MAPLE, and the main activities to include in the plan for pursuing the options.

[3] AECL has contracted the Idaho National Laboratory to predict the PCR using independent models and code calculations.

[4] AECL has contracted the Brookhaven National Laboratory to perform an independent review of the AECL work on the PCR.

Phase 2 Options Study:

Phase 2 of the options study will refine the options, based on the information gathered in items [1] to [4]. The work will involve defining and committing to implement a mitigation strategy or specific change, if a practical one (technically and economically feasible) exists. The results of these investigations will be documented and submitted to the CNSC.

To demonstrate that the safety case continues to meet the acceptance criteria of no sheath failure and avoidance of superprompt criticality for all design basis events for all operating core states, AECL has issued the following:

- "Safety Case to Support Operation of MAPLE Reactor to 2 kW," 6400-05600-ASD-019, was submitted to the CNSC. AECL's responses to CNSC staff comments are being prepared. As noted in Section 4.2.4, AECL is also producing the safety cases to support operation and testing at reactor powers up ~5 MW, and will be doing so for operation at 8 MW and 10 MW once the results of testing and operation at ~5MW are analyzed.
- "Common Cause Failure of Reactor Shutdown," 6400-05600-AR-018. This report demonstrates that the event sequence involving a loss of regulation event and failure to shut down can be considered beyond design basis with high confidence.

5.1.4.2 Computer Code Validation

Licensing Issues identified in CMD 04-M28 [13]:

- *AECL to demonstrate that the validation work has not shown any deviations that would have a negative impact on the FSAR (based on commissioning results up to 8 MW).*
- *AECL to quantify the simulation error (systematic departure from reality) in key output parameters over the range of phenomena and parameters for reactor operating conditions and geometries prototypical of the intended application.*

STATUS:

To address these issues, AECL has submitted to the CNSC the following:

- "Verification of Thermal Power Calculation Algorithm," 6401-92400-TD-001;
- "CATHENA Validation of Natural Circulation at 580 kW for MAPLE 1 Reactor," 6400-03000-SVR-013;
- "CATHENA Validation of Loss of Regulation MAPLE 1 Reactor LOR Commissioning Test at 2 MW," 6400-03000-SVR-015;
- "Neutronic and Gamma Powers During Reactor Trip," 6401-92400-TD-002.

AECL will further address these issues by producing the following:

- Assessment of Code Validation Results from MAPLE 1 Commissioning for 8 MW and impact on the safety cases. This assessment will summarize the results and identify their impact on the safety analysis in the FSAR.

5.1.4.3 High Power Commissioning Completion Assurance

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate, through the availability of objective evidence, that high power nuclear commissioning up to 8 MW(th) has been successfully completed.

STATUS:

At the completion of Phase C Commissioning up to 8 MW, AECL submitted the Commissioning Completion Certificate and commissioning reports to demonstrate that the commissioning up to 8 MW has been successfully completed, with the exception of two non-conformances. Further tests to demonstrate that the measures to mitigate the positive PCR are effective and re-measurement of the radiation fields at the surface of the reactor pool will be performed to disposition the two non-conformances. Once the non-conformances have been dispositioned, the Commissioning Completion Certificate will be updated.

5.1.5 Acceptance of MAPLE 1 for In-Service Operation

5.1.5.1 Commissioning Completion Assurance

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate, through the availability of objective evidence, that high power nuclear commissioning up to 10 MW(th) has been successfully completed.

STATUS:

At the completion of Phase C Commissioning up to 10 MW, AECL will submit the Commissioning Completion Certificate and commissioning reports to demonstrate that the commissioning up to 10 MW has been successfully completed.

5.1.5.2 Baseline and Residual Regulatory Activities

Licensing Issue identified in CMD 04-M28 [13]:

AECL to modify its Periodic Inspection Program documentation to be fully compliant with documentation requirements.

STATUS:

AECL will address this issue by producing the revised version of "Dedicated Isotope Facilities (DIF) Periodic and Inaugural Inspection Program," 6423-01510-TD-001, to address CNSC staff comments in Reference [23].

Licensing Issue identified in CMD 04-M28 [13]:

AECL to update the Operational Limits and Conditions document to reflect lessons learned and knowledge gained from commissioning.

STATUS:

To address this issue, the AECL has submitted the following to the CNSC:

- "MAPLE Reactors Operating Limits and Conditions Document," 6425-05410-OLC-001, Revision 9. This document has been approved by the CNSC Designated Officer, as noted in Section 3.2.4. Additional revisions to the OLC document will be produced to be consistent with the safety cases listed in Section 4.2.4.

AECL is also preparing a technical basis document outlining the sources for each requirement in the OLC document. This document will be submitted to the CNSC.

Licensing Issue identified in CMD 04-M28 [13]:

AECL to establish document and implement a document baseline.

STATUS:

AECL will address this issue by producing a reference document baseline for design, maintenance and operation, based on the current project and operations documents. This will be done for In-Service for MAPLE 1 reactor and updated as required for In-Service for MAPLE 2 reactor.

Licensing Issue identified in CMD 04-M28 [13]:

AECL to update the Final Safety Analysis Report.

STATUS:

A schedule is being produced to update Volume 1 of the FSAR. Volume 2 will not be updated until the PCR issue is resolved. In the meantime, AECL has submitted to the CNSC the "Safety Case to Support Operation of MAPLE Reactor to 2 kW," 6400-05600-ASD-019. AECL's responses to CNSC staff comments are being prepared. As noted in Section 4.2.4, AECL is also producing the safety cases to support operation and testing at reactor powers up ~5 MW, and will be doing so for operation at 8 MW and 10 MW once the results of testing and operation at ~5MW are analyzed.

5.2 MAPLE 2 Reactor

5.2.1 Approval to Operate Above 2 kW(th)

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate, through the availability of objective evidence, that low power nuclear commissioning up to 2 kW(th) has been successfully completed. This includes confirmation that the design change to address the stuck moly target holder has been successfully implemented.

STATUS:

The MAPLE 2 reactor is currently in GSS. MAPLE 2 reactor will remain in this configuration until completion of the SS1 and SS2 wiring remediation work (Letter D. Taylor to B. Pearson, *Plan to Place the MAPLE 2 Reactor in a Guaranteed Shutdown State*, 6400-ACNO-05-0041-L, 2005 March 28) and CNSC staff approval to remove GSS. Confirmation that MAPLE 2 reactor was placed in GSS was provided with:

- Letter D. Taylor to B. Pearson, *MAPLE 2 in the Guaranteed Shutdown State*, 6400-ACNO-05-0053-L, 2005 April 25.

An update of the status of the short-term and long-term solutions regarding the stuck target cluster holder was sent to CNSC with:

- Letter D. Taylor to E. Langlois, *MAPLE 2 Stuck Target Cluster Holder*, 6400-ACNO-05-0047-L, 2005 April 4.

AECL will close these issues by producing the following:

- Signed Interim MAPLE 2 Phase B CCA Certificate;
- Commissioning Reports for commissioning tests up to 2 kW;
- Letter of confirmation from the Design Review to demonstrate completion of the design for the cluster holder.

5.2.2 Approval to Operate Above 500 kW(th)

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate, through the availability of objective evidence, that low power nuclear commissioning up to 500 kW(th) has been successfully completed.

STATUS:

AECL will address these issues by producing the following:

- Signed MAPLE 2 Phase B CCA Certificate;
- Commissioning Reports for commissioning tests up to 500 kW.

5.2.3 Approval to Operate Above 8 MW(th)

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate, through the availability of objective evidence, that high power nuclear commissioning up to 8 MW(th) has been successfully completed.

STATUS:

AECL will address these issues by producing the following:

- Signed MAPLE 2 Phase C CCA Certificate;
- Commissioning Reports for commissioning tests up to 8 MW.

5.3 MAPLE 1 IODINE PRODUCTION FACILITY

5.3.1 Approval of Nuclear Commissioning

5.3.1.1 Commissioning

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate that the commissioning tests proposed are appropriately planned and that tests can be performed safely and are capable of meeting their intended objectives.

STATUS:

To address this issue, AECL has issued the following:

- Revised Work Management procedure, 6423-650.1, and related procedures, to ensure that proposed commissioning tests are appropriately planned, performed safely and capable of meeting their intended objectives.
- Commissioning Manual - I-125 Production Facility, 6401-43000-CM-001. This revision of the MAPLE 1 IPF commissioning plan ensures consistency with the MAPLE commissioning plan.

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate, through the availability of objective evidence, that non-nuclear commissioning has been successfully completed.

STATUS:

Phase A commissioning is currently on hold pending completion of residual NCRs and CRs. Once the residual NCRs and CRs are completed, the Non-Nuclear commissioning tests can be executed and the Non-Nuclear CCA issued.

AECL has submitted the Commissioning Manual - I-125 Production Facility, 640l-43000-CM-001, to define the IPF commissioning program. To support the nuclear commissioning of MAPLE 1 IPF, AECL will submit a revised MAPLE Reactor Commissioning Plan, 6401-92000-CM-001. The revised MAPLE commissioning plan will reference and include the MAPLE 1 IPF commissioning plan to facilitate approval for nuclear commissioning of the MAPLE 1 IPF.

Phase A commissioning of the MAPLE 1 IPF will be completed by issuing the following:

- Signed MAPLE 1 IPF CCA Certificate for non-nuclear commissioning;
- Commissioning Reports for non-nuclear commissioning tests.

5.3.1.2 Training

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate it has established, documented and implemented a program for refresher and continuing training that meets the requirements of AECL's Systematic Approach to Training.

STATUS:

The classroom training program for the MAPLE 1 IPF has been established, documented, and is in routine use. The OJT elements have been defined. Pilot testing and ensuing operator training to be conducted as required to meet the requirements of Phase B IPF commissioning prior to commencement of such.

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate that it has successfully qualified staff (through classroom training and OJT) to operate the IPF.

STATUS:

The classroom training on the MAPLE 1 IPF has been completed for all of the certified Managers, Operations and Reactor Operators. This training has been included in the re-certification of the Managers, Operations and Reactor Operators.

5.3.2 Acceptance of the MAPLE 1 IPF for In-Service Operation

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate, through the availability of objective evidence, that nuclear commissioning has been successfully completed.

STATUS:

AECL will address this issue by producing the following:

- Signed MAPLE 1 IPF CCA Certificate for nuclear commissioning;
- Commissioning Reports for commissioning tests.

5.4 GENERIC LICENSING ISSUES

5.4.1 Quality Assurance Audits

5.4.1.1 Commissioning Quality Assurance Program Audit

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate that actions taken to correct and prevent a recurrence of deficiencies identified during the SS1 Shutoff Rod Redesign audit (CNSC Audit Report 01-QA-05) have been effective.

STATUS:

CNSC Audit Report 01-QA-05 was closed, as per Reference [24].

Licensing Issue identified in CMD 04-M28 [13]:

AECL to demonstrate that actions taken to correct and prevent a recurrence of deficiencies identified during the Commissioning Quality Assurance Program audit (CNSC Report No. 03-C-05) have been effective.

STATUS:

AECL has submitted responses and supporting information to CNSC audit report 03-C-05. CNSC staff are currently reviewing AECL's responses. In the meantime, all corrective actions applicable to MAPLE have been completed.

QA program reviews to cover the period up to January 2005 have been completed. QA program reviews for 2005 to the end of 2007 have been planned.

5.4.2 Continuing Training and Requalification Training

Licensing Issue identified in CMD 04-M28 [13]:

Programs for continuing training and requalification training must be established and implemented in accordance with AECL's Systematic Approach to Training.

STATUS:

The training program for recertifying the Managers, Operations and Reactor Operators has been established, documented and implemented.

Licensing Issue identified in CMD 04-M28 [13]:

AECL must demonstrate that it has successfully requalified operations staff to operate the MAPLE reactors.

STATUS:

All of the certified Manager, Operations and Reactor Operators, except the Facility Manager, have been recertified by the CNSC. There are sufficient certified Manager, Operations and Reactor Operators to cover the shift requirements for the MAPLE 1 and MAPLE 2 reactors. In addition, eight new Reactor Operators and one new Manager, Operations, have also successfully completed the facility specific AECL training, including a final AECL comprehensive examination, Facility Performance, and Facility Manager Interview.

6 CONCLUSIONS

Programs are in place at the Chalk River site and in the MAPLE reactors that will ensure the safety of the public, the environment and the workers. The licensing issues are being addressed, and the issues that must be resolved prior to a specific phase of commissioning or operation are clearly identified.

7 REFERENCES

[1] AECL-MISC-314-03, MAPLE-1 Reactor Annual Safety Review 2003, March 2004.
[2] AECL-MISC-315-03, MAPLE-2 Reactor Annual Safety Review 2003, March 2004.
[3] AECL-MISC-314-04, MAPLE-1 Reactor Annual Safety Review 2004, March 2005.
[4] AECL-MISC-315-04, MAPLE-2 Reactor Annual Safety Review 2004, March 2005.
[5] "Documentation in Support of Site Licence Renewal for Chalk River Laboratories," RC-693-CRL, Revision 5, 2002 May.
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Ratajczak, Teresa

From: Hayhurst, Lindsay
Sent: Friday, July 15, 2005 4:40 PM
To: 'interventions@cnsc-ccsn.gc.ca'
Cc: Hedges, Ken; Taylor, Don; Garrick, David; Snell, Victor; Letourneau, Jean-Pierre; Archinoff, Glenn; 'Pearsonb (E-mail); Lafrenière, Paul
Subject: Letter Re: Submission for License Renewals of the MAPLE 1 AND MAPLE 2 Reactors And New Processing Facility - Public Hearing 2005-H-12

Ms. Levert,

Please find attached letter **"Re: Submission for License Renewals of the MAPLE 1 AND MAPLE 2 Reactors And New Processing Facility - Public Hearing 2005-H-12"**, 6400-ACNO-05-0137-L.

6400-ACNO-05-0137-L PL_LL Subm...

Information in Support of Lice...

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Thanks,

Lindsay Hayhurst for Paul Lafrenière
Business Administrator
DIF Operations
☎3422
✉66B

bc:

Aly, Aly
Archinoff, Glenn
Benton, Doug
Bamji, Xerxes
Farkas, Adam
Garrick, David
Harvel, Glenn
Hedges, Ken
Hunt, Neale
Ion, Mihaela
Kanner, Rose
Krishnan, V.S. (Krish)
Labrie, Jean-Pierre
Lafreniere, Paul
Lupton, Lawrence
Lee, Albert
Lee, John
Letourneau, Jean-Pierre
Mantifel, Neil
Osborne, John
Padhi, Nath
Petrilli, Marc-Antoine
Reynolds, Nigel
Sayer, Greg
Shalaby, Basma
Singh, Kuldip
Singh, Ranjit
Shorter, Tina
Smith, Harold
Snell, Victor
Sullivan, Kevin
Tamm, Heiki
Taylor, Don
Walker, James
Zemdegs, Raidis