Implementing the AECL Decommissioning Quality Assurance Program at the Chalk River and Whiteshell Laboratories

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Abstract

This paper describes the approach and progress in developing, implementing and maintaining a quality assurance (QA) program for decommissioning at the nuclear facilities managed by Atomic Energy of Canada Limited (AECL). Decommissioning activities conducted by AECL are varied in nature, so the QA program must provide adequate flexibility, while maintaining consistency with accepted quality standards. Well-written documentation adhering to the applicable decommissioning standards is a key factor. Manager commitment and input during the writing of the documentation are also important to ensure relevance of the QA program and effectiveness of implementation. Training in the use of the quality assurance plan and procedures is vital to the understanding of the QA program. Beyond the training aspect there is a need for the quality assurance program to be supported by a QA subject expert who is able to advise the group in implementing the Quality Program with consistency over the range of decommissioning work activities and to provide continual assessment of the quality assurance program for efficiency and effectiveness, with a concomitant continuous improvement process.

1. BACKGROUND

At AECL, decommissioning of retired facilities is an ongoing activity within the Chalk River Laboratories (CRL) in Ontario, the Whiteshell Laboratories (WL) in Manitoba, and at three "Off-Site" prototype power reactor locations:

- Nuclear Power Demonstration (NPD) located in Rolphton, Ontario;
- Douglas Point (DP), Tiverton, Ontario; and
- Gentilly-1 (G1), Gentilly, Quebec.

At CRL, decommissioning is considered part of the renewal of the research site. Many of the early buildings (some constructed as early as 1945) are made of wood. It is costly to upgrade and continue to maintain these buildings to current standards. Other buildings are no longer useful and require demolition or refurbishment because they contain radioactive or other contamination. There are also areas of legacy wastes and contaminated lands within the CRL site that are managed by the decommissioning group.

The CRL decommissioning group has taken "ownership" of these buildings and land areas, monitors them to keep them in a safe state, and oversees their decommissioning.

The three "Off-Site" locations are also managed under the umbrella of the CRL decommissioning program. Each of these "Off-Site" locations houses a prototype power reactor, which has been permanently shut down and is now in a storage and surveillance mode. Until facilities are available for disposal of low-level nuclear waste, the best approach to decommissioning these reactors is to keep them in a safe shutdown state *in situ*, where they are closely monitored and protection of the public is maintained.

In 2003 AECL obtained a licence[1] from the Canadian Nuclear Safety Commission (CNSC) to decommission the Whiteshell Laboratories site in Pinawa, Manitoba. The research site has been declared redundant by AECL, and a plan is in place to decommission it in three stages, with the first stage to be completed by 2009. The entire decommissioning process will be completed by approximately 2060, again depending on the availability of radioactive waste disposal facilities.

2. DOCUMENTATION AND ORGANIZATIONAL STRUCTURE

The QA programs in use at CRL, the Off-Sites, and WL must follow the requirements established by the CNSC. Through the site licences, the CNSC requires the use (as applicable) of the Canadian Standards Association (CSA) N286.x suite of standards. For decommissioning, the applicable CSA standard is entitled *Decommissioning Quality Assurance for Nuclear Power Plants*[2]. AECL has made additional commitments to follow the ISO 9001:2000 business standard [3] for all its activities, and the ISO 14001:1996[4] environmental standard for activities at its laboratories.

AECL's QA program for decommissioning embodies all the documentation and activities implemented to meet the applicable QA requirements. The documents at the core of this program are the company-wide Overall and Decommissioning QA Manuals, and the site-specific decommissioning QA Plans, that lay out the activities required to meet the QA specifications in each local setting.

AECL's Decommissioning QA Manual conveys the N286.6 structure and requirements for any AECL-managed decommissioning work. CRL and WL each have QA Plans that follow the same organization of sections as the Decommissioning QA Manual. This makes it clear to the users of the QA Plans and to the regulator how the QA programs meet the requirements of the N286.6 standard [2]. Following a consistent organization for the structure of the documentation also provides a useful framework for organizing work. The decommissioning work at the sites adheres to the ISO 9001:2000 [3] by adding the following sections to the existing N286.6 framework:

- Quality Objectives
- Quality Performance Metrics
- Customer Satisfaction
- Preventive Action

Each Decommissioning QA Plan is the primary field guide for staff to use locally. The process of writing a local QA Plan obliges an organization to understand the way the program works or the way it should work in the local circumstances. The QA Plan helps an organization to understand personnel responsibilities and activities, thereby avoiding both overlapping work duties and the possibility that some work may not get performed. The QA Plan can also provide cohesiveness to a group and a road map for the group to follow. When responsibilities change or activities are added to the group, the QA Plan provides a mechanism to record and implement those changes in a form that will be understood by the whole group.

Decommissioning management at a nuclear laboratory site involves numerous activities (See Figure 1).

- **Initiate**
  - complete the final shutdown of each operating system and put the entire facility in a stable condition,

- **Define**
  - establish the past history of each facility to identify hazard sources,
  - assess the hazards in each facility in its current condition, and as they may evolve during decommissioning (or if decommissioning is delayed),
  - determine the logical sequence and timing of the physical decommissioning activities for each facility,
  - set defensible priorities among all the decommissioning to be done, and
  - collect, interpret and protect the masses of important information.

- **Enable**
  - keep under surveillance and maintain building structures and support systems (e.g., power, lighting, plumbing, fire protection, ventilation),
  - obtain AECL and regulatory approvals.

- **Mitigate**
  - reduce health, safety & environmental risks by removing hazards and improving support systems

- **Remediate**
  - decontaminate and dismantle to reach the decommissioning end state

Figure 2 provides a pictorial representation of the activities involved in decommissioning building 430 at CRL. Figure 3 illustrates the two-year schedule to decommission one CRL facility, Building 430, which formerly housed chemical processing equipment. Delays in the process of obtaining the necessary approvals can significantly extend the time spent monitoring and safely maintaining a facility before any mitigation and remediation work can begin.

3. CHALK RIVER LABORATORIES AND THE OFF-SITES

Much care was taken to set up an organization and responsibility structure appropriate for decommissioning at CRL and the Off-Sites. The Division called Decommissioning Planning and Operations (DP&O) has this responsibility, and it forms part of AECL's Decommissioning and Waste Management (D&WM) Unit. This Division must carry out its work in the midst of numerous operating facilities managed by a different AECL unit. For consistency with the distribution of organizational responsibilities in the other unit, a similar structure was used for the facilities to be decommissioned. This helped us describe what needed to be done and it also meant that both groups at CRL and the regulator (CNSC) understand our terminology. Like the operating nuclear facilities listed on the CRL site licence [5], the facilities managed by DP&O have a "Facility Authority." The Facility Authority holds continuous management responsibility for the overall safety of their facility and compliance with the requirements set by the regulator. All activities in the facility, including projects to maintain, upgrade or decommission parts of the facility, can be carried out only if authorized by the Facility Authority. A "Facility Manager," who reports to the Facility Authority, is responsible for the day-to-day protection of health, safety, and the environment (HSE) in their facility. This person is also the single point of responsibility for approving the work to be performed within the facility (e.g. maintenance, monitoring, surveillance, assessments). Each Facility Manager is assisted by a "Facility Supervisor," who directly supervises the operating personnel working within the facility who perform the continuing surveillance and maintenance work. Daily Work Permits approved by the Facility Supervisor must be obtained before non-routine work in the facility may be conducted.

In addition to the facility staff, DP&O includes several people who provide program support:

- The Planning and Assessment group performs the long and short term planning needed to effectively manage the numerous shutdown facilities and legacy areas. This group also conducts technical assessments to assess health hazards, amounts of wastes that decommissioning will generate, and the associated costs to provide the detailed information needed to determine priorities and strategies for dealing with nuclear liabilities and to define requirements for waste remediation projects.

- All communication with the regulator passes through a Licensing Manager, to ensure consistency in the communication as well as to allow our group to efficiently track the communiqués.

- A Technical Coordinator provides the interface between the Facility Authority and projects initiated for decommissioning activities. This person ensures that the goals, objectives, schedules, technologies, etc, associated with various projects are integrated and consistent in content so that overall budget priorities and expenditure targets are met.

- A Program Coordinator compiles resource and budget forecasts and associated schedules related to decommissioning activities, and tracks expenditures and progress of the work.

- An Information Management group ensures that historic and current information needed for decommissioning purposes is gathered, catalogued, protected, and maintained, to ensure searchability and retrievability, both now and in the future.

- An Administrative Assistant who reports to the Facility Authority supports the administrative activities related to decommissioning.

- Finally, a Quality Assurance Representative (QAR) ensures that quality documentation is current, trains decommissioning personnel on how to apply it, monitors their adherence to the program, and ensures that proper records are being kept of their activities.

All these organizational arrangements are described in the first two sections of the DP&O QA Plan. Once the roles and responsibilities within DP&O had been defined, writing the rest of the QA Plan to describe the other general decommissioning provisions (Section 3 of N286.6) was straightforward. The remainder of Section 3 of the Plan consists of core components for any quality assurance program:

- Personnel capability;
- Accountability;
- Communication;
- Use of experience;
- Work planning and control;
- Control of items processes and practices;
- Verification;
- Non-conformances/Corrective Actions;
- Change control;
- Document control;
- Records;
- Program assessment.

We wrote specific QA procedures for communication, change control, document control, and records management because of the details that must be specified in each case. The other components were dealt with either by following company-wide procedures or by fully explaining them within the text of the QA Plan itself.

The most complex component was Work Planning and Control, which describes the entire business cycle for decommissioning. Activities within DP&O have been divided into the five discrete areas mentioned earlier: Initiate, Define, Enable, Mitigate and Remediate (Figure 4). The business planning cycle takes into account these five areas. The process begins with regular evaluations and prioritizations of the HSE and business risks of the redundant nuclear liabilities managed by AECL. Annual plans are written that take into account the outcome of the prioritization activity. The work described in the annual plans becomes the day-to-day work for the following year. The work is controlled by ensuring that personnel follow prescribed procedures. We included recognition of the fact that some work would be performed by personnel outside DP&O. Such work must to be conducted using either their own group's QA program, if acceptable to DP&O, or the DP&O QA program. Verification of the decommissioning work activities takes place through independent testing and review of records generated

as work is carried out, and by monitoring the reported completion of annual targets, cost and schedule targets, and reduction of legacy liabilities (measured as described in Measuring and Reporting on Decommissioning. Monthly and annual progress reports generated by the various parts of DP&O record the work completed

Section 4 of the DP&O QA Plan, like the N286.6 Standard [2] itself, lists the requirements that are specific to decommissioning work proper. Again most of the requirements are commonly understood, especially by personnel who have come from an operating work environment. In particular, the eight company-wide programs that cover the key elements of HSE compliance were referenced wherever applicable:

- Emergency Preparedness
- Environmental Protection
- Nuclear Materials and Safeguards Management
- Occupational Safety and Health
- Operating Experience
- Radiation Protection
- Radioactive Materials Transportation
- Security

The section of the Plan on turnovers between DP&O and other groups proved to be the most complicated to describe. The turnover of facilities from operations to decommissioning involves transfer of financial and management responsibilities as well as safety-related technical information, and both groups on the CRL site and the regulator. The nuclear facilities are explicitly listed on the CRL site licence, but some buildings and lands to be decommissioned are not. We have five process charts describing the turnover of facilities of different types. Each process chart describes the different requirements to turn over a facility depending on the facility type, e.g. if is it listed on the CRL licence, and if it is an operating facility or is under a more passive management regime.

The last two sections of the QA Plan (Section 5, Links to Other QA Standards, and Section 6, Requirements for Emergency Preparedness) were straightforward to describe, and to cross-reference with the other parts of the AECL QA program.

All DP&O quality assurance documentation was translated into French for the French-speaking staff at Gentilly-1 (G1). The current official English and French versions have been posted on the AECL IntraNet (internal internet) page for convenient viewing by all AECL personnel.

4. WHITESHELL LABORATORIES

The Whiteshell Laboratories (WL) site is smaller than CRL but decommissioning is a much more prominent activity. The WL Decommissioning Project (WLDP) is managed as a Division within the D&WM Unit. It consists primarily of subject experts and project

leaders, assisted by support staff both inside and outside the Division. Specialists in the fields of engineering, health physics, and project management within the Division direct the work of support groups elsewhere on site. The largest support group outside WLDP is the Common Services Division, which includes design & engineering services, power, grounds & maintenance, trades support, analytical support, and quality assurance.

All nuclear facilities at WL (i.e., whether they are operating, shut down, or under decommissioning) are under the control and management responsibility of the Nuclear Facilities Authority and Facility Managers. The operating facilities are managed using a QA Plan that follows the N286.5 standard [6], which is similar but not identical to the N286.6 standard [2] for decommissioning. The Nuclear Facilities Authority also has the responsibility for HSE across the whole Whiteshell site (except for the few R&D facilities that are managed by research groups), including both nuclear and non-nuclear facilities, buildings and grounds, and including both operating facilities and those being decommissioned.

The WL Decommissioning (WLD) QA Plan is organized to follow the N286.6 topics, referencing the company-wide Decommissioning QA Manual for the basic framework used. Company-wide procedures are referenced and used wherever applicable, for consistency and efficiency, and to minimize the different provisions that staff must learn when moving within the company. This approach applies, for example, to the non-conformance and corrective action process, AECL's work permit system, radiation protection (ALARA) guidelines, and most of the other compliance programs, which have strong regulatory input. Local procedures written specifically for the WL Decommissioning QA program include:

- Control of Communications, Documents, and Records;
- WL Decommissioning Key Staff Responsibilities;
- Work Planning for WLD.

Local WL procedures for housekeeping and for work permit authorization and emergency preparedness are also referenced in the WLD QA Plan.

5. TRAINING

While the decommissioning QA Plans are the field guides for decommissioning activities at the respective sites, their implementation is the heart of the QA Program. A dedicated local specialist QAR is the guide to each QA Plan. The QAR takes a prominent supporting role in writing the QA Plan, training personnel, providing continuing practical guidance on how to follow the QA provisions, and monitoring that effectiveness and consistency of implementation in the activities carried out.

The training course provided for each site was specific to the QA Plan issued. At CRL, NPD, DP, G1 and WL, it was decided to provide two initial half-day courses: the first to train people on the QA Plan and the second to train them on the associated decommissioning procedures. It was important to make these training sessions

interactive and interesting. The number of people in each training session was limited to allow for discussion. At CRL, NPD, DP, and G1, at the end of each session there was a test to make sure people had assimilated the training.

At WL, the training began at an earlier stage prior to completion of the first issued version of the QA Plan, to allow staff to provide practical input before it was finalized and implemented. Comments received on the training were positive. Staff felt that the small groups made the training courses more effective.

For G1 personnel it was necessary (and mandatory for conformance with the Quebéc Charter of the French Language) for training to occur in French. Both training sessions were translated and delivered in French at G1. The method of training was identical to the English version with small groups, discussion, a test at the end of each half day, and training feedback. Again, the response to this approach was positive.

The introductory training courses are an important step in helping decommissioning personnel to understand the QA program. It is also important for the QAR to follow-up, and monitor implementation of the QA Plan, record feedback and seek out opportunities for improvement.

6. IMPLEMENTATION

The official current version of all key decommissioning documentation is permanently available on AECL's IntraNet. This provides everyone with a trustworthy source of the information in an efficient manner.

At CRL, DP&O managers met thirteen times to review drafts of the QA Plan, so the resulting Plan had good ownership and acceptance by the managers. Suggestions for improvement were collected from the managers and considered for the next version of the QA Plan. With the managers understanding the QA Plan, the next step was to get employee input and commitment. Again, an approachable QAR who is able to assist personnel in interpreting the QA documents is imperative.

Finally, there is a need for ongoing support of the QA Program. Self-assessments and surveillance activities represent a form of maintenance of the QA Program. Self-assessment activities at CRL consist of regular meetings of managers with small groups of decommissioning personnel and the QAR. These meetings provide an opportunity for managers and other users of the plan to examine the operation of the QA Program in greater depth by looking at a very small portion of its implementation.

The surveillance activities for DP&O consist of a routine report prepared by the QAR that looks at certain aspects of the QA Program, e.g. meeting quality objectives, number of non-conformances issued, number of unplanned events, etc. The surveillance reports give decommissioning personnel a snapshot of the QA activities and let everyone know that their contribution to QA is important. During the first year and a half, the self-

assessments resulted in 15 actions, in the categories of Form Completion (4), Requesting Information (7), Altering Existing Documentation (1), Communication with DP&O Personnel (1), and Updating the DP&O Web Page (2).

At WL, surveillance activities are conducted on the initiative of the QAR and on request from management. Monthly monitoring reports are issued to document the findings of informal and formal assessments, non-conformances, actions taken, etc. The QAR also provides oral reports on quality-related activities to the regular monthly meetings of the WL Decommissioning team. Staff initiatives have led to improvements in documentation of physical changes to facilities and to the description of work planning processes.

Internal AECL quality audits are another source of input for improvement. Internal audits are scheduled regularly, and are conducted by staff with no direct connection to the decommissioning group being audited. Thus they provide more independent feedback on adherence to the QA Program, including adherence to the N286.6 standard. Findings from the initial audits have been useful in steering revisions to the documentation and also to enhancing training in several areas.

External reviews and audits have also provided valuable feedback to the quality programs at both laboratories. At CRL, the decommissioning group has been audited by the Quality Management Institute (QMI) as part of the global AECL registration to the ISO 9001:2000 [3] standard. The environmental aspects of DP&O management of its facilities have also been reviewed as part of AECL's commitment to operate its sites under the provisions of ISO 14001:1996 [4]. At WL, the CNSC has undertaken a thorough review of the decommissioning documentation to evaluate its degree of conformance to the N286.6 standard.

7. CURRENT STATUS

The AECL Decommissioning QA programs are in the third year of implementation following issuance of the documentation and completion of the initial training programs. They have undergone annual program reviews, including consideration of both compliance and business effectiveness aspects. The program review can be seen as the end of the yearly cycle of self-assessments, audits and continuous improvement efforts. Led by decommissioning management, it provides an opportunity to look back on the year to see what has and has not been accomplished as measured against the plans developed at the beginning of the year, and how appropriate, effective and efficient the QA program is. Actions from the program review help improve the QA Program and also help those personnel who use it in their work lives to better understand, use and appreciate it.

8. CONCLUSION

In summary, over the last three years AECL has implemented an integrated quality assurance program for decommissioning at the Chalk River and Whiteshell Laboratories and at the Off-Sites. This program is guiding AECL's decommissioning activities effectively, maturing rapidly, adapting to a changing regulatory and quality environment, and providing a model for quality implementation in other groups at the laboratories.

Acknowledgements
The authors wish to thank Bob Helbrecht, Grant Koroll, William Kupferschmidt, Bruce Lange, Bob McCamis, and Cliff Zarecki for their past and continuing efforts in developing, implementing and managing the AECL decommissioning QA Program.

References

[1] NRTEDL-02.00/2008, Nuclear Research and Test Establishment Decommissioning Licence - Whiteshell Laboratories, Canadian Nuclear Safety Commission.

[2] Decommissioning Quality Assurance for Nuclear Power Plants, N286.6-98, Canadian Standards Association, September 1998.

[3] ISO 9001:2000, Quality Management Systems – Requirements, International Organization for Standardization, 2000.

[4] ISO 14001:1996 Environmental Management Systems – Specifications with Guidance for Use, International Organization for Standardization, 1996.

[5] NRTEOL-01.02/2006, Nuclear Research and Test Establishment Operating Licence – Chalk River Laboratories, Canadian Nuclear Safety Commission.

[6] Operations Quality Assurance for Nuclear Power Plants, CAN/CSA-N286.5-95, Canadian Standards Association, 1995.

Figure 1: The five stages of decommissioning are represented in this pictorial display**. Initiate** is the completion of operational responsibilities for a redundant facility (vacate, shut down, turn over). **Define** is the assessment of the nature and extent of risks and liabilities. **Mitigate** is the reduction of immediate HSE and business risks. **Remediate** is achieving the final endstate for the facility or site and turnover to another responsible owner. Throughout, there are **Enabling** activities (approvals – facilities, systems) taking place to support execution of the other four stages.

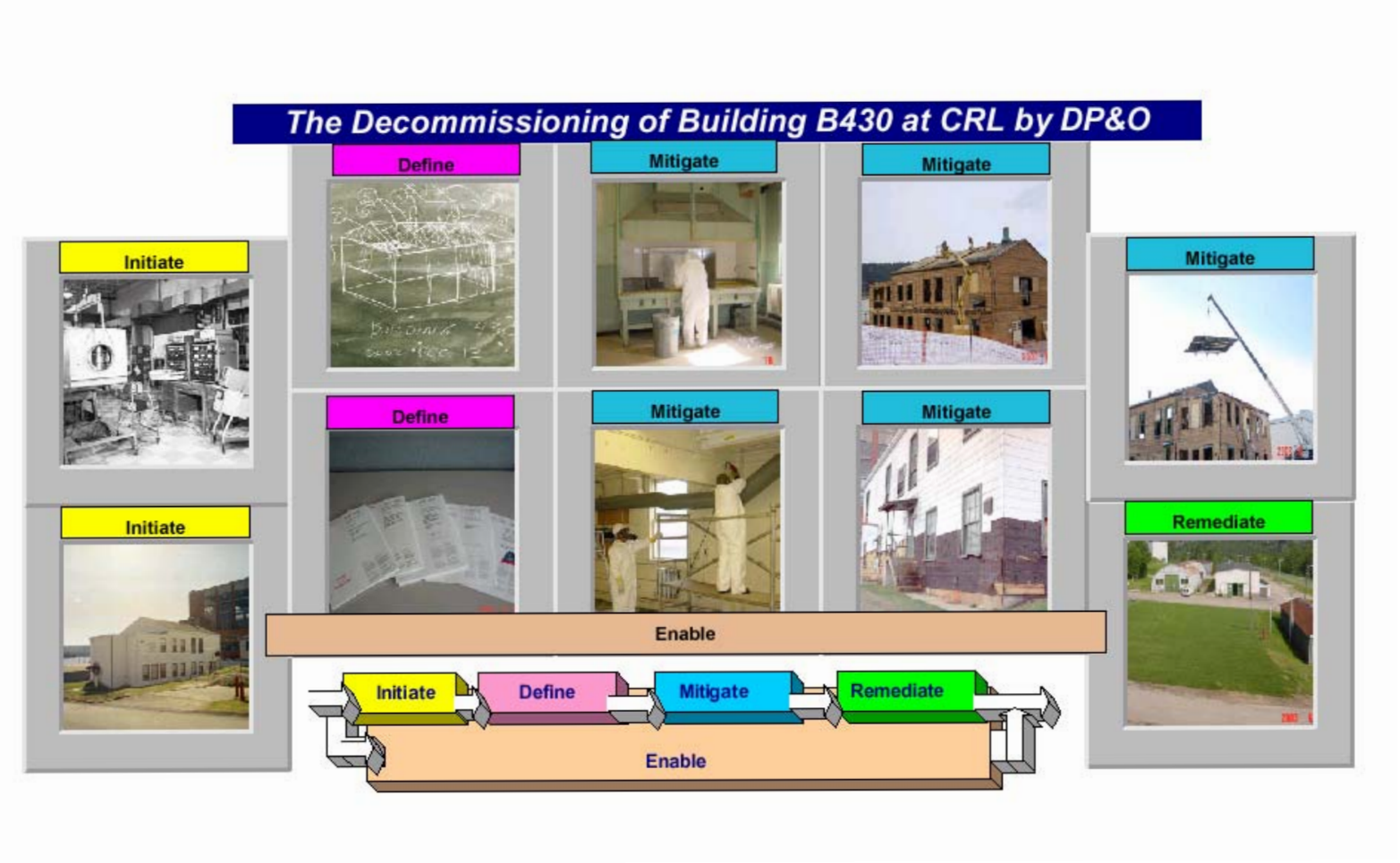
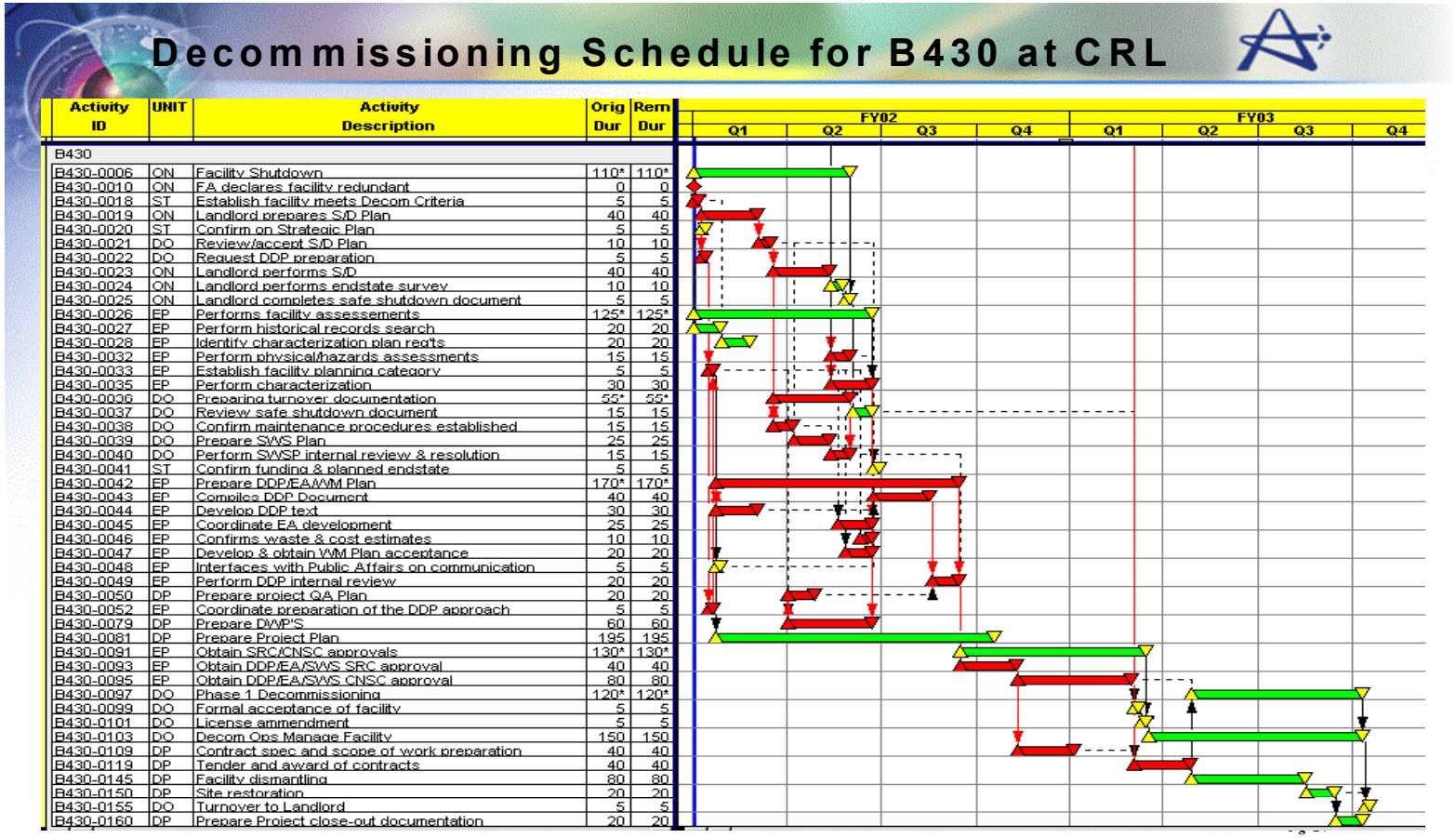


Figure 2: Pictorial representation of decommissioning of Building 430 at CRL.



Activity ID	UNIT	Activity Description	Orig Dur	Rem Dur
B430				
B430-0006	ON	Facility Shutdown	110*	110*
B430-0010	ON	FA declares facility redundant	0	0
B430-0018	ST	Establish facility meets Decom Criteria	5	5
B430-0019	ON	Landlord prepares S/D Plan	40	40
B430-0020	ST	Confirm on Strategic Plan	5	5
B430-0021	DO	Review/accept S/D Plan	10	10
B430-0022	DO	Request DDP preparation	5	5
B430-0023	ON	Landlord performs S/D	40	40
B430-0024	ON	Landlord performs endstate survey	10	10
B430-0025	ON	Landlord completes safe shutdown document	5	5
B430-0026	EP	Performs facility assessements	125*	125*
B430-0027	EP	Perform historical records search	20	20
B430-0028	EP	Identify characterization plan req'ts	20	20
B430-0032	EP	Perform physical/hazards assessments	15	15
B430-0033	EP	Establish facility planning category	5	5
B430-0035	EP	Perform characterization	30	30
B430-0036	DO	Preparing turnover documentation	55*	55*
B430-0037	DO	Review safe shutdown document	15	15
B430-0038	DO	Confirm maintenance procedures established	15	15
B430-0039	DO	Prepare SWS Plan	25	25
B430-0040	DO	Perform SWSP internal review & resolution	15	15
B430-0041	ST	Confirm funding & planned endstate	5	5
B430-0042	EP	Prepare DDP/EA/WM Plan	170*	170*
B430-0043	EP	Compiles DDP Document	40	40
B430-0044	EP	Develop DDP text	30	30
B430-0045	EP	Coordinate EA development	25	25
B430-0046	EP	Confirms waste & cost estimates	10	10
B430-0047	EP	Develop & obtain WM Plan acceptance	20	20
B430-0048	EP	Interfaces with Public Affairs on communication	5	5
B430-0049	EP	Perform DDP internal review	20	20
B430-0050	DP	Prepare project QA Plan	20	20
B430-0052	EP	Coordinate preparation of the DDP approach	5	5
B430-0079	DP	Prepare DWP'S	60	60
B430-0081	DP	Prepare Project Plan	195	195
B430-0091	EP	Obtain SRC/CNSC approvals	130*	130*
B430-0093	EP	Obtain DDP/EA/SWS SRC approval	40	40
B430-0095	EP	Obtain DDP/EA/SWS CNSC approval	80	80
B430-0097	DO	Phase 1 Decommissioning	120*	120*
B430-0099	DO	Formal acceptance of facility	5	5
B430-0101	DO	License ammendment	5	5
B430-0103	DO	Decom Ops Manage Facility	150	150
B430-0109	DP	Contract spec and scope of work preparation	40	40
B430-0119	DP	Tender and award of contracts	40	40
B430-0145	DP	Facility dismantling	80	80
B430-0150	DP	Site restoration	20	20
B430-0155	DO	Turnover to Landlord	5	5
B430-0160	DP	Prepare Project close-out documentation	20	20

Figure 3: Example of a Decommissioning Schedule (Building 430 at CRL)

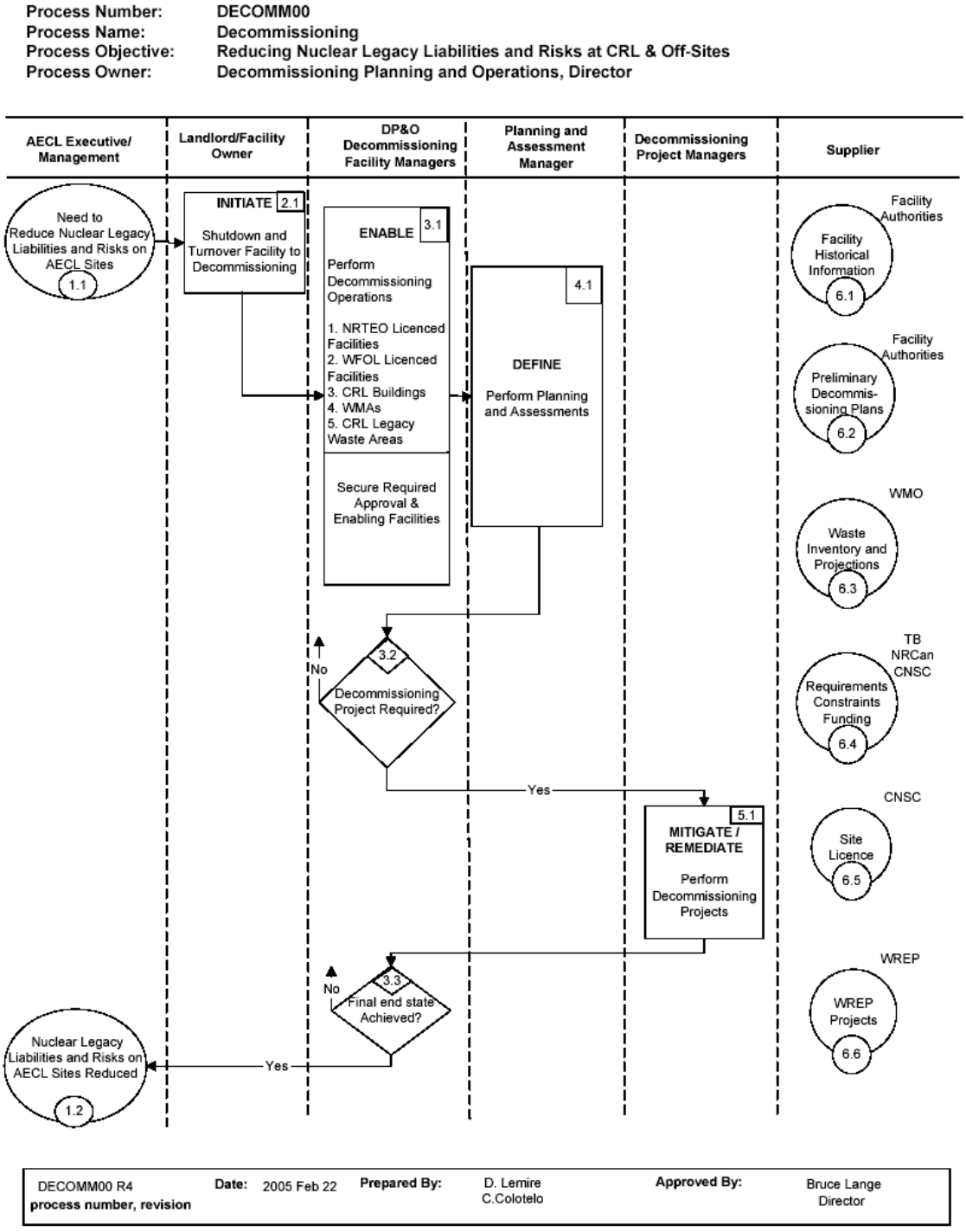


Figure 4: CRL Decommissioning Process