WASTE MANAGEMENT PROGRAM AT ATOMIC ENERGY OF CANADA LIMITED

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ABSTRACT

The Atomic Energy of Canada Limited (AECL) Waste Management Program establishes requirements for waste management activities at AECL sites in Canada. It ensures that activities involving planning for, handling, processing, transporting, storage and long-term management of wastes are performed in a manner that protects the workers, the public, and the environment, and are in compliance with applicable regulatory and licence requirements. The program translates applicable legal requirements into program requirements appropriate for AECL, and assists AECL management in implementing those requirements.

The Waste Management Program was formally established at AECL in 2007 as one of the nuclear programs. The activities conducted in the first two years (2007 - 09) were mainly focused on program development. Currently the program is executing the waste management improvement initiatives based on the Waste Management Program Improvement Plan.

- During the program implementation, close collaboration between the Waste Management Program and other departments resulted in improved waste management performance at Chalk River Laboratories (CRL). This included increased segregation of the waste at the source, reduction in waste generation, improved labeling and identification of waste packages, improved recyclables collection and initiating recycling of selected hazardous wastes.

In accordance with pollution prevention, the quantities and degree of hazard of wastes requiring long-term management shall be minimized, following the principles of Prevent, Reduce, Reuse, and Recycle. The annual volume of solid waste generated is one of the key indicators for waste management performance. AECL has been successful in reduction of operational waste and diversion of materials for recycling at CRL. From 2007 to 2010, the annual volume of solid waste, including inactive and radioactive wastes, generated from routine operations at CRL decreased by 26%, and the annual amount of recyclables sent to off-site recycling agents increased by 19% showing a significant amount of waste diverted from landfills. The overall refuse volume generated at CRL, including solid waste and recyclables, decreased by 14% from 2007 to 2010. This is a notable achievement in view of the fact that the workforce at CRL increased by about 15% during the same period.

The Waste Management Program continues to make improvements in waste management at AECL through implementation of initiatives. Program review and self-assessment are used to identify ways to continuously improve the adequacy, suitability, and effectiveness of the program. The current and future improvement initiatives are discussed in the paper.

Subject Keywords: Waste Management, Pollution Prevention

1. INTRODUCTION

The Atomic Energy of Canada Limited (AECL) Waste Management (WM) Program establishes requirements for waste management activities at AECL sites in Canada. It ensures that activities involving planning for, handling, processing, transporting, storage and long-term management of wastes are performed in a manner that protects the workers, the public, and the environment, and are in compliance

with applicable regulatory and licence requirements. The WM Program translates applicable external legal requirements and related internal requirements into program requirements appropriate for AECL, and assists AECL management in implementing those requirements.

The WM Program implements AECL's Environment and Health & Safety Policies with regard to waste management. AECL's Environment Policy states that:

> "We are committed to pollution prevention",
>
> "We comply with environmental laws, requirements, and recognized standards and guidelines applicable to our activities", and
>
> "We also focus our environmental efforts on minimizing nuclear legacy obligations for future generations".

The WM Program was formally established at AECL in 2007 as one of the nuclear programs alongside other nuclear programs such as Radiation Protection (RP) Program, Environmental Protection (EnvP) Program, Nuclear Materials & Safeguards Management (NM&SM), Radioactive Materials Transportation (RAMT), etc. The activities conducted in the first two years (2007 - 09) were mainly focused on the program development. Implementation is initially focusing on Chalk River Laboratories (CRL) and will expand to AECL's other sites in the future. Currently the program is executing the planned improvement initiatives based on the Waste Management Program Improvement Plan.

- During the program implementation period, close collaboration between the WM Program and other departments resulted in improved waste management performance at CRL. This included increased segregation of the waste at the source, reduction in waste generation, improved labeling and identification of waste packages, improved recyclables collection and initiating recycling of selected hazardous wastes (e.g., Waste Electrical and Electronic Equipment). The key initiatives and achievements are discussed in this paper.

2. ORGANIZATIONAL STRUCTURE

To support development and ensure a consistent application of the WM Program across all operations and activities at AECL sites, a WM Program organization has been established as shown in Figure 1. The Waste Management Program Authority currently reports to the Director of Waste Management Division (WMD). The WMD is responsible for the management of all waste generated at CRL and radioactive wastes generated by the off-site generators such as Canadian hospitals, research institutions, and industry, and currently consists of four branches to carry out all aspects of waste management at CRL.

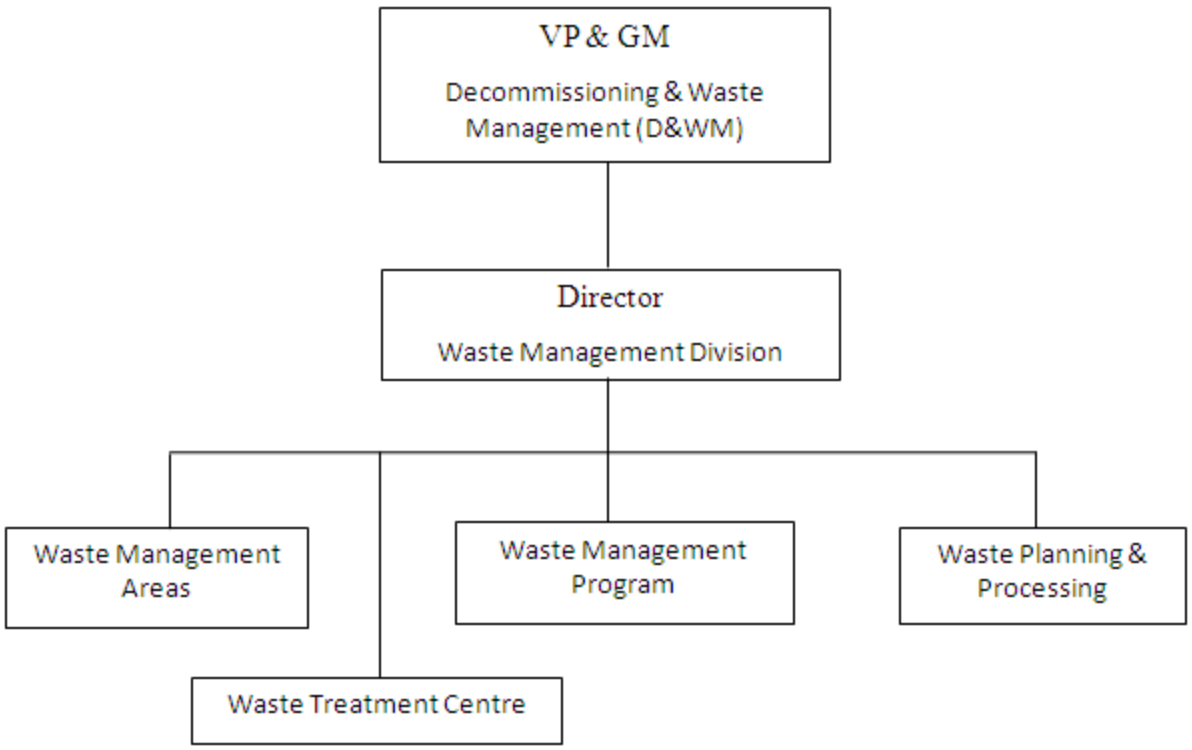

Figure 1. Position of Waste Management Program in Decommissioning & Waste Management Business Unit

3. PROGRAM DEVELOPMENT AND IMPLEMENTATION

Prior to 2007, requirements for the management of radiological and non-radiological wastes were the responsibilities of the EnvP and RP Programs. A need of an individual program for waste management was recognized and the WM Program was established in 2007 to address the CRL Site Licence Conditions [1] pertaining to waste management and improve the waste management practices at AECL sites. The activities conducted in the first two years by the program were mainly focused on program development. Implementation is initially focusing on CRL and will expand to other AECL sites in the future.

The WM Program is developed in conformation with the ISO-14001 standard [2] for Environmental Management Systems (EMS). The program incorporates the five key elements of the ISO-14001 standard including 1) Environmental Policy; 2) Planning; 3) Implementation and Operation; 4) Checking and Corrective Action; and 5) Management Review.

During the program development, the key goal of the newly formed WM Program is to ensure that AECL is in compliance with regulatory requirements and meets CRL Site Licence Conditions [1]. The activities carried out during this period were to execute the "quick win" while developing an understanding of the best practices and identifying opportunities for improvement. The key activities are described in the following subsections.

3.1 Standards and requirements

AECL is a federal crown corporation. As such, operations and activities at AECL owned or operated sites in Canada shall comply with applicable federal environmental or waste management legislation and associated regulatory instruments. To the extent practical and as long as those requirements do not conflict

with applicable federal legislation, operations and activities at AECL sites in Canada should strive to conform to waste management legislation and associated requirements in the province and/or the municipality in which the site is located.

A WM Program overview document was created to describe the framework of the program, including key processes, organizational structure and responsibilities. All the WM Program standards and requirements are detailed in the lower level requirements documents.

The WM Program standards and requirements are mainly based on the Canadian Nuclear Safety Commission (CNSC) site licences and regulations, Federal and Provincial acts, regulations and guidelines. The codes, standards and guidelines from International Atomic Energy Agency (IAEA) and Canadian Standards Association (CSA) applicable to AECL waste management are also used for the development of the program requirements documents. Provincial acts, regulations and guidelines for hazardous wastes are incorporated into each site's waste management requirement documentation. As well, each AECL site aligns itself according to local/municipal landfill and recycling requirements and programs.

The WM Program continues to undertake benchmarking comparisons with external organizations to understand issues and adopt best practices.

The WM Program documents are also in alignment with the internal nuclear compliance programs such as RP, EnvP, RAMT, and NM&SM. All applicable requirements from these programs, relating to waste management, have been incorporated into the WM Program.

In addition, a governing documentation index has been maintained in order to provide an easy guide of all regulations and requirements pertaining to waste management. This document also provides a list of definitions used in the program to ensure that consistent terminology is used across the organization.

3.2 Planning

A long-term (i.e., 10 years) high-level plan for the management of radioactive and hazardous wastes at CRL has been developed. The specific focus is to lay out the current and planned facilities, including storage facilities, process facilities and long-term management facilities and the steps required to manage the wastes in the long term. The plan has been developed in support of AECL's obligations to protect the health and safety of the public, the workers and the environment, and to minimize nuclear legacy obligations for future generations. In addition, several more detailed documents have been created in support of the long-term planning for wastes generated at AECL. These include: 1) waste streams documents; 2) waste management plans; and 3) interim Integrated Waste Plan (IWP).

A Waste Management Program Improvement Plan was developed for the period from 2009 to 2014 to improve waste management practices through effective implementation of improvement initiatives. This improvement plan was developed based on AECL's waste management strategy, input from stakeholders, information acquired from benchmarking and experience gained from the program development and implementation.

The improvement plan identifies key elements in order to plan, implement and track associated activities essential to the success of the WM Program and to address identified gaps for the waste management processes. The key initiatives include:

- Implementation of standardized waste containers and colour coding system to improve waste segregation at the source.
- Establishing robust waste clearance requirements and process.

- Development of a standard methodology for documenting waste streams for CRL and WL.
- Development of a modern, integrated Waste Management Information System to provide the tools to the waste generators and waste receivers to manage their wastes, and maintain a comprehensive inventory of waste being managed by AECL with sufficient information on characteristics to plan future processing and/or long-term management facilities.
- Revising current documents and development of new requirements documents to improve the waste management practices at AECL sites.

3.3 Communications

Communication and training are important tools for providing all stakeholders with the standards, knowledge and support to ensure that the WM Program requirements are met. The tools include:

- Creation of the WM Program webpage on AECL's internal web site for information on waste management requirements;
- Communication bulletins on AECL's internal web site and articles in AECL's publications to promote improved waste management practices;
- AECL's sites participation in Waste Reduction Week (WRW) in Canada as an opportunity to promote waste minimization, to educate staff on the costs of wastes and how waste is processed, and improvements being implemented;
- Presentations at branch and safety meetings for waste management awareness; and
- Creation of waste management awareness training for managers/supervisors and employees to describe the waste management requirements and practices, and also the importance of waste segregation and waste minimization to reduce future liability.

Communications with various waste management organizations have been established to share the experience, to understand and discuss issues of common concern.

3.4 Waste management plans

One of the program requirements for waste characterization and tracking requires the waste generators to prepare and maintain waste management plans for their operations and activities that generate solid or liquid wastes. This requirement also addresses the Site Licence Condition to characterize radioactive and hazardous wastes generated and received at CRL.

The waste management plans describe the waste expected to be generated during the operations, maintenance or decommissioning of facilities or activities so that the waste receiver can ensure appropriate facilities are available to receive the waste. A waste management plan represents an agreement or "contract" between the waste generator and the waste receiver regarding specific characteristics and quantities of the wastes, the waste minimization strategy, and packaging, transfer and interim storage arrangements.

For routine operations, waste management plans include expected volumes, physical, chemical, biological, and radiological characteristics, waste classification, the proposed means of packaging and handling, and the intended locations and/or means of processing, storage or disposal. For non-routine operations or activities such as decommissioning, remediation, and refurbishment projects, waste management plans describe the expected properties of wastes to the extent practicable (expected volumes, general physical, chemical, biological and radiological characteristics), the proposed means of packaging and handling, and a plan for

the detailed characterization of the wastes expected to be generated. For complex facilities or activities, the appropriate information may be contained in additional documentation.

During the program development and implementation, the WM Program assumed an active role to provide technical support for the preparation of waste management plans and supporting documents for radioactive waste at CRL. Currently the waste management plans for the facilities listed in CRL's EMS have been completed. These waste management plans will be updated to include other waste types.

4. IMPROVEMENT INITIATIVES

Currently the program is executing the planned improvement initiatives based on the Waste Management Program Improvement Plan. The key initiatives are described in the following subsections.

4.1 Waste minimization initiative

Waste minimization supports AECL's Environment Policy with regard to pollution prevention and has positive impacts on the environment, human health and safety, and economy. In accordance with the principle of pollution prevention, the quantities and degree of hazard of wastes requiring long-term management shall be minimized, following the principles of Prevent, Reduce, Reuse, and Recycle, and "Prevent" is being the most favourable option.

Various initiatives for waste minimization have been implemented since 2007. The key initiatives have focused on source reduction, segregation and recycling. Initiatives include:

- Developed waste minimization requirements and recycling procedure to establish the framework for applying the Waste Minimization Hierarchy;
- Performed waste minimization assessments for the facilities, which generate significant amounts of waste, to identify the opportunities for waste reduction and assist the waste generators to develop waste reduction targets and action plans to achieve the targets;
- Implemented colour-coded, standardized waste and recycling containers to enhance waste segregation;
- Established partnerships with external recycling agents (e.g., Ottawa Valley Waste Recovery Centre);
- Extended the likely clean waste and recyclables collection to active areas;
- Provided on-going communications, including waste minimization webpage, participation in the Waste Reduction Week in Canada, awareness training to managers and employees, presentations and educational sessions, to promote and answer questions related to waste minimization; and
- Continually monitored performance, with respect to waste minimization, to identify opportunities for improvements and to communicate these improvements.

4.2 Colour coding for waste containers

Proper segregation of waste is the key step to minimize the radioactive and hazardous wastes that require long-term management. The initiative to standardize the waste containers and develop a colour-coding system to improve waste segregation at the source has been implemented at CRL and will be implemented at the AECL Whiteshell Laboratories (WL). Through this colour-coding system radioactive, likely clean waste, likely clean recyclables, clean waste and clean recyclables are easily identified through various coloured identifiers on the waste bags. This colour coding system is also applied to waste cans and sheds for these waste types. Figure 2 illustrates the colour-coding system at CRL.

CRL personnel can segregate their wastes using the colour-coded, standardized containers available at their workplace. The coloured identifiers on the waste bags are used by waste clearance facility personnel to identify the clearance requirements of waste contained in the bags. For examples, the likely clean waste generated in the active area (i.e., Controlled Area 2; CA2) is collected in the waste bags with double grey horizontal stripes on it and the likely clean recyclables in CA2 are collected in clear plastic bags with double blue horizontal stripes. The waste bags used for clean waste generated in the inner area (Controlled Area 1; CA1) have a single vertical brown stripe and for recyclables have a vertical blue stripe to distinguish from the waste or recyclables generated in CA2.

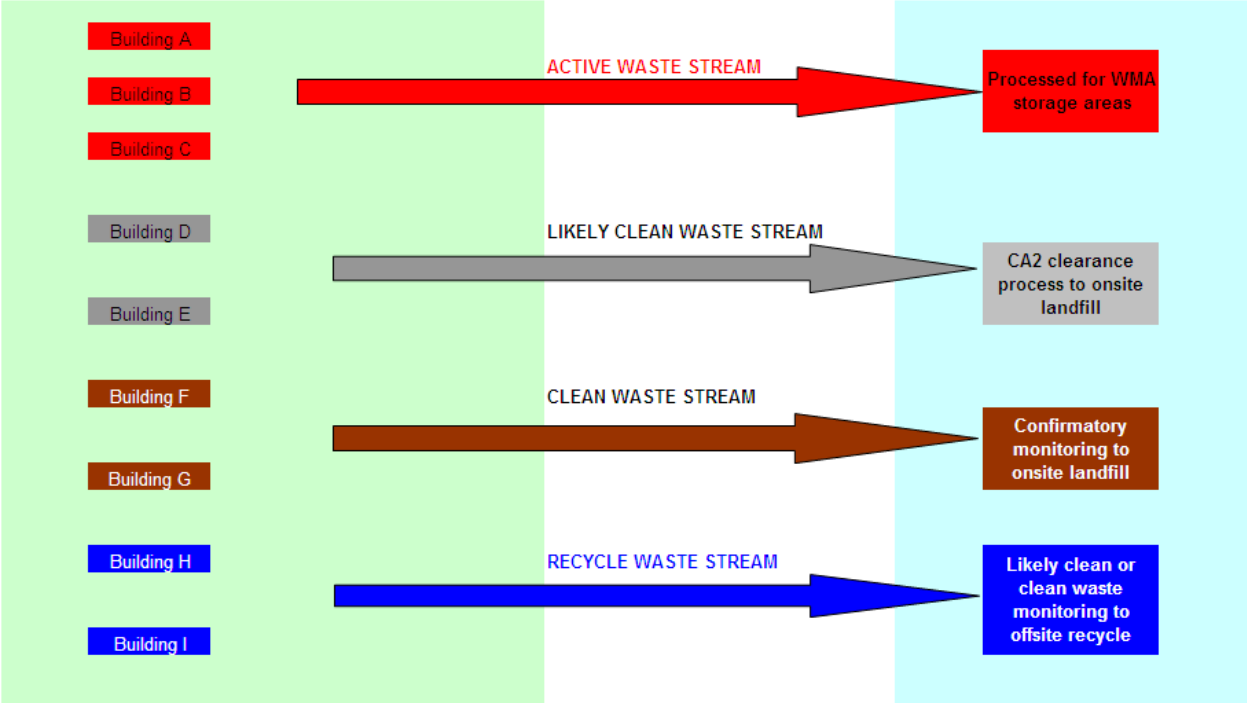

Figure 2. Colour-Coding System for Waste Bag, Cans and Sheds at CRL

4.3 Likely clean waste collection

A robust process is required for segregation of likely clean waste from the radioactive waste at CA2 in support of AECL's obligations to protect the health and safety of the public, the workers and the environment, and to minimize nuclear legacy obligations for future generations. Working with the RP Program, a process for approval of suitable likely clean waste collection locations at CA2 has been developed.

The process identifies the radionuclides possibly present at the potential collection location in a facility and utilizes the radionuclide fingerprint of the facility to determine whether the likely clean waste collected at this location can be cleared by the waste clearance facility at CRL based on its detection capabilities. Currently CRL clears the waste based on the unconditional clearance levels as specified in the CNSC Nuclear Substance and Radiation Devices Regulation [3]. Furthermore, the approval process also takes into account the history of the collection location. For example, the known history of contamination incidents, personal contamination incidents and work culture of the facility personnel increases the risk of collected wastes failing the clearance process. Likely clean waste containers are only placed in the approved collection areas for process control.

Changes in facility operations or changes in equipment or personal contamination incidents may trigger a review of the approved collection locations at any time during the two-year review cycle.

4.4 Waste streams documents

A waste stream represents a collection of wastes with similar radiological and non-radiological properties from various collection points for similar handling, processing, storage and disposition requirements. A waste streams document provides an overview of the management of waste at a specific site that defines steps from waste generation to disposition. The waste streams documents have been developed to identify the waste streams being stored and currently generated at CRL and WL. All known waste materials are aligned to the waste streams to ensure that all waste materials generated are captured within the identified waste streams. The waste streams are also mapped to waste reporting categories and disposition options, to ensure that waste management operations are in compliance with the WM Program requirements.

Each identified waste stream is presented by a waste stream flow chart showing the current and potential management steps from "cradle to grave" (Figure 3) and a requirements table listing the process requirements. The waste stream flow chart also identifies process gaps and areas for improvement. The requirements table outlines the process parameters and requirements for each process step.

The waste streams documents provide valuable input to waste planning, identification of gaps in waste management and opportunities for improvement, and the development of the interim Integrated Waste Plan.

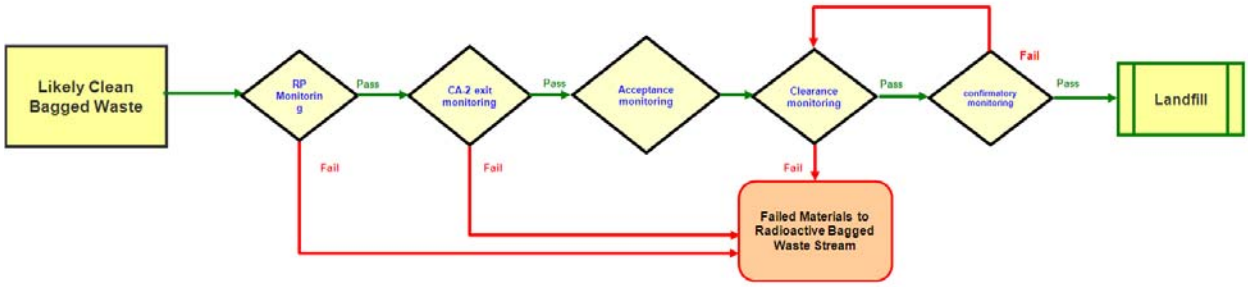

Figure 3. Examples of Waste Stream Flow Chart

4.5 Improvement in waste identification and transfer

An initiative for improving waste identification and transfer has been implemented. This initiative leads to changes in the current waste management processes. The key changes include: 1) the waste generators appoint waste officers representing their facilities or activities as the single-point-of-contact to manage their wastes, 2) the WMD will provide training to the waste officers and ensure that they understand the waste management practices and requirements, and 3) the WMD Customer Support service provides guidance to waste generators for waste issues. A two-day training course for the waste officers has been developed and training sessions have been provided at CRL. The trained waste officers would be knowledgeable resources within various internal organizations and promote the culture changes for waste minimization. After this initiative is implemented, the interface between the waste generators and waste receivers will be simplified significantly resulting in improved efficiency and consistency.

5. PERFORMANCE MEASURES

The waste management objective for success, is demonstrating that materials and wastes are effectively managed (i.e., recycled, cleared, managed as waste) according to a clearly defined, defensible set of rules. This measure is related both to the waste generated by AECL activities and waste received.

The volumes of inactive waste, radioactive waste, hazardous and mixed waste, and recyclables generated from routine operations (i.e., excluding wastes generated from decommissioning activities) at CRL are tracked on a regular basis for measuring waste minimization performance. The WM Program has aligned its initiatives and activities to this performance measure in order to reduce the life-cycle waste management cost and future liability.

The annual volumes of various types of waste and recyclables generated from routine operations at CRL from 2007 to 2010 are shown in Figure 4. The data show that the generation rate of inactive waste to landfills decreased from 4,370 m^3/a in 2007 to 3,195 m^3/a in 2010. This represents a reduction of 27% in the annual inactive waste volume to landfill during the reporting period. Similarly the generation rate of radioactive waste decreased by 22% from 2007 to 2010. As a result, the combined solid waste (the sum of radioactive and inactive wastes) volume generated from routine operations at CRL decreased by 26% during the reporting period. Furthermore, the amount of recyclables sent to the off-site for reuse and recycling increased by 19% from 2007 to 2010, indicating a significant amount of waste diverted from landfills.

From 2007 to 2010, the overall refuse volume, including solid waste and recyclables, generated from routine operations at CRL decreased by 14%. This is a notable achievement in view of the fact that the workforce at CRL increased by about 15% during the same period. When considering the volume data on a personal basis, the volume of overall refuse per person reduced from 3.03 m^3/person in 2007 to 2.25 m^3/person in 2010.

The total saving in waste management costs resulted from the waste volume reduction from 2008 to 2010 is approximately one million dollars (using 2007 waste management costs as the reference).

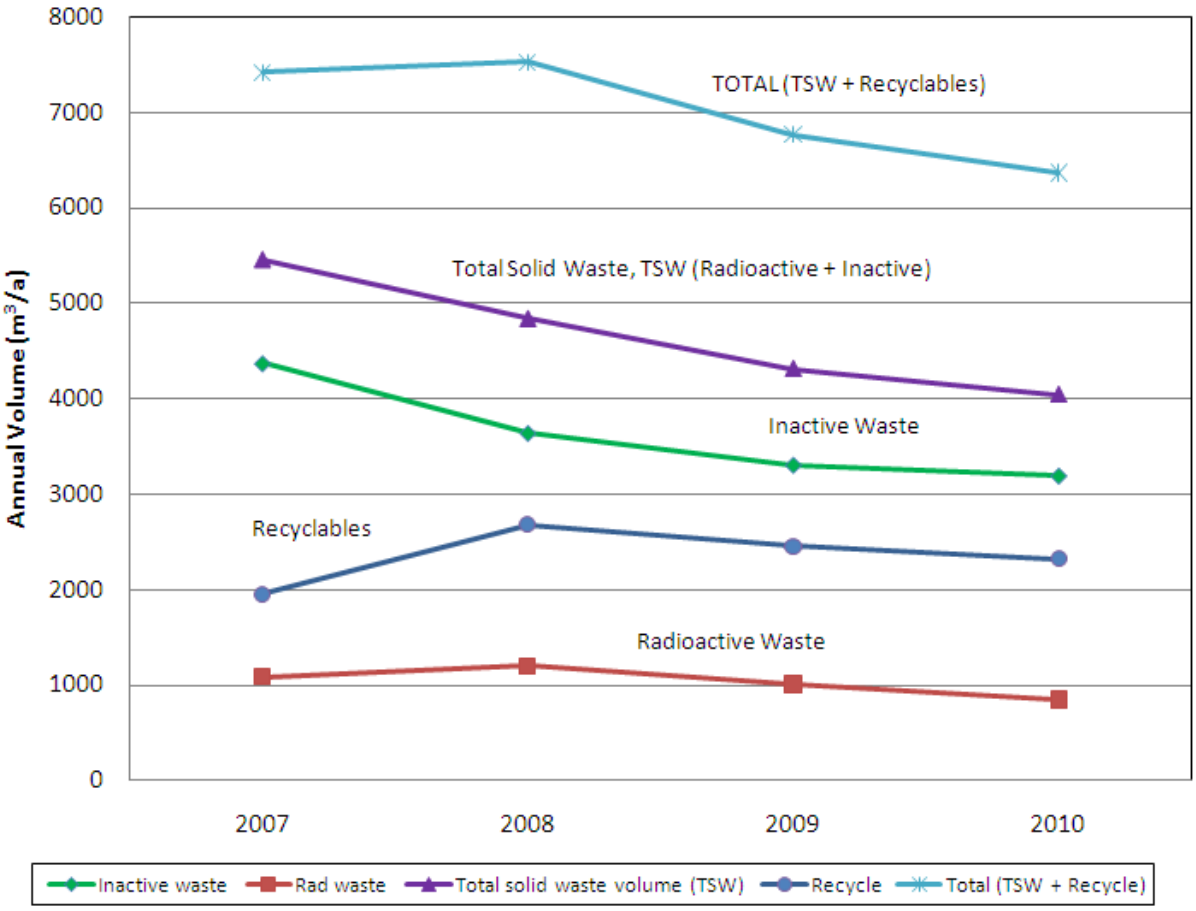

Figure 4. Volumes of Various Types of Wastes and Recyclables Generated from Routine Operations at CRL from 2007 to 2010

The adequacy, suitability and effectiveness of the WM Program are monitored through the internal quarterly program review and the self-assessment process. Through these processes, the gaps and areas for improvement are identified. Remedial and corrective actions are also identified and carried out to address the gaps and to continuously improve the program performance.

The compliance inspection and self-assessment required by waste generators, which was developed by the WM Program, are used to measure the level of adherence to the WM program requirements and identify opportunities for improvement.

6. FUTURE IMPROVEMENT INITIATIVES

In addition to the continuation of the five-year improvement plan, the WM Program continues to seek out opportunities to improve the waste management practices at AECL, while ensuring that AECL meets or exceeds the industry standards and regulation requirements. The followings are some examples for future initiatives to be implemented for improvements:

- Development of compliance monitoring requirements for waste verification;
- Development of a modern, integrated waste management information system for improved data management and reporting;
- Development of classification criteria for Very Low Level Waste (VLLW) at CRL;

- Assessment of innovative technologies for waste reduction and safe long-term waste management;
- Expanding recycling areas and materials to be recycled.

7. CONCLUSION

Significant progress has been made for the development and implementation of the WM Program at AECL. The program is maturing and now focusing on the areas that have not been fully developed such as oversight activities. The WM program continues to make improvements in waste management at AECL through implementation of initiatives and is undergoing program review and self-assessment to assess and continuously improve the adequacy, suitability, and effectiveness of the program.

Most important, the employees are more aware of their wastes and practice waste segregation and minimization in their facilities and activities. As a result, CRL has achieved a significant waste volume reduction of 14% in the last three years.

8. REFERENCES

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