

**NMT-7 APPROACH TO WASTE MANAGEMENT AT  
LOS ALAMOS NATIONAL LABORATORY'S  
CHEMISTRY AND METALLURGY RESEARCH FACILITY**

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**ABSTRACT**

The Chemistry and Metallurgy Research (CMR) Facility at Los Alamos National Laboratory (LANL) is a 550,000-square-foot building that was constructed in 1952, to house research and experimental facilities for analytical chemistry, plutonium and uranium chemistry, metallurgy, engineering design and drafting, electronics, and other support functions. Operations conducted within this diverse facility generate significant volumes of a wide range of hazardous, radioactive, and mixed wastes, as well as large quantities of sanitary waste and recyclable materials. Managing the wastes that are generated by operations in an aging nuclear research facility in today's regulatory environment presents tremendous challenges that need to be addressed. Significant changes that have recently been implemented at the CMR Facility have enabled the development and implementation of an improved waste management system, which has successfully addressed many of these waste management challenges and positioned the CMR Facility to have a successful future waste management system.

**INTRODUCTION**

The CMR Facility is operated by the University of California (UC) for the U.S. Department of Energy (DOE). The CMR Facility's primary function is to provide analytical chemistry capabilities to support major experimental programs at LANL and throughout the DOE Complex.

Developing and operating a waste management system that is in compliance with all applicable environmental regulations and that meets the formality requirements of a modern nuclear facility is very challenging. Adding to this difficulty was an outdated management structure and philosophy that needed to be changed to enable implementation of a successful waste management system.

Recognizing that a major change in management philosophy was necessary, LANL, in March 1998, transferred management of the CMR Facility from the Chemistry, Science, and Technology (CST) Division to the Nuclear Materials Technology (NMT) Division. A major reason NMT Division was selected to manage the CMR Facility was the demonstrated successful management of another major LANL nuclear facility, the TA-55 Plutonium Facility. This management change resulted in implementation of a new waste management system at the CMR that has made significant strides in addressing the waste management challenges of the facility.

**CMR FACILITY BACKGROUND/HISTORY**

**Facility Mission**

The CMR Facility was designed and constructed in 1952, in accordance with 1949 Universal Building Codes. At present, the building is nearing the end of its original design lifetime and does not meet many of today's standards or requirements.

The CMR Facility is a multiuser facility. Current programmatic activity in the CMR Facility is predominantly analytical chemistry to support major experimental programs at LANL and within the DOE Complex. These programs include nuclear materials process technology, waste minimization,

environmental restoration and remediation, nuclear safeguards, high-temperature superconductivity, support for the Rocky Flats site, mixed waste characterization, support for the Waste Isolation Pilot Plant (WIPP), and Special Nuclear Materials (SNM) standards development. Hot cells located in Wing 9 are used for activities that require a heavily shielded facility, such as processing irradiated targets and radioactive source recovery. The CMR Facility is considered a critical facility for stockpile management programs within the DOE.

While the primary use and mission of the CMR Facility is not expected to change in the near future, various new programs that involve similar types of work are being proposed.

### **Facility Design Features**

The approximately 550,000-square-foot CMR Facility consists of a basement, first floor, and attic floor. An administration wing, office wing (Wing 1), and seven laboratory wings (Wings 2, 3, 4, 5, 7, and 9) are joined together by a spinal corridor and comprise the building. Wings 2, 3, 4, 5, and 7 are similar in construction, having equipment or change rooms located at the front of each wing, individual laboratories in the main areas of the wing, and filter towers located at the end of the wings. In 1959, the 54,000-square-foot Wing 9 was added to the facility to provide heavily shielded facilities (hot cells) for remote handling operations. This unique design makes the CMR Facility more like several isolated facilities, rather than like one single facility. The CMR Facility also contains a Waste Assay Facility (WAF) and other structures that are required to support the facility mission. Figure 1 is an aerial photograph that shows the size and layout of the CMR Facility.

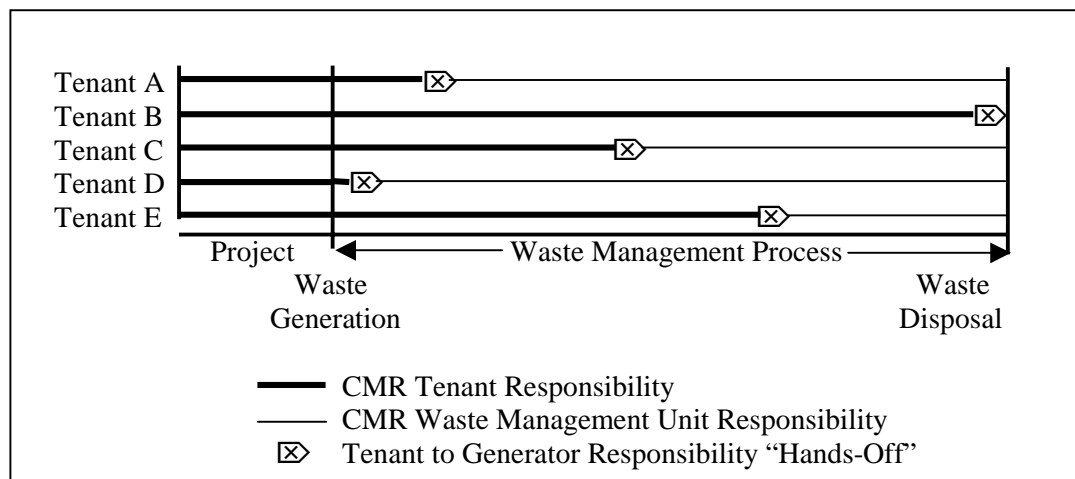
### **Past CMR Facility Organization and Management Structure**

Until March 1998, the CMR Facility was managed by the CST Division. Operations within the facility, however, were conducted by many different groups from several LANL divisions. The CST Division was responsible for maintaining the facility in an operating condition and for maintaining all critical support systems for the facility, including ventilation systems, electrical systems, fire detection and suppression systems, etc. The CST Division was also responsible for ensuring that all operations within the facility were conducted within the approved safety envelope for the facility. Organizations that conducted work in the facility, the facility tenants, were authorized to conduct their activities through facility/tenant agreements. These agreements detailed both tenant and facility organization responsibilities, as well as authorized activities. There was, however, no single line management authority that controlled all activities within the facility. Facility/tenant agreements were not uniform in delineating responsibilities or authorities. This management structure resulted in the facility being operated as if it were several distinct "companies" as opposed to one integrated company with one management authority.

The CST Facility management organization did operate a small waste management unit within the facility. This unit consisted of only two individuals that were part of the facility environment, safety, and health team. These individuals were available to assist tenant organizations with their waste management needs; however, the facility/tenant agreements often allowed tenant organizations to entirely manage their waste on their own, or to only engage the waste management unit at various points in the waste management process. These varying facility/tenant agreements resulted in inconsistent and inadequate, and sometimes redundant, management of waste generated by the facility. Figure 2 is a graphical representation of how the facility was organized to manage its waste.



**Figure 1. Chemistry and Metallurgy Research (CMR) Facility, Technical Area-3, Building SM-29**



**Figure 2. Graphical Representation of CMR Waste Management "System"**

### Waste Types and Volumes

Operations at the CMR Facility generate a wide variety of waste types. Although volumes of any one specific waste type are not extraordinary, the diversity of waste types and the formal systems required to properly manage them present significant challenges. Table I shows the estimated volumes of waste types being generated by operations at the CMR Facility.

**Table I. CMR Estimated Annual Waste Generation Rates**

Waste Type	CMR Estimated Annual Generation Rates
<b>Solids:</b>	
Low-Level Radioactive Waste	250 m <sup>3</sup> /yr
Low-Level Mixed Waste	6.0 m <sup>3</sup> /yr
Transuranic Waste	7.0 m <sup>3</sup> /yr
Transuranic Mixed Waste	1.5 m <sup>3</sup> /yr
Hazardous Waste (RCRA/TSCA)	5 m <sup>3</sup> /yr
<b>Liquids:</b>	
Low-Level Radioactive	5,000,000 gal./yr
Hazardous Waste (RCRA/TSCA)	4.5 m <sup>3</sup> /yr

### CMR WASTE MANAGEMENT INTEGRATION COMMITTEE

In early 1997, the Waste Management Integration (WMI) Committee was chartered to evaluate the CMR waste management system, identify regulatory drivers and requirements, identify issues and liabilities with the current system, and recommend appropriate and necessary changes. The charter of the committee was to "define a path forward to develop an efficient and logical integrated waste management system for the CMR Facility and its users to meet current and future waste management requirements." The WMI Committee was organized in two tiers: a strategic planning team and an integration implementation team. The strategic planning team consisted of division directors and group leaders of tenant organizations in

the facility. The implementation team consisted of key knowledgeable representatives from each tenant organization that were intimately familiar with waste management needs and activities within their respective tenant organization.

The WMI Committee began its work by identifying the myriad applicable federal and state regulations pertaining to management of CMR Facility wastes, as well as DOE and LANL requirements. The committee then identified the various waste streams and their sources within the CMR Facility. Based on this information, the committee identified the program elements, along with various functions and activities that must be conducted to manage the waste safely and in compliance with all requirements. This information enabled the committee to identify issues and liabilities with the existing waste management system and to recommend changes to the system to meet requirements.

The committee issued its draft report to CST Facility management in November 1997. The report concluded that managing waste under the existing facility/tenant agreements resulted in various serious deficiencies. The committee identified the following:

- While external organizations view the facility as a single waste generating entity and need to interact with it as such, within the facility, various tenants maintain responsibility for certain waste management activities. There is no single authority to deal with waste management issues and interfaces at the CMR Facility.
- Multiple responsibilities result in duplication of effort and extensive and redundant training required to meet the expanding complexities of waste management.
- Inconsistent management resulted in the following:
  - increased risk of nonconformance with laws and regulations
  - inadequate material control and accountability
  - ineffective waste minimization
  - inadequate quality assurance
  - inadequate documentation of acceptable knowledge
  - inadequate and poorly defined records retention and transfer

### **COMMITTEE RECOMMENDATIONS**

The committee report outlined numerous recommendations to change the waste management system at the CMR Facility. The main recommendations, however, were 1) to designate an integrated waste management organization in the CMR Facility to consistently manage all waste generated by facility operations; and 2) to designate a centralized waste management area within the facility to enable safe and efficient staging, segregation, accumulation, characterization, repackaging, and transportation of wastes. Implementation of the integrated waste management system at the CMR Facility would result in the following:

- Accountability for all generated waste
- Cost efficiency
- Increased reliability and risk reduction
- Improved coordination with internal groups and external organizations
- Identification of opportunities for source reduction and waste minimization

Before the CST Division was able to take action on the recommendations in the committee report, LANL management mandated broad and sweeping changes in the management of the CMR Facility. In March 1998, the NMT Division was given management authority for the entire CMR Facility. All tenants

within the facility were transferred from their previous divisions into the NMT Division, resulting in a single line management authority over all activities in CMR and, by default, all recommendations of the WMI being implemented. Responsibility for management of all waste generated in the CMR Facility was integrated into one waste management organization within the NMT Division, NMT-7—the same organization with responsibility for management of all waste generated in the TA-55 Plutonium Facility.

### **BENEFITS OF INTEGRATION**

The goal of the integration was to combine the strengths of both the NMT waste management organization and CMR Facility waste operations personnel in order to address challenges with the management of waste and environmental compliance issues at the CMR Facility. The transition had to be accomplished with minimal impact to the CMR Facility analytical capabilities that were essential to the support of plutonium facility operations and program commitments. Changes in the program were essential to bring it into compliance with improved formality of operations and updated safety basis in the facility. Key skilled personnel from these two entities were merged to form one unified organization.

NMT personnel had successfully updated the TA-55 Plutonium Facility Final Safety Analysis Report and Technical Safety Requirements, and obtained DOE approval for operations under current regulatory standards for nuclear facility operations. This experience was gained from years of stressful circumstances with the understanding that the viability of TA-55's mission depended upon their success. These personnel would save months, if not years, at CMR working to accomplish the same goal. Many of the deficiencies identified in CMR operations were the same ones that NMT had already addressed at TA-55: integrated safety management, formality of operations; risk-based hazards analysis and mitigation; establishment of facility safety basis documentation; and establishment of the operational safety envelopes and procedures necessary to maintain operations within the limits established for the facility. The CMR Facility was still operating in an academic mode and had not made the transition to a formal, nuclear facility mode of operation. The integration of CMR Facility residents provided the experience and history to complement NMT experience with ISM and formality of operations.

Personnel from each site lent consistency to the transition. Waste management was removed from the facility group and organized to operate independently of other infrastructure functions within the facility. This provided the flexibility, independence, and focus needed to gain the credibility and confidence of regulatory agencies and disposal facilities, while maintaining a sensitivity to the needs of the operations groups that produced the waste. The maintenance of dependability and consistency in the evolving program was very important in sustaining the confidence necessary to maintain certification. TA-55 personnel with skills to complement those already working in the CMR Facility were asked to join CMR Facility waste operations. It was important that these personnel were actually located on-site to facilitate communications and present an NMT presence in the facility. A functional organizational structure was adopted in the manner that TA-55 operations are organized. Specialized personnel were obtained to work with the group in the areas of quality assurance and regulatory compliance. An on-site NMT-7 satellite group office was established.

The temporary work instructions necessary to conduct operations were a hybrid of the CMR Facility and TA-55 procedures with the minimum detail necessary to address and mitigate the hazards encountered in daily operations (radiological, toxicological, chemical, and physical), and to ensure that waste characterization, documentation, packaging and labeling would meet waste acceptance criteria. Most waste operations personnel were already trained and certified on the reference standard operating procedures, could conduct operations immediately under the new special work permits, and were familiar with the standard forms, computer programs, and databases necessary to document and track the waste.

## CMR FACILITY INTEGRATION INTO NMT

The integration of CMR Facility operations into the NMT Division was a profoundly traumatic experience for both the organization and the facility. Two fundamentally different philosophies were at conflict: the rigid formality of DOE nuclear facility operations that had been embraced by the plutonium facility with the academic, free-thinking, and flexible mode of CMR operations. The latter operating philosophy was outdated and no longer acceptable to the DOE from the standpoint of risk and litigation (i.e., rules codified in the *Code of Federal Regulations*, UC/DOE Contract, DOE orders, and Price-Anderson Act). Also during this time, the costs of doing business (facility infrastructure costs which are substantial) were coming under more scrutiny with dramatically shrinking project budgets and appeared to be disproportionate with operating funds. Consequently, facilities operations, including waste management tended to be underfunded in order to maintain programmatic deliverables and were incapable of keeping up with the increasing frequency of regulatory changes and mandated formality. It was under these conditions that NMT came to inherit waste operations in the CMR Facility. It was exciting to be given the flexibility to establish a new program, but challenging given the constraints of funding, resource limitations, and physical condition of the facility at that point in time.

The NMT Division accepted responsibility for operations in the CMR Facility in March 1998, including the support operations of waste management and environmental compliance. This was at the end of the CMR Resumption Project, which had been instituted by CST Division under the supervision of DOE mentors to address the deficiencies which resulted in a fire and explosion in Wing 9. This exercise followed the format of a readiness assessment though not quite as formal in determining the readiness of personnel, procedures, and processes for restart. Resumption packages were done for all activities and operations in the CMR Facility. The first order of business for NMT-7 was to complete the four resumption packages authorizing waste management operations.

NMT carried their “can-do” reputation to CMR Facility operations and worked to establish operations in the TA-55 model under the developing CMR Facility formality of operations. The limited variety of operations and smaller quantities of waste dictated that there be no specialization in waste operations as at TA-55, but that waste management personnel be cross-trained in the specialized requirements for handling many different waste types and develop a flexibility in assignment.

The CMR Facility waste management personnel already had done much work in assessing the status and needs for an effective waste management program, and these studies formed the foundation for establishing waste operations in the CMR Facility. The goal was to establish a viable waste management program as quickly as possible. There was already a substantial backlog of waste in the facility. During the CMR Resumption Project, processing and analytical activities were allowed to restart and generate waste, although the assessment for waste operations was left until last in the process. For some waste types, there was a three-year backlog of waste in the facility and the storage yard outside the facility that awaited shipment to the disposal facility.

This situation presented some unique challenges. Waste had to be properly characterized, packaged, and certified to meet appropriate waste acceptance criteria. Data and documentation needed to be tracked and filed in a manner amenable to audit scrutiny. The strength of the program lay in its ability to demonstrate compliance with all applicable orders, waste acceptance criteria, and regulations that mandate the way in which waste must be characterized, packaged, labeled, treated, stored, and disposed. In the short term, temporary work permits were developed and implemented under the resumption project to allow the acceptance of newly generated waste. This would also allow the development of basic program documentation (Waste Management Plan) and to tailor standard operating procedures developed at TA-55 to the unique operations at the CMR Facility. A contract with an environmental subcontractor was written to assist with this task. Another challenge was dealing with the backlog of legacy waste in the facility.

Much of the waste was not completely characterized before it was packaged and records were sketchy. This would necessitate reopening the packages, in some cases with the possibility of exposure to radiological, physical, and chemical hazards.

Successful waste management is viewed as a partnership with the waste generators. Waste minimization and avoidance must be implemented at the source, and no one is more qualified than the waste generator to provide the information necessary to properly characterize a waste. A generator with a basic understanding of waste regulations is essential to the success of the waste management program. In this manner, a balance can be established to maximize the cost-effectiveness of the program with a modest investment of time by the generator. Due to the fragmented nature of operations and division responsibility in CMR operations, there existed several approaches to waste management in the same building and minimal understanding of the process by the waste generators.

## **CAMPAIGNS**

Many challenges that faced the fledgling waste management organization were quantified and prioritized, and assignments were made to waste management personnel. The challenges facing the organization were very dynamic and required flexibility in assignments and reliance upon contractors to fulfill specialized, limited-term needs. The following examples present major challenges in waste management and environmental compliance that the waste management personnel addressed and resolved.

- NMT initiated several discrete waste operations at CMR in support of CST activities prior to NMT's formal assumption of ownership. Initial work on updating the facility safety basis identified wing-wide fire as one of the most serious and probable events resulting in the release of radioactive materials from the building due to its design (circa 1950). This resulted in the establishment of a stringent limit on the combustible load allowed in the building. In some cases, this was as low as 0.5 pound of combustibles per square foot of floor space. As can be imagined, over a 47-year period, a significant quantity of combustibles had accumulated in the form of books, reports, and periodicals to wood furniture, skids under equipment, cardboard, plywood boxes, and plastic. This resulted in the removal of more than 20 tons of combustible material from the facility over a three-week period.
- In performing a Resumption Package Independent Verification for waste operations, it was discovered that waste generators had a very limited understanding of waste characterization and regulatory issues under the Resource Conservation and Recovery Act (RCRA). This resulted in the discovery of a population of 56 improperly characterized transuranic (TRU) waste drums that had to be identified and marked properly as mixed waste. A letter was written, as required by law, to notify the state regulatory agency of the oversight and LANL actions to correct it. In addition, it became obvious that the Laboratory RCRA training (a one-time, four-hour course) was inadequate, and the TA-55 Waste Generation and Pollution Prevention Course (site-specific generator training) was quickly modified and offered to all CMR Facility residents working in the operations areas. As discussed earlier, the program is a partnership; a generator population familiar with environmental regulations is critical to the success and cost-effectiveness of the waste management program.
- LANL management identified a regulatory vulnerability in the inventory of chemicals that had accumulated throughout the Laboratory over the years. A block of funding was secured to engage a contractor to work with generators to dispose of their excess, expired, and otherwise unneeded chemicals and orphans with no cost to the generator's home organization. NMT readily recognized the value of this program in making progress with the disposal of chemicals in the CMR Facility and enthusiastically embraced it. The program, unfortunately, was complicated in the CMR Facility by the sheer quantity of items, lack of acceptable knowledge about many of the items, and by the multitude of radiological control areas out of which the items were moved. A protocol was



established and implemented to characterize, track, stage, package, and ship these items for disposal. This program had many starts and stops as unanticipated problems were identified and resolved, which ranged from chemical compatibility issues, age-induced chemical instability concerns, free-release criteria from a radiological standpoint, paperwork completion issues, fume generation and ventilation problems in the less-than-90-day storage areas, radioassay complications, record keeping anomalies, and coordination of activities with the generators and the contractor disposal team. Over the nine-month duration of this project, over 7,500 legacy chemical items were removed from the facility.

- Another activity that began before NMT took responsibility for waste management in the CMR Facility was the identification of sample residues from environmental sample analysis. Analytical operations did not consider the disposition of excess sample or residues from the analysis process. The cost of analysis should have covered disposal, and the proper information should have been received with the sample to allow proper characterization; or an agreement should have been made to allow the residues to be returned to the requestor for disposal. Eight hundred fifty environmental samples and sample residues were accumulated before a project was initiated to identify and prepare them for disposal. The first step was to identify all items and gather any available information on them. In this manner, the items could be combined with similar materials and documented for disposal. It was discovered in the course of gathering acceptable knowledge, that many of the records were contradictory, incomplete, or did not exist. The Laboratory environmental group was contacted to help identify where a parent sample had been split for different types of analysis. Once determined, several splits of the same sample could be recombined to reduce the total number of items. The disposal facility was also contacted to identify samples from waste streams that were already documented by waste profile forms. Finally, samples for which acceptable knowledge (AK) did not exist or could not be found would be categorized by matrix, and then combined for sampling and analysis to allow disposal. To date, approximately 600 of these items have been disposed.
- When NMT established waste operations in the CMR Facility, they accepted responsibility for legacy waste packages in the facility. There was a backlog of two to three years' worth of TRU waste in one-hundred sixty-five 55-gal. drums. Additionally, there were seventy-four 90-ft<sup>3</sup> boxes that contained low-level, noncompactable waste in storage. Documentation on the contents of the packages varied from accurate to nonexistent. As discussed previously, a fraction of the TRU waste drums were discovered to be mixed waste and were properly characterized, documented, labeled, and staged in accordance with state regulations. Information was gathered to complete the data packages; reviews and approvals were completed; and shipments were arranged to the TA-54 waste disposal facility for all but 15 boxes of low-level waste that could not be adequately characterized. It was necessary to open the boxes to document the contents, despite the radiological, hazardous material, and mechanical hazards. A portable containment enclosure that was large enough to accommodate the waste boxes was set up inside the facility and high-efficiency particulate air (HEPA)-filtered for contamination control. Personnel wore anti-contamination clothing and respirators in case of airborne release of radioactivity. Work was coordinated closely with radiological control technicians to prevent the inadvertent release of contamination and personnel protection during the process. Each box was opened, and any suspect materials were removed. Items on top, including heavy and awkward waste items, were removed so that the material on the bottom could be visually inspected and photographed to complete document packages. Work was conducted around regularly scheduled activities and was completed on schedule and without incident.
- The WIPP commissioned the Source Term Test Project to confirm assumptions that were made regarding variables in the computer codes that were used to conduct the performance assessment of the geologic repository. These studies were conducted in the CMR Facility with actual samples of TRU waste. The waste was mixed with brine, and samples were taken periodically for analysis. Since

many of the waste types carried F codes for toxicity, the waste from the analytical activities also had to be classified as mixed waste. These wastes were tracked from the activities that produced them, with the assistance of analytical personnel who used their improved understanding of environmental regulations to the corresponding TRU mixed waste. The drums of waste were recharacterized, documented, marked, and shipped to TA-54, where they will be staged until they are ready for shipment to the WIPP.

## **REMAINING CHALLENGES**

Budget limitations have prescribed the modest size of the CMR waste management organization and limited the rate of progress in many areas. There remains much work to be completed; many activities as important as those already accomplished and, in many cases, even more challenging. The following activities have been identified and will be pursued in the future as current projects are completed and as additional funding is secured to address them:

- A variety of abandoned in-place materials, instruments, and equipment are situated throughout the six operations wings, and their basement and attic spaces. These comprise 47 years' accumulation of items left behind when programs were terminated or moved. NMT-7 is attempting to obtain funding to catalog and perform a hazards assessment of these items. It is anticipated that many of these items will be left in place until the building is decontaminated and decommissioned if it is safe to do so. These items must be evaluated for risk to the safety of personnel or potential for environmental impact and disposed, or stabilized as necessary. It is anticipated that a contractor will work with CMR Facility personnel to catalog these items and accumulate as much AK as possible in a database, which can be searched and sorted according to attribute. Top priority items will be stabilized so that they may be packaged and disposed as funding becomes available.
- The compliant and cost-effective handling of waste is a cooperative activity that involves the generator, as well as the waste management organization. This presumes that the generator has a working knowledge of program requirements and a willingness to follow the rules. With decreasing budgets and a more competitive environment, there is a temptation to overlook hazardous waste statutes in the name of expediting research. NMT-7 has a full-time regulatory compliance officer and environmental compliance engineer on-site working with the generators to ensure that all operations are in compliance with waste and environmental regulations. In addition, periodic inspections are performed on operations from an independent laboratory regulatory organization. Significant advances have been made in the review of new activities, prior to implementation or startup, to identify any hazardous material or waste concerns and ensure that any waste generated is factored into the life-cycle cost of the activity. This is a major step in avoiding many of the surprises that were encountered and described previously in this paper. Educational programs are still being refined to become more effective and will be modified as changes in the regulations dictate.
- Operations and waste management at the CMR Facility are gradually developing a stable working relationship as procedures are refined and as personnel become more familiar with facility needs and regulatory requirements. The need for additional waste management personnel has been identified; however, funding to support them has not been forthcoming. The NMT-7 Waste Management team has made great advances over the past 2 years. Patience and diligence will ensure that progress, however slow, continues.

## **SYNOPSIS**

Significant progress has been made toward establishing a stable and compliant waste management and environmental compliance program in the CMR Facility. A schedule and prioritization of activities will allow continuation of the progress at a rate defined by the funding allocated for waste management

activities. Completion of all standard work procedures was completed in December 1999, and progress can be made toward improving the efficiency of waste operations and achieving a more cost-effective operation. Emphasis will continue on generator education and the improvement of regulatory compliance. Success will be measured by 1) a drop in internal and external audit findings, and 2) when there are no more “surprises” from operations in the form of waste without a disposal path or requested variances to regulatory requirements and unanticipated extensions to environmental operating permits.

#### **REFERENCES**

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