

**FORMALIZATION OF WASTE MANAGEMENT PROGRAMS
IN SUPPORT OF THE CHEMISTRY AND METALLURGY RESEARCH FACILITY
AUTHORIZATION BASIS**

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ABSTRACT

The Chemistry and Metallurgy Research (CMR) Facility conducts analytical operations that are vital to the Stockpile Stewardship Program at Los Alamos National Laboratory (LANL). From 1952 to the early 1990s, this facility operated without a Safety Analysis Report (SAR) and bounded the risks associated with its diverse operations. An Interim Safety Analysis Report (ISAR) prepared in 1992, served until further guidance on SAR content could be provided to LANL by the U.S. Department of Energy (DOE). In 1998, a Basis for Interim Operation (BIO) and Interim Technical Safety Requirements were approved for use until the Technical Safety Reviews (TSRs) are finalized.

Neither the ISAR nor the BIO systematically addressed the risks and liabilities associated with waste management operations at the CMR Facility. In early 1997, waste management, along with other building operations, began to receive more visibility, and Special Work Permits (SWPs) were developed and progressively modified to govern waste management. The SWPs have been replaced with a current comprehensive plan, five Safe Operating Procedures (SOPs), and numerous Work Instructions (WIs). Their development is, in turn, governed by new Administrative Procedures that govern both the work control and new activity process at the CMR Facility.

The CMR Waste Management and Environmental Compliance Group (NMT-7) began to request approval from NMT-14, the Authorization Basis (AB) Team, for new activities. Upon evaluation, it was discovered that the BIO information was not sufficiently detailed to perform Unreviewed Safety Question Determinations (USQDs) for waste management activities. In fact, the BIO did not provide information on existing waste management activities, such as outside storage of low-level waste (LLW), storage of combustible waste in the wings, and movement and disposal of transuranic (TRU) and oversized TRU waste.

As operating experience accumulated, NMT-7 undertook a multipronged approach to update SWPs to keep operations current. This included preparing a comprehensive waste management plan; developing SOPs and supporting WIs; managing the current facility waste inventory; establishing a baseline for regulatory compliance; and training waste generators. The history of poor waste management practices at the CMR Facility and the lack of knowledge about where these operations fit into the BIO required the development of a Process Hazards Analysis (PrHA). This iterative analysis, developed as the CMR Facility's experience in waste operations accumulates, systematically examines the type, severity, and frequency of accidents that involve these operations at the CMR Facility and predicts their position in relation to the AB for the facility. To date, 60+ separate hazards that involve each type of waste generated at the CMR Facility have been identified. Accidents were postulated based on hazards identified within the PrHA. While no single accident challenged the AB, which translates consequence into off-site exposure to civilians, severe operational consequences could be predicted for accidents that are not bounding. These include wing and building shutdown, regulatory penalties from the state of New Mexico,

Compliance Orders from the DOE, and repercussions involving Appendix F measures in the DOE/University of California contract.

HISTORY AND BACKGROUND

Safety Analysis at the CMR Facility

The Chemistry and Metallurgy Research (CMR) Facility was constructed in 1952, to support the development of nuclear weapons with wet chemistry and nondestructive analysis. The largest facility at Los Alamos National Laboratory (LANL), the CMR Facility spans about 550,000 ft² and is composed of six laboratory wings on three floors connected by a spinal corridor.

For 40 years of its operational life, the CMR Facility operated without the benefit of a comprehensive safety analysis report (SAR) to describe a baseline operational envelope for the facility and provide a basis to accept operational risk. In 1992, a draft SAR was established as an acceptable “interim” document, but never obtained final approval. In 1995, because the interim SAR was still not approved, a Justification for Continued Operations (JCO) was completed that summarized CMR Facility accidents, including a bounding seismic event.

The concept of safety analysis as central to formality and conduct of operations at the CMR Facility remained poorly understood by both CMR Facility management and facility tenants. There exists a wide gap between the intellectual acknowledgement of the need for the definition of a safety envelope and the impact of that definition on day-to-day operations. The development of procedure hierarchy, formalization of operations, quality assurance, and the provision of objective evidence of compliance have resulted in widespread resentment of increased formality. Staff competence, credibility, ability to operate safely, and the physical capability of the facility to provide a compliant operational environment all seem to be called into question as a result of the formality initiative.

November 1996 Explosion and Fire

In November 1996, an explosion and fire in the CMR Facility that involved a mission that was critical to the Stockpile Stewardship Program at LANL focused the attention of LANL management and the DOE on CMR Facility operations. Inadequate implementation of changes mandated in the accident investigation report resulted in the facility being placed in shutdown status in September 1997. During the shutdown, the NMT Division took over CMR Facility operations, and a phased restart was accomplished during Spring 1998. Under NMT Division’s direction, an approved Basis for Interim Operations (BIO) was put in place in August 1998, and superceded the interim SAR and JCO. Interim Technical Safety Requirements (ITSRs) added in December 1998, are a subset of the TSRs and are deemed critical for the safe operation of the CMR Facility. As soon as TSR bases are developed and in place, the complete set of TSRs will be implemented for the facility.

In spite of these milestones, periodic accidents/incidents have occurred at the CMR Facility during the formalization process. These high-visibility occurrences are superimposed on a regular series of occurrences whose root causes include facility inadequacies, operator error, failure to follow procedure, or failure to employ the Integrated Safety Management (ISM) system. Regulatory pressure has simultaneously increased with RCRA compliance issues as a constant concern at the largest laboratory in the DOE Complex.

Waste Management Operations

Despite the high-visibility safety occurrences, waste management, along with some other essential facility operations, was never stood down. Instead, the equivalent of a hot restart was accomplished while waste operations supported operational laboratories and serious facility waste issues were addressed. This involved the compilation of four Work Authorization Packages (WAPs) in the areas of transuranic (TRU) waste, low-level waste (LLW), Resource Conservation and Recovery Act (RCRA) and mixed waste (LLMW), and recycle/salvage waste. By Spring 1998, each WAP was supported by SWPs, training records, lists of personnel authorized to perform work, formalization status, and a variety of information that was deemed necessary to ensure the DOE that operations were being conducted within the newly established safety envelope.

All activities planned for restart underwent a USQD before operation was authorized. NMT-AP-007, *Research, Development, and Process Work Control*, was issued to instruct staff who performed work in the CMR Facility of when to use an SOP, WI, or experimental plan. NMT-AP-006, *Use of Special Work Permits at CMR and TA-55*, outlined the conditions under which nonroutine work could be performed. CMR-AP-015, *CMR New Activity Process*, defined the method for initiating new activities at the CMR Facility after the process of initial startup was complete. This and all other work in the facility is reviewed and approved today by the CMR Facility Steering Committee.

METHOD

Assess and Prioritize

When the NMT Division assumed operation of the CMR Facility, waste management was in the process of developing a series of procedures and had just issued a draft waste management plan pursuant to a noted deficiency. The NMT-7 waste management staff grew immediately from four to 17 full-time personnel. A complete assessment of the status of issues facing the group was undertaken, and the compiled list was prioritized into those issues of immediate safety, regulatory concern, and mandatory work. The major waste issues facing NMT at the CMR Facility included the following:

- No waste shipments had been made in three years.
- Seventy-plus B-25 (4 x 4 x 6-ft) boxes were in outside storage.
- Of the 118 TRU waste drums in storage in the building, over one-half were mislabeled.
- LLW was creating a combustible loading hazard in the wings (ITSR violation).
- The attics were full of abandoned furniture and equipment that awaited recycle/salvage.
- Thousands of legacy chemicals awaited sorting and disposition.
- Waste originators were not trained to identify, segregate, minimize, and handle their waste.
- Liquid waste was being disposed without adequate controls.
- RCRA staging areas were inadequately managed.
- Waste management was inadequately treated in the SAR and TSR. USQ analysts were unable to determine whether a specific waste management activity fell within the bounds of the authorization basis.

Educate Building Occupants

Draft procedures that were under development when NMT-7 assumed operations were tabled in favor of training waste originators. Facility-wide training was undertaken, accompanied by the initial revision of CMR-SOP-007, *CMR Waste Management Requirements*, that had just been completed. SWPs were then developed for all waste management operations based on experience gained in the field. While revisions were required every 90 days, the influx of expertise represented by TA-55 personnel actually made these revisions advantageous. The old procedures, drafted before the arrival of NMT personnel, quickly became obsolete. The method used to establish an information base for SOPs was to revise the SWPs until the process for handling each type of waste matured. This method technically violated a procedure (SWPs should be reauthorized no more than three times) and, thus, required Division Director signature; however, the method did allow facility management to put in place administrative procedures that enabled the SOP development process to be uniform throughout the facility. These procedures included one for new activities, one for process and document control, and one for the uniform use of SWPs.

Establish Formality Baseline

As formality of waste operations developed, making USQDs became increasingly difficult because little information on the subject was included in the BIO. A Process Hazards Analysis (PrHA) was drafted in October 1997, to begin a dialogue with the AB Team (NMT-14) so that they could understand waste operations that were evolving in the CMR Facility. Process descriptions were developed for TRU, LLW, LLMW, and abandoned (legacy) materials that were known to be present. Eleven accidents that involved these materials were originally postulated. Further analysis was accomplished using a “what-if” hazards analysis (HA) technique that expanded on the types of accidents addressed in other operations (i.e., fire, flood, earthquake, explosion, spill, release, etc.). Observed or expected concentrations of waste were exposed to the hazard or fault, and the releases were calculated. These releases and their associated doses were compared to the releases reported in the BIO.

A PrHA was developed for waste management activities within the facility since the AB contains insufficient detail for USQDs, and it is necessary to ensure that CMR Facility waste management operations are performed safely. The PrHA did not become part of the CMR AB, but rather provides supporting documentation to the USQD analysis to perform analyses. The PrHA provides more detailed information than the BIO on the hazards that exist during waste handling. The PrHA was developed to document the potential hazards for current operations from which accidents could be derived and evaluated (see Table I). It was also developed to provide information to facility management regarding the impact of the hazard on the facility’s operational or regulatory status. For instance, a given hazard may not result in an accident, but could result in fines or other penalties for regulatory violations. Other hazards could result in a shutdown of one or more wings in the facility if ITSRs were violated.

The CMR Facility’s occurrence reporting system maintains records of facility occurrences, including off-normal events and Unusual Occurrences Reports (UORs). The system has maintained records at the CMR Facility since early 1991, that were reviewed to determine the total number of occurrences for each quarter versus the number of waste management-related occurrences. The events were compared against a facility timeline to show the impact of facility status, operational events, and formalization of the waste management process on the number of occurrences.

Table I. Summary of Potential Waste Management Accidents as Identified in the PrHA

Accident	Number of Scenarios Identified				Comments
	LLW	LLMW	TRU/TRU Mixed Waste	Hazardous Waste	
Releases or spills of radiological material	7	5	4	0	Includes dropping or breaching containers or other scenarios that may disperse radioactive materials
Toxic/chemical material release	0	5	4	11	Includes dropping or breaching containers or other scenarios that may release toxic materials
Waste Handling Errors	7	6	5	3	Includes human error events such as improperly sealing containers, improper packaging, and failure to perform NMT-7 activities. These scenarios may have more of a regulatory impact.
Fires	3	3	3	4	Includes ignition sources internal and external to the waste packaging. Considers localized fire, spread of fire to the area, and a wing-wide fire.
Overpressures	1	1	1	1	May result in failure of the primary container due to mixing of incompatible materials
Operational Events	1	1	1	1	Loss of ventilation and/or electric power events
Seismic	1	1	1	1	Design basis seismic event as provided in the BIO

Retrieve Records and Establish Integrated System

Waste management record keeping was inadequate since the facility became operational. In 1990, when occurrence reporting was instituted at DOE facilities, waste records and occurrence reports were examined for possible accidents at the CMR Facility that involved waste that might bound a release to the public, present a unique scenario or risk, or pose a high probability of occurrence.

The waste types gradually divided themselves, largely by accident consequence, into TRU/TRU mixed, LLW/LLMW, hazardous (RCRA) waste, and unknown waste. Combining each accident scenario with each type of waste generated more than 60 separate accident cases. Consequences for each case were compared to the bounding analysis in the BIO. In addition, regulatory and Occupational Safety and Health Act (OSHA) liabilities were addressed in the PrHA to ensure that facility management and the DOE were informed of waste activities and their potential liabilities.

Conduct a Formal Hazards Analysis

In conjunction with staff specifically assigned to maintain the existing AB for the CMR Facility, a draft HA was developed and updated as operational experience accumulated. More than 60 accident scenarios

were eventually developed in the latest draft HA. This information will enhance understanding of the tasks routinely performed at the facility, and promote acceptance of the validity of the AB.

RESULTS AND ANALYSIS

Unusual Occurrence Reports at the CMR

Figure 1 is a histogram showing the unusual occurrence reports (UORs) written each quarter at the CMR Facility between 1991, when the program began, and 1999. For discussion purposes, the UORs are divided into two periods: 1991–1995, and 1996–1999. This division corresponds roughly to the time when management of the facility came under increased scrutiny. Several interesting facts are highlighted by Figure 1, as follows:

- From 1991–1995, 156 UORs were prepared, 16 of which involved waste. This represents about 10 percent of the total over five years. The total number of UORs occurred at a rate of 31 per year. UORs where waste was an issue occurred in about 50 percent of the quarters (11 of 20).
- From 1996–1999, 149 UORs were prepared, 14 of which involved waste. This represents about nine percent of the four-year total. However, the UOR rate is much higher for these four years, with a rate of 37 per year.
- From 1996–1997, the CMR Facility was in stand-down for six months (two quarters) to bring all facility operations back up under Work Authorization Packages (WAPs). Waste UORs were spread more evenly, occurring in 10 of 16 quarters (63 percent) reported.

We have observed UORs involving waste occurring as a rate function of the overall rate of UORs. The overall rate of UORs should be lowered by an increase in formality of operations; however, this has not been evident in the CMR Facility data. This may be the result of an uneven development in formality throughout the CMR Facility user groups. A significant difference in the type of waste UOR shown in the 1991–1995 versus 1996–1999 period is that the earlier period involved spills or releases of waste materials by the waste originators during handling and documented room closure or personnel contamination, whereas the second period featured waste UORs that involved regulatory noncompliance, failure to have or follow procedures, or violation of RCRA.

As changes in the formality of waste management operations coincided with changes in the overall management of the CMR Facility, waste management was perceived as an “agent” of that change and was resisted by some. The overall UOR rate has not dropped in the facility partly because formality requires that all tenants comply to effect change. Some have been slower than others to adapt, thereby affecting facility performance.

Unreviewed Safety Question Determinations at the CMR Facility

A more positive trend has been seen in the USQs for waste management activities. Since the BIO scarcely mentioned waste management, it was difficult for the AB team to make a determination whether a specific waste management activity was new or existing. LLW, for instance, was not addressed in the BIO. A positive USQD was prepared, and a limit based on radionuclides in the waste and absolute tonnage was established based on a calculation of the off-site dose from a release.

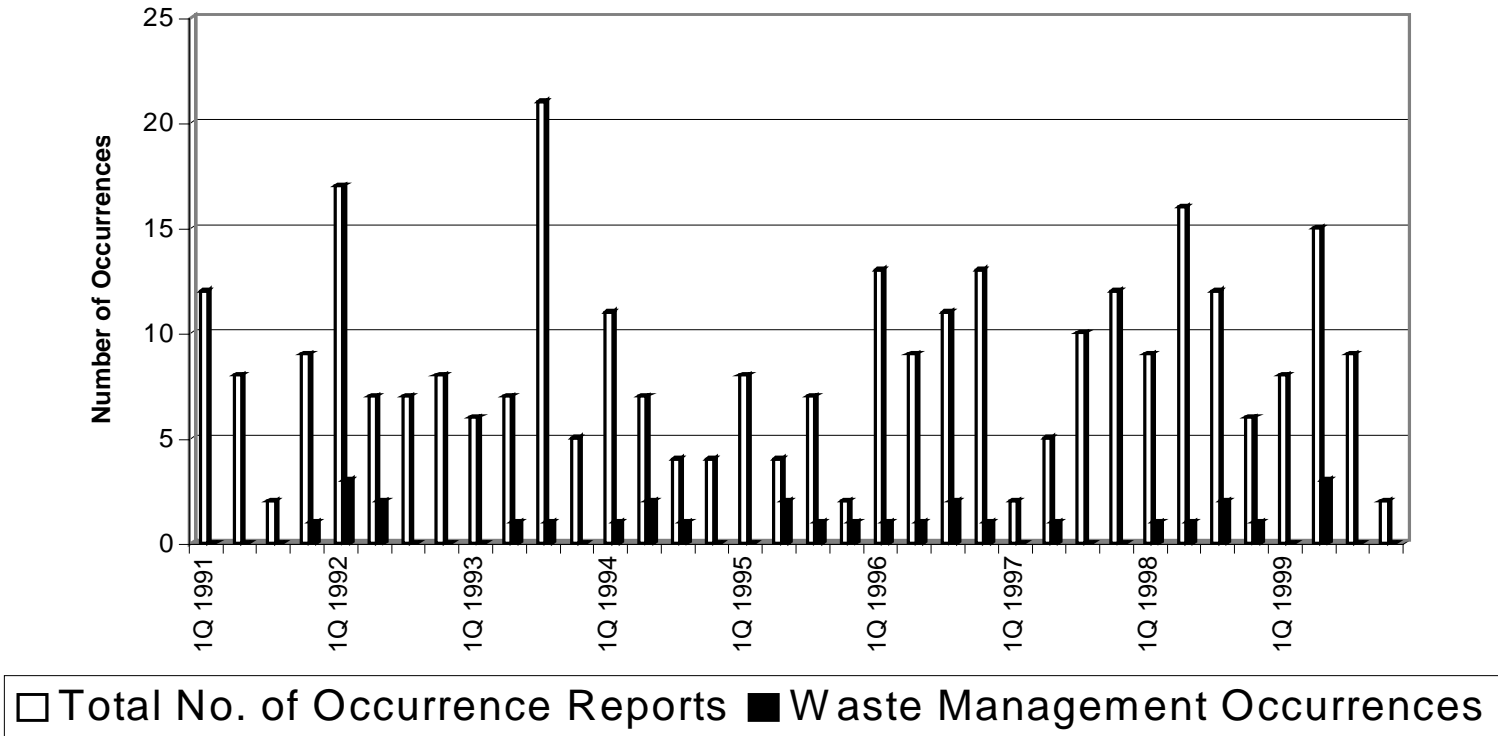


Figure 1. CMR Occurrence Reports (1991–1999)

A cursory review of the USQDs (including screens, negative, and positive USQDs) shows an increase in the total number of USQDs performed as a function of time, including an increase in USQDs that pertain to the waste management process. This increase reflects an increased awareness of waste management issues and formalization of the waste management process, especially in 1998 and 1999. It should, however, be noted that some of the increase could be attributed to significant changes to the USQD process over the years. The USQD process has evolved from evaluating facility process changes to including work control related changes (e.g., installing electrical circuits, remodeling rooms, etc.). Toward the end of 1998, the number of USQD screens was significantly reduced by a strict interpretation of DOE Order 5480.21, *Unreviewed Safety Questions*, regarding facility changes, although some categorical exclusion screening criteria have since been approved by the DOE.

Since then, waste operations has dedicated considerable resources to understanding the BIO and making allowances for its provisions. As shown on Figure 2, this has resulted in a steady downward trend of positive USQDs, even though the USQ screens have remained the same or greater with new procedures and activities.

How Do Waste Operations Become Part of the BIO?

How does one decide whether accidents in an operational area are included in the BIO? Does waste management have to be mentioned specifically? Do other operations merit specific mention in a BIO accident failure mode and effects analysis?

The BIO does not mention specific processes when discussing accidents and their consequences. Instead, the time-honored tradition of pitting the four elements of Greek Mythology—air, earth, water, and fire—against the facility matrix is used to see what consequences, if any, occur. The CMR Facility has few features unavailable to the Greeks in terms of withstanding high winds, earthquakes, flooding, and fire.

Essential systems, structures and components (SSCs) include stone walls, a roof, enough sense to build above the floodplain, enough luck not to have a bad earthquake, good containers, a ventilation system (ours is better), and quality (administrative controls or procedures).

Using the material at risk (MAR or ²³⁹Pu) and calculating a release fraction specific to the accident, an effect can be calculated, usually to an unsuspecting off-site individual. Calculating the worst-case scenario by the most MAR derives the “bounding accident,” or the worst-case scenario. If it is decided that this calculated consequence is too severe, then the analyst has two choices: make the building tougher, or change the test conditions.

In waste operations at the CMR Facility, the “conditions of the test” are managed by the use of good containers, distributing the MAR in diverse ways, keeping the combustible loading down, and moving waste materials out of the building to disposal on a regular basis.

Accidents in Waste Operations

A draft PrHA provides a list of supporting documentation that creates a framework for evaluation of future changes. It becomes necessary to develop a PrHA when details in the SAR or BIO are insufficient to make determinations using the USQD process.

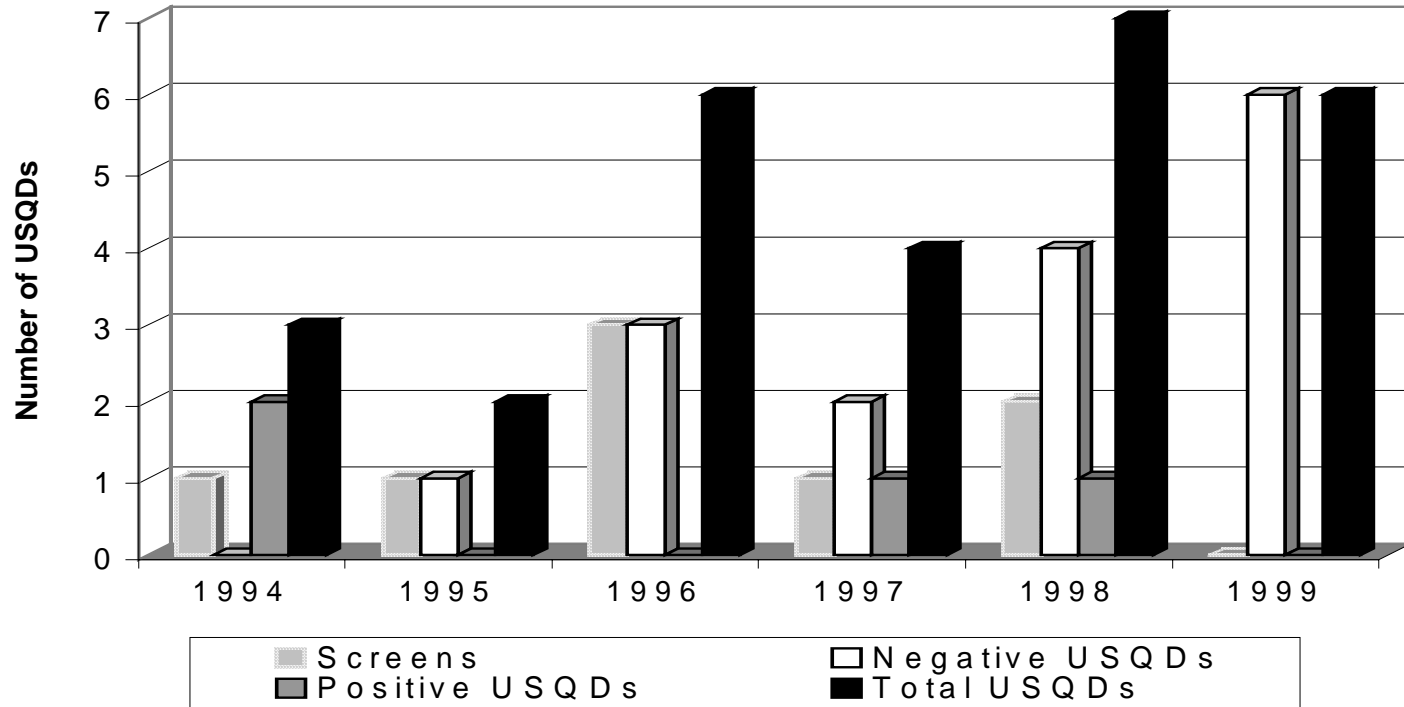


Figure 2. CMR Waste Management USQ Determinations

A draft PrHA identifies hazards associated with the waste management operations and provides a qualitative assessment of the risk associated with those hazards. Frequencies and consequences were assigned to each scenario according to the potential affects of the hazard on the local worker, the public, and the environment. Risk rankings of 1 through 4 were assigned to each scenario according to the frequency and consequence rankings. A ranking of 1 or 2 indicates unacceptable or undesirable risk. Preventative or mitigative controls are proposed for these scenarios to reduce the risk to an acceptable level. The table also identifies regulatory liabilities that may result from the incident and the impact on facility operations. Any scenarios not covered with the authorization basis are also identified. This analysis concludes that all waste management scenarios fall within the authorization basis.

Also included in the PrHA are references to waste management procedures and operations. These include specific procedures for activities, such as generator waste-handling activities and NMT-7 inspections. The end result of the PrHA is a document that lists all the waste-handling accident scenarios and the associated controls. The waste management procedures are provided throughout the PrHA as an indication of the formalization of these controls.

Accidents identified within the PrHA include radiological spills, fires, toxic chemical releases, and seismic events. The impacts of facility events, such as loss of electric power and loss of ventilation on the waste handling operations, are also included. The accidents with the highest risk rankings in the PrHA are high-frequency/low-consequence scenarios, such as the breach of a LLW inner package during re-packaging in Wing 4. These scenarios are for operations that occur frequently, but generally only have consequences to the worker.

The draft PrHA results' focus is a contrast to accidents evaluated within the BIO. The BIO focuses on accidents with high public consequence, although they may be relatively low-frequency events. The PrHA may be instrumental in helping facility management to identify more clearly those accidents that may contribute the most to risk, but are not specifically analyzed within the BIO. The PrHA is an important risk management tool to the facility and can place facility controls on accidents that are more likely to occur, even though the consequence to the worker or public might not be significant. Significant risks to facility operational status, or of regulatory violations, which are liabilities not addressed in the BIO, were formally documented.

Three accidents that involve wastes are analyzed within the BIO: a CMR TRU waste fire, a fire in a LLW storage area, and a spill involving a Type-A WIPP drum. For the CMR TRU waste fire accident, the BIO assumed that up to 1,000 grams of Pu²³⁹-equivalent material resided as TRU waste within a wing. Table II summarizes these accidents and several design-basis accidents that affect waste. A fire large enough to affect the containers was assumed to occur only if the wing combustible loading limit had been exceeded and the fire protection and suppression systems failed. The resulting likelihood was estimated to be between 1E-02 and 1E-04/yr (i.e., Category III). The consequences of such a fire were evaluated based on the 1,000 grams of MAR and associated Airborne Release Fractions (ARFs), Respirable Fractions (RFs), and Leak Path Factors (LPFs). As a result, the bounding consequence to the public was 3.6 rem cumulative effective dose equivalent. This translates to a public consequence "B" (i.e., long-term health effects). Although not specifically evaluated in the BIO, the worker consequence from a fire could be "A" due to the possibility that the worker could be killed in the fire. The overall risk ranking of this accident is, therefore, a "2," which is undesirable and should be mitigated to a risk rank "3."

Table II. Relative Risk of BIO and Waste Management Accidents

Accidents	BIO Frequency	BIO Public Consequence	Waste Mgmt Frequency	Waste Mgmt Public Consequence	Bounded by BIO?
<u>Fires</u>					
BIO - Unfiltered medium wing wide fire (bounding)	IV	A	IV ¹	A ¹	Yes
TRU Waste Fire	III	B	III	D	Yes
LLW Fire	III	C	III	D	Yes
<u>Explosions</u>					
BIO - Bounding Explosion Overpressure due to chemical reaction	IV	A	IV	C	Yes
<u>Radiological Spills</u>					
BIO - Bounding Spill	I	C			
BIO - Spill of Type-A WIPP Drum	I	C	I	D ²	Yes
Spill during Waste Handling			I	D	Yes
<u>Toxicological Spills</u>					
BIO - Bounding Spill	III	B			
Spill during Waste Handling			I	D	Yes
<u>External Events</u>					
BIO - Bounding Seismic Event	IV	A	IV ¹	A ¹	Yes

- [1] Waste management activities are performed in accordance with the wing MAR limits. The consequences of this accident as analyzed in the BIO would not be increased by these activities. Facility protective features are also not altered as a result of any waste management activities.
- [2] Waste management allows drums to be repackaged in Wing 4, which has a MAR limit of 200g Pu²³⁹ grams equivalent material. Drums brought into this wing would not contain more than this amount of MAR. The BIO assumes that the drum may contain over 700 grams Pu²³⁹, which accounts for the higher BIO consequence.

Frequency Categories:

- I – 1/yr to 0.1/yr
- II – 0.1/yr to .01/yr
- III – 1E-02/yr to 1E-04/yr
- IV – 1E-04/yr to 1E-06/yr
- V - less than 1E-06/yr

Consequence Categories (Public):

- A – Immediate health effects
- B – Long-term health effects
- C – Irritation or discomfort but not permanent health effects
- D – No significant off-site impact

Similar analyses were performed in the BIO for the accidents involving a LLW Fire and Spill from Type A WIPP Drum. The LLW fire accident yielded Category III frequency and a consequence ranking of “C” for the public and “A” for the worker. The risk ranking for this accident was also “2.” The Spill from Type A WIPP Drum accident yielded a Category I frequency (i.e., between 0.1 and 1 per year). The consequence ranking for the accident was “C” for the public and “C” for the worker. This also resulted in a risk ranking of “2.”

A fire analyzed in the waste management draft PrHA is assumed to occur in Wing 4, where centralized waste management operations are performed. A fire large enough to involve the waste containers in the area is assigned a Category III frequency, which is consistent with the analysis in the BIO. Less radiological material would be involved in the fire (due to the wing MAR limit of 200 grams), resulting in a consequence of “D” to the public and “A” to the worker. The overall risk ranking of “2” is consistent with the BIO. It should be noted that other waste management draft PrHA scenarios would result in the same consequences as those analyzed within the BIO due to the higher MAR limits that exist in other areas of the CMR Facility.

For spills, the draft PrHA to BIO consequence comparison is inconsistent since the entire Wing 4 limit is 200 grams of Pu²³⁹-equivalent material. The BIO assumes a 5,000-gram Wing inventory. The TRU waste drums that are entered into the wing would contain significantly less than 200 grams of MAR (the actual historical maximum is six grams in one drum) to prevent the wing limit from being exceeded. However, the frequency of a spill in the PrHA is consistent with the BIO in that it is a Category I frequency event. Since the consequences of the draft PrHA scenario would be less (ranking of “D” to the public and “C” to the worker), the overall risk ranking for the PrHA scenario is “3.” Here again, draft PrHA scenarios for other areas of the CMR Facility would result in the same consequences as the BIO since the MAR limits in other areas are higher.

The risk rankings between the BIO and PrHA (draft) are fairly consistent for accidents that appear in both documents. Several more scenarios identified within the draft PrHA are high-frequency/low-consequence events with an overall risk ranking of “2.” For example, a release could occur during repackaging of TRU waste containers within Wing 4. Since an error during repackaging is largely caused by human error, the likelihood of failure is high (Category I frequency), but the consequences remain low (public consequence “D” and worker consequence “C”). This scenario has the same risk ranking as the “Spill of Type A WIPP Drum” evaluated within the BIO, but the controls are not elevated to the level of those accidents postulated within the BIO. Using a tool like the draft PrHA, CMR Facility management can be informed of high-risk scenarios that would allow them to evaluate the effectiveness and/or need for controls established in the BIO for accidents of similar type.

Other PrHA scenarios evaluate the likelihood of shutting down a wing or violating a regulatory requirement by incorrectly performing procedures or procedure steps (see Table III). For example, packaging mixed LLW as TRU mixed waste would result in a RCRA violation. Although this scenario does not result in a consequence to the worker or the public, it could have the same operational impacts as a fire or spill within the facility if the wing is shut down. This results in extra efforts to restart a wing or comply with regulatory requirements that involve facility resources. The draft PrHA is an effective tool for use in identifying these regulatory or operational problems and addressing them before they become a reality.

Table III. Programmatic and Regulatory Impacts Possible in Various CMR Event Scenarios

	Programmatic Impact	State/Price Anderson Liability
Risky Behavior	Shutdown of operation/wing under DOE order 5480.19	State is involved with RCRA issues, Negligence mandates Price Anderson
Near Miss	Shutdown of operation/wing under DOE Order 5480.19	Same as above
Fire (as described in Table II)	Shutdown of affected area	State and Price Anderson implications
Rad Spill/Release (Table II)	Addressed in BIO/	Price Anderson implications
Waste Handling Error	Shutdown of operations	State and Price Anderson Implications
Toxic Chemical or Material Release	Operations shutdown	State and Price Anderson Implications
Container Overpressure	Operations Shutdown and Review	N/A
Other Operational Event	Operations Shutdown and Review	State and Price Anderson Implications
Seismic	N/A	N/A

Formality should reduce liability; however, deliberate noncompliance can increase penalties and the perception of deliberate, “at-risk” behavior. Providing management visibility to risks of shutdown that are well below the bounding accident threshold should reduce the likelihood of waste management occurrences and regulatory noncompliance.

Formality: Plan, SOPs, and WIs

Appendix A lists, in order of hierarchy, the documents that have been developed to govern waste management operations at the CMR Facility. It is no accident that the majority of these documents are revision zero or one in 1998–1999. This list is an example of the type of system that should be in place for a nonreactor nuclear facility in every area of operations.

While starting from scratch with a document hierarchy has the advantages of continuity and clear scope definition, imposing a new program on an entire facility has drawbacks. Tenants are unfamiliar with the concepts that govern formality of operations. The sudden (as opposed to gradual) change is an onerous one and, to the tenant, holds little apparent meaning or value. Tenants perceive safety and effectiveness in their day-to-day operations; imposing a new system seems unnecessary. Informing them of “new requirements” or a “change in the way we do business” seems unnecessary and unfair. Retirements, increased turnover, and poor morale are coincident to this type of change.

Nonetheless, the procedures and PrHA have, together, given NMT-7 a thorough working knowledge of CMR and a path forward that has the understanding of the customer and the support of management. The framework of documents is designed to survive the end of the CMR Facility operational life and serve as the basis for waste management operations in its replacement.

NMT-13 provided two important documents that allowed movement from WAPs to SOPs in NMT-7: NMT-AP-007, *Research, Development, and Process Work Control*, and NMT-AP-015, *CMR Activity Approval Process*. NMT-AP-015 also requires that all new activities predict wastes that will be generated.

CONCLUSIONS

The PrHA and procedures and have provided an adequate understanding of waste management operations as they exist today in the CMR Facility. The process of USQDs instituted in the facility provides a dynamic check that ensures that new procedures are in balance and supports the current AB. WIs and experimental plans place the responsibility for staying within the SOP AB in the hands of the line manager where it belongs.

New activities are reviewed and formalized by a steering committee, which represents the affected groups in the facility, as well as building management.

Waste management at the CMR Facility has developed a completely integrated system and has less likelihood that a change will be evaluated that will cause the customer to react and shut down the facility. There is less likelihood of a shutdown through a waste management Potentially Inadequate Safety Analysis (PISA). Positive USQDs are much less likely to be generated. Real problems, like unknowns, are much easier to pick out of the maze of waste management issues.

We can be proactive with the DOE. Our goal is to stop the cycle of precipitous shutdowns due to the fact that we have been unable to adequately describe our waste management (and other) operations in a way required by the DOE orders that we are committed to follow.

In a practical way, formalization of operations decreases the number of risky behaviors in the facility by ensuring that work instructions exist and training is current. By narrowing the base of the risk pyramid (risky behavior), the area (frequency) of all the events above it (including near-misses, minor accidents) and major accidents are also made smaller. Since even minor accidents can result in closure of a wing and severe repercussions from the customer, formalization is a real necessity.

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1. LANL, *Interim Safety Analysis Report for the CMR Facility*, Los Alamos National Laboratory, March 1992.
2. LANL, "Justification for Continued Operation of the Chemistry and Metallurgy Research Building," CMR-FAC-92-194, Rev. 1, Los Alamos National Laboratory, January 1995.
3. "CMR Basis for Interim Operations" (BIO), LA-CP-98-142, Rev. 1, Los Alamos National Laboratory, 1998.
4. "Management Evaluation Report for the Chemistry and Metallurgy Research (CMR) Facility Basis for Interim Operations (BIO)," LAM: 3DG-030, transmitted by letter from Daniel E. Glenn (DOE) to R. Bruce Matthews (LANL), August 31, 1998.
5. "Control and Execution of CMR Safety System LCOs and Surveillances," ITSRs, NMT13-TSR-002, R1, Los Alamos National Laboratory, February 1, 2000.

6. “Approval of CMR Facility Interim Technical Safety Requirements (ITSRs),” LAM: 3CS-020, memorandum by David A. Gurulé (DOE), December 11, 1998.
7. “Research, Development, and Process Work Control” NMT-AP-007, Nuclear Materials Technology Division, Los Alamos National Laboratory, March 13, 1999.
8. “Use of Special Work Permits at CMR and TA-55,” NMT-AP-006, Rev. 0, Nuclear Materials Technology Division, Los Alamos National Laboratory, March 13, 1999.
9. “CMR Activity Approval Process,” CMR-AP-015, Rev. 0, Nuclear Materials Technology Division, Los Alamos National Laboratory, March 13, 1999.

APPENDIX A

Document Hierarchy Supporting Waste Management Operations At the CMR Facility

1.0 DIVISION LEVEL DOCUMENTS

- 1.1 NMT-DIV Generator Waste Certification Program; **DRAFT**
- 1.2 NMT-DIV Quality Management Plan; **NMT-OLA-001, R0; 1/25/99**
- 1.3 NMT-DIV Document Control; **NMT-AP-001, R0.1; 1/20/99**
- 1.4 NMT-DIV Writer’s Guide; **NMT-AP-002, R0; 1/6/99**
- 1.5 NMT-DIV Records Management; **NMT-AP-003, R0; 12/15/98**
- 1.6 NMT-DIV Occupying or Vacating Workspace; **NMT-AP-005, R0; 3/30/99**
- 1.7 NMT-DIV Research, Development, and Process Work Control; **NMT-AP-007, R0; 3/13/99**
- 1.8 NMT-DIV Operating Experience Review Program; **NMT-AP 009, R0; 4/7/99**
- 1.9 NMT-DIV Receipt Acceptance of Items and Materials; **NMT-AP-011, R1; 4/14/99**
- 1.10 NMT-DIV Quality Assurance Procurement Guidelines; **NMT-AP-013, R1; 5/11/99**
- 1.11 NMT-DIV Controlling Nonconforming Items, Processes, Services, and Document; **NMT-AP-018, R0; 9/3/99**
- 1.12 NMT-DIV Walk-around; **561-GEN-R03; 7/14/98**
- 1.13 NMT-DIV Audit and Assessment Protocol; **575-GEN-R00; 8/7/98**
- 1.14 MT-DIV Issues Management Program; **NMT-10-PED-111-02-02.0; 8/6/98**

2.0 FACILITY LEVEL DOCUMENTS

- 2.1 **CMR-BIO Chapter 2 – Facility Description and Operation; 8/27/98**
- 2.2 **CMR Waste Management and Environmental Compliance Plan; CMR-PLA-001, R4; 7/23/99**
 - 2.2.1 LANL Course Number 15233 provides training to this plan

- 2.3 **CMR Waste Management Requirements; CMR-SOP-007, R1; 10/26/99**
 - 2.3.1 LANL Course Number 15233 provides training to this plan
- 2.4 **CMR (FMU 65) Facility Safety Plan; CMR-PLAN-028, R0; 9/23/99**
- 2.5 **CMR Operations Standing Order; LTSO-99-02; 1/20/99**
- 2.6 **CMR Radiation Protection Requirements; CMR-SOP-555, R1; 9/20/99**
- 2.7 **CMR New Activity Approval Process; CMR-AP-015, R2; 9/11/99**

3.0 GROUP LEVEL DOCUMENTS

3.1 Group Wide Documents

- 3.1.1 NMT-7 Organization Chart
- 3.1.2 NMT-7 Interface Working Agreement; NMT-PLA-001, Appendix F, R1
- 3.1.3 NMT-7 Waste Records Management; WM-TA55-RM, R1; 6/2/99
- 3.1.4 NMT-7 Calibration and Measurement Control; WMEC-PED-105-12, R0.1; 4/13/99
- 3.1.5 NMT-7 Control of Nonconformances; WMEC-PED-105-15,
- 3.1.6 NMT-7 Corrective Action Reports; WMEC-PED-105-16,
- 3.1.7 NMT-7 Surveillance/Self-Assessment Plan; WMEC-PED-105-18, R0.1; 5/25/99
- 3.1.8 NMT-7 Training Requirements; WM-TA55-TR, R00.1; 7/7/98

3.2 Low-Level Waste Procedures and Work Instructions

- 3.2.1 Low-Level Radioactive Waste; NMT7-SOP-CMR-010, R0; 9/29/99
 - 3.2.1.1.1 LLW Inspections and Storage; NMT7-WI1-SOP-CMR-010, R0; 9/28/99
 - 3.2.1.1.2 Preparing and Transporting Compactible LLW Boxes; NMT7-WI2-SOP-CMR-010, R0; 9/28/99
 - 3.2.1.1.3 Packaging and Transporting Noncompactible LLW; NMT7-WI3-SOP-CMR-010, R0; 9/28/99
 - 3.2.1.1.4 Assay and Shipping Coordination; NMT7-WI4-SOP-CMR-010, R0; 9/28/99
 - 3.2.1.1.5 Sorting, Segregating, and Re-packaging Waste Containers; NMT7-WI5-SOP-CMR-010, R0; DRAFT

3.3 TRU Waste Procedures and Work Instructions

- 3.3.1 Processing TRU Waste Generated at the CMR Facility; NMT7-SOP-CMR-008, R0; DRAFT
 - 3.3.1.1.1 Managing TRU Waste and TRU Mixed Waste at the CMR Facility; NMT7-WI1-SOP-CMR-008, R0; DRAFT
 - 3.3.1.1.2 Managing Oversize TRU Waste at the CMR Facility; NMT7-WI2-SOP-CMR-008, R0; DRAFT
 - 3.3.1.1.3 TRU Waste Container Preparation; NMT7-WI3-SOP-CMR-008, R0; DRAFT

3.4 Sanitary, Salvage, and Recycle Procedure

- 3.4.1 Preparation, Packaging, and Disposal of Sanitary, Recycle, and Salvage Materials from CMR; NMT7-SOP-CMR-019, R0; DRAFT

3.5 RCRA and TSCA Procedures and Work Instructions

- 3.5.1 RCRA and TSCA Waste Storage and Disposal; NMT7-SOP-CMR-011, R0; DRAFT
 - 3.5.1.1.1 Storage Area Inspections; NMT7-WI1-SOP-CMR-011, R0; DRAFT

- 3.5.1.1.2 Satellite Accumulation Areas; NMT7-WI2-SOP-CMR-011, R0; DRAFT
- 3.5.1.1.3 <90 Day Storage Areas; NMT7-WI3-SOP-CMR-011, R0; DRAFT
- 3.5.1.1.4 Universal Waste Area; NMT7-WI4-SOP-CMR-011, R0; DRAFT
- 3.5.1.1.5 Treatment, Storage, and Disposal Areas; NMT7-WI5-SOP-CMR-011, R0; DRAFT
- 3.5.1.1.6 Polychlorinated Biphenyl Waste Storage Area; NMT7-WI6-SOP-CMR-011, R0; DRAFT
- 3.5.1.1.7 Asbestos Waste Storage Areas; NMT7-WI7-SOP-CMR-011, R0; DRAFT
- 3.5.1.1.8 [Place-holder for Unknowns]

3.6 Waste Assay Procedures and Work Instructions

- 3.6.1 CMR Waste Characterization Using Portable Gamma Spectroscopy Systems; NMT7-SOP-CMR-001, R0; 5/18/99
 - 3.6.1.1.1 Analysis of Gamma Spectroscopy Data Collected with the PGT Gamma Spectroscopy System; NMT7-WI1-SOP-CMR-001, R0; 5/18/99
 - 3.6.1.1.2 Calibrating the PGT Gamma Spectroscopy System and Establishing the QA Acceptance Criteria; NMT7-WI2-SOP-CMR-001, R0; 5/18/99
 - 3.6.1.1.3 Operation of the PGT Gamma Spectroscopy System; NMT7-WI3-SOP-CMR-001, R0; 5/18/99
 - 3.6.1.1.4 Setup, Maintenance, and Disassembly of the PGT Gamma Spectroscopy System; NMT7-WI4-SOP-CMR-001, R0; 5/18/99
- 3.6.2 CMR Box Counter (MADAM II) Operation and Calibration; CMR-SOP-022, R01; 7/99
- 3.6.3 Operating the WAF Segmented Gamma Scanner for SNM and Waste Assay; CMR-SOP-021, R01; 12/8/97

3.7 Other Applicable Documents

- 3.7.1 CMR Facility Transuranic Waste Interface Document; NMT7-AP-CMR-018; DRAFT