United States Government **Department of Energy**

# memorandum

**Albuquerque Operations Office**
**Los Alamos Area Office**
**Los Alamos, New Mexico 87544**

**DATE:** MAR 2 1 2000

**REPLY TO ATTN OF:** SABT:3CS-034

**SUBJECT:** Departmental Approval of Mosler Record Safe Model 308030 for CMR Containerization Program

**TO:** Timothy George, Division Director, NMT-DO, LANL, MS-E500
ATTN: Eric Ernst, Facility Manager, NMT-13, LANL, MS-G746
Derek Gordon, Senior Safety Analyst, NMT-14, LANL, MS-E578

My office and DP-45 have reviewed the CMR Containerization Program Engineering Evaluation provided by your March 9, 2000 memorandum to me (Attachment 1). Based on this review, the Mosler Record Safe Model 308030 is approved for implementation at CMR per the requirements of the Facility Basis for Interim Operations (BIO), CMR White Paper, and the Management Evaluation Report (MER) commitments. The Engineering Evaluation, including Mosler UL Qualification Testing, provides sufficient information to support the conclusion that material contained within these safes should be protected in the event of the Design Basis Earthquake and fully meets the intent of the authorization basis requirements. Additionally, the information supports your conclusions that these safes also possess characteristics to protect the material in the event of a fire at CMR.

The projected completion dates for the activities associated with executing the CMR Containerization Program were also reviewed and are acceptable as conditions of approval to be implemented by the dates listed on the attachment. You are required to brief the CMR Facility Representative once you have completed Activities 6 and 7, and upon completion of the activities associated with MAR inventory software and the procedures governing use of the safes regarding MAR storage.

Given the low unit cost of the Mosler Record Safe Model 308030, we recommend that consideration be given to procurement of one or two additional safes to execute rapid deployment in the event that additional locations are identified by NMT-13 for material protection within a safe.

Should you have any questions regarding this approval, please contact Jeff Kimball of DP-45 at (301) 903-6413, matrix staff support to LAAO, or contact me at 667-3418.

Tim, this report sets the excellent and standard for quality in the context [illegible]
Chr

Christopher M. Steele
Senior Authorization Basis Manager

Attachment

cc:
See page 2

cc w/attachment:
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D. Chung, DP-45, HQ
J. Kimball, DP-45, HQ
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**ATTACHMENT 1**

# Los Alamos National Laboratory

***CMR Facility Management Group***
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To/MS: Chris Steele, DOE-LAAO, A316
From/MS: Eric Ernst, NMT-13, G746
Phone/Fax: 7-3501/5-8729
Symbol: NMT13:00-009
Date: March 9, 2000

**SUBJECT: CMR CONTAINERIZATION PROGRAM**

In accordance with condition of approval #7 of the Management Evaluation Report, please find the attached Containerization Program Engineering Evaluation Report for your approval. Based on the findings of the engineering tests and analysis, Mosler Record Safe Model 308030 is recommended for implementation at CMR. Upon approval, NMT-13 will complete the following activities as part of container implementation:

| Activity | Projected Completion |
|---|---|
| 1. Identification of number of safes required | March 9, 2000 |
| 2. Procurement of safes from Mosler | June 8, 2000 |
| 3. Develop Design Change Packages for modifications to wing vaults (shelf removal) to enable safe installation | June 8, 2000 |
| 4. Conduct wing vault modification work | June 8, 2000 |
| 5. Obtain ESH-6 criticality safety review | June 8, 2000 |
| 6. Ensure compatibility of MAR inventory software with safe use | June 8, 2000 |
| 7. Develop requirements governing MAR storage in safes | June 8, 2000 |
| 8. Conduct safe preparation (wheel removal, shelf setup, etc.) and install safes in wing vaults | July 27, 2000 |
| 9. Store MAR in safes | July 27, 2000 |

In addition, NMT-13 conducted further analysis of MAR quantities and locations to determine if implementation of safes in areas other than wing vaults would be feasible. Using 300 g $^{239}Pu$ equivalent as the minimum threshold level (anything below this level was not considered), an analysis of MAR quantities in locations other than wing vaults indicated that the following areas were candidates for use of Mosler Record Safes:

**ATTACHMENT 1**

| **MAR LOCATION SUMMARY** | | |
|---|---|---|
| ***Location*** | ***MAR (grams $^{239}$Pu equivalent)*** | ***Activity*** |
| Wing 7/PS | 913 | Plasma Spectroscopy |
| 9010 | 645 | WIPP/STTP |
| Wing 5/PA | 599 | Pu Assay |
| Wing 3/SM | 485 | Sample Management |
| S007 | 310 | Waste Assay |

Reviews of each potential area/activity and interviews of process owners were conducted to determine whether Mosler Record Safe usage was feasible. Results are as follows:

- MAR associated with the Waste Assay and WIPP/STTP processes is contained in 55-gallon drums and stainless steel drums, which cannot be stored in safes. Therefore, safe use in these areas is not feasible.

- The majority of MAR associated with Plasma Spectroscopy, Sample Management, and Pu Assay cannot be readily stored in Mosler Record Safes without significant impact on the processes. That amount of MAR, which can be readily stored in a Mosler Safe, can be moved to the safes located in wing vaults, rendering safe use in these process areas unnecessary.

Based on the results of this analysis, Mosler Record Safes will initially be placed in wing vaults. As the facility gains experience in the use and application of the safes, other areas for safe use may be identified. Safe use in these areas will be addressed on a case-by-case basis. If there are any questions, please call me. Thank you.

**Cy:**
Jeffrey Kimball, DP-45
Joe Houghton, DOE-LAAO, A316
Veronica Martinez, DOE-LAAO, A316
Derek Gordon, NMT-14, E583
Scott Dick, NMT-13, G746
NMT-13 Information Management

# CMR CONTAINERIZATION PROGRAM
# ENGINEERING EVALUATION

## Introduction

In accordance with the DOE Management Evaluation Report (MER) Condition of Approval #7, CMR developed a Material at Risk (MAR) Containerization Program Plan. The major objective of the program is to strive to reduce off-site dose consequences during seismic events to below the evaluation guideline for the Maximally Exposed Off-site Individual (MEOI). Additionally, the program must weigh the competing factors of MAR reduction for seismic events against potential increased MAR dispersion due to pressurized containers in fire scenarios. In support of this program, CMR conducted an engineering evaluation and selected a container technology for implementation.

## Container Technology Characteristics

Consistent with the program objective stated above, the facility developed a set of desired characteristics to guide the evaluation and selection of container technologies. These characteristics are as follows:

- Thermal Resistance: The container must possess at least a 2-hour fire resistance rating to withstand the thermal effects of the 2-hour design basis fire and protect internal contents.
- Seismic Robustness: The container must demonstrate resistance to the effects of a seismic event (i.e., drop, crush, puncture).
- Pressurization: The container must balance the ability to withstand the effects of seismic events against over-pressurization during fires, which could cause dispersal of contained materials.
- Utility: The container must be able to fit in selected areas of laboratory operating wings while meeting floor-loading criteria, and must provide easy access for storage and retrieval of materials by user groups.

## Qualitative Assessment

The facility conducted a qualitative assessment to identify container technologies to undergo further engineering tests and evaluation. Specific activities supporting the qualitative assessment are described below.

### MAR Analysis

An analysis of MAR quantities and locations was performed to identify areas where containerization implementation would provide the maximum benefit. A summary of MAR quantities and locations is provided in the following table.

**Table 1**

| MAR LOCATION SUMMARY | | |
|---|---|---|
| ***Location*** | ***MAR (grams $^{239}$Pu equivalent)*** | ***Activity*** |
| Vault 3S | 1882 | Storage |
| Vault 7S | 1108 | Storage |
| Wing 7/PS | 913 | Plasma Spectroscopy |
| Vault 5S | 854 | Storage |
| 9010 | 645 | WIPP/STTP |
| Wing 5/PA | 599 | Pu Assay |
| Wing 3/SM | 485 | Sample Management |
| Vault 3N | 423 | Storage |
| S007 | 310 | Waste Assay |
| Wing 5/MS | 210 | Mass Spectrometry |
| 3111S | 207 | Sample Management |
| Wing 3/RC | 144 | Radiochemistry |
| Wing 7/XA | 121 | X-ray Analysis |
| 3117N | 118 | Sample Management |
| Vault 2N | 104 | Storage |
| Vault 5N | 95 | Storage |
| Wing 7/MS | 90 | Mass Spectrometry |
| 9020 | 26 | Storage |
| Wing 7/SA | 26 | Satellite Accumulation |
| Wing 7/P7 | 22 | Storage |
| 3113E | 17 | Sample Management |
| **Total MAR** | **8398** | |
| ***MAR in Wing Vaults*** | ***4466*** | ***(100 % Containerizable)*** |
| **Total MAR After Containerization** | **3932** | |

The analysis, which is derived from weekly surveillance results, indicates that approximately a 4.5-kg reduction in total MAR can be obtained through containerization of inventories located in wing vaults (shaded areas). Containerization in wing vaults provides the facility the capability to achieve a significant reduction in total MAR inventory through container deployment in relatively few areas. Therefore, wing vaults were designated as the primary target area for the containerization program. However, containers are not limited to wing vaults and will probably be used in other locations as well.

Technology Screen/Selection

Given that wing vaults were designated as the target area for containerization, the remainder of the qualitative assessment focused on identifying an optimal container technology for these areas. A combination of interviews with programmatic user groups and reviews of manufacturer product information were used to identify a container technology for further engineering evaluation. Based on the results of interviews and information reviews, the Mosler Record Safe (Model 308030) was selected. Manufacturer product information on construction and destructive testing indicated that this type of safe was robust and had the greatest potential to demonstrate desired characteristics during engineering tests. Manufacturer construction and destructive testing descriptions are provided below.

Mosler Record Safe Construction

Record safes consist of two metal shells, one placed inside the other leaving a large gap in between. Insulating material composed of gypsum or a cement vermiculite binder mix is poured between these shells during manufacture and allowed to set. A bottom plate is then welded into place. Safe doors are constructed in a similar manner. The doorjamb has a labyrinth pattern and is sealed when closed so that neither radiant heat nor convection heat can enter via this pathway. Doors are maintained closed by a latching/locking device that engages all sides of the main container structure.

Mosler UL Qualification Testing

The selected Mosler Record Safe possesses a UL Label of "350-2". Records safes with this classification possess the following capabilities:

- Prevent the temperature of safe contents from rising above 350$^{B}$F during a 2-hour exposure period at 1850$^{B}$F and subsequent cooling-off period, where the safe absorbs the heat from the refractory furnace lining until the entire mass cools.
- The safe will not explode if suddenly exposed to a rapid heat rise up to 1850$^{B}$F.
- After falling 30 feet onto a concrete floor, the safe will remain intact to protect contents.

In order to demonstrate these capabilities, Mosler conducts a series of UL qualification tests. UL qualification tests are designed to simulate a major fire where the heat builds up gradually to 1850$^{B}$F, and where the safe might fall several stories through burned out floors to the basement. Additional tests simulate a circumstance where the safe might drop into a fire while cold. If the safe is not well designed or improper insulating materials are employed, gases generated by the sudden increase in temperature might produce pressures great enough to rupture one of the safe's steel shells, thus destroying its fire resistance. UL testing procedures conducted by the manufacturer are described below.

The record safe is subjected to thermal testing as follows:

1. A sample safe is wired with thermocouples sealed inside the safe at six specified locations so that the interior temperature can be recorded continuously during the tests. Papers, which simulate records, are also placed inside.
2. The safe is locked, placed in a furnace, and heated for 2 hours, during which time; the furnace reaches a maximum temperature of 1850$^{B}$F.
3. The furnace heat is turned off and, without opening the furnace door, the safe is allowed to cool. This procedure is called the "bake-out". Recording of the temperature inside the safe

is continued until a definite drop is noted. The interior of the safe must not exceed 350$^{B}$F at any time.
4. Once the safe cools to room temperature, it is opened and examined. If the papers are legible and not charred and the interior surface and locking mechanism are in good shape and show not visible signs of undue heat transmission, the safe is given a passing grade for “fire endurance” for the 350-2 classification.

Next, Explosion Hazard/Impact tests are conducted. These tests are conducted as follows:

1. Another sample safe of the same design is selected. Papers, which simulate records, are placed inside and the door is locked. No internal heat sensing equipment is installed.
2. The safe is placed in a furnace that is pre-heated to 2000$^{B}$F. This temperature is maintained for 30 minutes. If an explosion (over-pressurization) does not result, the impact phase of the test begins.
3. Furnace temperature is reduced to 1550$^{B}$F (the temperature that a theoretic fire will reach after 30 minutes based on a standard time-temperature curve), and then raised to 1640$^{B}$F over an additional 15-minute period.
4. The furnace is then opened and the safe is removed and dropped 30 feet onto a bed of broken brick on a heavy concrete base. No more than 2 minutes can elapse between the time the furnace fire is extinguished and the safe is dropped.
5. After impact, the safe is examined for deformation, rupture of parts, damaged insulation, and other evidence of openings into the interior of the safe.
6. When cooled sufficiently for handling, the safe is returned to the furnace and placed in an upside-down configuration. The safe is re-heated to 1700$^{B}$F for 45 minutes.
7. The safe is allowed to cool to normal temperature inside the furnace.
8. The safe’s doors are then forced open and the assembly is dismantled. Examinations are made in regard to heat-insulating properties of the safe as evidenced by the usability of the paper contents, the condition of the finish on the inside, and any other evidence of undue transmission of heat or moisture. The condition of interior equipment, locks and fastenings between parts is also recorded.
9. If results are satisfactory, the manufacturer is permitted to affix the UL label “350-2” to record safes of this design.

**CMR Engineering Test and Evaluation**

<u>Modeling</u>
A model, which analyzed the effects of a seismic event on a Mosler Record Safe located in a wing vault, was developed. This analysis considered two scenarios:

1) The floor of the wing vault remains intact and the concrete slab, which forms the ceiling above the wing vault, impacts the Mosler Record Safe

2) The floor of the wing vault collapses and the record safe suffers the impact of the drop to the basement, as well as the crushing impact of the concrete ceiling structure from above.

In the first scenario, the ceiling would fall a distance of approximately 7 feet onto the top of the safe. Ignoring the effects of the rebar, this scenario resulted in deformation of the top of the safe, but did not cause buckling of the outer shell. In the second scenario, the outer shell was buckled. Additionally, the model determined that a piece of rebar, long enough to penetrate the inner shell of the Mosler Record Safe (approximately 4 inches) would buckle upon impact and would not penetrate the inner shell of the safe.

Destructive Testing

In order to perform adequate destructive testing, a test scenario that reasonably simulated the effects of the evaluation basis seismic event analyzed in the CMR Basis for Interim Operation (BIO) was developed. During the BIO seismic event, it is postulated that the building structure will collapse. As a result, nuclear material containers located in the first floor Wing Vaults fall through the first floor approximately 17 feet to the basement floor. These containers impact a 6-inch thick concrete basement floor, and are subjected to impact from falling debris (concrete and rebar) from the collapsed building structure. A representative test scenario was established as follows:

A Mosler Record Safe identical to that used in the analytical model, was subjected to destructive testing, which simulated the conditions of the second modeling scenario discussed above. The safe was filled with 10 small canisters packaged to the exact specifications used by programmatic groups for MAR stored in wing vaults. These small canisters were filled with a measured amount of blue chalk powder to simulate MAR in a powdered, dispersible form. The containers were evenly distributed about three shelf locations in the record safe and the safe door was latched closed. The destructive testing was performed as follows:

1. Drop Test: The safe was dropped 17 feet from a tower onto a concrete pad (non-yielding surface) to simulate the safe falling through the wing vault floor to the basement and impacting the basement floor.
2. Crush/Puncture Test: Following the drop test, a concrete slab with a protruding piece of rebar, was dropped from the tower from a height of 33 feet onto the safe to simulate the wing vault ceiling structure falling into the basement and impacting the safe below. The concrete slab was built to the dimensions of a 50% section of the wing vault ceiling and weighed approximately 1300 pounds. This figure is based on a 50% value of the volume of the concrete ceiling slab located above the Wing Vault, which was calculated to weigh 2588 pounds. It was assumed that only 50% of the concrete would contact one safe because typically, there would be two safes in the Wing Vault to absorb the falling load. In addition, it is unlikely that the ceiling would fall as one complete unit and fully impact the safes. In the event there is only one safe in the Wing Vault it would be positioned close to the exterior wall and would experience a pivoting impact of the slab rather than a direct impact by the full slab.

   The protruding piece of rebar was 3/8" diameter and 4 inches long (length required for full penetration). The rebar was located at the center of the slab and positioned so that it would strike the top of the safe in an orthogonal orientation to avoid a glancing blow. **Note: A value of 1300 pounds dropped from 33 feet exceeds 10CFR71 crush test specifications for Type B Containers of 1100 pounds dropped from 30 feet. (This specification does not include a penetrating spike)**

Two regular video cameras and a high speed video camera were positioned around the test zone. The drop and crush/puncture tests were captured on the high speed video, while pre-test and post-test conditions were captured on the regular video. Accelerometers were attached to the inside of the top of the safe for data collection.

Test Results/Comparison to Desired Characteristics

The safe was dropped from 17 feet and landed in the upright position. Minor deformation to the lower left front corner of the safe (door jamb area) was observed, causing the safe to slightly lean. Slight deformation was also noticed on the outer plate of the safe door, however, the safes labyrinth door arrangement maintained the safe sealed shut and prevented an open pathway to the outside. The left side panel slightly buckled near the bottom due to the deformation of the left front corner. The metal skirt at the bottom of the safe, which provides a cosmetic cover for the safe wheel area (wheels were cut off of the safe prior to testing because they will not be used in the CMR application to prevent movement and to eliminate high stress areas), but had no impact on the safe's structural integrity. The immediate area around the safe was inspected to determine if any leakage of internal contents (blue chalk powder simulating MAR) occurred. No evidence of leakage was observed.

Next, the concrete slab was dropped from 33 feet onto the top of the safe. The slab struck the safe flush on the top and sheared off around the edges. The safe remained upright, with a pile of crumbled concrete around the immediate vicinity and a solid piece of concrete resting on top. The piece resting on top covered approximately the area of the top of the safe. An initial inspection of the exterior of the safe was conducted and revealed that deformation, which occurred during the drop portion of the test, was slightly increased, and there was some slight deformation on the top of the safe, mostly dents around the edges. Additionally, inspection of the surrounding area indicated that no leakage of internal contents occurred. Photographs displaying the post-test condition of the safe are provided in Figures 1 through 6 below.

Figure 1 - Post test safe with door intact, worker attempting to remove door

Figure 2 - Post test safe with hinge pins cut and door being removed, exposing collapsed shelves

Figure 3 - Door Jamb Bottom Left Front View

Figure 4 - Door Jamb Bottom Left Side View

Figure 5 - Door Bottom Left Corner Top View

Figure 6 - Door Bottom Left Corner Side View

Next test personnel attempted to open the safe door to view the condition of the internal contents. The safe door was jammed closed and several attempts with crowbars were unsuccessful. The hinge pins were cut and the safe door was removed. Inside, the adjustable shelves had fallen to the bottom of the safe along with the canisters. All canisters were intact with only minor denting in metal canisters and minor cracks and chips in plastic canisters caused by the impact of the falling shelves (See Figures 7 through 10). There was no breakage of glass vials or glass bottles stored inside of the canisters. However, plastic bottles stored inside canisters did have some breakage. The integrity of the canister assemblies was confirmed by the fact that no signs of leakage (blue chalk powder) were found in the safe. Further inspection of the safe indicated that the 4-inch rebar had penetrated both the inner and outer shells of the safe, forming a hole approximately 1/2-inch in diameter (See Figures 11 through 16). The rebar, however, was held in place by the piece of concrete resting on top of the safe and served as a plug. Therefore, the puncture was self-sealing and did not compromise the ability of the safe to prevent contents from dispersing to the outside. (Note: The analytical model predicted that the rebar would buckle and not penetrate. The model, however, assumed that the tip of the rebar striking the safe was blunt. The actual piece of rebar was semi-sharp. This characteristic probably contributed to the puncture.) The remainder of the safe interior was intact with no further penetration of the inner shell.

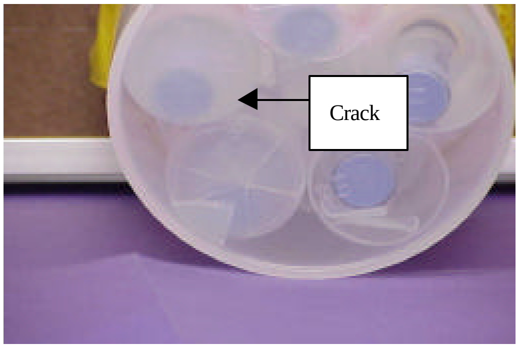


Figure 7 - Post-Test Plastic Canister (Internal plastic bottles broken and glass vials containing powder intact)

Figure 8 - Post-Test Plastic Canister (Outer canister cracked and internal glass bottles and vials intact)


Figure 9 - Worst case metal canister with denting

Figure 10 - Post-test Container Sample

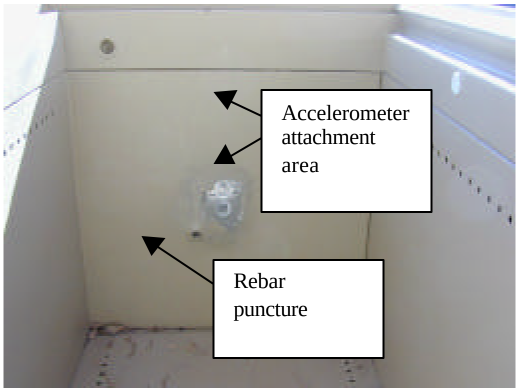


Figure 11 - Safe Top Puncture Inside View

Figure 12 - Safe Top Puncture Inside View Close-up

Figure 13 - Safe Top Puncture Outside View

Figure 14 - Safe Top Puncture Outside View Close-up

Figure 15 - Safe with concrete slab, rebar, and rigging laying on top

Figure 16 - Safe with concrete slab, rebar, and rigging laying on top, close-up view

The safe was then turned over to view the damage to the bottom. A slight separation of the weld joint of the bottom plate of the safe (outer shell) was suffered, exposing the thermal insulation (See Figures 17 through 20). Because no penetrations of the inner shell were discovered during interior inspections (other than the rebar puncture) the damage was limited to the outer shell of the safe. The damage to the bottom plate was probably suffered during the initial drop test. Like earlier inspections, no leakage of powder was observed.

Figure 17 - Bottom Plate Weld Separation

Figure 18 - Bottom Plate Weld Separation

Figure 19 - Bottom Plate Weld Separation

Figure 20 - Bottom Plate Weld Separation

Based on the above test results, the Mosler Record Safe is assessed to be an extremely robust container, and meets all of the desired characteristics. A comparison with each of these characteristics is provided as follows:

- Thermal Resistance: Thermal testing performed by the manufacturer to achieve the UL "350-2" fire resistance rating is deemed adequate and no further testing is required. The Mosler Record Safe, with its 2-hour fire resistance rating, meets the thermal resistance requirement.
- Seismic Robustness: The ability of the safe to withstand a drop, crush, and puncture test with only minimal damage and no leakage is proof of its ability to withstand the effects of a seismic event. The CMR engineering tests combined with the manufacturer drop test are sufficient to declare the Mosler Record Safe a robust, seismically resistant container. Therefore, the Mosler Record Safe meets the seismic robustness requirement.
- Pressurization: Explosion Hazard (over-pressurization) testing performed by the manufacturer to achieve the UL "350-2" fire resistance rating is deemed adequate and no further testing is required. The Mosler Record Safe is capable of withstanding gas buildup due to sudden temperature increase and meets the pressurization requirement.
- Utility: Up to two Mosler Record Safes will fit into the wing vault and will not exceed floor-loading limits if placed in the appropriate configuration (configuration already determined through floor loading analysis). A spacious door and adjustable shelving provide easy access for storage and retrieval of packaged materials of various sizes used in the wings. Interviews with user group personnel indicate that the Mosler Record Safe is an acceptable technology for their applications. Therefore, the Mosler Record Safe meets the utility requirement.

Off-site Dose Consequence Reduction

The seismic and fire resistance of the Mosler Record Safe provide the facility with the capability to reduce off-site dose consequences below those levels calculated in the BIO. Revised off-site dose consequences for a seismically induced facility fire, assuming deployment of Mosler Record Safes in wing vaults, are derived as follows:

Assumptions:

- Consistent with the BIO, Hot Cell MAR is counted toward the source term for the seismic event, but is unavailable for release during the fire. The Hot Cells collapse into the basement and the MAR is covered by collapsed alpha boxes, hot cell walls and building debris.
- For seismic events, the bounding ARF and RF are 1E-2 and 0.5, respectively. The average ARF and RF are 6E-4 and 0.4, respectively.
- For fire events the bounding and average ARF x RF factors are 1.7E-2 and 4.3E-3, respectively.
- The LPF is 1.0.
- The DR is 1.0 for MAR not contained in a Mosler Record Safe. The DR is zero for MAR contained in a Mosler Record Safe. The latter assumption is valid based on the robust construction of the safes and the results of testing conducted by both the manufacturer and the facility. The safe suffered only a minor split in the weld seam of the outer shell bottom plate. Although a very small portion of the thermal insulation was exposed, the insulation itself and the inner shell were still intact. In addition, if the safe landed upright (as it did in the test), this small opening would be sealed against the concrete basement floor. If the safe had landed on its side, the split in the weld seam may not even have occurred because the load would have been spread over a larger area and resulted in less stress to this portion of the safe. Even if the split in the weld seam occurred for a safe landing on its side, the opening would probably be covered by rubble and debris and the inner shell would still be intact, protecting internal contents. The puncture suffered because of the protruding rebar is inconsequential because it was sealed by the rebar and the concrete. Finally, the canisters used to package the material inside of the safe remained intact and further protected the MAR.
- Total MAR in the facility (excluding Hot Cells) is 12 kg $^{239}$Pu equivalent (eq). This assumption differs from the BIO, but is valid due to limitations placed on the facility by its Administrative Controls. The Administrative Controls maintain total facility MAR (excluding Hot Cells) at $\leq$12 kg $^{239}$Pu eq. This limit can only be exceeded with Division Director approval and DOE notification, and was exceeded only once in 18 months. In addition, the daily average total MAR inventory (excluding Hot Cells) is approximately 9 kg $^{239}$Pu eq. Based on this daily average, a maximum of 12 kg $^{239}$Pu eq is reasonable since it conservatively provides a 33% margin, which is adequate to account for potential deviations from the daily average.
- The percentage of MAR contained in Mosler Record Safes is approximately 50%. This percentage is based on the ratio of MAR in wing vaults available for containerization to total MAR determined in the MAR analysis provided in Table 1. This percentage is valid, since any increase or decrease in MAR would most likely occur in a wing vault. Therefore, the ratio would remain constant for increases or decreases in MAR. Using this ratio, the amount of MAR which would not be containerized and could be acted upon during accident scenarios would be 50% of the 12 kg $^{239}$Pu eq maximum total MAR, or 6 kg $^{239}$Pu eq (i.e., 6 kg $^{239}$Pu eq is in Mosler Record Safes).

- Consistent with the BIO, the Hot Cell source term contribution for the seismic portion of the accident scenario is 77.4 g maximum and 3.8 g average, based on a 300 g $^{238}$Pu eq maximum. Note: Over the past year, Hot Cell MAR inventory averaged approximately 15 g $^{238}$Pu eq.

Using the above assumptions, off-site dose consequences are as follows:

ST = MAR x ARF x RF x LPF x DR

ST seismic bounding = [(6 kg x 1E-2 x 0.5 x 1.0 x 1.0) + 77.4 g] + [6 kg x 1E-2 x 0.5 x 1.0 x 0]

= 107.4 g

ST fire bounding = [6 kg x 1.7E-2 x 1.0 x 1.0] + [6 kg x 1.7E-2 x 1.0 x 0] = 102 g

ST total bounding = 107.4 + 102 = **209.4 g**

ST seismic avg = [(6 kg x 6E-4 x 0.4 x 1.0 x 1.0) + 3.8 g] + [6 kg x 6E-4 x 0.4 x 1.0 x 0]

= 5.2 g

ST fire avg = [6 kg x 4.3E-3 x 1.0 x 1.0] + [6 kg x 4.3E-3 x 1.0 x 0] = 25.8 g

ST total avg = 5.2 g + 25.8 = **31 g**

CEDE bounding = 209.4 g x 6.2E-2 Ci/g x 6.3E-5 sec/$m^3$ x 3.5E-4 $m^3$/sec x 3.1E8 rem/Ci

= **88.7 rem**

CEDE average = 31 g x 6.2E-2 Ci/g x 6.3E-5 sec/$m^3$ x 3.5E-4 $m^3$/sec x 3.1E8 rem/Ci

= **13.1 rem**

The BIO-calculated doses for bounding and average cases were 218.9 rem CEDE and 40.6 rem CEDE, respectively. Applying a more likely total facility MAR inventory and crediting the Mosler Record Safes for their ability to withstand effects of fire and seismic events provides a reduction in both the bounding and average doses of approximately 2/3.

Recommendation

The Mosler Record Safe met all desired characteristics established by the facility, and therefore, meets requirements set forth in the MER. Given this safe's ability to achieve significant reduction in MAR inventory and off-site dose consequences and its relatively low unit cost (approximately $2000), it is an extremely cost-effective solution. Therefore, it is recommended that the Mosler Record Safe be approved as an acceptable container technology for CMR MAR Containerization Program implementation.

Approved by: 3/20/00

Chris Steele, DOE-LAAO
Senior Authorization Basis Manager