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WANL

CRITICALITY HAZARDS CONTROL PROCEDURE
HIGH TEMPERATURE TEST ROOM
ENGINEERING MECHANICS LABORATORY

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I. INTRODUCTION

To maintain adequate criticality control within the high temperature test room of the Engineering Mechanics Laboratory, criticality control procedures have been established with reference to the Criticality Hazards Control Guide (WANL-TME-185). These procedures will assure the prevention of accidental critical assemblies by limiting the mass, establishing the geometry, or restricting the handling of enriched uranium within and between designated criticality zones. The boundaries of these zones are designated by special tape, and a detailed listing of criticality zones and the equipment contained therein is given in Section IV.

Both mass and geometry are used as control parameters; the control in some zones is based on mass, in others, on geometry. The specific parameters of control and the applicable rules, limitations and restrictions are posted in each criticality zone.

The Supervisor, Core Components Test Group, is responsible for maintenance of nuclear safety within the test room. This responsibility is not delegated; but, for implementation and control reasons, certain duties, with respect to criticality hazards control, are assigned to specific individuals.

To strengthen the criticality hazards control procedures, all forms and categories of uranium-bearing material entering or leaving the high temperature test room must be cleared through the Accountability personnel assigned to the Engineering Mechanics Laboratory. In addition, the Industrial Hygiene Department will have available a Criticality Engineer who will make periodic inspections of the test room. He will make an immediate verbal report of violations to the responsible supervisor, followed by a written report to the supervisor with copies to the appropriate management levels within the Astronuclear Laboratory. A file of the reports will be maintained by the supervisor.

II. CHANGE PROCEDURES

No changes may be made to the procedure described by this document without written approval of the Criticality Engineer and the Manager, Engineering Mechanics. The Criticality Engineer will examine proposed changes and determine whether they fall within the intent of the present document and comply with WANL-TME-185. If so, he may approve them and he shall so notify the Chairman of the Astronuclear Laboratory Nuclear Safety Committee. Proposed changes which he decides do not fall within this intent, or any change which he desires to so refer, will be referred by the Manager, Engineering Mechanics to the Safety Committee for consideration.

All changes will be submitted to the Criticality Engineer with a "Request for Criticality Manual Change" form (See Figure 1). This form will define the portion of the manual that is being added to or superseded, and will be reviewed by the Criticality Engineer and/or the Nuclear Safety Committee, and the Criticality Engineer will add to it any calculations in support of his recommendations. Upon the concurrence of the Criticality Engineer and/or the Nuclear Safety Committee, the change will become effective with the approval by the Manager, Engineering Mechanics.

It is the responsibility of the facility management to mark the altered portions of their manuals with the number of the approved "Request for Criticality Manual Change" form, and to maintain supplemental manuals which compile all approved changes. Periodically, the supplemental manual will be incorporated into the basic manual at a time jointly agreed upon by the Criticality Engineer and the facility management.

A complete, current master copy of this procedure will be maintained by the Supervisor, Core Components Test Group.

III. DESCRIPTION OF OPERATIONS

The primary operation to be carried out in this room will be the mechanical testing of fueled elements and clusters with uranium loadings up to 500 mg/cc. These tests, tension, compression, flexure and fatigue, will be performed with partial length and full length specimens, at temperatures ranging from room temperature to temperatures in the order of 5000° F.

The high temperature tests will be performed in special furnaces in a gaseous atmosphere.

Storage facilities for fueled elements and clusters will be available within the test facility. Details of these storage facilities are given in Section VI of this report.

IV. FLOOR PLAN

Figure 2 shows a floor plan of the high temperature test room. The location and identification of the criticality zones, and the equipment placed within these zones is also shown in Figure 2.

A. Criticality Zones and Limits

Zone No. 1: Storage Rack

The limits for this zone and rack, are defined in Section VI, Storage Vaults.

Zone No. 2: Storage Cabinet

The limits for this zone and cabinet, are defined in Section VI, Storage Vaults.

Zone No. 3: Preparation Table

No more than one (1) full suitcase of fueled elements may be placed on this table at any one time. No more than ten (10) individual fueled elements may be removed from the suitcase and arrayed on this table at one time. When complete clusters

are being handled, no more than two clusters may be placed on the table at one time.

Zone No. 4: Work Table

No more than one (1) test specimen which is being prepared for installation in one of the high temperature test units may be on this table at one time. The test specimens are specified for each test criticality zone, however, the maximum test specimen will be six (6) fueled elements, which may be surrounded by unfueled graphite strips or rings, not to exceed six (6) inches in outer diameter.

Zone No. 5: Test Area; 6 x 54 Furnace

Only one (1) test specimen may be in this zone at one time. Full length specimens will be tested in this furnace. These specimens shall consist of a maximum of six (6) fueled elements which may be surrounded by unfueled graphite strips or rings, not to exceed six (6) inches in outer diameter.

Zone No. 6: Test Area; 6 x 10 Furnace

Only one (1) test specimen may be in this zone at one time. Partial length specimens (10 inches long, maximum) will be tested in this furnace. These specimens shall consist of a maximum of 6 partial length fueled elements, which may be surrounded by unfueled graphite strips or rings, not to exceed six (6) inches in outer diameter.

B. Special Equipment

The following special test and maintenance equipment will be located within the test room:

1. 6 x 54 inch Furnace. This furnace has a resistance heated graphite element which provides a specimen heating zone 6 inches in diameter and 54 inches long. Surrounding the heating element is a graphite radiation

shield; an insulating layer of graphite felt insulation approximately 2 inches thick; and a water-cooled (the coolant water flows between two concentric shells) stainless steel jacket. The furnace is closed at the top and bottom ends, so that material in the furnace cannot escape unless and until the furnace is opened. Testing within the furnace will be in a gaseous atmosphere to temperatures in the order of 5000° F.

2. 6 x 10 inch Furnace. This furnace is identical to the 6 x 54 inch furnace, except that the heated length is 10 inches rather than 54 inches. Figure 3 shows the details of this furnace.
3. Vacuum Cleaner. This is an industrial vacuum cleaner modified with an Aerotec cyclone and an absolute filter. These modifications have been approved by the Criticality Engineer. No other vacuum cleaners will be permitted in the area.

C. Flow of Material and Control Methods

1. All fueled material entering or leaving the Engineering Mechanics Laboratory will be logged in and out by the Accountability Clerk or his alternate on the appropriate SS Material Accountability forms. No fueled material may enter or leave the Laboratory without the clearance and acknowledgment of the Accountability Clerk.
2. All fueled material coming into the high temperature test room will be logged in, and assigned an identification number by the Accountability Clerk. Where test specimens have been prepared from full length elements, a cross-check log will be kept to identify the specimen and its source. (See Figure 4)
3. All specimens will be placed in the appropriate storage rack by the Accountability Clerk, and the location noted in the cross-check log.

From the storage rack, specimens will be moved to the appropriate preparation or test area for installation in the test equipment. At the completion of a test, the specimen will be returned to the storage rack or cabinet for final disposition. Test specimens will be removed from and returned to the storage area by the Accountability Clerk only.

4. A current log showing the amount of fueled material in each criticality zone will be maintained by the Accountability Clerk, and movement of fueled materials between criticality zones may be made only with his cognizance and permission.

V. PROCESSES

- A. Criticality Zones and Limits. These are shown in Figure 2, and are detailed in Section IV.
- B. Process. The function of this room is to provide an area with proper equipment for the mechanical test and evaluation of fueled materials which are to be used in future reactors. No assembly or process, other than that which is necessary for the preparation of test specimens, will be carried out in this room.

VI. STORAGE VAULTS

Two storage racks will be available for the storage and safekeeping of nuclear materials while in the room.

- A. Storage Rack. (Reference: Dwg. No. NT701445). This rack, a metal frame structure, will store up to four (4) fully loaded suitcases, each containing nineteen (19) fuel elements in aluminum tubes, for a limit of 76 elements. The suitcases will be stored in a vertical row with a center-to-center spacing of 18 inches. (See Figure 5)

- B. Storage Cabinet. (Reference: Dwg. No. 577F057). This is a metal cabinet, which has four (4) storage drawer/trays, and provisions for storing up to four (4) filled standard, 4 5/8 in. diameter plastic scrap bottles. (See Figure 6). There will be a minimum of 12 inches of enclosed dead space between the openings for adjacent drawer/trays. The contents of an individual drawer/trays shall be limited as follows:
1. Two (2) complete assembled clusters, or several partial length clusters, the sum of which does not exceed two full length clusters, placed with at least a 16 inch center-to-center spacing, or
 2. Twenty (20) full length elements, placed with at least a 1 inch center-to-center spacing, or
 3. Twenty-eight (28) partial length elements with special graphite end fittings arrayed in seven (7) rows, with at least a 3 inch center-to-center spacing. The combined length of the partial length fuel elements in any row shall not exceed the length of an uncut fuel element, or
 4. Twenty (20) rows of partial length single fuel elements, placed with at least a 1 inch center-to-center spacing. The combined length of partial length fuel elements in any row shall not exceed the length of an uncut fuel element.
 5. The drawer/trays shall be fitted with aluminum liners to assure that only the arrangements specified above can be placed in the drawer/tray. Figures 7 and 8 show the liners to be used for VI. B. 1 and VI. B. 2.
- C. The storage space for the standard plastic scrap bottles in the storage cabinet shall be arranged so that there is a minimum of 10 inches of enclosed dead space between adjacent storage spaces.
- D. Both racks will have provisions for security bars and locks.

VII. SCRAP AND WASTE

The majority of the tests to be conducted within this room will be mechanical ultimate load tests, that is, the specimens will be loaded to determine the load at failure and the mode of failure.

Handling and storing procedures for failed specimens shall be as follows:

- A. Full length specimens. Generally, full length specimens will break into two large pieces, with some debris from the failure area. The large pieces will be weighed and then placed in an aluminum carrier tube and returned to a specially marked suitcase. Such pieces of the debris which are large enough, will be picked up by hand, weighed, and placed in plastic bags and stored in a standard plastic scrap bottle. The remainder of the debris will be picked up by the special vacuum cleaner described in Section IV. B. 3. The difference in weight between the untested specimen and the remaining fragments will be recorded.
- B. Partial length specimens. These specimens may break in different ways, that is, in some cases there will be a few large fragments, in other cases, many small fragments. Those pieces of the debris which are large enough, will be picked up by hand, weighed, and placed in plastic bags and stored in a standard plastic scrap bottle. The remainder of the debris will be picked up by the special vacuum cleaner. The difference in weight between the untested specimen and the remaining fragments will be recorded.

VIII. NUCLEAR SAFETY ANALYSIS

The nuclear safety of the storage cabinet and the storage rack may be demonstrated by the Solid Angle Method¹ of calculation for spacing interacting units:

Storage Cabinet

The solid angle of interaction, Ω , 12 inches from a drawer of the storage rack is calculated from the formula -

$$\Omega = 4 \sin^{-1} \left\{ \frac{(a/2)}{\sqrt{(a/2)^2 + h^2}} \frac{(b/2)}{\sqrt{(b/2)^2 + h^2}} \right\}$$

where: a = 60 inches
b = 24 inches
c = 12 inches

$$\Omega = 2.86 \text{ steradians}$$

The solid angle of interaction for storage bottles (5" Dia. x 9") is calculated from the formula -

$$\Omega = \frac{dL}{h^2} \left[1 + \left(\frac{L}{2h} \right)^2 \right]^{-1/2}$$

where: d = 5 inches
L = 9 inches
h = 12.5 inches (10 + d/2)

$$\Omega = 0.55 \text{ steradians}$$

Based on these numbers, the maximum solid angle of a shelf is 5.76 steradians and the corresponding allowable multiplication factor for an individual unit is 0.32. The reactivity of 20 elements, with the channels filled with water, in a handling tray, has been calculated² to be 0.035. The reactivity of 20 elements in a slab is lower. Drainage holes are provided in the cabinet so that if water is introduced it will not be retained.

The solid angle of interaction of a storage bottle is 3.96 $[2.86 + 2 (0.55)]$ steradians which has an allowable multiplication factor of 0.5. The maximum multiplication factor under optimum moderation and with a 1" water reflector has been calculated² and is less than 0.5.

The units in this cabinet satisfy the interaction - multiplication factor criteria of the Nuclear Safety Guide under hypothetical drained conditions which would follow flooding and individual safe units are isolated in the event of complete flooding.

Storage Rack

The solid angle of interaction of a suitcase in the storage rack is -

$$\Omega = \frac{dL}{h^2} \left[1 + \left(\frac{L}{2h} \right)^2 \right]^{-1/2}$$

where: d = 5 inches
L = 60 inches
h = 15.5 inches

$$\Omega = .574 \text{ steradians}$$

Therefore, the solid angle of interaction of a central suitcase is 1.15 steradians and the allowable multiplication factor of a unit is 0.77. The maximum multiplication factor² under optimum moderation is 0.3.

Each individually safe suitcase would be isolated in the event of flooding, therefore, this array is safe under all conceivable conditions.

Vacuum Cleaner

The special vacuum cleaner is equipped with an Aerotec dust collector which deposits the material in a safe geometry collection bottle. An absolute filter prevents the spread of contamination. Experience indicates that the pressure drop across these filters becomes excessive before 350 grams of U-235 from fuel material can be accumulated. Following filter replacement, used filter medium is removed from the frame and placed in standard scrap bottles for uranium recovery. The frame is disposed of as normal radioactive solid waste.

Crit Zones 3 and 4 - Preparation and Work Tables

The nuclear safety in these zones is based on calculations³ which indicate the minimum number of elements which can be made critical under optimum spacing and flooding is 34. Therefore the limits

Crit Zone 3

19 elements - no more than 10 elements out of a suitcase

Crit Zone 4

6 elements

are within the recommended safety factors.

Crit Zone 5, 6 x 54 Furnace

The maximum test specimen for this furnace contains 6 elements. The maximum compression of the test is 3 inches so it is unlikely that elements would break in more than 2 or 3 pieces. If each piece is considered as an element, this would still be less than the minimum number of elements required to obtain criticality. In addition, the graphite heating elements are such that the fuel material would be retained within their 6 inch inside diameter. Stratton's data for 8 inch water reflected cylinders indicates a minimum critical radius of 9 cm, or 7.08 inch diameter. Therefore, even if the test specimen were broken into small pieces and the furnace flooded, there would be a geometry safety factor of $7.08/6 = 1.18$.

Crit Zone 6, 6 x 10 Furnace

The tests performed in this furnace are expected to break the elements into smaller pieces so that the element geometry is not considered. The quantity of U-235 in a maximum test specimen is 165 gms., which is a safe mass, so this test is safe under all conceivable conditions.

References:

1. Nuclear Safety Guide, TID 7016, Rev. 1, 1961.
2. Astrofuel Facility Criticality Control Procedures, WANL-TME-621.
3. Criticality of NRX-A Fuel Lattices, WANL-TME-760.
4. Critical Dimensions of Uranium (93.5) - Graphite - Water Spheres, Cylinders and Slabs, LAMS-2955.

IX. EMPLOYEE INSTRUCTION

A. Definitions of Terms

These definitions apply to the Engineering Mechanics Laboratory.

1. Enriched Uranium: Uranium which has been enriched with the U_{235} isotope.
2. Enriched Uranium Material: Any material containing enriched uranium. This includes scrap and test specimen debris as well as full length and partial length fuel elements.
3. Non-Fuel Material: Any item resembling fuel material, but containing no uranium.
4. Criticality Zone: A well-defined area where a specific operation involving fissionable material is performed. The boundaries of each criticality zone are designated by yellow and black tape marked "CRIT-ZONE", or by such physical boundaries as fences, walls, railings, etc. In addition, a sign designating the "maximum permissible value" will be posted for each zone.
5. Identity: A serial number engraved or otherwise permanently affixed to each component part, fuel element, or other test specimen, or any chemical or metallographic report associated with these items. A cross-referencing file of these serial numbers and associated items will be maintained.
6. Accountability Personnel: Those employees of the Engineering Mechanics Laboratory who have been assigned the responsibility of accounting for all enriched material which is assigned to the Engineering Mechanics Laboratory. They shall be responsible for the control of such material (receipt, storage, movement, etc.) as long as it is in the cognizance of the Engineering Mechanics Laboratory; and they shall be responsible for the maintenance of all accountability logs.

B. Responsibilities

1. Manager, Engineering Mechanics: The individual assigned the responsibility for the operations of Engineering Mechanics shall:
 - a. Familiarize himself and comply with the Astronuclear Criticality Hazards Control Guide (WANL-TME-185, November, 1962), the Nuclear Safety Guide (TID-7016, Revision 1), and the WANL Health Physics Manual.
 - b. Assure the Nuclear Safety Committee that the Supervisor, Core Components and Thermal Experiments, and the Supervisor, Core Components Test Group are properly indoctrinated, and that they, in turn, indoctrinate their personnel.
 - c. Enforce reprimands for non-compliance of procedures.
 - d. Be responsible for obtaining reviews of change in procedure or new facilities by the Criticality Engineer and/or the Nuclear Safety Committee.
 - e. Approve procedures after review by the Criticality Engineer and/or Nuclear Safety Committee.
2. Supervisor, Core Components Test Group is responsibility for the following:
 - a. Assure that all personnel working in his area or group are thoroughly indoctrinated in their specific duties relative to criticality hazards control, and that they observe the criticality hazards control rules set forth in this procedure.
 - b. Assure that all uranium bearing materials and non-fuel materials are properly identified and perform identity checks; that identification markings appear on all

accompanying paperwork and materials and non-fuel materials as required.

- c. Assure, by periodic inspection, that the criticality hazards control procedure is effective in his area, and that personnel are observing that procedure.
 - d. Assure that all personnel working in his group are thoroughly indoctrinated in the emergency procedures, and in the event of an emergency such as a fire, explosion or personnel injury, that the proper action is taken in accordance with established Astronuclear Emergency Procedures.
 - e. Initiation of changes to these procedures, as set forth in Section II of this document.
 - f. Maintain a complete and current file of all action relative to Criticality and Accountability procedures.
 - g. Refer all special situations not covered by this document to the Criticality Engineer and Manager, Engineering Mechanics.
 - h. Understand and be governed by the WANL Criticality Hazards Control Guide (WANL-TME-185, November 1962), the Nuclear Safety Guide (TID-7016, Revision 1), and the WANL Health Physics Manual.
 - i. Be directly responsible for surveillance, posting and enforcing limits, educating personnel, and exercising disciplinary action.
3. Supervisor, Core Components and Thermal Experiments is responsible for the following:

- a. Assure that all personnel under his supervision are thoroughly indoctrinated in their specific duties relative to criticality hazards control, and in emergency procedures.
 - b. Understand and be governed by the WANL Criticality Hazards Control Guide (WANL-TME-185, November 1962), the Nuclear Safety Guide (TID-7016, Revision 1), and the WANL Health Physics Manual.
 - c. Assure that any visitor to the area has a need to know, and is instructed to refrain from handling any part or entering any criticality zone without specific approval.
 - d. To act for, or to designate any individual to act for the Supervisor, Core Components Test Group in the latter's absence.
4. Engineering Mechanics Personnel: Every Engineering Mechanics employee whose job assignment requires his presence in the high temperature test room, and/or entails the handling, processing, or movement of uranium bearing materials in any form shall:
- a. Familiarize himself and observe all criticality hazards control procedures as set forth in this document or any addendum.
 - b. Refer all questions or special situations which are not covered by this procedure to the Supervisor, Core Components Test Group.
 - c. Insure that his physical and mental condition, while at work, does not impair his judgment or ability to effectively perform his duties concerning criticality hazards control.

- d. If required by his assignment, move enriched material within or between criticality zones in his work area, subject to transfer approval by the Accountability Clerk.
 - e. If required by his assignment, identify, package or store enriched material by approved techniques and in approved storage devices or areas.
5. Accountability Personnel: The Engineering Mechanics Accountability Clerk, and his designated alternate in his absence, shall perform the following criticality control duties:
- a. Move, direct, or control the movement of enriched uranium material between criticality zones and between work areas in the facility.
 - b. Obtain the required agreement and instructions as to quantity, time and place to deliver prior to moving or directing the movement of enriched uranium materials to another facility under the control of another individual.
 - c. Receive, direct, or control the receipt of enriched uranium materials from another facility.
 - d. Properly identify, package, or store material by approved techniques and in approved storage devices or areas.
 - e. Refer all questions or special conditions which are not covered by this procedure to the Supervisor, Core Components Test Group.
 - f. Observe all criticality hazards control rules as outlined in this procedure or any addendum.

- g. Maintain all records and logs concerning material quantities and locations within the high temperature test room.
6. Criticality Engineer: The individual, whose responsibilities have been designated by the Nuclear Safety Committee, shall:
- a. Supply nuclear calculations for the facility.
 - b. Insure compliance with the Astronuclear Laboratory Criticality Hazards Control Guide (WANL-TME-185, November 1962) and this document, with its approved revisions.
 - c. Supply the established facility surveillance to insure compliance with established procedure. The prime responsibility for compliance, however, is with the Supervisor, Core Components Test Group, per Section IX, B.2.i.

C. General Rules

- 1. Without exception, only containers approved by the Criticality Engineer may be used for storage, handling, or transporting.
- 2. All containers, including empty containers, shall be properly labeled at all times.
- 3. All movements of enriched material within the high temperature test room must be approved and recorded by the Accountability Clerk.
- 4. No deviations from published limits and conditions may be made without the approval of the Manager, Engineering Mechanics.
- 5. Protective clothing will be worn at all times within the high temperature test room.
 - a. Engineering Mechanics personnel assigned to the area shall change their personal clothing for the following protective clothing: white coveralls, head covers, shoe covers, and gloves.

- b. Visitors shall wear white laboratory coats over their personal clothing, and in addition, shall wear head covers, disposable shoe covers, and gloves.
- c. Protective clothing shall be removed as follows:
 - 1. Personnel assigned to the room: All exterior clothing; shoe covers; gloves.
 - 2. Visitors: Lab coats; shoe covers; gloves.
- 6. Personnel monitoring devices shall be available, and will be worn within the high temperature test room when required by Industrial Hygiene.
- 7. Eating, drinking and smoking anywhere within the high temperature test room is prohibited.
- 8. Floors may be mopped only after all fuel has been locked in the approved storage arrays.
- 9. Any violation of rules will be subject to disciplinary action.
- 10. At the completion of shift operations, and before all operating personnel leave the area, all fueled material shall be returned to the appropriate storage area or sealed in the furnaces. For all other periods during the working day, when operating personnel are not in the room, the room is to be locked by the last man leaving.

D. Emergency Procedures:

References: (1) WANL Emergency Procedures

(2) IL-017 Medical Emergency Procedures

(3) IL-018 Industrial Hygiene Emergency Procedures

- 1. ANY INJURY, NO MATTER HOW SLIGHT, MUST BE REPORTED TO MEDICAL FOR TREATMENT.
- 2. In the event of an accident which might result in local or airborne contamination of the room, but no injury to personnel, the following should be done:

- a. Evacuate the immediate area.
 - b. Notify Health Physics, extensions 547, 8159, or 497 immediately.
Also notify the Supervisor, Core Components Test Group.
 - c. Decontamination may be possible by cleaning up as much of the debris as possible using the approved vacuum cleaner.
 - d. All personnel not concerned with the cleanup are to remain outside of the area.
3. In the event of a serious personnel injury, whether or not contamination exists, the following should be done:
- a. Initiate first aid
 - b. Call the emergency phone number, 500, and notify them of the emergency. Also notify the Supervisor, Core Components Test Group.
 - c. All personnel not concerned with the administration of first aid, or, in the event of contamination, cleaning-up, are to clear the area.
 - d. If contamination is present in addition to the injury, the procedure outlined in paragraph 2 is to be followed, with first aid treatment immediately outside the affected area.

REQUEST FOR CRITICALITY MANUAL CHANGE

SUBMITTAL NO. _____ DATE _____

THE CHANGE DESCRIBED HEREIN, SUPERCEDES/ADDS TO, PART _____,
SECTION _____, PARAGRAPH _____, PAGE _____
OF WANL-TMI-1405.

SIGNED _____
Supervisor, Core Components
Test Group

APPROVED _____
Manager, Engineering
Mechanics

ACTION BY CRITICALITY ENGINEER

1. APPROVED WITHIN SCOPE OF MANUAL

SIGNED _____
Criticality Engineer

2. REJECTED

Comments: _____

SIGNED _____
Criticality Engineer

3. CONCEPT APPROVED

SIGNED _____
Criticality Engineer

REQUIRES ADDITIONAL CALCULATION

REQUIRES COMMITTEE APPROVAL

COMMITTEE ACTION:

APPROVED

REJECTED

MEETING MINUTES NO. _____

DATE _____

Figure 1

Request for Criticality Manual Change Form

Figure 2
High Temperature Test Room Floor Plan

Figure 3
Detail of 6 x 10 in. Furnace

Engineering Mechanics – S. S. Material Accountability Log Form

Figure 5
Storage Rack

Figure 6
Storage Cabinet

Figure 7
Drawer/Tray Liner for Assembled Clusters

Figure 8
Drawer/Tray Liner for Individual Elements