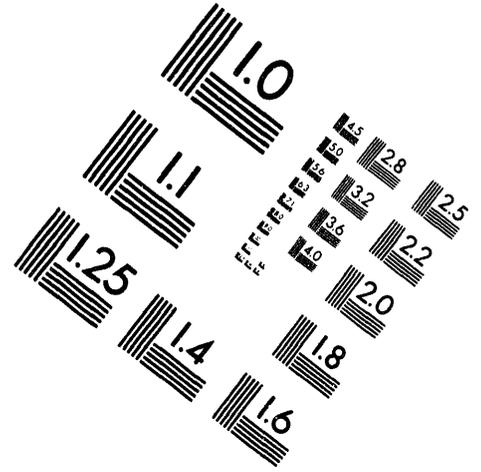
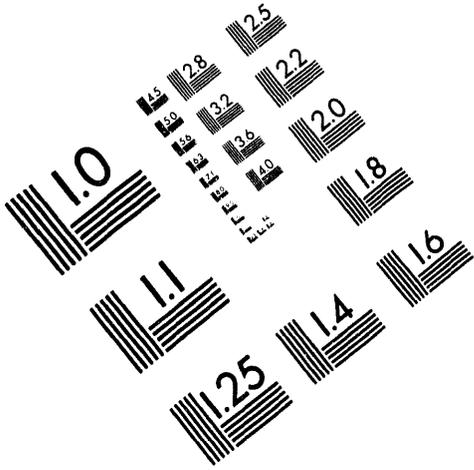




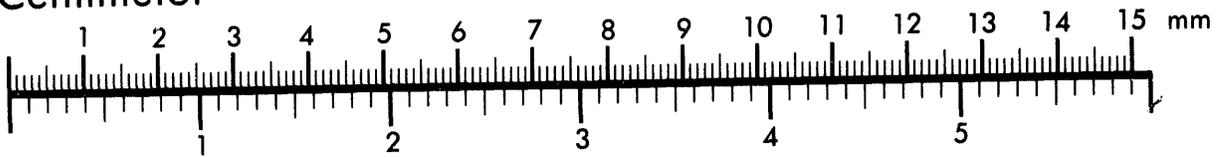
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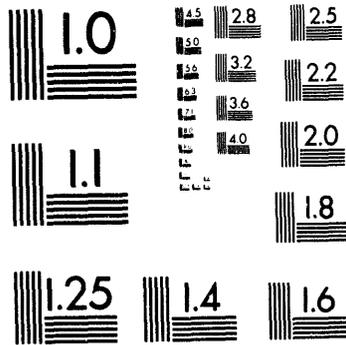
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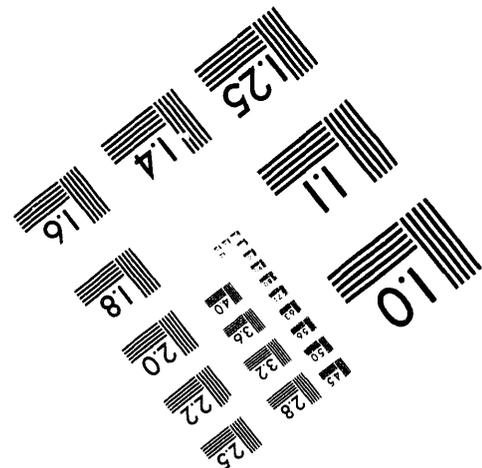
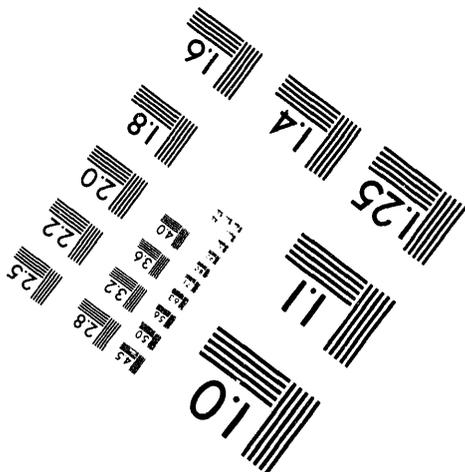
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Rockwell Hanford Operations

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EXECUTIVE SUMMARY

Federal regulations and Rockwell Hanford Operations (Rockwell) planning documents require that radioactive waste sites disposed in-place be permanently marked. A number of technical studies have addressed the materials to be used for permanent markers as well as the design configurations. Criteria and standards for markers have also been prepared and issued in draft form.

The next step in marker development requires laboratory and field testing of prototype markers. This document provides design specifications for the first generation surface and subsurface markers. At the conclusion of testing activities, definitive specifications can be prepared.

Included herein are specifications for marker placement, marker materials, marker configuration and dimensions and marker messages. This document presents specifications only and does not provide rationale or justification for the specifications. Such rationale and justification is available in referenced documents.

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1.0 INTRODUCTION AND SCOPE

Federal regulation requires that radioactive waste disposal sites be marked. To quote the appropriate draft rule (40 CFR 191.14e), "Disposal systems shall be identified by the most permanent markers and records practicable to indicate the dangers of the wastes and their location." Hanford plans for the disposal of radioactive waste sites therefore, appropriately call for solid waste burial sites, liquid waste disposal sites and single-shell tank wastes disposed in-place to be permanently marked as part of a barrier/marker disposal system (reference 1). Marker development is identified as a technical issue which must be closed prior to the implementation of waste disposal operations (reference 2). Draft criteria and standards for the in-place disposal of radioactive waste sites at Hanford have also been prepared. Among the criteria and standards included are a number relating to markers (reference 3). In general, the draft criteria and standards require that:

- Markers be placed on, near or in the surface cover.
- For TRU sites, the markers be at least as durable as the disposal (barrier system).
- Markers and messages resist destruction by expected processes.
- Sites be marked by redundant surface and/or subsurface marker systems such that the . . . intruder can be reasonably expected to be warned of the hazard.
- Markers be shown effective by methods including field testing, accelerated testing in environmental chambers and by comparison with historical data and human artifacts.

A number of engineering studies at Hanford have addressed the technical aspects of marker design and development (references 4-5). These documents have been reviewed by outside technical experts (reference 6).

Because of the work done to date and the review it has received, the test phase of marker development can be entered.

The purpose and scope of this technical information document is as follows:

- To provide design specifications for the first generation of Hanford full scale surface and subsurface markers to be used in field testing. (This generation of markers will be tested according to a plan being prepared in consultation with a subcontractor and may be the marker placed at the first disposal demonstration sites. The materials of which these markers are constructed will be subjected to accelerated testing per this plan as required by criteria and standards.)
- To provide more specific and up-to-date guidance concerning markers to be used in subsequent revisions of disposal criteria and standards (reference 3).
- To provide a benchmark of progress in the continuing effort to close the marker technical issue as outlined in reference 2.

It is anticipated that these first draft marker specifications will be revised periodically as additional technical progress is made and will eventually become the basis for definitive marker technical specifications for Hanford.

The specifications given in the following sections are based upon the documentation mentioned in the above paragraphs. It is not the intent to provide a rationale for the specifications in this document but to provide specifications only.

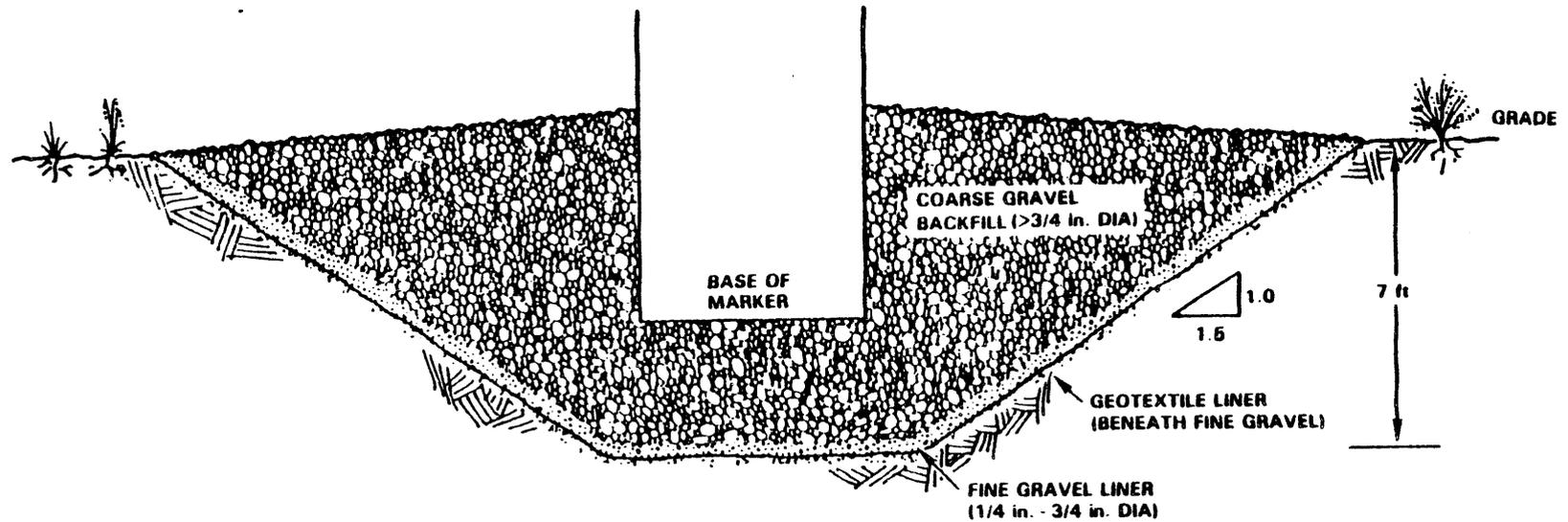
2.0 SURFACE MARKER SPECIFICATIONS

2.1 MARKER PLACEMENT

2.1.1 - Surface markers will be placed around the perimeter of those disposed portions of 200 East area, 200 West area and other areas wherein sites or groups of sites are disposed. (For purposes of field testing and demonstration, the initial set of surface markers may be placed at the corners of surface barriers constructed over demonstration disposal sites.)

2.1.2 - Surface markers shall be placed such that a person standing at any marker can see at least the next marker in either direction. (The spacing of markers on the perimeter will therefore vary depending on such factors as topography and expected vegetation cover. The spacing should be established by actual field surveys.) An attempt should be made to avoid placing markers at low points in the perimeter topographic profile.

2.1.3 - To place the marker, an excavation about 7 feet in depth should be made outside the zone of contamination. The excavation should be made in well drained sandy or rocky soil where consistent with specification 2.1.2. The excavation should be lined with a geotextile and overlain by several inches of clean fine gravel (1/4 to 3/4 inches in diameter). Approximately 3 feet of angular or rounded clean coarse gravel (>3/4 inch in diameter) should be placed on the fine gravel. The marker should rest upon the gravel bed and the excavation backfilled with the clean coarse gravel to grade. The distance from any point on the base of the marker to the native soil should exceed 3 feet. After placement, additional backfill gravel should be mounded-up around the base of the marker to a depth of about 1 foot (Figure 1).



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Figure 1. Placement of Surface Marker.

2.2 MATERIALS

2.2.1 - Surface markers should be constructed of sound, unweathered, fine-grained granite or basalt (nonvesicular). The stone should meet the following specifications:

- 0.4 maximum water absorption by weight
- 160 lb/ft minimum density
- 19,000 psi minimum compressive strength
- 1,500 psi minimum modulus of rupture
- 12 minimum abrasive hardness

These properties should be determined by testing as elaborated in American Society for Testing and Materials (ASTM) standard C615-80, "Standard Specification for Granite Building Stone."

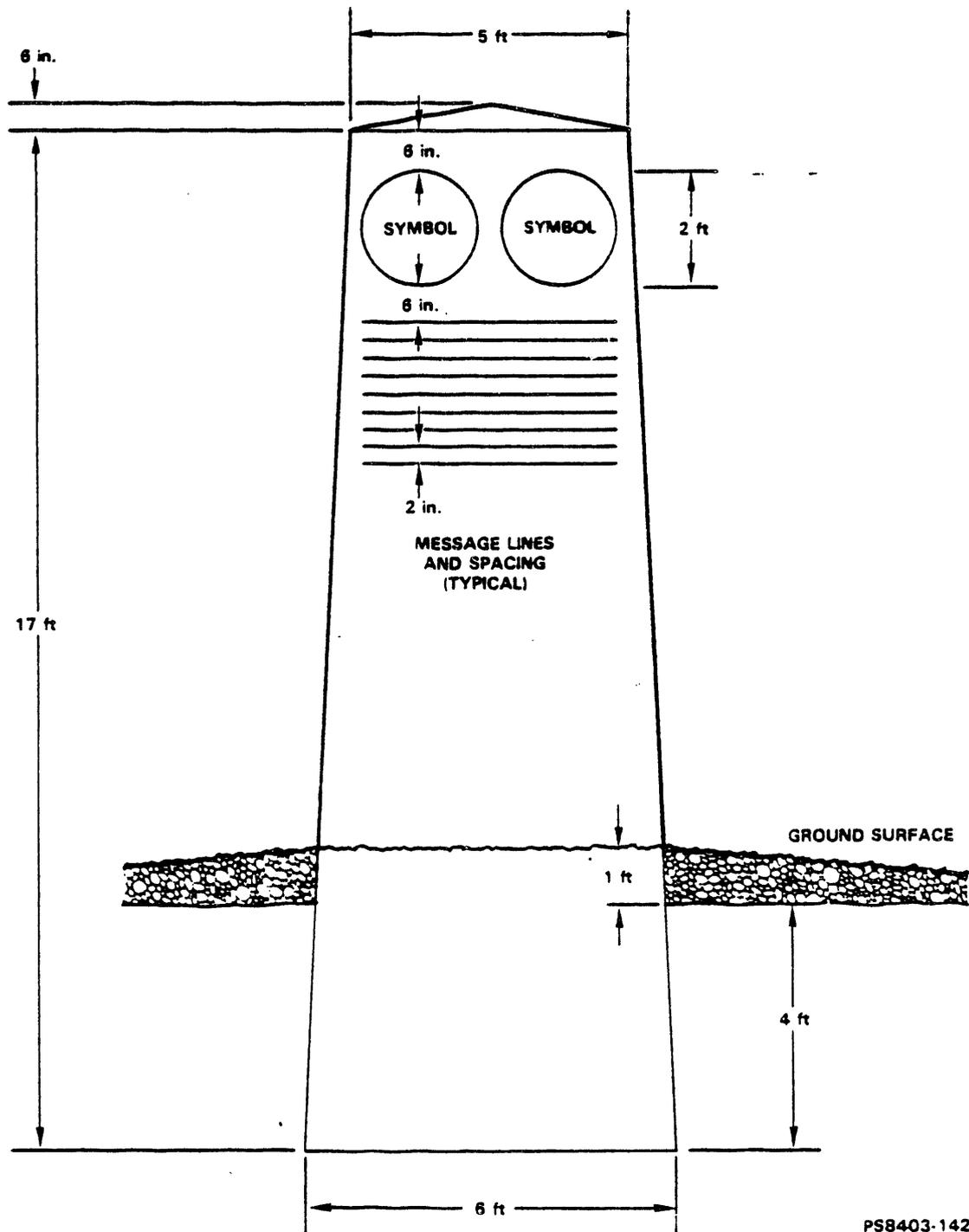
2.2.2 - The marker should be constructed from a single piece of stone where practicable, the stone block should be stored several months before working to provide stress relief after quarrying. The block should also be washed with distilled water if obtained from a desert area.

2.3 CONFIGURATION AND DIMENSIONS

2.3.1 - The marker should be a tapered four-sided or hexagonal form wider at the base than at the top (Figure 2). The truncated top should not be flat but should be pyramidal with a slight rise.

2.3.2 - The marker should be 17 feet high (to the base of the pyramidal top), 6 feet wide at the base and 5 feet wide at the top. The pyramidal top should have a rise to the center of 6 inches.

2.3.3 - Three faces of the marker should be polished to bear inscribed messages.



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Figure 2. Surface Marker Configuration and Dimensions

2.4 MESSAGES

2.4.1 - Messages should be engraved into the polished faces to a depth of 1 inch with V-shaped cuts. (Raised letters or symbols should not be used.) A raised boss 1 inch high should be placed or left completely around the polished faces which are to bear the messages.

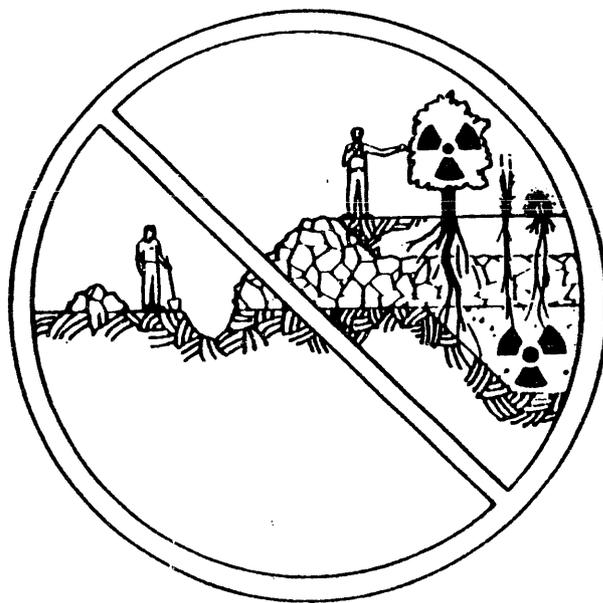
2.4.2 - Two of the polished faces should have the standard radiation symbol inscribed 6 inches below the top of the face. A do not dig symbol should be placed next to each radiation symbol (Figure 3). The symbols should be 2 feet in diameter.

The words:

DANGER
RADIOACTIVE WASTE
DO NOT DIG HERE

shall be inscribed beneath the symbols in letters of equal size in the order shown. The three lines of this message will be repeated down the polished face in English, French, Arabic, Spanish, Russian and Chinese. The letters shall be 2 inches high with a separation of 2 inches between lines. The uppermost lines should be separated from the symbols by a distance of 6 inches.

2.4.3 - The third polished face should have an inscribed symbolic description of the total area to be marked with the marked perimeter clearly indicated. A "you are here" indication should point to the marker being viewed to indicate its position on the perimeter. (This description cannot be placed on the first generation markers since the marked perimeter will not be determined until planning for disposal is more advanced.)



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Figure 3. Do-Not-Dig Symbol.

2.4.4 - All polished faces containing messages should be confined to the upper 10 feet of the marker.

3.0 SUBSURFACE MARKER SPECIFICATIONS

3.1 MARKER PLACEMENT

3.1.1 - Subsurface markers shall be emplaced as an integral part of those barrier systems used to cover (dispose of) sites classified as containing TRU waste. (TRU waste is defined as waste with more than 100 nCi/g of TRU contamination.)

3.1.2 - Subsurface markers should be placed at three levels (layers) within the barriers. In multilayer barriers; one layer should be placed in the soil component about 2 feet below the surface, one layer near the interface between the soil and rock components and one layer at the bottom of the rock component directly over the contaminated zone. The bottommost layer of markers should extend under the rock perimeter overlap and/or into the rock filled trenches at the perimeter of the barrier. Subsurface markers should be placed 10 feet apart (center to center) within each marker layer.

3.1.3 - Subsurface markers placed under (or near) rock should be shrouded by a covering as required to afford protection during construction. (Candidate covering materials include geotextiles, wire mesh or wood.) Construction procedures should also be established such that the markers are not damaged during barrier construction. Such procedures and coverings should be field tested prior to their approval and operational adoption.

3.2 MATERIALS

3.2.1 - The subsurface marker body should be made of porcelain or dense-fired stoneware. (Both materials should be used in the initial marker test

program.) A clear overglaze should be applied to the body of some of the prototype test pieces to provide a comparison with unglazed pieces.

3.3 CONFIGURATION AND DIMENSIONS

3.3.1 - The subsurface markers should be of disc or lenticular form. Discs should be 5 inches in diameter and 1/2 inch thick. The lenticular form should be 5 inches in diameter and 1/2 inch thick at midpoint. (The lenticular form is thick in center and tapers to the edge.)

3.4 MESSAGES

3.4.1 - One side of the subsurface marker should have imprinted the same do-not-dig symbol used on surface markers (Figure 3). The other side should have imprinted a standard radiation symbol with the words, "DO NOT DIG HERE. HAZARDOUS WASTE BELOW" encircling the radiation symbol (Figure 4). The wording should be in English.

3.4.2 - The color of the subsurface disc (or lenticular form) should be yellow with the lettering and radiation symbol in magenta/purple.



RCP8212-25A

Figure 4. Message for Reverse Side of Subsurface Marker.

4.0 REFERENCES

1. Hanford Waste Management Plan, RHO-WM-PL-7, December 1983.
2. Hanford Waste Management Technology Plan, RHO-WM-PL-9, December 1983.
3. Adams, M. R. and Wood, D. E., "Draft Criteria and Standards for In Situ Disposal of Existing Hanford Defense Waste," SD-HS-CSD-001, September 1982.
4. Adams, M. R., et al., "Liquid Waste Site In Place Stabilization Demonstration Plan," SD-RE-PAP-007, January 1983.
5. Adams, M. R., Carlson, R. A. and Brockman P. K., "Long-Term In Situ Disposal Engineering Study," RHO-CD-1142, June 1981.
6. Letter from Dr. M. F. Kaplan to M. R. Adams, "Comments on Documents RHO-CD-1142 and SD-RE-PAP-007," 65632-071, February 15, 1984.

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