ATTACHMENT

INSPECTION OF THE AS-BUILT CONDITION

OF THE MASONRY WALLS

SAN ONOFRE UNIT 1

OCTOBER, 1984

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1.0 INTRODUCTION

On September 5, and 6, 1984 meetings were held with the NRC staff on the SONGS 1 masonry wall test program. In the meetings, the NRC staff requested that an assessment be made, on a statistical sampling basis, of the "As-Built" condition of the masonry walls at the plant with respect to rebar, anchorage and grouting. In response to this request, inspection of the existing masonry walls at the San Onofre Unit 1 plant structures was undertaken to verify that these walls were built in accordance with the plans and specifications of original plant construction. This report summarizes the findings of this inspection.

2.0 BACKGROUND

The masonry walls at the San Onofre Unit 1 plant structures are shown in Figure 1. The masonry walls were constructed in various structures: enclosure walls in the Turbine Building, walls of Fuel Storage Building at the Spent Fuel pool, the 480V Room, the new Fuel Storage Room, parts of the Reactor Auxiliary Building, and the Control and Administration Building. All the walls of the Ventilation Equipment Building are also masonry walls.

All the masonry walls whose response, when subjected to the Design Basis Earthquake (DBE) of 0.67g Housner, may affect safety related systems have been analyzed previously. These analyses concluded that some of the masonry walls would respond inelastically when subjected to the DBE motion, however, their integrity would be maintained. A masonry wall test program was subsequently undertaken and successfully completed to demonstrate the conservatisms in the non-linear analysis of the walls. The masonry wall analyses as well as the test program utilized data from the masonry wall drawings and construction specifications. During the review of the results of the test program, on September 5, and 6, 1984, the NRC staff requested that a statistical sampling inspection program of the masonry walls be initiated to assure that the "As-Built" field condition of the walls is consistent with the design drawings and specifications.

3.0 METHOD OF VERIFICATION

The inspection of the masonry walls was done by a team of Bechtel engineers familiar with the San Onofre plant structures and masonry wall construction in particular. Various means were employed for the verification of the as-built condition of the walls. These included field walkdowns for visual inspection of masonry wall anchorages, use of electro-magnetic rebar locators, review of a large number of construction inspection data reports (CIDRs), review of photographs of construction in progress during 1981-1984 outage and review of laboratory reports of the masonry wall prism tests performed in January through September, 1983.

The specific items inspected were:

1. Vertical and horizontal rebar location.
2. Continuity of horizontal rebar thru vertical joints.
3. Masonry wall anchorages.
4. Grouting of blockwall cells containing rebars and bond beam locations.

3.1 Verification of Vertical and Horizontal Rebar Location:

Verification of the presence of the rebar was based on inspecting specific sample rebar locations selected using a computerized random

number generator. Sampling was performed without replacement. The rebar sampling plan was designed to provide 95 percent confidence that 95 percent or more of the blockwall rebars have been installed in accordance with specifications and design drawings.

The sampling plan utilized inspection by attributes and consisted of five stages. At the end of each stage, the cumulative data were analyzed to determine whether the "95-95" acceptance criteria had been met. The plan also contained a set of backup samples taken in order as required when specified rebar locations were inaccessible for inspection.

The inspection of the rebar inside the masonry walls was conducted using a rebar locator (instrument manufactured by James Electronics, Model C-4952-R-Meter). This instrument has been in use by Bechtel construction personnel at the SONGS 1 jobsite for the past five years to locate existing rebar in reinforced concrete and masonry walls prior to drilling holes in the walls. The sensitivity of the instrument was verified by testing it at known rebar locations in the masonry walls.The inspection for the rebar sampling plan was conducted from September 24 through September 29, 1984. The specified rebar at the designated 56 locations of stage one were positively located which completely satisfies the acceptance criteria. This inspection verifies at a 95-95 confidence level that the rebar in the masonry walls are placed and located in accordance with the construction specifications

and the design drawings. The summary of observations, including locations where predetermined backup bars were substituted for those that were inaccessible at the original sample location, are listed in Table 2.

3.2 Continuity of Horizontal Rebar thru Vertical Joints

During the inspection for rebar location as outlined in Section 3.1, each horizontal rebar from stage one was traced with the rebar locator across the vertical joints along the path of the rebar where there was accessability. In all instances where this check was made, the rebar was found to be continuous across the vertical joint. The inspection of the continuity of the rebar across every vertical joint along the length of the wall was not always possible because of physical obstructions such as presence of other structural steel, conduits, openings in the walls, wall mounted panels, or unacceptable radiation environment for engineers to spend long durations of time in the area. The summary of findings is tabulated in Table 2. Based on the observations it is verified that the horizontal rebar is continuous through the vertical control joints.

3.3 Inspection of Wall Anchorages

The anchorages between masonry walls and the structural members were verified by visual inspection. All the walls which were part of the

rebar inspection were also checked for the presence of the appropriate anchorage or attachment as shown on the masonry wall design drawing. This was accomplished by visually verifying that the design detail as shown on the drawing physically exists and the spacing of the anchorage matches the design spacing. During this inspection, however, no physical measurements were taken. In some instances, the anchorages at the top were not visible because of the ceiling in the rooms or other obstructions. This data was recorded in the field notes and is reproduced in Table 2. The Table 2 indicates the wall panels inspected for anchorage, the specific design detail and the drawing number used and the finding of the inspection.

In all the wall panels that were inspected, the visible anchorages were found to be as shown on the design drawings.

3.4 Inspection of Grouted Cells and Bond Beam Locations

For the inspection of grouted cells no destructive examinations were performed, however, the available data was utilized to reach conclusions about the grouted cells.

Three sets of existing information were used to establish that the blockwall cells with rebar and the bond beams are grouted. These included:

a. Review of Construction Inspection Data Reports (CIDR).

b. Review of photographs taken during the construction in the present outage (March, 1981 - October, 1984).

c. Review of laboratory reports for the prism samples taken from the existing masonry walls.

The discussions of each of these data are presented below:

One of the tasks for the seismic upgrading program for the Electrical Raceway Supports is the replacement of the expansion anchors in the ungrouted masonry cells with through bolts. The procedure followed by the construction forces to determine whether a cell is grouted or not, is either drilling a pilot hole in the same block near the anchorage and verifying that the cell is grouted or applying an inspection torque to the expansion anchors. The results of the inspections are documented in the CIDRs for every support attached to the masonry walls.

Approximately 200 CIDRs were reviewed along with the raceway support drawings to determine the locations of the grouted cells.

As an example, on the wall TB7 of the Turbine Building, ten CIDRs for the completed supports were available for the review. Four supports from this group had concrete expansion anchors as part of their anchorage. These expansion anchors were accepted by construction quality inspector as anchors installed in the grouted cells. Using the conduit support

drawing dimensions, the supports were located on the elevation of the wall TB-7. With the known spacing of the vertical and horizontal rebars it was verified that the grouted cell locations matched the rebar locations. In case of wall TB-7, all four locations of the grouted cells matched the rebar locations for that wall. Similarly, three grouted cells were located on wall TB-10 with corresponding rebar location match.

During construction activities related to the seismic upgrade of structures in the present outage, holes were made in the existing blockwalls. Photographs of these locations show grouted cells at the bottom or top of the walls where a set of horizontal bars or bond beam is located. Review of the pictures of Turbine Building wall, TB-11, at the locations of holes at elevation 14-0 through the wall indicate that the bottom 3 cells are fully grouted. The rebar drawings show continuous horizontal bars at the bottom course and third course from the bottom. Thus, it is verified that the bottom horizontal cells with rebar at wall TB-11 are grouted.

Similarly, review of the laboratory report for some of the prism samples taken from the Ventilation Equipment, Reactor Auxiliary, and Turbine Buildings indicated presence of solidly grouted cells.

The masonry prism samples taken from walls VB-1 and VB-2 at elevation 22'-10" of the Ventilation Equipment Building, walls SB-1, at elevation 24'-1", of the Reactor Auxiliary Building and wall TB-5, at elevation 22'-0, of the Turbine Building gave positive indication of the grouted cells.

The review of all the above data verifies that the cells in block walls where rebar exist are grouted.

4.0 CONCLUSION

Based on the inspections described in Section 3.0, it is verified that the San Onofre Unit 1 masonry walls are built in accordance with the construction specifications and the design drawings.

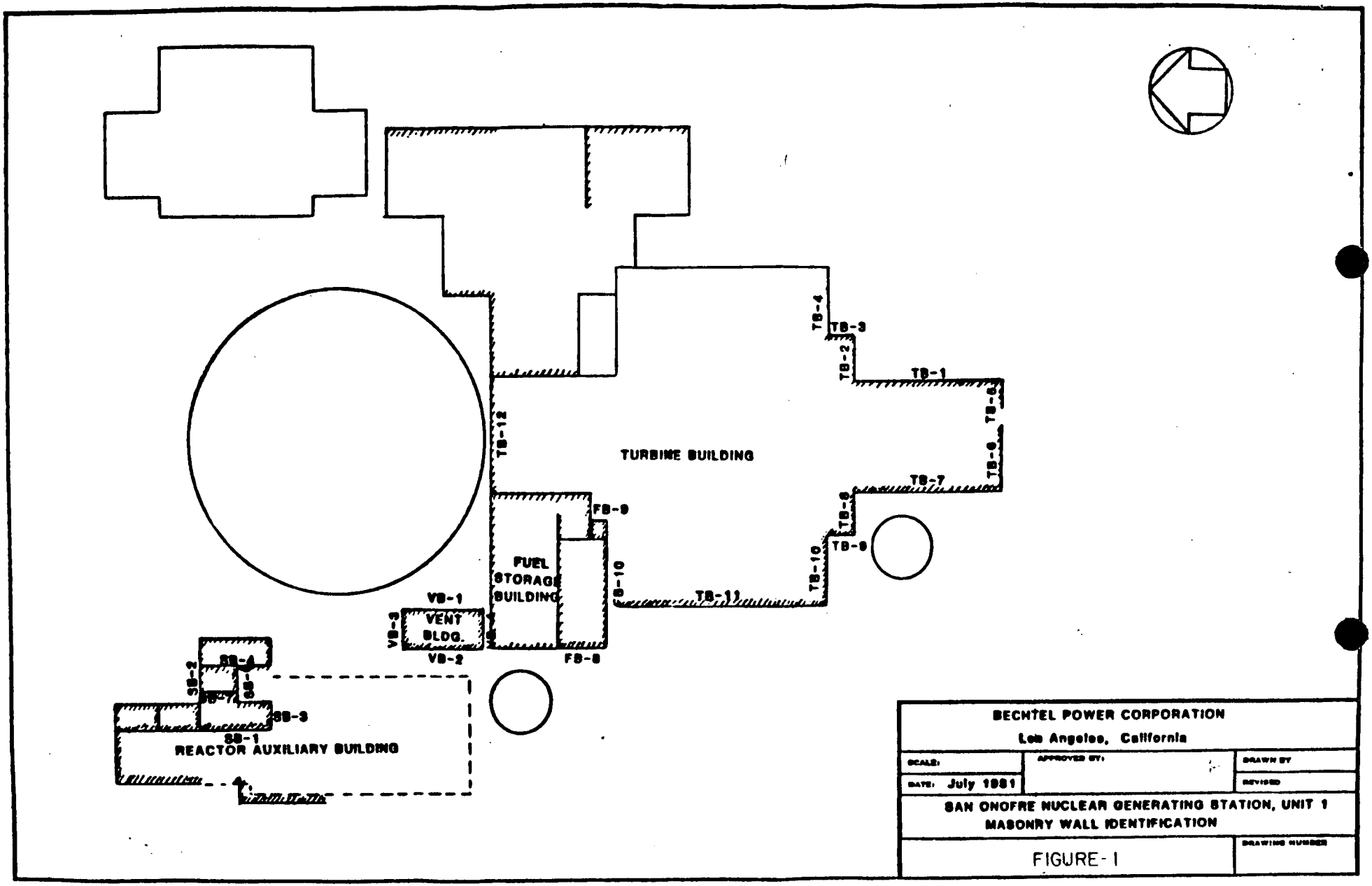
TB-1
TB-2
TB-3
TB-4
TB-5
TB-6
TB-7
TB-8
TB-9
TB-10
TB-11
TB-12
TURBINE BUILDING
FB-9
FUEL STORAGE BUILDING
FB-10
FB-8
VB-1
VB-2
VB-3
VB-4
VENT BLDG.
SB-1
SB-2
SB-3
SB-4
SB-5
SB-6
SB-7
REACTOR AUXILIARY BUILDING
BECHTEL POWER CORPORATION
Los Angeles, California
SCALE:
APPROVED BY:
DRAWN BY
DATE: July 1981
REVISED
SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1
MASONRY WALL IDENTIFICATION
FIGURE-1
DRAWING NUMBER

TABLE 1

REBAR SAMPLING PLAN

Rebar Sample Stage	Rebar Sample Size	Cumulative Sample Size (N)	Acceptance Number (K1)	Rejection Number (K2)
1	56	56	0	$\geq$ 5
2	32	88	1	$\geq$ 7
3	29	117	2	$\geq$ 9
4	27	144	3	$\geq$ 11
5	26	170	4	$\geq$ 12

NOTE:

N = Total number of rebars to be located

K1 = Total number of missing rebars consistent with 95 percent confidence of 95 percent reliability considered acceptable for this cumulative sample size

K2 = If the total number of missing rebars exceed the rejection number K2 then the entire sample will be considered unacceptable, since there is less than a 5 percent chance that the "95-95" criterion can be met.

TABLE 2. MASONRY WALL INSPECTION SUMMARY

Bar No.	Wall I.D.	Rebar Type (2)	Which Bar in Wall (3)	Wall Anchorage Details	Wall Anchorage Verified	Remarks (6)
1	TB-11	V	22	567683 Section F	Yes	Found
2	VB-2	V	10	568139 Section W	Yes	Found
3	FB-3	V	11	568141 Section D	Yes	Found
4	FB-3	V	14	568141 Section D	Yes	Bar located in opening.- use backup B-1 (FB-2 V12)
5	TB-7	V	15	567683 Section B	Yes	Found
6	FB-3	V	1	568141 Section D	Yes	Found
7	FB-1	V	1	568140 Section A	Yes	No access; column inside, too high outside - use backup B-2 (FB-6 V1)
8	TB-1	V	3	567683 Sections A&B	Yes	Found
9	VB-1	H	4	568136 Section W	Yes	Found, continuous across joints
10	FB-5	V	15	568140 Section A	Yes	Found

TABLE 2. MASONRY WALL INSPECTION SUMMARY
(Continued)

Bar No.	Wall I.D.	Rebar Type (2)	Which Bar in Wall (3)	Wall Anchorage Details	Wall Anchorage Verified	Remarks (6)
11	TB-12	V	16	5171935 Section A	Yes	Found
12	TB-12	V	13	5171935 Section A	Yes	Found
13	TB-11	V	30	567683 Section F	Yes	Found
14	SB-2	V	2	568122 Sections C&D	Yes	No access - see Note 1 - use backup B-3 (TB-6 V11)
15	TB-1	V	8	567683 Sections A&B	Yes	Found
16	TB-1	V	7	567683 Sections A&B	Yes	Found
17	FB-1	H	4	568140 Section A	Yes	Found, continuous across joints
18	SB-1	V	5	568122 Section C,D&H	Yes	Found
19	SB-12	V	14	449873 Section D&E	Ceiling Blocked View	Found
20	FB-1	H	2	568140 Section A	Yes	Found - Continuous across joints

TABLE 2. MASONRY WALL INSPECTION SUMMARY
(Continued)

Bar No.	Wall I.D.	Rebar Type (2)	Which Bar in Wall (3)	Wall Anchorage Details	Wall Anchorage Verified	Remarks (6)
21	FB-10	V	18	568140 Section M	Yes	Found
22	SB-3	V	10	568122 Section C&D	Yes	Found
23	FB-1	V	6	568140 Section A	Yes	Found
24	FB-8	H	6	568140 Section M	Yes	Found - Continuous across joints
25	AB-3	V	5	568024 Section H	Yes	Found
26	FB-7	H	4	568140 Section A	Yes	Found - Continuous across joints
27	FB-10	H	7	568140 Section M	Yes	Found - Continuous across joints
28	FB-5	V	18	568140 Section A	Yes	Found
29	TB-7	V	14	567683 Section B	Yes	Found
30	SB-3	V	6	568122 Section C&D	Yes	Found

TABLE 2. MASONRY WALL INSPECTION SUMMARY
(Continued)

Bar No.	Wall I.D.	Rebar Type (2)	Which Bar in Wall (3)	Wall Anchorage Details	Wall Anchorage Verified	Remarks (6)
31	TB-1	V	27	567683 Section A&B	Yes	Found
32	VB-2	H	3	568139 Section W	Yes	Found - Continuous across joints
33	FB-5	V	19	568140 Section A	Yes	Found
34	FB-6	V	10	568140 Section B	Yes	Found
35	FB-6	H	3	568140 Section B	Yes	Found - Continuous across joints
36	TB-9	H	3	567683 Section E	Yes	Found - Continuous across joints
37	SB-7	H	2	568122 Section E	Yes	No access - see Note 1 - use backup B-12 (FB-9-H2)
38	TB-3	H	2	567683 Section D	Yes	Found - Continuous across joints
39	TB-7	V	27	567683 Section B	Yes	Found
40	TB-10	H	1	567683 Section F	Yes	Found - Continuous across joints

TABLE 2. MASONRY WALL INSPECTION SUMMARY
(Continued)

Bar No.	Wall I.D.	Rebar Type (2)	Which Bar in Wall (3)	Wall Anchorage Details	Wall Anchorage Verified	Remarks (6)
41	AB-1	V	2	568024 Section F	Yes	Found
42	TB-6	V	6	567683 Section B	Yes	Found
43	FB-9	H	4	568140 Section M & 14/Section W	Yes	No access; conduit lines both sides of wall - [redacted]e backup B-13 (VB-4 H1)
44	FB-8	V	3	568140 Section M	Yes	Found
45	SB-9	V	18	449873 Section D&E	Ceiling Blocked View	Found
46	FB-8	V	4	568140 Section M	Yes	Found
47	TB-8	V	1	567683 Section D	Yes	Found
48	FB-7	V	3	568140 Section A	Yes	Found
49	SB-9	H	3	449873 Section D&E	Ceiling Blocked View	Found - Continuous across joints

TABLE 2. MASONRY WALL INSPECTION SUMMARY
(Continued)

Bar No.	Wall I.D.	Rebar Type (2)	Which Bar in Wall (3)	Wall Anchorage Details	Wall Anchorage Verified	Remarks (6)
50	SB-12	H	7	449873 Section D&E	Ceiling Blocked View	No access - use backup B-15 - too high in wall (TB-2 H1)
51	TB-12	V	24	5171935 Section A		Found
52	FB-5	V	7	568140 Section A	Yes	Found
53	FB-10	H	6	568140 Section M	Yes	Found - Continuous across joints
54	AB-2	V	6	568024 Section G	Yes	Found
55	FB-5	V	13	568140 Section A	Yes	Found
56	FB-3	V	2	568141 Section D	Yes	Found
B-1 (4)	FB-2	V	12	568140 Section B	Yes	Found - Backup (4)
B-2	FB-6	V	1	568140 Section B	Yes	Found - Backup
B-3	TB-6	V	11	567683 Section B	Yes	Found - Backup

TABLE 2. MASONRY WALL INSPECTION SUMMARY
(Continued)

Bar No.	Wall I.D.	Rebar Type (2)	Which Bar in Wall (3)	Wall Anchorage Details	Wall Anchorage Verified	Remarks (6)
B-4	FB-4	V	5	568140 Section A	Yes	Found - Backup
B-5	FB-10	V	9	568140 Section M	Yes	Found - Backup
B-6	TB-8	V	4	567683 Section D	Yes	Found - Backup
B-12 (5)	FB-9	H (5)	2	568140 Section M	Yes	Found - Backup - Continuous across joints
B-13	VB-4	H	1	568139 Section X	Yes	Found - Backup - Continuous across joints
B-15	TB-2	H	1	567683 Section D	Yes	Found - Backup - Continuous across joints
B-18	FB-2	H	6	568140 Section A	Yes	No access - Too high in wall - Backup
B-20	FB-4	H	3	568140 Section A	Yes	Found - Backup - Continuous across joints
B-23	FB-7	H	5	568140 Section A	Yes	No access - Too high in wall - Backup
B-25	TB-1	H	2	567683 Section A&B	Yes	Found - Backup - Continuous across joints

NOTES:

1. SB-2 and SB-7 are walls for the Baling Rooms for contaminated laundry. Both sides of both walls are inaccessible due to highly contaminated material stored next to the walls which is not easily moved. Per Health Physics 9/26/84.

2. V indicates a vertical bar, H indicates a horizontal bar.

3. Number indicates the specific bar number, counting bars from left to right on the wall inside the building for vertical bars. Similarly, number of the horizontal bar, counting bars from bottom to top.

4. First vertical backup bar taken from a preselected backup sample.

5. First horizontal bar taken from a preselected backup sample.

6. These remakrs pertain to the rebar only.