Southern Nevada. The following events were located:

November 2, 1978

15h25m00.2s, 37.29°N, 116.30°W, focal depth 0 km, constrained (GS). 37°17′16.60″N, 116°17′50.98″W, surface elevation 2131 m, depth of burial 576 m, shot time 15h25m00.169s, "Emmenthal," Nevada Test Site (U.S. Department of Energy). Magnitude 4.3 (BRK M_L), 4.2 (GS m_b).

November 18, 1978

19h00m00.0s, 37.13°N, 116.08°W, focal depth 0 km, constrained (GS). 37°07′36.73°N, 116°05′01.94″W, surface elevation 1302 m, depth of burial 542 m, shot time 19h00m00.166s, "Quargel," Nevada Test Site (U.S. Department of Energy). Magnitude 5.2 (BRK M_L), 5.1 (GS m_b).

December 16, 1978

15h30m00.2s, 37.27°N, 116.41°W, focal depth 0 km, constrained (GS). 37°16′24.22″N, 116°24′36.99″W, surface elevation 2006 m, depth of burial 689 m, shot time 15h30m00.158s, "Farm," Nevada Test Site (U.S. Department of Energy). Magnitude 5.5 (BRK M_L), 5.5 (GS m_b).

Northwestern Iran.

November 4, 1978

15h22m19.3s, 37.67°N, 48.90°E, 34-km depth phases (GS). Felt in the Rasht-Zanjan area (Foreign Broadcast Information Service). Magnitude 6.8 (PAS M_S), 6.0 (BRK M_S), 6.1 (GS m_b), 6.0 (GS M_S).

Solomon Islands. The following earthquakes were located:

November 4, 1978

22h29m22.1s, 11.23°S, 162.18°E, focal depth 33 km, constrained (GS). Felt on San Cristabol and Guadalcanal (Honiara Seismograph Station). This appears to be a multiple event with the second event about 10 seconds later being the larger. Magnitude 6.8 (PAS M_S), 6.8 (BRK M_S), 5.8 (GS m_b), 6.9 (GS M_S).

November 4, 1978

22h51m54.6s, 11.18°S, 162.09°E, focal depth 33 km, constrained (GS). Magnitude 5.9 (GS m_b), 6.0 (GS M_S).

November 5, 1978

22h02m07.1s, 11.13°S, 162.14°E, focal depth 33 km, constrained (GS). Felt strongly on San Cristobal and (IV) at Honiara, Guadalcanal (Honiara Seismograph Station). Magnitude 7.4 (PAS M_S), 7.4 (BRK M_S), 6.3 (GS m_b), 7.1 (GS M_S).

November 7, 1978

17h33m59.5s, 10.10°S, 162.22°E, focal depth 33 km, constrained (GS). Felt at Kira Kira and Honiara (Honiara Seismograph Station). Magnitude 6.2 (PAS M_S), 6.0 (BRK M_S), 5.7 (GS m_b), 6.1 (GS M_S).

November 9, 1978

00h51m28.3s, 10.81°S, 161.37°E, focal depth about 29 km (GS). Magnitude 6.1 (PAS M_S), 5.7 (BRK M_S), 5.3 (GS m_b), 5.8 (GS M_S).

November 27, 1978

23h50m21.4s, 10.85°S, 162.13°E, focal depth 33 km, constrained (GS). Felt (II) at Honiara (Honiara Seismograph Station). Magnitude 6.4 (PAS m_b), 6.1 (PAS M_S), 5.9 (GS m_b), 5.9 (GS M_S).

December 21, 1978

14h36m53.3s, 11.21°S, 162.58°E, focal depth about 30 km (GS). Magnitude 6.4 (PAS M_S), 6.3 (BRK M_S), 5.6 (GS m_b), 6.3 (GS M_S).

Queensland, Australia.

November 28, 1978

17h33m36.1s, 23.34°S, 152.55°E, focal depth about 19 km (GS). Felt in the Rockhampton area (Brisbane Observatory). Believed to be the first instrumentally located hypocenter in this area. Magnitude 4.8 (GS m_b).

Oaxaca, Mexico.

November 29, 1978

19h52m47.6s, 16.01°N, 96.59°W, 18-km depth phases (GS). Eight people reported killed, many injured and extensive damage in the Mexico City area. One person killed, several injured and damage in the state of Oaxaca. Felt throughout southern Mexico and in Guatemala and El Salvador (Foreign Broadcast Information Service and press reports). Magnitude 7.5 (PAS M_S), 7.8 (PAS m_b), 7.9 (BRK M_S), 6.4 (GS m_b), 7.7 (GS M_S).

Tuamotu Archipelago Region. The following events were located:

November 30, 1978

17h31m58.4s, 21.90°S, 138.97°W, focal depth 0 km, constrained (GS). Probable nuclear explosion. Magnitude 6.0 (BRK m_b), 5.9 (GS m_b), 4.0 (GS M_S).

December 19, 1978

16h57m00.1s, 21.73°S, 139.05°W, focal depth 0 km, constrained (GS). Probable nuclear explosion. Magnitude 4.9 (GS m_b).

> Considerations of cost, schedules, and test objectives shall not enter into the review of the technical adequacy of any test from the viewpoint of containment.[18]

Along with their judgments on containment, each panel member evaluates the probability of containment using the following four categories:[19]

1. *Category A:* Considering all containment features and appropriate historical, empirical, and analytical data, the best judgment of the member indicates a high confidence in successful containment as defined in VIII.F. below.
2. *Category B:* Considering all containment features and appropriate historical, empirical, and analytical data, the best judgment of the member indicates a less, but still adequate, degree of confidence in successful containment as defined in VIII.F. below.
3. *Category C':* Considering all containment features and appropriate historical, empirical, and analytical data, the best judgment of the member indicates some doubt that successful containment, as described in VIII.F. below, will be achieved.
4. *Unable to Categorize*

Successful containment is defined for the CEP as:

> . . . no radioactivity detectable off-site as measured by normal monitoring equipment and no unanticipated release of activity on-site.

The Containment Evaluation Panel does not have the direct authority to prevent a test from being conducted. Their judgment, both as individuals and as summarized by the Chairman, is presented to the Manager. The Manager makes the decision as to whether a Detonation Authority Request will be made. The statements and categorization from each CEP member are included as part of the permanent Detonation Authority Request.

Although the panel only advises the Manager, it would be unlikely for the Manager to request detonation if the request included a judgment by the CEP that the explosion might not be contained. The record indicates the influence of the CEP. Since formation of the panel in 1970, there has never been a Detonation Authority Request submitted for approval with a containment plan that received a "C" ("some doubt") categorization from even one member.[20 21]

The Containment Evaluation Panel serves an additional role in improving containment as a consequence of their meetings. The discussions of the CEP provide an ongoing forum for technical discussions of containment concepts and practices. As a consequence, general improvements to containment design have evolved through the panel discussions and debate.

CONTAINING VERTICAL SHAFT TESTS

Once a hole has been selected and reviewed, a stemming plan is made for the individual hole. The stemming plan is usually formulated by adapting previously successful stemming plans to the particularities of a given hole. The objective of the plan is to prevent the emplacement hole from being the path of least resistance for the flow of radioactive material. In doing so, the stemming plan must take into account the possibility of only a partial collapse: if the chimney collapse extends only halfway to the surface, the stemming above the collapse must remain intact.

Lowering the nuclear device with the diagnostics down the emplacement hole can take up to 5 days. A typical test will have between 50 and 250 diagnostic cables with diameters as great as 15/~ inches packaged in bundles through the stemming column. After the nuclear device is lowered into the emplacement hole, the stemming is installed. Figure 3-4 shows a typical stemming plan for a Lawrence

[18] Containment Evaluation P.,e] Charter, June 1, 1986, Section III.D.

[19] Containment Evaluation Panel Charter, June 1, 1986, Section VII.

[20] The grading system for containment plans has evolved since the early 1970's. Prior to April, 1977, the Containment Evacuation Panel categorized tests using the Roman numerals (I-IV) where I-III had about the same meaning as A-C and IV was a D which eventually was dropped as a letter and just became "unable to categorize."

[21] However, one shot (Mundo) was submitted with an "unable to categorize" categorization, Mundo was a joint US-UK test conducted on May 1, 1984.

Table 2-3: Magnitude Yield Relations for NTS

Yr	Mo	Day	Name / Site	m_b GRF	Yield GRF	m_b GERESS	Yield GERESS	Yield Nuttli	No.
1988	Jun	2	Comstock	5.4	60	5.4	49	68	13
1988	Aug	17	Kearsarge, JVE	5.5	75	5.4	150	68	12
1990	Jun	13	Bullion	5.8	150	5.7	114	150	19
1990	Jun	21	Austin			<3.9	<0.8		2
1990	Jul	25	Mineral Quarry	5.0	20	4.7	7	8	9
1990	Oct	12	Tenabo	5.6	90	5.5	65	92	16
1990	Nov	14	Houston	5.5	70	5.4	49	68	14
1991	Mar	08	Coso			4.2	2		7
1991	Apr	04	Bexar	5.7	110	5.5	65	92	15
1991	Apr	16	Montello	5.4	50	5.3	37	50	10
1991	Aug	15	Floydata			<3.6	<0.3		1
1991	Sep	14	Hoya	5.6	90	5.6	86	125	18
1991	Oct	18	Lubbock	5.2	30	5.4	49	68	11
1991	Nov	26	Bristol	4.9	10	4.7	7	8	8
1992	Mar	26	Junction	5.6	100	5.6	86	125	17
1992	Jun	23	Galena			<4.0	<1		4
1992	Sep	18	Hunters Trophy			4.2	2		6
1992	Sep	23	Divider			<3.9	<0.7		3
1993	Sep	22	NPT			4.0	1		5

The GERESS yields are from $\log y = 1.21\ mb - 4.84$. The Nuttli yields were calculated using his 1986 paper and GERESS magnitudes (see text).

The No. column indicates a sorting of the events according to mb(GERESS).

TABLE 1

NTS SHOTS RECORDED AT JAS

No.	Date	Name	Shot Medium	m_b	Gas Porosity (vol %)	Shot Depth (m)	Depth of WT (m)	Symbol*
1	14 Nov 1980	DAUPHIN	tuff	4.1	17.0	320	580	YO
2	17 Dec 1980	SERPA	tuff	5.1	10.0	573	627	PO
3	29 May 1981	ALIGOTE	tuff	4.2	8.0	320	605	YO
4	06 Jun 1981	HARZER	tuff	5.5	3.0	637	668	PO
5	27 Aug 1981	ISLAY	tuff	-	23.0	294	567	YO
6	01 Oct 1981	PALIZA	tuff	4.9	6.0	472	530	YO
7	11 Nov 1981	TILCI	alluvium	4.8	10.1	445	494	YO
8	12 Nov 1981	ROUSANNE	tuff	5.3	2.0	518	495	YX
9	03 Dec 1981	AKAVI	tuff	4.6	14.3	494	580	YO
10	28 Jan 1982	JORNADA	tuff	5.9	0.0	640	507	YX
11	29 Sep 1982	BORREGO	tuff	-	0.0	564	501	YX
12	26 May 1983	FAHADA	tuff	4.4	12.0	384	600	YO
13	09 Jun 1983	DANABLU	alluvium	4.5	12.5	320	584	YO
14	22 Sep 1983	TECHADO	tuff	-	0.0	533	500	YX
15	31 May 1984	CAPROCK	tuff	5.8	0.0	600	500	YX
16	20 Jun 1984	DUORO	tuff	4.6	14.0	381	480	YO
17	02 Aug 1984	CORREO	tuff	4.7	13.0	335	470	YO
18	15 Mar 1985	VAUGHN	tuff	4.8	11.0	427	498	YO
19	12 Jun 1985	SALUT	rhyolite	5.5	4.0	698	622	PX
20	05 Dec 1985	KINIBOTO	tuff	5.7	0.0	579	488	YX
21	22 Mar 1986	GLENCOE	tuff	5.1	0.0	610	522	YX
22	14 Nov 1986	GASCON	tuff	5.8	0.0	594	508	YX

* P and Y denote Pahute Mesa and Yucca Flats regions and

O represents above and X below the water table shots

Digital, vertical component data from JORNADA and the Joint Verification Experiment (JVE) shot, KEARSARGE (17 August 1988; 37.29° N, 116.31° W) are shown in Figure 1. The JVE shot was recorded at the new DWWSSN station, CMB, about 10 km away from JAS; all available data are shown. JORNADA, detonated below WT, has m_b = 5.9 which suggests a yield value close to 150 kt (see, e.g. Bache, 1982). The JVE shot, known to be above WT, also had a yield of probably close to 150 kt although its m_b is only 5.4. The large difference in the Pn amplitudes for the two shots is most probably due to the large differences

RESULTS FROM THE RSTN STATION, RSSD

Short-period, vertical component, digital data from 17 NTS explosions, well recorded at the RSTN station, RSSD (40 samples/sec), with epicentral distances of about 1300 km, are also analyzed in the same manner as the JAS data. These shots are listed in Table 4; note that 10 shots are common with Table 1.

TABLE 4

NTS SHOTS RECORDED AT RSSD

No.	Date		Name	Lat	Lon	shot medium	mb	symbol*
1	1982028	28 jan 82	JORNADA	37.09	-116.05	tuff	5.9	X
2	1982175	24 jun 82	NEBBIOLO	37.24	-116.37	rhyolite	5.6	O
3	1982217	05 aug 82	ATRISCO	37.08	-116.01	tuff	5.7	X
4	1982344	10 dec 82	MANTECA	37.03	-116.07	alluvium	4.6	O
5	1983104	14 apr 83	TORQUOISE	37.07	-116.05	tuff	5.7	X
6	1983125	05 may 83	CROWDIE	37.01	-116.09	alluvium	4.5	O
7	1983146	26 may 83	FAHADA	37.10	-116.01	tuff	4.4	O
8	1983160	09 jun 83	DANABLU	37.16	-116.09	alluvium	4.5	O
9	1984091	31 mar 84	AGRINI	37.15	-116.08	alluvium	4.1	O
10	1984152	31 may 84	CAP ROCK	37.10	-116.05	tuff	5.8	X
11	1984172	20 jun 84	DUORO	37.00	-116.04	tuff	4.6	O
12	1984215	02 aug 84	CORREO	37.02	-116.01	tuff	4.7	O
13	1985074	15 mar 85	VAUGHN	37.06	-116.05	tuff	4.8	O
14	1985122	02 may 85	TOWANDA	37.25	-116.33	tuff	5.7	X
15	1985163	12 jun 85	SALUT	37.25	-116.49	rhyolite	5.5	X
16	1985339	05 dec 85	KINIBOTO	37.05	-116.05	tuff	5.7	X
17	1986318	14 nov 86	GASCON	37.10	-116.05	tuff	5.8	X

* O represents above and X below the water table

Spectra of Pn (window length 6.4 sec) from ATRISCO and NEBBIOLO, two shots of similar magnitudes but the first below WT and the other above WT, are shown in Figure 8. The spectra are not smoothed and are not corrected for instrumental response. The S/N is good up to about 5 Hz. The attenuation correction for the RSSD data is assumed to be t* =