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UCRL-ID-119479

KERNVILLE

Containment Data Report

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December 1994

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This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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<u>Classification Guide</u>	<u>Topic Number</u>	<u>Subject</u>
COK-88-024	1.5.6	Event announcement
NV-89-18		Event announcement
TCG-WT-1	1113	Contractor identification
TCG-WT-1	1121	Personnel identification
TCG-WT-1	1210	Geology
TVG-WT-1	1260	Crater (map)
TCG-WT-1	1413	Statement concerning venting
TCG-WT-1	1452	Event announcement
TCG-WT-1	1831	Depth of burial
TCG-WT-1	1843	Stemming material, amount,etc
TCG-WT-1	1925	Diagnostic canister dimensions
TCG-WT-1	3542.3	Ground motion
TCG-WT-1	4810	Radiation measurement
TCG-WT-1	4820	Acceleration, pressure, temperature measurement

KERNVILLE Instrumentation Summary

Instrumentation	Fielded on this Event	Data Return	Present in this Report
<u>Plug Emplacement</u>	yes	yes	yes
<u>Radiation</u>	no	-	-
<u>Pressure</u>	no	-	-
<u>Motion</u>			
Free Field	no	-	-
Surface	yes	yes	yes
Plug	no	-	-
Stemming	no	-	-
Surface Casing	no	-	-
Emplacement Pipe	no	-	-
<u>Hydroyield^(a)</u>	yes	yes	no
<u>Collapse^(b)</u>	yes	no	-
<u>Stress</u>	no	-	-
<u>Strain^(c)</u>	yes	yes	yes
<u>Other Measurements</u>	no	-	-

- (a) CORRTX and SLIFER in emplacement and satellite holes.
 (b) EXCOR in emplacement and satellite holes.
 (c) Strain gages on emplacement pipe.

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Contents

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1. Event Description

1.1 Containment summary

The KERNVILLE experiment was executed in Hole U20ar of the Nevada Test Site at 10:10 PST on February 15, 1988. on the Pahute Mesa of the Nevada Test Site as indicated in figure 1.1. All early phenomena observed appeared normal, however, cavity collapse reached the ground surface producing a crater having a mean radius of about 61 m and a maximum depth of about 12 m.

No radiation arrivals were detected; the KERNVILLE event containment was considered satisfactory.

1.2 Site

The working point of 540 m was in layered tuffs about 30 m above the static water level (SWL), as seen in figure 1.2⁽¹⁾. Figure 1.2 also contains a geologic map of the region near hole U20ar.

Stemming of the 3.05 m diameter emplacement hole followed the plan shown in Fig. 1.3. The 31 cm diameter satellite hole was stemmed to within a few feet of the top with grout. A log of the stemming operations was maintained by Holmes & Narver⁽²⁾.

1.3 Instrumentation

The instrumentation fielded by the containment group for the KERNVILLE event was confined to emplacement diagnostics, stemming quality assurance, treaty verification measurements, and standard motion stations. Figure 1.4 is a schematic layout of the instrumentation designed to monitor the emplacement and stemming procedures of the KERNVILLE event. Further details of the instrumentation are given in Reference 3. There was no final engineering report issued for this event.

Two EXCOR stations were fielded in the satellite hole to observe the progression of post-shot collapse.

Yield verification measurements in the emplacement hole consisted of two CORRTEX stations (figure 1.4) and in the satellite hole two CORRTEX stations, two SLIFER stations and two pin-switch arrays (figure 1.5). Results of these experiments are reported elsewhere⁽⁴⁾.

Surface motion measurements consisted of a vertically oriented station placed 15.24 m horizontally from Surface-Ground-Zero (SGZ) and 0.6 m below the ground surface and a triaxial station mounted in the recording trailer about 270 m from SGZ. Additionally, a geophone station was fielded in the ground surface near the recording trailer. Both of the motion transducers in this station were ranged for motion of very low amplitude and were greatly over-driven by the explosion signals.

Atmospheric pressure was monitored by a transducer mounted inside the recording trailer and ported through the wall to the outside. The recording time period (about 3 hours) was too short to sample the long-term changes in the atmosphere, the porting precluded an accurate representation of the airblast waveform, and the signal included many noise spikes. For these reasons the signal is not shown in this report.

The emplacement pipe strain data collected during emplacement and stemming were taken from the stemming log maintained by Holmes & Narver⁽²⁾. The curing temperature data of the SGC plugs are not available.

Figure 1.1 Map of the Nevada Test Site indicating the location of hole U20ar.

A-A' GEOLOGIC CROSS SECTION THROUGH U20ar

Figure 1.2 Geologic cross section through hole U20ar.

Figure 1.3 As-built stemming plan for the event KERNVILLE, in Hole U20ar.

2. Emplacement

2.1 Pipe strain

Figure 2.1 is the strain history measured on the emplacement pipe and read from the stemming log⁽²⁾ during stemming of the KERNVILLE experiment. The emplacement pipe was instrumented with a strain gage station on the final pipe section just below the load collar, (Station 88), and another station just above the diagnostics canister (Station 81).

2.2 Plug levels and temperature

The emplacement of each of the six SGC plugs was monitored with an array of conductivity probes and thermistors. The locations of each of the components (probes) of these arrays are shown in Figure 1.4. The upper and lower boundary positions of the plugs were determined by tag lines. Figures 2.2 through 2.7 contain plots of the arrival times of the SGC slurry as a function of depth (as determined from the conductivity probes and tag lines) and SGC temperature histories. These data indicate that all plugs were emplaced as planned.

The satellite hole was grouted from depth to within a few feet of the ground surface.

Figure 2.1 Strain measurements during the stemming at stations 88 (near the top of the emplacement pipe), and 81, (on the emplacement pipe just above the diagnostics canister).

Figure 2.2 Emplacement diagnostics data at SGC plug #1. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; open symbols are at the tag depths. Probes annotated with 'T' included temperature sensors.

Figure 2.3 Emplacement diagnostics data at SGC plug #2. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; open symbols are at the tag depths. Probes annotated with 'T' included temperature sensors.

Figure 2.4 Emplacement diagnostics data at SGC plug #3. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; open symbols are at the tag depths. Probes annotated with 'T' included temperature sensors.

Figure 2.5 Emplacement diagnostics data at SGC plug #4. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; open symbols are at the tag depths. Probes annotated with 'T' included temperature sensors.

Figure 2.6 Emplacement diagnostics data at SGC plug #5. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; open symbols are at the tag depths. Probes annotated with 'T' included temperature sensors.

Figure 2.7 Emplacement diagnostics data at SGC plug #6. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; open symbols are at the tag depths. Probes annotated with 'T' included temperature sensors.

3. Stemming Performance

Pressure and radiation were not monitored down the hole on this event. No radiation was detected above ground. Containment of KERNVILLE was considered satisfactory.

Atmospheric pressure was monitored by a transducer mounted inside the recording trailer and ported through the wall to the outside. The recording time period (about 3 hours) was too short to sample the gross changes in the atmosphere, the porting precluded an accurate representation of the airblast waveform, and the signal included many noise spikes. For these reasons the signal is not shown in this report.

The EXCOR signal (station 51, in the satellite hole) was terminated very shortly after detonation. This allowed only one datum from which to determine the position of cable breakage. With no other corroborating data, the EXCOR is assumed to have malfunctioned and is not presented. All other data derived from the satellite hole were yield-related measurements and may be obtained from reference 4.

4. Motion

Figures 4.1 and 4.2 show the explosion- and collapse-induced motion of the ground surface 15.24 m from SGZ. Figures 4.3, 4.4, and 4.5 show the three components of the explosion-induced trailer motion. Motion of the trailer during collapse was too small to be meaningfully processed and is thus not shown. For completeness, the signals from the geophone station are shown in Figure 4.6. These have not been converted to engineering units since, for the most part, they exceeded the dynamic range of the recording system.

Motion arrival times and peaks are given in Table 4.1. Characteristics of the motion transducers are given in Tables 4.2 and 4.3.

Table 4.1 Summary of Motion

Gage	Slant Range (m)	Arrival Time (ms)	Acceleration Peak (g)	Velocity Peak (m/s)	Displacement Peak (m)	Displacement Resid. (cm)
61av	540	296	3.44,12.2 ^(a)	4.7	2.13	0
61uv	-	-	-	4.3	1.88	-.10
71av	605	380	2.8	3.5	0.80	0.30
71uv	-	-	-	3.10	0.77	0.13
71ar	605	390	1 ^(b)	1.13	0.90	0.15
71ur	-	-	-	1.18	0.92	0.13
71at	605	385	-.25 ^(b)	-.15,0.85	-0.05,0.37	0.2
71ut	-	-	-	-.17,0.80	-0.05,0.39	0.07

(a) Slap - down peak.

(b) Too noisy to accurately determine.

Table 4.2 Accelerometer Characteristics

Gage	Natural Frequency (Hz)	Damping Ratio	System Range (g's)
61av	380	.75	24
71av	350	.62	20
71ar	420	.85	15
71at	300	.55	7.5

(a) All gages were manufacturer by Validyne, Inc.

Table 4.3 Velocimeter Characteristics

Gage	Natural Frequency (Hz)	Time to 0.5 Amplitude (s)	Calibration Temperature (°C)	Operate Temperature (°C)	System Range (m/s)
61UV	3.375	8.34	24.80	2.44	16
71UV	3.515	9.28	25.25	14.9	7
71ur	3.334	9.40	24.95	14.99	5
71ut	3.315	9.29	25.01	14.99	5

Figure 4.1 Explosion-induced vertical motion of ground surface 15.24 m from SGZ (Station 61). Traces annotated with "a" are derived from the accelerometer history.

Figure 4.2 Collapse-induced vertical motion of ground surface 15.24 m from SGZ (Station 61).
Traces annotated with "a" are derived from the accelerometer history.

Figure 4.3 Explosion-induced vertical motion of recording trailer about 270 m from SGZ (Station 71). Traces annotated with "a" are derived from the accelerometer history.

Figure 4.4 Explosion-induced horizontal-radial motion of recording trailer about 270 m from SGZ (Station 71). Traces annotated with "a" are derived from the accelerometer history.

Figure 4.5 Explosion-induced horizontal-transverse motion of recording trailer about 270 m from SGZ (Station 71). Traces annotated with "a" are derived from the accelerometer history.

Figure 4.6 As-digitized explosion- and collapse-induced signals recorded at the geophone station in the ground surface near the recording trailer about 270 m from SGZ (Station 62). The only processing of these records was to set the baseline to zero digitizer counts.

References

1. Steve Clark, Robin Newmark, and Dick McArthur, "U20ar Site Characteristics Report", Lawrence Livermore National Laboratory, CP 87-26, March 16, 1987.
2. R. Hutchinson (for S. L. Doney), "Emplacement and Containment Report for KERNVILLE U20ar," Holmes & Narver, Inc., NTS:A2:88-14, February 14, 1988.
3. B. Bellow, "Special Measurements Physics/Instrumentation, KERNVILLE, U20ar", EG&G, energy Measurements, Las Vegas Operations, SM:87E-144-37, Sept.1,1988.
4. LLNL contacts for additional information: H. Goldwire (CORRTEX and SLIFER data).

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