12/2-14-95 JSL

ROQUEFORT

Containment Data Report

Ted Stubbs
Ray Heinle

December 1994

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

SL

DISCLAIMER

This document was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor the University of California nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or the University of California. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or the University of California, and shall not be used for advertising or product endorsement purposes.

This report has been reproduced
directly from the best available copy.

Available to DOE and DOE contractors from the
Office of Scientific and Technical Information
P.O. Box 62, Oak Ridge, TN 37831
Prices available from (615) 576-8401, FTS 626-8401

Available to the public from the
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Rd.,
Springfield, VA 22161

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

<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

ROQUEFORT Instrumentation Summary

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

- (a) CORTEX or SLIFER in emplacement hole.
(b) EXCOR or CLIPER in emplacement hole.
(c) Emplacement pipe and instrumentation pendant.

Event Personnel

Containment Physics

B. Hudson	LLNL
V. Wheeler	LLNL
J. Kalinowski	EG&G/AVO
T. Stubbs	EG&G/AVO

Instrumentation

C. Cordill	LLNL
R. McNairy	LLNL
C. Simkins	EG&G/AVO
T. Williams	EG&G/NVO
L. Farthing	EG&G/NVO

Contents

[illegible]

1. Event Description

1.1 Site

The ROQUEFORT event was detonated in hole U4as of the Nevada Test Site as indicated in Fig. 1.1. The device had a depth-of-burial of 415 m in the tunnel beds tuff, immediately below a 12 m thick layer of light ash (Grouse-Canyon Airfall) of Area 4. The working point was about 180 m above the standing water level (SWL), as shown in Figures 1.2 and 1.3.⁽¹⁾ Stemming of the 2.44 m diameter emplacement hole followed the plan shown in Fig. 1.4. A log of the stemming operations was maintained by Holmes & Narver⁽²⁾.

Detonation time was 21:35 PST on October 16, 1985 and about 1 hours, 37 minutes later collapse reached the surface, leaving a crater with mean radius of 66.9 m and maximum depth of 8.9 m.

No radiation arrivals were detected in the emplacement hole and the ROQUEFORT containment was considered successful.

1.2 Instrumentation

Figure 1.5 is a schematic layout of the instrumentation designed to monitor the emplacement procedures and stemming performance of the ROQUEFORT event.

The usual final engineering report was not issued for this event, but details of the instrumentation are given in Reference 4.

Three of the five stemming plugs (the first, fourth and fifth) were composed of coarse gypsum aggregate in a gypsum cement slurry. Each of the three gypsum filled aggregate (GFA) plugs was monitored during emplacement with arrays of conductivity probes and thermistors. The remaining two plugs were soft, coal tar aggregate (CT/A) gas seal membranes having a thickness of about 3 m sandwiched between 3 m thick layers of fines. A 2 m thick CT/A membrane was poured on the top of the two uppermost GFA plugs.

Gas pressure challenging the bottom plug was monitored through two short sections (about 50 m) of gas-sample hose that penetrated the plug. One of the hose sections serviced two sensor stations, one within and near the bottom of the plug with the second on the top of the hose, about 35 m above the plug. The third challenge pressure station was fielded about 8 m below the second station and had its own hose section penetrating the plug. Although shown in Figure 1.5, Station 32 (containing crack gauges and a pressure sensor) was not recorded.

Two CLIPER/CORRTEX sensors were emplaced, as indicated in Figure 1.5, to measure the hydrodynamic yield of the device and to monitor cavity collapse and chimney formation. Results of the yield measurements are reported elsewhere⁽³⁾.

In the emplacement hole, vertical motion was monitored at each of the seven pressure-radiation stations in the coarse stemming and at two separate motion stations in each of the top GFA plugs. See Figure 1.5. Additionally, four motion stations were fielded in the ground surface and one in the recording trailer. The surface array stations were approximately equally spaced on a line extending from the emplacement hole for a distance of 630 m in a direction 44° west of north.

A Genisco reel-type displacement gauge was mounted between an anchor in the ground surface about 75 m from the emplacement hole and the gas sampling hose. It had an initial extension of 10 ft with a full system range of greater than 85 ft.

Stress was monitored at two elevations in the bottom GFA plug as indicated in Figure 1.5.

Figure 1.1 Map of the Nevada Test Site indicating the location of hole U4as.

Figure 1.2 Surface geological map of the U4as site.

Figure 1.3 Geologic cross sections through hole U4as.

Figure 1.5 As-built containment instrumentation plan for the ROQUEFORT event.

2. Emplacement

2.1 Pipe and instrumentation pendant strain

Figure 2.1 is the strain history measured on the emplacement pipe during stemming of the ROQUEFORT experiment. The emplacement pipe was instrumented with a strain gage station on the final pipe section just below the load collar (Station 86) and another station on the emplacement pipe just above the diagnostics canister (Station 80).

Load on the instrumentation pendant was monitored at elevations on either side of the top SGC plug (Stations 87 and 88). The data returned from these positions are also shown in Figure 2.1.

2.2 Plug levels and temperature

The emplacement of each of the three gypsum concrete plugs was monitored with an array of conductivity probes and thermistors. The locations of the probes are tabulated in Figure 1.7. The upper and lower boundary positions of the plugs were determined by tag lines. Figures 2.2 through 2.4 contain plots of the arrival times of the GFA slurry as a function of depth (as determined from the conductivity probes and tag lines) and GFA temperature histories. A temperature sensor was located at the approximate mean depth of each concrete plug. These data indicate that all plugs were emplaced as planned.

Figures 2.1 The upper pair of plots show the strain history of the emplacement pipe during the stemming at Stations 86 (near the top of the pipe), and 80 (above the diagnostics canister near the bottom of the pipe). The lower two plots show the load history measured on the instrumentation pendant (Stations 87 and 88).

Figure 2.2. Emplacement diagnostics data at GFA plug 1 at a depth of 344 m. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; the open symbols are at the tag depths. The temperature sensor was located at probe "E".

Figure 2.3. Emplacement diagnostics data at GFA plug 4 at a depth of 100 m. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; the open symbols are at the tag depths. The temperature sensor was located at probe "C".

Figure 2.4. Emplacement diagnostics data at GFA plug 5 at a depth of 28 m. The upper and lower boundaries of the plug were determined with a tag line. Solid symbols indicate the elevation of the probes; the open symbols are at the tag depths. The temperature sensor was located at probe "C".

3. Stemming Performance

3.1 Radiation and Pressure

As seen in Figure 1.7, the region below each GFA plug was monitored by pressure and radiation stations as were the regions between the deepest GFA plug and around the deepest CT/A plug. The signals were transmitted to the recording trailer in analog form and recorded on magnetic tape for later processing.

Emplacement hole pressure and radiation histories, from a few seconds before detonation until recording termination, are displayed in Figures 3.1 through 3.10. Cavity collapse reached the ground surface at about 1 hour, 37 minutes at which time all down-hole pressure and radiation instrumentation was lost.

Pressure and radiation challenging the deepest GFA plug are shown in Figures 3.1 -3.4. Station 31 (in the GFA plug and on a section of gas-sample hose) was lost at detonation time and the resulting pressure record is shown in Figure 3.1 for completeness (radiation was not monitored at this station). Pressure and radiation are separately shown in Figures 3.2 and 3.3 to linear scales while Figure 3.4 is a composite of both stations shown to logarithmic scales. This latter representation allows the earlier portion of the records to be shown to greater definition. Further, these data suggest a pressure decay history following $P \approx P_0 \cdot 10^{(-0.8T)}$ after about 5 minutes.

Figures 3.5 - 3.9 show the measured pressure and radiation histories from a few seconds before detonation until cavity collapse terminated the records. The only station showing neither radiation nor pressure change was 37 (below the top plug, Figure 3.9). A small pulse of radiation was observed at Station 36 (Figure 3.8), but not at Station 37, indicating that radiation was contained below plug 4. Figure 3.10 is a composite of pressure and radiation measured at all of the stemming stations with the exception of Station 37. Again, for ease of presentation, a logarithmic scale is used. Station 33 is included as a measure of the pressure below the deepest plug and to compare the radiation wave form with that of Station 31. Except for a scale factor, the radiation wave forms from Stations 31 and 33 are nearly identical between 200 and 2000 seconds. Further, the major radiation arrival appears to be riding on the pressure wave as it travels up the emplacement hole. A minor radiation arrival is evident at the stemming stations below 36 and both major and minor arrivals are plotted in Figure 3.11.

Note that the radiation detector electronics requires that the detector be shut down immediately after the EMP for a time of about 100 seconds, followed by a short recovery period. Thus there may be earlier, undetected arrivals.

Since no pressure changes other than those attributable to ground motion were seen above Station 35 and no radiation arrivals were seen above Station 36, the pressure and radiation data are consistent with satisfactory containment.

Figure 3.1 Measurement of the pressure challenging the deepest GFA plug. Sensor station (Station 30) was in the plug, connected to a section of gas-sample hose penetrating to a sand layer below the plug. Signals from this station were terminated at zero time.

Figure 3.2 Measurement of pressure and radiation challenging the deepest GFA plug. Sensor station (Station 33, at a depth of 307.9 m) was in the coarse stemming, 36 m above the plug, connected to a section of gas-sample hose penetrating through the plug to a sand layer below it. This was the same hose on which was mounted Station 30.

Figure 3.3 Measurement of pressure and radiation challenging the deepest GFA plug. Sensor station (Station 38, at a depth of 315.5 m) was in the coarse stemming, 29 m above the plug, connected to a section of gas-sample hose penetrating through the plug to a sand layer below it.

Figure 3.4 Composite of challenge pressure and radiation for the first 2000 seconds after detonation.

Figure 3.5 Pressure and radiation measured in the coarse stemming between the plugs 1 and 2 (Station 31 at 312.4 m depth).

Figure 3.6 Pressure and radiation measured in the coarse stemming below the CT/A plug 2 (Station 34 at 278.9 m depth).

Figure 3.7 Pressure and radiation measured in the coarse stemming above the CT/A plug 2 (Station 35 at 265.2 m depth).

Figure 3.8 Pressure and radiation measured in the coarse stemming below the GFA plug 4 (Station 36 at 117.4 m depth).

Figure 3.9 Pressure and radiation measured in the coarse stemming below the top GFA plug (Station 37 at 46.3 m depth).

U4as

Figure 3.10 Overlay of the pressure and radiation histories from stations in the stemming. Those stations which detected either radiation or gas pressure (other than ground motion-induced) are represented. Included for comparison are the data from Station 33 which was designed to monitor the gas challenging the deepest plug. Note the logarithmic scales.

Figure 3.11

Arrival times in the coarse stemming material. Detectable radiation does not flow above the stemming platform (plug 4). A first, low-level arrival is indicated by the open diamonds while the major radiation arrival is indicated by the solid circles. Arrival times (in seconds) are shown for convenience.

3.2 Motion

Explosion-induced motion histories obtained from the ROQUEFORT emplacement hole are shown in Figures 3.12-3.21. The motion data are ordered by station elevation in the emplacement hole, not by station number. Station 21 was mounted in GFA plug 4, Station 22 was in the top GFA stemming plug, Station 61 was 0.91 m deep in the ground surface 15.24 m from surface ground zero (SGZ), and the rest were in the coarse stemming material of the emplacement hole. Station 61 is part of a linear surface array and, as such, is also reported in section 4.1. Note that Stations 33 and 38 were attached to short sections of gas-sample hoses (48.8 m) that penetrated the bottom plug and thus might have motions that are not representative of the stemming. Elevations of all stations are shown in Figure 5.

Arrivals and peaks of the motion are given in table 3.1 while characteristics of the motion transducers are given in tables 3.2 and 3.3.

3.3 Collapse phenomena

Both the CLIPER and EXCOR cables (Stations 91 and 92) performed as expected, giving the lower position of each cable end as a function of time during the cavity collapse. These data are shown in Figure 3.22 along with collapse motion signals.

The collapse motion data shown in Figures 3.23-3.31 are ordered by station elevation in the emplacement hole, not by station number. As previously noted, Stations 33 and 38 are attached to section of gas-sample hoses, thus possibly accounting for the early loss-time of Station 33 (Figure 3.25) as compared to the nearby stations mounted free in the coarse stemming (Stations 31 and 34). A uniform progression of the collapse to the ground surface terminated all data transmission from the emplacement hole below 35 m depth. At 15 m from SGZ (Station 61, Figure 3.31) the ground surface is seen to drop by about 7-8 m.

A Genico "fishing reel" type displacement transducer was mounted between an anchor in the ground surface about 25 m from the emplacement hole and the gas-sample hose. The device was installed with an initial extension of about 3 m and the shock produced an additional 15 to 20 cm of extension. Upon collapse, a final extension of about 10.4 m was observed (Figure 3.32) in accord with the displacement data from Station 61. Figure 3.33 shows a composite plot of the CLIPER, EXCOR and Genico data during the 15 seconds of collapse. These data suggest that the gas-sample hose began to fall with plug 4 (at a depth of about 100 m). The survey taken the day following the event shows a crater with a maximum depth of 8.9 m and a mean radius of 66.9 m.

Table 3.1 Summary of Motion

Gauge	Slant Range (m)	Arrival Time (ms)	Acceleration Peak (g)	Velocity Peak (m/s)	Displacement Peak (cm)	Displacement Residual (cm)
21av	307.8	75(a), 157	2.35	0.36, 0.51	11, 14	11.5
21uv			-	0.47, 0.58	12.5, 15	4.3
22av	378.8	93(a), 201	1.55	0.3, 0.70	13.5	4.5
22uv			-	0.37, 0.86	16.0	4.0
31av	102.0	26	10, 23	13.1	178	150
33av	106.6	50	8.3, 25.2	11.2	130	0(b)
34av	135.6	34(a), 64	0.6, 2.2	0.8	9.8	8
35av	149.3	42(a), 71	4.9, 7.1	0.68, 1.80	19	30
36av	297.1	59(a), 75	0.85, 2.8	0.35	8.5, 10	-1
37av	368.1	96	1.35	0.61	11.6	12.5
38av	99.0	30	10.2, 29	13.6	198	187
61av	413.8	235	3.5, 7.3(c)	0.64	12.7	3
61uv			-	0.70	37	5.5

(a) Early arrival, possibly from the emplacement pipe.

(b) Very difficult to estimate.

(c) Slap-down peak.

Table 3.2 Accelerometer Characteristics

Gauge	Natural Frequency (Hz)	Damping Ratio	System Range (g's)
21av	250	0.77	4
22av	240	0.65	5
31av	(a)	(b)	625
33av	(a)	(b)	625
34av	(a)	(b)	62.5
35av	(a)	(b)	31.25
36av	(a)	(b)	31.25
37av	(a)	(b)	62.5
38av	(a)	(b)	625
61av	600	0.62	30

(a) Piezoresistive element: mounted resonance ≥ 2000 Hz.

(b) Manufacturer's specification: damping ratio = 0.7.

Table 3.3 Velocimeter Characteristics

Gauge	Natural Frequency (Hz)	Time to 0.5 Amplitude (s)	Calibration Temperature (°C)	Operate Temperature (°C)	System Range (m/s)
21uv	3.486	9.46	26.47	29.89	6
22uv	3.560	8.42	26.23	37.64	6
61uv	3.561	8.35	26.28	13.68	8

Figure 3.12

Explosion-induced vertical motion in the coarse stemming at a depth of 315.5 m (Station 38). This station was connected to a section of gas-sample hose penetrating the deepest plug and the motion is expected to be influenced by this element.

Figure 3.13 Explosion-induced vertical motion in the coarse stemming at a depth of 312.4 m (Station 31).

Figure 3.14

Explosion-induced vertical motion in the coarse stemming at a depth of 307.9 m (Station 33). This station was connected to a section of gas-sample hose penetrating the deepest plug and the motion is expected to be influenced by this element.

Figure 3.15 Explosion-induced vertical motion of the coarse stemming below the CT/A plug 2 (Station 34 at 278.9 m depth).

Figure 3.16

Explosion-induced vertical motion of the coarse stemming above the CT/A plug 2 (Station 35 at 265.2 m depth).

Figure 3.17 Explosion-induced vertical motion of the coarse stemming below the GFA plug 4 (Station 36 at 117.4 m depth).

Figure 3.18

Explosion-induced vertical motion of GFA plug 4 (Station 21 at 106.7 m depth). Those traces annotated with "a" are derived from the acceleration history.

Figure 3.19 Explosion-induced vertical motion of the coarse stemming below the top GFA plug (Station 37 at 46.3 m depth).

Figure 3.20

Explosion-induced vertical motion of the top GFA plug (Station 22 at 35.7 m depth). Those traces annotated with "a" are derived from the acceleration history.

Figure 3.21

Explosion-induced vertical motion of the ground surface 15.24 m from Surface Ground Zero (Station 61, at a depth of 0.91 m). This station is also part of the surface array and, as such, is also shown in section 4. Those traces annotated with "a" are derived from the acceleration history.

Figure 3.22 Progression of collapse in stemming column as indicated by CLIPER and EXCOR (Stations 91 and 92). Also shown are collapse signals obtained from stemming and surface motion stations.

Figure 3.23

Collapse acceleration seen at Station 38 at 315.5 m depth. This station was connected to a section of gas-sample hose penetrating the deepest GFA plug and the motion is expected to be influenced by this element. Integration of these data is not meaningful and is not reported.

Figure 3.24 Collapse acceleration in the coarse stemming at a depth of 312.4 m (Station 31). Integration of these data is not meaningful and is not reported.

Figure 3.25 Collapse acceleration seen at Station 33 at 307.9 m depth. This station was connected to a section of gas-sample hose penetrating the deepest GFA plug and the motion is expected to be influenced by this element. Integration of these data is not meaningful and is not reported.

Figure 3.26

Collapse motion of the coarse stemming below CT/A plug 2 (Station 34 at 278.9 m depth).

Figure 3.27 Collapse motion of the coarse stemming above CT/A plug 2 (Station 35 at 265.2 m depth).

Figure 3.28 Collapse motion of the coarse stemming below GFA plug 4 (Station 36 at 117.4 m depth).

Figure 3.29 Collapse motion of GFA plug 4 (Station 21 at 106.7 m depth). Those traces annotated with "a" are derived from the acceleration history.

Figure 3.30 Collapse motion in the coarse stemming below GFA plug 5 (Station 37 at 46.3 m depth).

Figure 3.31

Collapse motion of top GFA plug (Station 22 at 35.7 m depth). Those traces annotated with "a" are derived from the acceleration history.

Figure 3.31

Collapse motion of the ground surface 15.24 m from Surface Ground Zero (Station 61, at a depth of 0.91 m). Those traces annotated with "a" are derived from the acceleration history.

Figure 3.32 Displacement history monitored by a Genico "fishing reel" type transducer (Station 39) mounted between an anchor in the ground surface about 25 m from the emplacement hole and the full gas-sample hose in the emplacement hole. Initial extension was about 3. m.

Figure 3.33

Composite plot of CLIPER and EXCOR records (Stations 91 and 92) and the Genisco transducer (Station 39). The beginning of the Station 39 excursion occurs when the data from the CLIPER and EXCOR indicate that the collapse has progressed to a depth of about 110 m, in plug 4.

4. Other Measurements

4.1 Surface motion

Explosion-induced motion histories obtained from the ground surface and the recording trailer are shown in Figures 4.1-4.7. Arrivals and peaks of the motion are given in table 4.1 while characteristics of the motion transducers are given in tables 4.2 and 4.3. Stations 61 through 64 were located at a depth of 0.9 m in the ground surface on a line extending 44° west of north at intervals of approximately 210 m. Additionally, Station 61 is usually considered to be part of the emplacement hole diagnostics and, as such, is also reported in section 3.2.

4.2 Geophone history during and after detonation.

The histories of the geophone and sensitive accelerometer (Station 69) are shown in Figure 4.8. This station was buried in the ground surface just outside of the recording trailer.

4.3 Stress and strain in the bottom GFA plug.

The stress and strain transducers fielded in the deepest GFA plug on ROQUEFORT consisted of flat-pack, interwoven Ytterbium and Constantan grids. Fluid coupling of the grids to the stress field was attempted to remove the effects of the mounting medium, the grids were interwoven to sense the same stress and strain, the Constantan was used to remove the strain effects from the Yb, and the flat geometry was an attempt to assure that only one vector component was sensed. Radial and transverse transducers were fielded at each of two elevations in the plug.

Figures 4.9 and 4.10 show the output from the eight transducer grids. The EMP introduces an early time "ringing" in the electronics of the transducer, either from direct coupling to the grid, inadequate grounding, or both and invalidates the records for about the first 40 ms. Records are left in the form of percent resistance change since there is some ambiguity in the literature as to the correspondence of this measured quantity to the applied stress for Yb and these are the units in which the strain is removed from the Yb output.

Table 4.1 Summary of Motion

Gauge	Slant Range (m)	Arrival Time (ms)	Acceleration Peak (g)	Velocity Peak (m/s)	Displacement Peak (cm)	Displacement Residual (cm)
61av	413.8	235	3.5, 7.3(a)	0.64	12.7	3
61uv			-	0.70	37	5.5
62av	476.0	277	1.64, 2.12(a)	0.49, 0.68	14.3	5
62uv			-	0.51, 0.70	14.8	3.5
63av	599.8	358	0.45, 2.3(a)	0.22, 0.30	5.2, 10(b)	5
63uv			-	0.24, 0.31	5.2, 9(b)	1.3
64av	765.2	450	0.28, 0.43(a)	0.13	1.7	-0.5(c)
64uv			-	0.13	1.7	-0.3
71av	463(d)	275	2.6, 5.7(a)	0.78	16	6
71uv			-	0.80	16	4
71ar	463(d)	300	0.3	0.42	30	20
71ur			-	0.6	48	40
71at	463(d)	275	0.2	0.21	46	2
71ut			-	0.21	46	-4

(a) Slap-down peak.

(b) Maximum value.

(c) Difficult to approximate.

(d) Range is approximate: station is in recording trailer.

Table 4.2 Accelerometer Characteristics

Gauge	Natural Frequency (Hz)	Damping Ratio	System Range (g's)
61av	600	0.62	30
62av	540	0.62	30
63av	600	0.68	30
64av	530	0.65	30
71av	325	0.65	20
71ar	325	0.65	15
71at	355	0.65	15

Table 4.3 Velocimeter Characteristics

Gauge	Natural Frequency (Hz)	Time to 0.5 Amplitude (s)	Calibration Temperature (°C)	Operate Temperature (°C)	System Range (m/s)
61uv	3.561	8.35	26.28	13.68	8
62av	3.672	8.24	26.3	15.86	8
63uv	3.670	8.76	24.15	16.83	8
64uv	3.578	9.28	24.59	16.54	8
71uv	2.999	23.50	24.34	16.57	7
71ur	4.711	11.11	24.42	16.57	5
71ut	4.835	11.80	24.88	16.57	5

Figure 4.1 Explosion-induced vertical motion of ground surface at a depth of 0.91 m and horizontal range of 15.24 m from SGZ on a line extending 44° west of north (Station 61). This station is considered as being part of the emplacement hole environment and, as such, is also shown in section 3. Those traces annotated with "a" are derived from the acceleration history.

Figure 4.2 Explosion-induced vertical motion of ground surface at a depth of 0.91 m and horizontal range of 210 m from SGZ on a line extending 44° west of north (Station 62). Those traces annotated with "a" are derived from the acceleration history.

Figure 4.3 Explosion-induced vertical motion of ground surface at a depth of 0.91 m and horizontal range of 420 m from SGZ on a line extending 44° west of north (Station 63). Those traces annotated with "a" are derived from the acceleration history.

Figure 4.4 Explosion-induced vertical motion of ground surface at a depth of 0.91 m and horizontal range of 630 m from SGZ on a line extending 44° west of north (Station 64). Those traces annotated with "a" are derived from the acceleration history.

71v

Figure 4.5 Explosion-induced vertical motion of recording trailer (Station 71). Horizontal range is approximately 464 m. Those traces annotated with "a" are derived from the acceleration history.

Figure 4.6 Explosion-induced horizontal-radial motion of recording trailer (Station 71). Horizontal range is approximately 464 m. Those traces annotated with "a" are derived from the acceleration history.

71t

Figure 4.7 Explosion-induced horizontal-transverse motion of recording trailer (Station 71). Horizontal range is approximately 464 m. Those traces annotated with "a" are derived from the acceleration history.

Figure 4.8 Geophone and sensitive accelerometer histories. These have not been converted to engineering units.

Figure 4.9 Stress and strain measured in the bottom GFA plug at a range of 53.92 m from the reference depth. Amplitudes are left in percent of resistance change. Initial resistance was about 350 Ω for all transducers represented.

Figure 4.10 Stress and strain measured in the bottom GFA plug at a range of 66.97 m from the reference depth. Amplitudes are left in percent of resistance change. Initial resistance was about 350 Ω for all transducers represented.

References

1. Nancy W. Howard and Gayle A. Pawloski, "U4as Site Characteristics Report," CP 85-44, Lawrence Livermore National Laboratory, Livermore, CA, May 14, 1985.
2. R. Hutchinson for Alfred E. Burer, "Containment Report for U4as," Holmes & Narver, NTS:A2:85-71, October 15, 1985.
3. LLNL contact for additional information: R. E. Heinle (CORRTEX and SLIFER data)
4. Troy L. Williams, "Special Measurements Physics/Instrumentation for ROQUEFORT, U4as", EG&G, Energy Measurements, Las Vegas, NV, SM:85E-131-23, 23 August 1985.

Distribution:

LLNL

TID (11)	L-053
Test Program Library	L-045
Containment Vault	L-221
Burkhard, N.	L-221
Cooper, W.	L-049
Denny, M.	L-205
Dong, R.	L-140
Goldwire, H.	L-221
Heinle, R. (5)	L-221
Mara, G.	L-049
Moran, M.T.	L-777
Moss, W.	L-200
Olsen, C.	L-221
Patton, H.	L-205
Pawloski, G.	L-221
Rambo, J.	L-200
Roland, K.	L-221
Roth, B.	L-049
Valk, T.	L-154
Yunker, L.	L-203

LANL

App, F.	F-659
Brunish, W.	F-659
Kunkle, T.	F-665
Trent, B.	F-664

Sandia

Chabai, A.	MS-1159
Smith, Carl W.	MS-1159

EG&G/AVO

Brown, T.	A-5
Gilmore, L.	A-1
Hatch, M.	A-5
Still, G.	A-5
Stubbs, T.	A-5

EG&G/NVO

Bellow, B.	N 13-20
Davies, L.	N 13-20
Moeller, A.	N 13-20
Robinson, R.	N 13-20
Webb, W.	N 13-20

DNA

Ristvet, B.

S-Cubed

Peterson, E.

Eastman Cherrington Environment
1640 Old Pecos Trail, Suite H
Santa Fe, NM 87504

Keller, C.