National Security Technologies LLC
Vision • Service • Partnership

DOE/NV/25946--3266
DOE/NV/25946--3311-REV-1

Data Release Report for Source Physics Experiment 4Prime (SPE-4Prime) Nevada National Security Site

Revision 1

August 2017

Prepared for:

U.S. Department of Energy
National Nuclear Security Administration
Defense Nuclear Nonproliferation Research and Development
National Center for Nuclear Security

Compiled by:

Margaret Townsend and Curtis Obi
Test Readiness and Site Support Division, Global Security
National Security Technologies, LLC
Las Vegas, Nevada

With contributions from:

Robert Abbott, Sandia National Laboratories
Robert Mellors, Lawrence Livermore National Laboratory
Ken Smith and Gabe Plank, Nevada Seismology Laboratory, University of Nevada, Reno
David Steedman, Los Alamos National Laboratory
William Walter, Lawrence Livermore National Laboratory

AVAILABILITY STATEMENT

Available for sale to the public, in paper, from–

U.S. Department of Commerce
National Technical Information Service
5301 Shawnee Road
Alexandria, VA 22312
Telephone: 800.553.6847
Fax: 703.605.6900
E-mail: orders@ntis.gov
Online ordering: http://www.ntis.gov/help/ordermethods.aspx

Available electronically at http://www.osti.gov/bridge

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from–

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
Telephone: 865.576.8401
Fax: 865.576.5728
E-mail: reports@adonis.osti.gov

DOE/NV/25946--3266
DOE/NV/25946--3311-REV-1

Data Release Report for Source Physics Experiment 4Prime (SPE-4Prime) Nevada National Security Site

REVISION 1

Compiled by:

Margaret Townsend and Curtis Obi
National Security Technologies, LLC

With contributions from:

Robert Abbott, Sandia National Laboratories
Robert Mellors, Lawrence Livermore National Laboratory
Ken Smith and Gabe Plank, Nevada Seismology Laboratory, University of Nevada, Reno
David Steedman, Los Alamos National Laboratory
William Walter, Lawrence Livermore National Laboratory

August 2017

Distributed by:
Incorporated Research Institutions for Seismology
Data Management Center
1408 NE 45th Street, Suite 201
Seattle, Washington 98105 USA
www.iris.washington.edu

The near-field data for SPE-4Prime are found in ***Assembled Data Set 17-012****. This data set also includes this report. The far-field data were submitted directly using the Nevada Seismological Laboratory's "SN" network code and merged directly in the IRIS archive.*

Citation Reference: National Security Technologies, LLC, 2015*. Data Release Report for Source Physics Experiment 4Prime (SPE-4Prime), Nevada National Security Site, Revision 1.* Technical Report DOE/NV/25946--3311-REV-1, 70 pages. Las Vegas, NV

Source Physics Experiment 4Prime

Points of Contact:

Los Alamos National Laboratory

Howard Patton (Chief Scientist) Catherine Snelson

Lawrence Livermore National Laboratory

William Walter

Sandia National Laboratories

Robert Abbott

Defense Threat Reduction Agency

Kiran Shah Kash Winningham

Air Force Technical Applications Center

Chandan Saikia

Nevada Seismological Laboratory, University of Nevada, Reno

Ken Smith Gabe Plank

National Security Technologies, LLC

Jesse Bonner

Major Contributors:

Lawrence Livermore National Laboratory

Tarabay Antoun, Andrea Chiang, Doug Dodge
Souheil Ezzedine, Sean Ford, Lew Glenn
Phil Harben, Teresa Hauk, Robert Mellors
Arben Pitarka, Moira Pyle, Artie Rodgers
Oleg Vorobiev, Jeff Wagoner

Los Alamos National Laboratory

Christopher Bradley, David Coblentz, Joel Heidemann
Kenneth Huff, Earl Knight, Carene Larmat
Zhou Lei, Jonathon Mace, W. Scott Phillips
Esteban Rougier, Charlotte Rowe, Thomas Sandoval
Emily Schultz-Fellenz, David Steedman, Aviva Sussman
Rodney Whitaker, Xiaoning Yang

Sandia National Laboratories

Dave Aldridge, Nedra Bonal, Scott Broome, Kyle Jones
Hunter Knox, Leiph Preston, Nathaniel Roberts, David Yocky

National Security Technologies, LLC

Ryan Emmitt, Curtis Obi, Scot Tibbets, Margaret Townsend, Robert White

Executive Summary

The fourth test in the Source Physics Experiment series (SPE-4Prime) was conducted at a granite site in Nevada on May 21, 2015, at 18:35:44.000,003,989 ± 20 nanoseconds Coordinated Universal Time.

The explosive source was 69.1 kilograms (kg) (including detonator assembly) of Composition C4 plastic explosive (89.14 kg TNT equivalent) detonated at a depth of 87.2 meters (m). The explosion was recorded by an extensive set of instrumentation that includes sensors both at near-field (less than 100 m) and far-field (100 m or greater) distances.

The near-field instruments consisted of three-component accelerometers installed at various depths from 7 to 99 m in boreholes positioned around the source hole, and a set of single-component vertical accelerometers on the surface. The far-field network was composed of a variety of seismic and acoustic sensors, including short-period geophones, broadband seismometers, and three-component accelerometers at distances of 100 m to 25 kilometers. Infrasound data were collected from ground-based sensor arrays at distances out to 5 kilometers.

Publication of this report coincides with the release of these data for analysts and organizations that are not participants in this program. This report describes the fourth Source Physics Experiment tests and the various types of near-field and far-field data that are available.

This revised document includes a new section 3.2.2, which is a discussion of clock timing issues discovered at four far-field stations.

This page intentionally left blank.

Table of Contents

List of Appendices

List of Figures

List of Tables

List of Acronyms and Abbreviations

AFTAC	Air Force Technical Applications Center
AP	Access Point
DTRA	Defense Threat Reduction Agency
E	east
Hz	hertz
IRIS	Incorporated Research Institutions for Seismology
kg	kilogram(s)
km	kilometer(s)
L	lateral
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
m	meter(s)
$m/kt^{1/3}$	meters per $kiloton^{1/3}$
N	north
NNSS	Nevada National Security Site
NSL	Nevada Seismological Laboratory
NSTec	National Security Technologies, LLC
PASSCAL	Program for Array Seismic Studies of the Continental Lithosphere
R	radial
SAC	Seismic Analysis Code
sDOB	scaled depth of burial
SEED	Standard for the Exchange of Earthquake Data
SNL	Sandia National Laboratories
SPC	State Plane Coordinates
SPE	Source Physics Experiment
sps	samples per second
T	tangential
TNT	trinitrotoluene
UNR	University of Nevada, Reno
Z	vertical

This page intentionally left blank.

1 Introduction

1.1 Project Description

The Source Physics Experiment (SPE) is a series of chemical explosions. The SPE Phase I test bed was constructed in granitic rock of the Climax stock, in northern Yucca Flat at the Nevada National Security Site (NNSS; formerly known as the Nevada Test Site) in 2010–2011 (Figure 1). These tests are sponsored by the U.S. Department of Energy, National Nuclear Security Administration's Office of Defense Nonproliferation Research and Development. The SPE series is primarily designed to study the generation and propagation of seismic waves, and is providing data that will improve the predictive capability of numerical models for detecting and characterizing underground explosions (e.g., Ford and Walter 2013; Snelson et al. 2012, 2013). These validated, improved seismic-acoustic models and simulations will enhance the ability of the U.S. to detect and discriminate "low-yield" nuclear explosions.

The SPE tests are designed and conducted by a consortium of organizations, including Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), Sandia National Laboratories (SNL), and the Defense Threat Reduction Agency (DTRA), in conjunction with National Security Technologies, LLC (NSTec), the Management and Operations contractor at the NNSS. The University of Nevada, Reno (UNR) assists in data acquisition and compilation. Other organizations, including the Air Force Technical Applications Center (AFTAC), participate in data acquisition efforts as well.

The first SPE test (SPE-1) was conducted in May 2011; SPE-2 was conducted in October 2011; SPE-3 was conducted in July 2012; and SPE-4Prime was conducted on May 21, 2015. Two final tests were conducted at the NNSS granite site in 2016, and will be reported separately. The vast majority of data acquired under the SPE program is unclassified/unlimited but subject to a 2-year hold, similar to the policy of the U.S. National Science Foundation. The SPE-4Prime time-dependent data (strong motion and seismo-acoustic) have now been released for public access. This report presents information that will aid in the proper understanding and use of the SPE-4Prime data sets. See NSTec 2014 for descriptions of the SPE-1 experiment, and NSTec 2015 for information about the SPE-2 and SPE-3 tests.

Jesse Bonner, NSTec point of contact (bonnerjl@nv.doe.gov), can be contacted for further information, including information about other data collected at the SPE site.

1.2 Test Description

The SPE-4Prime test is a replacement for SPE-4, which did not detonate as planned in August 2013. The purpose of the SPE-4 test was to provide a deeply buried explosion that could serve as an approximate Green's function, with minimal damage at the explosion depth and little or no spallation of the surface. The 2011 SPE-1 test was originally planned to serve this purpose; however, even at a scaled depth of burial (sDOB) of 976 meters per kiloton$^{1/3}$ (m/kt$^{1/3}$), surface accelerometers clearly recorded spallation from SPE-1, thus limiting the use of the test as a Green's

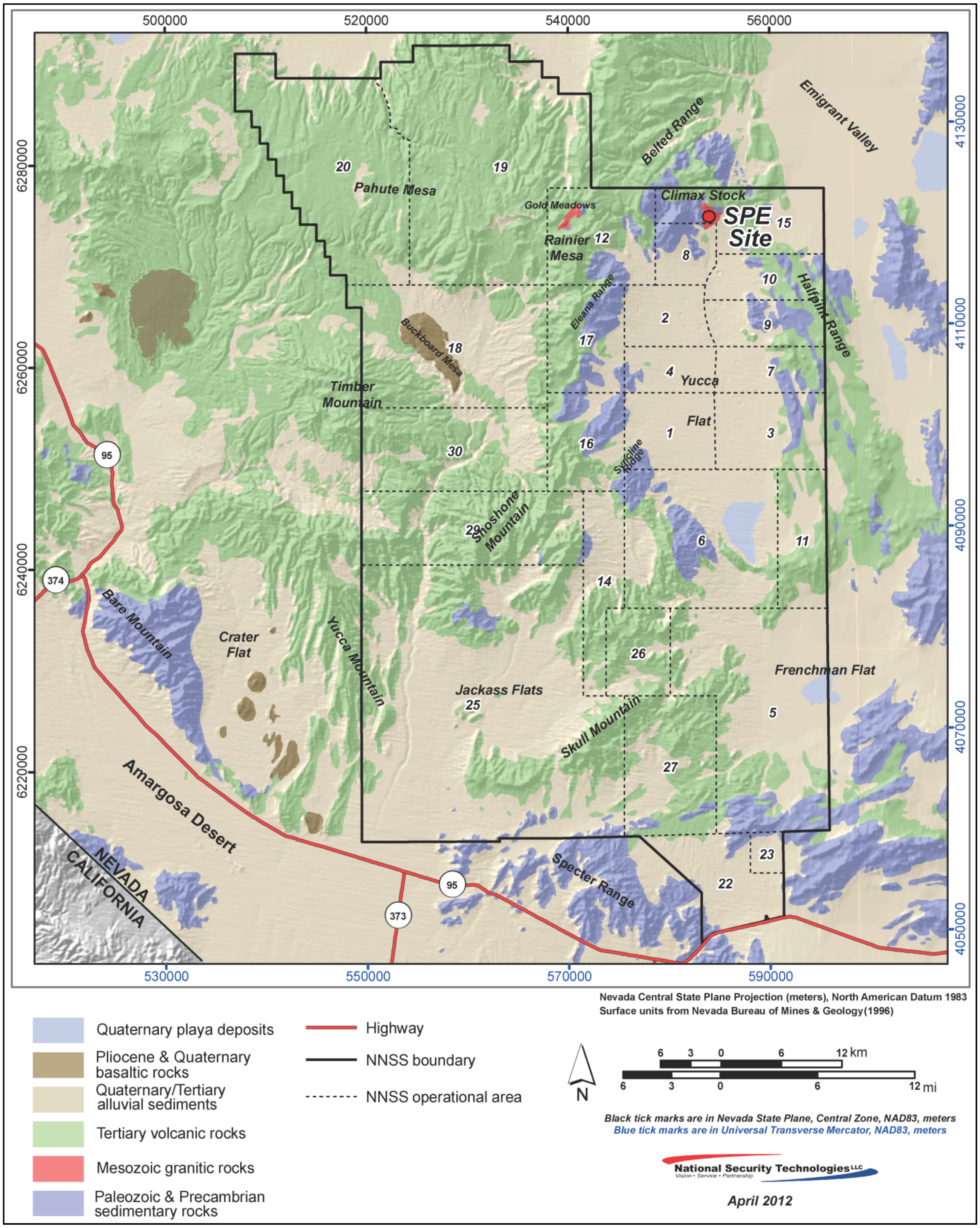

Figure 1
Map Showing Surface Geology and Location of the SPE Experiments at the Nevada National Security Site

function (Rougier and Patton 2015). SPE-4 was designed to be similar in yield to SPE-1, but was constructed at a greater depth (99.1 m), with a planned sDOB of almost 1,800 m/kt$^{1/3}$, to ensure that no surface spallation would occur. Due to the misfire on SPE-4, the depth of replacement test SPE-4Prime had to be reduced (e.g., placed above the original SPE-4 canister and stemming that were left in place). The explosive yield was likewise reduced, resulting in an sDOB of 1,549 m/kt$^{1/3}$. See a detailed description of the source in Section 2.1.

The SPE-4Prime test provided data for research and development of simulation capability at both near- and far-field distances. In general, the near field is expected to include inelastic nonlinear effects, while the far field can be considered primarily elastic (or visco-elastic).

A comprehensive set of strong-motion and seismo-acoustic instrumentation was deployed for SPE-4Prime. The near-field (< 100 meters [m] from the source hole) instrumentation included high-sample-rate, three-component accelerometers deployed in boreholes. A set of single-component accelerometers was also installed at the surface. At distances at and beyond 100 m (far-field), a large number of seismic and acoustic sensors were deployed at distances up to 25 kilometers (km). The data and metadata were compiled, archived, and distributed by the technical members of the Nevada Seismological Laboratory (NSL) at UNR. Records for stations at greater distances are available from the permanent UNR seismic network.

The full data set for SPE-4Prime, along with associated metadata, is available from the Incorporated Research Institutions for Seismology (IRIS) Data Management Center. The near-field and far-field data sets were submitted separately because they are in different formats. The high sample rates for the near-field recordings are not compatible with the miniSEED format used for the far-field data, and so were submitted separately in Seismic Analysis Code (SAC) format. The near-field data for SPE-4Prime were assigned the assembled data set number 17-012, with the short name "SPE4Prime." The far-field data were submitted directly using NSL's "SN" network code (UNR 1995) and were merged directly into the IRIS archive. This report is intended to complement the data set and provide ancillary information, including selected metadata. However, all data users should verify they are using the full current metadata, including the SN network dataless SEED volume from IRIS for the far-field data, and/or the CSS3.0 metadata from the assembled data sets for the near-field sites.

1.3 Site Description

The SPE test bed consists of a pad excavated and filled on the side of a hill that slopes to the southeast. The setting is weathered granite with a thin but variable cover of unconsolidated soil over bedrock. A 0.91-m-diameter source hole was drilled in the center of the test bed, and is surrounded by four rings of 0.20- to 0.25-m diameter instrument holes. The site is identified by the NNSS designator U-15n, with the source hole labeled U-15n, and instrument holes labeled U-15n#1, U-15n#2, and so on, in the order they were drilled. See sections 1.4.2 and 2.3 for additional information about the instrument holes and sensors installed in them.

1.4 Test Bed Construction

1.4.1 Source Hole

The 0.91-m-diameter source hole was drilled from the surface to a depth of 60.7 m over a period of several months in late 2010 and early 2011, and used for the first three SPE tests. Following SPE-3, the hole was cleaned out and deepened to 103.3 m. The SPE-4 explosives canister was installed at the bottom of the source hole, and the hole was stemmed with grout to the depth of 89.9 m, and with sand and gravel to the depth of 74.6 m. After the misfire, the cables were cut, and the sand and gravel stemming were removed from the hole, leaving the hole open to the depth of approximately 92.1 m. Prior to insertion of the SPE-4Prime canister, a layer of grout was placed to provide a level landing site for the canister; however, some fill material raveled from the upper part of the borehole prior to insertion of the SPE-4Prime canister, so that the hole depth at the time of insertion was 88.9 m.

1.4.2 Instrumentation Boreholes

Seventeen instrument holes of varying depths and with up to five accelerometer packages installed in them are positioned around the SPE source hole:

- An inner ring of four instrument holes (U-15n#1A, #2, #3, and #8) at 10 m from the source hole (hole U-15n#1A replaced #1 following SPE-1)
- A ring of eight instrument holes (U-15n#4, #5, #6, #7, #9, #14, #15, and #16) at 20 m from the source hole
- Hole U-15n#10, drilled at an angle from the surface to the position of the SPE-2 explosion, was instrumented for SPE-3, but is no longer active
- Instrument hole U-15n#11 located 51.2 m northeast of the source hole
- Hole U-15n#12 was drilled at an angle to intercept the position of the SPE-3 explosion to obtain data on the damage zone, but was not instrumented
- Hole U-15n#13 was drilled 10 m from the source hole to obtain material property and fracture data for the SPE-4 depth, but was not instrumented
- A ring of three instrument holes (U-15n#17, #18, and #19) at 34 m from the source hole
- Instrument hole U-15n#20 at 5 m from the source hole, specifically instrumented to measure surface spallation from the SPE-4Prime test

Appendix 1 of this report includes construction data for the U-15n source hole and instrument holes. Appendix C in Townsend et al. 2012 contains detailed information about the construction of the first six instrument holes at the SPE site. Figure 2 shows an aerial view of the SPE-4Prime test bed with the locations of the source hole and instrument holes marked. Figure 3 shows a cut-away view of the SPE test bed. See additional discussion of the near-field instrumentation in Section 2.3.

1.5 Geology

The Climax stock was selected as the site of the first set of SPE tests because its granite lithology provides a relatively “homogenous” medium and because, as the site of three historical underground

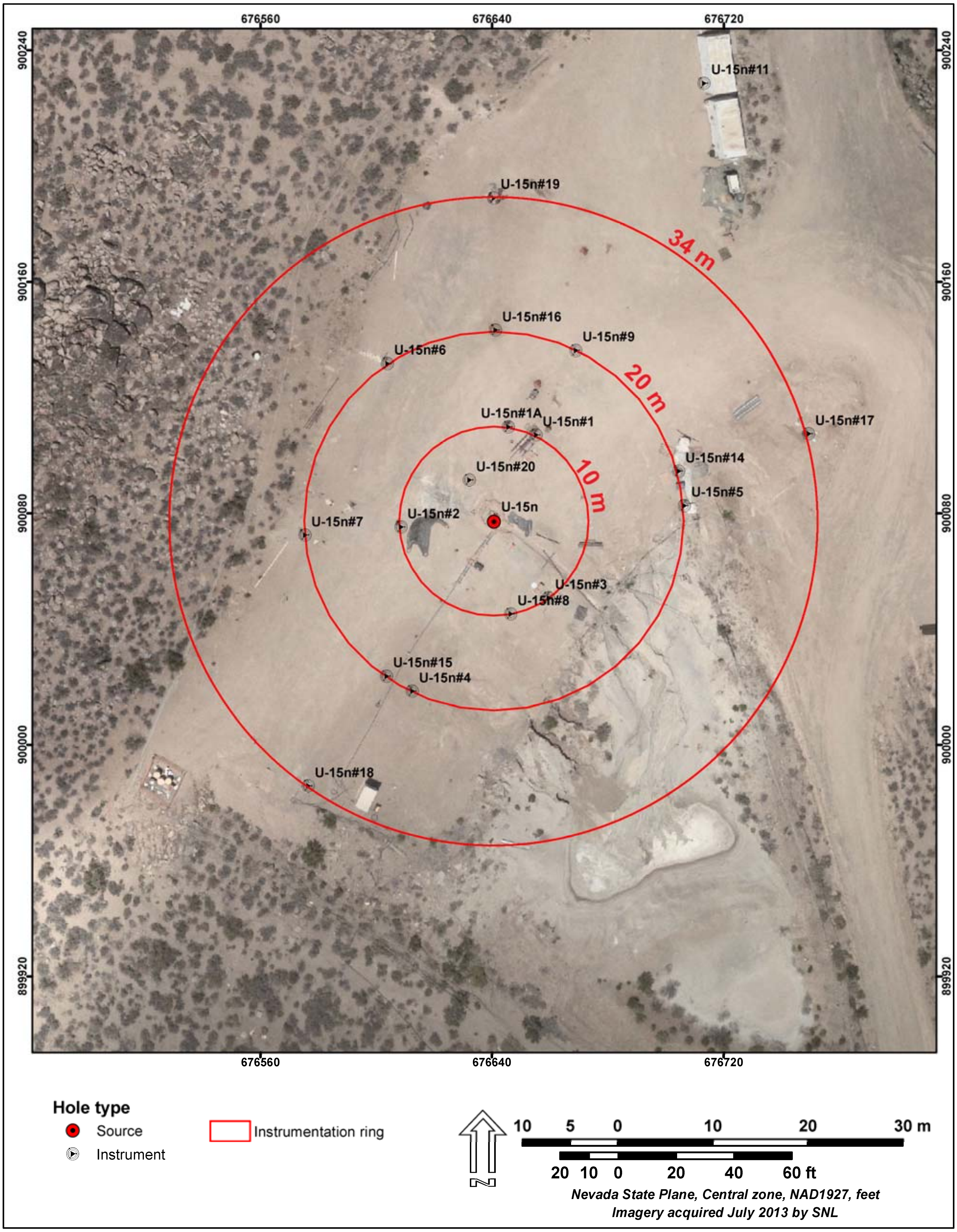

Figure 2
Aerial Photo of the SPE-4Prime Test Bed Showing Locations of Source Hole and Instrument Holes

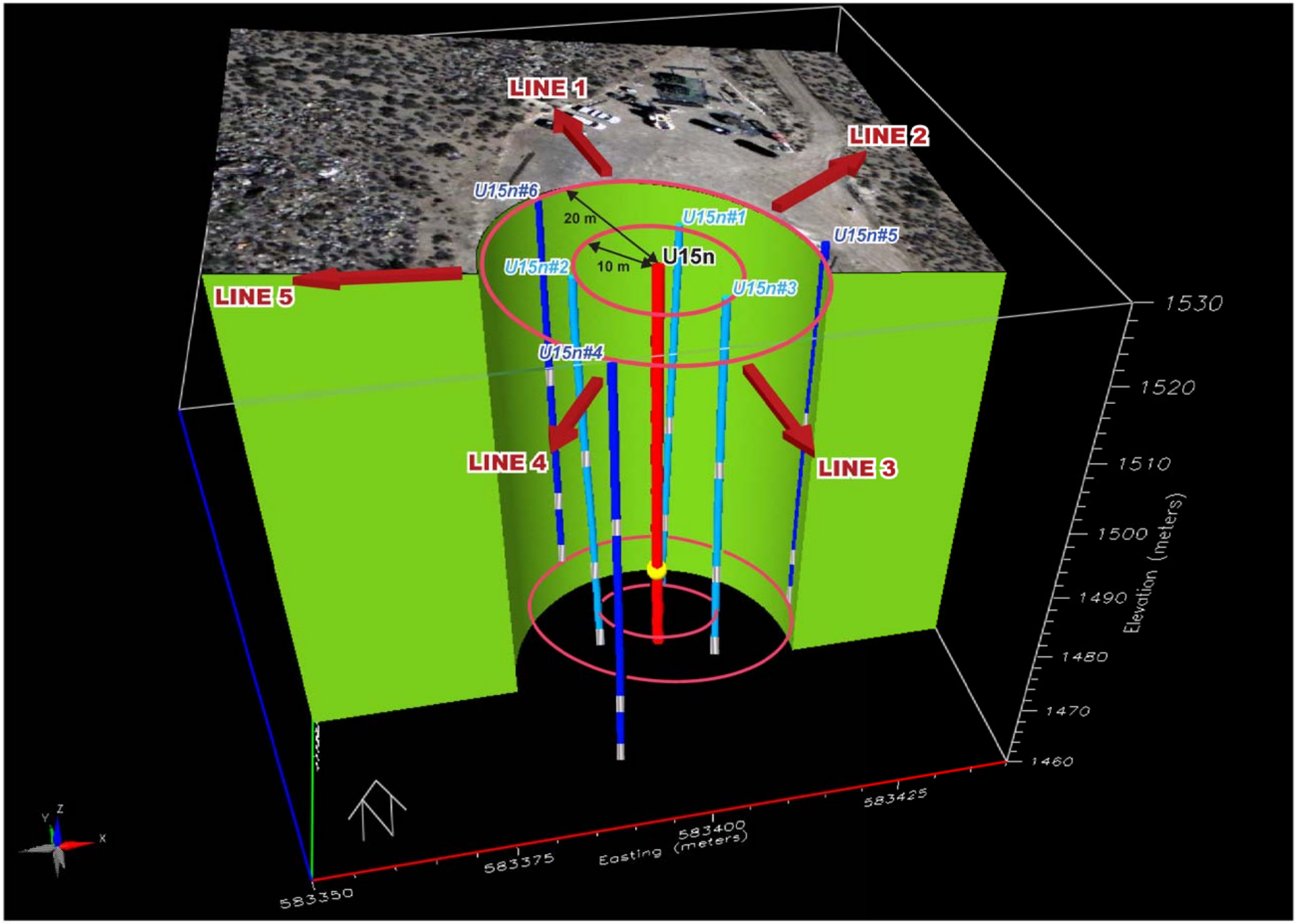

Figure 3
Sketch Showing Cut-Away View of Test Bed for SPE-4Prime
(All instrument holes not shown. Lines 1 through 5 are geophone lines; see Section 2.3.2)

nuclear tests, abundant geologic, seismic, and ground shock data are available for comparison to SPE test data.

1.5.1 Geologic Setting

The Climax stock is a composite granitic intrusive body of Cretaceous age that intruded sedimentary rocks of Paleozoic and Precambrian age. The granite body is exposed at the base of Oak Spring Butte, in extreme northern Yucca Flat (Figure 4). The surface exposures of the granite are weathered to depths ranging from about 7.6 to 38.1 m (Townsend et al. 2012).

The Climax stock is moderately to highly fractured. Three major faults define the structure of the Climax area; these are the Tippinip fault on the west and the Boundary and Yucca faults on the east and south. The SPE site is located approximately 245 m northwest, at closest approach, from the Boundary fault, which separates the surface exposure of the granitic rocks from the alluvium of the Yucca Flat basin. The Boundary fault dips steeply to the southeast, and offset on it is inferred from gravity data to be approximately 245 m down to the east near the SPE site. The offset apparently decreases to the northeast along the fault trace, as it approaches the junction with the Yucca fault to become the Butte fault (Orkild et al. 1983).

A perched groundwater table is present at the SPE site. The top of this groundwater averages about 22.4 to 24.1 m below the ground surface.

1.5.2 Geologic Characterization Data

Prior to construction of the test bed, a core hole was drilled at the location of the source hole. As described in Section 1.4.2, three additional core holes, two to characterize the damage zones associated with the SPE-2 and SPE-3 tests (U-15n#10 and #12), and a general characterization hole drilled to the SPE-4 depth (U-15n#13) have also been drilled at various stages in the test series. A suite of geophysical logs (listed below) has been run in all the core holes and all instrument holes to characterize the surrounding rock, and to support installation of instrumentation.

- Caliper
- Deviation
- Natural Gamma
- Resistivity
- Full-wave Sonic/Travel Time
- Acoustic Televiewer
- Optical Televiewer (instrument holes only)

Physical and mechanical properties, including fracture characterization (see list below), have been measured by SNL on samples from these holes.

- Bulk density
- Unconfined compressive strength
- Compressional and shear wave velocity
- Direct shear
- Triaxial shear
- Triaxial compression
- Dynamic Brazilian Tension

In addition, detailed characterization studies of fracture surfaces in the core samples are being conducted by LANL.

Direct inquiries about these data to the NSTec point of contact, Jesse Bonner (bonnerjl@nv.doe.gov).

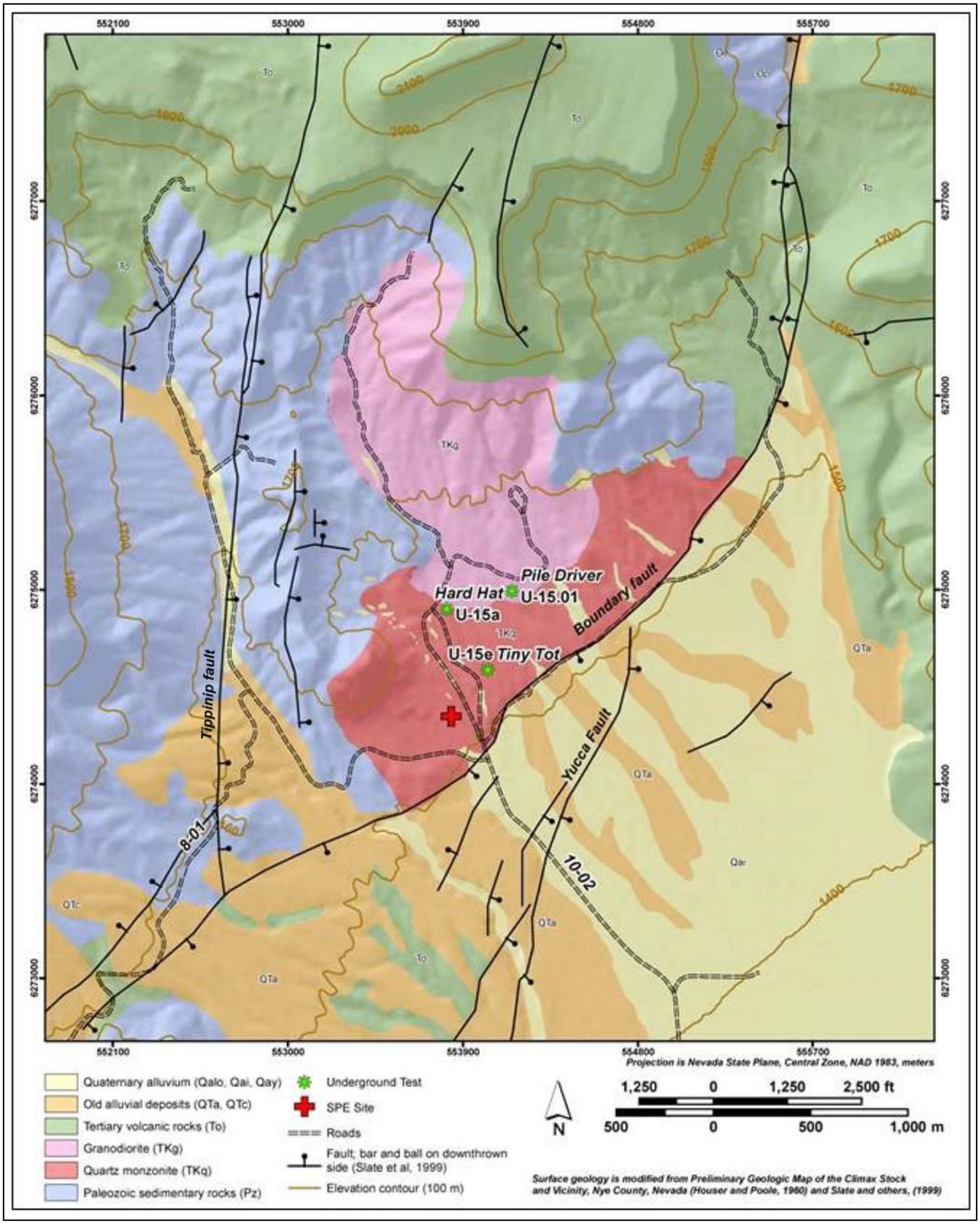

Figure 4
Surface Geologic Map of the Climax Stock Area

2 SPE-4Prime Test Description

2.1 Explosive Source

The explosive source for SPE-4Prime was 69.1 kilograms (kg) of Composition C4 plastic explosive, equivalent to 89.14 kg of trinitrotoluene (TNT). The C-4 was loaded into an aluminum canister at the surface and then lowered into the source hole so that the center of the explosive charge was at the depth of 87.2 m below ground surface. The charge canister was a right circular cylinder with a height of 0.49 m and diameter of 0.30 m, for a length-to-diameter ratio of 1.6 to 1. The wall thickness of the canister was 0.95 centimeters.

To fully confine the explosive source, the canister was cemented in place with a grout mixture up to the depth of 85.6 m below ground surface. Above the grout were placed 1.6 m of sand, followed by 6.2 m of pea gravel, 1.2 m of sand, and a final 11.7-m layer of pea gravel, the top of which was at the depth of 63.9 m below ground surface. The hole was un-stemmed above the upper gravel layer (Figure 5). The standing water level in the source hole was near the surface at the time of the test, having been forced to rise from its natural level of about 23 m below ground surface, as the stemming materials were added to the hole.

The SPE-4Prime test was executed on May 21 (day 141), 2015, at 18:35:44.000,003,989 ± 230 nanoseconds Coordinated Universal Time. The location was 37.221207, –116.0608674 and at a centroid depth of 87.2 m.

The explosion was fully confined; however, a gas bubble made its way up the hole and ejected some water and gravel onto the ground surface at approximately 0.8 seconds after detonation.

2.2 Diagnostic Instrumentation

Temperature and pressure transducers were installed in and on the explosives canister in the source hole to provide near-field diagnostic data for the SPE-4Prime test. These diagnostics provide a sense of the symmetry of the explosion that can be used to distinguish between the effects of the blast and effects of discontinuities within the formation.

2.3 Near-Field Instrumentation

As described in Section 1.4.2, near-field instrumentation included arrays of accelerometers installed in boreholes to record the response of the near-field region (defined as less than 100 m from the source). Instrumentation in these holes was designed to be in place for multiple SPE tests at different depths in the same source hole; the arrangement of the gauge packages reflects this purpose, as described in the following sections. Appendix 2 provides information about sensors in place for the SPE-4Prime test. However, all data users should verify they are using the full current metadata posted with the sensor data.

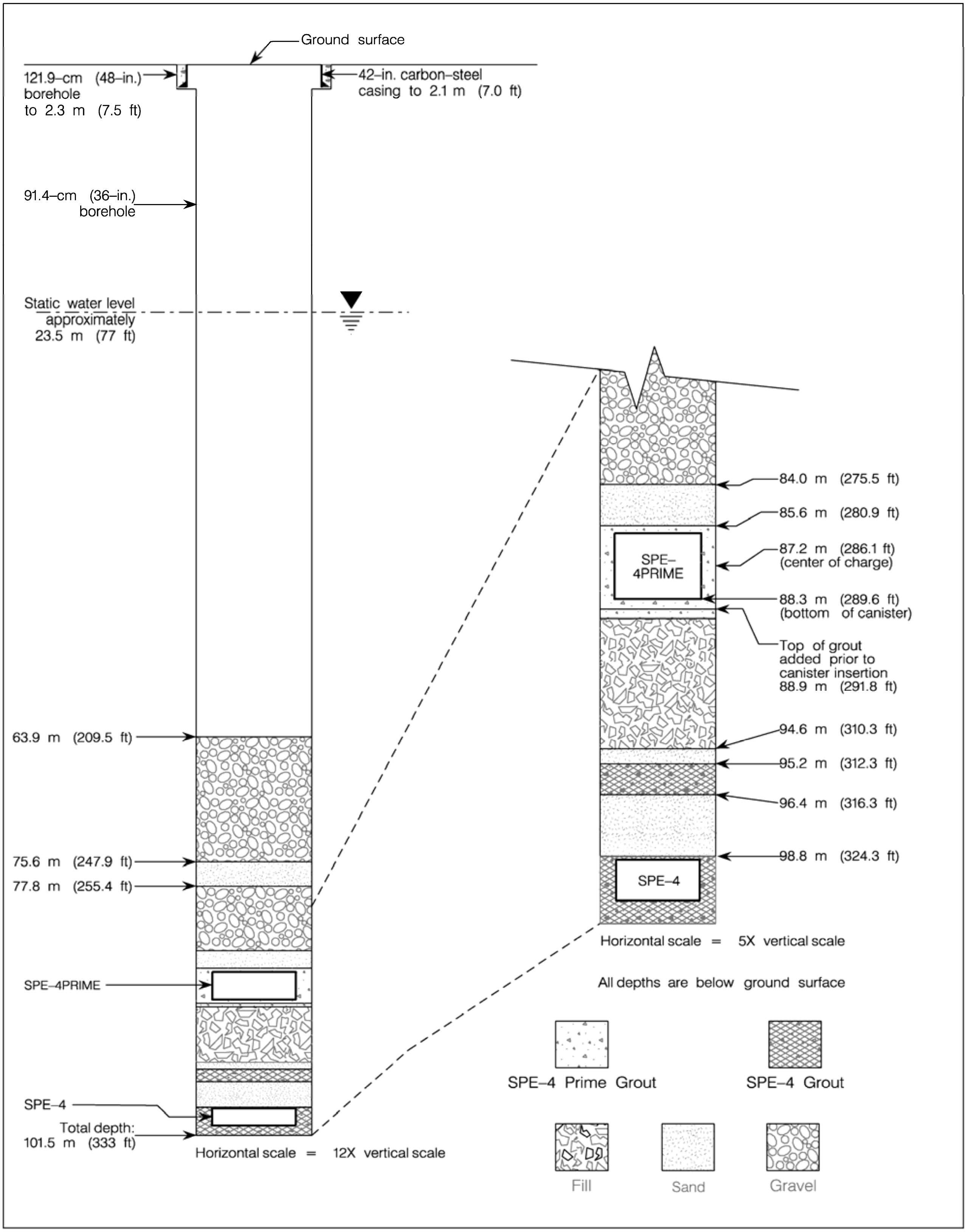

Figure 5
Schematic Drawing Showing Placement of Explosives Canister and Stemming in the SPE-4Prime Source Hole

2.3.1 Borehole Accelerometers

Figure 6 is a schematic representation of the near-field instrumentation array for the SPE site. Six new deep holes were drilled for instrumentation emplacement for SPE-4Prime. These included instrument holes U-15n#14, #15, and #16 at a nominal 20 m from the U-15n borehole axis, and holes U-15n#17, #18, and #19 at a nominal 34 m from the U-15n borehole axis. The holes included sets of triaxial accelerometer packages installed in the boreholes to record the close-in response. These triaxial packages sensed the motion on the radial from U-15n (the radial, or R, component), on the vertical aligned with the instrument hole axis (the longitudinal, or L, component), and in a transverse direction mutually orthogonal to the other two measurements (transverse, or T, component). There were two packages each in holes U-15n#14, #15, #16, and #17 at the depths indicated on Figure 6. Holes #18, and #19 each had five packages, also as illustrated.

Additionally, a shallow hole, shown on Figure 6 as U15-n#20, was drilled to the 10-m depth a distance of 5 m from the U-15n source hole. Hole #20 contained four vertically sensing, single-axis accelerometers placed to indicate the depth of any spall caused by the shock wave interaction with the free surface. The gauges were located at depths of 2 m, 4 m, 7 m, and 10 m; however, the shallowest of these gauges was inoperable at the time of the test.

Figure 6 also shows instrument holes U-15n#1, #1A, #2, #3, and #8 on a nominally 10-m radius circle around the source hole; U-15n#4, #5, #6, #7, and #9 on a nominally 20-m radius circle around the source hole; and hole U-15n#11 located 51.2 m northeast of the source hole. Each of these holes, drilled to a depth of 54.9 m, was drilled for emplacement of accelerometer canisters to measure the near field environments of earlier tests, SPE-1, SPE-2, and SPE-3. The emplacement details for these instruments are described in the data release reports (NSTec 2014, 2015) for those tests and will not be repeated here. The accelerometers in these older boreholes that were still active at the time of the SPE-4Prime test were recorded. However, those older accelerometers had been selected to record the early SPE tests, and we suggest caution in using their data for the low-yield, more distant SPE-4Prime source.

Gauge packages are referred to by their respective hole and depth (e.g., package 2-1 is in hole U-15n#2 at depth 1). Further, each individual accelerometer in the package is labeled by the first letter of its component (e.g., measurement 2-1-R is the radial measurement in package 2-1). Table 1 lists all near-field gauges installed in boreholes for the SPE-4Prime test. Figure 6 illustrates the SPE-4Prime gauge package arrangement.

2.3.1.1 Near-Field Gauge Placement Relative to the Source

Due to the complex deployment geometry of the test bed, these components need further description. The gauge packages at depths 1 and 2 are placed in a cylindrical coordinate system about the axis of the source hole. The “radial” gauges at these depths are, strictly speaking, horizontal outward measuring transducers. Thus, for SPE-4Prime none of the R gauges is perfectly radial. The other radial gauges are more accurately described as measuring the horizontal component of the spherically propagating shock for SPE-4Prime. Similarly, the lateral component is vertical. The tangential measurement is a horizontal component normal to the R–L plane.

Table 1
List of Near-Field Gauges Installed in Boreholes for the SPE-4Prime Test

See notes at bottom of table for additional information

Gauge Package Number	**Depth in Borehole** (feet)	**Depth in Borehole** (meters)	**Distance from Source Hole** (meters)
1-1-R	180	54.9	10
1-1-T	180	54.9	10
1-1-L	180	54.9	10
1-2-R	150	47.7	10
1-2-T	150	47.7	10
1-2-L	150	47.7	10
1-3-R	50	15.2	10
1-3-T	50	15.2	10
1-3-L	50	15.2	10
1A-2-L	150	45.7	10
1A-3-T	50	15.2	10
1A-3-L	50	15.2	10
2-1-R	180	54.9	10
2-1-T	180	54.9	10
2-1-L	180	54.9	10
2-2-R	150	45.7	10
2-2-T	150	45.7	10
2-2-L	150	45.7	10
2-3-R	50	15.2	10
2-3-T	50	15.2	10
2-3-L	50	15.2	10
3-1-R	180	54.9	10
3-1-T	180	54.9	10
3-1-L	180	54.9	10
3-2-R	150	45.7	10
3-2-T	150	45.7	10
3-2-L	150	45.7	10
3-3-R	50	15.2	10
3-3-T	50	15.2	10
3-3-L	50	15.2	10
4-1-R	180	54.9	20
4-1-R	180	54.9	20
4-1-T	180	54.9	20
4-1-L	180	54.9	20
4-2-R	150	45.7	20
4-2-T	150	45.7	20
4-2-L	150	45.7	20
4-3-R	50	15.2	20
4-3-T	50	15.2	20
4-3-L	50	15.2	20
5-1-R	180	54.9	20
5-1-T	180	54.9	20
5-1-L	180	54.9	20
5-2-R	150	45.7	20
5-2-T	150	45.7	20
5-2-L	150	45.7	20
5-3-L	50	15.2	20
5-3-R	50	15.2	20
5-3-T	50	15.2	20

Gauge Package Number	**Depth in Borehole** (feet)	**Depth in Borehole** (meters)	**Distance from Source Hole** (meters)
6-1-R	180	54.9	20
6-1-T	180	54.9	20
6-1-L	180	54.9	20
6-2-R	150	45.7	20
6-2-T	150	45.7	20
6-2-L	150	45.7	20
6-3-R	50	15.2	20
6-3-T	50	15.2	20
6-3-L	50	15.2	20
7-1-R	180	54.9	20
7-1-T	180	54.9	20
7-1-L	180	54.9	20
7-2-R	150	45.7	20
7-2-T	150	45.7	20
7-2-L	150	45.7	20
7-3-R	50	15.2	20
7-3-T	50	15.2	20
7-3-L	50	15.2	20
8-1-R	180	54.9	10
8-1-T	180	54.9	10
8-1-L	180	54.9	10
8-2-R	150	45.7	10
8-2-T	150	45.7	10
8-2-L	150	45.7	10
8-3-R	50	15.2	10
8-3-T	50	15.2	10
8-3-L	50	15.2	10
9-1-R	180	54.9	20
9-1-T	180	54.9	20
9-1-L	180	54.9	20
9-2-R	150	45.7	20
9-2-T	150	45.7	20
9-2-L	150	45.7	20
9-3-R	120	36.6	20
9-3-T	120	36.6	20
9-3-L	120	36.6	20
9-4-R	90	27.4	20
9-4-T	90	27.4	20
9-4-L	90	27.4	20
9-5-R	50	15.2	20
9-5-T	50	15.2	20
9-5-L	50	15.2	20
10-1-R			12
11-1-R	180	54.9	51.2
11-1-T	180	54.9	51.2
11-1-L	180	54.9	51.2
11-2-R	150	45.7	51.2
11-2-T	150	45.7	51.2
11-2-L	150	45.7	51.2

Table 1
List of Near-Field Gauges Installed in Boreholes for the SPE-4Prime Test (cont.)

Gauge Package Number	**Depth in Borehole** (feet)	**Depth in Borehole** (meters)	**Distance from Source Hole** (meters)
11-3-R	50	15.2	51.2
11-3-T	50	15.2	51.2
11-3-L	50	15.2	51.2
14-1-R	325	99.1	20
14-1-R1	325	99.1	20
14-1-T	325	99.1	20
14-1-L	325	99.1	20
14-2-R	275.8	84.1	20
14-2-R1	275.8	84.1	20
14-2-T	275.8	84.1	20
14-2-L	275.8	84.1	20
15-1-R	325	99.1	20
15-1-R1	325	99.1	20
15-1-T	325	99.1	20
15-1-L	325	99.1	20
15-2-R	275.8	84.1	20
15-2-R1	275.8	84.1	20
15-2-T	275.8	84.1	20
15-2-L	275.8	84.1	20
16-1-R	325	99.1	20
16-1-R1	325	99.1	20
16-1-T	325	99.1	20
16-2-R	275.8	84.1	20
16-2-R1	275.8	84.1	20
16-2-T	275.8	84.1	20
16-2-L	275.8	84.1	20
17-1-R	325	99.1	34
17-1-R1	325	99.1	34
17-1-T	325	99.1	34
17-1-L	325	99.1	34
17-2-R	275.8	84.1	34
17-2-R1	275.8	84.1	34
17-2-T	275.8	84.1	34
17-2-L	275.8	84.1	34
18-1-R	325	99.1	34
18-1-T	325	99.1	34
18-1-L	325	99.1	34
18-2-R	304.4	92.8	34
18-2-T	304.4	92.8	34
18-2-L	304.4	92.8	34
18-3-R	275.8	84.1	34
18-3-T	275.8	84.1	34
18-3-L	275.8	84.1	34
18-4-R	251	76.5	34
18-4-T	251	76.5	34
18-4-L	251	76.5	34
18-5-R	226.5	69.0	34
18-5-T	226.5	69.0	34
18-5-L	226.5	69.0	34
19-1-R	325	99.1	34
19-1-T	325	99.1	34
19-1-L	325	99.1	34
19-2-R	304.4	92.8	34
19-2-T	304.4	92.8	34
19-2-L	304.4	92.8	34
19-3-R	275.8	84.1	34
19-3-T	275.8	84.1	34
19-3-L	275.8	84.1	34
19-4-R	251	76.5	34
19-4-T	251	76.5	34
19-4-L	251	76.5	34
19-5-R	226.5	69.0	34
19-5-T	226.5	69.0	34
20-1-L	10	3.0	5
20-2-L	7	2.1	5
20-3-L	4	1.2	5

Notes:

In the Gauge Package Column:

- First numeral in gauge package number column indicates the instrument hole number in which the gauge package is installed.
- Second numeral is the order number of package in each hole.
- Third character indicates the orientation of the gauge: R=radial, T=transverse, L=lateral.

Grayed-out gauges indicate those installed for earlier SPE tests that were no longer recording at the time of the SPE-4Prime test.

See Appendix 3 for additional information about the gauges.

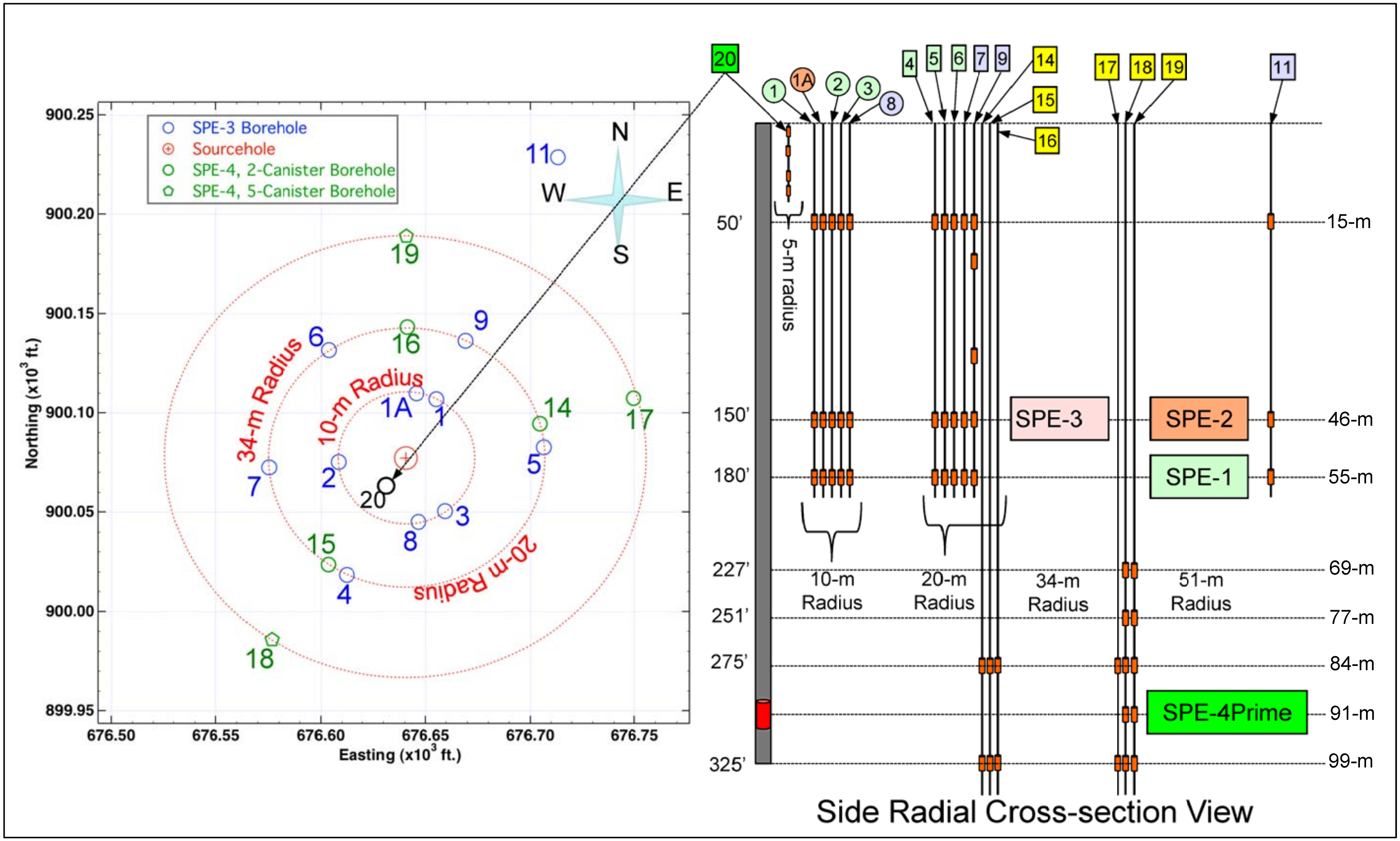

Figure 6

Schematic Diagram Showing Near-Field Accelerometer Array in Place for SPE-4Prime

The left figure is a plan view illustrating the positions of boreholes in which accelerometers were in place for SPE-4Prime. The right figure is a cross-sectional view showing the positions of the gauges in each hole and the depths of the SPE-1, SPE-2, SPE-3, and SPE-4 tests. See Table 1 for more specific information about the near-field gauges.

Appendix 3 provides information about the borehole sensors, including locations, elevations, and type of instruments installed.

2.3.1.2 As-Built Adjustments of Near-Field Gauge Positions

The description above provides nominal distances and directions between the gauges and the source, as if the source hole and instrumentation boreholes were perfectly vertical. However, due to the nature of the drilling process, none of the boreholes on the SPE test bed is truly vertical. The orientation ("deviation" from vertical) of each hole was measured after drilling, and the deviation data can be used to determine the exact position of each gauge and its distance from the source. These data are included with the SPE-4Prime data package, and are also listed in Appendix 3 of this report for each gauge. These data should be used for determining as-built locations of both the charge and the accelerometers.

2.3.2 Near-Field Surface Accelerometers

An array of vertical single-axis accelerometers was placed on the ground surface to indicate extent, if any, of surface spall. Figure 7 shows two rings of accelerometers at the ranges of 15 m and 30 m from the source hole on various azimuths. Another line of accelerometers was placed along an azimuth southwest from the source hole at distances of 2, 10, 15, 30, 45, 60, 75, and 90 m from the source hole.

2.4 Far-Field Instrumentation

Two primary types of far-field sensors (seismic and infrasound) were deployed for the SPE-4Prime test, as described below.

2.4.1 Seismic Instrumentation

To characterize the far-field seismic wavefield, a number of different instrument arrays were deployed starting at a distance of 100 m from the source hole and extending to distances as great as 25 km (Figures 8 and 9). Most seismic sensors were installed in five radial lines extending out from the source. Line 1 extends to the north and Line 2 extends to the northeast; both lines are relatively short due to proximity to the boundaries of the NNSS. Lines 3 and 4 extend to the south and southwest, while Line 5 extends roughly northwest. Instrument density on Line 5 is lower than on the other lines because steep topographic gradients hindered deployment.

As described in Section 4.1.1.2, data from all the stations except the four "mesa" stations of Line 5 (L5028, L5030, L5034, and L5036), located at the far western portion of the line, were telemetered in real time to the NSL data center in Reno. For the four mesa stations, recording was conducted on 6-channel RefTek 130 digitizers powered by batteries that were trickle-charged by solar panels. Data were stored to disk and collected manually at intervals.

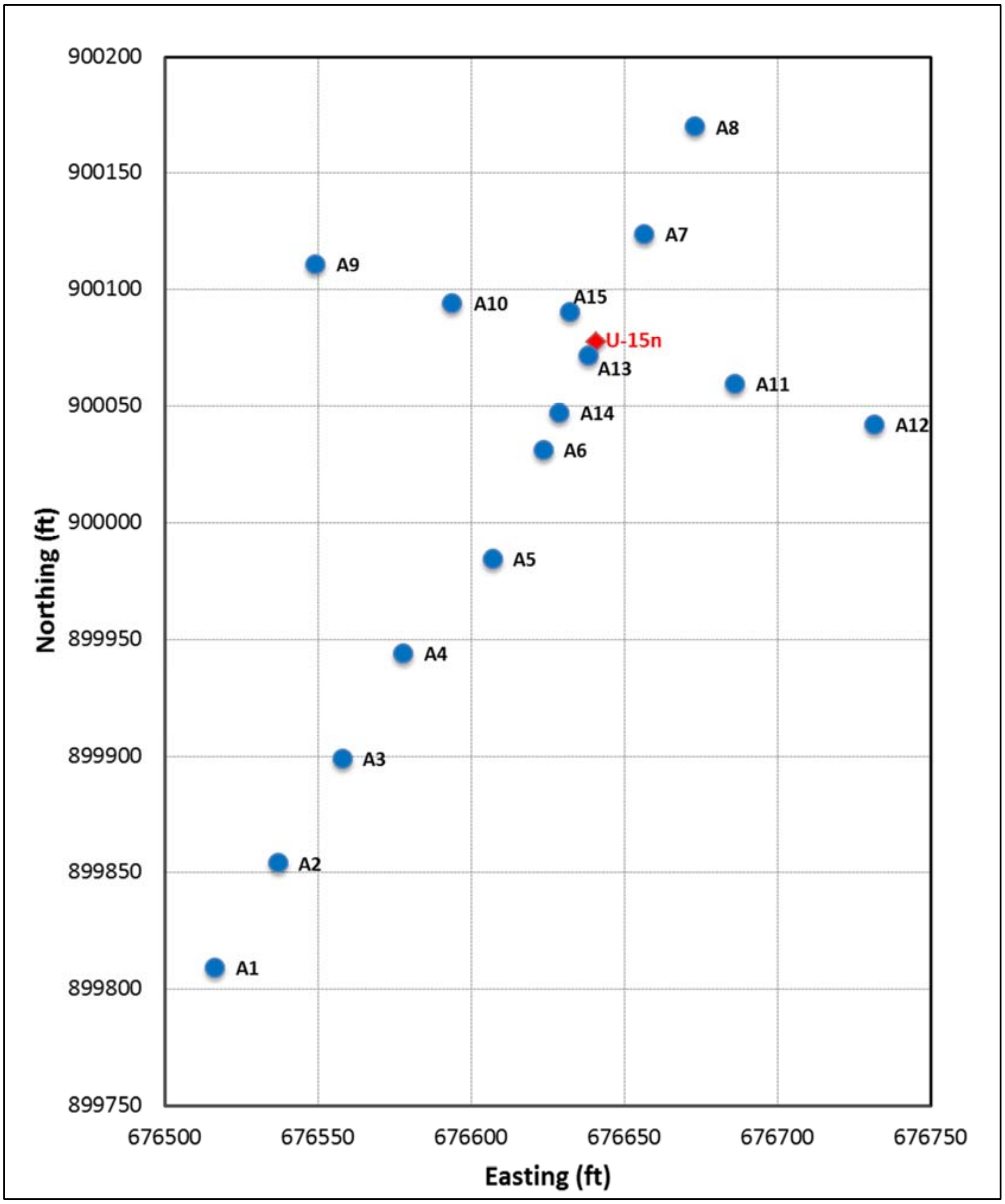

Figure 7
Plan View of Surface Accelerometer Layout for SPE-4Prime

See additional location data for accelerometers in Appendix 4. Table below provides key to Station IDs.

Accelerometer Label	Station ID	Accelerometer Label	Station ID
A1	DT018	A8	DT013
A2	DT017	A9	DT014
A3	DT016	A10	SL010
A4	DT015	A11	SL011
A5	SL007	A12	SL012
A6	SL008	A13	DT007
A7	SL009	A14	DT008

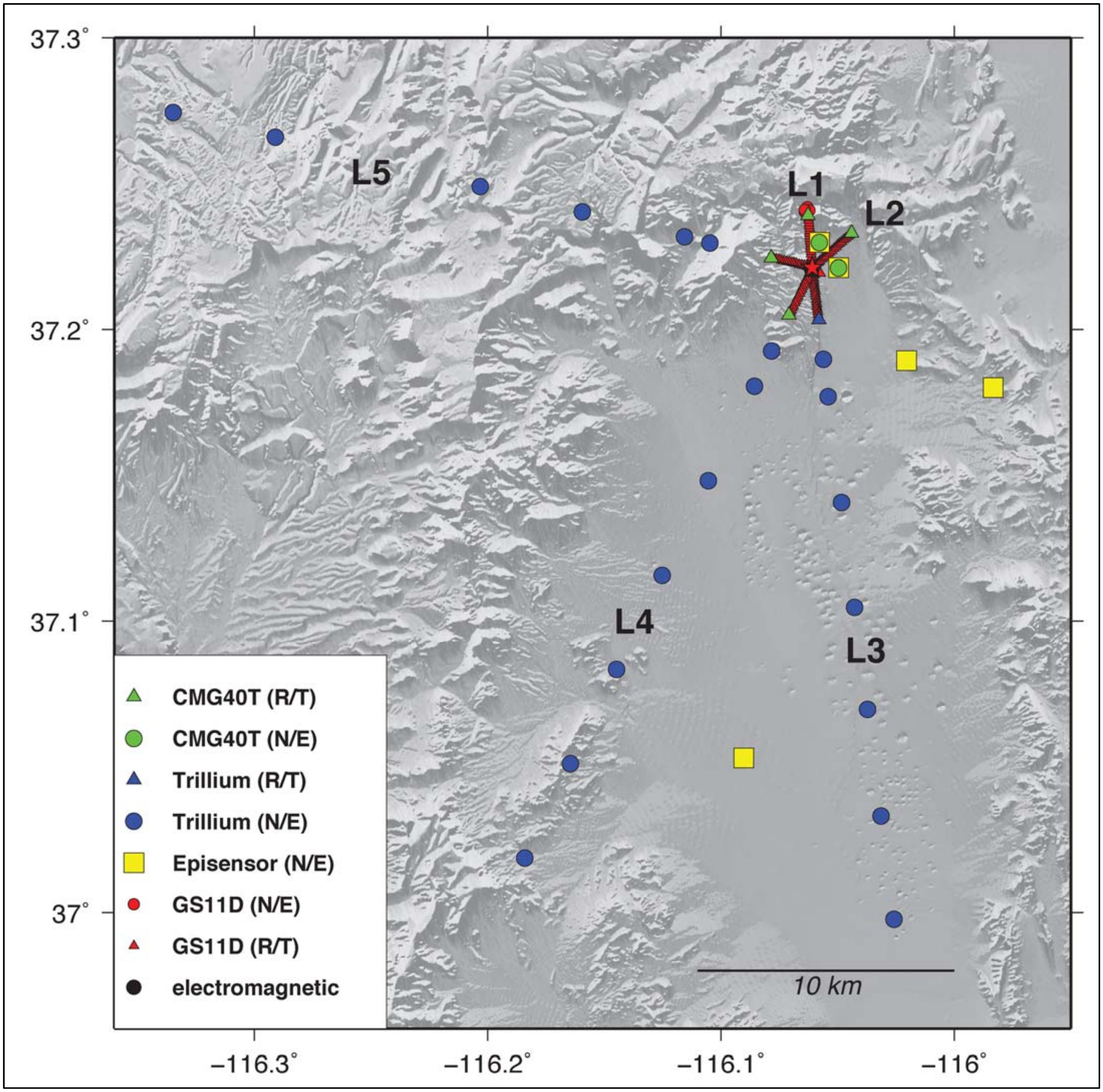

Figure 8
Map Showing Far-Field Instrumentation Layout for SPE-4Prime

See expanded view of close-in geophone locations on Figure 9. See text for sensor information.

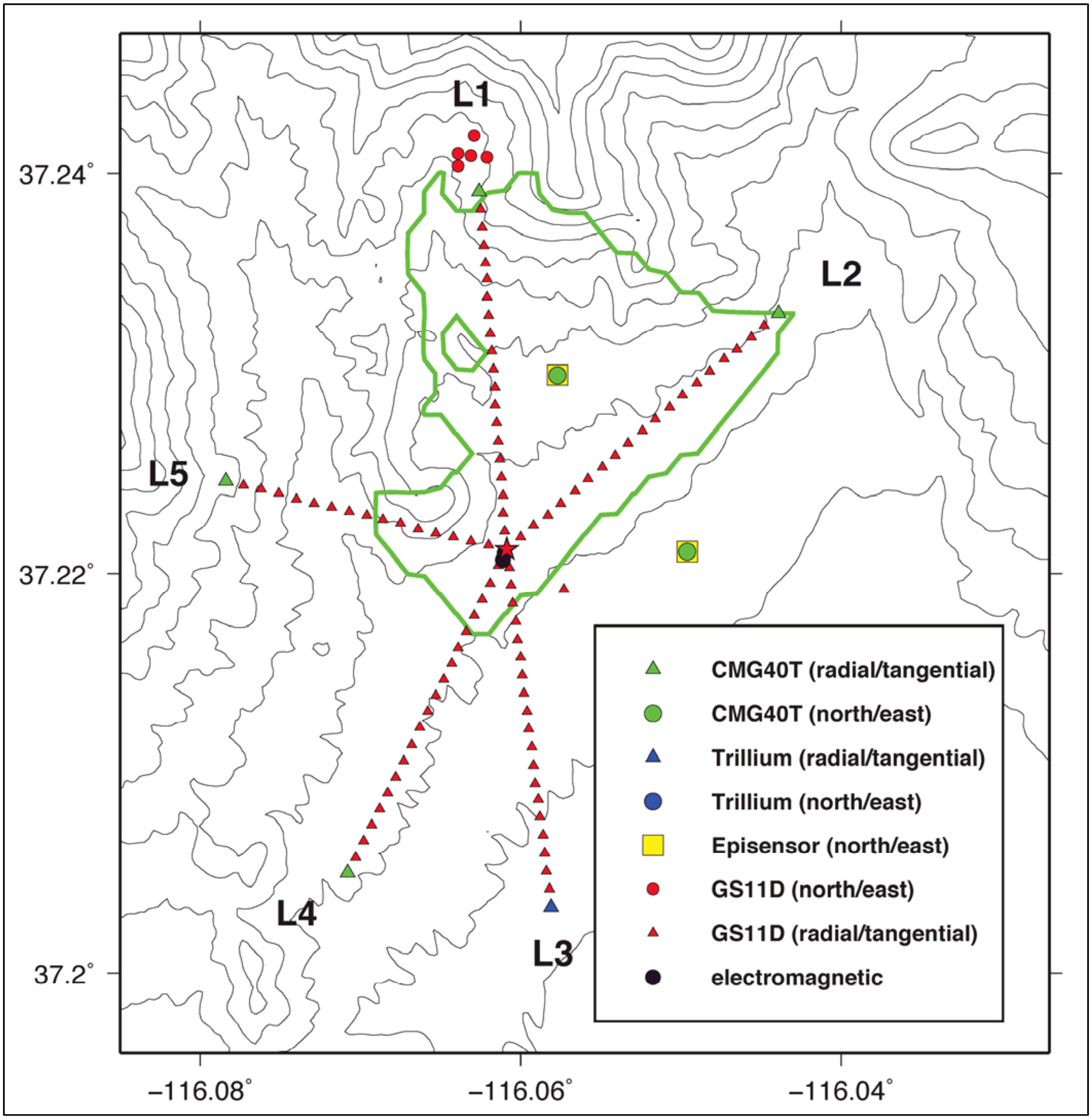

Figure 9
Map Showing Locations of Geophones Placed within Approximately 2 Kilometers of the SPE-4Prime Source Hole

Nominal distance between instruments is 100 meters. The green line is the approximate outline of the granite body at the surface. See text for sensor information.

It is important to note that data polarity standards for geophones and seismometers differ. Geophones produce negative voltages for upward ground motion, while the seismometers and accelerometers produce positive voltages for upward ground motion. This polarity standard is extended to three components in the case of three-component geophones. Geophone polarity follows a right-hand-rule standard with vertical pointing into the earth. The data in this collection are exactly as recorded by the sensors.

Characteristics of the instruments installed along the five geophone lines are summarized below. Exact details such as sensor type and response can be found in the metadata as well. Appendix 4 contains a summary of location and instrument information for each surface sensor site. However, all data users should verify they are using the full current metadata posted with the data.

Geospace GS-11D 4.5-hertz (Hz) geophones were deployed in five linear arrays, radiating out from the source hole distances from 100 m to 1.9 km. Nominal station spacing is 100 m, with some expected locations skipped due to steep topography (mostly along Line 5). All are three-component sensors oriented radial, transverse, and vertical to the source hole position. The geophones are buried less than 0.5 m deep in native material, with sandbags placed on top. A small array of five Geospace GS-11D geophones was also deployed just north of the end of Line 1.

Guralp CMG 40T three-component seismometers are installed at the ends of the geophone lines 1, 2, 4, and 5, 2 km distant from the source hole, and a Nanometrics Trillium seismometer was installed at the 2-km distance on Line 4. The components are oriented radial, transverse, and vertical to the source hole position. All are installed on a concrete pad set less than 10 cm into the soil.

Lines 3, 4, and 5 are extended beyond 2 km (to a maximum of 25 km) by either six or seven Nanometrics Trillium Compact seismometers each, oriented radial north-south, east-west, and vertical (Figure 8). The instruments are installed on a concrete pad set less than 10 cm into the soil. Two stations on Line 5 (L5-28 and L5-34) were very close (centimeters) to bedrock, so at those locations the broadband instruments were covered by a sensor case in an ice chest (not barometrically sealed) covered with sandbags.

On the broadband Compact Trillium sensors on Lines 3, 4, and 5, channels 1, 2, and 3, were oriented positive, up, north, and east, respectively. Orientation was estimated visually in the field, and the error is estimated to be less than about 5 degrees, as checked by later precise orientation measurements. At the 2-km distance and beyond, sensor orientations are set with respect to cardinal directions and not radial/tangential. This difference is denoted in the channel names. Timing was established by Geographic Positioning System receivers at each cataloger/digitizer. RefTek logs were reviewed for timing errors during data compilation.

In addition to this instrumentation, instruments were deployed for AFTAC at five sites. Kinemetrics Episensors were located at all five sites, and Guralp CMG40T three-component seismometers were placed at the two sites closest to the source hole (Figure 8). All sites were equipped with Chaparral infrasound sensors. All sensors were oriented to north (N), east (E), and vertical (Z) and recorded on Reftek digitizers.

2.4.2 Infrasound Arrays

Prior to the SPE-4Prime test, SNL deployed eight infrasound arrays around the source hole. Each array consists of four Hyperion IFS-3000 (www.hyperiontg.com) infrasound sensors. Each station telemetered data in real time to the SNL trailer at the command center, located approximately 365 m southeast of the SPE-4Prime source hole. The IFS-3000 has a flat response from 0.1 to 100 Hz (without porous hoses) and 0.1 to 40 Hz (with porous hoses) with a 100-pascal full-scale range and a nominal sensitivity of 0.15 volts per pascal. SNL recorded the SPE-4Prime infrasound data on Geotech Instruments SMART-24 digitizers at 200 samples per second. The data were also telemetered in real time to the database hosted by UNR, along with the seismic data.

The infrasound sensors were installed in a roughly triangular geometry with one sensor and the digitizer at the center and the other three sensors arranged azimuthally (~120-degree increments) around the center element at a distance of about 30 m. Attached to each sensor were four 15-m lengths of porous hoses, for wind noise reduction.

Four arrays were installed azimuthally around the explosives pad approximately 0.25 km from ground zero, and were at different elevations due to topography constraints. Three of the remaining arrays were located at 1, 2 and 5 km, respectively, linearly south-southeast of ground zero, and one additional array was installed 1 km east of ground zero (Figure 10).

2.4.3 Electromagnetic Instrumentation

Three-component magnetometers (Electromagnetic Instruments BF-5) were deployed by LLNL at two locations on the ground surface at distances of 30 m and 60 m laterally away from the source hole (straight-line distances of 92 m and 106 m from the SPE-4Prime explosion point). These instruments measure the magnetic field at low frequencies and were sampled at 500 Hz; they had high-pass filters set at 0.01 Hz and a 60-Hz notch. The components were oriented north–south, east–west, and vertical. A geophone was co-located to measure ground motion, because the ground motion will cause a signal due to movement of the sensors in the field. A signal caused by the explosion will appear almost simultaneously with the origin time and before the seismic signal.

All three components and the seismic geophone appeared to function correctly but no clear electromagnetic signal was observed at the origin time, as would be expected, and no clear signal was observed at either the 30-m or 60-m locations. Given the range and size of the explosion, the lack of any clear signal was not unexpected.

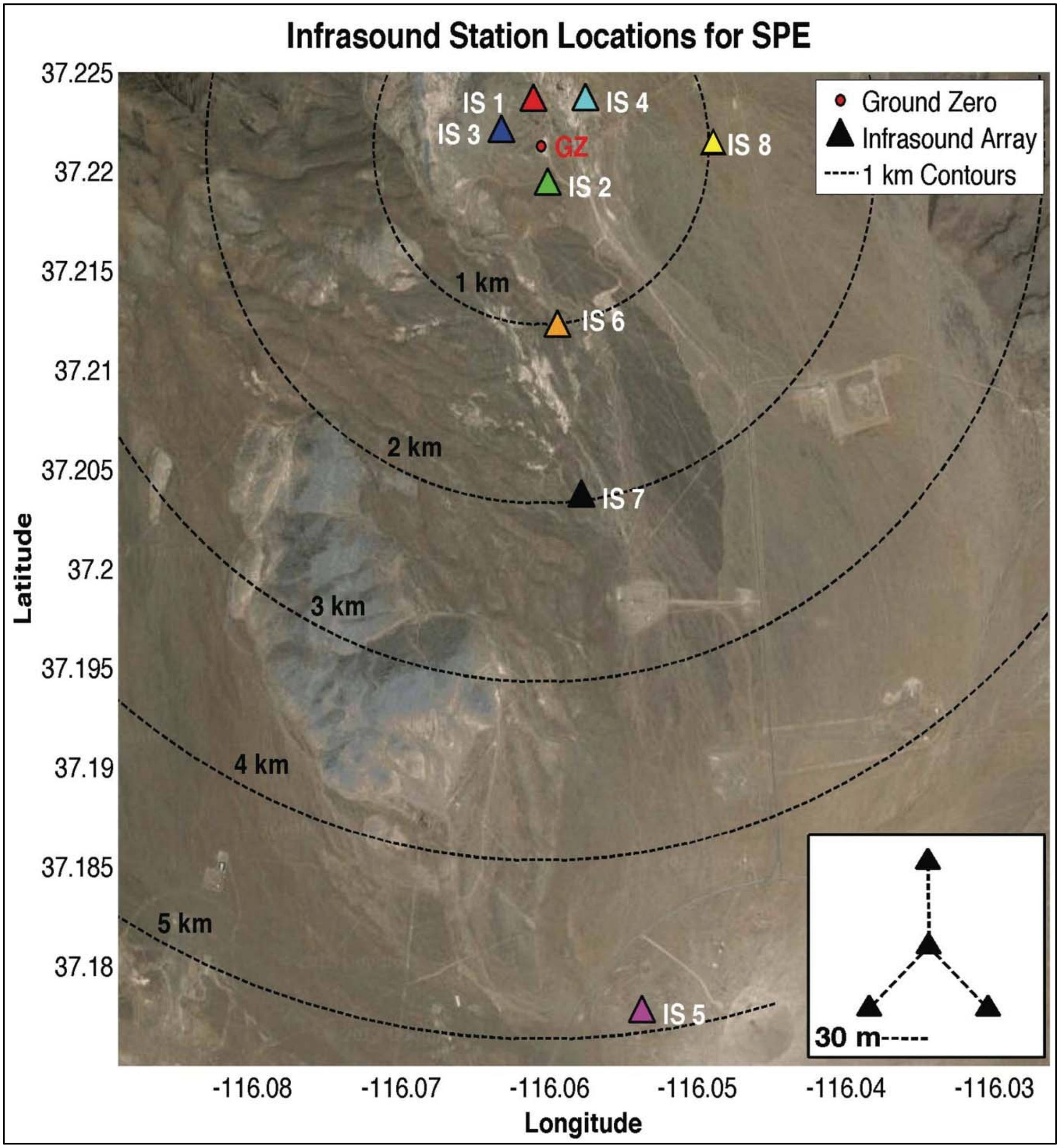

Figure 10
Map Showing Infrasound Array Locations (Triangles) around SPE-4Prime Source Hole

Dashed lines are 1-km contours from source hole ("GZ" in red). Inset shows an example of the sensor geometry at each array.

3 Data Acquisition and Corrections

3.1 Near Field Instrumentation

3.1.1 Data Acquisition

The data packages for SPE-4Prime include the raw acceleration-time pairs recorded for all accelerometers. The data are included as standard SAC files. SAC is a general purpose interactive program designed for the study of sequential signals, especially time series data. The program is available for download here: http://ds.iris.edu/ds/nodes/dmc/software/downloads/sac/

3.1.2 Data Corrections

These data files contain raw recorded acceleration histories with no corrections applied. Typical corrections that an analyst might apply are DC baseline shifts to account for pre-experiment voltage drift, and post-arrival drift to reflect the different transducer calibrations that are applicable on unload. We leave these corrections to the analyst.

A third correction relates to gauge rotation that the SPE team believes occurred during installation of transducers prior to SPE-1. This refers to transducers in boreholes U-15n#1, #2, #3, #4, #5, and #6 at the nominal 54.9-m and 45.7-m depths. The recommended corrections for these rotations are discussed in prior SPE data release reports (NSTec 2014; 2015) and will not be discussed further here.

3.2 Far Field Instrumentation

3.2.1 Data Acquisition

For the stations that were not telemetered (far western end of Line 5) data were rapidly acquired and sent on a portable hard drive to NSL for reformatting and construction of metadata.

An important note is that the signal polarity of the GS11D uses the Society of Exploration Geophysics standard: a downward ground motion yields a positive signal. The other instruments have the opposite polarity, i.e., upward ground motion yields a positive signal. Gains were set to unity on the Reftek instruments for the SPE tests.

Data features:

- Difference in polarity between geophones and other instruments
- Data spikes (most obvious on data prior to the test); these were most likely due to issues with the cable power systems, although thunderstorms and lightning produce similar signals
- Possible cross-talk causing low amplitude signals on non-functioning channels

3.2.2 Data Corrections: RefTek Clock Timing Issues

Timing issues were discovered at four SPE-4Prime stations that used certain older (Garmin) Global Positioning System (GPS) clocks. Stations L1007, L1008 and L4015, L4016 recorded negative time discrepancies of ‘exactly’ 1-second between the internal RefTek and external GPS clocks, which results in the signal from the explosion appearing early. The signal arrivals from these stations can be corrected to the SPE-4Prime origin by adding exactly one (1) second. Although these four stations seem to be the only ones affected during the recording window, it is possible that other stations with RefTek instruments may contain this same discrepancy for intervals surrounding the experiment.

The protocol for clock syncing in the RefTek RT-130 data loggers dictates that if a continuous discrepancy is seen across four consecutive clock sync cycles, the clock will self-correct. This takes about 4 hours in “duty-cycle” mode or about 15 minutes in “continuous” mode. Although most of the RT-130 data loggers were configured in continuous mode, some may have lapsed into duty-cycle mode during station maintenance. The SPE analysts have not attempted to find suspected time jerks or to modify waveform and other catalogue files; however it should be possible for data users to scan for 1-second negative and positive gaps (overlaps and spaces, respectively) to determine whether these intervals exist. Following SPE-4Prime, suspect clocks were replaced, and the issues at these sites were resolved.

4 Post-Experiment Procedures

4.1 Aggregation, Merging, and Archiving of SPE-4Prime Data

Post-experiment aggregation, merging, archiving, and distribution of SPE-4Prime data were conducted at UNR by the technical members of the NSL. The process employed the Antelope Real Time and data processing software system from Boulder Real Time Technologies (Boulder, Colorado); the data processing suite from the Program for Array Seismic Studies of the Continental Lithosphere (PASSCAL); the CSS 3.0 database format; and Ubuntu-Linux-based servers at NSL’s Reno data center.

4.1.1 Data Aggregation

Data aggregation is the phase of acquiring raw metadata and time series data from project participants, reviewing the submissions, and conducting initial format conversions to standardize the media.

4.1.1.1 Metadata

Metadata were compiled prior to the SPE-4Prime test and refined during the merging and archival process. For each sensor, NSL asked SPE-4Prime participants to submit standard station metadata, including the following items:

- Sensor make/model/type
- Sensor sensitivity factor
- Sensor serial number
- Sensor lat/long, decimal degrees
- Sensor frequency response file
- Sensor depth
- Sensor orientation
- Sensor on-time, off-time
- Sensor
- Data logger make/model
- Data logger serial number
- Data logger response file
- Data logger bit weight
- Data logger channel number
- Channel gain
- Channel sample rate
- Site name
- Site description

SPE investigators submitted these initial metadata to NSL through electronic transfer of spreadsheets, figures, and scanned drawings, which were then made available to all participants via document archives on the NSL SPE data server.

4.1.1.2 Real-Time Telemetry and Waveform Aggregation Procedure

Real-time telemetry was implemented for most geophone and broadband seismic stations in place for SPE-4Prime. Real-time telemetry eliminates the need to visit sites for data acquisition, allows real-time station diagnostics, provides capability to access stations remotely for parameter checks and adjustments, and ensures an overall increase in the level of data quality and data return rates, over stand-alone portable stations. Telemetered sites for SPE-4Prime included all stations except the "mesa" stations of Line 5, which are those located on the far western portion of the line (L5028, L5030, L5034, and L5036). Data from these four stations were collected as in SPE-1 (NSTec 2014). Figure 11A shows telemetry paths for all five geophone lines; Figure 11B shows the telemetry paths for the geophone stations closer in to the SPE-4Prime source.

Data for SPE-4Prime were routed from individual stations to one of four local Access Points (APs) AP1, AP2, AP3, AP4) and thence to the NSL microwave backbone site on Skull Mountain (just south of the image space on Figures 11A and 11B). From Skull Mountain, they were transmitted via microwave and fiber link to the NSL Reno data center. Data acquisition rates, transmitted in a compressed format to reduce through-put, averaged 11.5 gigabytes per day, with Broadband channels transmitting at 250 samples per second (sps) and geophone channels at 500 sps.

The NSL/SPE data storage and distribution server, established at the Nevada System of Higher Education's UNLV Systems Computing Services (SCS) data center, provided access to all SPE-4Prime data for project scientists. This included real-time data from the SPE array, NSL's Southern Nevada (SN) regional network (UNR 1995), and three Leo Brady network stations; and daily updates from NSL's entire Northern Nevada (NN) network. The data server functions not only as a distribution point for time series and other spatial data collected by the project, but also as a hub for project communication, light data analysis, and temporary and long-term data storage.

4.1.1.3 Near-Field Waveform Data Aggregation

Near-field waveform data recorded on high-sample-rate multi-channel digitizers were recovered by project principal investigators and submitted to NSL by electronic file transfer. The data formats included (1) SAC, (2) four-byte integer, and (3) non-standard ASCII formats with accompanying scripts and other supporting metadata. For data received in SAC format, there was no required initial conversion procedure. Other formats required varying amounts of effort to convert to a common format.

4.1.2 Merging of Data Sets

Data merging is the phase of generating a valid CSS 3.0 metadata volume and modifying waveform file headers so that they will synchronize with the CSS 3.0 metadata format.

4.1.2.1 Metadata Generation

Upon receipt of metadata submissions, NSL staff distilled and standardized the information into ASCII files, one per station, in an open format that provides the input to Antelope's *dbbuild* program. The *dbbuild* format tracks station information changes through time (i.e., station histories), and allows for (1) rapid regeneration of an entire CSS 3.0 database as corrections and

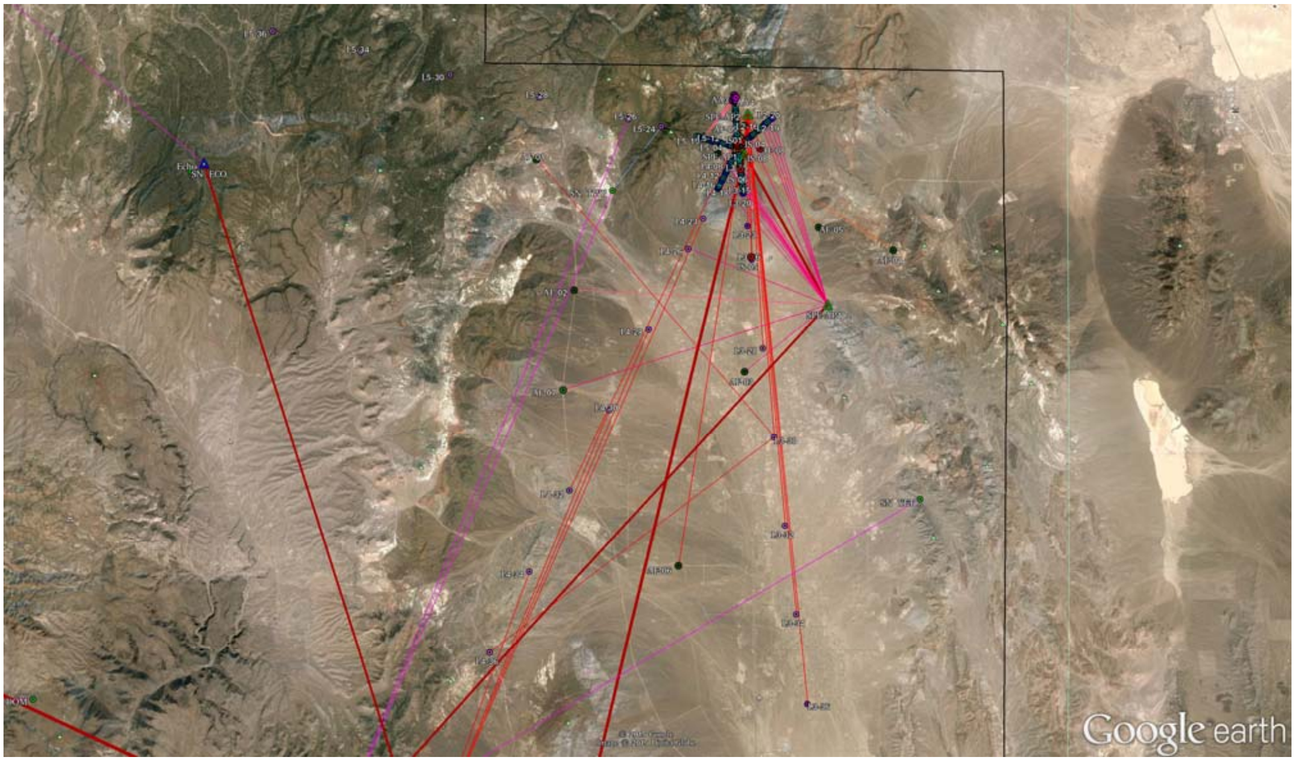

Figure 11A
Telemetry Paths for the Five Geophone Lines in Place for SPE-4Prime

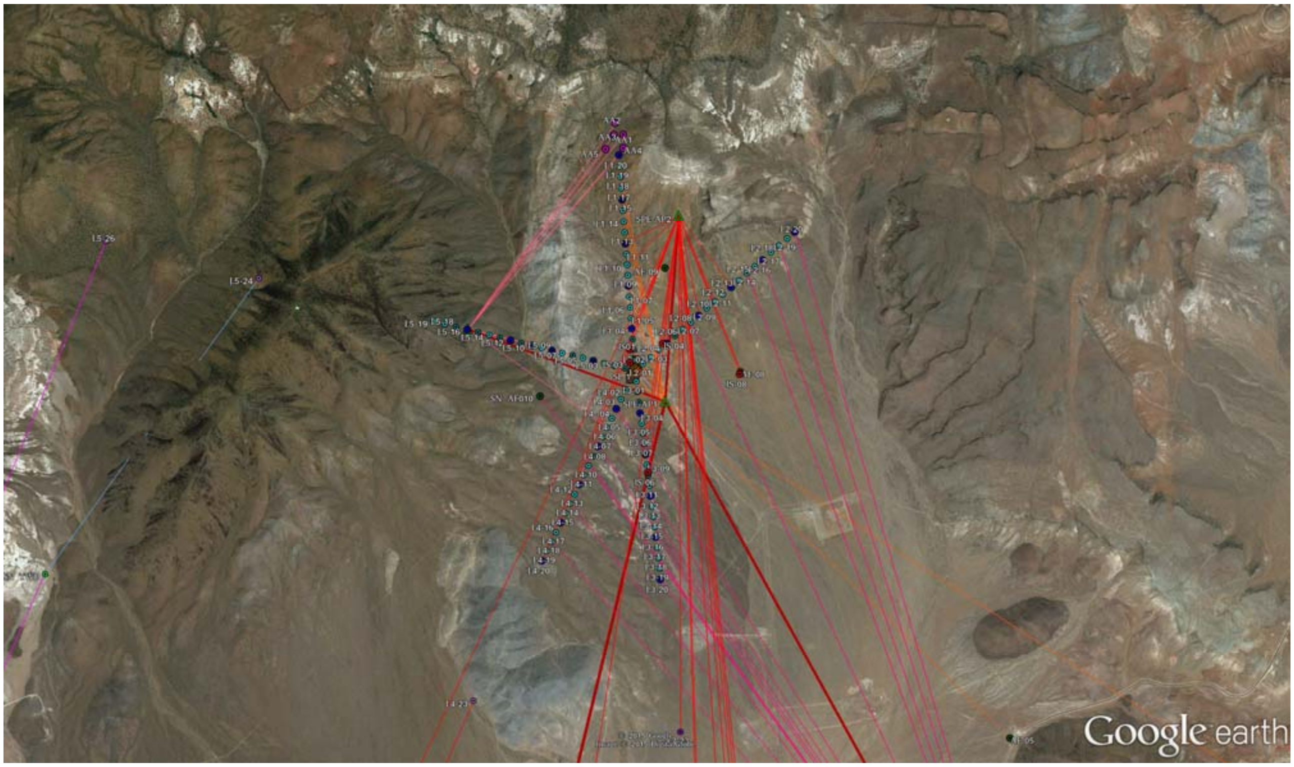

Figure 11B
Telemetry Paths for Geophone Stations Closer to the SPE-4Prime Source Hole

additions are required, (2) cross-institution database maintainability, (3) version control and revision history, and (4) a distributable and readable station record that can be useful even without proprietary tools.

4.1.2.1.1 Station Names and Descriptions

Upon submission, most metadata contained station descriptions and names that were meaningful only to the internal processes of the submitting institution. For the purpose of creating a single coherent volume, NSL technical staff created five-character station names that are compliant with the Standard for the Exchange of Earthquake Data (SEED). Where possible, the initial descriptions were preserved in the CSS 3.0 site descriptions to ensure new station names would be easily recognized by the various investigators.

4.1.2.1.2 Channel Codes

NSL staff created SEED-compliant channel codes describing the sample rate (band), instrument type, and orientation of each data channel. However, a collective decision was made by NSL and project investigators to leave the band code unchanged, even though per-instrument sample rates fluctuated from 100, to 500, to 250, to 200 sps. This was done to avoid generating confusion for the large party of investigators who were not yet familiar with SEED and CSS 3.0 database conventions, which are sometimes terse and detailed and can become lengthy when many configuration changes are made across a large array during the course of recording. In addition, it was widely held as important that channel codes be tied to certain sensor types to facilitate rapid association of a channel's code with the sensor's location relative to the source.

4.1.2.1.3 Precision of Sensor Location

Sensor locations were submitted to NSL in State Plane Coordinates (SPC, feet) and geographic coordinates (lat/long in decimal degrees). The submitted geographic coordinate submissions were merged directly into the CSS 3.0 metadata where station lat/long values were required. The SPC station locations were used to calculate northing and easting offsets in feet from the location of the SPE-4Prime source (station SP-01, northing 900077.22, easting 676640.6), and these offsets were then converted to meters using the conversion factor 1 m = 3.28084 feet.

4.1.2.1.4 Precision of Sensor Orientation

For the most part, measured sensor orientations were not submitted to NSL, with the exception of the vertical angles (in the radial direction) of the near-field borehole accelerometers. The remainder were submitted as orientation codes (N=North, E=East, Z=Vertical, R=Radial, T=Tangential, L=lateral), and NSL calculated the azimuths of the sensor axes from the geographic coordinates. All azimuthal calculations were based on the assumption that the particular axis of the sensor was correctly aligned, e.g., that a radial orientation was indeed radial, and that the geographic coordinates are accurate to <0.3 m. The estimated error on horizontal orientation is <5 degrees.

4.1.2.1.5 Sensor Sensitivities

Sensitivity values were submitted per sensor for the near-field borehole (stations BH) and surface accelerometers (stations DT and SL). Listed gauge sensitivities are measured, not nominal, as each accelerometer was tested at DTRA prior to deployment, with a tolerance of less than 2.4 percent. Far-field sensitivity values are nominal and were derived from manufacturer information sheets.

4.1.2.1.6 Gains

Pre-amplifier gains were submitted per sensor for the near-field accelerometers. These gains were set to optimize response with respect to the magnitude of the experiment, and estimated waveform amplitudes. Where gains were larger (compared to predicted signal size) there will be a larger error due to increased amplification, which increases the signal-to-noise ratio. For far-field, short-period and broadband instruments, gains were set at unity. Shortly after the test, gains for the short-period sensors were increased to high-gain.

4.1.2.1.7 Calibration Factors

Calibration factors for near-field accelerometers were calculated from pre-amplifier gains (as above), a digitizer constant (bit weight), and sensitivity values (as above). All of these components are listed in the CSS3.0 *stage* table for the assembled near-field data sets and in the data-less SEED volume. Calibration factors for stations SL001 through SL012 also include a 10 percent cable-attenuation factor. Alternative calibration factors, supplied by DTRA for the near-field channels, are included with the assembled data sets in the file *calibrations.txt*. These calibration factors employ the raw vertical bit weight for each channel, and include baseline averaging over 512 samples, but differ less than 2.4 percent from calculated values.

4.1.2.1.8 Instrument Response

Numerical (e.g., pole-and-zero) frequency responses are not available for the near-field accelerometers. Frequency response is expected to be essentially flat for frequencies of interest (Winningham 2011) and is represented as constant in the metadata. Response data for the far-field sensors are redistributed from the versions supplied with the Antelope data processing system, except in the case of the infrasound sensors; those responses were supplied in pole-zero format by SNL project personnel.

4.1.2.2 Synchronizing Waveform Data

The procedure for waveforms files collected from non-telemetered stations included correcting file headers to reflect the appropriate network-station-channel-location (net_sta_chan_loc) codes, and then using the Antelope *miniseed2db* or *sac2db* programs to generate a CSS 3.0 “wfdisc” table. The “wfdisc” table provides the mechanism to associate the time series data with the metadata set that describes the waveforms’ response, sensor parameters, etc.

For miniSEED files, header modification was done using the PASSCAL *fixhdr* program. By default, the station and channel names in miniSEED file headers are set to the data logger serial number and stream codes. The data logger and channel codes are then mapped to SEED net_sta_chan_loc. The net_sta_chan_loc code maps were derived from the site metadata for each data logger configuration.

For SAC files, the header modifications were done using the SAC analysis software, distributed through IRIS.

4.1.3 Data Archiving

Archiving is the phase of presenting final data products. It includes completion of quality control procedures and generation of final product formats.

4.1.3.1 Metadata Formats

4.1.3.1.1 CSS 3.0

The CSS 3.0 metadata format is an industry/community standard and is the format supported by the Antelope system. It is a readable and open database system that allows for schema extensions and therefore is flexible, scalable, and adaptable to non-standard sensor array configurations.

4.1.3.1.2 Dataless SEED

The dataless SEED format is an industry/community standard for metadata that includes station histories as well as sensor and data logger response information. It is distributed as a single file, and can be read and imported by a wide variety of programs and applications. The volume distributed by NSL was generated from CSS 3.0 metadata using the Antelope application *db2sd*. The lat/long values in the dataless SEED volume were then corrected to six-decimal-place precision to honor location information submitted by project participants.

4.1.3.1.3 Dbbuild

The *dbbuild* format is an ASCII-text-based format that tracks site parameters throughout all epochs, or periods of distinct recording configurations. The *dbbuild*-based metadata comprise one text file per station, and while the files by themselves do not include sensor frequency response or data logger response, they do include sensor sensitivity factors. As input to the Antelope *dbbuild* program, which builds CSS 3.0 metadata (and in turn is converted to dataless SEED), the *dbbuild*-format files are the canonical metadata records maintained by NSL for all SPE stations.

4.1.3.2 Time Series Formats

There are many time-series data formats, but for simplicity and for reusability of conversion and processing scripts, the technical staff at NSL resolved to create an archive based on either miniSEED or SAC formats. MiniSEED is the preferred format for data submissions to IRIS, and also the standard format for most Antelope-based programs and tools. SAC is the most widely known and used time-series format, and in some cases, such as with very high-sample-rate data (e.g., 1 million sps), it has capabilities that miniSEED does not.

4.1.3.3 Quality Control Measures

While the quality control of time-series data is left to SPE investigators (the near-field and far-field data committees), NSL is charged with creating a coherent database that is up to date and accurate with respect to the data submissions. Four quality control measures were used to verify the data products for SPE-4Prime, as described below.

4.1.3.3.1 Manual Inspection of dbbuild-Format Files

All metadata submissions are converted initially to the *dbbuild* format. These files are reviewed for completeness and then checked in to a revision-control system. The use of revision control allows

NSL to track completeness of array-wide edits, and is important for tracking metadata errors and corrections.

4.1.3.3.2 Output Warnings and Errors from dbbuild Program

The *dbbuild*-format files are used by the *dbbuild* program to generate the CSS 3.0 metadata. All runs of *dbbuild* are conducted with the use of verbose warnings; the standard output is captured in a log; and the log is reviewed after the run completes. This process allows NSL to find and fix inconsistencies, incomplete entries, and mistakes in the *dbbuild*-format metadata that are not caught during manual review.

4.1.3.3.3 Antelope dbverify Program

After generating a coherent CSS 3.0 metadata set that passes the first two levels of quality control, the data are examined for any additional problems using the Antelope *dbverify* program. This program performs consistency checks between database tables, and is largely a tool for checking the validity of database schema and formats, rather than for finding omissions or typographic mistakes.

4.1.3.3.4 Output from dbjoin and dbfixids

The final step in each iterative generation of a CSS 3.0 metadata set is to synchronize the wfdisc table with the new channel identifiers, waveform identifiers, channel names, and calibration values that often change as metadata are refined and improved. This process not only corrects out-of-sync values in the wfdisc tables, but also warns when there are entries in the wfdisc table that do not join with the CSS 3.0 metadata. This reveals the case where waveforms have been submitted, but no metadata exist for the particular station. This situation can occur when new stations are added, or when data loggers are changed in the field without the updated information being submitted; it can also indicate a case where NSL has missed a submission. This measure prompts staff to re-examine emails, contact field technicians, etc., to sort out why metadata are missing and contributed greatly to the completeness of the SPE-4Prime archive.

5 Summary

This report coincides with the official release of near- and far-field seismic station, gauge, and diagnostic data for SPE-4Prime, distributed by IRIS. The near-field data for SPE-4Prime are found in Assembled Data Set 17-012, which also includes this report. The far-field data were submitted directly using the NSL's "SN" network code and merged directly in the IRIS archive. The report includes a description of the experiment, the types of data and instruments, and post-experiment data processing.

6 Acknowledgements

SPE would not have been possible without the support of many people from several organizations. The authors wish to express their gratitude to the U.S. Department of Energy, National Nuclear Security Administration, Defense Nuclear Nonproliferation Research and Development and the SPE working group, a multi-institutional and interdisciplinary group of scientists and engineers. Deepest appreciation is given to Robert White and Ryan Emmitt (NSTec) for their tireless work on the seismic array, and to the NSL at UNR for their support of the seismic network and for data aggregation. Thanks also to IRIS for instrumentation partnership. This work was done by National Security Technologies, LLC, under Contract No. DE-AC52-06NA25946.

7 References

Ford, S., and W. R. Walter, 2013. "An Explosion Model Comparison with Insights from the Source Physics Experiments," *Bull. Seism. Soc. Am.,* vol. 103, pp. 2937–2945, doi: 10.1785/0120130035.

National Security Technologies, LLC, 2014. *Data Release Report for Source Physics Experiment 1 (SPE-1), Nevada National Security Site*. DOE/NV/25946--2018. Las Vegas, NV.

National Security Technologies, LLC, 2015. *Data Release Report for Source Physics Experiments 2 and 3 (SPE-2 and SP-3), Nevada National Security Site*. DOE/NV/25946--2282. Las Vegas, NV.

NSTec, see National Security Technologies, LLC.

Orkild, P. P., D. R. Townsend, M. J. Baldwin, D. L. Healey, G. D. Bath, C. E. Jahren, and J. G. Rosenbaum, 1983. *Geologic and Geophysical Investigations of Climax Stock Intrusive, Nevada*. Open-File Report 83-377. U. S. Geological Survey, Denver, CO.

Rougier, E., and H. J. Patton, 2015. "Seismic Source Functions from Free-Field Ground Motions Recorded on SPE: Implications for Source Models of Small, Shallow Explosions." *J. Geophys. Res. Solid Earth,* 120, 3459-3478, doi:10.1002/2014JB011773

Snelson, C. M., V. D. Chipman, R. L. White, R. F. Emmitt, M. J. Townsend, D. L. Barker, and P. Lee, 2012. "An Overview of the Source Physics Experiment at the Nevada National Security Site." In: *Proceedings of the 2012 Monitoring Research Review: Ground-Based Nuclear Explosion Monitoring Technologies, Volume I.* Albuquerque, NM.

Snelson, C. M., R. Mellors, H. J. Patton, A. J. Sussman, M. J. Townsend, and W. R. Walter, 2013, "Source Physics Experiments to Validate a New Paradigm for Nuclear Test Monitoring," *Eos Trans., American Geophysical Union,* vol. 94, no. 27, pp. 237–239.

Steedman, D. W., 2013. *Review of Data from Shock Physics Experiments SPE-1, SPE-2, and SPE-3: Data Corrections and Phenomenology Analysis*. Los Alamos National Laboratory Report LA-UR-13-22561. Los Alamos, NM.

Townsend, M., L. Prothro, and C. Obi, 2012. *Geology of the Source Physics Experiment Site, Climax Stock, Nevada National Security Site.* DOE/NV/25946--1448. Prepared by National Security Technologies, LLC, Las Vegas, NV.

University of Nevada (UNR Reno), 1995. Southern Great Basin Network. International Federation of Digital Seismograph Networks. Other/Seismic Network. doi: 10.7914/SN/SN.

UNR, see University of Nevada (UNR Reno).

Winningham, K., Defense Threat Reduction Agency, 2011. Personal communication to K. Smith, University of Nevada, Reno Seismological Laboratory, regarding frequency response of borehole sensors.

List of Appendices

All data users should verify they are using the full current metadata, including the SN network dataless SEED volume from IRIS for the far-field data (surface sensors), and the CSS3.0 metadata from the assembled data sets for the near-field sites (boreholes).

Appendix 1

Construction Data for Holes Drilled at the U-15n Site

Appendix 1

Construction Data for Holes Drilled at the U-15n Site

(As-built coordinates and elevations as of March 16, 2016)

Hole Name	State Plane Coordinates [a] at Collar		UTM Coordinates [b] at Collar		Geographic Coordinates [c] at Collar		Ground Elevation [d]	Conductor Hole Dimensions		Conductor Casing [e] Dimensions		Borehole Dimensions	
	Northing (feet)	Easting (feet)	Northing (meters)	Easting (meters)	Latitude (degrees)	Longitude (degrees)	(feet)	Diameter (inches)	Depth [f] (feet)	Diameter (inches)	Depth [f] (feet)	Diameter (inches)	Depth [f] (feet)
U-15n Source	900,077.28	676,640.62	4,119,823.7	583,318.7	37.221195	-116.060867	5,001.87	48	7.5	42	7	36	339
U-15n#1	900,107.01	676,655.17	4,119,832.8	583,323.1	37.221276	-116.060816	5,002.00	12.25	7	10.75	6.5	8	190
U-15n#1A	900,109.89	676,645.66	4,119,833.7	583,320.2	37.221284	-116.060849	5,002.10	12.25	7	10.75	7	8	194
U-15n#2	900,075.27	676,608.54	4,119,823.1	583,308.9	37.221190	-116.060977	5,002.16	12.25	10	10.75	9.5	8	190
U-15n#3	900,050.67	676,659.48	4,119,815.6	583,324.5	37.221121	-116.060803	5,001.58	12.25	10	10.75	9.5	8	190
U-15n#4	900,018.48	676,612.53	4,119,805.8	583,310.2	37.221034	-116.060965	5,001.54	12.25	10	10.75	9.5	8	192
U-15n#5	900,082.71	676,706.51	4,119,825.5	583,338.8	37.221208	-116.060641	5,001.29	12.25	10	10.75	9.5	8	192
U-15n#6	900,131.75	676,603.86	4,119,840.3	583,307.4	37.221345	-116.060992	5,005.09	12.25	7	10.75	6.5	8	190
U-15n#7	900,072.50	676,575.36	4,119,822.2	583,298.8	37.221183	-116.061091	5,002.87	12.25	10	10.75	7.5	8	305
U-15n#8	900,045.12	676,646.50	4,119,813.9	583,320.5	37.221106	-116.060848	5,001.59	12.25	10	10.75	10	8	305
U-15n#9	900,136.27	676,669.01	4,119,841.7	583,327.3	37.221356	-116.060768	5,002.00	12.25	10	10.75	7.4	8	305
U-15n#10	900,158.43	676,667.73	4,119,848.5	583,326.9	37.221417	-116.060772	5,002.59	12.25	(10)	5.5	(7)	3.9	(174)
U-15n#11	900,228.67	676,713.30	4,119,869.9	583,340.7	37.221609	-116.060614	5,003.48	12.25	10	10.75	6.5	8	305
U-15n#12	900,149.48	676,688.46	4,119,845.8	583,333.2	37.221392	-116.060701	5,002.22	12.25	(7.5)	6.5	(7)	3.9	(174)
U-15n#13	900,049.48	676,622.39	4,119,815.2	583,313.2	37.221119	-116.060930	5,001.88	12.25	9.5	6.5	9	3.9	375
U-15n#14	900,094.57	676,704.50	4,119,829.1	583,338.1	37.221241	-116.060647	5,001.57	20	10	13.375	9	10	345
U-15n#15	900,023.71	676,603.59	4,119,807.4	583,307.5	37.221048	-116.060995	5,001.75	20	10	13.375	9	10	345
U-15n#16	900,143.26	676,641.16	4,119,843.8	583,318.8	37.221376	-116.060864	5,002.95	20	8	13.375	4.5	10	345
U-15n#17	900,107.45	676,749.32	4,119,833.0	583,351.8	37.221276	-116.060493	4,997.76	20	7	13.375	5	10	345
U-15n#18	899,985.74	676,576.57	4,119,795.8	583,299.3	37.220944	-116.061089	5,001.48	20	9.5	13.375	8.5	10	345
U-15n#19	900,189.01	676,640.69	4,119,857.8	583,318.6	37.221502	-116.060864	5,005.28	20	6.5	13.375	5	10	345
U-15n#20	900,091.50	676,632.18	4,119,828.1	583,316.1	37.221234	-116.060896	5,001.70	12	4	8	3.6	6.5	38

NOTE

a. State Plane Coordinates, Central Nevada, North American Datum 1927

b. Univeral Transverse Mercator, Zone 11, North American Datum 1983

c. Latitude/Longitude, North American Datum 1983

d. National Geodetic Vertical Datum, 1929

e. All conductor casings are steel except for U-15n#10, U-15n#12, and U-15n#20 which are PVC (underlined in table).

f. All depths are measured from ground surface and are vertical except for U-15n#10 and U-15n#12 which are inclined 3^{o} from vertical with inclined depths (shown in parentheses) measured along borehole axis.

Appendix 2

Instrument Metadata for SPE-4Prime

Appendix 2

Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
1	Chapparral 2.5 microphone/Reftek 130 Datalogger	chapar	Long-period	250	Infrasound
2	Nanometrics Trillium 120 Compact/Reftek 130 Datalo	trilli	Broad-band	250	Velocity
3	Geospace GS-11D 380ohm/Reftek 130 Datalogger	gs11d	High frequency	500	Velocity
4	Geospace GS-11D 380ohm/Reftek 130 Datalogger	gs11d	High frequency	500	Velocity
5	Geospace GS-11D 380ohm/Reftek 130 Datalogger	gs11d	High frequency	250	Velocity
6	Geospace GS-11D 380ohm/Reftek 130 Datalogger	gs11d	High frequency	125	Velocity
7	IML ST Infrasound/Reftek 130 Datalogger	iml_st	Long-period	250	Infrasound
8	New Mexico Tech InfraNMT_xxC/Reftek 130 Datalogger	infran	Long-period	250	Infrasound
9	Chapparral 2.5 microphone/Reftek 130 Datalogger	chapar	Long-period	500	Infrasound
10	Geospace GS-11D 380ohm/Reftek 130 Datalogger	gs11d	High frequency	125	Velocity
11	EMI BF6 magnetometer/Reftek 130 Datalogger	emi_bf	Broad-band	500	N
12	Geospace GS-11D 380ohm/Reftek 130 Datalogger	gs11d	High frequency	250	Velocity
13	Geospace GS-11D 380ohm/Reftek 130 Datalogger	gs11d	High frequency	100	Velocity
14	Episensor 200 Hz 1.25 Volt per g/Reftek 130 Datalo	epi_1.	Broad-band	500	Acceleration
15	Eentec R1 Rotational Seismometer/Reftek 130 Datalo	eentec	Broad-band	500	Velocity
16	Episensor 200 Hz 1.25 Volt per g/Reftek 130 Datalo	epi_1.	Broad-band	250	Acceleration
17	Eentec R1 Rotational Seismometer/Reftek 130 Datalo	eentec	Broad-band	250	Velocity
18	Guralp CMG40T_30sec/Reftek 130 Datalogger	cmg40t	Broad-band	500	Velocity
19	Guralp CMG40T_30sec/Reftek 130 Datalogger	cmg40t	Broad-band	500	Velocity
20	Guralp CMG40T_30sec/Reftek 130 Datalogger	cmg40t	Broad-band	250	Velocity
21	Guralp CMG40T_30sec/Reftek 130 Datalogger	cmg40t	Broad-band	250	Velocity
22	Guralp CMG40T_30sec/Reftek 130 Datalogger	cmg40t	Broad-band	125	Velocity
23	Guralp CMG40T_30sec/Reftek 130 Datalogger	cmg40t	Broad-band	100	Velocity
24	Guralp CMG40T_30sec/Reftek 130 Datalogger	cmg40t	Broad-band	125	Velocity
25	Nanometrics Trillium 120 Compact/Reftek 130 Datalo	trilli	Broad-band	500	Velocity
26	Nanometrics Trillium 120 Compact/Reftek 130 Datalo	trilli	Broad-band	100	Velocity
27	Nanometrics Trillium 120 Compact/Reftek 130 Datalo	trilli	Broad-band	500	Velocity
28	Nanometrics Trillium 120 Compact/Reftek 130 Datalo	trilli	Broad-band	100	Velocity
29	Nanometrics Trillium 120 Compact/Reftek 130 Datalo	trilli	Broad-band	250	Velocity
30	Episensor 200 Hz 1.25 Volt per g/Reftek 130 Datalo	epi_1.	Broad-band	500	Acceleration
31	Eentec R1 Rotational Seismometer/Reftek 130 Datalo	eentec	Broad-band	500	Velocity
32	Episensor 200 Hz 1.25 Volt per g/Reftek 130 Datalo	epi_1.	Broad-band	125	Acceleration
33	Eentec R1 Rotational Seismometer/Reftek 130 Datalo	eentec	Broad-band	125	Velocity
34	Chapparral 2.5 microphone/Reftek 130 Datalogger	chapar	Long-period	250	Infrasound
35	PMD SP400U3/Reftek 130 Datalogger	SP400U	Broad-band	250	Velocity
36	PMD SP400U3/Reftek 130 Datalogger	SP400U	Broad-band	250	Velocity
37	PMD SP400U3/Reftek 130 Datalogger	SP400U	Broad-band	250	Velocity
38	Episensor 200 Hz 1.25 Volt per g/Reftek 130 Datalo	epi_1.	Broad-band	250	Acceleration
39	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
40	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
41	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
42	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
43	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
44	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
45	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
46	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
47	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
48	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
49	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
50	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
51	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
52	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
53	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
54	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration

Appendix 2
Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
55	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
56	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
57	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
58	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
59	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
60	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
61	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
62	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
63	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
64	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
65	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
66	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
67	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
68	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
69	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
70	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
71	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
72	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
73	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
74	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
75	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
76	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
77	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
78	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
79	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
80	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
81	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
82	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
83	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
84	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
85	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
86	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
87	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
88	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
89	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
90	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
91	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
92	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
93	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
94	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
95	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
96	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
97	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
98	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
99	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
100	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
101	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
102	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
103	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
104	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
105	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
106	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
107	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
108	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration

Appendix 2
Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
109	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
110	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
111	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
112	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
113	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
114	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
115	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
116	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
117	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
118	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
119	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
120	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
121	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
122	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
123	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
124	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
125	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
126	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
127	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
128	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
129	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
130	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
131	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
132	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
133	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
134	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
135	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
136	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
137	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
138	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
139	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
140	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
141	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
142	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
143	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
144	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
145	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
146	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
147	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
148	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
149	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
150	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
151	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
152	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
153	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
154	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
155	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
156	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
157	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
158	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
159	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
160	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
161	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
162	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration

Appendix 2

Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
163	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
164	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
165	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
166	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
167	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
168	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
169	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
170	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
171	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
172	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
173	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
174	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
175	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
176	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
177	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
178	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
179	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
180	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
181	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
182	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
183	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
184	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
185	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
186	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
187	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
188	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
189	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
190	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
191	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
192	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
193	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
194	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
195	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
196	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
197	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
198	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
199	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
200	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
201	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
202	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
203	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
204	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
205	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
206	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
207	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
208	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
209	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
210	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
211	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
212	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
213	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
214	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
215	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
216	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration

Appendix 2

Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
217	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
218	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
219	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
220	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
221	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
222	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
223	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
224	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
225	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	500000	Acceleration
226	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
227	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
228	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
229	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
230	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
231	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
232	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
233	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
234	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
235	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
236	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
237	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
238	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
239	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
240	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
241	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
242	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
243	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
244	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
245	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
246	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
247	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
248	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
249	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
250	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
251	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
252	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
253	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	500000	Acceleration
254	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
255	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
256	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
257	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
258	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
259	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
260	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
261	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
262	EGCS-D0-1000g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
263	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
264	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
265	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
266	EGCS-D0-1000g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
267	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
268	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
269	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
270	EGCS-D0-1000g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration

Appendix 2
Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
271	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
272	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
273	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
274	EGCS-D0-1000g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
275	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
276	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
277	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
278	EGCS-D0-1000g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
279	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
280	7264G Accelerometer 2000g/DTRA Datalogger	e7264g	Broad-band	1000000	Acceleration
281	EGCS-D0-1000g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
282	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
283	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
284	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
285	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
286	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
287	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
288	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
289	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
290	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
291	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
292	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
293	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
294	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
295	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
296	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
297	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
298	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
299	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
300	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
301	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
302	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
303	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
304	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
305	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
306	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
307	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
308	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
309	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
310	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
311	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
312	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
313	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
314	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
315	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
316	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
317	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
318	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
319	7264C Accelerometer 500g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
320	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
321	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
322	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
323	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
324	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration

Appendix 2
Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
325	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
326	Endevco 7270A-2K/DTRA Datalogger	e7270	Broad-band	1000000	Acceleration
327	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	1000000	Acceleration
328	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
329	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
330	Endevco 7270A-2K/DTRA Datalogger	e7270	Broad-band	500000	Acceleration
331	EGE-73A Accelerometer 5000g/DTRA Datalogger	ege73a	Broad-band	500000	Acceleration
332	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
333	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
334	Endevco 7270A-2K/DTRA Datalogger	e7270	Broad-band	1000000	Acceleration
335	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
336	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	1000000	Acceleration
337	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
338	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
339	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
340	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
341	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
342	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
343	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
344	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
345	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
346	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
347	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
348	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
349	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
350	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
351	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
352	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
353	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
354	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
355	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
356	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
357	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
358	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
359	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
360	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
361	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
362	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
363	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	1000000	Acceleration
364	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
365	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
366	Gentex 3301 acoustic/Ensco Datalogger	gentex	Long-period	2048	Infrasound
367	PCB103B02 HP acoustic/Ensco Datalogger	PCB103	Long-period	2048	Infrasound
368	Geospace OMNI-2400 geophone/Ensco Datalogger	omni24	High frequency	2048	Velocity
369	Endevco 7264B-500/SNL Datalogger	endevc	Broad-band	4000	Acceleration
370	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
371	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
372	Endevco 7264B-500/DTRA Datalogger	endevc	Broad-band	500000	Acceleration
373	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
374	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
375	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
376	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
377	7264B Accelerometer 2000g/DTRA Datalogger	e7264b	Broad-band	500000	Acceleration
378	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration

Appendix 2

Instrument Metadata for SPE-4 Prime

Instrument ID	Instrument Name	Instrument Code	Frequency Band	Sample Rate (samples/second)	Response Type
379	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
380	EGCS-D0-100g Accel/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
381	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
382	EGCS-D0-50g Accelerometer/DTRA Datalogger	egcsd0	Broad-band	500000	Acceleration
383	7264C Accelerometer 50g/DTRA Datalogger	e7264c	Broad-band	1000000	Acceleration
384	IML ST Infrasound/Reftek 130 Datalogger	iml_st	Long-period	500	Infrasound
385	Hyperion IFS3000 Infrasound/Geotech Smart24 DAS	hifs3k	Long-period	200	Infrasound
386	Geotech S-13 short-period seismometer/ping Tricom	s13	s	50	Velocity
387	Geotech S-13 short-period seismometer/cusp Tricom	s13	s	100	Velocity
388	Nanometrics Trillium 120 Compact/Reftek 130 Datalo	trilli	Broad-band	200	Velocity
389	Geotech S-13 short-period seismometer/cusp UNVCO-2	s13	s	100	Velocity
390	Geotech S-13_GS-13 1 Hz seismometer/Reftek 130 Dat	s13	s	100	Velocity
391	Geotech S-13_GS-13 1 Hz seismometer/Reftek 130 Dat	s13	s	200	Velocity
392	IESE S21g-2.0/Reftek 130 Datalogger	s21g_2	High frequency	200	Velocity
393	Geotech S-13_GS-13 1 Hz seismometer/Quanterra 330	s13	s	100	Velocity
394	IESE S21g-2.0/Quanterra 330 Linear Phase Composite	s21g_2	High frequency	100	Velocity
395	Geotech S-13_GS-13 1 Hz seismometer/Quanterra 330	s13	s	200	Velocity
396	IESE S21g-2.0/Quanterra 330 Linear Phase Composite	s21g_2	High frequency	200	Velocity
397	Episensor 200 Hz 1.25 Volt per g/Reftek 130 Datalo	epi_1.	Broad-band	200	Acceleration
398	Hyperion IFS3000 Infrasound/Reftek 130 Datalogger	hifs3k	Long-period	25	Infrasound
399	Hyperion IFS3000 Infrasound/Reftek 130 Datalogger	hifs3k	Long-period	25	Infrasound
400	Hyperion IFS3000 Infrasound/Reftek 130 Datalogger	hifs3k	Long-period	100	Infrasound
401	Hyperion IFS3000 Infrasound/Reftek 130 Datalogger	hifs3k	Long-period	100	Infrasound
402	Terratech 50 Hz/IDS strong mo, 16-bit, no fir file	terrat	Broad-band	100	Acceleration
403	Mark Products L4C/Reftek 72A-08 Datalogger	l4c	s	100	Velocity
404	Mark Products L4C/Reftek 72A-08 Datalogger	l4c	s	20	Velocity
405	KMI FBA23 50 Hz FS 2g/Reftek 72A-08 Datalogger	fba23_	Broad-band	100	Acceleration
406	Applied MEMS, 2.5 Volt per g/Reftek 130 Datalogger	mems_2	Broad-band	100	Acceleration
407	Mark Products L4C/Reftek 130 Datalogger	l4c	s	100	Velocity
408	Episensor 200 Hz 10 Volt per g/Reftek 130 Datalogg	epi_10	Broad-band	200	Acceleration
409	Mark Products L4C/Reftek 130 Datalogger	l4c	s	200	Velocity
410	Guralp CMG40T_30sec/Reftek 72A-08 Datalogger	cmg40t	Broad-band	100	Velocity
411	Guralp CMG40T_30sec/Reftek 72A-08 Datalogger	cmg40t	Broad-band	20	Velocity
412	Geotech S-13 short-period seismometer/Reftek 72A-0	s13	s	100	Velocity
413	Geotech S-13 short-period seismometer/Reftek 72A-0	s13	s	20	Velocity
414	Geotech S-13 short-period seismometer/Reftek 130 D	s13	s	100	Velocity
415	Terratech 50 Hz/Reftek 72A-08 Datalogger	terrat	Broad-band	100	Acceleration
416	Geotech S-13 short-period seismometer/Quanterra 33	s13	s	100	Velocity
417	Applied MEMS, 2.5 Volt per g/Quanterra 330 Linear	mems_2	Broad-band	200	Acceleration
418	Geotech S-13_GS-13 1 Hz seismometer/Reftek 72A-07	s13	s	100	Velocity
419	Nanometrics Trillium 120 Compact/Quanterra 330 Lin	trilli	Broad-band	100	Velocity
420	Episensor 200 Hz 10 Volt per g/Quanterra 330 Linea	epi_10	Broad-band	100	Acceleration
421	Terratech 50 Hz/Reftek 72A-08 Datalogger	terrat	Broad-band	100	Acceleration
422	Applied MEMS, 2.5 Volt per g/Reftek 72A-08 Datalog	mems_2	Broad-band	100	Acceleration
423	Episensor 200 Hz 10 Volt per g/Reftek 130 Datalogg	epi_10	Broad-band	100	Acceleration
424	Episensor 200 Hz 10 Volt per g/Quanterra 330 Linea	epi_10	Broad-band	200	Acceleration
425	Guralp CMG4/Reftek 72A-08 Datalogger	cmg4	Broad-band	100	Velocity
426	Guralp CMG4/Reftek 72A-08 Datalogger	cmg4	Broad-band	20	Velocity
427	Mark Products L4C/Reftek 72A-08 Datalogger	l4c	s	100	Velocity
428	Terratech 50 Hz/Reftek 72A-08 Datalogger	terra_	Broad-band	100	Acceleration
429	Mark Products L4C/Quanterra 330 Linear Phase Compo	l4c	s	100	Velocity
430	Geotech S-13 short-period seismometer/Reftek 72A-0	s13	s	100	Velocity
431	Geotech S-13 short-period seismometer/Reftek 72A-0	s13	s	20	Velocity
432	Geotech S-13_GS-13 1 Hz seismometer/Reftek 72A-08	s13	s	100	Velocity
433	Geotech S-13_GS-13 1 Hz seismometer/Reftek 72A-08	s13	s	20	Velocity

Appendix 3

Selected Metadata for SPE-4Prime Borehole Sensors

Appendix 3

Selected Metadata for SPE-4 Prime Borehole Sensors

SPE Borehole Station	Channel	Measurement Number (bh-c-o)	RSS Channel	Channel ID	Instrument ID	Gage Type	Serial Number	edepth[b] km	Northing	Easting	Elevation	Latitude	Longitude	Elevation
									SPC NAD27 ft		NGVD29 ft	GEO NAD83 dec deg		NAVD88 m
									NSTec Survey & Colog Deviation[c]			USACE Corpscon6 Conversion[d]		
BH-01A	GNL_2	1A-2-L	1-21	2942	330	7270	F22549	0.0457	900,109.8	676,645.2	4,852.47	37.22128	116.06085	1,480.0
	GNT_3	1A-3-T	1-38	2944	332	7264B	B11115	0.0152	900,103.3	676,645.5	4,952.47	37.22127	116.06085	1,510.5
	GNL_3	1A-3-L	1-39	2945	333	7264C	B14456							
BH-02	GNR_1	2-1-R	1-10	2675	68	EGE73A	M080WW	0.0549	900,076.4	676,614.2	4,822.47	37.22119	116.06096	1,470.9
	GNT_1	2-1-T	1-11	2676	69	7264	B18901							
	GNL_1	2-1-L	1-12	2677	70	7264	B18905							
	GNR_3	2-3-R	1-16	2680	73	EGE73A	Q06472	0.0152	900,075.8	676,609.5	4,952.47	37.22119	116.06097	1,510.5
	GNT_3	2-3-T	1-17	2681	74	7264	P10784							
	GNL_3	2-3-L	1-18	2682	75	7264	P10843							
BH-03	GNR_3	3-3-R	1-25	2703	96	EGE-73A	Q06474	0.0152	900,051.1	676,659.5	4,952.47	37.22112	116.06080	1,510.5
	GNT_3	3-3-T	1-26	2704	97	7264C	P10780							
	GNL_3	3-3-L	1-27	2705	98	7264C	P10853							
BH-04	GNR_1	4-1-R	1-28	2727	120	7264B	B44446	0.0549	900,015.0	676,612.6	4,822.47	37.22102	116.06096	1,470.9
	GNR_3	4-3-R	1-34	2731	124	7264C	P10778	0.0152	900,018.1	676,612.7	4,952.47	37.22103	116.06096	1,510.5
	GNT_3	4-3-T	1-35	2732	125	EGE-73A	R06402							
	GNL_3	4-3-L	1-36	2733	126	EGE-73A	R06403							
BH-05	GNR_2	5-2-R	1-40	2750	143	7264B	B44441	0.0457	900,083.6	676,706.5	4,852.47	37.22121	116.06064	1,480.0
	GNR_3	5-3-R	1-43	2753	146	7264C	P10777	0.0152	900,083.1	676,706.6	4,952.47	37.22121	116.06064	1,510.5
	GNT_3	5-3-T	1-44	2754	147	EGE-73A	R06401							
	GNL_3	5-3-L	1-45	2755	148	EGE-73A	R06396							
BH-06	GNR_1	6-1-R	1-46	2777	169	7264B	B17978	0.0549	900,131.2	676,604.9	4,822.47	37.22134	116.06099	1,470.9
	GNT_1	6-1-T	1-47	2778	170	EGE-73A	M06119							
	GNR_2	6-2-R	1-49	2779	171	7264B	B17999	0.0457	900,131.4	676,604.7	4,852.47	37.22134	116.06099	1,480.0
	GNT_2	6-2-T	1-50	2780	172	EGE-73A	M06112							
	GNL_2	6-2-L	1-51	2781	173	EGE-73A	M06116							
	GNR_3	6-3-R	1-52	2782	174	EGE-73A	M06113	0.0152	900,131.7	676,604.0	4,952.47	37.22134	116.06099	1,510.5
	GNT_3	6-3-T	1-53	2783	175	EGE-73A	M06072							
	GNL_3	6-3-L	1-54	2784	176	EGE-73A	M06073							
BH-07	GNR_1	7-1-R	1-61	2793	185	7264G	10443	0.0549	900,073.1	676,576.1	4,822.47	37.22118	116.06109	1,470.9
	GNT_1	7-1-T	1-62	2794	186	7264C	P11309							
	GNL_1	7-1-L	1-63	2795	187	7264C	P10849							
	GNR_2	7-2-R	1-64	2796	188	7264G	11230	0.0457	900,072.2	676,577.6	4,852.47	37.22118	116.06108	1,480.0
	GNT_2	7-2-T	1-65	2797	189	7264C	P10852							
	GNL_2	7-2-L	1-66	2798	189	7264C	P11317							
	GNR_3	7-3-R	1-67	2799	190	7264C	P11315	0.0152	900,072.6	676,576.0	4,952.47	37.22118	116.06109	1,510.5
	GNT_3	7-3-T	1-68	2800	191	7264B	B19917							
	GNL_3	7-3-L	1-69	2801	124	7264C	P11302							
BH-08	GNR_1	8-1-R	1-70	2811	201	EGE-73A	Z05808	0.0549	900,045.4	676,649.1	4,822.47	37.22111	116.06084	1,470.9
	GNT_1	8-1-T	1-71	2812	202	7264G	11021							
	GNL_1	8-1-L	1-72	2813	203	7264G	10495							
	GNR_2	8-2-R	1-73	2814	204	EGE-73A	Z05810	0.0457	900,045.4	676,647.6	4,852.47	37.22111	116.06084	1,480.0
	GNT_2	8-2-T	1-74	2815	205	7264G	10450							
	GNL_2	8-2-L	1-75	2816	205	7264G	10492							
	GNR_3	8-3-R	1-76			7264C	P11316	0.0152	900,045.4	676,646.3	4,952.47	37.22111	116.06085	1,510.5
	GNT_3	8-3-T	1-77			7264C	P11323							
	GNL_3	8-3-L	1-78	2818	206	7264C	P11312							
BH-09	GNR_1	9-1-R	1-79	2828	216	7264G	10488	0.0549	900,135.4	676,670.2	4,822.47	37.22135	116.06076	1,470.9
	GNT_1	9-1-T	1-80	2829	217	7264C	P10846							
	GNL_1	9-1-L	1-81	2830	218	7264G	10444							
	GNR_2	9-2-R	1-82	2831	219	7264G	10478	0.0457	900,135.9	676,670.0	4,852.47	37.22136	116.06077	1,480.0
	GNT_2	9-2-T	1-83	2832	220	7264C	P10790							
	GNL_2	9-2-L	1-84	2833	221	7264C	P11305							
	GNR_3	9-3-R	1-85	2834	222	7264G	10471	0.0366	900,136.2	676,669.7	4,882.47	37.22136	116.06077	1,489.2
	GNT_3	9-3-T	1-86	2835	223	7264C	P11304							
	GNL_3	9-3-L	1-87	2836	224	7264C	P11307							
	GNR_4	9-4-R	1-88	2837	225	7264G	11186	0.0274	900,136.1	676,669.4	4,912.47	37.22136	116.06077	1,498.3
	GNT_4	9-4-T	1-89	2838	226	7264C	P11320							
	GNL_4	9-4-L	1-90	2839	227	7264B	B20517							
	GNR_5	9-5-R	1-91	2840	228	7264C	P11310	0.0152	900,136.2	676,669.1	4,952.47	37.22136	116.06077	1,510.5
	GNT_5	9-5-T	1-92	2841	229	7264C	P11311							
	GNL_5	9-5-L	1-93	2842	230	7264C	P11240							
BH-11	GNR_1	11-1-R	1-94	2859	247	7264C	P10851	0.0549	900,227.2	676,716.7	4,822.47	37.22160	116.06060	1,470.9
	GNT_1	11-1-T	2-1	2860	248	7264C	P11313							
	GNL_1	11-1-L	2-2	2861	249	7264C	P10848							
	GNR_2	11-2-R	2-3	2862	250	7264B	B20516	0.0457	900,227.5	676,716.2	4,852.47	37.22161	116.06060	1,480.0
	GNL_2	11-2-L	2-5	2863	251	7264C	P11308							
	GNR_3	11-3-R	2-6	2864	252	7264C	P11314	0.0152	900,228.3	676,714.3	4,952.47	37.22161	116.06061	1,510.5
	GNT_3	11-3-T	2-7	2865	253	7264C	P11321							
BH-14	FNL_1	14-1-L	2-22	2876	264	7264C	P11565	0.0991	900,088.8	676,710.7	4,676.75	37.22127	116.05975	1426.5
	FNR_1	14-1-R	2-19	2873	261	7264C	P11563							
	FNR_11	14-1-R1	2-20	2874	262	EGCSDO	A012427							
	FNT_1	14-1-T	2-21	2875	263	7264C	P11564							
	FNL_2	14-2-L	2-26	2880	268	7264C	P11586	0.0841	900,090.7	676,709.8	4,725.91	37.22128	116.05976	1441.5
	FNR_2	14-2-R	2-23	2877	265	7264G	10780							
	FNR_21	14-2-R1	2-24	2878	266	EGCSDO	N02810							
	FNT_2	14-2-T	2-25	2879	267	7264C	P11566							
BH-15	FNL_1	15-1-L	2-30	2884	272	7264C	P11570	0.0991	900,016.3	676,604.2	4,676.95	37.22108	116.06012	1426.6
	FNR_1	15-1-R	2-27	2881	269	7264C	P11568							
	FNR_11	15-1-R1	2-28	2882	270	EGCSDO	P03340							
	FNT_1	15-1-T	2-29	2883	271	7264C	P11569							
	FNL_2	15-2-L	2-34	2888	276	7264C	P11572	0.0841	900,017.7	676,604.2	4,726.12	37.22108	116.06012	1441.5
	FNR_2	15-2-R	2-31	2885	273	7264G	11053							
	FNR_21	15-2-R1	2-32	2886	274	EGCSDO	R5233							
	FNT_2	15-2-T	2-33	2887	275	7264C	P11571							

Appendix 3
Selected Metadata for SPE-4 Prime Borehole Sensors

SPE Borehole Station	Channel	Measurement Number (bh-c-o)	RSS Channel	Channel ID	Instrument ID	Gage Type	Serial Number	edepth[b] km	Northing	Easting	Elevation	Latitude	Longitude	Elevation
									SPC NAD27 ft		NGVD29 ft	GEO NAD83 dec deg		NAVD88 m
									NSTec Survey & Colog Deviation[c]			USACE Corpscon6 Conversion[d]		
BH-16	FNL_1	16-1-R	2-35			7264C	P11573	0.0991	900,131.0	676,637.5	4,678.35	37.22139	116.06001	1427.0
	FNR_1	16-1-R1	2-36	2889	277	EGCSDO	S98034							
	FNR_11	16-1-T	2-37	2890	278	7264C	P11574							
	FNL_2	16-2-L	2-42	2895	283	7264C	P11577	0.0841	900,134.8	676,638.2	4,727.40	37.22140	116.06000	1441.9
	FNR_2	16-2-R	2-39	2892	280	7264G	11067							
	FNR_21	16-2-R1	2-40	2893	281	EGCSDO	S98037							
	FNT_2	16-2-T	2-41	2894	282	7264C	P11576							
BH-17	FNL_1	17-1-L	2-46			EGE-73A	M06029	0.0991	900,103.5	676,745.7	4,672.91	37.22131	116.05963	1425.3
	FNR_1	17-1-R	2-43	2896	284	EGE-73A	M06025							
	FNR_11	17-1-R1	2-44	2897	285	7264C	P11578							
	FNT_1	17-1-T	2-45	2898	286	EGE-73A	M06028							
	FNL_2	17-2-L	2-50	2903	291	EGE-73A	M06035	0.0841	900,104.9	676,746.5	4,722.08	37.22132	116.05963	1440.3
	FNR_2	17-2-R	2-47	2900	288	7264C	P11579							
	FNR_21	17-2-R1	2-48	2901	289	7264C	P11580							
	FNT_2	17-2-T	2-49	2902	290	EGE-73A	M06031							
BH-18	FNL_1	18-1-L	2-53	2906	294	EGE-73A	Q06426	0.0991	899,983.5	676,571.3	4,676.60	37.22099	116.06024	1426.5
	FNR_1	18-1-R	2-51	2904	292	7264C	P12036							
	FNT_1	18-1-T	2-52	2905	293	EGE-73A	M06037							
	FNL_2	18-2-L	2-56	2909	297	EGE-73A	Q06432	0.0928	899,983.7	676,571.6	4,697.20	37.22099	116.06024	1432.7
	FNR_2	18-2-R	2-54	2907	295	7264C	P11582							
	FNT_2	18-2-T	2-55	2908	296	EGE-73A	Q06431							
	FNL_3	18-3-L	2-59	2912	300	EGE-73A	Q06439	0.0841	899,983.8	676,572.0	4,725.79	37.22099	116.06023	1441.4
	FNR_3	18-3-R	2-57	2910	298	7264C	P11590							
	FNT_3	18-3-T	2-58	2911	299	EGE-73A	Q06438							
	FNL_4	18-4-L	2-62	2915	303	EGE-73A	Q06443	0.0765	899,984.0	676,572.2	4,750.59	37.22099	116.06023	1449.0
	FNR_4	18-4-R	2-60	2913	301	7264C	P11591							
	FNT_4	18-4-T	2-61	2914	302	EGE-73A	Q06440							
	FNL_5	18-5-L	2-65	2918	306	EGE-73A	Q06456	0.0690	899,984.2	676,572.4	4,775.08	37.22099	116.06023	1456.5
	FNR_5	18-5-R	2-63	2916	304	7264C	P11593							
	FNT_5	18-5-T	2-64	2917	305	EGE-73A	Q06444							
BH-19	FNL_1	19-1-L	2-68	2921	309	EGE-73A	X060CC	0.0991	900,191.8	676,645.3	4,680.41	37.22156	116.05998	1427.6
	FNR_1	19-1-R	2-66	2919	307	7264C	P11594							
	FNT_1	19-1-T	2-67	2920	308	EGE-73A	Q06461							
	FNL_2	19-2-L	2-71	2924	312	EGE-73A	M06004	0.0928	900,191.8	676,644.9	4,701.00	37.22156	116.05998	1433.9
	FNR_2	19-2-R	2-69	2922	310	7264C	P11595							
	FNT_2	19-2-T	2-70	2923	311	EGE-73A	M06003							
	FNL_3	19-3-L	2-74	2927	315	EGE-73A	M06010	0.0841	900,191.8	676,644.2	4,729.59	37.22156	116.05998	1442.6
	FNR_3	19-3-R	2-72	2925	313	7264C	P12032							
	FNT_3	19-3-T	2-73	2926	314	EGE-73A	M06006							
	FNL_4	19-4-L	2-77	2930	318	EGE-73A	M06023	0.0765	900,191.5	676,644.0	4,754.38	37.22156	116.05998	1450.2
	FNR_4	19-4-R	2-75	2928	316	7264C	P12033							
	FNT_4	19-4-T	2-76	2929	317	EGE-73A	M06015							
	FNR_5	19-5-R	2-78	2931	319	7264C	P12034	0.0690	900,191.3	676,643.6	4,778.87	37.22156	116.05998	1457.6
	FNT_5	19-5-T	2-79	2932	320	EGE-73A	X060CD							
BH-20	FNL_1	20-1-L	1-9	2949	337	64C-0050	A142909	0.0031	900,091.5	676,632.1	4,991.70	37.22128	116.06002	1522.5
	FNL_2	20-2-L	1-8	2950	338	64C-0050	A142908	0.0021	900,091.5	676,632.2	4,994.70	37.22128	116.06002	1523.4
	FNL_3	20-3-L	1-7	2951	339	64C-0050	A142906	0.0012	900,091.5	676,632.2	4,997.70	37.22128	116.06002	1524.3

NOTES

a. See Appendix 3 for key to instruments.
b. Depth in kilometers at which the instrument is positioned, relative to the ground surface elevation at the borehole collar.
c. State Plane Coordinates at sensor location based on the borehole collar location, as surveyed by NSTec, corrected for borehole deviation, along borehole path, as measured by IDS Colog Group.
d. Conversion of NSTec State Plane coordinates to latitude/longitude using USACE "Corpscon6" application.

ABBREVIATIONS

SPC	State Plane Cordinate Systems, Zone 2702 Nevada Central
NAD27	North American Datum 1927
ft	U.S. Survey Feet
NGVD29	National Geodetic Vertical Datum 1929
NSTec	National Security Technologies, Inc.
GEO	Geographic Coordinate System
NAD83	North American Datum 1983
NAVD88	North American Vertical Datum 1988
m	Meters
USACE	U.S. Army Corps of Engineers

Appendix 4

Selected Metadata for SPE-4Prime Surface Stations

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
Near Field					
DT007	FNZ	37.2212	-115.0609	1.5247	NNSS-SPE DTRA Surface sp1 0m A13
DT008	FNZ	37.2211	-116.0609	1.5247	NNSS-SPE DTRA Surface sp1 10m A14
DT009	FNZ	37.2210	-116.0610	1.5246	NNSS-SPE DTRA Surface sp1 20m
DT010	FNZ	37.2210	-116.0610	1.5246	NNSS-SPE DTRA Surface sp1 30m
DT011	FNZ	37.2209	-116.0611	1.5225	NNSS-SPE DTRA Surface sp1 40m
DT012	FNZ	37.2208	-116.0611	1.5223	NNSS-SPE DTRA Surface sp1 50m
DT013	FNZ GNZ	37.2215	-116.0608	1.5246	NNSS-SPE DTRA Surface A8 sp2 30m NE
DT014	FNZ GNZ GNZ_sl	37.2213	-116.0612	1.5273	NNSS-SPE DTRA Surface A9 sp2 30m NW
DT015	FNZ GNZ	37.2208	-116.0611	1.5219	NNSS-SPE DTRA Surface A4 sp2 45m SW
DT016	FNZ GNZ	37.2207	-116.0612	1.5213	NNSS-SPE DTRA Surface A3 sp2 60m SW
DT017	FNZ GNZ	37.2206	-116.0612	1.5221	NNSS-SPE DTRA Surface A2 sp2 75m SW
DT018	FNZ GNZ	37.2205	-116.0613	1.5229	NNSS-SPE DTRA Surface A1 sp2 90m SW
SL001	CNZ	37.2212	-116.0609	1.5247	NNSS-SPE Sandia NL surface 01 sp1
SL002	CNZ	37.2211	-116.0609	1.5246	NNSS-SPE Sandia NL surface 02 sp1
SL003	CNZ	37.2210	-116.0610	1.5246	NNSS-SPE Sandia NL surface 03 sp1
SL004	CNZ	37.2210	-116.0610	1.5245	NNSS-SPE Sandia NL surface 04 sp1
SL005	CNZ	37.2209	-116.0611	1.5224	NNSS-SPE Sandia NL surface 05 sp1
SL006	CNZ	37.2208	-116.0611	1.5222	NNSS-SPE Sandia NL surface 06 sp1
SL007	CNZ GNZ FNZ	37.2210	-116.0610	1.5243	NNSS-SPE Sandia NL surface A5 sp2 30m SW
SL008	CNZ GNZ GNZ_dt FNZ	37.2211	-116.0609	1.5244	NNSS-SPE Sandia NL surface A6 sp2 15m SW
SL009	CNZ GNZ FNZ	37.2213	-116.0608	1.5246	NNSS-SPE Sandia NL surface A7 sp2 15m NE
SL010	CNZ GNZ GNZ_dt FNZ	37.2213	-116.0610	1.5251	NNSS-SPE Sandia NL surface A10 sp2 15m NW
SL011	CNZ GNZ FNZ	37.2212	-116.0607	1.5244	NNSS-SPE Sandia NL surface A11 sp2 15m SE
SL012	CNZ GNZ FNZ	37.2211	-116.0606	1.5222	NNSS-SPE Sandia NL surface A12 30m SE
SPE Seismic Lines					
L1001	CLZ CLR CLT	37.2221	-116.0610	1.529	NNSS-SPE Line 1 site 01
L1002	CLZ CLR CLT	37.2230	-116.0611	1.537	NNSS-SPE Line 1 site 02

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L1003	CLZ CLR CLT	37.2239	-116.0611	1.54	NNSS-SPE Line 1 site 03
L1004	CLZ CLR CLT	37.2248	-116.0612	1.537	NNSS-SPE Line 1 site 04
L1005	CLZ CLR CLT	37.2257	-116.0613	1.55	NNSS-SPE Line 1 site 05
L1006	CLZ CLR CLT	37.2266	-116.0614	1.558	NNSS-SPE Line 1 site 06
L1007	CLZ CLR CLT	37.2275	-116.0615	1.559	NNSS-SPE Line 1 site 07
L1008	CLZ CLR CLT	37.2284	-116.0616	1.572	NNSS-SPE Line 1 site 08
L1009	CLZ CLR CLT	37.2293	-116.0616	1.589	NNSS-SPE Line 1 site 09
L1010	CNZ CNR CNT DJZ DJR DJT CLZ CLR CLT	37.2302	-116.0617	1.585	NNSS-SPE Line 1 site 10
L1011	CLZ CLR CLT	37.2311	-116.0618	1.597	NNSS-SPE Line 1 site 11
L1012	CLZ CLR CLT	37.2320	-116.0619	1.604	NNSS-SPE Line 1 site 12
L1013	CLZ CLR CLT	37.2329	-116.0620	1.616	NNSS-SPE Line 1 site 13
L1014	CLZ CLR CLT	37.2338	-116.0621	1.633	NNSS-SPE Line 1 site 14
L1015	CLZ CLR CLT	37.2347	-116.0621	1.656	NNSS-SPE Line 1 site 15
L1016	CLZ CLR CLT	37.2355	-116.0622	1.674	NNSS-SPE Line 1 site 16

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L1017	CLZ CLR CLT	37.2364	-116.0623	1.706	NNSS-SPE Line 1 site 17
L1018	CLZ CLR CLT	37.2373	-116.0624	1.739	NNSS-SPE Line 1 site 18
L1019	CLZ CLR CLT	37.2382	-116.0625	1.738	NNSS-SPE Line 1 site 19
L1020	DHZ DHR DHT	37.2391	-116.0626	1.752	NNSS-SPE Line 1 site 20
L2001	CLZ CLR CLT	37.2218	-116.0600	1.52	NNSS-SPE Line 2 site 01
L2002	CLZ CLR CLT	37.2224	-116.0592	1.515	NNSS-SPE Line 2 site 02
L2003	CLZ CLR CLT	37.2229	-116.0583	1.528	NNSS-SPE Line 2 site 03
L2004	CLZ CLR CLT	37.2235	-116.0575	1.528	NNSS-SPE Line 2 site 04
L2005	CLZ CLR CLT	37.2241	-116.0566	1.532	NNSS-SPE Line 2 site 05
L2006	CLZ CLR CLT	37.2247	-116.0558	1.531	NNSS-SPE Line 2 site 06
L2007	CLZ CLR CLT	37.2253	-116.0549	1.53	NNSS-SPE Line 2 site 07
L2008	CLZ CLR CLT	37.2259	-116.0541	1.53	NNSS-SPE Line 2 site 08
L2009	CLZ CLR CLT	37.2265	-116.0533	1.537	NNSS-SPE Line 2 site 09
L2010	CNZ CNR CNT DJZ DJR DJT CLZ_04 CLR_05 CLT_06 CLZ CLR CLT	37.2271	-116.0524	1.531	NNSS-SPE Line 2 site 10

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L2011	CLZ CLR CLT	37.2277	-116.0516	1.537	NNSS-SPE Line 2 site 11
L2012	CLZ CLR CLT	37.2283	-116.0507	1.537	NNSS-SPE Line 2 site 12
L2013	CLZ CLR CLT	37.2289	-116.0499	1.536	NNSS-SPE Line 2 site 13
L2014	CLZ CLR CLT	37.2295	-116.0490	1.541	NNSS-SPE Line 2 site 14
L2015	CLZ CLR CLT	37.2301	-116.0482	1.543	NNSS-SPE Line 2 site 15
L2016	CLZ CLR CLT	37.2307	-116.0473	1.536	NNSS-SPE Line 2 site 16
L2017	CLZ CLR CLT	37.2312	-116.0465	1.549	NNSS-SPE Line 2 site 17
L2018	CLZ CLR CLT	37.2318	-116.0456	1.548	NNSS-SPE Line 2 site 18
L2019	CLZ CLR CLT	37.2324	-116.0448	1.552	NNSS-SPE Line 2 site 19
L2020	DHZ DHR DHT	37.2330	-116.0439	1.533	NNSS-SPE Line 2 site 20
L3001	CLZ CLR CLT	37.2203	-116.0607	1.516	NNSS-SPE Line 3 site 01
L3002	CLZ CLR CLT	37.2194	-116.0606	1.512	NNSS-SPE Line 3 site 02
L3003	CLZ CLR CLT	37.2185	-116.0605	1.512	NNSS-SPE Line 3 site 03
L3004	CLZ CLR CLT	37.2176	-116.0603	1.496	NNSS-SPE Line 3 site 04
L3005	CLZ CLR CLT	37.2167	-116.0602	1.496	NNSS-SPE Line 3 site 05
L3006	CLZ CLR CLT	37.2158	-116.0600	1.494	NNSS-SPE Line 3 site 06

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L3007	CLZ CLR CLT	37.2149	-116.0599	1.487	NNSS-SPE Line 3 site 07
L3008	CLZ CLR CLT	37.2140	-116.0598	1.484	NNSS-SPE Line 3 site 08
L3009	CLZ CLR CLT	37.2131	-116.0596	1.469	NNSS-SPE Line 3 site 09
L3010	CNZ CNR CNT DJZ DJR DJT CLZ CLR CLT	37.2122	-116.0595	1.481	NNSS-SPE Line 3 site 10
L3011	CLZ CLR CLT	37.2113	-116.0593	1.475	NNSS-SPE Line 3 site 11
L3012	CLZ CLR CLT	37.2104	-116.0592	1.464	NNSS-SPE Line 3 site 12
L3013	CLZ CLR CLT	37.2095	-116.0591	1.459	NNSS-SPE Line 3 site 13
L3014	CLZ CLR CLT	37.2087	-116.0589	1.463	NNSS-SPE Line 3 site 14
L3015	CLZ CLR CLT	37.2078	-116.0588	1.453	NNSS-SPE Line 3 site 15
L3016	CLZ CLR CLT	37.2069	-116.0586	1.437	NNSS-SPE Line 3 site 16
L3017	CLZ CLR CLT	37.2060	-116.0585	1.431	NNSS-SPE Line 3 site 17
L3018	CLZ CLR CLT	37.2051	-116.0584	1.434	NNSS-SPE Line 3 site 18
L3019	CLZ CLR CLT	37.2042	-116.0582	1.428	NNSS-SPE Line 3 site 19
L3020	DHZ DHR DHT CHZ CHR CHT	37.2033	-116.0581	1.423	NNSS-SPE Line 3 site 20

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L3023	CHZ CH1 CH2 CHZ_04 CH1_05 CH2_06	37.1899	-116.0560	1.345	NNSS-SPE Line 3 site 23
L3026	CHZ CH1 CH2	37.1770	-116.0539	1.31	NNSS-SPE Line 3 site 26
L3028	CHZ CH1 CH2 CHZ_04 CH1_05 CH2_06	37.1407	-116.0482	1.285	NNSS-SPE Line 3 site 28
L3030	CHZ CH1 CH2	37.1049	-116.0426	1.274	NNSS-SPE Line 3 site 30
L3032	CHZ CH1 CH2	37.0697	-116.0370	1.236	NNSS-SPE Line 3 site 32
L3034	CHZ CH1 CH2	37.0330	-116.0314	1.218	NNSS-SPE Line 3 site 34
L3036	CHZ CH1 CH2	36.9976	-116.0258	1.204	NNSS-SPE Line 3 site 36
L4001	CLZ CLR CLT	37.2204	-116.0614	1.523	NNSS-SPE Line 4 site 01
L4002	CLZ CLR CLT	37.2195	-116.0619	1.521	NNSS-SPE Line 4 site 02
L4003	CLZ CLR CLT	37.2187	-116.0624	1.532	NNSS-SPE Line 4 site 03
L4004	CLZ CLR CLT	37.2179	-116.0629	1.523	NNSS-SPE Line 4 site 04
L4005	CLZ CLR CLT	37.2171	-116.0634	1.502	NNSS-SPE Line 4 site 05
L4006	CLZ CLR CLT	37.2163	-116.0639	1.499	NNSS-SPE Line 4 site 06
L4007	CLZ CLR CLT	37.2155	-116.0643	1.513	NNSS-SPE Line 4 site 07

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L4008	CLZ CLR CLT	37.2147	-116.0648	1.505	NNSS-SPE Line 4 site 08
L4009	CLZ CLR CLT	37.2139	-116.0653	1.507	NNSS-SPE Line 4 site 09
L4010	CLZ CLR CLT	37.2131	-116.0658	1.504	NNSS-SPE Line 4 site 10
L4011	CLZ CLR CLT	37.2123	-116.0663	1.508	NNSS-SPE Line 4 site 11
L4012	CLZ CLR CLT	37.2114	-116.0668	1.511	NNSS-SPE Line 4 site 12
L4013	CLZ CLR CLT	37.2106	-116.0673	1.512	NNSS-SPE Line 4 site 13
L4014	CLZ CLR CLT	37.2098	-116.0678	1.511	NNSS-SPE Line 4 site 14
L4015	CLZ CLR CLT	37.2090	-116.0683	1.514	NNSS-SPE Line 4 site 15
L4016	CLZ CLR CLT	37.2082	-116.0688	1.514	NNSS-SPE Line 4 site 16
L4017	CLZ CLR CLT	37.2074	-116.0693	1.512	NNSS-SPE Line 4 site 17
L4018	CLZ CLR CLT	37.2066	-116.0698	1.508	NNSS-SPE Line 4 site 18
L4019	CLZ CLR CLT	37.2058	-116.0703	1.513	NNSS-SPE Line 4 site 19
L4020	DHZ DHR DHT	37.2050	-116.0708	1.507	NNSS-SPE Line 4 site 20
L4023	CHZ CH1 CH2	37.1928	-116.0782	1.44	NNSS-SPE Line 4 site 23
L4026	CHZ CH1 CH2	37.1807	-116.0856	1.38	NNSS-SPE Line 4 site 26
L4028	CHZ CH1 CH2	37.1483	-116.1053	1.355	NNSS-SPE Line 4 site 28

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L4030	CHZ CH1 CH2	37.1159	-116.1250	1.378	NNSS-SPE Line 4 site 30
L4032	CHZ CH1 CH2	37.0835	-116.1447	1.421	NNSS-SPE Line 4 site 32
L4034	CHZ CH1 CH2	37.0510	-116.1644	1.568	NNSS-SPE Line 4 site 34
L4036	CHZ CH1 CH2	37.0186	-116.1841	1.527	NNSS-SPE Line 4 site 36
L5001	CLZ CLR CLT	37.2214	-116.0620	1.539	NNSS-SPE Line 5 site 01
L5002	CLZ CLR CLT	37.2216	-116.0631	1.556	NNSS-SPE Line 5 site 02
L5003	CLZ CLR CLT	37.2218	-116.0642	1.577	NNSS-SPE Line 5 site 03
L5004	CLZ CLR CLT	37.2220	-116.0653	1.622	NNSS-SPE Line 5 site 04
L5005	CLZ CLR CLT	37.2222	-116.0664	1.641	NNSS-SPE Line 5 site 05
L5006	CLZ CLR CLT	37.2225	-116.0675	1.619	NNSS-SPE Line 5 site 06
L5007	CLZ CLR CLT	37.2227	-116.0686	1.612	NNSS-SPE Line 5 site 07
L5008	CLZ CLR CLT	37.2229	-116.0696	1.589	NNSS-SPE Line 5 site 08
L5009	CLZ CLR CLT	37.2231	-116.0707	1.579	NNSS-SPE Line 5 site 09
L5010	CNZ CNR CNT DJZ DJR DJT CLZ CLR CLT	37.2233	-116.0718	1.568	NNSS-SPE Line 5 site 10

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
L5011	CLZ CLR CLT	37.2235	-116.0729	1.566	NNSS-SPE Line 5 site 11
L5012	CLZ CLR CLT	37.2237	-116.0740	1.586	NNSS-SPE Line 5 site 12
L5013	CLZ CLR CLT	37.2240	-116.0751	1.612	NNSS-SPE Line 5 site 13
L5014	CLZ CLR CLT	37.2242	-116.0762	1.642	NNSS-SPE Line 5 site 14
L5015	CLZ CLR CLT	37.2244	-116.0773	1.678	NNSS-SPE Line 5 site 15
L5016	DHZ DHR DHT	37.2246	-116.0784	1.725	NNSS-SPE Line 5 site 16
L5024	CHZ CH1 CH2	37.2297	-116.1047	1.767	NNSS-SPE Line 5 site 24
L5026	CHZ CH1 CH2	37.2319	-116.1156	1.808	NNSS-SPE Line 5 site 26
L5028	CHZ CH1 CH2	37.2404	-116.1594	1.911	NNSS-SPE Line 5 site 28
L5030	CHZ CH1 CH2	37.2490	-116.2032	2.074	NNSS-SPE Line 5 site 30
L5034	CHZ CH1 CH2	37.2660	-116.2909	2.077	NNSS-SPE Line 5 site 34
L5036	CHZ CH1 CH2	37.2745	-116.3347	2.1	NNSS-SPE Line 5 site 36

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
Far Field					
A7001	CDF_01	37.0996	-116.0416	1.2469	NNSS-SPE Area 7 Inf-N no.1
A7002	CDF_02	37.0993	-116.0412	1.2476	NNSS-SPE Area 7 Inf-E no.2
A7003	CDF_03	37.0989	-116.0417	1.2464	NNSS-SPE Area 7 Inf-S no.3
A7004	CDF_04	37.0993	-116.0421	1.2455	NNSS-SPE Area 7 Inf-W no.4
A7005	CDF_05	37.0993	-116.0416	1.2467	NNSS-SPE Area 7 Inf-C no.5
AC001	CHZ CHN CHE	37.2213	-116.0603	1.5273	NNSS-SPE Area 12 sp4 loc 9
AF001	CDF CHZ CHN CHE	37.2160	-116.1611	1.6371	NNSS-SPE AFTAC site 01
AF002	CDF CHZ CHN CHE	37.1640	-116.1423	1.4941	NNSS-SPE AFTAC site 02
AF003	CDF CHZ CHN CHE	37.1313	-116.0573	1.2618	NNSS-SPE AFTAC site 03
AF004	CDF CHZ CHN CHE	37.1801	-115.9834	1.437	NNSS-SPE AFTAC site 04
AF005	CDF CHZ CHN CHE	37.1894	-116.0204	1.3372	NNSS-SPE AFTAC site 05
AF006	CNZ CNN CNE	37.0531	-116.0903	1.2484	NNSS-SPE AFTAC site 06
AF007	CDF CHZ CHN CHE	37.1239	-116.1478	1.4521	NNSS-SPE AFTAC site 07
AF008	CNZ CNN CNE DHZ DHN DHE	37.2211	-116.0496	1.4539	NNSS-SPE AFTAC site 08
AF009	CNZ CNN CNE DHZ DHN DHE	37.2299	-116.0577	1.549	NNSS-SPE AFTAC site 09

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
AS001	CLZ_01	37.2203	-116.0490	1.4467	NNSS-SPE SP3 Asymmetric Array site 01
AS002	CLZ_02	37.2212	-116.0487	1.4503	NNSS-SPE SP3 Asymmetric Array site 02
AS003	CLZ_03	37.2201	-116.0481	1.4414	NNSS-SPE SP3 Asymmetric Array site 03
AS004	CLZ_04	37.2194	-116.0490	1.4414	NNSS-SPE SP3 Asymmetric Array site 04
AS005	CLZ_05	37.2204	-116.0500	1.4507	NNSS-SPE SP3 Asymmetric Array site 05
AS006	CLZ_06	37.2210	-116.0496	1.4531	NNSS-SPE SP3 Asymmetric Array site 06
AS007	CLZ	37.2409	-116.0631	1.7116	NNSS-SPE SP4 Asymmetric Array A site 01
	CLR				
	CLT				
AS008	CLZ	37.2419	-116.0629	1.7298	NNSS-SPE SP4 Asymmetric Array A site 02
	CLR				
	CLT				
AS009	CLZ	37.2408	-116.0621	1.7369	NNSS-SPE SP4 Asymmetric Array B site 03
	CLR				
	CLT				
AS010	CLZ	37.2397	-116.0628	1.7122	NNSS-SPE SP4 Asymmetric Array B site 04
	CLR				
	CLT				
AS011	CLZ	37.2404	-116.0639	1.6988	NNSS-SPE SP4 Asymmetric Array C site 05
	CLR				
	CLT				
AS012	CLZ	37.2410	-116.0639	1.7049	NNSS-SPE SP4 Asymmetric Array C site 06
	CLR				
	CLT				
AX001	CDF_01	37.1776	-116.0541	1.2842	NNSS-SPE Area 10 Sedan-N no.6
AX002	CDF_02	37.1772	-116.0540	1.284	NNSS-SPE Area 10 Sedan-SE no.7
AX003	CDF_03	37.1773	-116.0544	1.2837	NNSS-SPE Area 10 Sedan-SW no.8
AX004	CDF_04	37.2036	-116.0581	1.4004	NNSS-SPE Area 10 NMT-2K-N no.9
AX005	CDF_05	37.2033	-116.0578	1.3934	NNSS-SPE Area 10 NMT-2K-E no.10
AX006	CDF_06	37.2033	-116.0584	1.3993	NNSS-SPE Area 10 NMT-2K-W no.11
BE1	CLZ	37.0992	-116.0952	1.2726	BEEF E-1 SP3
	CLN				
	CLE				
BE2	CLZ	37.0991	-116.0940	1.2706	BEEF E-2 SP3
	CLN				
	CLE				
BE3	CLZ	37.0990	-116.0929	1.2688	BEEF E-3 SP3
	CLN				
	CLE				
BE4	CLZ	37.0990	-116.0918	1.2665	BEEF E-4 SP3
	CLN				
	CLE				
BE5	CLZ	37.0989	-116.0907	1.2646	BEEF E-5 SP3
	CLN				
	CLE				
BE6	CLZ_04	37.0988	-116.0896	1.263	BEEF E-6 SP3
	CLN_05				
	CLE_06				
BE7	CLZ	37.0988	-116.0884	1.2616	BEEF E-7 SP3
	CLN				
	CLE				

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
BE8	CLZ CLN CLE	37.0987	-116.0873	1.2601	BEEF E-8 SP3
BE9	CLZ CLN CLE	37.0986	-116.0862	1.2588	BEEF E-9 SP3
BE10	CLZ CLN CLE	37.0985	-116.0851	1.2573	BEEF E-10 SP3
BW1	CLZ CLN CLE	37.0994	-116.0974	1.276	BEEF W-1 SP3
BN1	CLZ CLN CLE	37.1003	-116.0962	1.2753	BEEF N-1 SP3
BN5	CLZ CLN CLE	37.1039	-116.0958	1.2762	BEEF N-5 SP3
BN10	CLZ CLN CLE	37.1084	-116.0952	1.2783	BEEF N-10 SP3
BN1I	CDF_01	37.0988	-116.0851	1.2576	BEEF North 1k INF SP3
BSE1I	CDF_02	37.0984	-116.0848	1.2568	BEEF Southeast 1k INF SP3
BSW1I	CDF_03	37.0984	-116.0854	1.2576	BEEF Southwest 1k INF SP3
BEXIN	CDF_01	37.0978	-115.9900	1.3328	BEEF East 10k INF N SP3
BEXIW	CDF_02	37.0973	-115.9903	1.3308	BEEF East 10k INF SW SP3
BEXIE	CDF_03	37.0973	-115.9899	1.3316	BEEF East 10k INF SE SP3
BEXIG	CLZ CLN CLE	37.0975	-115.9901	1.332	BEEF East 10k INF Geo SP3
BE5IN	CDF_01	37.0992	-116.0417	1.2462	BEEF East 5k INF N SP3
BE5IE	CDF_02	37.0987	-116.0414	1.2461	BEEF East 5k INF SE SP3
BE5IW	CDF_03	37.0988	-116.0420	1.2446	BEEF East 5k INF SW SP3
BE5IG	CLZ CLN CLE	37.0989	-116.0417	1.246	BEEF East 5k INF Geo SP3
EM001	CFZ_01 CFR_02 CFT_03	37.2210	-116.0610	1.4992	NNSS-SPE LLNL EMP 30m SP3
EM002	CFZ_04 CFR_05 CFT_06	37.2207	-116.0611	1.496	NNSS-SPE LLNL EMP 60m SP3
EN001	GDF_01 GDF_02 GDF_03 GDF_04 GDF_05 GDF_06 GDF_07 GDF_08 GDF_09 GLZ	37.2134	-116.0577	1.4745	NNSS-SPE DTRA FCA Site 01

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
EN002	GDF_01 GDF_02 GDF_03 GDF_04 GDF_05 GDF_06 GDF_07 GDF_08 GDF_09 GLZ	37.1771	-116.0543	1.3114	NNSS-SPE DTRA FCA Site 02
EN003	GDF_01 GDF_02 GDF_03 GDF_04 GDF_05 GDF_06 GDF_07 GDF_08 GDF_09 GLZ	37.1321	-116.0593	1.2938	NNSS-SPE DTRA FCA Site 03
EN004	GDF_01 GDF_02 GDF_03 GDF_04 GDF_05 GDF_06 GDF_07 GDF_08 GDF_09 GLZ	37.2159	-116.1612	1.667	NNSS-SPE DTRA FCA Site 04
FO001	CLZ CL1 CL2	37.1842	-116.1430	1.5273	NNSS-SPE SP4 Fiber Optic site 01
FO002	CLZ CL1 CL2	37.1001	-116.1453	1.4411	NNSS-SPE SP4 Fiber Optic site 02
FO003	CLZ CL1 CL2	37.0207	-116.1138	1.3001	NNSS-SPE SP4 Fiber Optic site 03
FO004	CLZ CL1 CL2	36.9536	-116.0546	1.2156	NNSS-SPE SP4 Fiber Optic site 04
TP001	CLZ CLR CLT	37.2192	-116.0573	1.4961	NNSS-SPE SP4 Trailer Park
IS11	CDF_01	37.2235	-116.0614	1.5451	NNSS-SPE Sandia Inf 250 m N
IS12	CDF_02	37.2234	-116.0611	1.5419	NNSS-SPE Sandia Inf 233 m N
IS13	CDF_03	37.2232	-116.0609	1.5385	NNSS-SPE Sandia Inf 208 m N
IS14	CDF_04 CDF_05	37.2232	-116.0614	1.5451	NNSS-SPE Sandia Inf 218 m N
IS21	CDF_01	37.2193	-116.0604	1.5138	NNSS-SPE Sandia Inf 226 m S
IS22	CDF_02	37.2190	-116.0605	1.5163	NNSS-SPE Sandia Inf 251 m S
IS23	CDF_03	37.2189	-116.0603	1.512	NNSS-SPE Sandia Inf 271 m S

Appendix 4

Selected Metadata for SPE-4 Prime Surface Stations

Station ID	Channel	Estimated Latitude (degrees)	Estimated Longitude (degrees)	Estimated Elevation (km amsl)	Station Full Name
IS24	CDF_04 CDF_05	37.2188	-116.0608	1.5182	NNSS-SPE Sandia Inf 270 m S
IS31	CDF_01	37.2219	-116.0635	1.5704	NNSS-SPE Sandia Inf 249 m W
IS32	CDF_02	37.2217	-116.0636	1.5659	NNSS-SPE Sandia Inf 251 m W
IS33	CDF_03	37.2215	-116.0634	1.5597	NNSS-SPE Sandia Inf 229 m W
IS34	CDF_04 CDF_05	37.2215	-116.0638	1.5627	NNSS-SPE Sandia Inf 261 m W
IS41	CDF_01	37.2235	-116.0579	1.5325	NNSS-SPE Sandia Inf 363 m E
IS42	CDF_02	37.2233	-116.0580	1.5315	NNSS-SPE Sandia Inf 339 m E
IS43	CDF_03	37.2232	-116.0576	1.5301	NNSS-SPE Sandia Inf 353 m E
IS44	CDF_04 CDF_05	37.2233	-116.0582	1.5301	NNSS-SPE Sandia Inf 320 m E
IS51	CDF_01	37.1776	-116.0541	1.3107	NNSS-SPE Sandia Inf 5 Km S
IS52	CDF_02	37.1773	-116.0542	1.3107	NNSS-SPE Sandia Inf 5 Km S
IS53	CDF_03	37.1771	-116.0540	1.3107	NNSS-SPE Sandia Inf 5 Km S
IS54	CDF_04 CDF_05	37.1773	-116.0545	1.3106	NNSS-SPE Sandia Inf 5 Km S
IS61	CDF_01	37.2125	-116.0595	1.4833	NNSS-SPE Sandia Inf 1 Km S
IS62	CDF_02	37.2122	-116.0594	1.4826	NNSS-SPE Sandia Inf 1 Km S
IS63	CDF_03	37.2123	-116.0591	1.4809	NNSS-SPE Sandia Inf 1 Km S
IS64	CDF_04 CDF_05	37.2121	-116.0598	1.4821	NNSS-SPE Sandia Inf 1 Km S
IS71	CDF_01	37.2035	-116.0581	1.4267	NNSS-SPE Sandia Inf 2 Km S
IS72	CDF_02	37.2033	-116.0581	1.4253	NNSS-SPE Sandia Inf 2 Km S
IS73	CDF_03	37.2033	-116.0578	1.4201	NNSS-SPE Sandia Inf 2 Km S
IS74	CDF_04 CDF_05	37.2033	-116.0583	1.4261	NNSS-SPE Sandia Inf 2 Km S
IS81	CDF_01	37.2212	-116.0494	1.4803	NNSS-SPE Sandia Inf 1 Km E
IS82	CDF_02	37.2210	-116.0494	1.4787	NNSS-SPE Sandia Inf 1 Km E
IS83	CDF_03	37.2208	-116.0491	1.4766	NNSS-SPE Sandia Inf 1 Km E
IS84	CDF_04	37.2209	-116.0497	1.4787	NNSS-SPE Sandia Inf 1 Km E