SAND2016-6885PE

Component Evaluation at Sandia National Laboratories

B. John Merchant

July, 2016

Sandia National Laboratories

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Component Evaluation

Motivation:

Provide independent evaluations of the primary hardware components (waveform recorders, seismometers and infrasound sensors) used by for monitoring for nuclear explosions. Key objectives include:

- Maintain facilities, knowledge, and experience of testing procedures to conduct evaluations on hardware components.
- Provide evaluation reports to sponsors
- Perform research in new methods and capabilites of testing hardware components.

Sponsors include:

- U.S. Department of Energy
- U.S. Department of State
- U.S. Defense Threat Reduction Agency
- U.S. National Data Center
- CTBTO

Sandia FACT Site

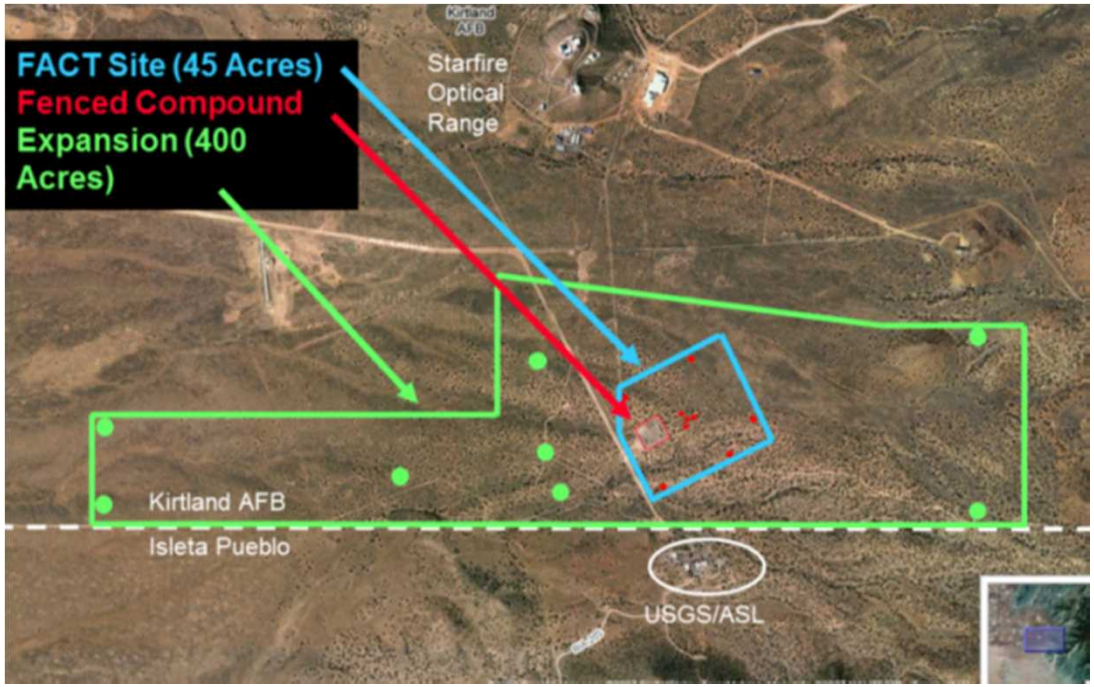
Facility for **A**cceptance **C**alibration and **T**esting

Located near southern edge of Kirtland Air Force Base in Albuquerque, NM, USA

2.5 acre compound
- Component Testing

45 acre, exclusive use
- Subsystem Testing

400 acres, 8 sites
- System Testing
- Array Configuration



FACT Site History

- ~1980, established to support RSTN (Regional Seismic Test Network) development at Sandia
- ~1990, expanded to support DSVS (Deployable Seismic Verification System) development at Sandia
- Early 1990s, after fall of Soviet Union, transitioned from monitoring system development to evaluation
- Mid-2000's, 45 acre expansion established subsystem field sites
- 2012, 400 acre expansion established to support 8-element Fact Site Array
- 2015-16, equipment at Fact Site Array being populated

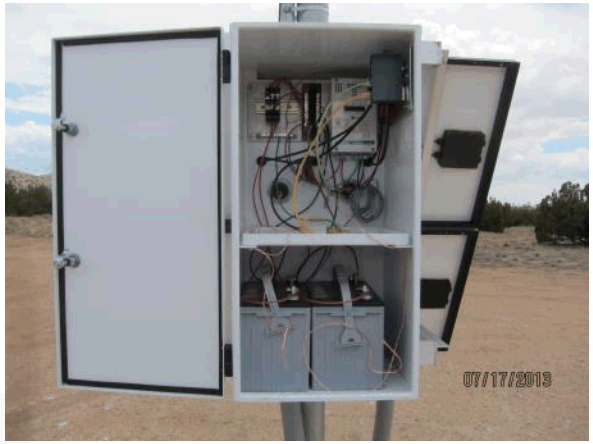
FACT: key capabilities

- Field sites for system & subsystem testing
- Signal generation equipment, ultra-low distortion oscillators
- Underground bunker, thermal stability and noise isolation
- Infrasound isolation chambers
- Thermal chamber for temperature testing

- Sandia Primary Standards Laboratory onsite

Sandia FACT Site Array

- 8 sites covering 400 acres, limited by KAFB land-use
- 3.2 km widest aperture
- Surface vault & pad
- 260 Watt Power
- Radio telemetered



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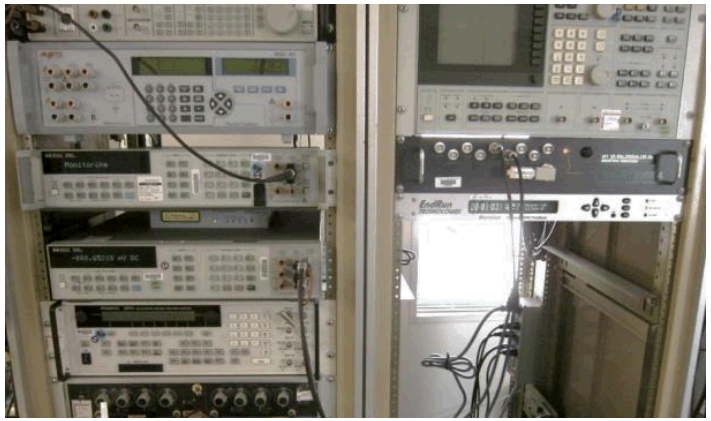
FACT Site Array - IMS

- Deploying semi-permanent IMS-style seismic and infrasound stations at array sites.
- Work being performed currently in 2016
- Intended for trial of US-IMS hw/sw upgrades

- Wind Filters study
  - IMS Pipe Array
  - UAF Poly-hose
  - NCPA Dome

Digitizer Testing

- Capable of testing high resolution digitizers across entire frequency / amplitude range



- Measurements traceable to NIST calibrations
- Reference meters, calibrated at Sandia PSL
- High quality signal generators
  sinusoid, 2-tone, broadband, square
- Ultra-low distortion oscillators
  < -140 dB THD
- Timing sources, capable of measuring
  < 50 uS of error

- All measurements tied back to calibrated references

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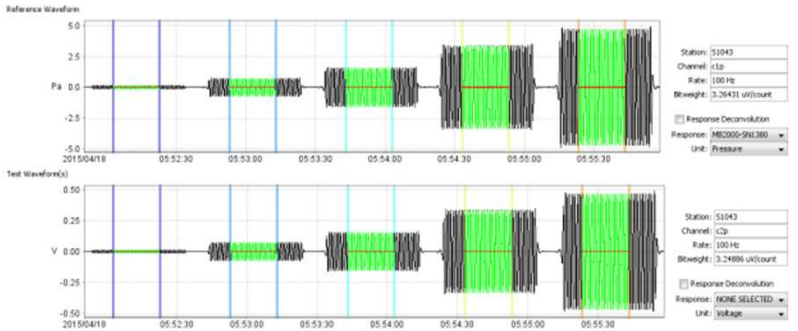
Seismometer Testing

- Underground bunker, provides thermal stability and some separation from surface noise
- Shallow bore-holes
- FACT is in aluvium, short-period sensors can be readily tested, broad-band/long-period are more challenging
- USGS/ASL Tunnel nearby, permission to use
- Reference sensors, manufacturers calibration, long history of use:
  - Geotech GS13 (short-period)
  - STS-2 (broadband)

Infrasound Testing

- Underground bunker, provides thermal stability
- Isolation chamber, attenuate ambient background
- Piston-phone, generates pressure signal
- Traceable measurement of ambient conditions
- Reference sensors, calibrated at LANL chamber to within < 5%



Infrasound Testing

- New, larger infrasound chamber
  - Designed & built by U. Mississippi, NCPA
  - 84” x 40”
  - 4000 lb, inch-thick steel
  - Improved ambient isolation
  - More sensors tested simultaneously

- Developing a new piston-driver
  - 10” professional speaker
  - 1 kw high-end amplifier
  - Custom feedback control to linearize
  - Goal is 0.001 – 10 Hz, 100 Pa amplitude

Infrasound International Pilot Study

- Participating in a pilot study coordinated by the CTBTO to investigate improved definitions and testing methodologies for infrasound sensors.
- Performing comparison evaluations on a set of infrasound sensors.
- Resulted reported on by CTBTO at ITW and WG-B.
- Co-participants:
  - CEA
  - U. Mississippi (NCPA)
  - LANL
  - Spektra

Recent Evaluations

- 2016
  - Chaparral M60 Infrasound Sensor
  - Nanometrics Trillium Seismometers
- 2015
  - Guralp Preamplifier to a Geotech GS21
  - Chaparral 50A Infrasound Sensors
  - CEA MB2005 Infrasound Sensors
  - Hyperion 5113-A Infrasound Sensor
- 2014
  - Refurbished Guralp CMG-3TB Seismometers
  - Nanometrics Trillium 120 PH Seismometers
  - Kinemetrics STS-5A Seismometers
  - Hyperion 3113 / 5113 Infrasound Sensors
  - CEA MB3a Infrasound Sensor
- 2013
  - CEA SMAD Digitizer

Questions?

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