

Defense Nuclear Nonproliferation Research & Development

Nuclear Explosion Monitoring Program Review

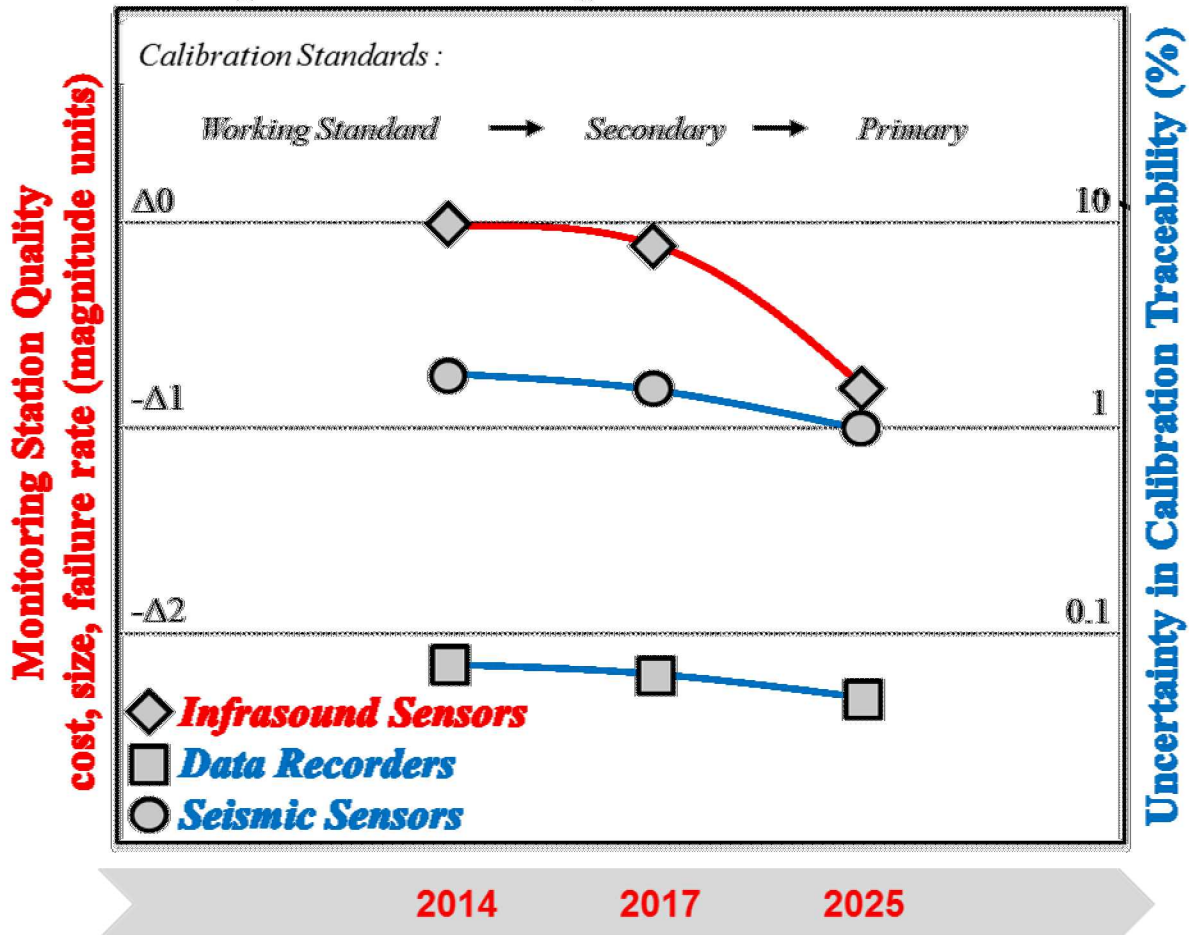
NEM2020

Sensors for Waveform Technologies – The FACT Site

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17 March 2020

Waveform Sensors Metric: Improve performance of the monitoring system through the development of improved sensor designs and sensor evaluation



The major R&D for Sensors has evolved as monitoring instrumentation has become increasingly commercially available and requirements have moved to lower measurement uncertainties.

The metrological standards used in laboratory calibrations have been evolving:

- Working Standard
- Secondary Standard
- Primary Standard

} includes uncertainty

Providing traceable calibrations and reducing measurement uncertainty in the monitoring system.

FY19 Highlights

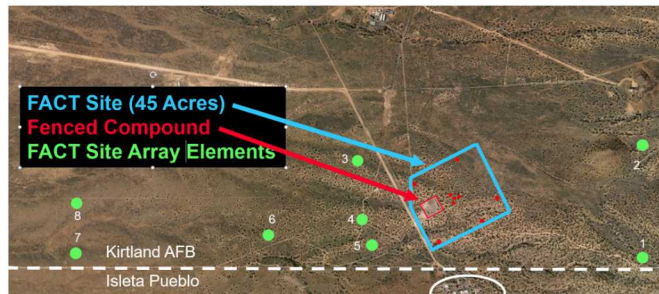
Sandia National Laboratory's (SNL's) Facility for Acceptance, Calibration, and Testing (FACT) of sensors

- Provide independent evaluations of the primary hardware components (waveform recorders, seismometers and infrasound sensors) used by for monitoring for nuclear explosions.
- In FY2019, SNL developed a design for increasing the test signal amplitude provided within the acoustic isolation chamber.

*Perform research
in new methods
and capabilities*



*Maintain facilities, knowledge, and
experience of testing procedures*



FY20 Highlights and Works in Progress

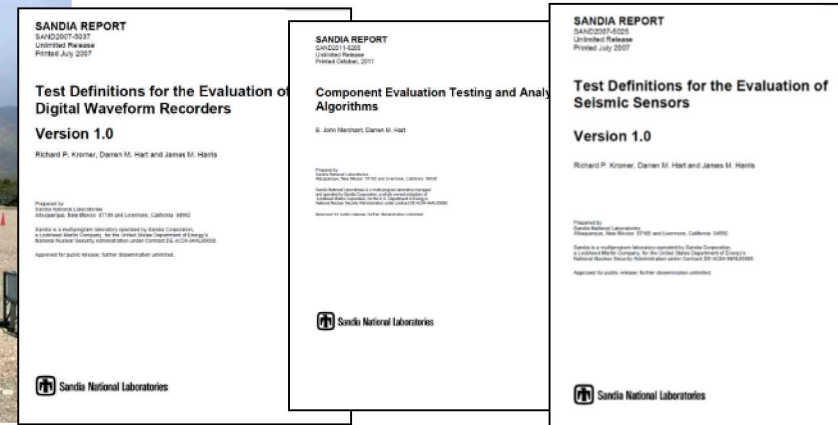
Operate an Evaluation Facility

[improved sensor evaluation]

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

Provide evaluation reports to support U.S. Nuclear Treaty Monitoring interests

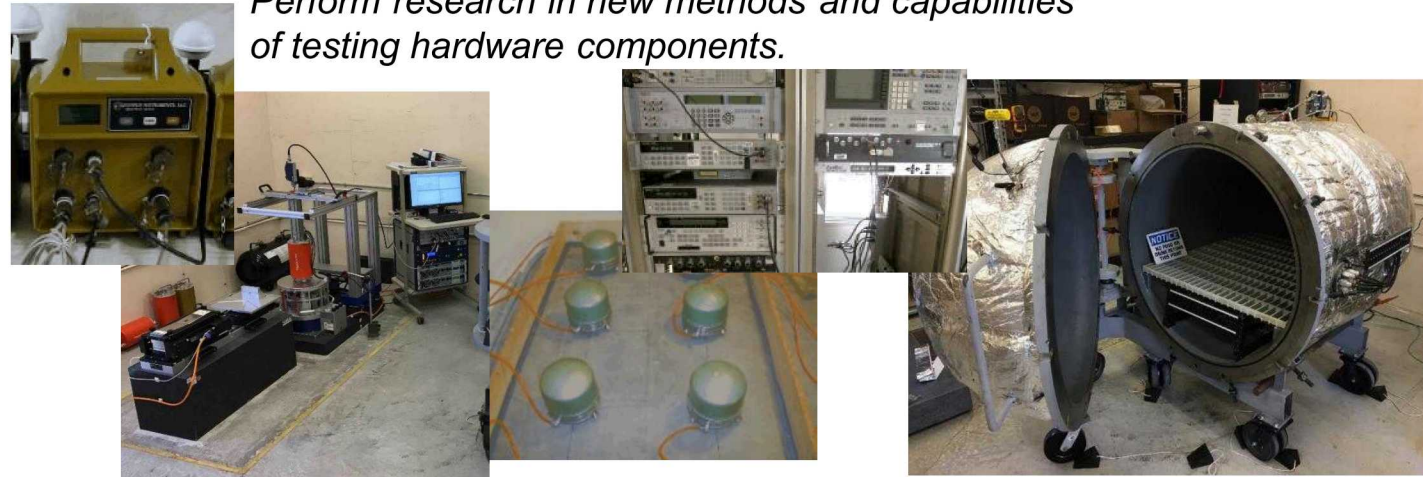
Maintain facilities, knowledge, and experience of testing procedures to conduct evaluations on hardware components.



NA22 GNDD Sensors enables multiple sponsors:

- AFTAC
- U.S. Department of Energy
- U.S. Department of State
- DTRA / NACT
- CTBTO

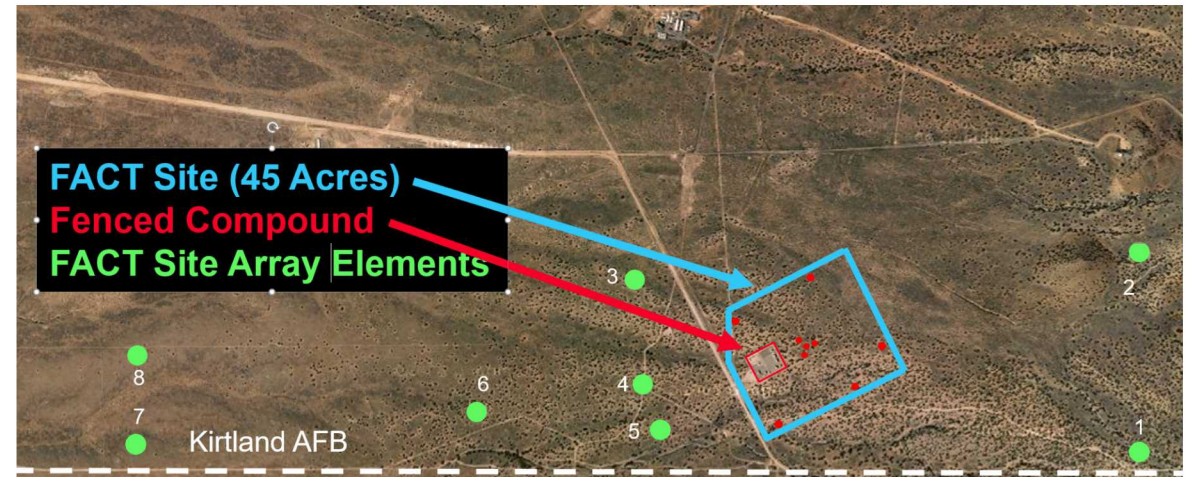
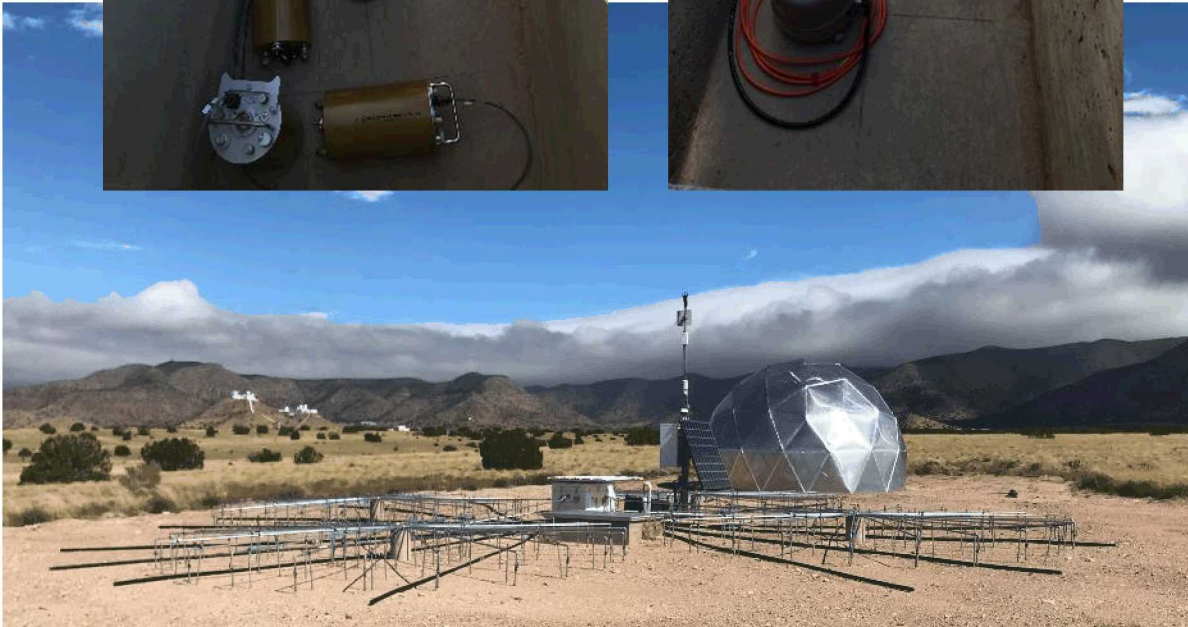
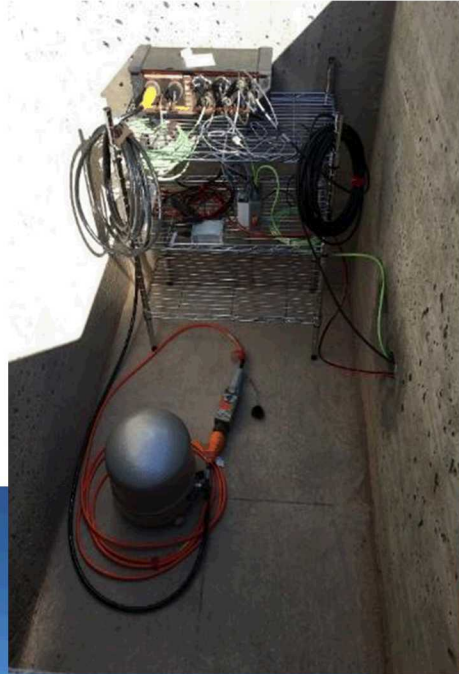
Perform research in new methods and capabilities of testing hardware components.



<http://www.sandia.gov/fact/>

Field Site System Evaluations

[improved system evaluation]

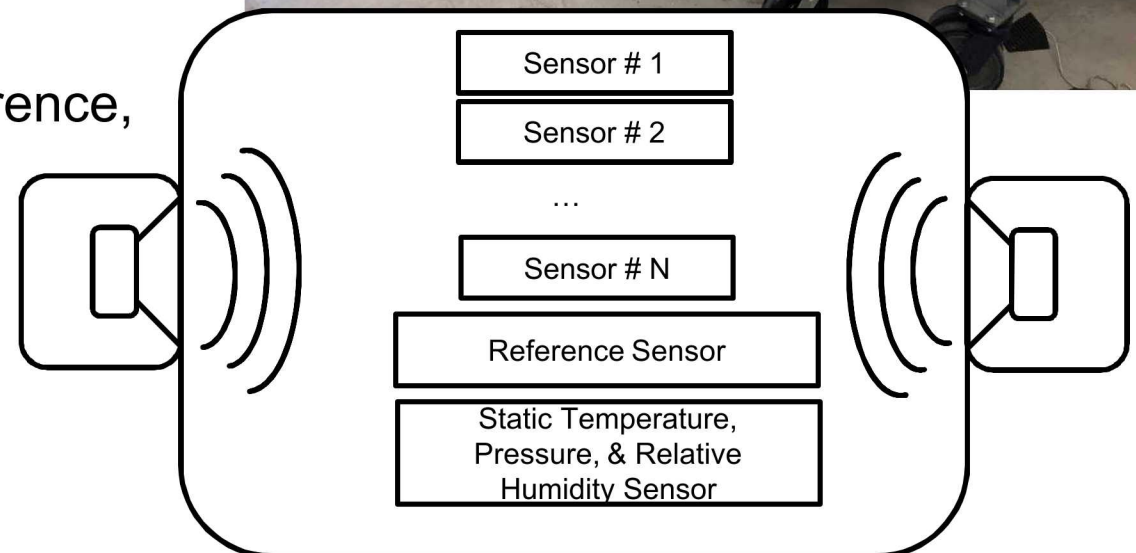
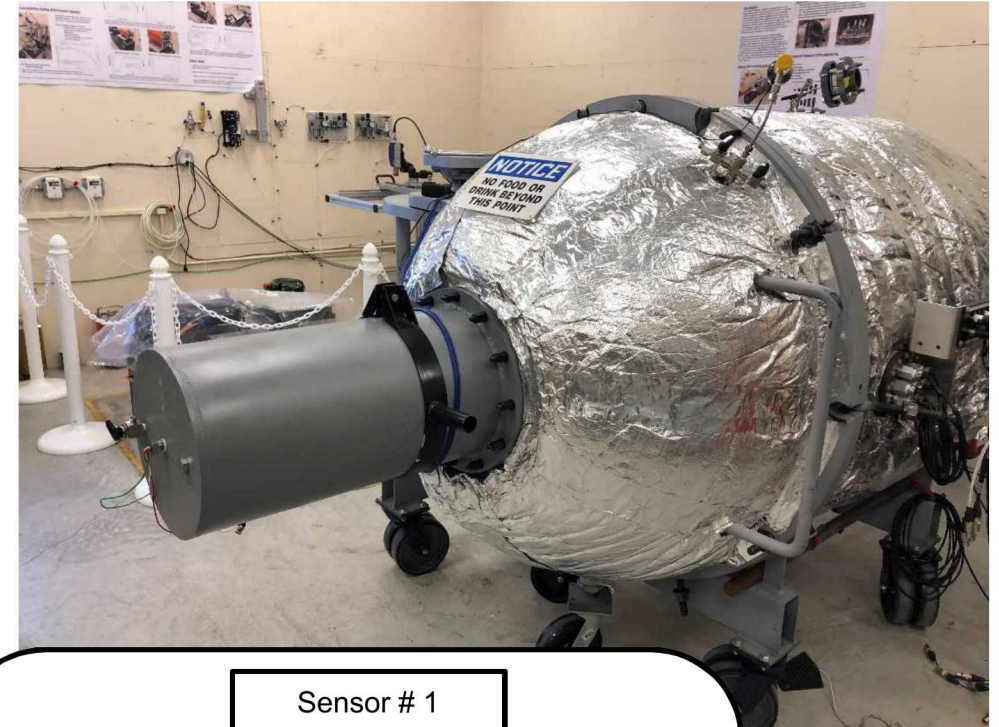


Infrasound Test Chamber for evaluations.

- Implemented a design developed in FY19 to increase chamber amplitude by increasing piston back-volume:
 - Increased amplitude levels by 50%
 - Went from 8 Pa continuous (16 Pa peak) to 12 Pa continuous (16 Pa peak)

Changing to B&K 4193 microphone references, rather than MB2005:

- Microphones calibrated by LNE(France) metrology lab.
- Traceable calibrations over 0.02 to 20 Hz
- First metrologically traceable infrasound reference, over the frequency band of interest (0.02 – 4 Hz)

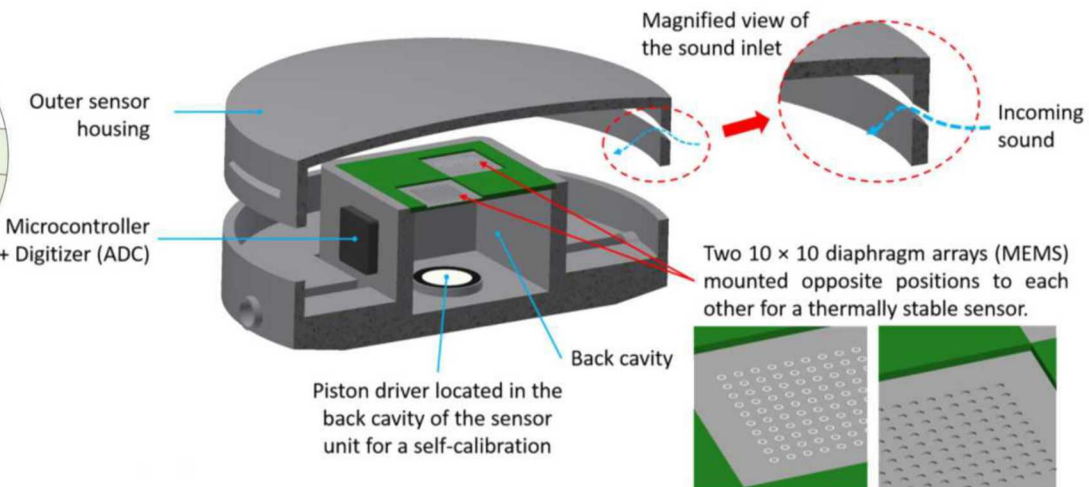
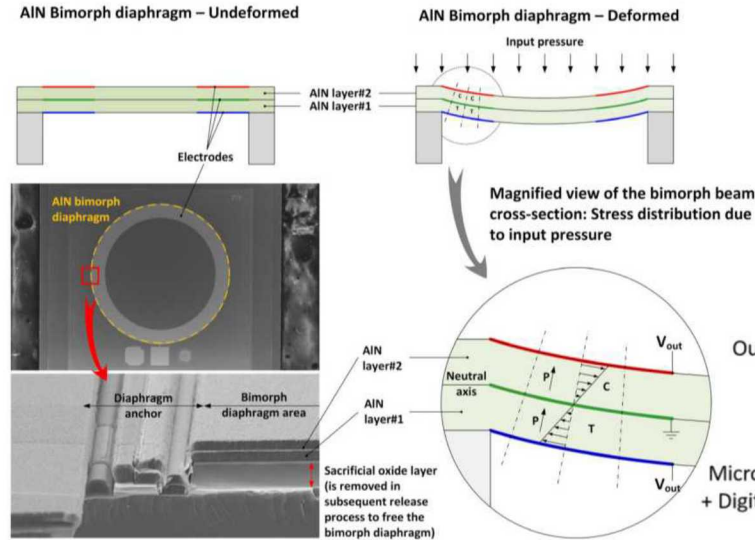
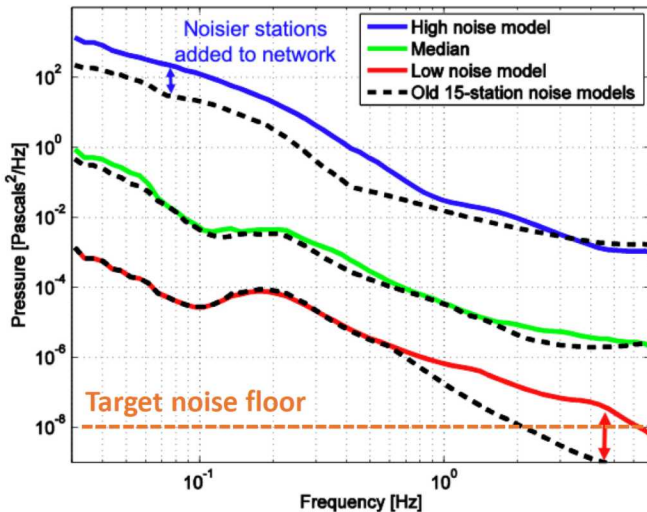
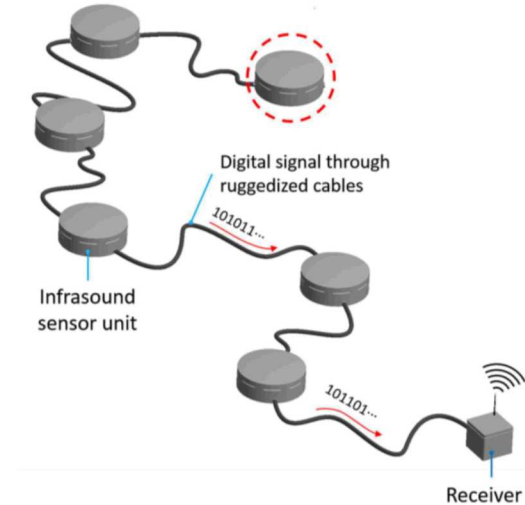


Silicon Audio Infrasond Sensor

[improved sensor design]

Develop a modern, smart infrasond monitoring system

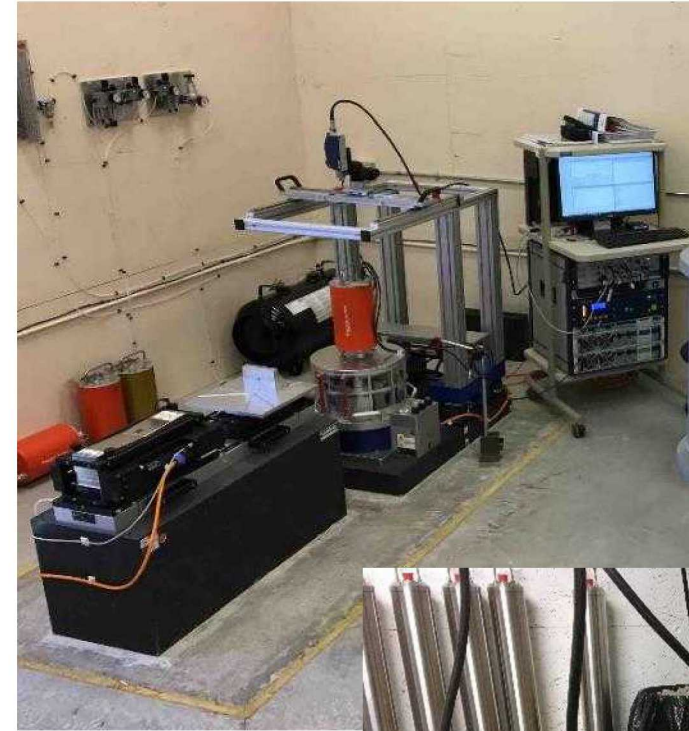
- Low-cost, low-noise sensing nodes.
- Modular design: support small and large arrays of nodes.
- Digital communication: deploy arrays in challenging terrain.
- Self-health monitoring and self-calibration.



(SBIR DE-SC0013829)

Primary Seismic Calibrator

- ~1% measurement uncertainty
- Horizontal and vertical shakers
- Handles up to 50 kg
- 0.1 Hz – 160 Hz
- Used short-period and broadband seismometers
- Working this year to reduce the impact of local vibration noise and air movement.
 - Improve SNR and measurement repeatability
 - Better calibrations at lower frequencies.

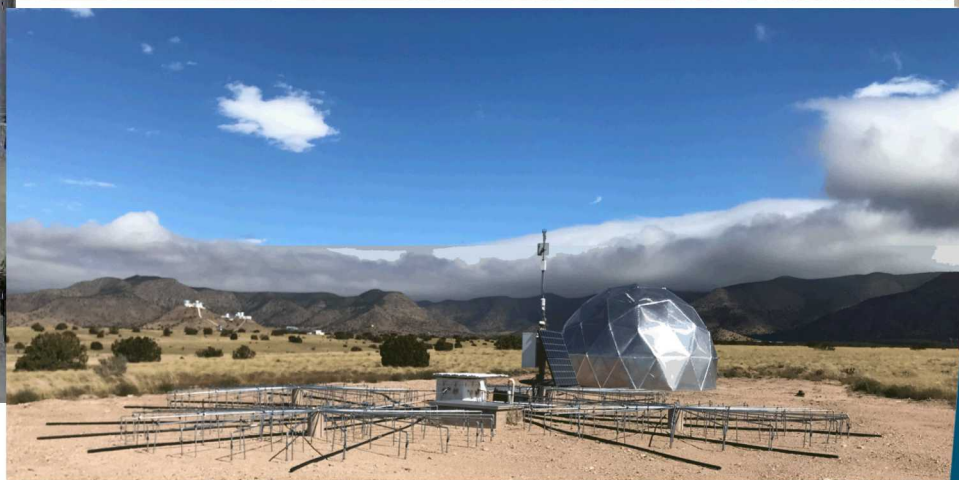
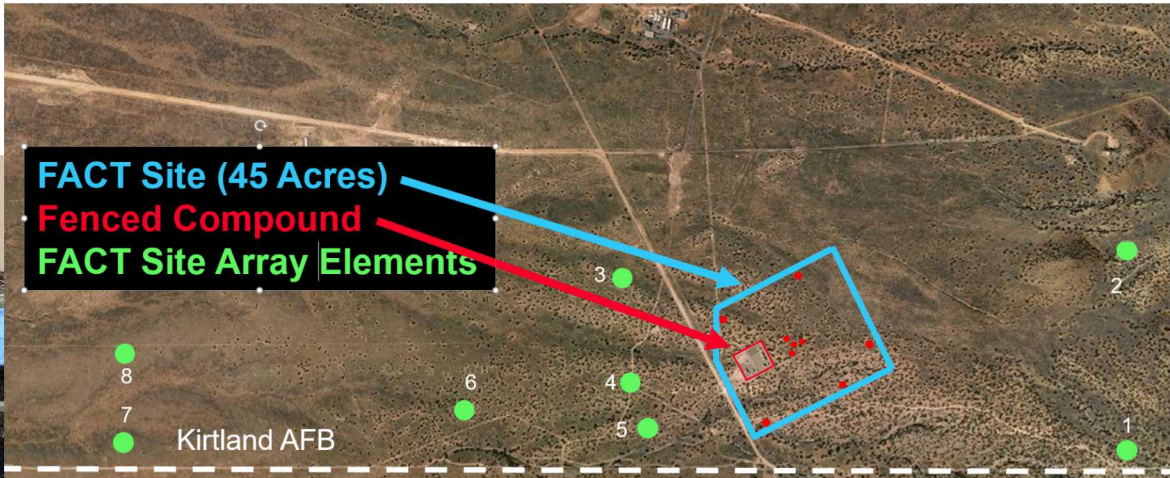
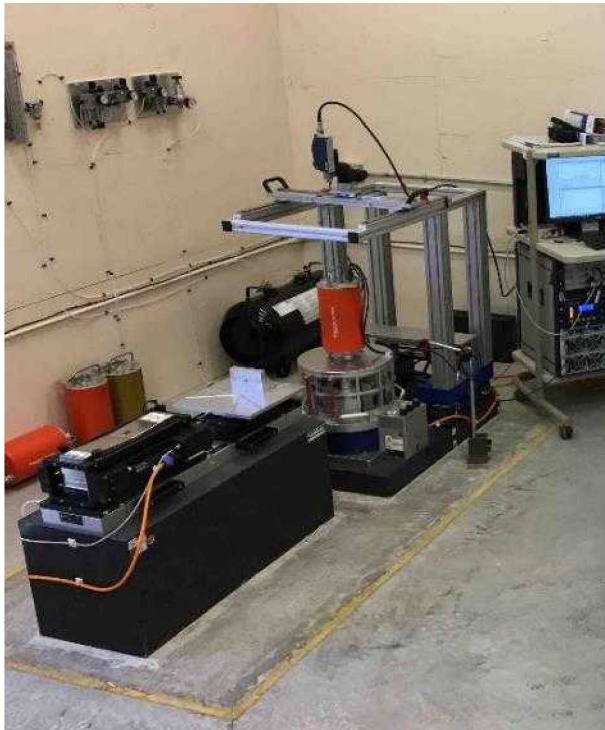


Underground Bunker

- Sensor comparison test
 - Relative response using a working standard as reference
- More thermally stable than the surface
- Removed from ambient surface noise
- Quiet environment suitable for short-period self-noise



February 20, 2020



Presentation

- [11/11/2019] Poster at Infrasound Technology Workshop in Aqaba, Jordan, entitled "Evaluation of Experimental Hyperion Infrasound Shrouds as an Improved Means of Wind Noise Attenuation"

Upcoming Laboratory Report

- Geotech GS13BH Seismometer Evaluation Report

