SAND2020-2076PE

SNL GNDD Sensors: FACT Enabled Projects

PRESENTED BY

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February 20, 2020

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FACT Enabled projects

The Component Evaluation project, which maintains the underlying capabilities at FACT, enables projects from a variety of sponsors:

- US Air Force:
  - SHDAS
  - Next Generation Digitizer
  - Next Generation Infrasound
- US State Dept: CiK contributions to CTBTO
- CTBTO: Type Approval of IMS Instrumentation
- DTRA/NACT:
  - US Waveform Technology Testbed
  - Wind Noise Reduction System Evaluation
  - Infrasound International Interlaboratory Comparison
  - Long-Term Infrasound Sensor Field Test
  - Next Generation Digitizer Evaluation
  - Field Power System Evaluation

US Air Force: Seismic Hydroacoustic Data Acquisition System (SHDAS)

Assist in the development of an ocean-bottom seismic station by evaluating and validating the performance of the equipment to be used in the SHDAS deployment. (2015 – 2016)

Performed in-depth evaluations of every digitizer and seismometer:

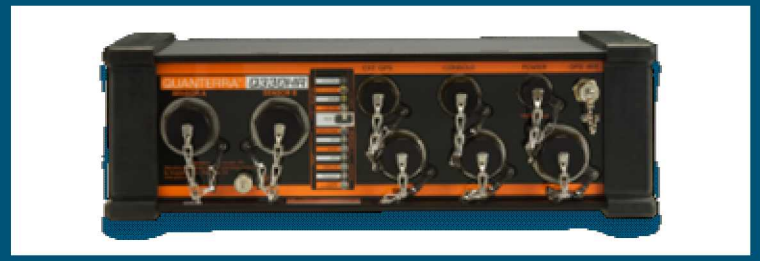
- 18 custom digitizers, developed by Leidos
- 18 custom short-period 3-axis seismometers
- 18 Nanometrics OBS seismometers

SNL identified several components that required repair or replacement to ensure proper operation of the system, without which significant portions of the system would have failed in operation.

US Air Force: Next Generation Digitizer Qualification

Perform evaluations of modern digitizers and seismometers to support the US Air Force in their upgrades of monitoring stations: (2016-2017)

- Digitizers
  - Kinemetrics Q330HR
  - Nanometrics Centaur
  - Guralp Affinity
- Seismometers
  - Trillium 120PH
  - STS-5A
  - Guralp CMG-3V



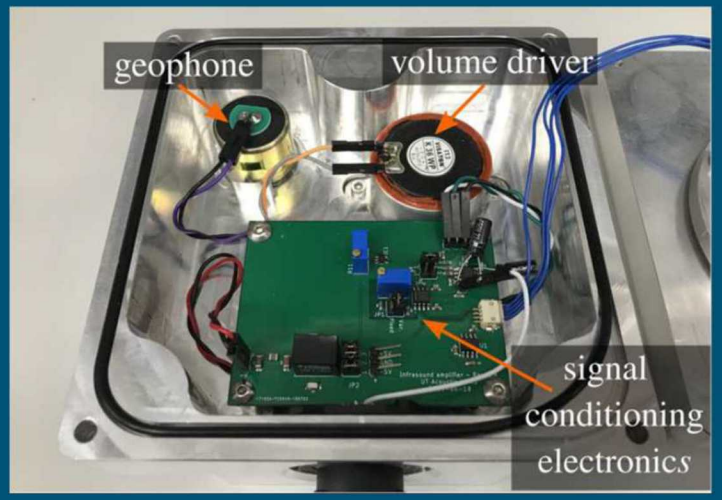
Assisted in the field deployment of instruments at seismic facility Pinedale, WY.

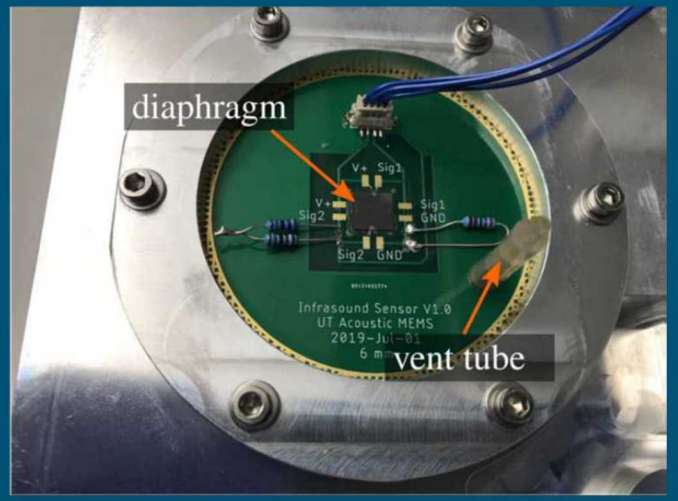
US Air Force: Next Generation Infrasound Sensor

Evaluate a new infrasound sensor design from Silicon Audio (2019 – present)

- MEMS diaphragm
- Claims improved performance in a reduce package size

- SNL will perform laboratory and field evaluations to validate performance.

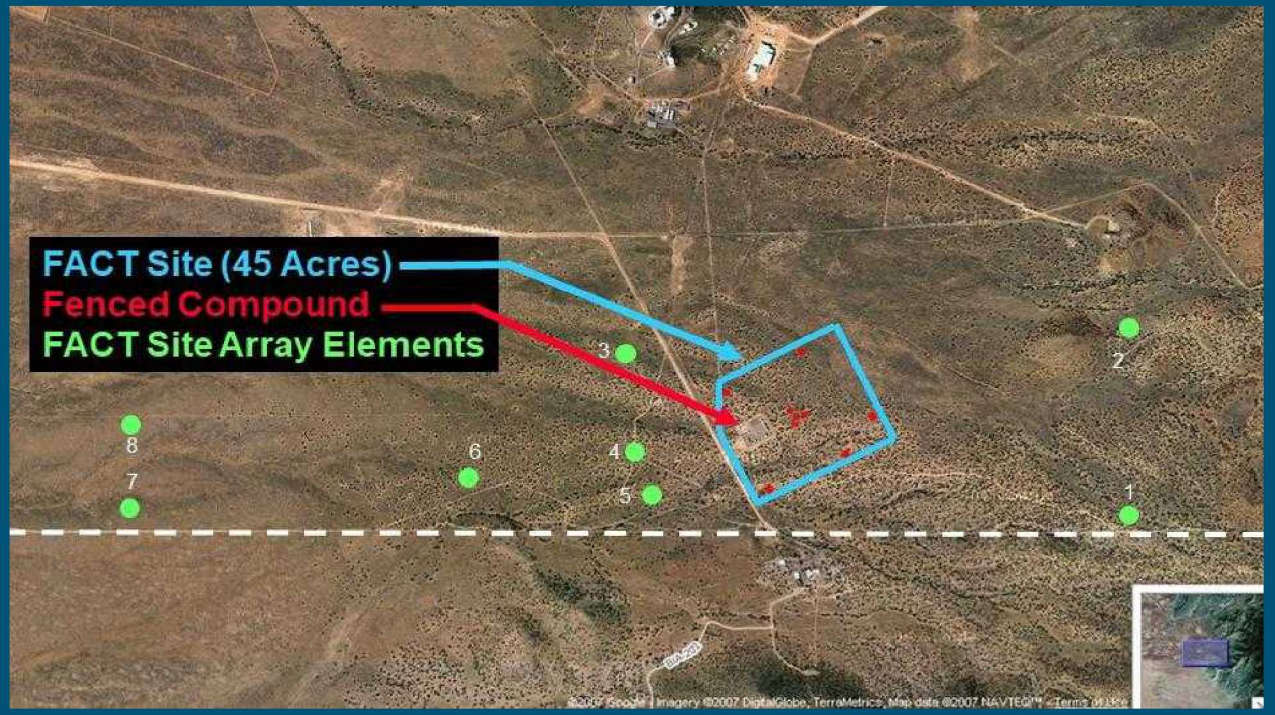




U.S. State Department Contribution In Kind (CiK)

State Department funded SNL to make capability improvements to FACT and assist the CTBTO. (2012 – 2014)

- Infrastructure for 8-element FACT Site Array



- Purchase 2 new Ultra-low Distortion Oscillators to replace outdated equipment (digitizer testing)
- Perform equipment evaluations for CTBTO:
  - French SMAD Digitizer (2012)
  - MB3a Infrasound Sensor (2014)
  - Guralp GS21 Preamplifier (2015)

CTBTO: IMS Type Approval

Perform evaluations of equipment to aid the Comprehensive Nuclear-Test-Ban Treaty Organization in determining whether it meets the requirements of the International Monitoring System, a process called Type Approval (2016 – present).

SNL has evaluated for the CTBTO:

- French SMAD Digitizer (2016)
- Guralp Preamp for Geotech GS13 (2017)
- Guralp Affinity Digitizer (2017)
- ISGM Infrasound Sensor (2018)
- Kinemetrics Q330M+ Digitizer (2018)
- Nanometrics Centaur Digitizer (2018)
- GERES Revalidation and GS13 calibrations (2018)
- Hyperion Infrasound Sensor (2019)

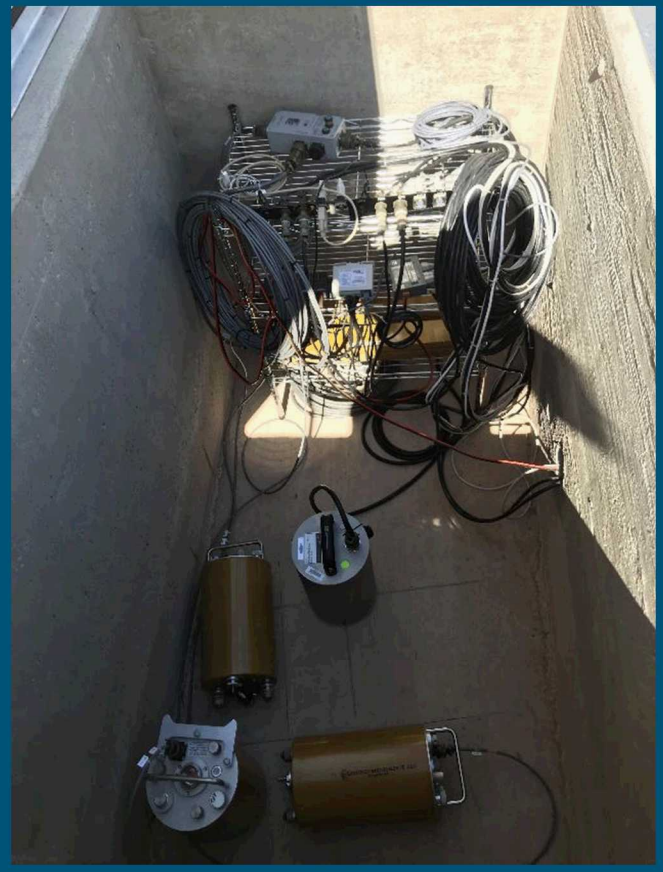
DTRA/NACT: U.S. Waveform Technology Testbed

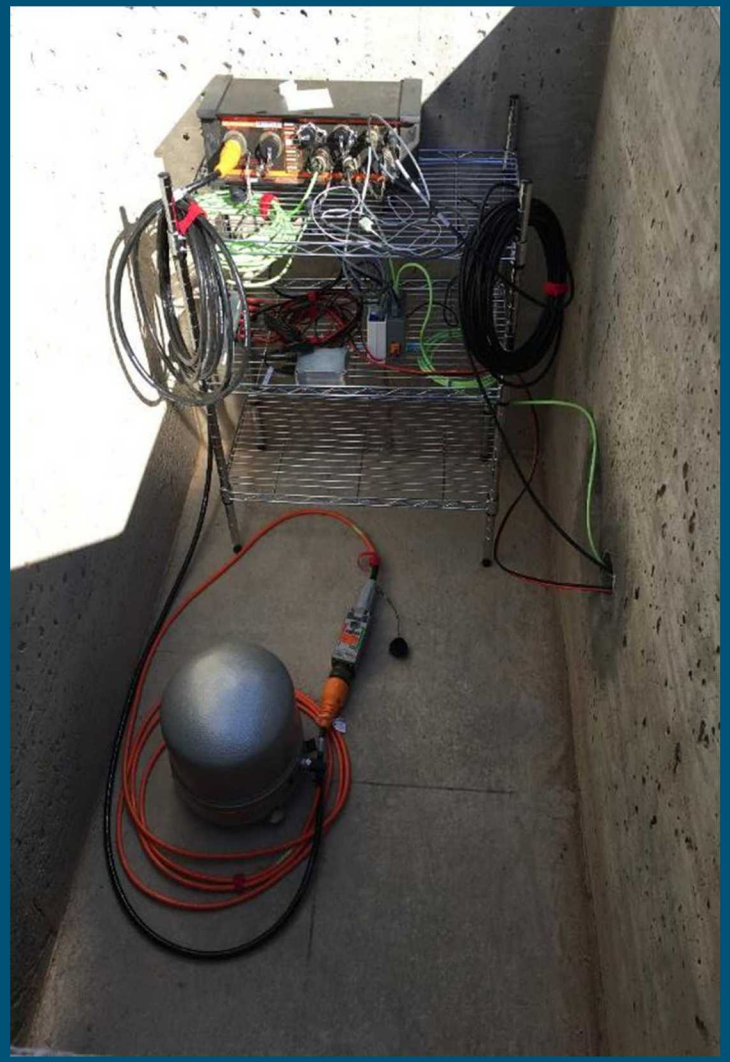
Provide a testbed for U.S. IMS Station Configuration changes (2018-present):

- Primary Seismic Stations
- Auxiliary Seismic Stations
- Infrasound Stations

Test configuration changes at FACT Site Array before making them at actual US IMS Stations.

In collaboration with Univ. Alaska, Fairbanks.





DTRA / NACT: Wind Noise Reduction System Study

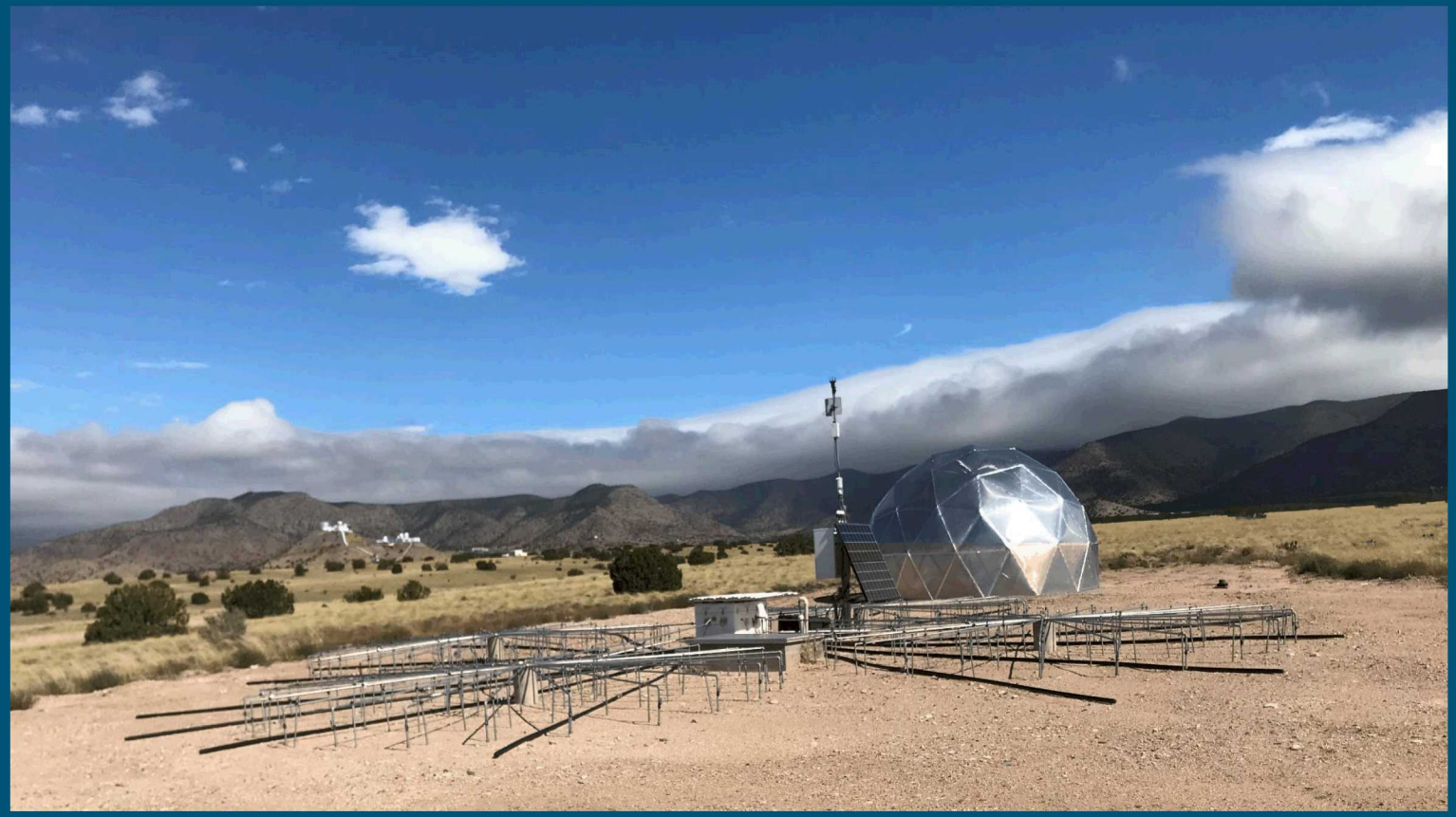
Evaluate several different Wind Noise Reduction Systems (2016 – present)

- CTBTO 18 meter Rosette
- 18 meter poly-pipe
- NCPA 6 meter dome

Determine if poly-pipe performs well

Used as 2 US IMS Stations:

- Windless Bite (Antartica)
- Midway Island



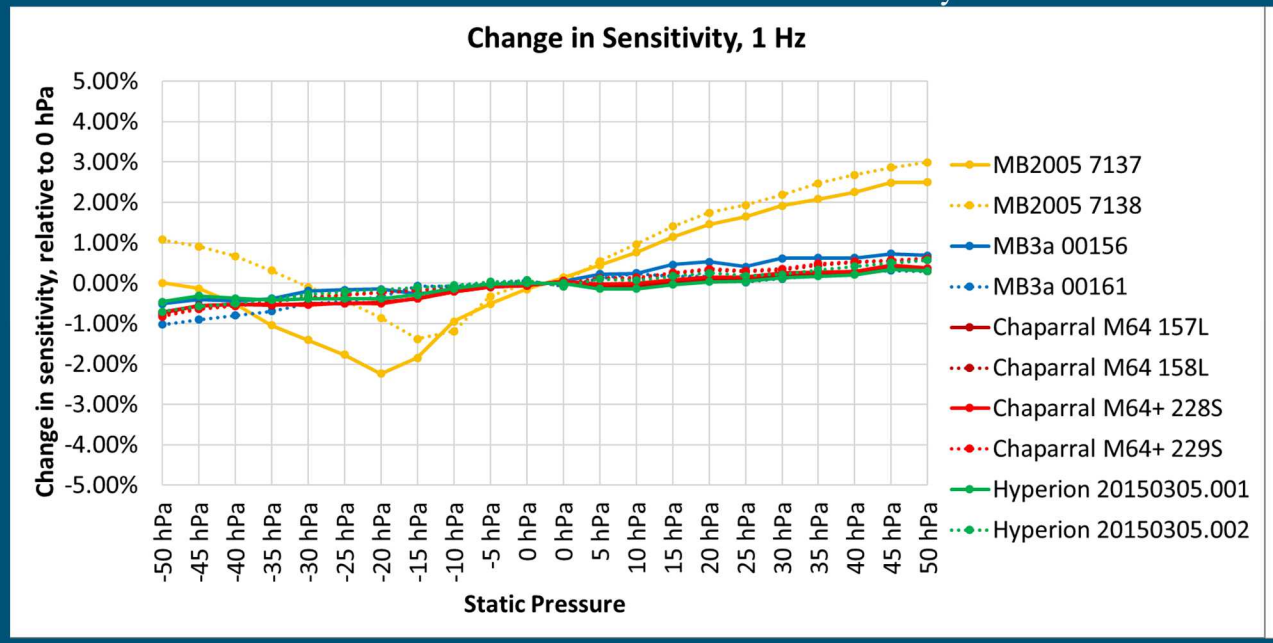
In collaboration with Univ. Alaska, Fairbanks.

DTRA / NACT: Infrasound International Interlaboratory Comparison

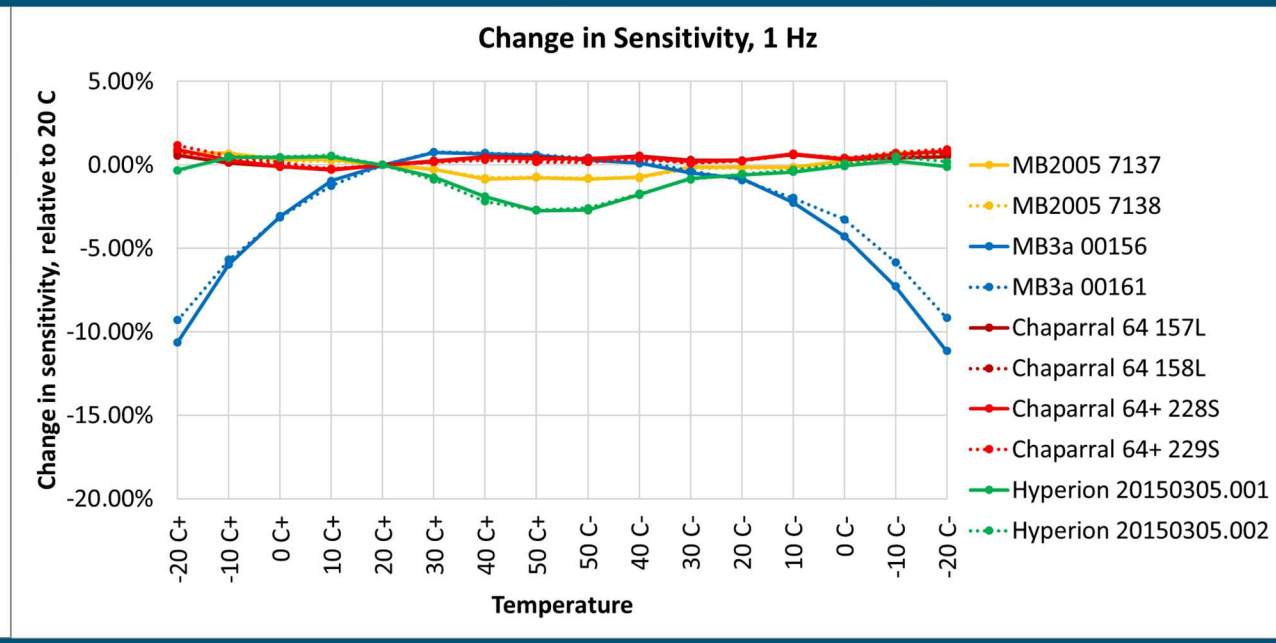
Collaborate with CTBTO, CEA (France), LNE (France), Acoustic Systems (UK), U. Mississippi, and Penn State to perform comparison of infrasound calibrations (2015 – present)

- Determine equivalence between measurements
- Develop robust estimates of measurement uncertainty
- Perform more extensive calibrations (i.e. infrasound acceleration sensitivity, sensitivity dependence on changes in static temperature and pressure)

Static Pressure Sensitivity



Static Temperature Sensitivity



DTRA / NACT: Long-Term Infrasound Field Study

Evaluate Infrasound sensor changes in response in a field environment (2018 – present)

- Sensors connected to a common manifold for signal:
  - Chaparral 50A, Chaparral 64 / 64S, Hyperion 5000, MB2005, MB3a
- Continuous measurement of relative response
- Environmental monitors (barometric pressure, wind speed, wind direction, temperature outside, temperature inside)
- Determine correlation between the environment and relative changes in infrasound sensor response
- Determined issues with certain sensors
- Inform decision for US IMS Infrasound Station recapitalization: Hyperion 5xxx

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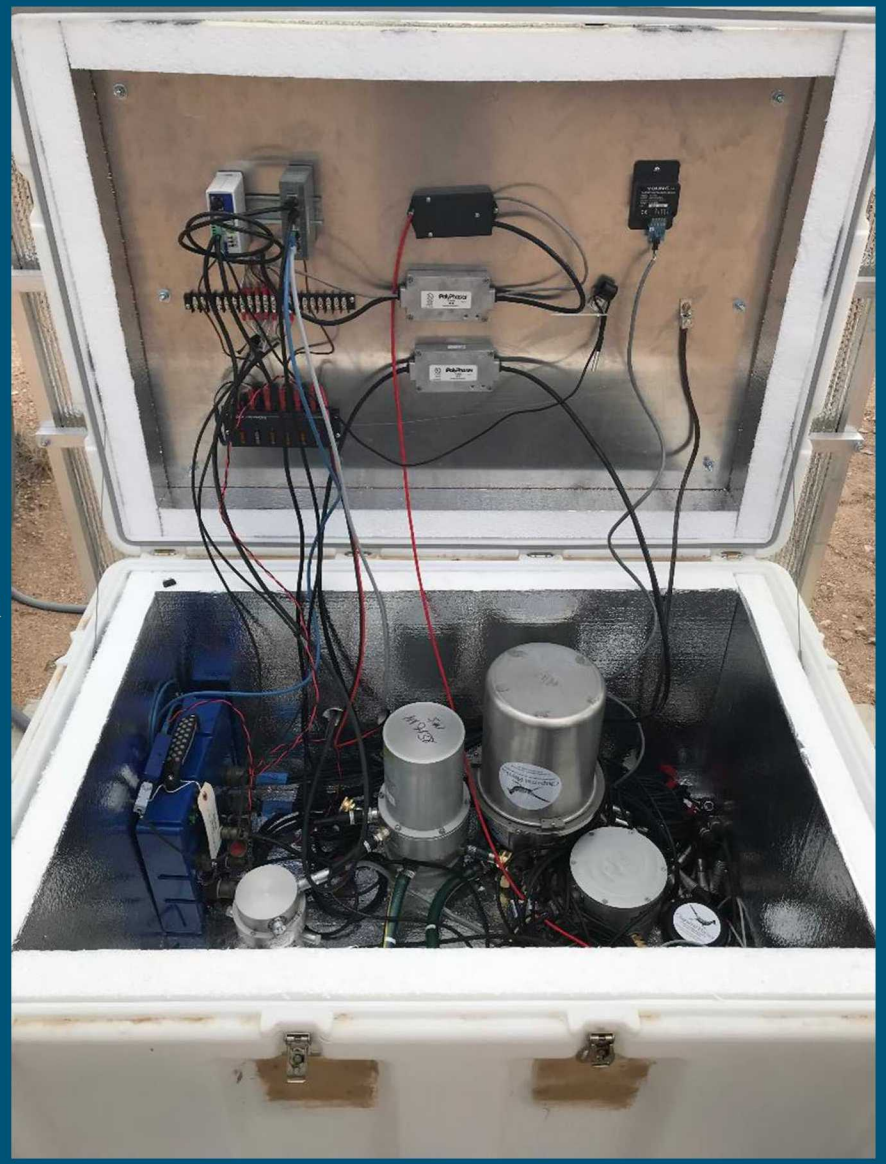
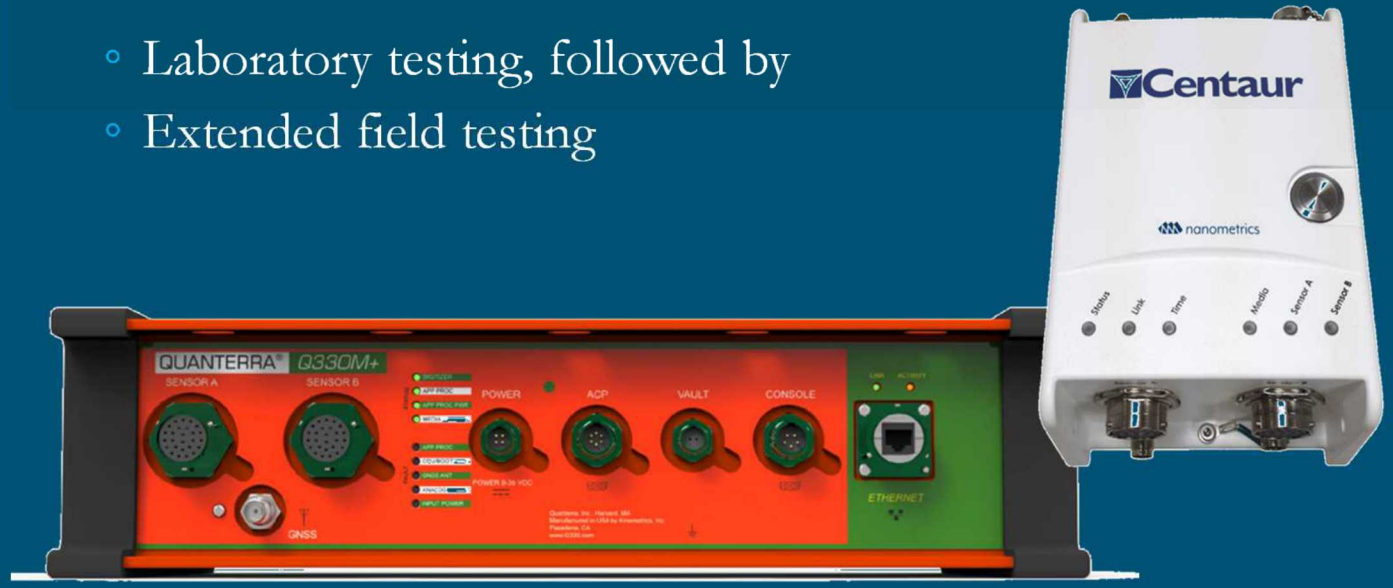


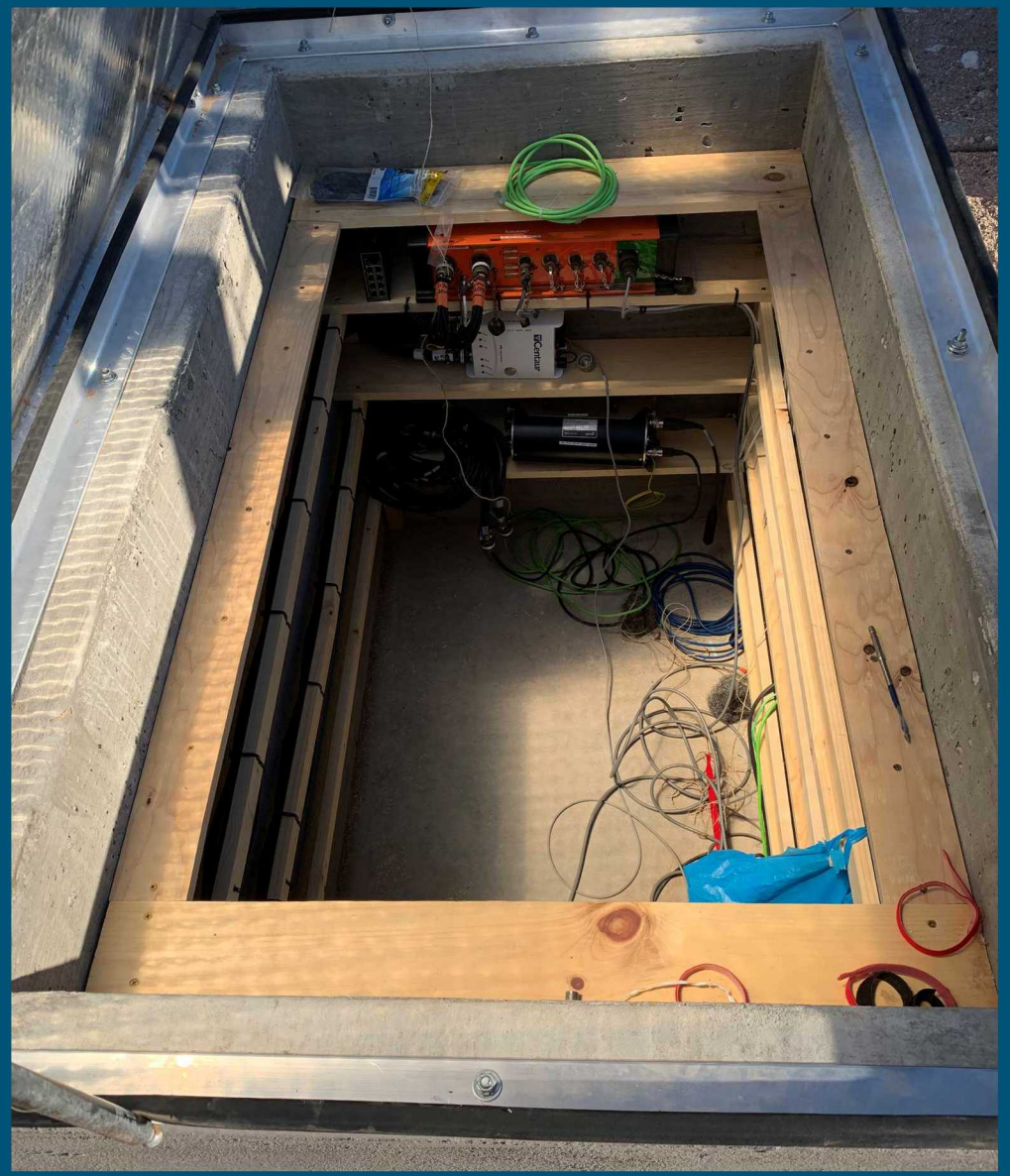
DTRA / NACT: Next Generation Digitizer Evaluation

Evaluate several digitizer models, for possible use in NACT supported US IMS stations (2019 – present)

- Kinemetrics Q330M+
- Nanometrics Centaur
- Guralp Affinity

- Laboratory testing, followed by
- Extended field testing





DTRA / NACT: Field Power System Evaluations

Evaluate standardized power systems intended for CTBTO/IMS stations, designed and built by Nanometrics (2020)

- Standardization of components
- Variety of simultaneous power sources (PV, Wind, Fuel Cell, Battery)
- State of Health monitoring
- At FACT until summer, followed by U. Alaska Fairbanks