SAND2011-1706P

# SNL Well-Testing Equipment & Methods in Carlsbad, NM

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# Well-Testing Trailers

- The trailers contain all the mechanical and electronic equipment needed for SNL to perform any type of pumping test, with full pressure (head) and flow-rate data-acquisition and control capabilities.
- Trailers are self-contained mobile laboratories that enable measurement of water quality parameters (pH, conductivity, fluid temperature, specific gravity), borehole pressure in multiple zones, flow rates, ambient conditions such as barometric pressure and temperature, and operational parameters.

# Well-Testing Trailers (continued)

- Systems within the trailers provide data acquisition and feedback control of pumping rates, and control of all downhole tools such as shut-in valves, packers, and pulse tools.
- Design of trailers and equipment is extremely flexible and can be readily modified to incorporate various instrumentation, test systems and remote communications capabilities, etc.

# Well-Testing Trailer #1 on a Well Pad

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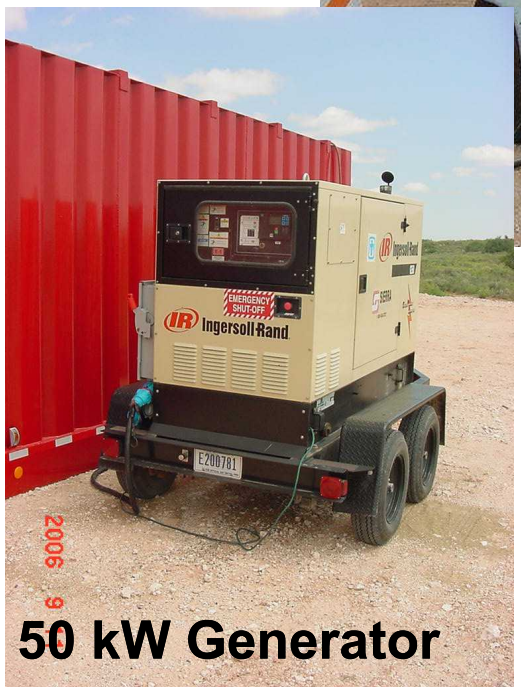
# Well Testing Trailer #1 (WTT#1) & Support Equipment

Power Distribution Trailer




50 kW Generator

Interior of WTT#1

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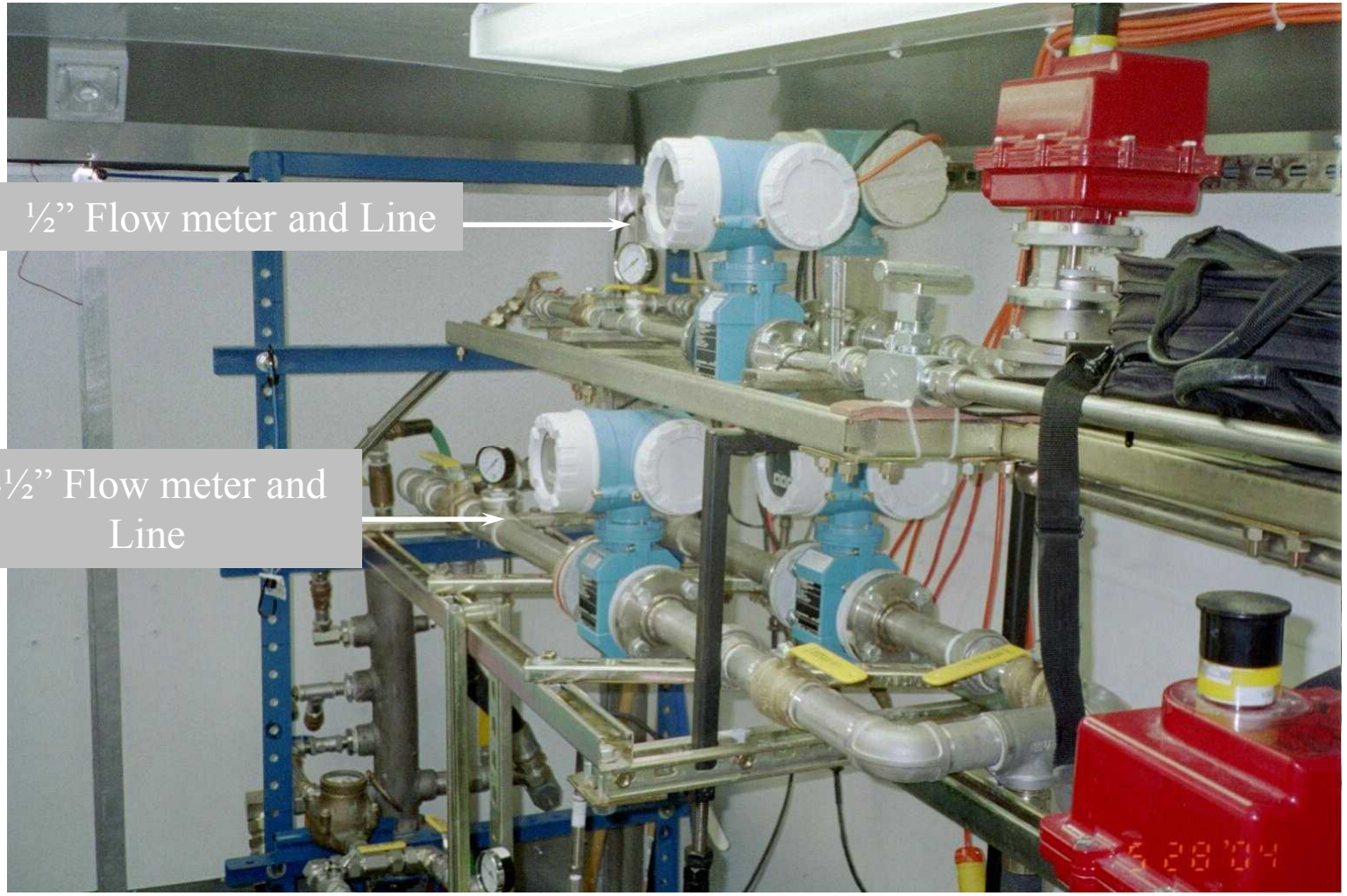
# Well-Testing Trailer #1 (continued)
## Flow-System Manifold

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# Well-Testing Trailer #1 (continued)
# Data Acquisition and Controls for Electric Pumps


Data Acquisition
and Controls for Pumps

Water Chemistry
Inline Measurement
Manifold

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# Well-Testing Trailer #1 (continued)

## Unique Capabilities:

- Flow ranges from 0.1 to 100 gpm
- Redundant water quality (pH, conductivity, temperature) measurements
- Control pumps ranging from 1/2 to 10 HP, 230VAC or 460VAC, three-phase motors
- ¼”, ½”, 1” and 1½” flowlines and instrumentation

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# Well-Testing Trailer #2

Hitch-side View of Berth & On-board Generator Compartments

View of Rear Section: DAS Panel, Flowlines, Workbench & Storage Cabinets

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# Well-Testing Trailer #2 (continued)


**View of Controls: Operator Console, Motor Control and DAS Panel**


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# Well-Testing Trailer #2 (continued)

## Unique Capabilities:

- Flow ranges from 0.5 to 1500 gpm
- Redundant water quality (pH, conductivity, temperature) measurements
- Self-contained 7-kW electric power generator
- Control pumps ranging from 1/2 to 15 HP, 230VAC or 480VAC, and either single- or three-phase motors
- ½”, 1”, 2”, and two 4” flowlines, with redundant instrumentation
- Self-contained flowline flush system

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# Stand-Alone Equipment

- Portable Pump Control Systems
- Mini-DAS & Portable Instrumentation
- Well Sampling Trailer
- Downhole Video Inspection System

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# Portable Pump Control Systems



## 230 VAC & 460 VAC Pump Control Panels

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# Mini-DAS & Portable Instrumentation

**Mini-DAS, WQ Measurement System, and Flowmeters**

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# Mini-DAS & Instrumentation (cont.)

**Flowline Screen Assembly, Total Flow Measurement, Specific Gravity & Temperature Measurements**


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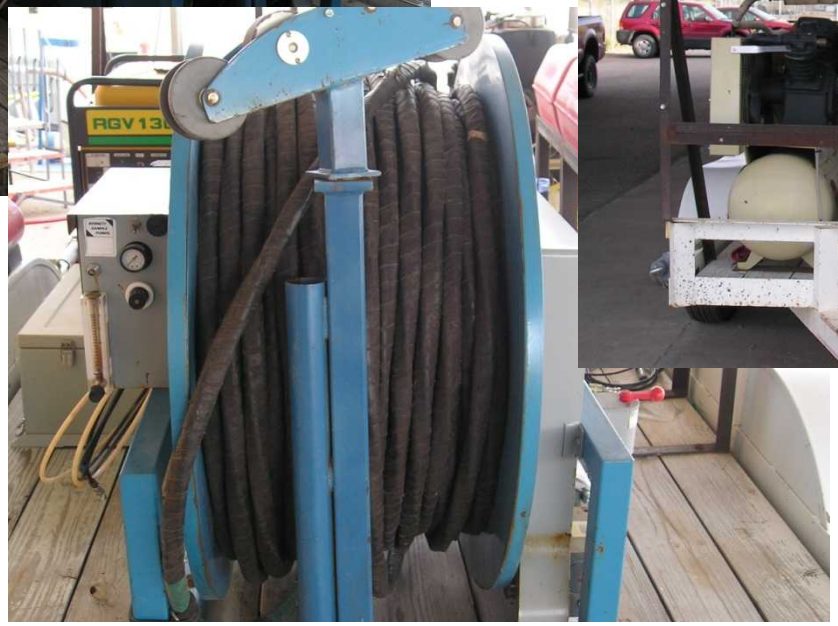
# Well Sampling Trailer

**Pump Reel Unit, Generator, & Air Compressor**

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# Downhole Video Inspection System/Trailer

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# Stand-Alone Equipment Capabilities

- **Portable Pump Control Systems**
  - Manual speed/pumping-rate control and over-current protection of ½ to 10-HP, 230 VAC & 460 VAC, 3-phase pump motors
  - Local keypad & display for programming and monitoring of pump parameters
- **Mini-DAS & Portable Instrumentation**
  - DAS/Controller module & accessories capable of datalogging and monitoring or controlling devices
  - Flowrate & Water quality (pH, conductivity, specific gravity, temperature) measurements using remotely-read/logged or hand-held instruments

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# Stand-Alone Equipment Capabilities (cont.)

- **Well Sampling Trailer**
  - Trailer-mounted system includes sample pump unit (1.4” & 1.8” dia. pneumatic pumps, tubing bundle, & motorized reel assembly), 13-kW generator, and air compressor
  - Capable of lifts of up to 1000 ft (fresh water) at flowrates from 0.1 to 2.0 GPM
- **Downhole Video Inspection System**
  - Trailer-enclosed system includes on-board 7-kW generator, camera winch & boom, and climate-controlled operator’s station
  - Provides color-camera output in either forward and side-viewing mode to 1800 ft, with real-time display and video recording features

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# Aquifer Test Types

- Well purging
- Constant-discharge tests
- Constant-head tests
- Slug Test (using either solid slug or pneumatic)
- Low-permeability straddle-packer testing
  - Slug (instantaneous pressure perturbation in open borehole)
  - Pulse (instantaneous pressure perturbation in closed borehole)
  - DST (slug test converted to closed borehole test)
- Sinusoidal aquifer tests (periodic and controlled rate perturbation in testing well)

# Advantages of Equipment and Aquifer Testing Methods

- Methods for collecting transient pressure data in wells are designed to eliminate uncertainty during analysis as a result of poor field observation data.
- Data collection factors that can affect the analysis uncertainty are controlled as much as possible during data collection. i.e., flow rate is controlled to within +/- 0.05 gpm for a 25-gpm pumping test using PID Control.
- All parameters that are fed into the analysis solution are collected in real-time during testing and logged automatically.
- Data are analyzed as the test is being conducted, so the test is concluded when sufficient data exist to infer the formation properties of interest.