
CampusEnergy2021
BRIDGE TO THE FUTURE
Feb. 16-18 | CONNECTING VIRTUALLY
WORKSHOPS | Thermal Distribution: March 2 | Microgrid: March 16

Innovations in Level Measurement Technology Improve Boiler Control & Reliability

Tom Wienke, Emerson Automation Solutions

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INTERNATIONAL DISTRICT ENERGY ASSOCIATION

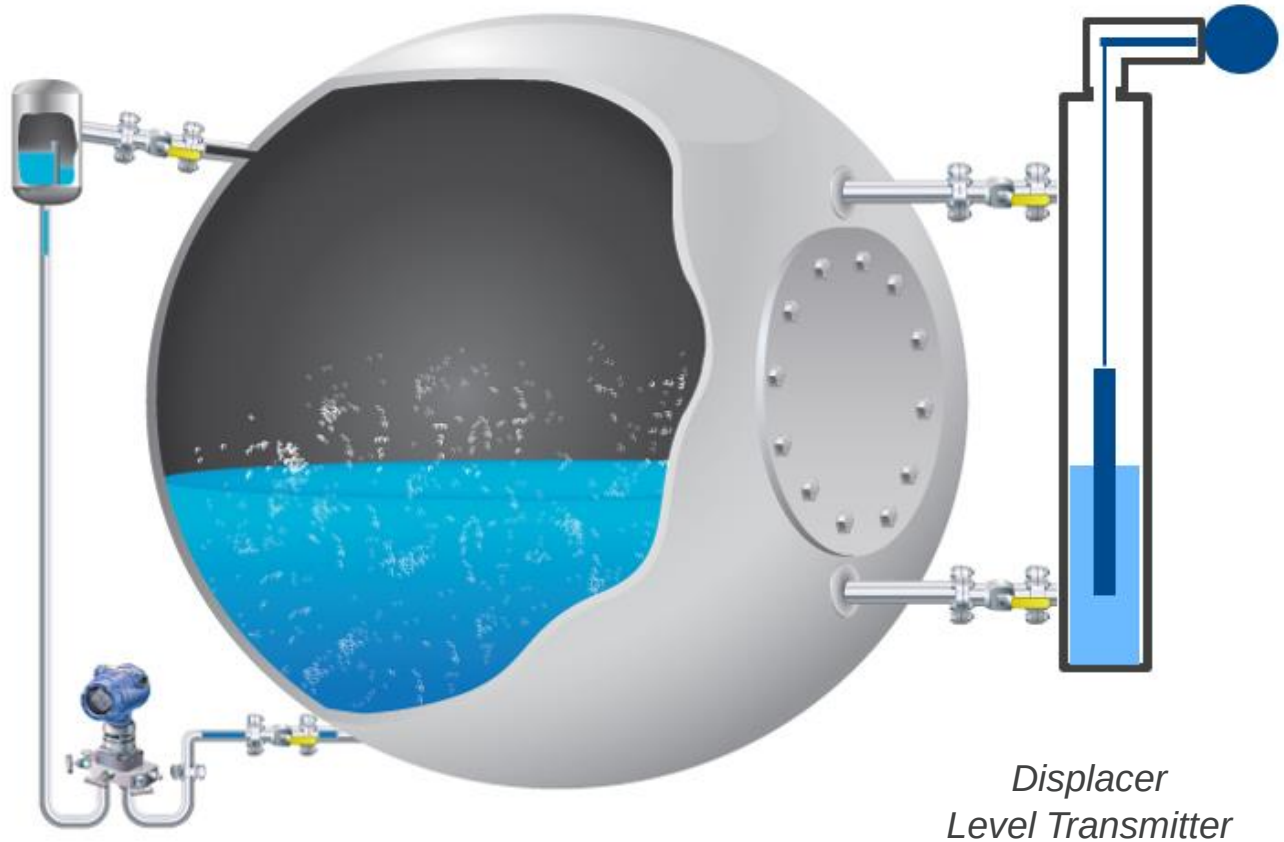
Q&A Will Not Be Answered Live

Please submit questions in the Q&A box.
The presenters will respond to questions off-line.

Contents

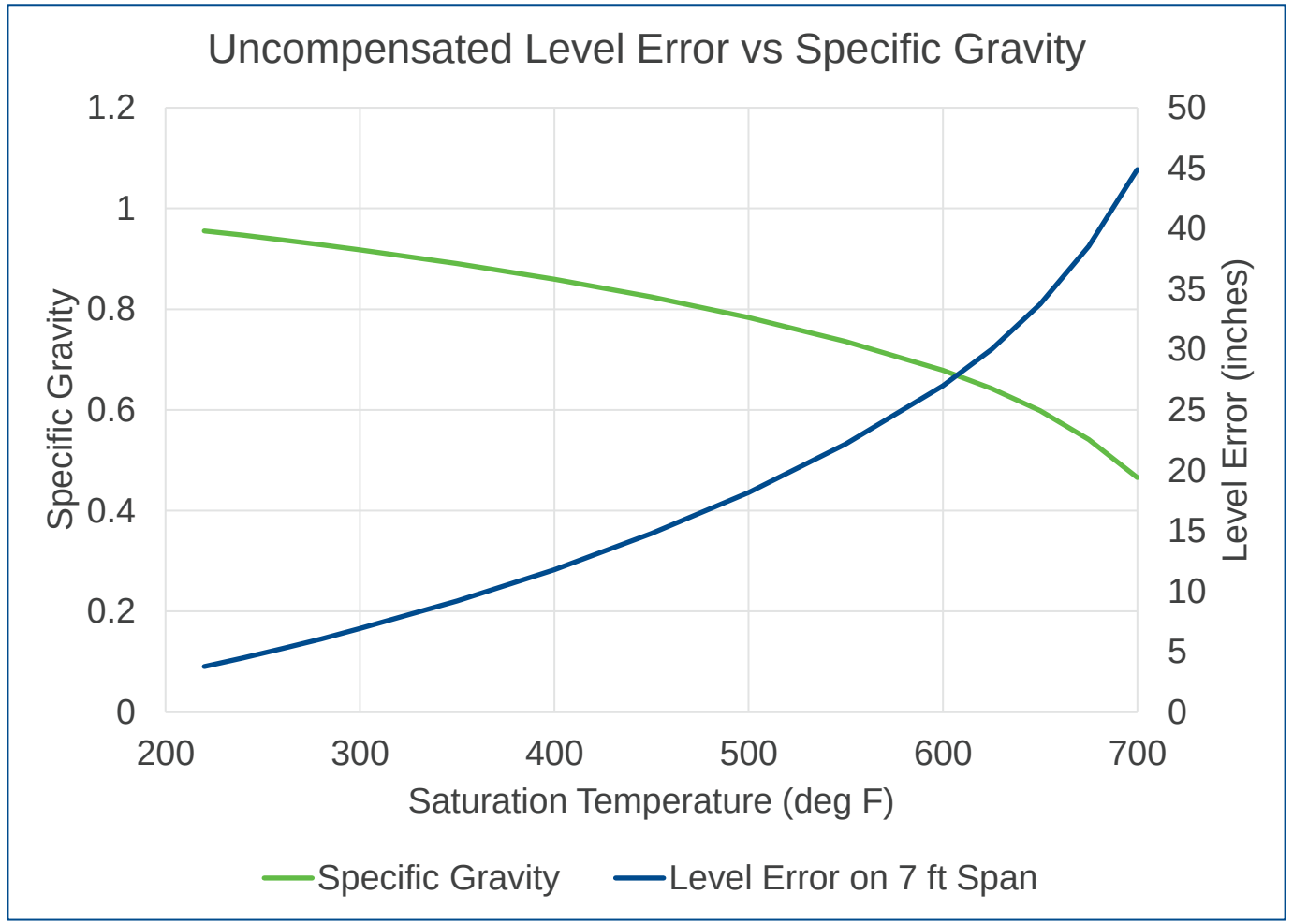
Level Measurements for Steam Applications
Upgrade Traditional Technology to Improve Reliability and Responsiveness

- Traditional Level Technology
  - Differential Pressure
  - Displacers
- DP requires a wet leg
  - Creates unique challenges
- Displacers have moving parts
  - Maintenance and reliability implications
- Both affected by temperature changes
  - Require external compensation for specific gravity changes with temperature
  - Can perform erratically during start-up and shut-down



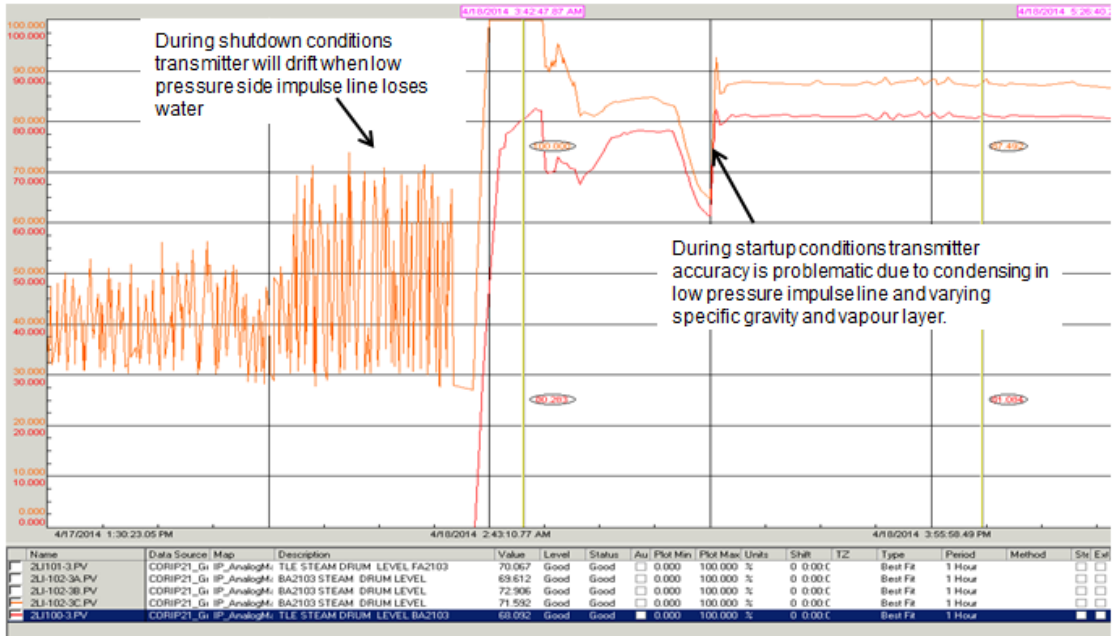
Inaccurate or Missing Compensation for Temperature Changes Can Lead to Large Level Inaccuracy

- Changing process temperature changes water specific gravity
- Compensation must be performed in the control system
  - Requires separate temperature measurement
  - Requires specific programming
  - Compensation will lag dynamic load changes



Wet Legs Can be Problematic

Unstable Readings—Startup & Shutdown



You Need to Always Have Confidence in the Level Reading

Outdoor Wet Legs Must Be Heat-traced

The New York Times

The Arctic Plunge: From Feeling Like 92 to Freezing in a Day

Temperatures have plummeted across the eastern United States, but spare a thought for McAllen, Texas, where the drop was precipitous.

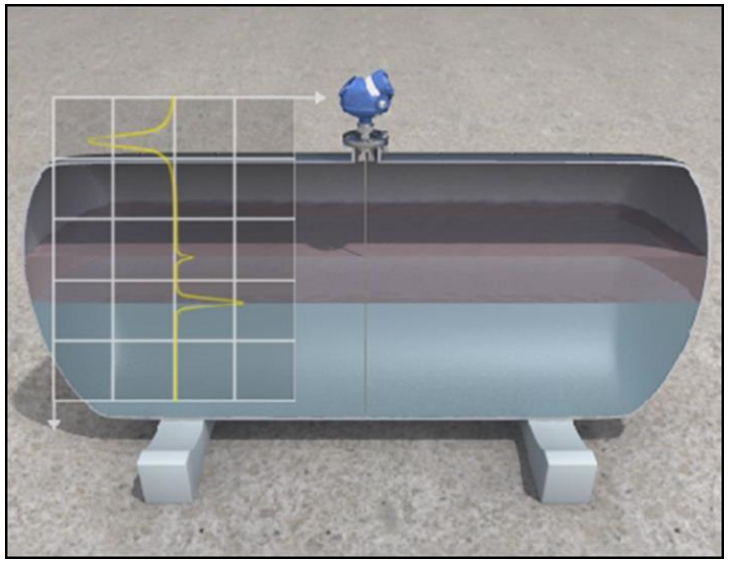
One forced outage typically costs more than $250K from lost generation and maintenance costs

-NERC Generating Availability Data System (GADS)

An Unexpected Cold Snap is a Bad Time to Find out Your Heat Tracing has Failed

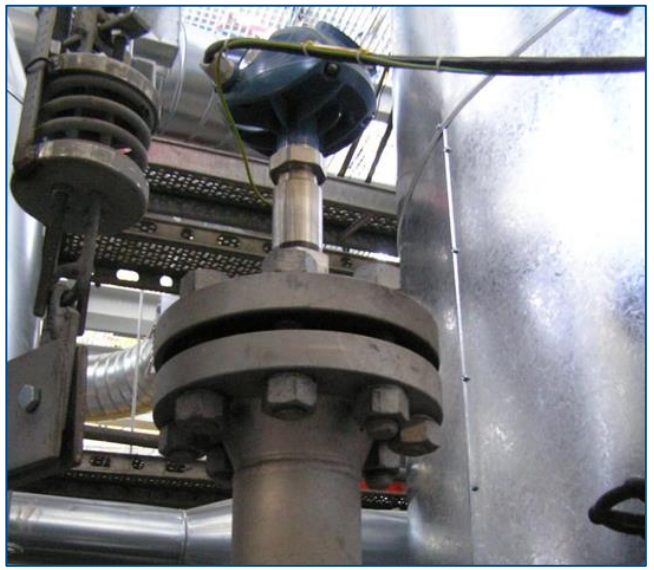
Guided Wave Radar Overcomes Traditional Level Challenges

GWR Principle



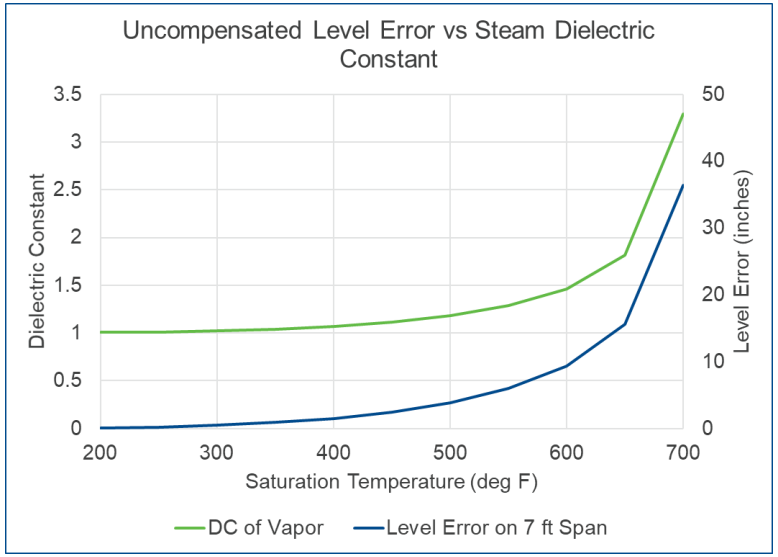
- Microwaves directed down a probe
- Echoes are created whenever an impedance change is created
- Echo time of flight is measured
- Distance to echo is calculated

GWR Advantages



- Unaffected by density changes
- Handles high pressure and temperature
- No moving parts
- No calibration and zeroing
- Generally unaffected by vapor space dynamics except for steam

Steam is a Special Case



- The dielectric of steam changes as saturation conditions change
- Guided Wave Radar has capability to compensate
  - Automatically
  - No custom programming required
  - Compensation happens in real time dealing more effectively with sudden load changes

Guided Wave Radar With Dynamic Vapor Compensation

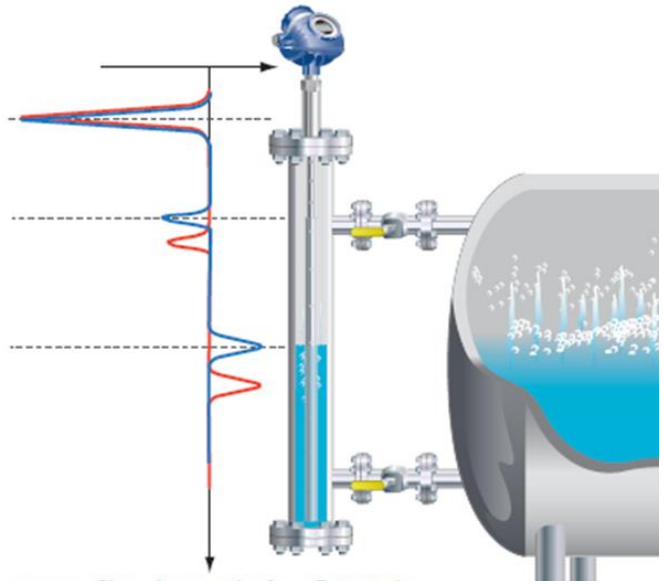
Probe with Reference Reflector

Change in diameter introduces an impedance change at a known and fixed position

Working Principle

- Changing saturation conditions change steam dielectric constant
- Steam DC variation changes microwave speed
- If we know the steam DC we can compensate
- Reference reflector enables this compensation
  - Slowing microwaves make the reflector electrically appear further away
  - GWR reconciles apparent reflector distance with true reflector distance
  - Level is dynamically compensated in real-time as dielectric of steam changes

Working Principle Illustrated

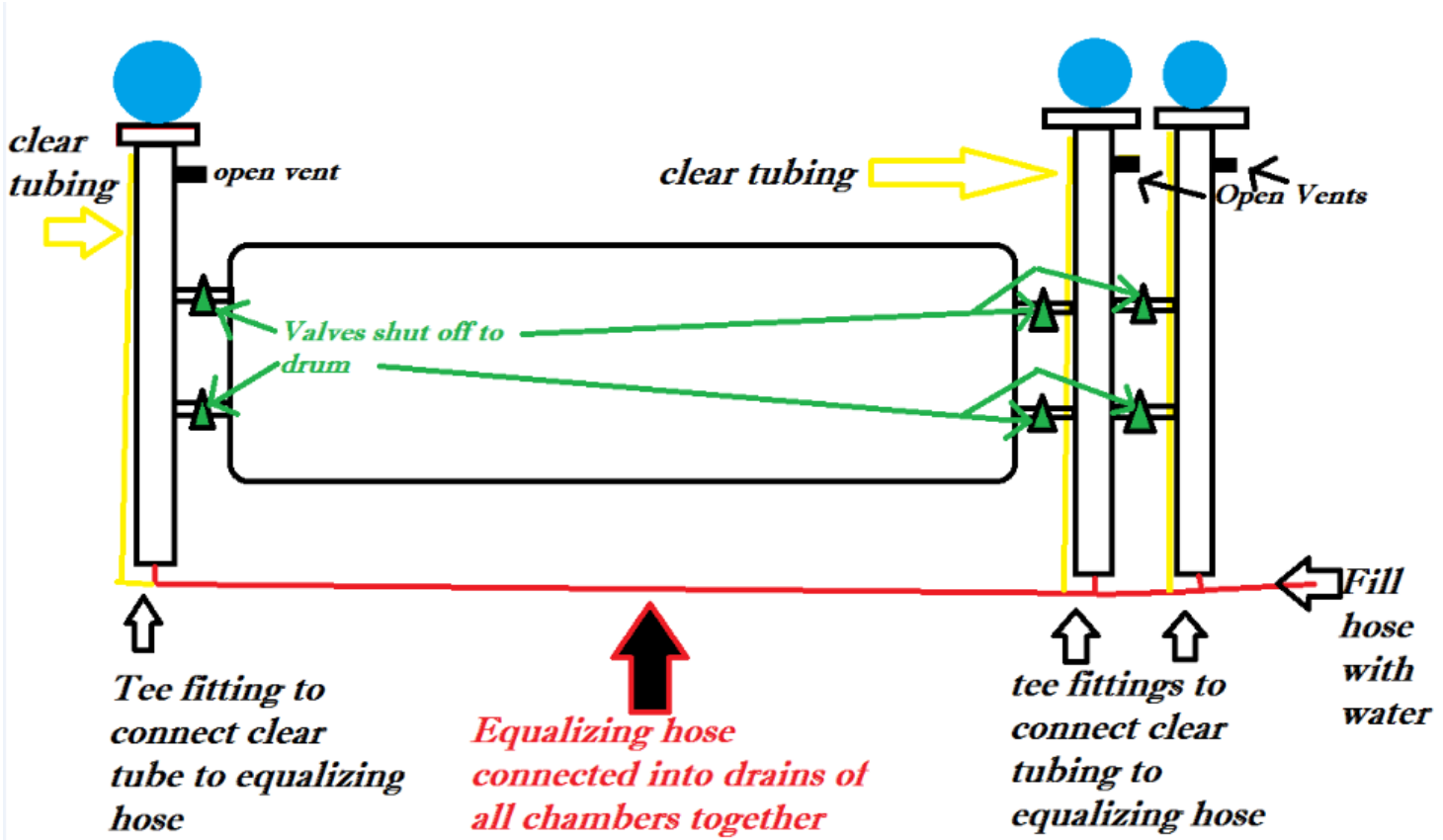


True Reflector and Surface Locations

Apparent Reflector and Surface Locations

Float Testing Drum/ Laser Level

- Redundant Level Transmitters are typical
- Voting scheme and deviation alarms are used to maintain confidence
- Establish zero deviation during commissioning by floating the chambers that contain the Guided Wave Radar Transmitters



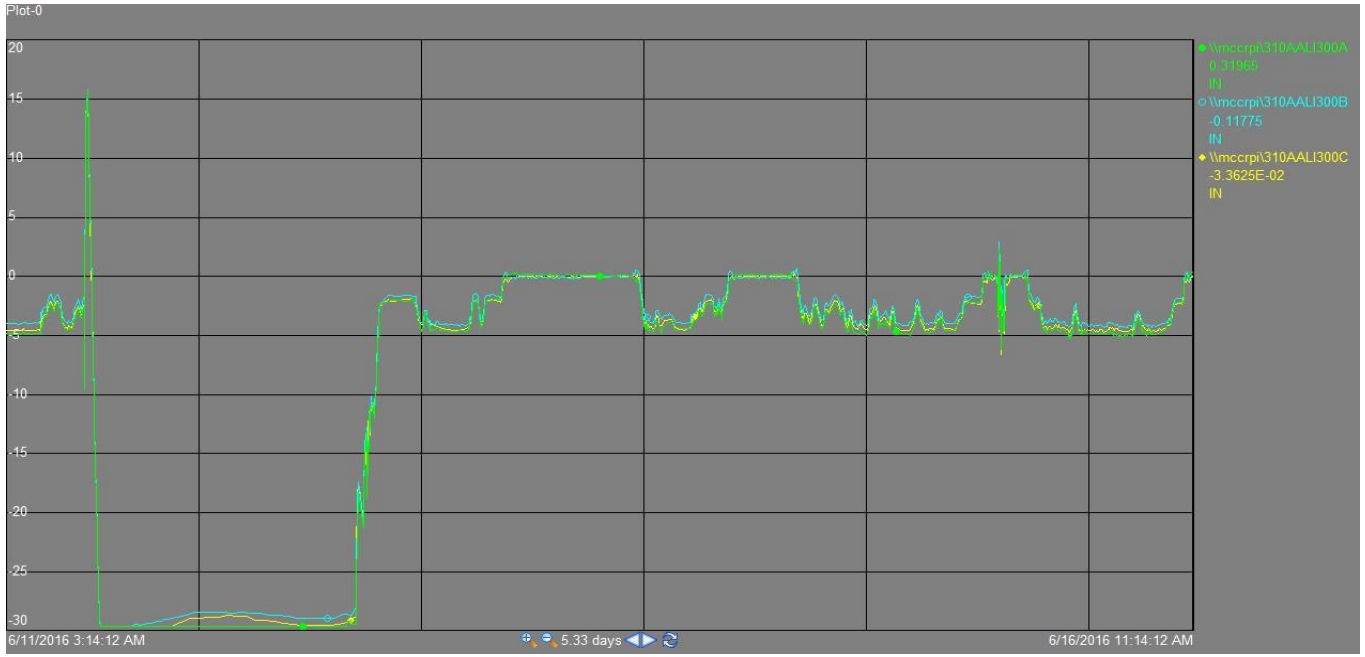
Case Study

- 900 MW Combined Cycle Natural Gas Power Plant located in the Southeastern US
- HP, IP and LP drum level measurements made using differential level technology
- HP drum design conditions exceeded 2300 psi and 650 F
- Level control strategy employed traditional 2/3 voting scheme with DP Level Transmitters
- Outdoor wet legs insulated and heat-traced
- Unexpected cold-snap plus failed heat tracing caused loss of level measurement
- Forced outage cost hundreds of thousands of dollars

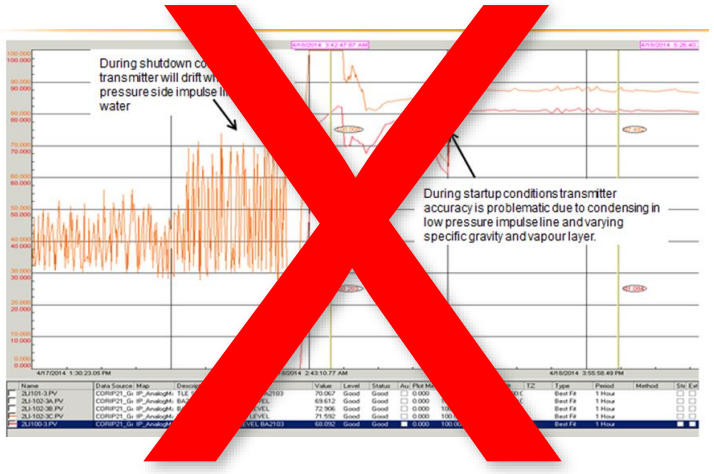
Solution
Guided Wave Radar with Dynamic Vapor Compensation

- Replaced DP Level technology
- 27 Guided Wave Radars equipped with Dynamic Vapor Compensation and supplied with external cages (chambers)
- Emerson Service Technicians commissioned the radars and “floated” the chambers

Eliminating Wet Legs
Enabled Reliable Level Readings Throughout Start-up

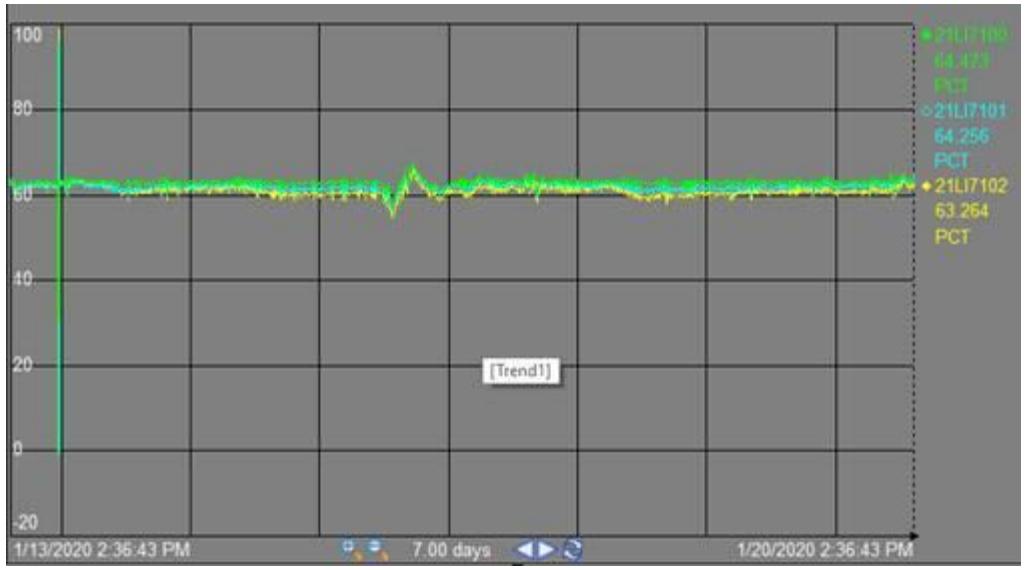


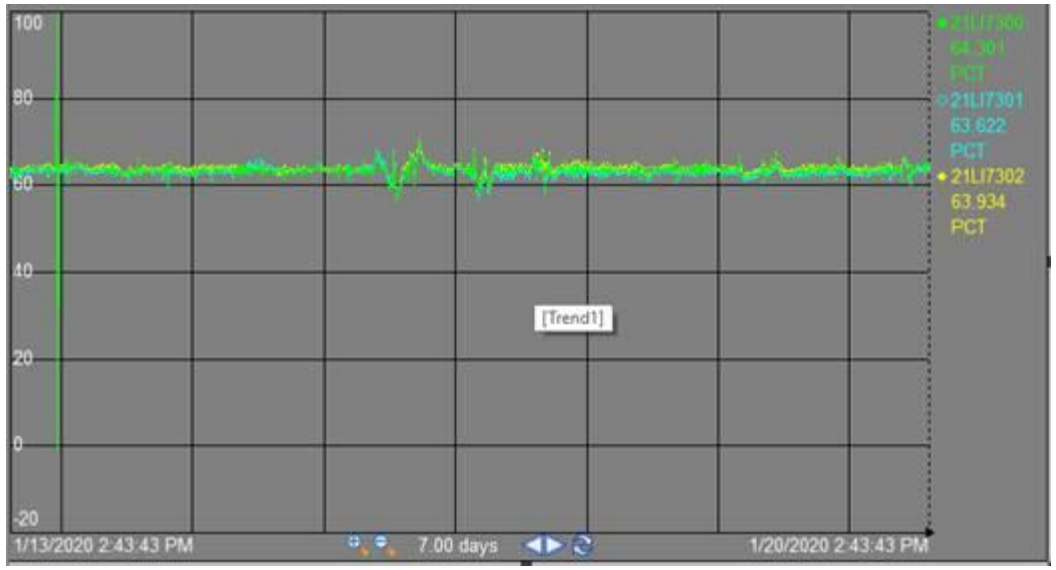
Three Guided Wave Radar Tracking Within 0.5 Inch



- *No more evaporation and condensation from wet-legs during changing load conditions*
- *No more risk for wet-legs to freeze*

Two Heaters
Each with Triple-Redundant Guided Wave Radar Transmitters





7-day historian trend after start-up

All GWR's read within 0.4" even when installed at opposite ends of the drum

Conclusion

- Guided Wave Radar with Dynamic Vapor Compensation overcomes challenges with traditional level measurements
  - Eliminates need to externally compensate for specific gravity changes as temperature changes
  - Self-compensates in real-time for changing dielectric constant delivering faster response
  - Eliminates moving parts for higher reliability
  - Removes wet-legs
    - Improves reliability by eliminating heat-tracing
    - More reliable level measurement during start-up and shut-down
    - Faster response to sudden load changes