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Technology Keeping Railcar Loading on Track

Session ID# 1-1523

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CALUMET

CALUMET
Montana Refining, LLC

MONTANA
RENEWABLES™

Calumet Montana Refining

Calumet, Inc. (NASDAQ: CLMT) manufactures, formulates, and markets a diversified slate of specialty branded products and renewable fuels to customers across a broad range of consumer-facing and industrial markets. Calumet is headquartered in Indianapolis, Indiana and operates twelve facilities throughout North America

Calumet Montana Refining Great Falls

- Calumet Montana Refining
  - 15,000 Barrel per day production
  - Gasoline, Diesel, Asphalt
- Montana Renewables
  - 15,000 Barrel per day production
  - Renewable Diesel
  - Sustainable Aviation Fuel

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History of Great Falls Refinery

Great Falls Refinery History

Home Oil & Refining Co. 1929

Great Falls Refinery History

- Refinery began operations in 1922 as Sunburst Refinery
  - With in three years had a total daily capacity of 3,000 bpd and sat on 22-acres
  - Montana's largest refinery at the time
- 1929 H.O. Botzer purchased the refinery renamed it Home Oil & Refining Co.
- 1948 Phillips Petroleum Co. and Ada Oil Co. purchased the Great Falls refinery
- 1952 Phillip Petroleum Co. bought Ada Oil Co.'s interest to take full ownership
- 1982 Simmons Oil Corp. purchased the refinery
- 1984 Holly Oil Corp. acquires the refinery
  - Changes the name to Montana Refining Company
- 2006 Connacher Oil and Gas Limited of Canada purchases the assets of Montana Refining Company
- 2012 Calumet Specialty Products purchases the assets of Montana Refining Company
  - Operates as Calumet Montana Refining

Great Falls Refinery History

- 2015 Calumet Montana Refining Expansion
  - $400 million expansion project that more than doubled its refining capacity to 28,000 barrels per day.
- 2022 Renewable Fuels Project
  - Constructed a new renewable diesel facility
  - Converted 50% of production from traditional petroleum products to Renewable products
  - Renewable products produced
    - Renewable Diesel
    - Sustainable Aviation Fuel
    - Renewable Naphtha
  - North America leader in Sustainable Aviation Fuel production

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Railyard Operations

Calumet Montana Refining

Calumet Montana Refining Railyard Operations

- Manage raw material railed to site
- Logistics of rail car movement through compact railyard
  - In-flow of railcars
  - Staging for off-loading and loading
  - Out-flow of railcars
- Manage unloading of raw materials
- Manage loading of product
- Manage product being railed to customers
- Optimize throughput

Railyard Operation Challenges

- Small compact railyard
- Throughput
  - Raw materials in
    - Bottleneck for renewable fuel operations
  - Product out
    - 45% of product is shipped via rail
- Overfill and spills
  - Impacts scheduling and railcar movement
  - Environmental reporting
  - Fines

Railcar Tanker Loading

- Accuload Program used for railcar loading
  - Operations enters set-point based on railcar tanker size
  - Flow monitored
  - Full level switch
- Railcar tanker sizes are not all the same
  - Can range from 6,500 gallons up to 34,500 gallons
  - Typical railcar tankers leaving refinery
    - 26,000 gallons
    - 30,000 gallons
    - 34,500 gallons
- Multiple loading stations
- Asphalt is loaded through the manway

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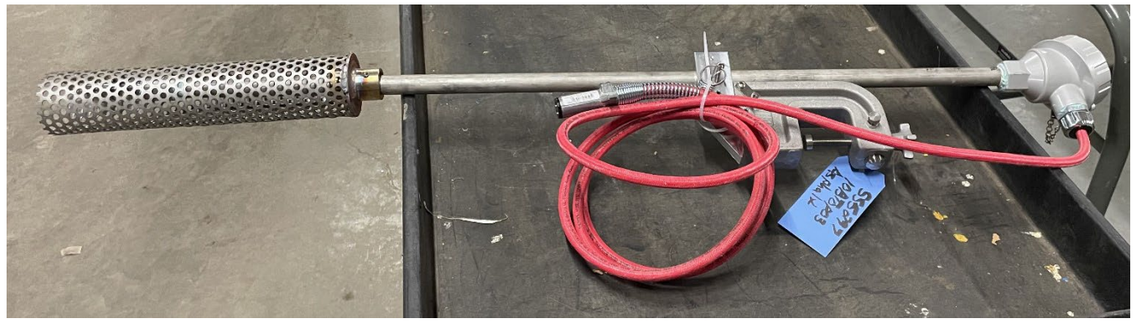
Railcar Tanker Loading Level Measurement

Old solution

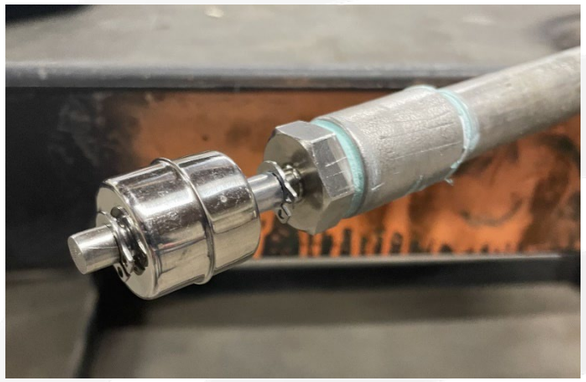
Point Level

Railcar Tanker Loading Level Measurement

- Old Solution
  - Used point level technology
  - Float switch attached to probe
    - Inserted into railcar manway
  - High level indication shutdown
    - Switch interlock with pump



- Issues/Problems
  - Switch assembly damaged by operations
  - Switch failure
    - Contaminated with asphalt
    - Damaged during use
  - Loss of pump shutdown interlock



Operational Impact of Level Switch Failure

- Overfill railcar tanker
  - Spill
  - contamination
- Product loss
- Shutdown railyard
  - All or part for clean-up
- Production curtailment
  - Impacts flow of raw materials into refinery
- Impacts product shipments

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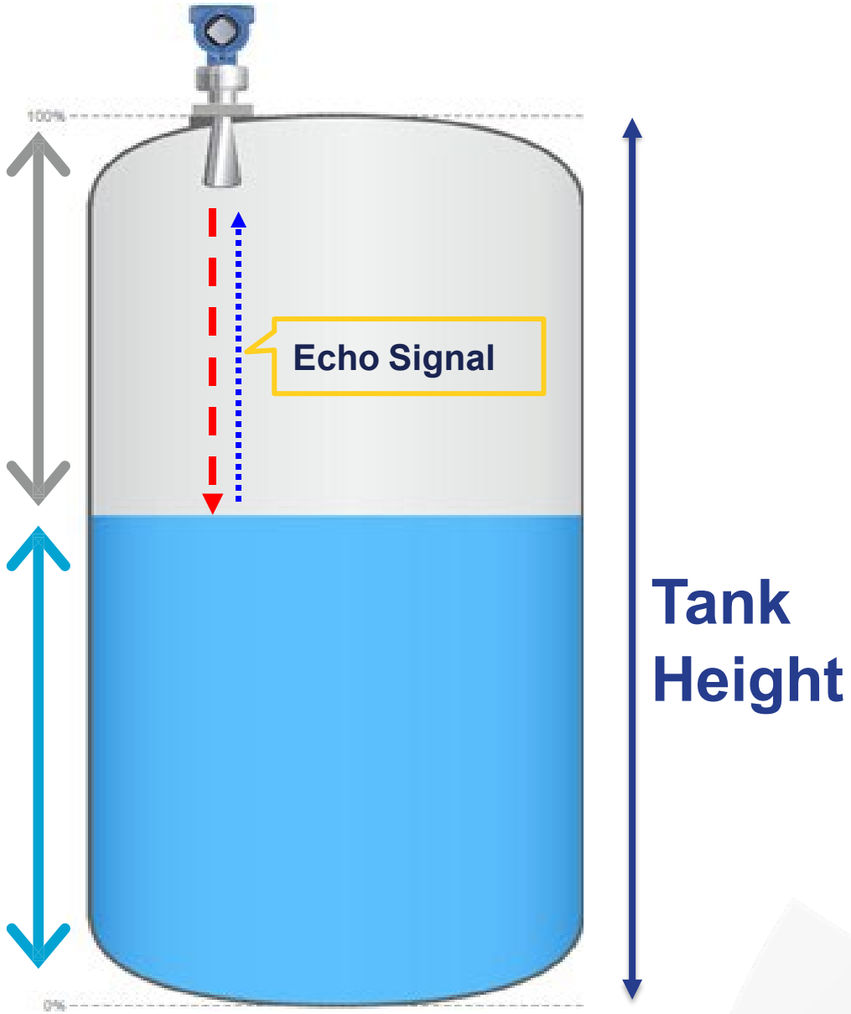
Emerson Level Technology Implemented

Non-Contact Radar Level

Emerson Level Technology Implemented

- Non-Contacting Radars (NCR):
  - Frequency Modulated Continuous Wave radars (FMCW)
  - Fast Sweep Technology
- NCR can measure:
  - Liquids
  - Solids
- Advantages
  - Top-Down Measurement
  - Direct Measurement
  - Factory Calibrated
  - Immune to Temperature and Density changes

Measured vs Calculated



Distance

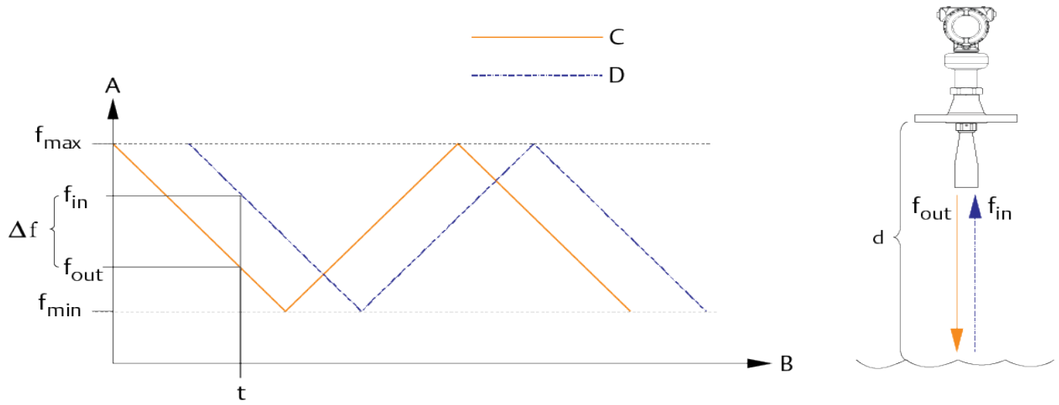
Tank Height

Level

Level = Tank Height – Distance

Tank Height = Level + Distance

Basic Principle of FMCW Measurement Technology



Δf≈d=distance

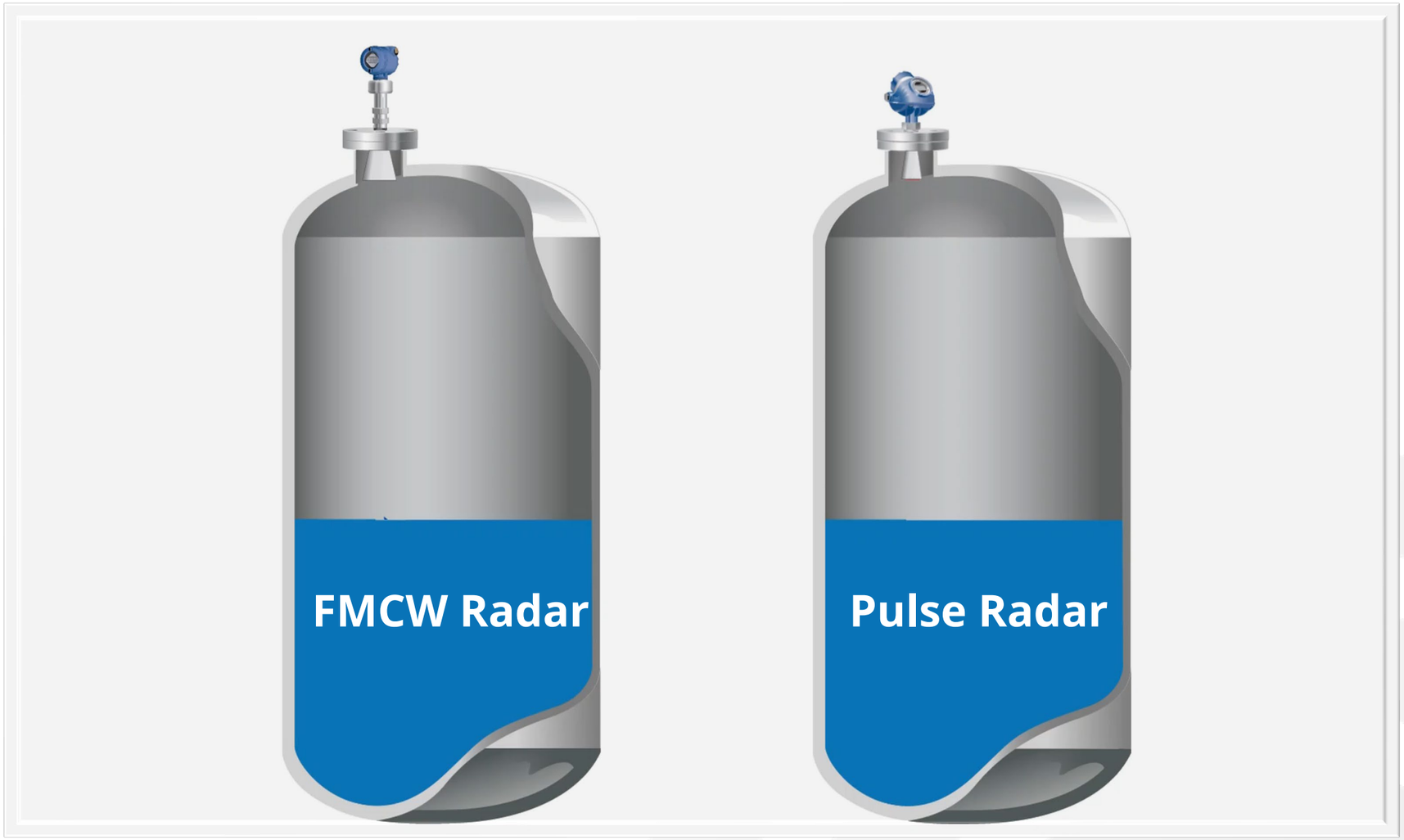
A. Frequency (GHz)
B. Time (s)
C. Transmitted signal
D. Reflected signal

How does it work?

1. The device sends out a ”fast sweep”. The emitted signal’s frequency varies over a span of 24-27 GHz
2. The returning signal will be proportional to the sweep that was sent out
3. The distance to the target (the level) is then found by detecting the difference in frequency between the received and emitted radar signals

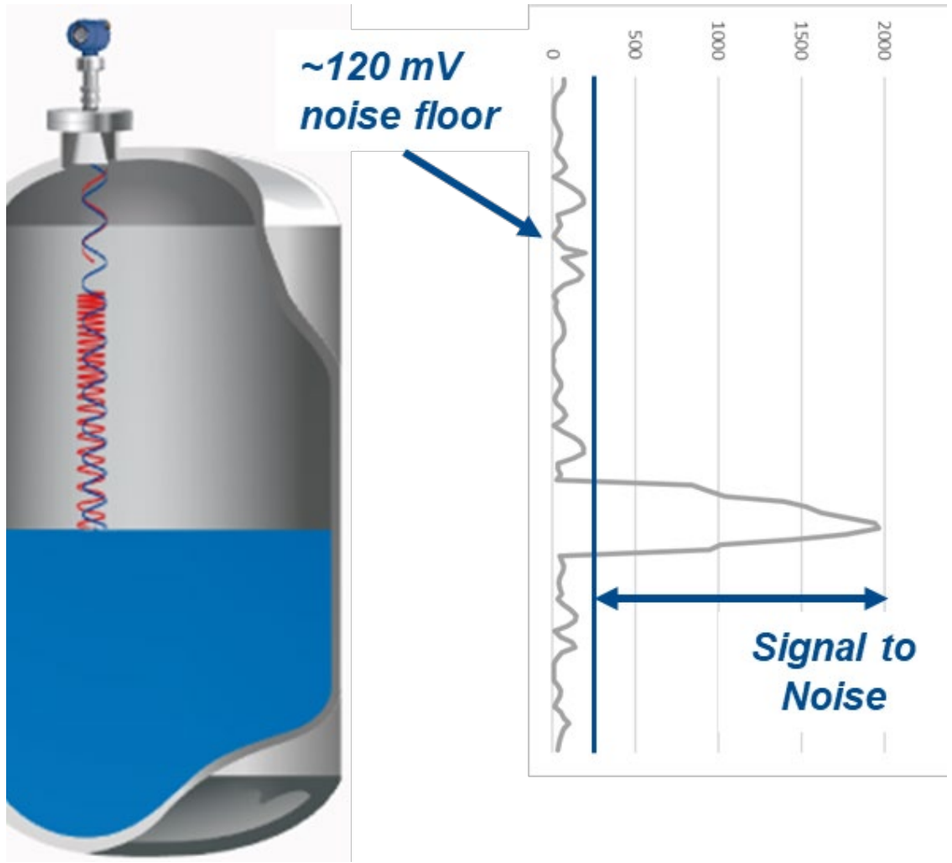
Frequency Modulated Continuous Wave (FMCW) is a robust technology that has been used for many years by 4-wire radars

FMCW Radar Enables a Step-Change in Performance

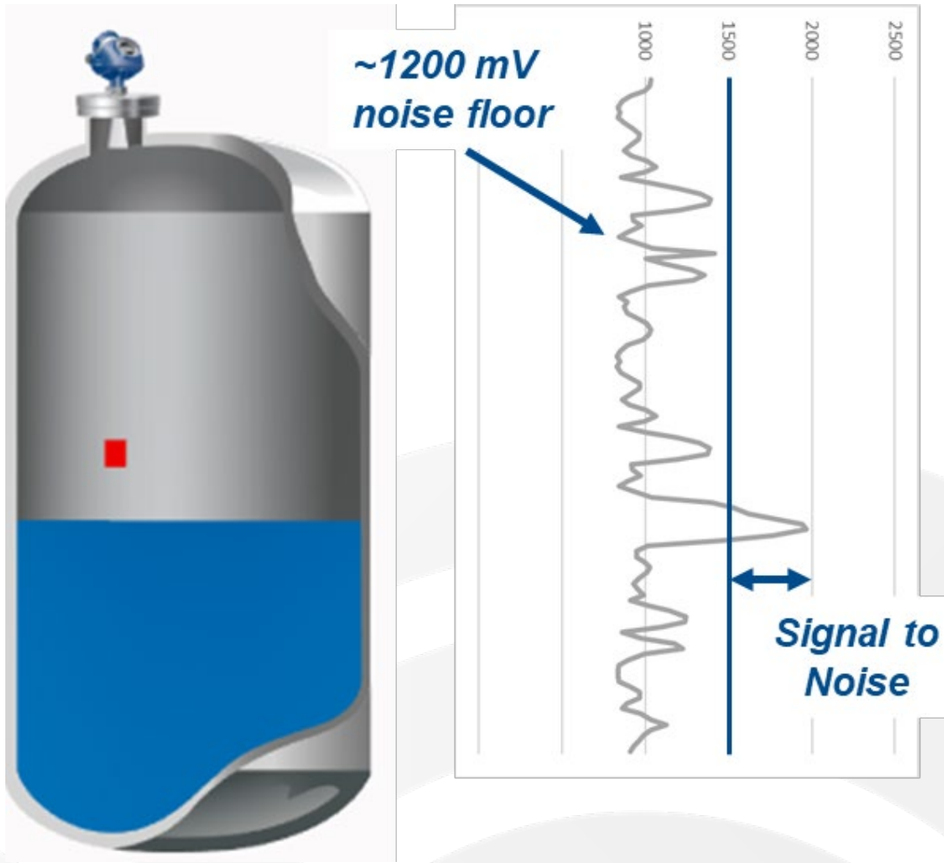


Superior Noise Reduction

FMCW Radar



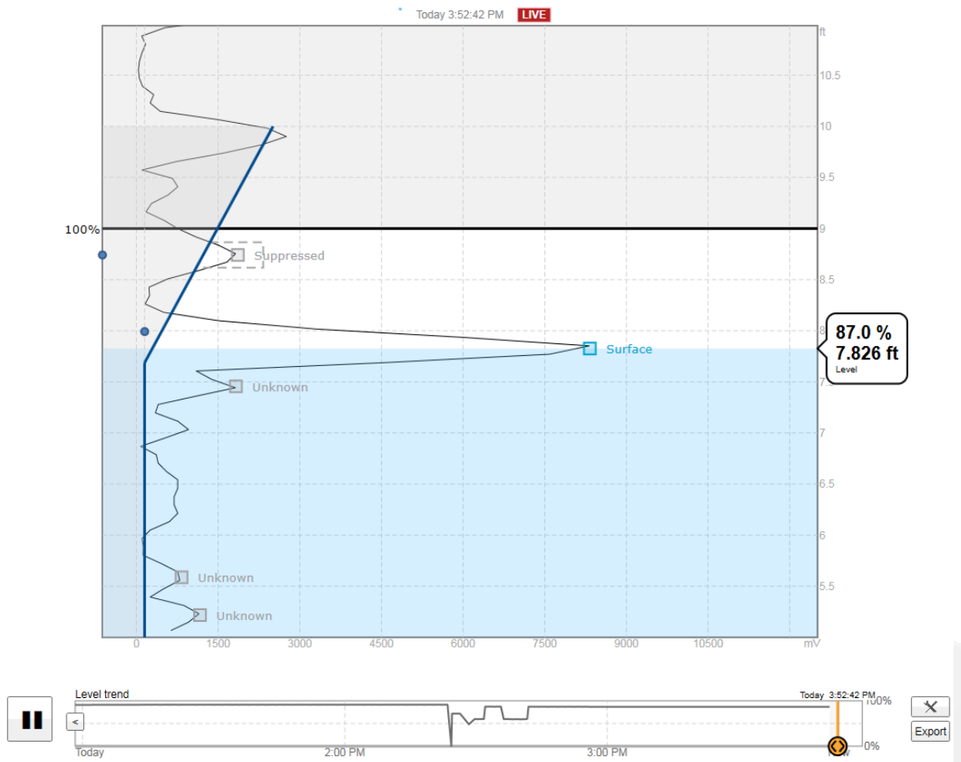
Traditional Radar



Smart Echo Supervision™ Automatically Handles False Echoes

- FMCW Signal Processing identifies all the echoes
- Our devices are smart enough to ***dynamically*** identify which echoes are false
- Smart Echo Supervision™ maintains awareness of the strongest echoes and will track as the surface the echo that behaves like a liquid surface
  - The device automatically suppresses echoes that aren't moving
- Every Non-contacting Radar Transmitter in the Emerson portfolio uses FMCW and Smart Echo Supervision™!

Echoes from tank obstructions happen—Smart Echo Supervision™ enables the device to deal with them as they occur.



Smart Echo Supervision™ has automatically identified all the echoes. The surface echo has been clearly identified and the remaining echoes have been labeled as "unknown" or "suppressed".

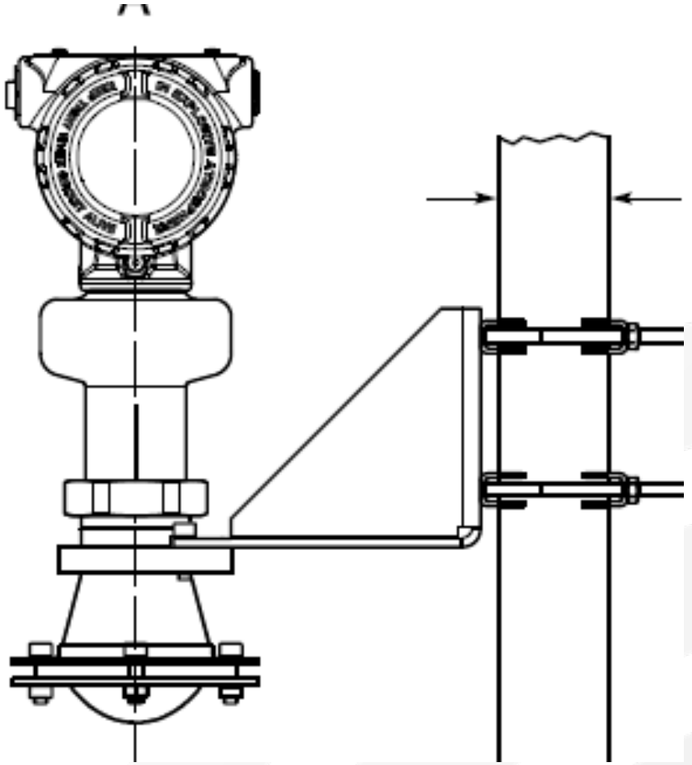
Rosemount 5408 Level Transmitter

Specifications

Media	Liquids, Solids
Frequency	26GHz, FMCW
Housing	Aluminum dual compartment housing
Seal	Cone, Process seal PTFE, Parabolic
Connections	Flanged, Threaded, Triclamp, Bracket
Operating pressure	-15 to 1450 psig
Operating temperature	-76 to 482°F
Approvals	Class I Div I, 3-A, CRN, ATX
Measuring range	131 ft
Communication protocols	4-20mA HART 7, FF
Safety Certification	SIL2

Bracket Mount Design

- Process Seal Antenna with bracket mounting design



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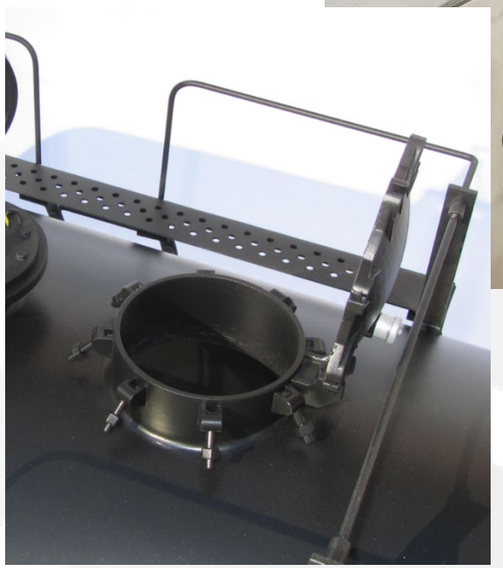
New Railcar Tanker Level Solution

Non-Contact Radar Level

New Railcar Tanker Loading Level Solution

- Rosemount 5408 Non-Contact Level Transmitter
  - Process Seal Antenna
  - Bracket mounting design
- Custom Fabricated Bracket
  - Designed for fast and easy installation on railcar manway
  - Protects the 5408 from damage
  - Incorporates 5408 bracket mount design



New Railcar Loading Level Solution

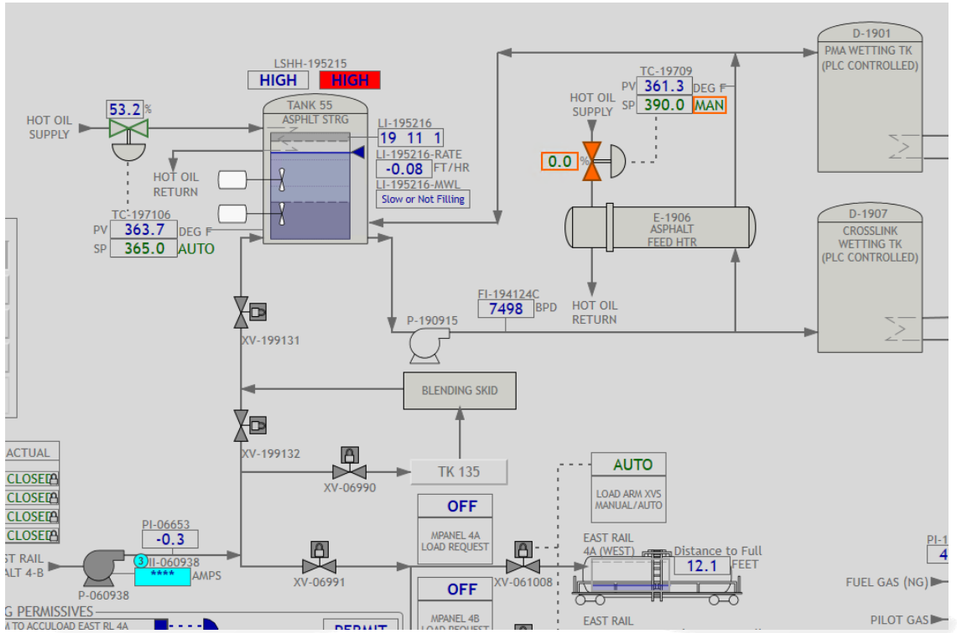
Side View

Top View

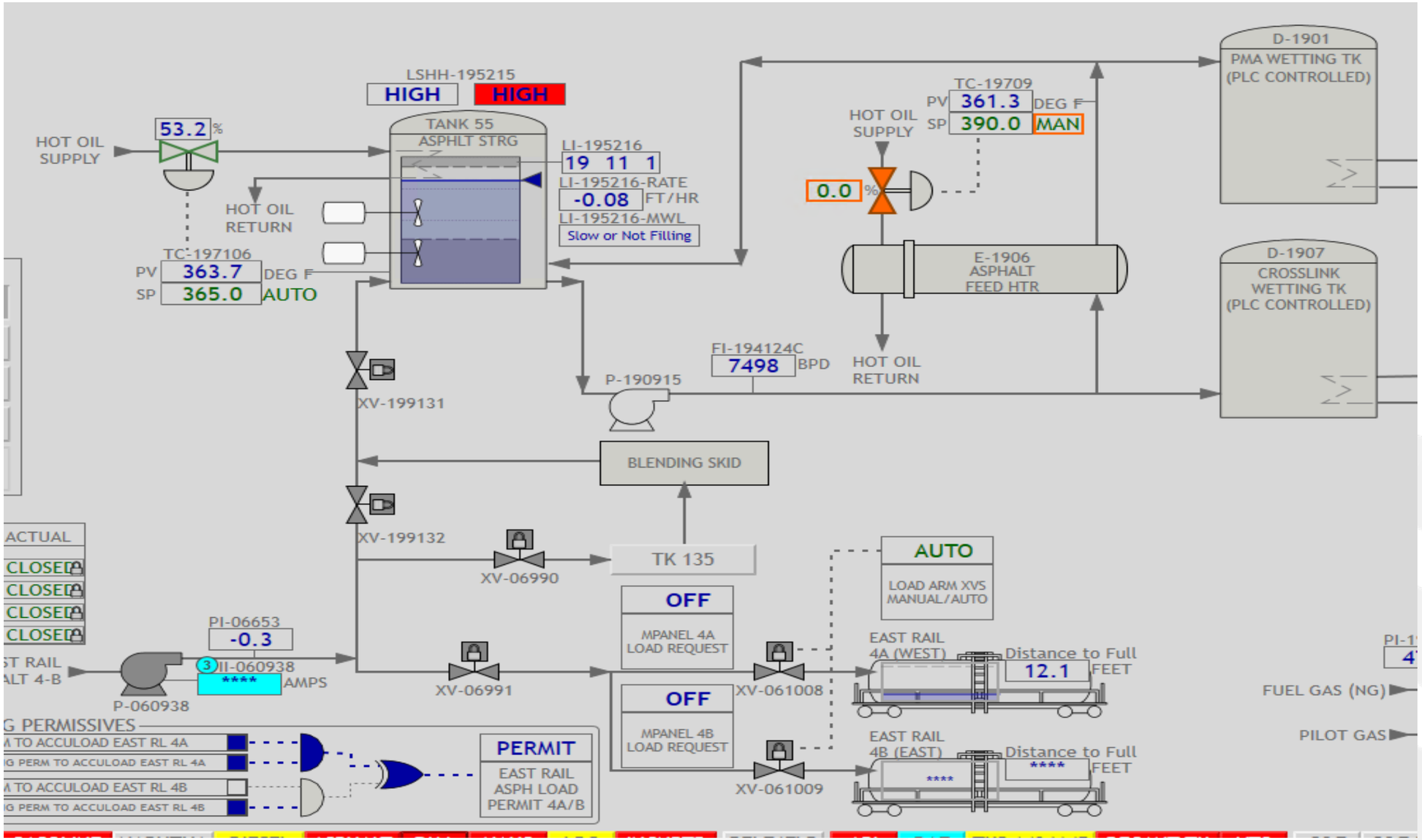
Bottom View

Railcar Tanker Loading Level Control

- Continuous level measurement
- Analog input into DCS
- High level alert programmed into DCS
- DCS provides discrete output
  - Into Accuload program
- Accuload program stops loading



Railcar Loading HMI



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Realized Value

Non-Contact Radar Level

Benefit of Improved Level Control

- Realized Benefit
  - Reduce/eliminate overfill
  - Reduce spills
  - Reduce product loss
  - Reduce clean-up cost
- Financial Benefit
  - Previous spills resulted in over $100,000 operational cost impact
  - Reduced maintenance cost: maintaining level switches, spill clean-up cost
- Operational Benefit
  - Increased railcar throughput

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Find More Information

www.emerson.com Search “5408 non-contacting radar level”

Visit Process Level Team at the Emerson Exchange Technology Exhibit #357

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Thank You