

MiNTEQ

A MINERALS TECHNOLOGIES COMPANY



FT-LevelNet: Bath Level Assessment For Hot Vessels

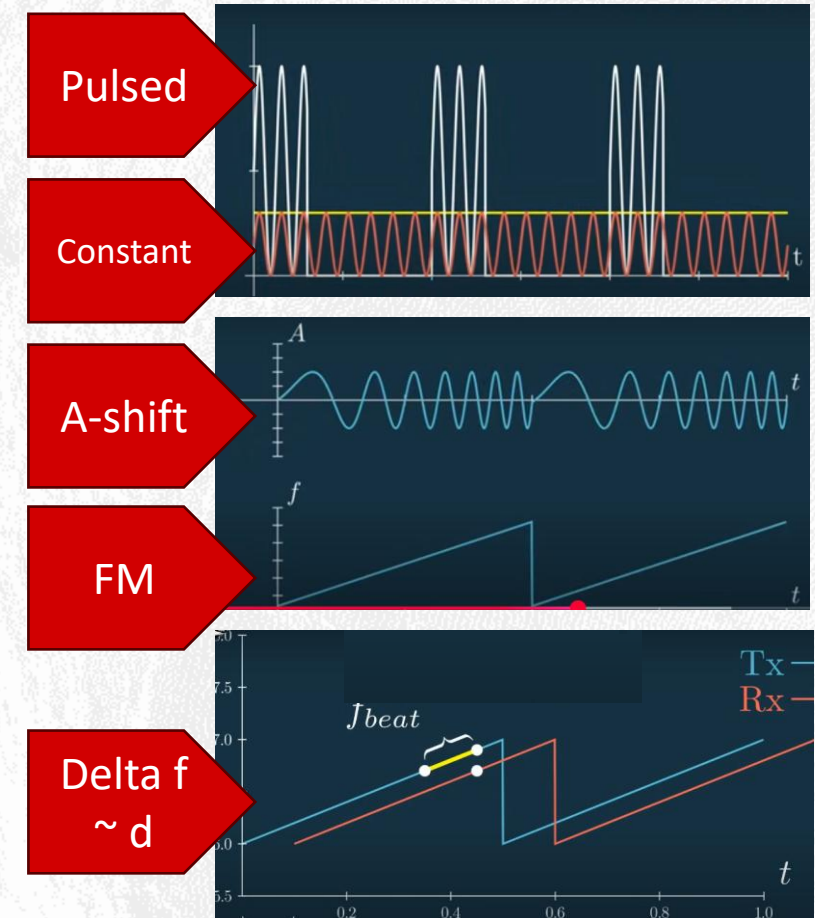
RADAR BASED LEVEL MEASURING SYSTEM

FT-LevelNet is a non-contact, “Time-of-flight” (ToF) measuring system based on a non-guided 60GHz FMCW*-Radar featuring:

- Measuring distances from 0.5m up to 20m (max.)
- High accuracy:
 - from 0.75m - ~ 2m distance to target surface: $\leq \pm 0.1 \text{ mm}$,
 - from $> \sim 2\text{m}$ - ~ 20m distance to target surface: $\leq \pm 2.0 \text{ mm}$
- Narrow antenna alignment and a **beam angle** of 6°
- Active cooling systems using water

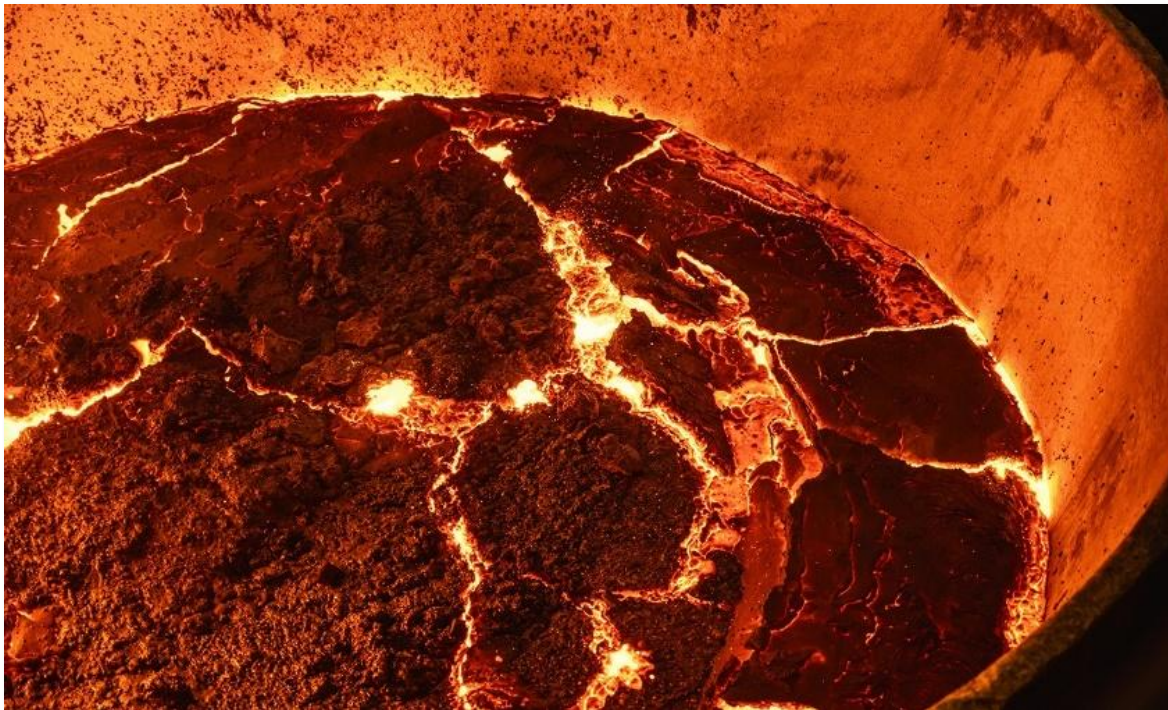
* FMCW-Radar = frequency modulated, constant range radar

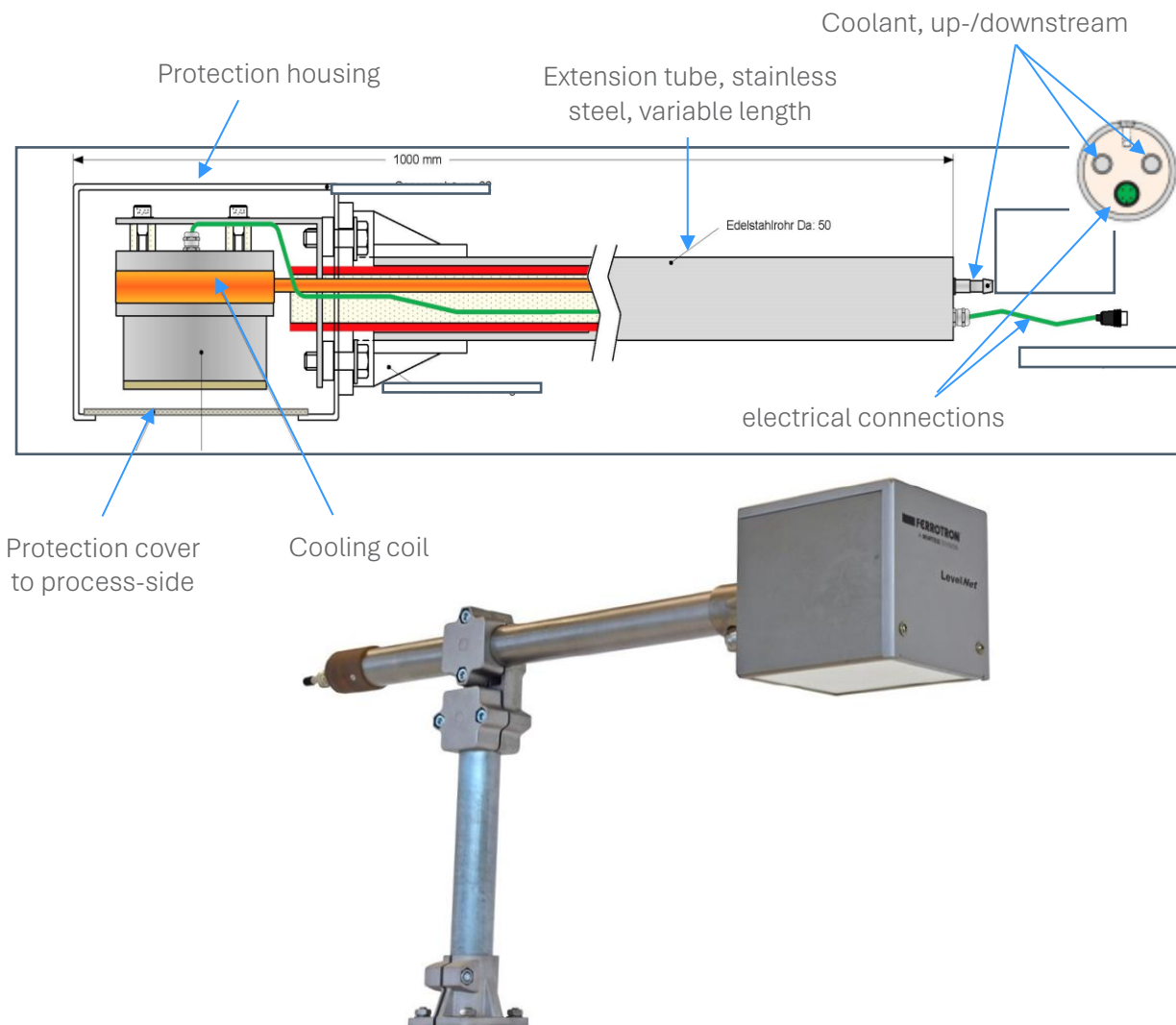
FMCW-Technology:



FT-LevelNet measures distance in hot areas, e.g. steel and non-ferrous metals:

- Freeboard or bath level for ladles, EAF, tundish for steel shops
- Freeboards or levels for converters of steel shops
- Slag thickness on steel bath



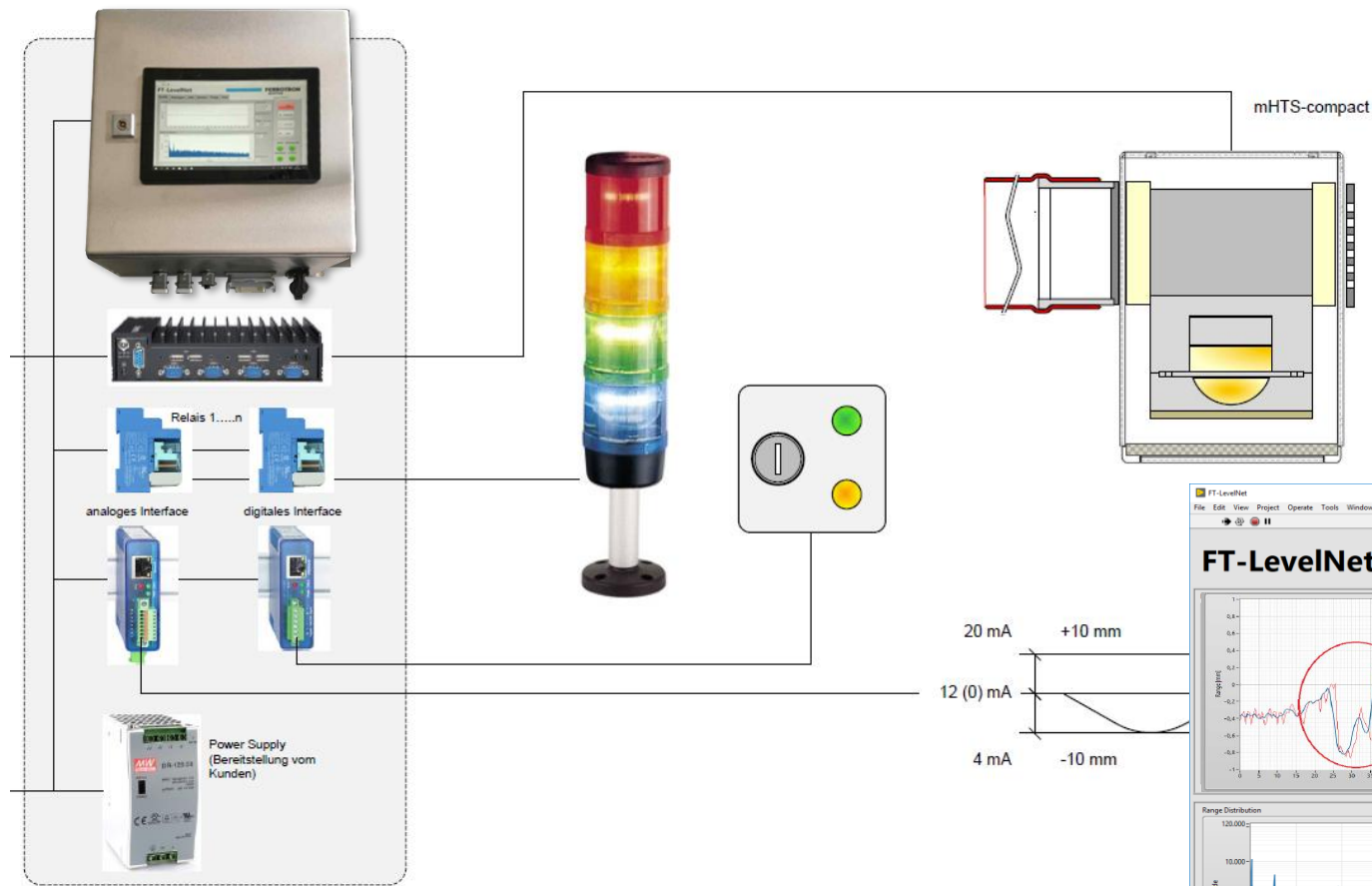


Sensor

- Robust sensor with laterally offset of water connections and sensor. High standard against leakage at the hose connection
- Water connections with plugs
- Water connectors dislocated from the measurement opening
- The sensor can be integrated easily into standard mounting frames. Easy exchange.



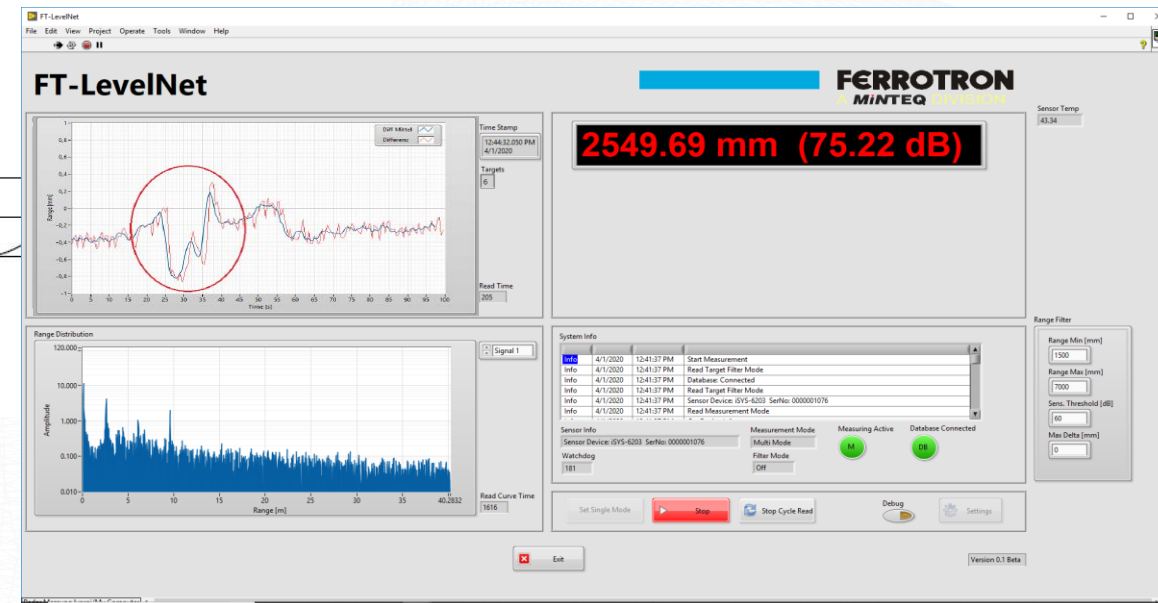
FT-LEVELNET – SYSTEM COMPONENTS



Evaluation and control unit AWE
with built-in accessories (Touch-
Panel-PC, Interface modules,
etc.)

HMI of AWE

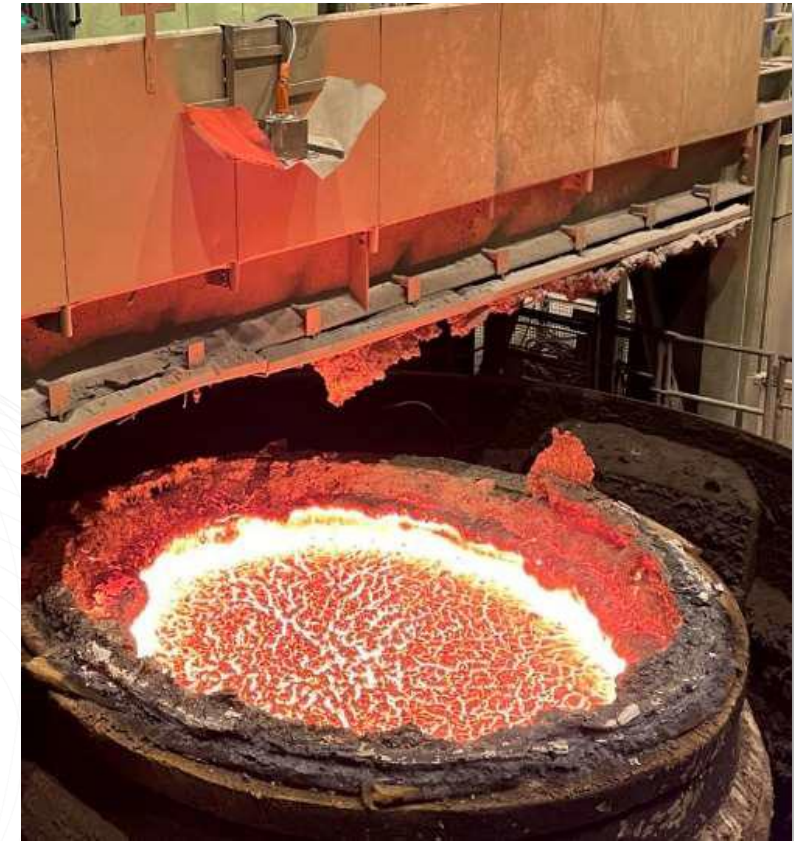
- Indicator lights for status display
- Sensor temperature critical / WARNING
- Sensor temperature exceeded / ALARM
- Sensor sends too little dB / cleaning or readjustment necessary
- No connection to sensor / cable, check power supply
- Watchdog etc.



- The sensor is mounted on a traverse perpendicular to the melt above the ladle track. Opening of sensor covered by a furnace-RADOM window
- Connection to data- and cooling water line
- Adjustment to maximum and next lower maximum values of the power-spectrum of the radar reflections
- Assessing the bath level and slag level per ladle passing this point
- Auto detection of incoming ladles - data acquisition only, when ladle is detected by radar to reduce data amount



RADAR sensor mounted on a traverse.



Radar signals can penetrate the slag of a steel ladle due to:

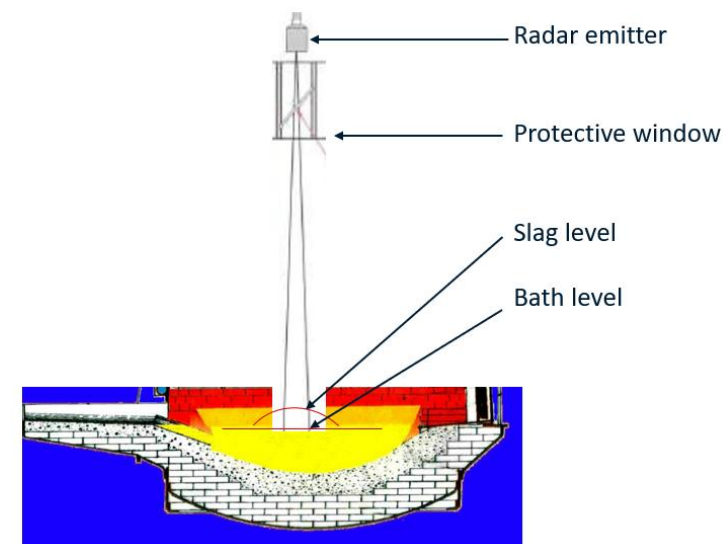
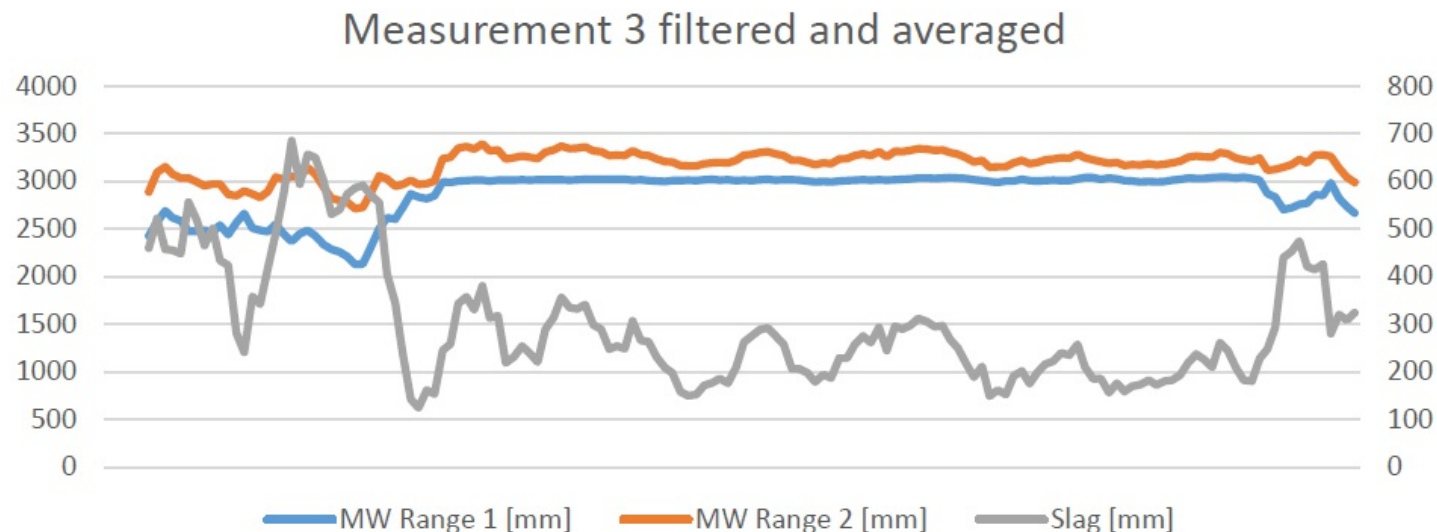
1. Radar Technology using the time-of-flight (ToF) principle and FMCW-radar

2. Material Properties:

The slag in a steel ladle typically consists of oxides like Al_2O_3 , SiO_2 , CaO , MgO , and FeO . Radar signals penetrate the slag due to **lower density and different dielectric properties**. The underlying molten steel surface reflects radar very strongly.

3. Sophisticated signal processing differentiates signals reflected from slag and molten steel.

4. Modern radar sensors are designed to operate in harsh environments.

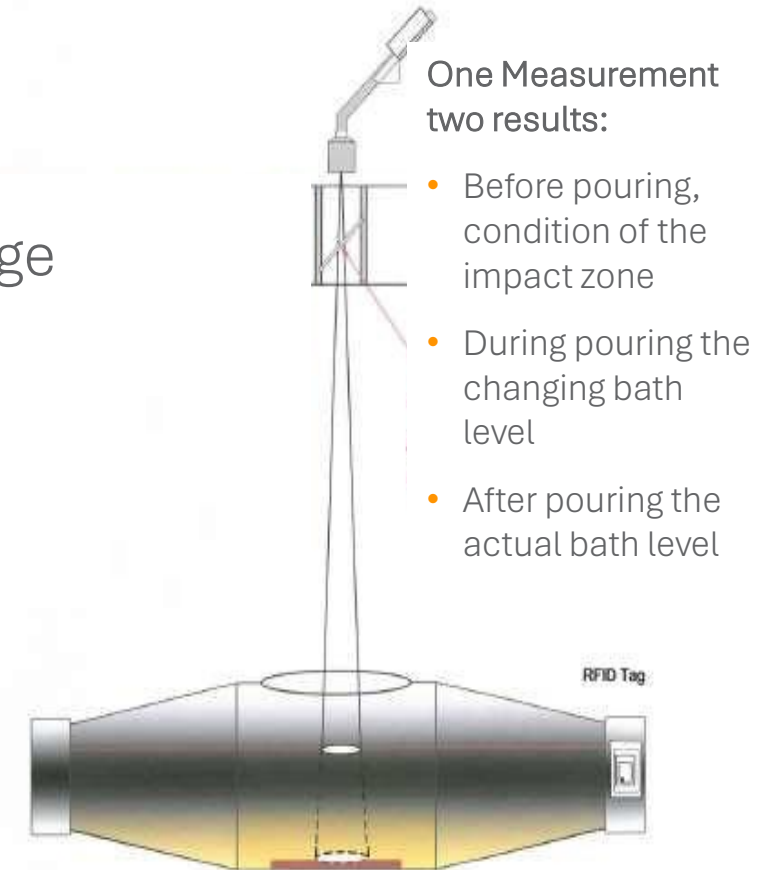


Two measurements in parallel, while flushing-gas is added, filtering and averaging both signals to calculate slag height. Echo 1: Slag line (~15% of energy). Echo 2: Bath line (~85%)

- Blue line represents the smoothed slag line echo, radar penetrates this material
- Orange line represents the steel bath line echo, which sees flushing gas agitation
- The grey line is the calculated slag line (use right hand legend)

FT-LevelNet mounted above a Torpedo ladle car

- The radar level measuring system measures the liquid metal level in the torpedo ladle
- The signal generated is used to control the furnace charge
- The operator controls safely the pig-iron level during the discharge of liquid iron when tapping the blast furnace





Safety

- Contactless ToF-measuring designed for high temperature environment
- No moving parts
- Reliable very high precision measurement



Extension of furnace life time – Reduction in operating costs

- Easy-to-use mechanical device
- Simple commissioning and adjustment in a very short time
- Only minor maintenance required



Optimized Process Control, Predictive Maintenance

- Radar is resistant to aggressive dust, gas and smoke with no significant measurement errors due to (some) bubbles in the melt (averaging)
- Unaffected by temperature, pressure or vacuum and provides accurate measurements in all environmental conditions
- Insensitive to contamination and does not need to be cleaned

Added value by FT-LevelNet measuring system:

- Use of modern radar technology with patented cooling guarantees a long lifetime with maximum reliability
- Simple connection to customer-specific systems due to FT-LevelNet and modular sensor system
- Simple commissioning and adjustment in the shortest possible time
- Maintenance contract and remote maintenance possible
- Radar sensor is protected by a RADON window to limit exposure to direct radiant heat, dust and smoke
- Radar waves are unaffected by temperature, pressure or vacuum and provide accurate measurements under all environmental conditions

Connectivity of the FT-LevelNet system:

- Expansion and integration of additional measuring systems is easy to implement thanks to the modular design of the measuring system
- Modular sensor design in several variants, adapted to the desired installation and environment
- Industry 4.0 integration due to modular infrastructure
- Additional software packages for various applications are available on request

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