



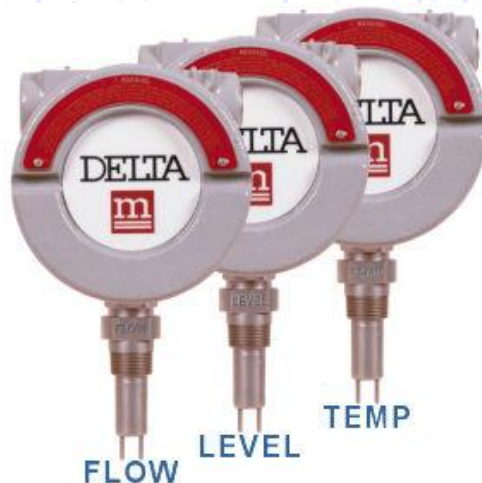
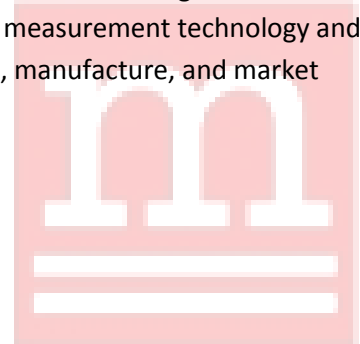
# COMPANY PROFILE



**DELTA M Corporation** was established in 1983 in Oak Ridge, Tennessee as one of the first Department of Energy (DOE) technology transfers from the Oak Ridge National Laboratory (ORNL). Since then, DELTA M has established a strong and vibrant business based on patented technologies in the flow, level, and temperature industry.

DELTA M Corporation continues to design, develop, manufacture, and market unique fluid flow, level, temperature measurement, and nuclear reactor power products using proprietary and patented thermal-based technologies. Because of our extensive experience and expertise in thermal measurement technology and high quality manufacturing we are able to develop, manufacture, and market innovative state of the art instruments.

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DELTA M Corporation provides a complete line of innovative process monitoring instrumentation for applications in industrial level, flow, temperature, and heat flux. Designed for the most demanding measurements and control applications, DELTA M's advanced thermal differential technology based microtuf® and Versa-Switch® product lines offer solutions to complex process monitoring problems.

DELTA M Corporation is the world's leading provider of Gamma Thermometers for use in nuclear reactor power monitoring and nuclear reactor coolant level monitoring applications.

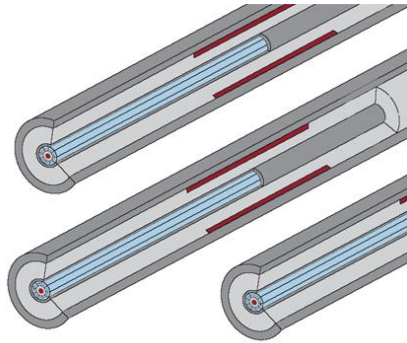


**INADEQUATE CORE COOLING**

- Above Core
- In-Core
- Outside Vessel

**POWER MONITORING**

- All Reactor Types



**GAMMA THERMOMETER SYSTEM**

DELTA M Corporation designs, develops, and manufactures various thermal devices to the customer's specifications. Generally, the Delta M thermal sensor group can design and fabricate thermocouple or RTD assemblies for almost any application. Our specialty is custom small diameter fast time response (milliseconds), high temperature (to 3990°F) thermocouples which few companies in the world can make. Our thermal sensor products are of the highest quality and can be produced under our ISO9001/2000 QA Program to comply with Military Specifications and **Nuclear Grade 10CFR50** when required.

**DELTA M Corporation is ISO 9001:2008 certified.**



**THEORY OF OPERATION**



**Thermal Differential Theory of Operation**

**Liquid level**

**Note:** Probe tips contain matched RTD's one of which is self-heated with about 400mw of power. The other provides temperature compensation



The heated RTD responds to the heat transfer coefficient of the media with which it is in contact. Gases with low heat transfer result in a high differential temperature between the heated and reference tips

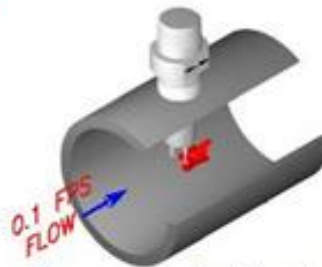
When the heated tip makes contact with a liquid with higher heat transfer the differential temperature drops and the lower differential results in a switch trip to indicate liquid

**Gas Or Liquid Flow**

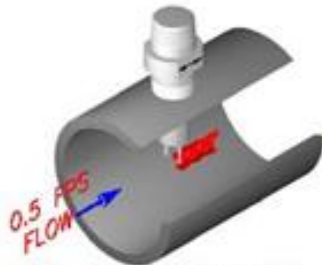
**Note:** The fluid velocity and heat absorption ability determine the differential between the tips. Their combination determines the measurable velocity. In water velocities from 0.01 to 5 FPS are measurable, whereas in air velocities of 0.1 to 500 FPS can be measured



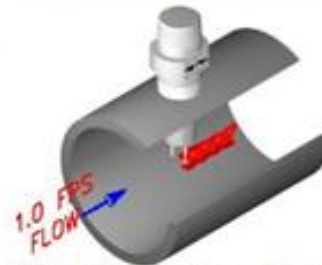
For a no flow condition the thermal differential between the two tips is high because of relatively low heat transfer.



Flow across the tips decreases the thermal differential because of the higher heat transfer of flowing fluids. This differential is compared with the trip point.



When the lower differential matches the customer select flow velocity trip point (set point) the switch relay and red LED are tripped.



When flow is above the trip point the differential is smaller than at the set point and the relay and Led remain tripped.

## RANGE OF PRODUCTS

### microtuf<sup>®</sup> PRODUCT LINE



microtuf<sup>®</sup> LS3200 - Single Channel Point Level Switch for detection of liquid level in all vessels

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microtuf<sup>®</sup> FS4200 - Single Channel Mass Flow Switch for the detection of mass flow rate of liquids and gases

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microtuf<sup>®</sup> II LS1100 - Single Channel Point Level Switch for detection of liquid level in all vessels

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microtuf<sup>®</sup> II FS2200 - Single Channel Mass Flow Switch for the detection of mass flow rate of liquids and gases

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### VERSA-SWITCH<sup>®</sup> PRODUCT LINE

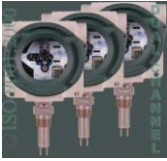


Versa-Switch<sup>®</sup> FS51SC - Single Channel Mass Flow Switch for the mass flow rate detection of liquids and gases

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Versa-Switch<sup>®</sup> LS51SC - Single Channel Point Level Switch for the detection of liquid level in all vessels

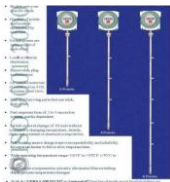


Versa-Switch® VS5100 - Dual Channel Simple Field configurable unit for mass flow, level, and/or temperature detection of liquids or gases

#### AVAILABLE OPTIONS



Livetap (LT) - Allows for the safe insertion and removal of Delta M switches without interrupting the flow in pipelines



Liquid Level Multi-point - Allows for multiple points of measurements using one instrument



Sanitary Switch - 3-A certification for all flow and level switches



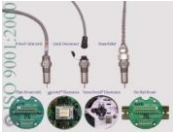
Mass Flow Switch SP76 - Helps make modular sample systems possible



Truck and Railcar Loading Sensor - A specially designed sensor for loading trucks and railcars with a quick locking clamp that attaches to the manhole or the sensor can be attached to the loading arm. This allows the probe to be adjusted to the desired level within the tank



Low Flow Sensor - Developed for low flow gas and liquid applications where reliability and durability are mandatory



Switch Kit - Designed for organizations that are building their own systems and have no need for the housings normally associated with industrial instrumentation



Failure Alarm (FA) - A separate electronic circuit board that monitors critical functions of the Versa-Switch<sup>®</sup> on a continuous, real-time basis initiating an output alarm should a malfunction occur - THIS OPTION IS FOR THE Versa-Switch<sup>®</sup> VS5100 ONLY

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## APPLICATIONS

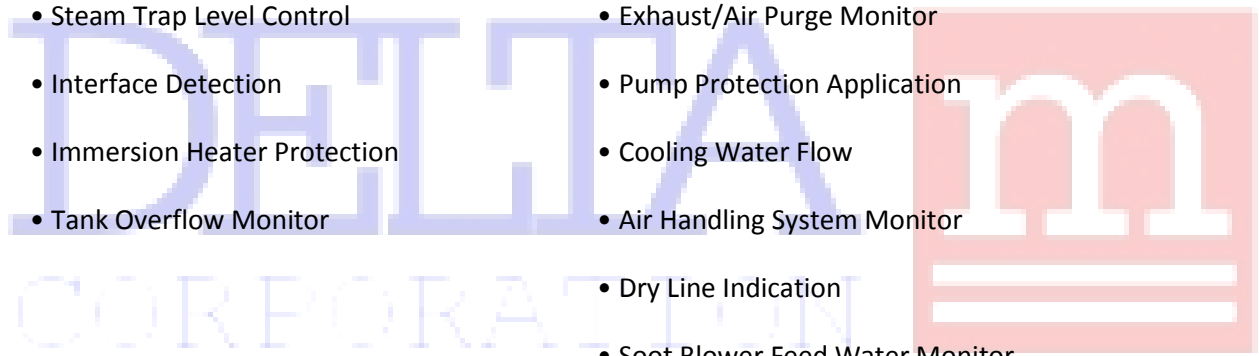
Applications to choose from include:

### LEVEL

- Tank Leak Detection
- Truck and Railcar Loading
- Reactor/Vessel Charging
- Foam Control In Tanks
- Water Detection In Fuel Tanks
- Sump Level Control
- Steam Trap Level Control
- Interface Detection
- Immersion Heater Protection
- Tank Overflow Monitor

### FLOW

- Pump Protection
- Analytical Sample Confirmation
- Safety Shower Monitoring
- Heat Transfer Fluid Monitoring
- Rotating Equipment Lubrication
- Safety Relief Valve Monitor
- Exhaust/Air Purge Monitor
- Pump Protection Application
- Cooling Water Flow
- Air Handling System Monitor
- Dry Line Indication
- Soot Blower Feed Water Monitor
- Chemical Injection Monitor
- Vapor Recovery Monitor
- Fire Suppression System Monitor
- Gas Purge Confirmation
- Sanitary Cleaning System Monitor
- Flow Confirmation

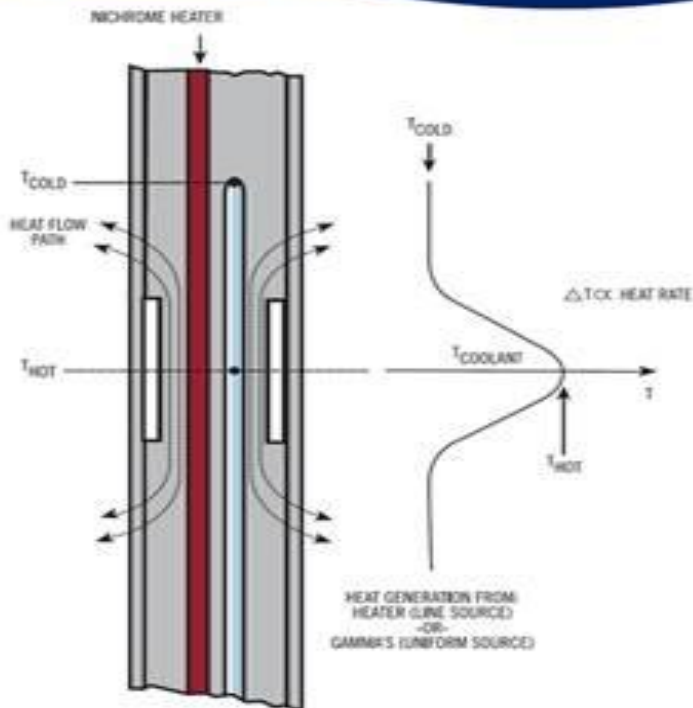


**THEORY OF OPERATION**

**Principle of Operation for the Gamma Thermometer**

**BASIC PRINCIPLES OF GAMMA THERMOMETRY (GT)**

Product Summary



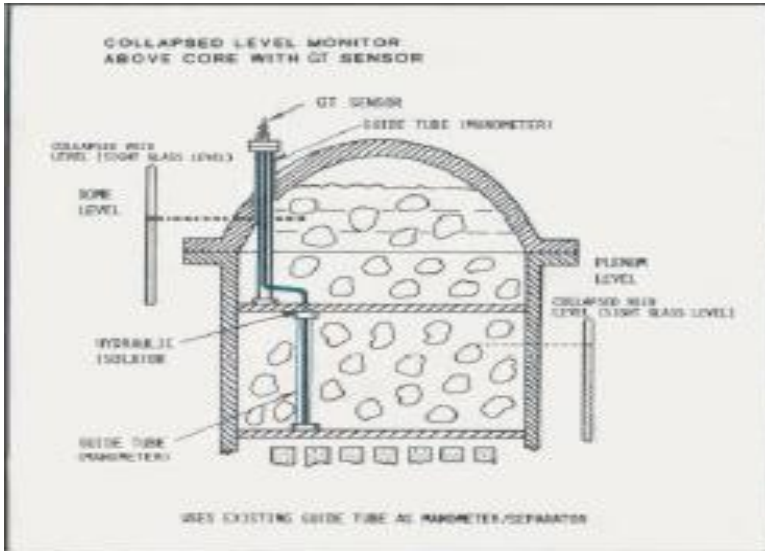
Gamma Thermometers are a non-depleting source of information about the power level in a nuclear reactor. Their monolithic design allows for an expected lifetime higher than 10 years.

- In-situ calibration allows for accurate measurements all the time.
- Robust mechanical design allows for years of worry free operation.
- With no fissile material to worry about, no sophisticated burnup algorithms are needed to utilize output.

COOPERATION

For power measurement, Gamma Thermometers depend upon the heating of the instrument rod by fission and fission product gamma rays. The heat generated is proportional to the linear power of nearby fuel rods. Heat generated is permitted to escape to the coolant sink only along a closely controlled conduction path while the temperature drop is measured by a differential thermocouple. Signal is proportional to fuel power, not neutron flux! Signal is strong and constant with fuel burnup.

### Use of GT as a collapsed level monitor



#### Product Summary

Because of the nature of their design, Gamma Thermometers are excellent instruments for use in Inadequate Core Cooling Monitoring (ICC) applications.

- As level indicator
- As shutdown power monitors
- As heat transfer monitors
- To measure reactor temperature

Gamma Thermometers can be used to provide fast and accurate information about the primary coolant level in a nuclear reactor vessel. A heater inside the GT creates a signature temperature differential between the differential thermocouples when water is present on the boundary of the GT. When the rod becomes uncovered, caused by a drop in primary coolant level, the temperature difference rapidly increases and can be used to trip an emergency reactor shutdown.

