

Level, Flow and Temperature Instrumentation for Nuclear Power Utility Applications



Flow Switches and Alarms for Air, Gases and Liquids
Level Switches and Alarms
Level Gauges and Transmitters
Air and Gas Mass Flow Meters

Nuclear Safety Class 1E Supplier Since 1978

Qualified to IEEE 323, IEEE 344

EMC and Electrical Safety per USNRC RG 1.180, EN 61000-6-4/2, EN 610101-1

ISO 9001 Certified, NUPIC Approved, HAF604 Certified

QA in Accordance with 10CFR50 App. B, ANSI N45.2, ASME NQA-1

Item Dedication Program

ASME Section III, Class 1, 2, 3 (N-Stamp) Instruments





Proven Results with FCI

- Improve plant efficiency
- Reduce instrumentation requirements
- Reduce piping footprint and tap points
- Reduce power, cabling and wiring requirements
- Increase reliability for critical systems
- Reduce installation and maintenance costs
- Meet latest nuclear industry certifications, qualifications, and guidelines
- Non Destructive Testing (NDT) available to latest norms
- Quality Assurance (QA) in accordance to global standards
- Local and factory field service, and start-up services



ABWR

ESBWR

VVER

US-APWR

APR1400



EPR™

AP1000™

USEPR™

ACR1000®

CANDU®

OPR1000

CPR1000

CAP1400

SMRs



FCI's proven solutions continue to drive savings and enhance plant performance for new, existing, and re-licensed nuclear power facilities worldwide

Nuclear Power Resurgence

Today, nuclear utility design engineers, plant engineers and operators are delivering the most competitive energy in the world. While current operating facilities continue to safely improve performance, a reemergence of interest is driving new construction and extended plant re-licensing. Activity levels are high and strong, proven partners are needed for sustainable success.

The next generation of nuclear power plants will achieve even greater efficiencies, lower operational costs and faster construction time. Requirements for new construction demand less piping, mechanical equipment, cement and other base footprint materials. These new plants will provide improved operating efficiencies and better asset utilization.

FCI is nuclear power's proven partner for driving instrumentation costs down while reducing maintenance and increasing safety, plant performance and labor efficiencies. FCI is ready to help you meet new nuclear plant I&C operating strategies like defense-in-depth, and objectives including diversity, redundancy and independence.

FCI Nuclear — Committed to the Nuclear Power Industry

Since 1978, FCI has designed and produced level, flow and temperature instruments that improve plant performance, protect equipment and maintain vital processes. Our unique expertise in the nuclear power industry delivers valuable time and cost savings during both construction and operational phases.

FCI delivers products that meet nuclear industry requirements from HVAC to inside containment to balance-of-plant applications. Products stand ready for harsh environments under guidelines of IEEE 323, IEEE 344, IEEE 382, IEEE 383; Class 1E Seismic Category 1, RCC-E, and comply with the latest EMC and electrical safety standards.

FCI Quality Assurance meets 10CFR50 Appendix B and complies with 10CFR21, ANSI N45.2 and NQA-1. FCI has developed products that comply with software quality control standard DO178, and are capable of meeting new and emerging nuclear industry software QC and digital I&C standards applicable to microcomputer-based instrumentation.

FCI is ISO 9001 certified. Our manufacturing processes are inspected by and comply with NUPIC, NIAC, and FENOC. An item dedication program is maintained in-house. For China nuclear programs, FCI has obtained accreditation per HAF 604.

FCI Nuclear Power Instrumentation at Work

FCI products are operating in more than 30 different applications in more than 115 nuclear power plants in the USA ...

- American Electric Power
- Arizona Public Service
- Constellation Nuclear
- Detroit Edison
- Dominion
- Duke Energy
- Energy Northwest
- Entergy Nuclear
- Exelon Corp
- FirstEnergy Nuclear Op Co
- Florida Power & Light Co
- Luminant Energy
- Nebraska Public Power District
- Omaha Public Power
- Pacific Gas & Electric
- PPL Corporation
- Progress Energy
- South Carolina Electric & Gas
- Southern Cal Edison
- Southern Nuclear Op Co
- STP Nuclear Op Co
- TVA
- Xcel Energy

... and Worldwide:

- British Energy
- CGN
- CNNC
- Comisión Fed de Electricidad
- EDF
- Endesa
- Iberdrola, SA
- KHNP
- Nuclenor
- Nucleoelectrica
- OKG
- Ontario Power Generation
- Slovenske Elektrarne / Enel
- Taiwan Power Co



Meet Supply Chain Objectives

FCI is the only manufacturer of thermal dispersion technology flow meters, flow switches, level switches and level transmitters accredited for both nuclear safety related and balance-of-plant applications.

The FCI Instrumentation Advantage

Reduce Instrumentation, Power, Wiring, Cabling and Installation – FCI multi-variable sensors reduce requirements for purchasing, installing, powering, maintaining and documenting additional instruments.

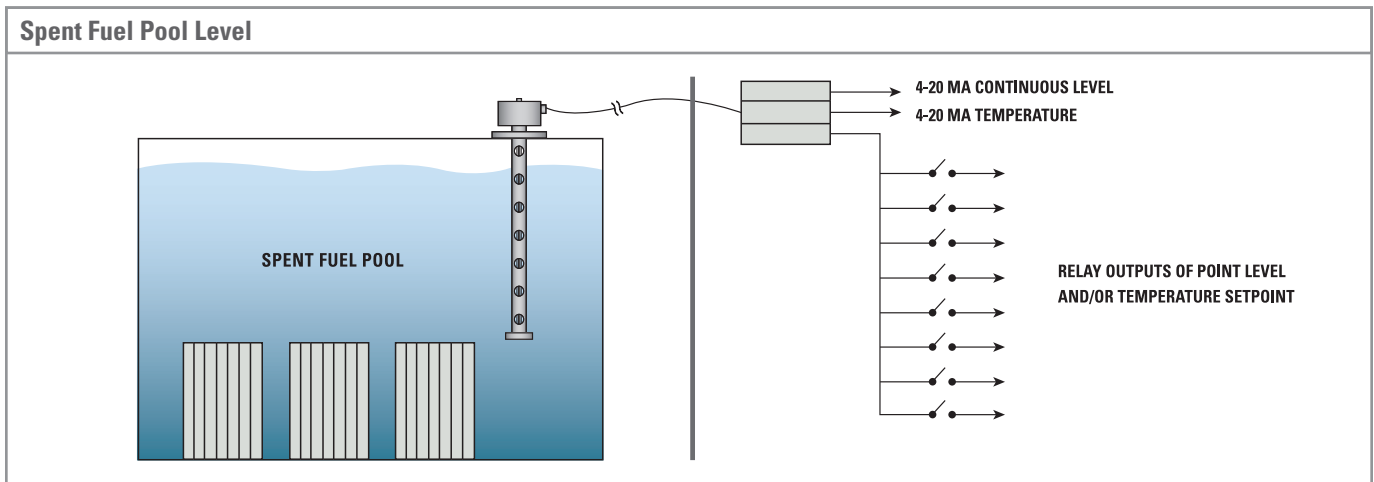
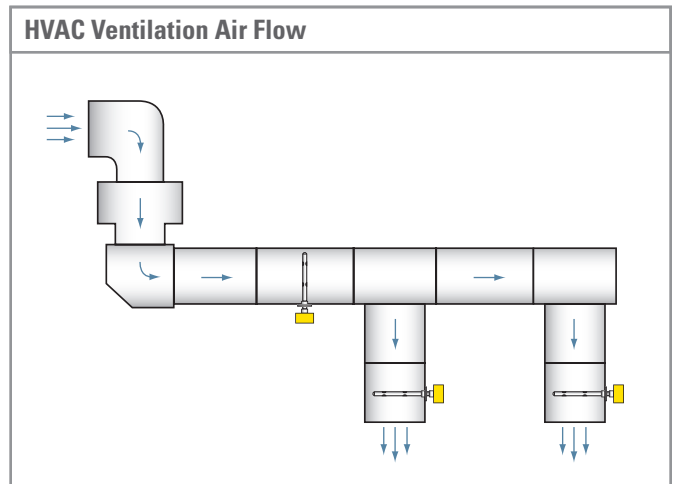
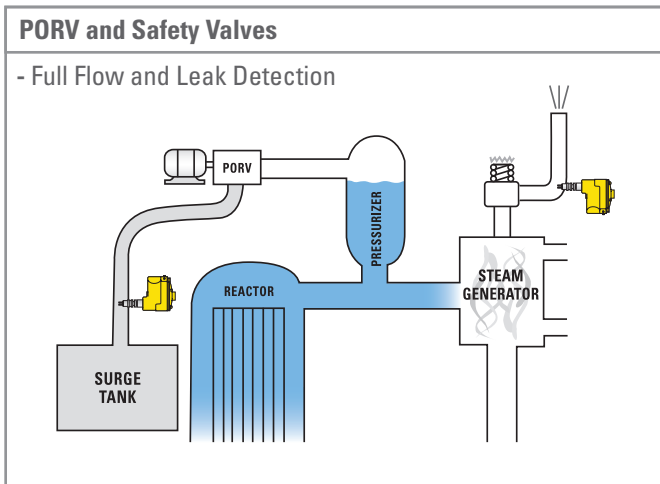
Thermal dispersion level and flow measurement products are inherently dual-function, providing both level and temperature, or flow and temperature

outputs with just one sensor.

Because FCI thermal dispersion flow products are direct mass flow measuring, they do not require the addition of temperature and/or pressure sensors to be installed in the process to compute inferred mass flow. The elimination of these devices delivers significant savings in instruments.

Reduce Cost per kWh – Replacing a single Delta P (DP) orifice plate flow meter with an FCI thermal dispersion flow meter eliminates significant pressure

losses, which can achieve substantial cost savings. For example, in a 5' x 5' air duct flowing at 50 feet per second, DP will lose 1/28 PSI more than FCI's thermal meter. At \$0.10 per kWh energy cost, the DP device pressure loss costs \$21 per day, or nearly \$460,000 over a 60 year life more to operate than a comparable FCI thermal flow meter.



Unique 'Flow + Temperature' and 'Level + Temperature' Sensing Technology

FCI's thermal dispersion technology excels in applications where both flow and temperature or level and temperature are measured. Temperature sensing is inherent in FCI's thermal dispersion flow and level measurement technology. A single sensor provides dual measuring functions. Nuclear plant operations save weight, save space, and save costs over two or more discreet sensors. You realize reduced qualification installation costs and complexity.

Ease of Use – Single penetration points for sensor elements provide easy mechanical connection to the process and simplified wire-up to power input and outputs. Field set switch points and calibration with complete system precheck verification provides accurate alarm and metering with total confidence.

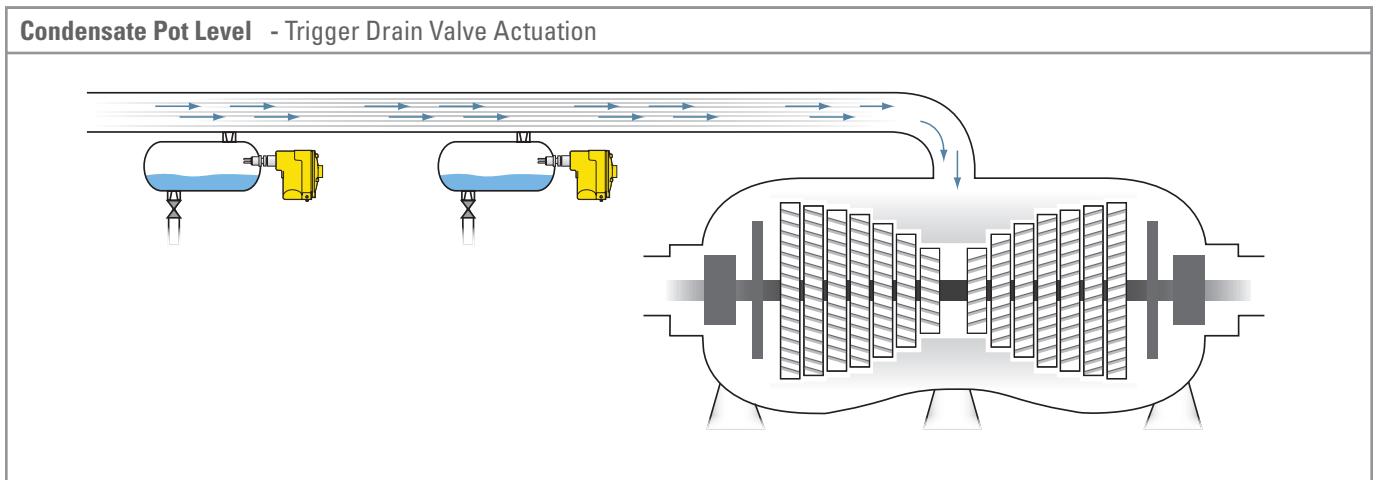
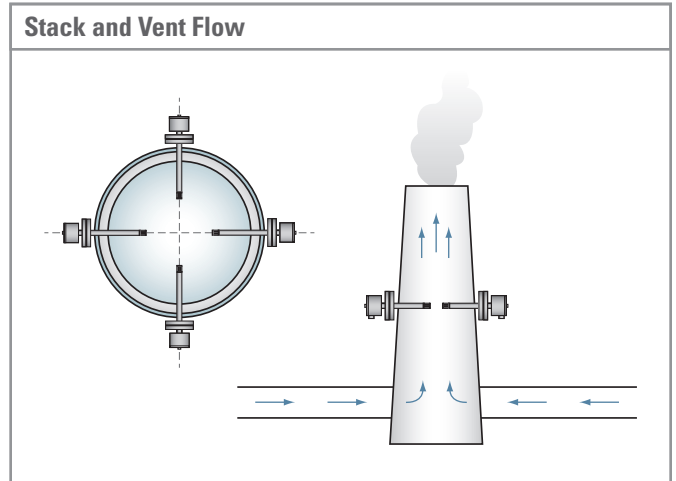
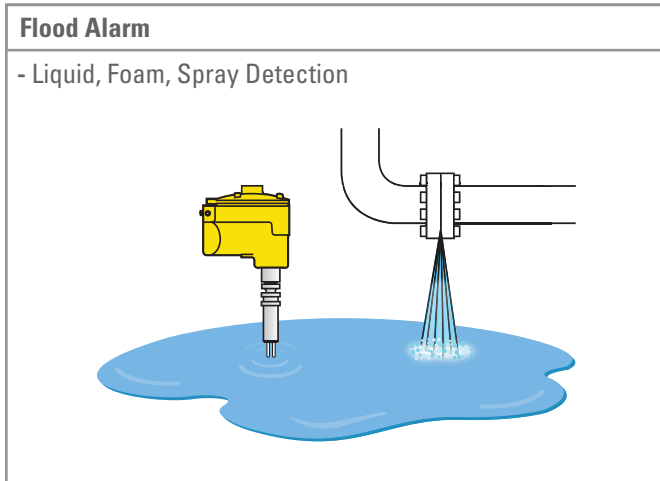
Critical Equipment Protection, Plant Integrity Validation – Level, flow and temperature detection is critical to

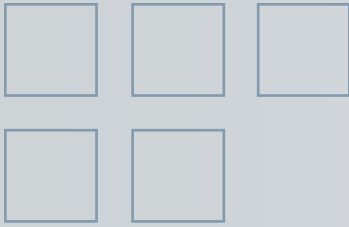
numerous processes within every nuclear power plant operation. Examples include operational integrity of turbines, pumps, cooling systems and valves, as well as process off-gases and HVAC systems.

FCI provides flow sensor solutions for line sizes from 1/8" to the largest of stacks and ducts. FCI products are designed robustly with proven track records, MTBF ratings in excess of 100 years, SIL 2 ratings, and an exacting specification of nuclear plant certification pedigrees.

FCI's no moving parts technology is the safest choice for critical equipment protection and plant integrity validation.

Technological Advantage – With no moving parts to clog, stick or foul, FCI thermal dispersion units are virtually maintenance free, needing little more than an occasional wipe down. It is a fail-safe technology that translates to an increase in both reliability and tangible savings in maintenance costs.





Innovations like system precheck in switches and VeriCal™ in-situ calibration verification in flow meters, demonstrate FCI's commitment to continuously improving features and functions that increase installed reliability and performance.

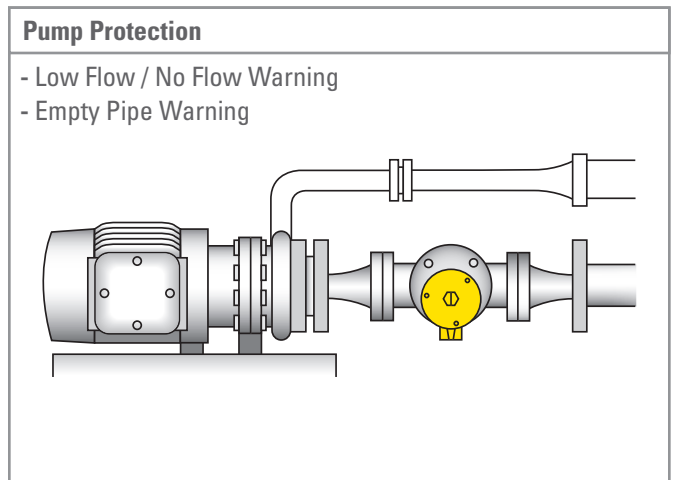
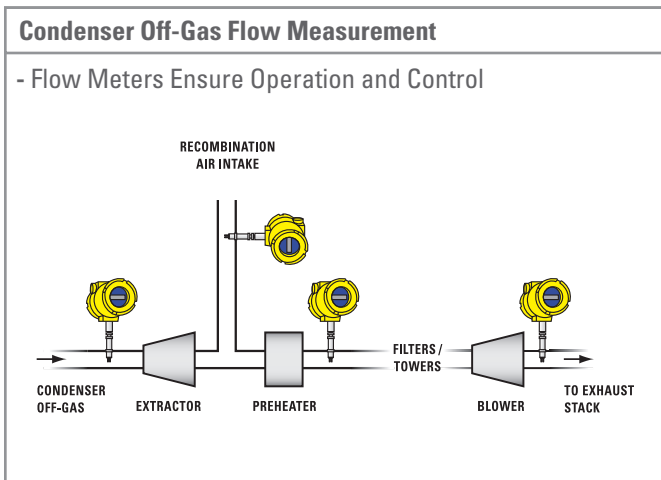
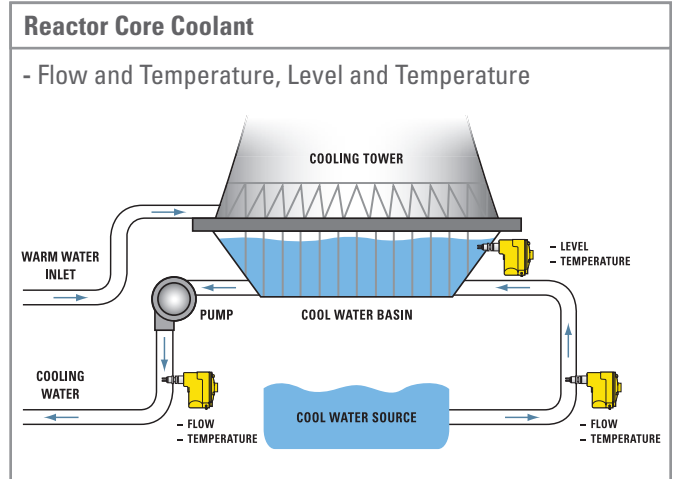
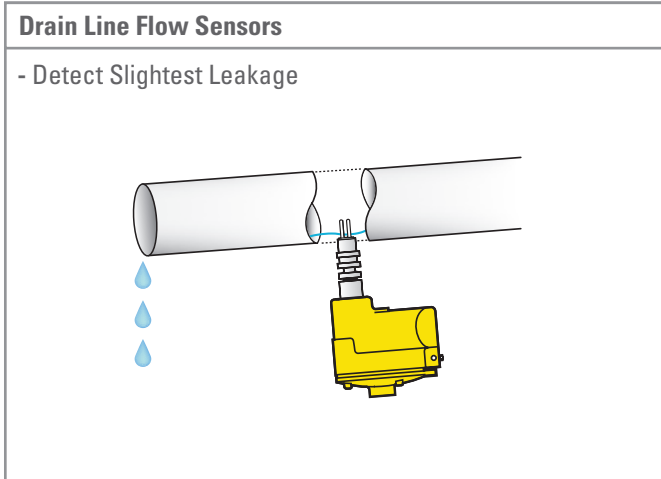
Whether your nuclear plant retains traditional analog process interfaces (like 4-20mA and contact closures) or advances to digital bus communications, FCI products are available. Industrial bus communications such as HART, FOUNDATION™

Fieldbus and PROFIBUS are available in FCI products now or as field upgrades.

Confidence – Since 1978, FCI's continuous service to the nuclear industry speaks volumes.

Global support assures that specifying FCI products is a sound decision for any plant in the world. Global nuclear regulatory agency approvals, certifications and participation in nuclear industry supply-chain programs mean FCI can deliver

products to the standards demanded by the industry. This high level of dedication and commitment to the nuclear industry means FCI is a supplier you can depend on—today and tomorrow.



FCI is the world's number one ranked supplier of thermal flow meters and flow switches, as independently reported by Control Magazine. Breakthroughs like equal mass sensing, advanced signal processing, high accuracy calibrations and the ability to mitigate installation challenges make FCI the right partner for modern nuclear power.



An Engineering Partnership

It is FCI's ability and passion to develop special designs for our customers. Here is just one of thousands of examples:

A nuclear plant customer had a level application, but access to the tank was blocked by an overhead structure. FCI responded to the challenge by developing a "flex joint" sensor so the level sensor array could be "bent" during installation (see figure below).

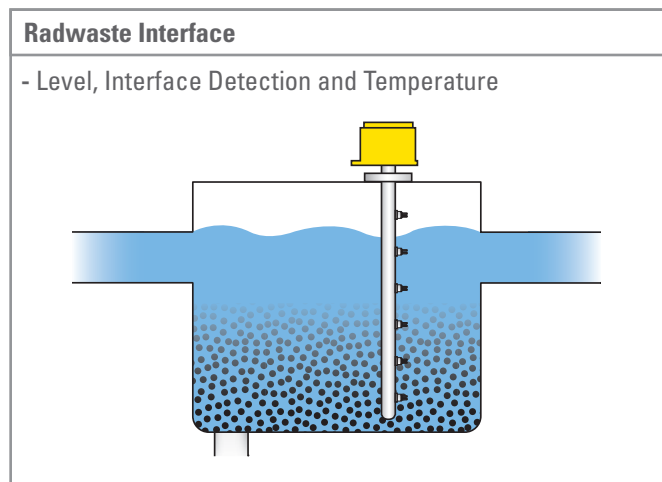
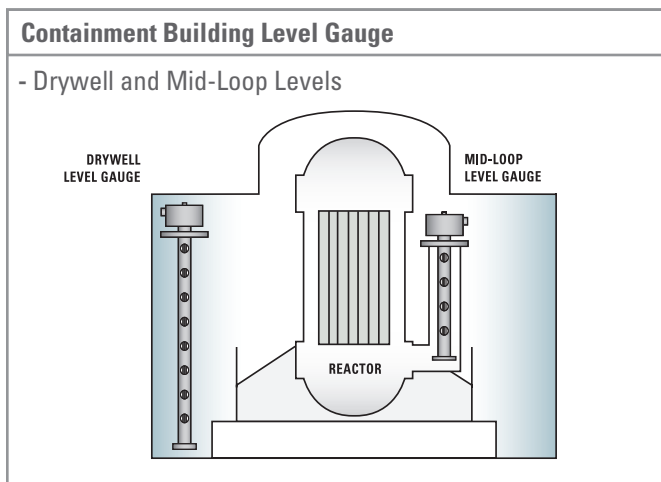
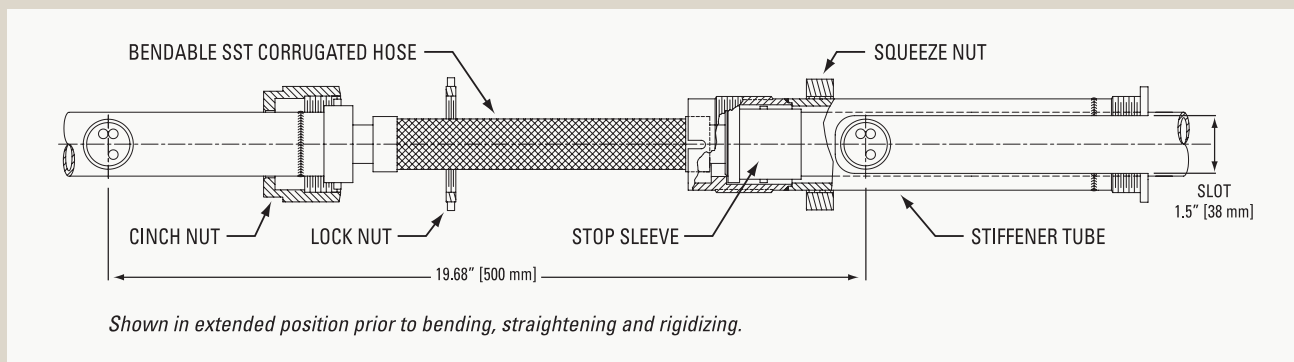
FCI's team of application engineers, nuclear plant specialists, computer and software engineers are an integral part of the FCI solution and experience.

Post-sales support from FCI is available around the clock. In addition to FCI's 24/7 service hot line, FCI has multiple service, support and calibration depots, and a global team of field service

engineers that can be dispatched quickly to your site.

When unique engineering situations occur and application challenges are found that leave you with little time or painfully expensive options, contact FCI. FCI will develop specifications with you and design the right instrument solution to meet your application.

Figure 1: Flex Joint Option — Installation Solution for Tight Spaces and Low Headroom





Challenging application? Special designs and custom configurations are a mainstay of FCI nuclear instrument capabilities. The agility of in-house certification, testing and calibration ensures responsiveness and saves you time.

FCI — Your Expert Partner

FCI continues to be at the forefront of advances in thermal dispersion flow and level measurement technology. With continuous innovation and investment in sensor designs, sensor packaging, electronics and calibration, you can count on FCI's products to deliver the highest accuracy and repeatability along with the longest service life.

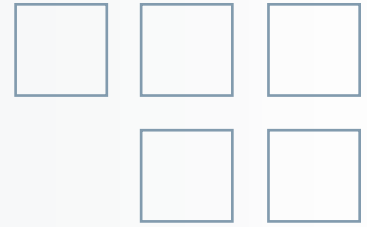
Sensor Innovation – FCI pioneered the first equal mass sensor configuration. This design ensures that sensor elements consistently track process changes at identical rates and magnitudes. These equal mass sensors greatly broadened the range of applications and flow rates for thermal technology.

Further, FCI has applied new heat path aging and materials optimization techniques which provide higher performance at lower costs.

Temperature Compensation Sets FCI Apart – Temperature compensation circuitry ensures thermal dispersion instruments perform to specification regardless of temperature swings in the measured process fluid or the ambient environment. This important functionality is standard in FCI products while often overlooked or minimized by other manufacturers. Individual sensors are normalized in reference fluids, then precise correction

FCI Product Selection Overview

		FLT93 Series	FLT93 M	CL86 / CL86 Plus	LT81, LT87, LF87	MT86	ST50 / ST75 Series	ST100 Series
Nuclear Safety Qualified		✓	✓	✓	✓	✓		
Industrial, Balance of Plant		✓	✓	✓		✓	✓	✓
Application	Media							
LEVEL								
Point Level <i>Low or high level alarm, or interface</i>	Liquids, Foam, Interface	■						
Multi-Point Level <i>Multiple alarm points at and/or between low and high levels, and/or interface</i>	Liquids, Foam, Interface		■	■				
Continuous Level	Liquids			■				
LEVEL and TEMPERATURE								
Point Level and Temperature <i>Low or high level alarm or interface, plus high or low temperature alarm</i>	Liquids, Foam, Interface	■						
Multi-Point Level and Temperature <i>Multiple alarm points at and/or between low and high levels, and/or interface, plus high or low temperature</i>	Liquids, Foam, Interface		■	■				
Continuous Level and Single Point Temperature	Liquids			■				
FLOW								
Alarm <i>No flow, low flow, high flow</i>	Liquids, Air, Gases	■						
Single Point, Continuous	Air, Gases				■		■	■
Single Point, Continuous	Liquids				■			
Multiple Point Averaging, Continuous	Air, Gases					■		■
FLOW and TEMPERATURE								
Flow and Temperature Alarms <i>No flow, low flow, high flow, plus high or low temperature</i>	Liquids, Air, Gases	■						
Single Point, Continuous Flow and Temperature	Air, Gases				■		■	■
Single Point, Continuous Flow and Temperature	Liquids				■			
Multiple Point Averaging, Continuous Flow and Temperature	Air, Gases					■		■



factors are applied within built-in temperature compensation electronics. The result is a stable, drift-free measurement immune to the effects of fluid and/or ambient temperature changes.

Unequaled Calibration and NIST/ISO 17025 Traceable Facilities – FCI invested extensively to bring high accuracy calibration capability and equipment traceable to NIST and ISO 17025 in house. Optimized sensing requires knowledge of the process fluid because the cooling rate is a function of thermo-physical properties, such as viscosity, density, specific heat, thermal conductivity, and coefficient of thermal expansion.

While new modeling and equivalency methodologies have become effective at approaching reference gas calibrations, it remains clear that the highest level of performance is achieved with actual gas and actual liquid calibrations. FCI's capability to perform these actual fluid calibrations with automated data collection and reference standards results in superior instrument calibration and performance.

FCI Calibration Ensures Installed Accuracy

All FCI products are tested and calibrated to rigorous standards so that you get the

instrument that does the job specified. To design and produce the highest quality flow instrumentation, FCI operates a world-class, fully NIST traceable flow calibration laboratory that is certified to meet such stringent standards as MIL-STD 45662A and ANSI/ NCSL Z-540.

Other suppliers are often limited to air and water calibrations then rely on un-validated theoretical equivalencies for other fluids. This procedure can be inadequate and result in installed errors well outside published specifications. To eliminate this risk, for most fluids, FCI thermal dispersion flow instruments are calibrated using the actual fluid, as well as the actual temperature and process conditions of your application. The result is a flow instrument you can install with total confidence and assurance that it meets your application.

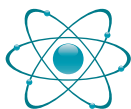
Transferring Laboratory Results to the Field – FCI products and their calibration processes are designed to provide optimum performance in their actual installation. FCI's years of experience and in-depth understanding of real-world conditions such as straight-run, fluid stratification, transitional flow profiles, swirl turbulence, temperature changes and pulsation are factored into product

designs and the calibration process. The end result is a thermal dispersion flow or level measurement product you can count on to provide superior installed performance.

Examples include "in-line" configurations that fix the sensing element in a spool-piece section so the measurement is unaffected by installation variation effects such as pitch, yaw, rotation or depth. Other examples include lock-in-place or keyed mechanical stays, multi-point sensor arrays, best-practice installation guides, flow conditioners, flat profile calibrations and extended range temperature compensation.

Sensor improvements, temperature compensation, calibration and transferring product to the field assure total confidence in FCI products.

A Lasting Commitment – FCI has never wavered from its commitment to advancing the technology and serving the nuclear industry with lasting results. FCI is a proven partner for your success.



**Continuous Class 1E Supplier
for over 40 Years**



More than 18 precision flow stands to match NIST traceable fluids, process conditions, flow rates and line sizes specified in your application.

Level & Interface Solutions

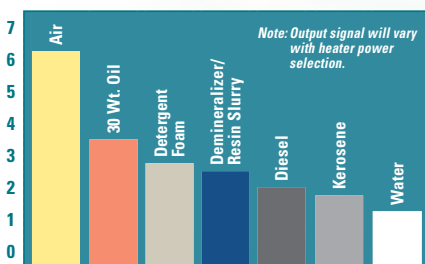
- High Reliability, No Moving Parts
- Dual Function, Level and Temperature
- AC, DC and Loop Powering Options
- 3 Phase Interface
- Interface Between Two Non-Miscible Fluids
- Easy to Install
- Rugged, Heavy-Duty

FCI level switches and transmitters provide fast response, accurate fluid level alarms and set-point controls. Units sense the temperature difference between a heated sensor and an unheated reference sensor, where the difference is greatest in the absence of liquid and decreases proportionally as the elements are submerged in various fluids with varying thermal conductivities.

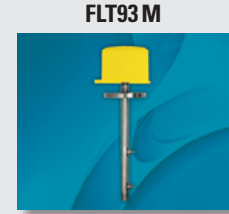
For example, when submerged in radwaste interface applications with air, water and pelletized water, the heated sensor cools as it dissipates heat. In turn, each media changes in the magnitude of the temperature difference. An electronic control circuit converts the RTD temperature difference into signal for either set-point alarm, control or continuous level transmission.

Because all fluids exhibit different heat transfer characteristics, FCI's highly sensitive level switch technology can detect historically difficult interface applications between fluids such as liquids, gases, emulsions, slurries and foam, regardless of their physical properties. In the radwaste water example (page 4), where temperature stratification is reversed, FCI solves this phenomenon with special time delays to correctly allow stabilized signaling and accurate measurement.

Typical Level and Interface Output Signals



Point Level Switches and Alarms



Multi-Point Level Switch

Model/Series	N-FLT93 / FLT93 Series	FLT93 M
Key Features and Applications	<ul style="list-style-type: none"> • Heavy-Duty • Dual, 6A Relays • Exclusive Precheck Circuitry • 3 year Warranty • SIL 2 Rated, 110 Year MTBF • N-Stamp Certified (opt.) 	<ul style="list-style-type: none"> • Heavy-Duty • Up to 8 Sense Points • Up to 120" [3048 mm] Length • Heavy-Duty Relays • Radwaste Interface Detection • 3 Year Warranty • SIL 2 Rated, 110 Year MTBF
Media Compatibility		
Water	■	■
All Other Liquids	■	■
Slurries	■	■
Interface	■	■
Measurements and Outputs		
Level	■	■
Temperature	■	■
Media Temperature Service	FLT93: -100 °F to 850 °F [-73 °C to 454 °C] N-FLT93: -100 °F to 577 °F [-73 °C to 303 °C]	-100 °F to 500 °F [-73 °C to 260 °C]
Wetted Materials Available	Stainless Steel, Hastelloy, Monel, Tantalum, Others	Stainless Steel, Hastelloy
Transmitter Outputs and Displays		
Analog Outputs	■	■
Relay or Contact Closure	■	■
Digital Display		
Transmitter Mounting		
Integral	■	■
Remote	■	■
Nuclear Safety Certification	■ (N-FLT93)	■
Radiation		
Sensor	8 x 10 ⁵ RADS; 2 x 10 ⁸ RADS based on analysis	8 x 10 ⁵ RADS; 2 x 10 ⁸ RADS based on analysis
Electronics	5 x 10 ⁵ RADS	5 x 10 ⁵ RADS
Aging	40 years at 150°F [66°C], extendable to 60 years Relay: 5100 full load cycles	40 years at 150°F [66°C], extendable to 60 years Relay: 5100 full load cycles
Seismic	<i>Sensor and Electronics:</i> Standard Temp (N-FLT93) Biaxial: 7 g SSE ZPA; RIM: 5.8 g SSE High Temp (N-FLT93 HT) Triaxial: 11.7 g SSE ZPA	<i>Sensor and Electronics:</i> Standard Temp (N-FLT93 M) Biaxial: 7 g SSE ZPA; RIM: 5.8 g SSEv

CL86



Continuous Level Gauge

Model/Series	CL86 / CL86 Plus
Key Features and Applications	<ul style="list-style-type: none"> • True Continuous Level • Continuous Level + Point Level Hybrid (CL86 Plus) • Up to 55' [16,7 m] Length • Wet or Dry Detection • Custom Flex Joint Design Solves Installation Challenges • VeriCal™ In-situ Calibration Verification option
Media Compatibility	
Water	■
All Other Liquids	■
Slurries	
Interface	
Measurements and Outputs	
Level	■
Temperature	■
Media Temperature Service	32°F to 330°F [0°C to 160°C]
Wetted Materials Available	Stainless Steel
Transmitter Outputs and Displays	
Analog Outputs	■
Relay or Contact Closure	■
Digital Display	Optional
Transmitter Mounting	
Integral	
Remote	■
Nuclear Safety Certification	■
Radiation	
Sensor	2 x 10 ⁸ RADS
Electronics	1 x 10 ⁴ RADS
Aging	40 years at 120°F [49°C], extendable to 60 years
Seismic	<i>Sensor:</i> 1.8 g Horizontal SSE TRS 1.2 g Vertical SSE TRS <i>Electronics:</i> Biaxial 5.3 g SSE ZPA

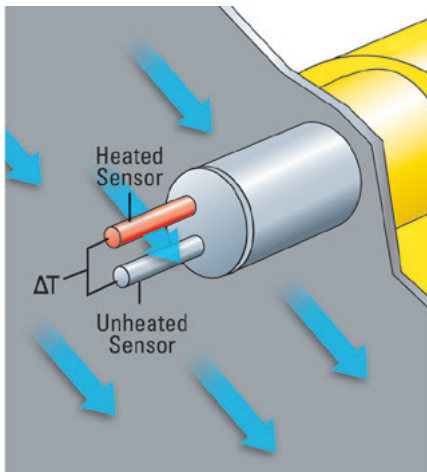
Level Applications

- Sump Flood Level
- Spent Resin Interface
- Containment Water Level
- Containment Building Sump Level
- SCRAM Discharge Level
- Condensate Pot Level
- Tank Level
- Mid Loop Level
- Suppression Pool Level
- Dry Well Level
- Spent Fuel Pool Level
- Pond Level
- Accumulator Level
- Turbine Oil Level
- Steam Drain Level
- Loop Seal Level
- Oil Reservoir Level
- Room/Area Flooding Alarm
- Fuel Pool Level
- Chemical and Volume Control Boric Acid
- Main Steam MSCV Hydraulic Tank Level
- Main Steam Reheater Drain Tank Level
- Main Steam Condensate Storage Tank Level
- Auxiliary Boiler Water Level
- Auxiliary Boiler Fuel Level
- Generating System Lube Oil Alarm
- Generating System Stator Cooling Water Level
- Diesel Generator Lube Oil/Fuel/Water Level
- Steam Generator Level
- Feedwater Level
- Ice Condenser Reactor Containment Level
- Water Treatment Systems Level
- Circulating Water Systems Level
- Service Water Systems Level
- Crib House Systems Level
- LOCA Alarm/Switch
- Foam Detection
- Reactor Cavity

Flow Solutions

- High Reliability, No Moving Parts
- Dual Function, Flow and Temperature
- Line Sizes from 1/8" [3 mm] to Stacks and Ducts
- Widest Measuring Ranges
- Nuclear Safety Certified Versions
- Analog, Relays and Digital Bus Outputs
- Qualified to 40 Years Continued Service, Extendable to 60 Years

FCI flow instruments utilize thermal dispersion technology that applies the principle of measuring the heat loss, or cooling effect, created by a flowing fluid. Using two thermowell-encased precision RTDs, heat is applied to one to create a differential temperature between the two. The temperature difference is greatest at no flow. As flow velocity increases, heat dissipates and changes the magnitude of the temperature difference between the RTDs.



FCI offers the widest selection of thermal dispersion flow products, from models for metering virtually any gas to switch/alarms for most liquids, slurries and gases.

FCI technology offers fast response, accurate fluid sensing, field adjustable set points and factory installed temperature, pressure and flow capabilities to suit a broad range of safety monitoring and balance-of-plant applications. (See sample applications listed on page 13.)

	FLT93 Series	N-LT80 Series	LF87
	Flow Switches / Alarms		Flow Meters
Model/Series	N-FLT93 / FLT93 Series	LT81 / LT87	LF87
Key Features and Applications	<ul style="list-style-type: none"> • Heavy-Duty • Dual, 6A Relays • Exclusive Precheck Fail Guard • 3 year Warranty • SIL 2 Rated, 110 Year MTBF • High Pressure Ratings • N-Stamp Certified (opt.) 	<ul style="list-style-type: none"> • Nuclear Safety Certification • Dual Calibrations • Wide Flow Range • Analog and Relay Outputs 	<ul style="list-style-type: none"> • Nuclear Safety Certification • Extremely Low Flow Sensitivity (1 GPM [3,8 l/min]) • Virtually No Pressure Drop • N-Stamp Certified (opt.) • Design Temperature to 650 °F [343 °C]
Media Compatibility	Air ■ Gas ■ Water ■ Other Liquids ■	Air ■ Gas ■ Water ■ Other Liquids ■	Air ■ Gas ■ Water ■ Other Liquids ■ (Borated)
Installation Type	Insertion ■ In-Line (spool piece) ■ (FLT93L)	Insertion ■ In-Line (spool piece) ■ (LT87)	Insertion ■ In-Line (spool piece) ■
Measurements and Outputs	Flow Rate ■ Total Flow ■ Temperature ■	Flow Rate ■ Total Flow ■ Temperature ■	Flow Rate ■ Total Flow ■ Temperature ■
Media Temperature Service	FLT93: -100 °F to 850 °F [-73 °C to 454 °C] N-FLT93: -100 °F to 577 °F [-73 °C to 303 °C]	-100 °F to 350 °F [-73 °C to 177 °C]	50 °F to 125 °F [10 °C to 52 °C]
Wetted Materials Available	Stainless Steel, Hastelloy, Monel, Tantalum, Others	Stainless Steel, Hastelloy	Stainless Steel
Transmitter Outputs and Displays	Analog Outputs ■ Pulse Output Total Flow ■ Relay/Contact Closure ■ Digital Serial Output ■ Bus Comms ■ Other ■ Digital Display ■	Analog Outputs ■ Pulse Output Total Flow ■ Relay/Contact Closure ■ Digital Serial Output ■ Bus Comms ■ Other ■ Digital Display ■	Analog Outputs ■ Pulse Output Total Flow ■ Relay/Contact Closure ■ Digital Serial Output ■ Bus Comms ■ Other ■ Digital Display ■
Transmitter Mounting	Integral ■ Remote ■	Integral ■ Remote ■	Integral ■ Remote ■
Nuclear Safety Certification	■ (N-FLT93)	■	■
Radiation	Sensor: 8 x 10 ⁵ RADS; 2 x 10 ⁸ RADS based on analysis Electronics: 5 x 10 ⁵ RADS	Sensor: 2 x 10 ⁸ RADS Electronics: 5 x 10 ⁵ RADS	Sensor: 2 x 10 ⁸ RADS Electronics: 5 x 10 ⁵ RADS
Aging	40 years at 150°F [66 °C], extendable to 60 years Relay: 5100 full load cycles	40 years at 150°F [66 °C], extendable to 60 years Relay: 50,000 full load cycles	40 years at 150°F [66 °C], extendable to 60 years Relay: 50,000 full load cycles
Seismic	<i>Sensor and Electronics:</i> Standard Temp (N-FLT93) Biaxial: 7 g SSE ZPA; RIM: 5.8 g SSE High Temp (N-FLT93 HT) Triaxial: 11.7 g SSE ZPA	<i>Sensor:</i> Biaxial: 8.1 g SSE ZPA RIM: 6 g SSE ZPA <i>Electronics:</i> Biaxial: 8 g SSE ZPA RIM: 6 g SSE ZPA	<i>Sensor:</i> Biaxial: 8.1 g SSE ZPA RIM: 6 g SSE ZPA <i>Electronics:</i> Biaxial: 8 g SSE ZPA RIM: 6 g SSE ZPA

MT86 / MT91



ST50/ST51/ST75/ST75 V



ST100 Series



Flow Meters

N-MT86 / MT86	ST50/ST51/ST75/ST75 V	ST100 Series
<ul style="list-style-type: none"> • Large Line, Stacks and Ducts • Multiple Sensors Automatically Averaged • Up to 16 Sensors per System • Nuclear Safety Certification 	<ul style="list-style-type: none"> • Low Cost • Compact Size • Dual Analog Outputs • Vortab® Flow Conditioning (ST75V) • Wireless IR Comm • SIL 1 Rated • Ex d Protection 	<ul style="list-style-type: none"> • Highest Accuracy • HART, Foundation™ Fieldbus, PROFIBUS PA, Modbus RS-485 • Triple Analog Output • Dual-Element Systems • VeriCal • SIL 1 Rated • Ex d Protection
■	■	■
■	■	■
■	■	■
■	■ (ST75)	■ (ST100L)
■	■	■
■	■	■
■	■	■
MT86: -50°F to 850°F [-45°C to 454°C] N-MT86: -50°F to 350°F [-45°C to 177°C]	0°F to 250°F [-18°C to 121°C]	-100°F to 850°F [-73°C to 454°C]
Stainless Steel, Hastelloy, Others	Stainless Steel	Stainless Steel, Hastelloy
■	■	■
Optional	■	■
■	■ (HART)	■ (HART, Foundation Fieldbus, PROFIBUS, Modbus)
■	Optional	Optional
■	■	■
■ (N-MT86)	Contact FCI	Contact FCI
* 2 x 10 ⁸ RADS N/A, mild		
* 40 years at 130°F [55°C], extendable to 60 years Electronics: N/A, mild		
* <i>Sensor:</i> Biaxial: 8 g SSE ZPA RIM: 4.5 g * <i>Electronics:</i> Biaxial: 8 g SSE ZPA RIM: 4.5 g		

* Model N-MT86 only

Flow Applications

- Effluent Stack Flow Monitoring
- HVAC - Air Monitoring
- Radiation Monitoring and Sampling Systems
- Fire Protection Flow Monitoring
- Chemical and Volume Control System Sampling
- Auxiliary Boiler Combustion Air Flow Balancing
- Diesel Combustion Air Flow Balancing
- N₂ Compressor Storage Flow
- H₂ Storage Flow
- Auxiliary Building Sampling
- Containment Building Sampling
- Fuel Storage Building Sampling
- Relief Valve Flow Detection
- Main Steam System Flow Monitoring
- Containment Building Pressurization Flow
- Valve Stem Leak Off Flow
- Drain Line Systems Flow
- Waste Gas Decay Tank Outflow
- Water Hammer Flow Prevention
- MSIV Leak Detection Alarm
- Power Operation Relief Valve Flow Sensing
- Reactor Heat Vent Flow
- Reactor Coolant Pump Seal Flow
- Reactor Pump Motor Cooling Flow
- Auxiliary Feed Water Pump Minimum Flow
- Tank Discharge Flow
- Ventilation Stack Flow
- Hydrogen Water Chemical Flow
- Vacuum Pump Flow
- Safety Injection System Flow
- Crib House Intake Flow
- Component Cooling System Flow
- Circulating Water System Flow
- Feedwater Systems Flow
- Generating Systems Flow
- Feedwater System Lube Oil Flow
- Generating System Lube Oil Flow
- Steam Dump Flow
- Containment Spray System Flow
- Water Treatment/Purification Systems Flow
- Circulating Water Systems Flow
- Service Water System Leakage Alarm
- LOCA Alarm Switch

Temperature Solutions

Nuclear Qualified Temperature Switches and Alarms

It is no surprise that FCI nuclear capabilities also include extremely accurate temperature switches and alarms. That is because FCI utilizes precision temperature measurement technology in its entire line of flow and level instruments.

FCI uses precision RTD sensing elements, joined with nuclear approved electronics and enclosures, to create highly accurate temperature measurement instruments for the most demanding nuclear industry applications. These instruments are produced in the same FCI nuclear industry certified manufacturing facility, using the same certified quality control processes, that are in place to ensure the quality and performance of FCI's level and flow solutions.

FCI products are highly adaptable and can be customized. For example, FCI's FLT93 Series Flow/Level/Temperature switches are easily configured for use as a temperature switch/alarm.

Versions with a single temperature sensing element, or a totally redundant dual-sensor system, can also be produced.

Relays can be precision-set for alarm trips on high/low, high/higher or low/lower conditions. These all-welded sensing elements measure in ranges from -100 °F to 850 °F [-73 °C to 454 °C] and provide process connection choices from NPT to flanged.

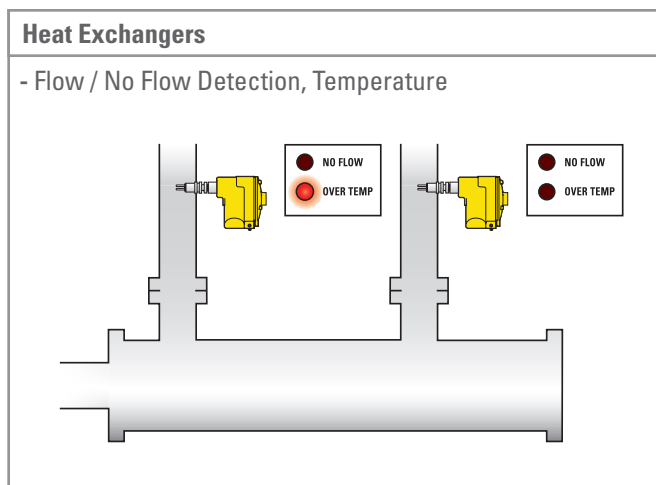
Just like FCI's flow meters and level switches, these temperature sensors achieve superior reliability and require

very little maintenance for the most demanding safety-rated and balance-of-plant applications. They are also easy to install.

Contact FCI with your application and engineering specifications to obtain details on a temperature instrument designed to match them.

Temperature Switches and Alarms — Available Capabilities

Sensor Type	RTD; Platinum, Balco, or others
Range	-100 °F to 850 °F [-73 °C to 454 °C]
Accuracy	±0.2 °F [±0.1 °C]
Repeatability	±0.1 °F [±0.1 °C]
Sensor Element Wetted Materials	316L Stainless Steel (std.)Hastelloy C-276, Monel, Titanium, others
Flow Element Construction	All Welded
Outputs/Control Circuit	Single Relay, Dual Relays, 4-20mA, other DC
Remote Mountable Electronics	Yes
Enclosure Type	All Metal, Fiberglass; NEMA 4 or NEMA 4X [IP67]; Rack-Mount
Power Supply	AC or DC
Nuclear Safety Rated	Yes



Temperature Applications

- High Energy Line Break (HELB) Room Temperature Transmitter
- Reactor Coolant Loop Temperature
- Turbine/Feedwater Temperature
- Containment Building Temperature
- Heat Sink Temperature
- Containment Fan Cooler System Temperature
- Circulating Water System Temperature
- Component Cooling System Temperature
- Spent Fuel Pit Cooling System Temperature
- HVAC: Temperature Monitoring, Switching
 - Crib House Intake Temperature
 - Control Room Temperature
 - Heater Bay Temperature
 - Turbine Room Temperature
 - Containment Building Temperature
 - Fuel Storage Building Temperature
 - Sampling Room Temperature
 - Chem Lab Temperature

Flow Conditioning Solutions

Flow Conditioners Reduce Piping, Improve Plant Efficiency

Flow conditioners are an effective, proven solution for reducing pipe straight-run requirements needed to achieve accurate, repeatable flow meter measurements and for improved reliability and long-life operation of pumps, compressors and control valves.

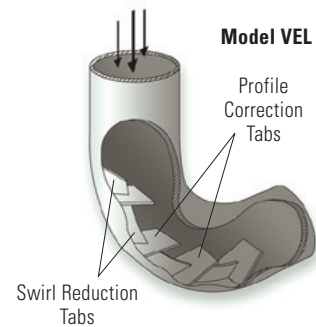
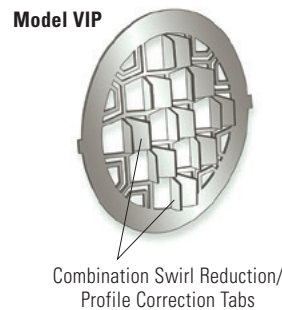
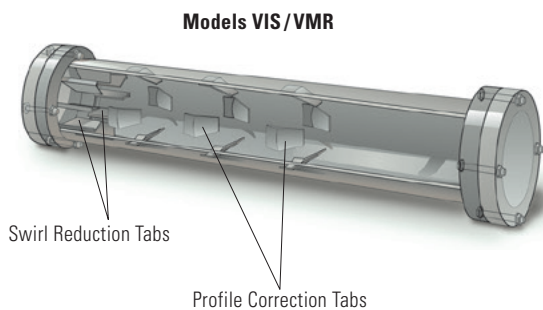
Conditioning For Flow Meters

- Reduce Flow Meter Straight-Run Requirements up to 75%
- Eliminates Profile Distortions and Swirl
- Lowest Pressure Drop Technology
- Improves All Flow Meter Measurements:
 - Thermal
 - Ultrasonic
 - Magnetic
 - Vortex Shedding
 - Turbine Meters
 - Pitot Tube

Conditioning for Process and Plant Equipment

- Increase Pump and Compressor Efficiency
- Decrease Pump Noise, Cavitation and Maintenance Intervals
- Improve Process Temperature and Pressure Stratification

Swirl Reduction & Profile Conditioning Tabs – Swirl reduction is achieved by generating small vortices (swirls) opposite the main swirl resulting in swirl degradation. Profile conditioning tabs produce vigorous cross-stream mixing, which rapidly mixes faster velocity regions with slower regions. This mixing quickly produces a homogenous (i.e. conditioned) velocity profile. Combining anti-swirl with profile correction mechanisms also benefit equal distribution of particulates and temperature gradients. Static mixing is another side benefit of all Vortab products.



Patented Vortab® flow conditioners, supplied by FCI, provide technology recommended most by flow and process control experts to eliminate both flow swirl and flow profile distortions.

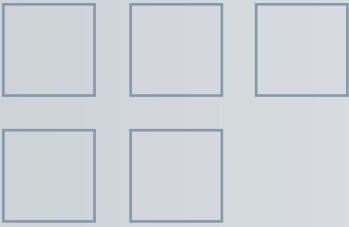
Vortab creates repeatable flow in as little as 7 pipe diameters. With process equipment and flow meters specifying 20, 35 and even up to 100+ pipe diameters for proper operation, the savings in pipe run are obvious and can be dramatic.

Vortab technology creates the least pressure drop and therefore results in a significant savings in energy costs over other flow conditioning techniques. Finally, because Vortab does not have

constriction holes or orifices they are immune to clogging and fouling.

Vortab flow conditioners are available in mechanical designs to meet your installation parameters. A spool-piece meter run section, an insertable sleeve, a field weldable kit, an elbow piece and an insertion plate (VIP) are available to accommodate a variety of installation needs.





**FCI FLUID COMPONENTS
INTERNATIONAL LLC**

Locally Represented By:

Visit FCI online at www.FCINuclear.com | FCI is ISO 9001 and AS9100 Certified

FCI World Headquarters

1755 La Costa Meadows Drive | San Marcos, California 92078 USA
Phone: 760-744-6950 **Toll Free (US):** 800-854-1993 **Fax:** 760-736-6250

FCI Europe

Persephonestraat 3-01 | 5047 TT Tilburg, The Netherlands | **Phone:** 31-13-5159989 **Fax:** 31-13-5799036

FCI Measurement and Control Technology (Beijing) Co., LTD | www.fluidcomponents.cn

Room 107, Xianfeng Building II, No.7 Kaituo Road, Shangdi IT Industry Base, Haidian District | Beijing 100085, P. R. China
Phone: 86-10-82782381 **Fax:** 86-10-58851152

Fluid Component Saudi Arabia, LTD

King Saud Bin Abdulaziz Street, Near Kanoo Building | Al Rabea District | PO Box 3422, 31471 Dammam | Kingdom of Saudi Arabia
Phone: 966-128351500 ext 605 **Fax:** 966-138311500

