

Instrumentation for **Nuclear Applications**



Nuclear Instrumentation Overview

Delta Mobrey has been designing and manufacturing instrumentation for the power and process industries for over 65 years and has served the nuclear industry in the UK since the first nuclear reactors were designed and built over 55 years ago.

A specialist in pressure, temperature and flow instrumentation, Delta has provided a range of generic and bespoke instruments to the industry across all the UK Nuclear Fleet including Magnox, AGR, PWR and PFR.

Delta has also worked extensively on decommissioning projects, fuel processing and reprocessing, working with Sellafield (formerly BNFL), Westinghouse and the UKAEA.

Available instruments include products that meet the RCC-E and IEEE Class 1E requirements for seismic and radiation endurance. Tests details are given in the Testing Summary Table opposite. The IEEE tests are equivalent to RCC-E level K2. Many products also meet SIL 2 requirements and numerous international Hazardous Area approvals.

Products are used within containment, in the nuclear island, in safety shut down applications, critical areas of process control, alarm and general process monitoring.

Delta has worked in the worldwide nuclear industry for over 40 years with projects in China, Sweden, Finland, South Korea, the USA, Canada, India and Spain on PWR, BWR and CANDU reactor types.

Microswitches

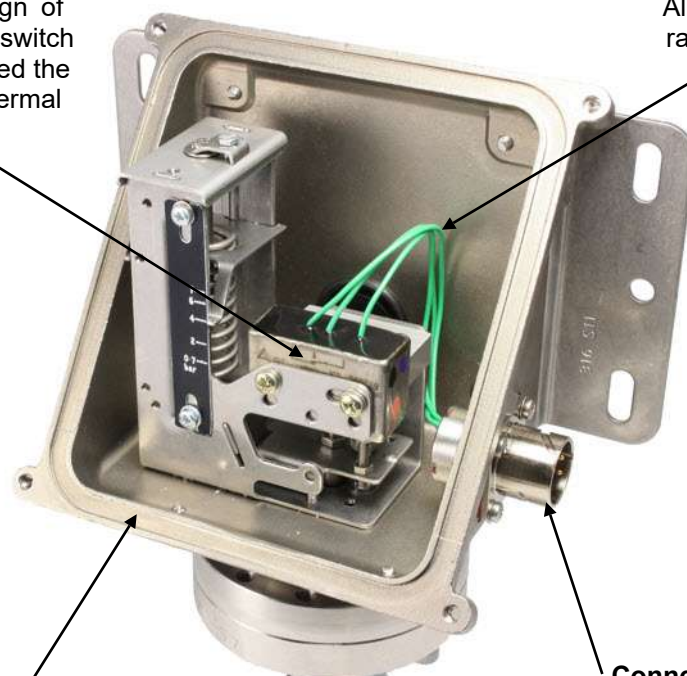
Delta Mobrey's own design of Hermetically Sealed Microswitch has been tested and passed the DBE LOCA event after thermal and radiation aging.

Wires

All wires used are Habia with radiation resistant sleeving

Housings

Delta's all stainless steel construction provides the highest quality enclosures for all the Nuclear Qualified products.



View inside a Nuclear Switch showing the microswitch, mechanism, wires and connector

Connectors

A number of different connectors have been tested on our products including the Harting 7D, the Souriau 8N45S and the EGS Quick Disconnect Connector (QDC)

Nuclear Instrumentation Overview



*Nuclear 300 Series
Differential Pressure Switch*



*Nuclear S20 Series
Pressure Switch*



*Nuclear 200 Series
Pressure Switch*



*Nuclear 700 Series
Temperature Switch*



*Fast Response
Temperature Switch*



*Air Flow
Transmitter / Switch*

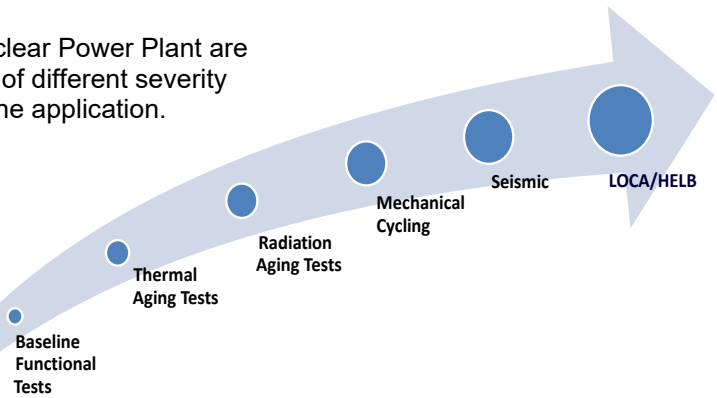
Nuclear Switch Test Programme

Nuclear Product Qualification

Instrumentation used in the Nuclear Island of a Nuclear Power Plant are required to survive seismic and radiation exposure of different severity levels depending on the location on the plant and the application.

Delta has subjected various instruments to testing regimes that meet the requirements of IEEE Standard 323-1974, IEEE Standard 344-1975 and the RCC-E Code (Design and Construction Rules for Electrical Equipment of Nuclear Islands).

This qualification involved the accelerated ageing of the products (thermal aging, radiation aging, mechanical cycling) before subjecting them to SSE/DBE seismic profiles and finally a LOCA/HELB accident simulation. The product's performance was checked before and after each test and compared with the baseline functional tests conducted at the beginning of the programme.



Baseline Functional Testing

These tests, designed to establish baseline conditions prior to testing, included:

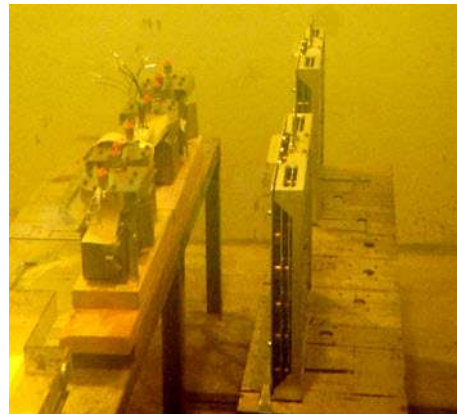
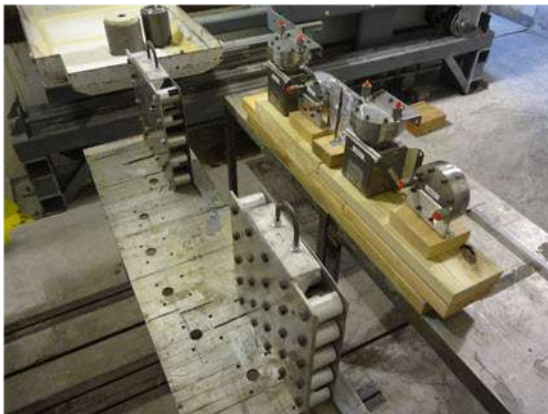
- Contact Rating
- Insulation Resistance
- Operability

Thermal Aging

The switches were thermally aged at 122°C for 1053 hours to simulate an end-of-life condition after 20 years. This accelerated aging was performed according to the Arrhenius model and based on the lowest activation energy of the non-metallic materials used in construction.

Radiation Aging

A number of the switches were exposed to a Total Integrated Dose (TID) of 17.82 MRads at a rate of 0.25 MRads/hr using Cobalt 60 gamma rays to achieve the end-of-life condition expected after being exposed to both normal and accident conditions. Other switches were exposed to a TID of 27.5 MRads.



Delta Switches undergoing radiation testing

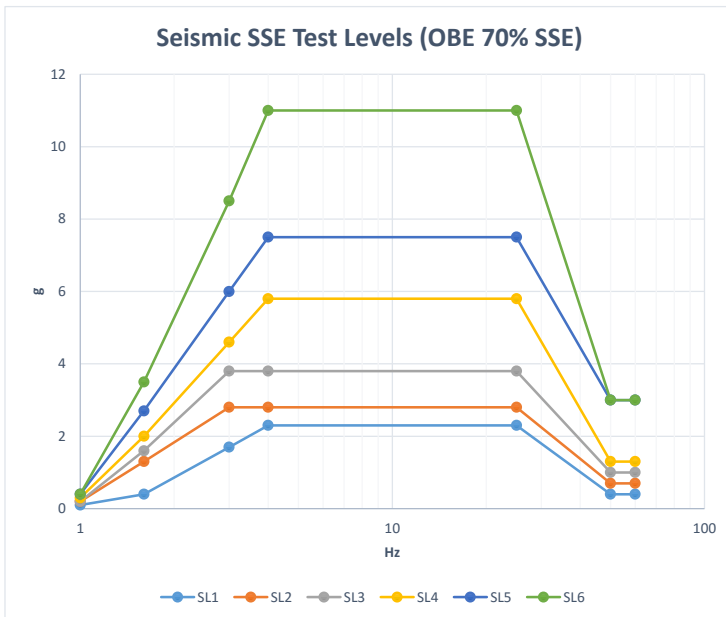
Mechanical Cycling

The Switches were cycled a minimum of 1000 times, actuating the switches for 15 seconds then de-actuating them for 15 seconds, while monitoring and recording the current across a precision resistor throughout the test to ensure correct operation. The purpose of this was to mechanically age the product by simulating the typical number of actuations over a 20 year period for a specific alarm application.

Nuclear Switch Test Programme

Seismic Qualification

In separate test programmes Delta's products were seismically tested using the random multi-frequency (RMF) test requirements of Standard IEEE 344-1975/1987 and were subjected to tri-axial RMF test levels as shown below, and also to the spectra as defined in the RCC-E Code



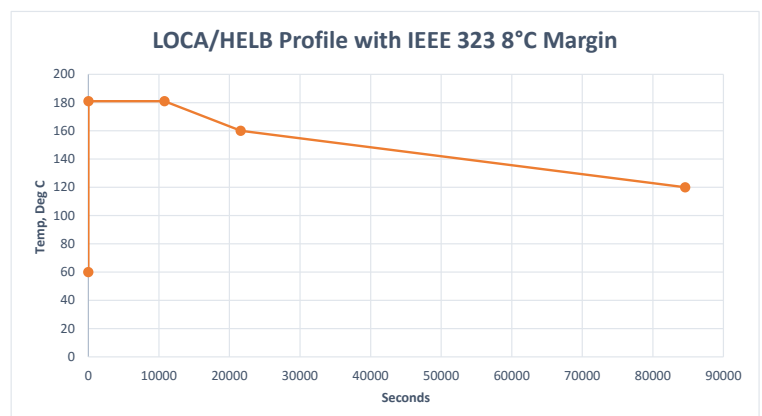
Delta Switches being seismically tested at the SOPEMEA test facility in France to the RCC-E seismic spectra

LOCA/HELB Accident Simulation

Following the aging programme and the seismic tests the products were subjected to a HELB (High Energy Line Break) / LOCA (Loss of Coolant Accident) simulation. This exposed the products to 173°C superheated steam for 3 hours at 550KPa abs, and 160°C for 6 hours and 24 hours at 120°C with saturated steam.



Delta Switches mounted in LOCA chamber



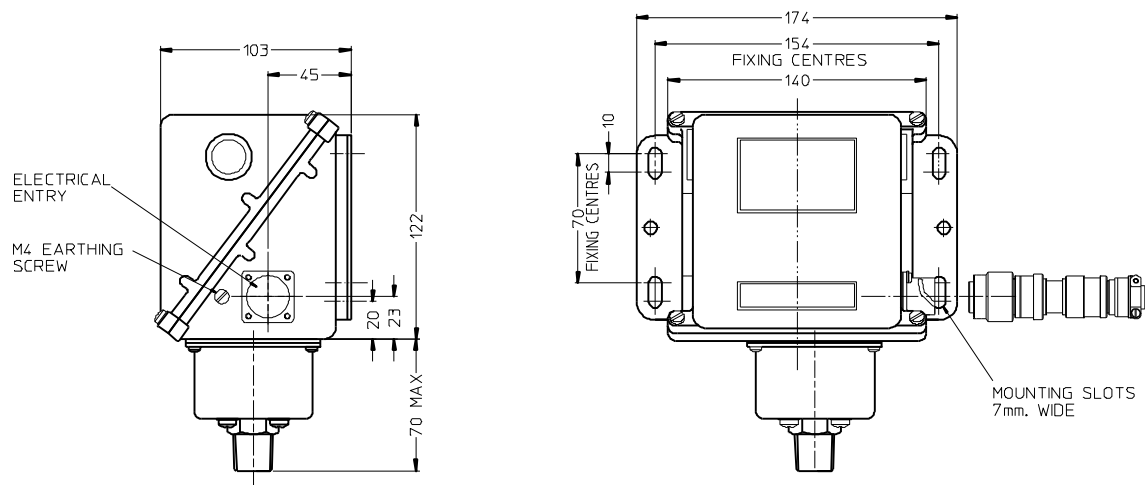
Nuclear Grade Pressure Switch

200 Series

- Qualified Harting 7D, EGS QDC and Souriau connectors available
- Delta Mobrey Microswitch tested to meet requirements of RCC-E K2
- Best in class accuracy of $\pm 0.5\%$
- FEP and EPDM seals and gaskets suitable for exposure to radiation
- Weatherproof and Flameproof models Ex d IIC - ATEX
- Ranges available up to 75 Bar (1,000 psi)
- Precision stainless steel mechanism for arduous atmospheres and high humidity
- Set point adjustable over whole range against calibrated scale with tamperproof adjustment
- Precise and accurate operation guaranteed by use of hydraulic formed bellows or capsule stack
- Models for fixed and adjustable switching differential
- Safety vented or blow out device as standard



Dimensions



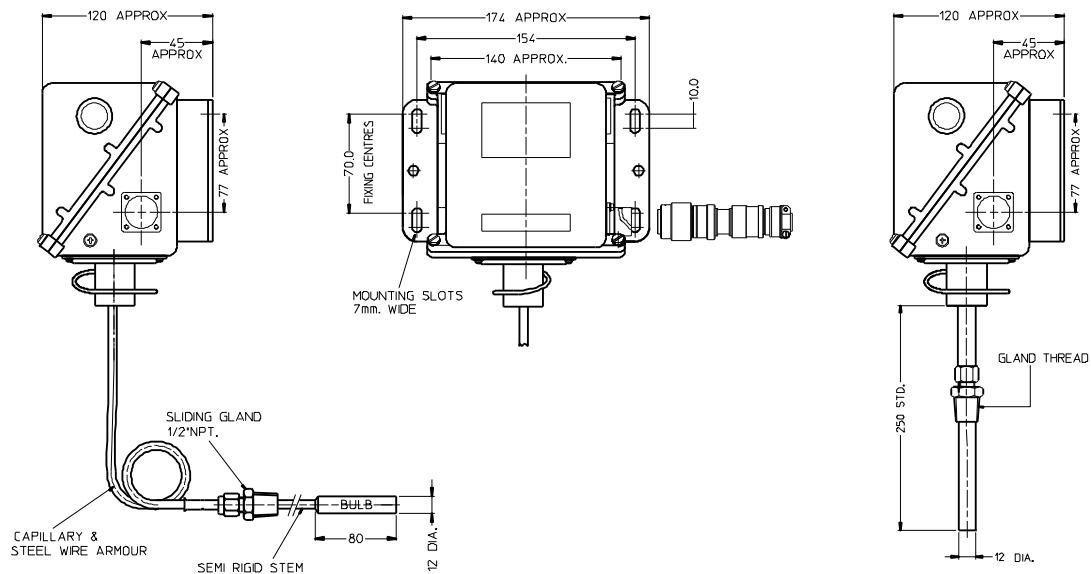
Nuclear Grade Temperature Switch

700 Series

- Qualified Harting 7D, EGS QDC and Souriau connectors available
- Delta Mobrey Microswitch tested to meet requirements of RCC-E K2
- Best in class accuracy of $\pm 0.5\%$
- FEP and EPDM seals and gaskets suitable for exposure to radiation
- Weatherproof and Flameproof models EEx d IIC - ATEX
- Set point ranges up to 300°C (580°F)
- Rigid and semi-rigid thermal system options
- Precision stainless steel mechanism for arduous atmospheres and high humidity
- Set point adjustable over whole range against calibrated scale with tamperproof adjustment
- Models for fixed and adjustable switching differential
- Safety vented or blow out device as standard



Dimensions

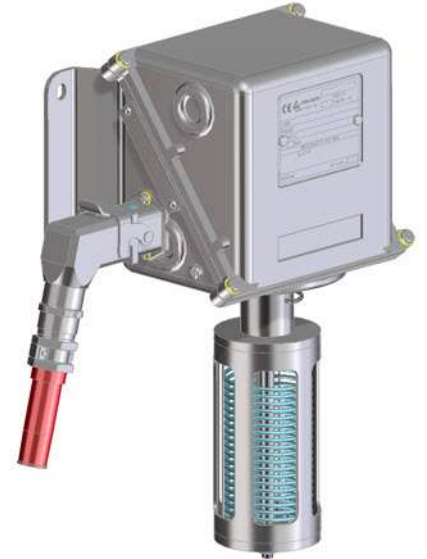


Fast Response Temperature Switch

720 Series

Fast reaction air temperature switches are used throughout a nuclear power plant to detect sudden rises in ambient temperature. Delta has optimised the design of this product to react very quickly to temperature change and can provide fast early warning of possible problems in the plant.

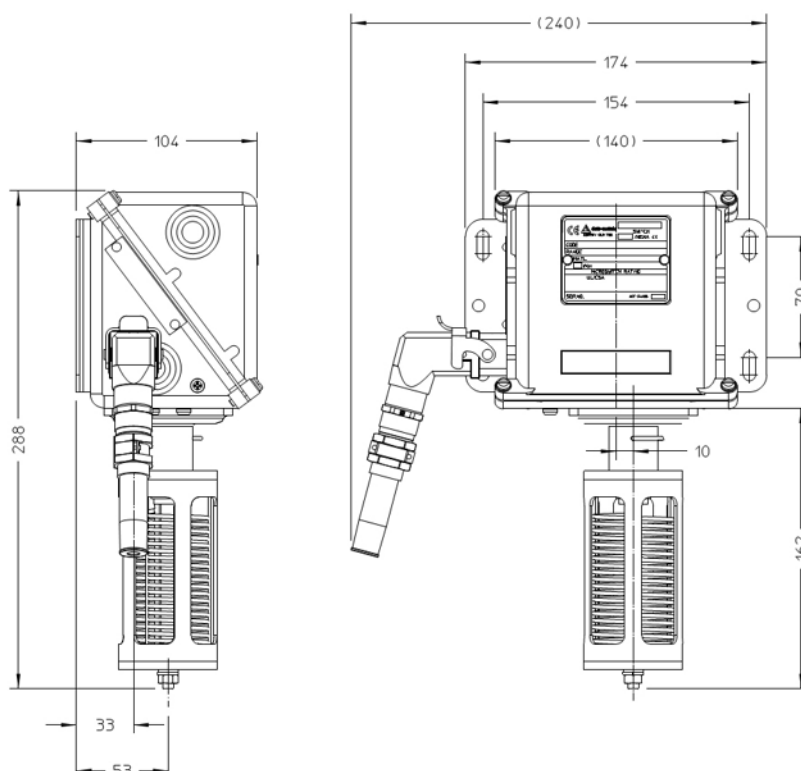
This model consists of a sensing element manufactured from thin walled copper tube filled with a volatile fluid. By keeping the length to diameter ratio high, the surface area of the sensing element is maximised achieving a faster response to temperature changes than more traditional types.



The element is coiled into a helix and mechanically supported and protected by a shroud without impairing sensitivity to changes in ambient temperature.

Response times will vary depending on the movement of the surrounding atmosphere. Depending on the location, air movement and ambient temperature, response times can be expected within seconds

Dimensions



Air Flow Transmitter / Switch

588 Series – EMPHASIS Assessed – Smart Instrument

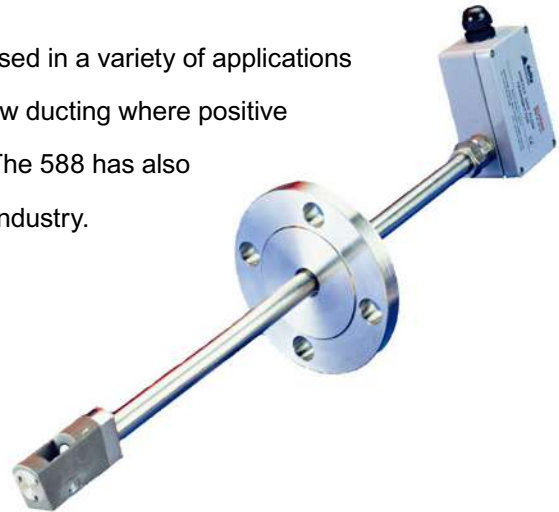
The 588 Series of Flow Transmitters and Switches have been used in a variety of applications in the nuclear industry including HVAC systems and other air flow ducting where positive measurement of Flow is critical for plant and personnel safety. The 588 has also undergone EMPHASIS Assessment for use in the UK Nuclear Industry.

The latest variant of the Flow Transmitter has an integrated switch for simple alarm applications.

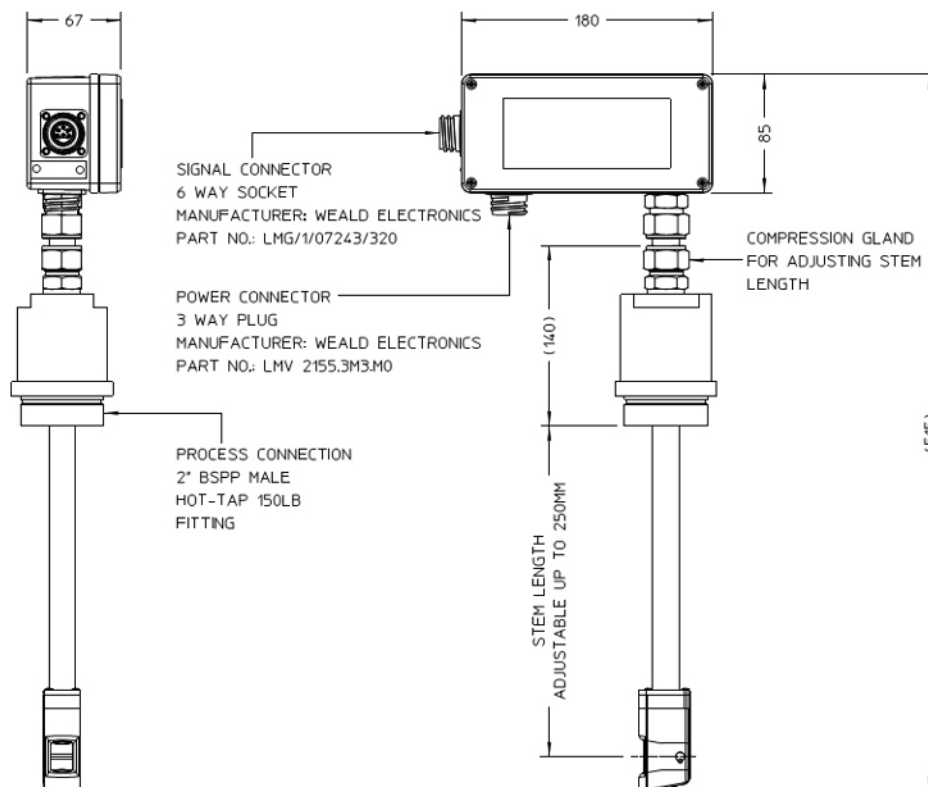
The Transmitter is SIL 1 Level certified.

Flow rates from 0.8 m/s and up to 38.5 m/s

Small bore diameter flow transmitters are also available



Dimensions



Level Measurement

Delta Mobrey is one of the leading companies worldwide for the design and manufacture of robust, reliable and competitively priced industrial and high performance transmitters and switches - all internationally approved for use in hazardous areas for control, safety alarm and shutdown applications. Delta Mobrey is also now the supplier of all Mobrey and KDG products, complementing the range with level measurement and nuclear qualified transmitters.

Instrumentation for the Power Industry

The power generation industry is changing rapidly, driven by growing demand, and increasing economic and environmental pressures. Choosing the right level measurement instrumentation not only helps keep your power plant and personnel safe, but also increases operational efficiency.

Turbine water ingress prevention (TWIP)

Ultimate protection of plant and increased personnel safety.

Mobrey Hydratect Water Detection System



Condensers

Ensure continuous feedwater to boiler feed pump with accurate level monitoring and control.



De-aerators

Ensure continuous feedwater to boiler with accurate level monitoring and reliable high/level alarms.

Mobrey Hydrastep Water/Steam Monitoring System
Mobrey Magnetic Float Switches

Condensate pots

Eliminate false trips with reliable detection of steam/water.

Mobrey Hydratect Water Detection System
Mobrey Magnetic Float Switches

Auxiliary plant processes

Increased safety and efficiency with flexible, reliable level monitoring and control of tanks and sumps.

Vibrating Rod
Level Measurement



Feedwater heaters

Prevent dangerous flood or low condensate level conditions and increase efficiency with reliable high/low level alarms.



Ultrasonic Level
Measurement

Steam drum

Exceptional protection against costly and potentially disastrous low water levels.

Mobrey Hydrastep Water/Steam Monitoring System



LK Hydrastep Electrodes

About Delta Mobrey

Delta Mobrey, has built a global reputation over 65 years for its expertise in the design and manufacture of reliable, high quality instrumentation for the power and process industries. Delta offers both customised and standard solutions for process monitoring, alarm and shutdown applications, backed by local support from a worldwide network of carefully selected, professional and fully trained representatives. Now with a more comprehensive range of measurement techniques.

Quality is a cornerstone of the company's success. This is recognised by industry and international approvals that cover every aspect of Delta Mobrey's manufacturing, test and product portfolio.

Service and Support

Delta Mobrey is totally committed to delivering the best possible customer service and technical support reducing the lifetime cost of ownership while providing long term security - for one-off engineering specials through to large volume, more standard requirements.

To add value for each customer, a flexible responsive approach to meeting individual instrumentation requirements has been put in place. Delta

Mobrey's support infrastructure includes:

- Technical advice
- Spare parts
- Recalibration
- Tailored accessory packages
- Installation support
- Operations and maintenance assistance
- Comprehensive documentation
- Extended warranty
- Local support

Special Engineering

In addition to offering over 1 million product variants, Delta Mobrey can also provide custom engineered solutions to meet your exact requirements. The complexity of special engineering can vary from a simple change in process connection to a completely redesigned product to meet specific performance criteria.



Vertical Level Measurement

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