Advanced Technology Flow Logging

FOR SEWER MONITORING UNDER ATEX DIRECTIVE

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Recent innovations in open channel flow measurement have improved reliability, data integrity, and cost effectiveness in sewer flow studies. But intrinsic safety requirements for in-sewer equipment in the UK (and pending in other European countries) have presented a challenge in adapting this highly successful technology to meet ATEX standards.

To meet this challenge, Teledyne Isco (Lincoln NE, USA) enlisted the help of UK distributor, Envitech Ltd. in conferring with end users, regulatory bodies, and consultants, to adapt the Isco 2100 Series modular flow meters for the ATEX standard.

The resulting new 2150EX Area Velocity Flow Monitoring System has full ATEX approval while retaining the functionality of the standard 2100 Series for wastewater flow applications.

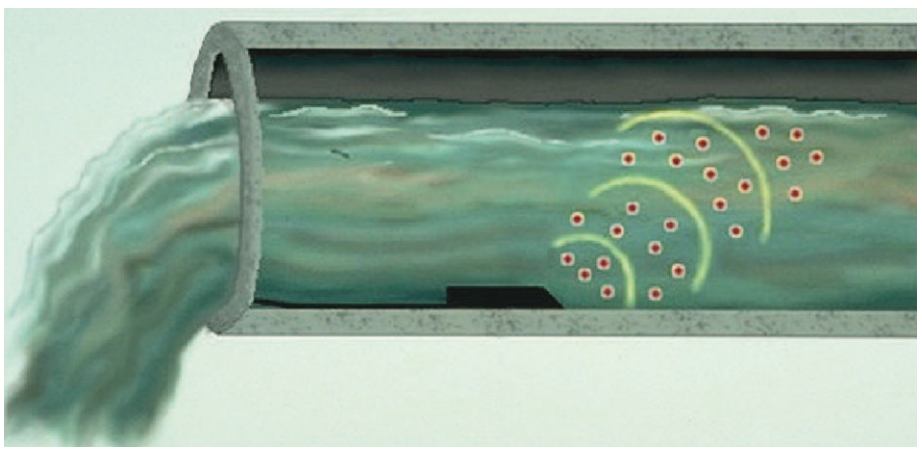

Figure 1. Isco's Area Velocity flow meters use optimized Doppler technology to accurately measure flow velocity over a wide range of pipe sizes and particulate loads.

UK Wastewater Flow Measurement

Three areas of activity exist: Industrial and municipal discharge to water course, Industrial discharge to sewer, and sewer network flow monitoring, the latter two being particularly suitable for Area/Velocity technology.

- Industrial discharges to sewer require flow records for charging purposes. The methods used are not subject to any particular legislation or certification, other than those of safety. Area velocity is a favoured method, requiring no primary structure and having relatively low capital costs.
- A major requirement is sewer network flow monitoring. Measurement has to take place "in-pipe" with no primary structure, making area velocity meters the method of choice for use in the next major municipal capital expenditure programme (AMP 4).

UK AMPs

The demand for sewer monitoring equipment in the UK has been inextricably linked to the Asset Management Plan (AMP) of the time and its particular technical focus.

Five-year capital expenditure periods, or AMPs, were initiated in 1990. The focus of AMP1 was to alleviate sewer flooding, which had become severe in the 1980's and was now subject to various EU legislative requirements. Large numbers of flow loggers, samplers, and depth gauges were required, along with an organisational structure for delivering data, analysing results, allocating resources, and implementing actions.

AMP2 swung away from sewer investment and into "clean water networks", which had attracted bad press due to severe leakage problems. AMP3 saw another change of emphasis, being driven primarily by "Water Environment" issues. This focussed on "Unsatisfactory Intermittent Discharges" (UIDs) from wastewater works, storm discharges, and especially sewer surcharges, and required equipment for monitoring frequency, quality, and flow of discharge, together with quality of receiving water.

The latest AMP4 period for 2005-2010 includes a two-prong attack: the first, to complete the work on UIDs from AMP3; the second, to revisit the sewer flooding problems originally addressed in AMP1.

Organisational Structure

Virtually all of the sewer monitoring, modelling, and renovation program has been led by EU legislation. Essentially, the EU sets the policy, and the UK regulators (Environment Agency) strategically deploy through the issuing of consents and initiation of prosecutions.

Network owners and operators (the Water Companies) assess priorities, allocate resources, employ consultants, and retain flow survey companies to provide data for verification of the predictive models.

Environmontel, a newly formed and fast growing flow survey company, purchased several units of the 2150EX to help fulfil their contracts under the AMP4 programme.

Monitoring Requirements

In AMP3, the flow loggers were deployed for about 3 years, covering very large catchment areas. Each survey would last a nominal 13 weeks. In practise this could range from 5 to 20 weeks, but had to include 3 or more significant storm events.

The current AMP4 monitoring period is not yet fully established. It is anticipated that the peak number of flow loggers deployed will be somewhat less than AMP3. However, over the past 5 years, safety requirements for equipment deployed in sewers have changed somewhat.

Virtually all in-sewer locations in the UK are now categorised as Zone 1, based on the IEC and CENLEC standards. Table 1 shows the hazard and zone rating under both European and North American systems. Sewers fall into Class 1. Subdivision into "Zones" is based on the probability that a potentially explosive gas atmosphere may be present in a given location. Table 2 shows the difference between the zones:

Figure 2. Modular, stackable design of the Isco 2100 Series allows compact configuration for redundant and multi-stream measurements. Left: the standard 2100 Series shown with Area Velocity and Modem Modules stacked on battery module. Centre: the 2151 models are rated for CSA Class 1 Div 1. Right: The 2150EX described in this article is approved under ATEX standard for Zone 0 locations.

Figure 3. Quick, simple setup and deployment are popular features with field crews.

The ATEX Directive

The major change is the implementation of the ATEX directive, applicable throughout the EC. Since January 7, 2003, it has been mandatory for manufacturers to comply with the terms of the directive. Its scope is much wider than the old voluntary product certification schemes, and now requires CE certification and QA audit systems, as well as IS requirements. In short, it is now a legal requirement that any product sold for use in potentially explosive environments must be fully ATEX approved. This requirement is common across Europe. Differences in implementation between constituent countries stem from zone ratings assigned to different locations. Currently, the UK and Germany rate municipal sewer environments as Zone 1.

Regardless of developments in other countries, there is a clear need under the ATEX directive for area velocity flow loggers that are rated for deployment in potentially hazardous areas.

Isco 2150EX Flow Logger

The Isco 2150EX measures depth using a pressure transducer, and liquid velocity using Doppler shift (See Figure 1). Several features are incorporated to ensure measurement reliability. Shielding of the ultrasonic emitter and receiver removes interference from other sensors or stray reflections. Depth signals are processed and digitized by a microcontroller encapsulated within the sensor, further reducing noise and signal instability, and virtually eliminating level drift. Flow measurement remains accurate during surcharges, and even when flow is reversed.

The Doppler technology also allows a true average velocity to be determined across the pipe section, instead of relying on point measurement. The low profile sensor allows operation in only a few centimetres of liquid. Recent Environmontel surveys have proven successful deployment in 150mm pipes.

Modular design permits multiple units to be stacked together, enabling multi-channel measurement or redundancy (figures 2 and 4). For portable applications, the 2150EX can be powered by either rechargeable lead-acid batteries or by high-capacity lithium batteries, which provide up to 8 months operation when using a 2-minute data storage interval.

In permanent installations, the 2150EX is connected via a network interface cable to a network isolator module located in the safe area. The network module provides the power supply as well as the network or PC data connection.

Setup and data management are handled with Isco's Flowlink¨ software. Data may be exported into other software packages, or independent data may be imported into Flowlink software and manipulated along with the flow data. For flow meters deployed in sanitary sewers, the physical integrity of the casing, sensor, and cables is clearly an important consideration. This was tested under extreme conditions in the US during the September 2004 events of Hurricane Ivan (Figure 5). The rainfall and storm surge completely flooded sewers in Mobile, Alabama – including installed flow loggers – to depths of 15 feet or more. However, the 2150 flow meters continued to record accurate data.

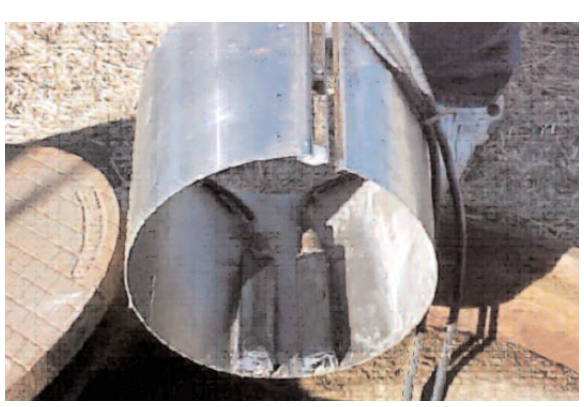

Figure 4. Dual area velocity sensors in mounting ring.

Table 1. Class/Division and Zone systems for hazardous locations.

Hazardous Materials	Class/Division System	Zone System[1]
Gasses or Vapors[1]	Class I, Division 1 Class I Division 2	Zone 0 Zone 1 Zone 2
Combustible Dusts[2]	Class II Division 1 Class II, Division 2	Zone 20 Zone 21 Zone 22
Fibres or Flyings	Class III Division 1 Class III, Division 2	No Equivalent

Table 2. Zone ratings based on probability of explosive atmosphere.

Grade of Release	Zone	Flammable Mixture Present
Continuous	0	1000 hours per year or more (10%)
Primary	1	Between 10 and 1000 hours per year (0.1% to 10%)
Secondary	2	Less than 10 hours per year (0.01% to 0.1%)
Unclassified	–	Less than 1 hour per year (less than 0.01%)

UK Applications

In using the 2150EX to help satisfy recently won framework contracts, the Environmontel consultancy in Worcester reports that the 2150EX found favour with management and site crews alike. The physical configuration is light to carry, easy to install and set up, and requires very little maintenance due to the depth measurement stability. The quick release connectors - as well as the interchangeability of cables and sensors without the need for recalibration – also improve the efficiency of on-site setup. (Figure 3).

With one eye on the future, Mike Leafe of Environmontel has expressed interest in the remote telemetry capabilities offered by the Isco hardware. Current UK contract conditions require weekly visits to logging sites. Historically, this requirement is to ensure that level measurement calibrations are kept accurate; however, the new technology eliminating level drift removes this reason for mandating the frequent site visits. Remote surveillance with site attendance according to need is far more cost effective and offers savings to both survey provider and end user alike. Hopefully, contract requirements will soon reflect these technical capabilities, producing benefits for all.

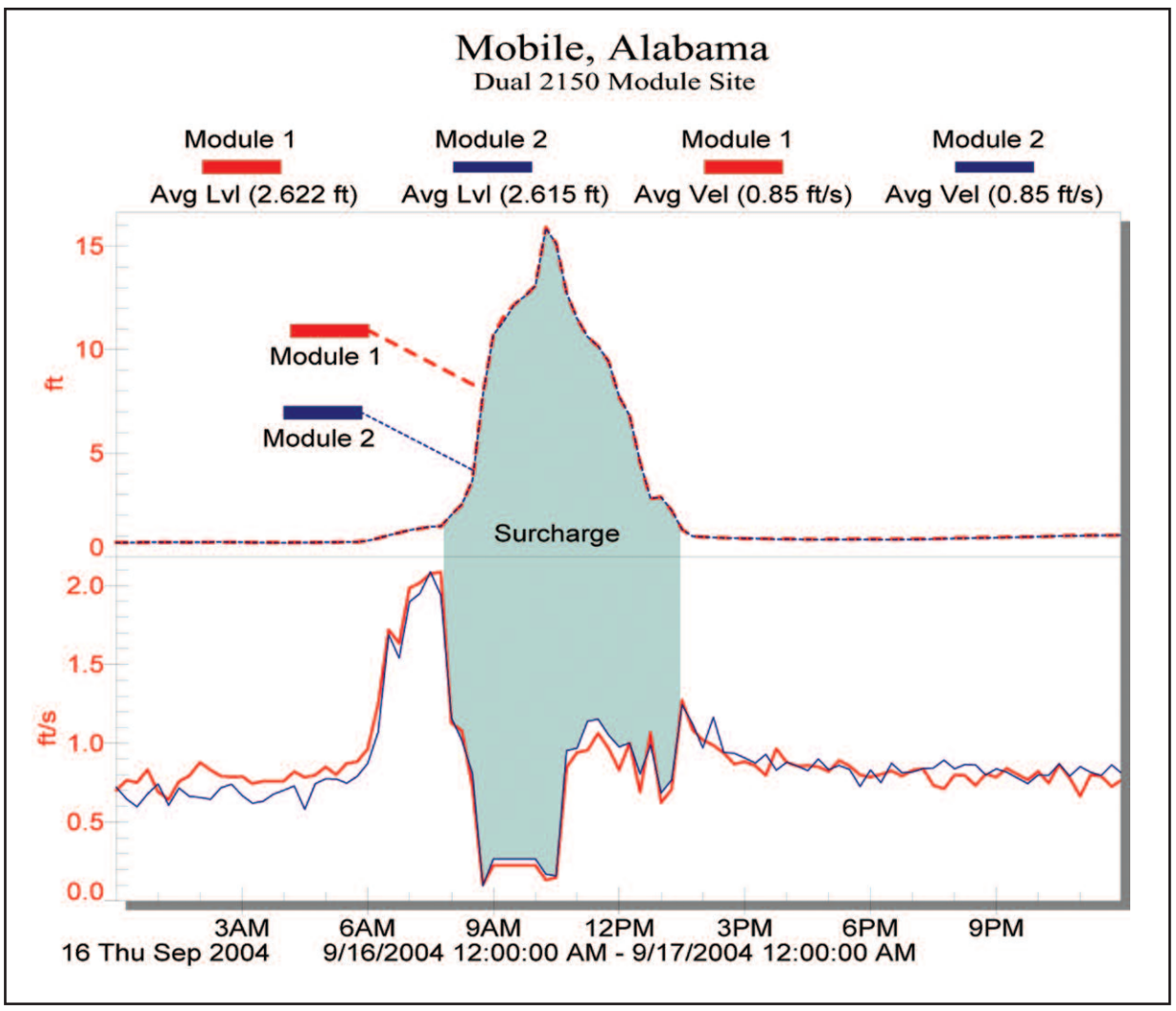

Figure 5. Flow and level recorded by Isco 2150 meters in Mobile, Alabama during Hurricane Ivan. Measurements returned to normal without recalibration after this extraordinary sewer surcharge event.