Tracerco News

Volume 3 Edition 3

Delivering Precision Diagnostics Worldwide.

Cost Effective Methods Used For Monitoring Flare and Other Piping Systems

By Lowell Pless, *Business Development Mgr – Distillation Applications* and Justin Tippit, *Senior Technical Specialist*

Accurate flare gas flow measurement is a critical requirement to the refining and petrochemical industries to ensure regulatory compliance and reduce or eliminate the loss of valuable process material. Issues with either of these can cost a refinery or chemical plant reputational harm due to the additional greenhouse gases released into the environment and millions of dollars each year in profits. Predictive maintenance programmes can help operators identify and isolate fugitive emissions, measure flow rates, locate leaking process safety valves (PSV), detect pipeline blockages and calibrate or monitor flare line flow meters.

Tracerco is often contacted by our customers to help with problems such as:

- identification of unit fugitive gas flow or excessive flow to the flare,
- identifying the location of solid or liquid accumulations in flare lines,
- inaccurate flow meters,
- leaking PSV, block, or relief valves

Tracerco offers flow rate and leak testing applications, pipe scanning and meter proving services that are routinely applied to plant piping systems. These are fast, accurate, and cost effective methods to determine the flow of vapour, carry over of liquid, build-up of sludge and fouling materials in piping, and the calibration of flow meters.

Diagnosing Fugitive Flare Flow…

TRACERCO Diagnostics™ flow studies can provide information on where excess gas is entering a flare system, either on a unit or equipment level. As well as determining the source of the flow, Tracerco's flow measuring capability also determines the volume and thus the value of the material being lost to the flare.

Isolating Fugitive Flare Flow

A refinery requested a flow rate analysis to be conducted on various units connecting into their main flare header to determine the overall flow to the flare and specific unit contributions. The study involved several days of data collection using tracer injections into the flare lines and strategically placing sensitive detection devices externally on the piping to monitor the tracer's position and movement. The initial overall average flow rate to the flare was observed to be 26,000 standard cubic metres per day, substantially higher than the refinery expected.

Flow rate data was collected from each unit sub-header to the main flare header. The data revealed substantial portions coming from four specific tie-ins with the largest contributor being the Crude and SRU/SCOT Tail Gas Units. (Figure 1, page 2) Further investigation was carried out within these units to identify the sources of the flow.

In this specific refinery, natural gas is added to the flare sub-headers to ensure continuous flow. This is commonly known as sweep gas and can be costly when not regulated properly. Flow rate analysis of the sub-header in the Crude/SRU/SCOT Tail Gas Units found the sweep gas to be 1,400 standard cubic metres per day higher than necessary with the cause of the problem found to be a failure to re-install a restriction flow orifice in the sweep gas line following a turnaround.

In addition to the high sweep gas, it

was determined that the overall flow from the Crude/SRU/SCOT Tail Gas was 6,200 standard cubic metres per day that was considered to be abnormally high. After reporting the results to the customer and looking at possible causes for this high flow rate operators closed the nitrogen purge to an offline compressor to examine its contribution to the flare. Subsequent flow rate measurement showed a dramatic decrease of 4,600 standard cubic metres per day. It was determined that the process valve for the nitrogen purge was open more than necessary to maintain purging of the compressor.

Result Benefits

Isolating the source of flare flow resulted

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in a substantial saving to the plant. The flare study showed that a large portion of the sweep gas flow was being wasted. Reducing this flow resulted in an estimated annual saving of $73,000 USD. In addition to the sweep gas saving, the plant reduced the nitrogen purge to the compressor. At 4,600 standard cubic metres per day, it was determined that the cost per year to the plant was approximately $473,000 USD. The refinery reduced the nitrogen flow to the compressor by 50-75% resulting in an estimated savings of $237K to $355K.

More Piping Technologies

In addition to flow studies two more common flare applications include relief valve leak and solids build-up detection. The following case studies are examples of these two technologies that can provide a better understanding of an entire flare system process.

Unit Investigation to Detect and Quantify Relief Valve Leakage

Refinery flare systems combust flammable, toxic, and corrosive vapours to form less harmful compounds. The flare system activates when the integral relief system discharges. Relief systems open when equipment is over pressured during plant startups and shutdowns, unit upsets, and plant emergencies such as fire, power failure, and cooling water loss. The most common pressure relieving devices are relief valves, rupture disks, and pressure-control valves. Relief devices are primarily installed to prevent injury to personnel and damage to equipment.

Possible sources of unknown flare flow are:

- Relief valve leakage due to corrosion, fouling, or from mechanical damage.
- Block valves sealing poorly due to any number of problems, including normal wear of the valve seat.
- Poor pressure control resulting in cyclic pressure swings.

The previous section described the method of tracking down where fugitive flows are originating. Once it is determined which unit(s) are contributing to the flare flow, each PSV, block valve or relief valve can be individually tested to determine which are leaking.

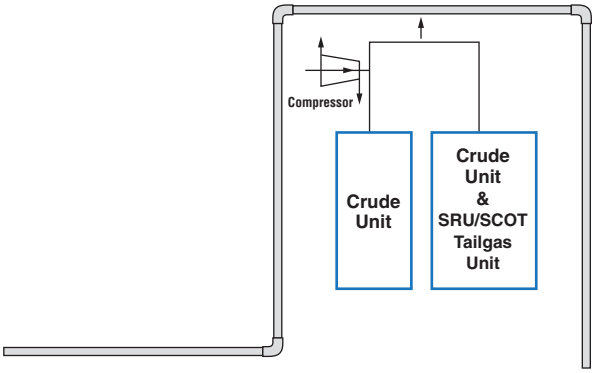

Figure 1 – *Flow rate data revealed substantial portions coming from four specific tie-ins with the largest contributor being the Crude and SRU/SCOT Tail Gas Units. Further investigation was carried out within these units to identify the sources of the flow.*

Tracer flow (or lack thereof) is used to determine which pressure relief devices are leaking and by how much. There are several possible scenarios to successfully test pressure relief devices.

In the example shown in Figure 2 tracer is injected into a process pipe or piece of equipment. If the pressure relief device is leaking then some proportion of tracer will be detected downstream of the pressure relief device. Alternatively if an injection point is available on the downstream side of a pressure relief device; the tracer can be injected and if it remains stationary there is no flow through that pressure relief device. Conversely if the tracer is swept away due to flow coming through the pressure relief device, leakage is confirmed. Its' velocity will allow volumetric flow to be determined. Another option is to use the "flare flow" technique. Tracer is injected into a pipe with radiation detectors placed at pipe junctions where pressure relief devices tie-in. At any point where the flow velocity increases it will be due to a leaking pressure relief device.

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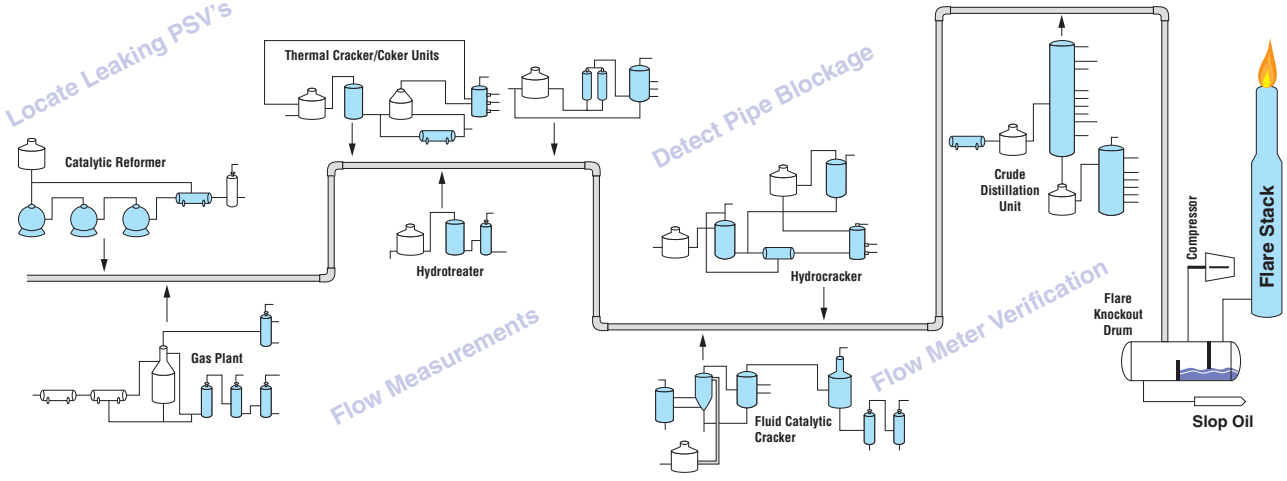

TRACERCO Diagnostics™ Flow rate studies is one of many applications that Tracerco provides for monitoring flare systems. Other technologies include pipe scans for solids build-up, flow meter verifications and relief valve leak detection.

Flare Systems

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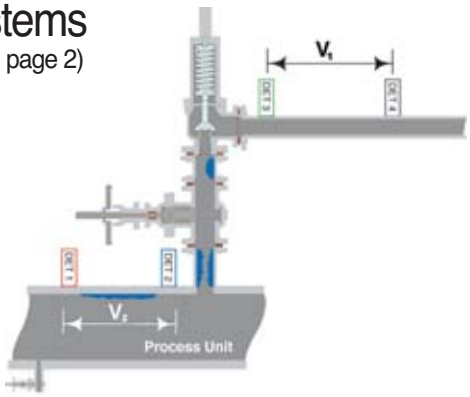

Figure 2 – *Leakage past block valves or pressure safety valves is confirmed by injecting a tracer upstream and locating detectors downstream of a suspected cross-over point. If two detectors are used upstream and downstream of the cross-over point, velocities and flowrates can be determined. V1 and V2 are compared to determine the size of the leak.*

Piping Blockage

A common request from Tracerco clients is for routine inspection of flare lines or other piping to determine the level of solids build-up. Blockage of piping associated with pressure relief devices or flare systems can be an extremely dangerous situation, as fouling and partial plugging can restrict the capacity of the relief system preventing the safe venting of pressure from process equipment. Blockage of regular process piping can reduce flow capacity, increase pressure drop, cause process equipment to run dry or fill with liquid, etc.

Tracerco has two techniques able to diagnose the location and extent of any blockage. The choice of technique depends on the nature of solid under investigation, access to the piping, how much piping is to be surveyed, and ultimately what information you, the customer, desire to learn. For example, if the solids are hydrogenous in nature and access is limited, only certain spot locations require to be surveyed (e.g. before and after bends and valves), and an answer of 'yes' or 'no' to presence of fouling material, then a Neutron Backscatter survey may suffice. However if the goal is to identify how much fouling material is present through a complete section of piping, then a TRACERCO Diagnostics™ Scan is necessary.

Neutron Backscatter Identifies Localised Fouling and Piping Blockage

One major chemical manufacturer's flare line was showing an abnormally high pressure drop in its relief piping. Tracerco was asked to survey the line that extended for hundreds of feet to determine the location and extent of a blockage. Figure 3 shows an isometric of the flare line system.

The first survey carried out, which was in increments of several feet, identified localised fouling and blockage in several key areas. Following the first series of neutron measurements, the suspect areas were scrutinised in smaller increments to assess the extent of the fouling. The system was then shutdown for maintenance. During the shutdown, fittings were installed on the piping in Zones 4 and 5, to allow access for specially designed hydroblast lances. Following a cleaning programme of the system, polymer debris was removed from the No. 1 Knockout and Seal Drums. The blast taps were then plugged off using standard 3/4 inch NPT fittings and the system was brought back on-line. Subsequent pressure drop and Neutron Backscatter measurements confirmed that the problem had been resolved.

In this instance, the survey confirmed original suspicions concerning the severity of the blockage within the relief line, and enabled maintenance crews to focus their efforts by identifying the most severely plugged sections of relief piping. The Neutron Backscatter survey was selected over the TRACERCO Diagnostics™ Scan in this specific case because the neutron system source and detector unit can be held on the end of an extendable pole. This allowed the Tracerco technician to walk along the ground under the pipe rack and survey the underside of the piping and very quickly locate areas of concern.

Figure 4 – *Example of Pipe Scan Set-up*

Pipe Scans Locate Solids Build-up

A TRACERCO Diagnostics™ Scan is a well-established technique that can determine both the location and depth of solid deposits. It is performed by placing a yoke assembly across the pipe under investigation at a number of lateral positions. The yoke is constructed to maintain the scan source and detector in a fixed orientation so the radiation beam passes through the mid-section of the pipe from the source to the detector, allowing for consistent data readings. (Figure 4) The yoke system is then passed down the pipe with readings being taken in select, small increments. If the density of solids is known readings can be further analysed to provide total depth of material to establish the severity of the blockage. Figure 5 is an example of the information provided from a

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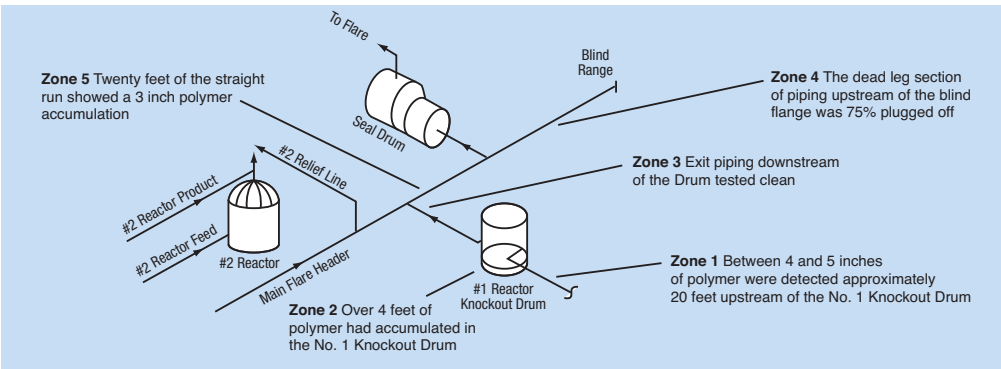

Figure 3 – *Illustrates results of the TRACERCO Diagnostics™ Scan surveys where fouling was found in several key areas.*

TRACERCO Diagnostics™ Scans of Centre Downcomers Assist in Determining Tray Capacity Limits

A FCC Debutaniser had been equipped with 2-pass valve trays. With plant expansion being considered, engineers had performed simulations of the Debutaniser and were concerned that at higher rates the Debutaniser would exceed the tray capacity limits. In addition, at the current operating rate, the Debutaniser overhead stream was slightly off-specification. Before deciding on how to revamp the Debutaniser, plant engineers wished to have a better look at the existing tray hydraulics.

A baseline was established at current operating conditions by carrying out two TRACERCO Diagnostics™ Scans — one active area and one through the centre downcomers. The results are presented in Figure 6. The active area scan did not reveal anything remarkable about the tray hydraulics. The tray active areas held reasonable levels of liquid and their vapour spaces were relatively clear. However, the centre downcomer scan showed a very interesting phenomenon. The top centre downcomer, below Tray 39, looked normal. But the data showed that the rest of the centre downcomers had a layer of more dense, less aerated liquid suspended in the middle rather than at the bottom of the downcomer. In addition, the scan showed that there was some frothing material above these centre downcomers. Remarkably, it appeared that vapour was bypassing through the centre downcomers as there was no liquid seal at the bottom of these. Apparently this vapour bypass was enough of a separation efficiency loss to cause the slightly off-specification overhead flow.

Plant personnel decided to increase the reflux flow substantially (approximately 33%) and repeat the scans to accomplish two things–one, to see if the increased liquid flow would seal the centre downcomers, and two, to simulate the Debutaniser operations at the anticipated higher operating rates.

The results from the second set of scans, along with the baseline scans, are shown in Figure 7. First there was no observable change in the operation of the tray active areas. Next, a layer of denser, non-aerated liquid was located at the bottom of the downcomer providing a liquid seal as should be. Also, the froth material above the centre downcomers was gone without the vapour bypassing through the centre downcomers.

TRACERCO Diagnostics™ Scans of the Debutaniser, particularly the centre downcomer scans, gave plant engineers confidence that the Debutaniser trays would handle the expected rate increase. As a "bonus", the scans showed a problem, easily remedied by a change in operating procedures, that corrected a product specification issue.

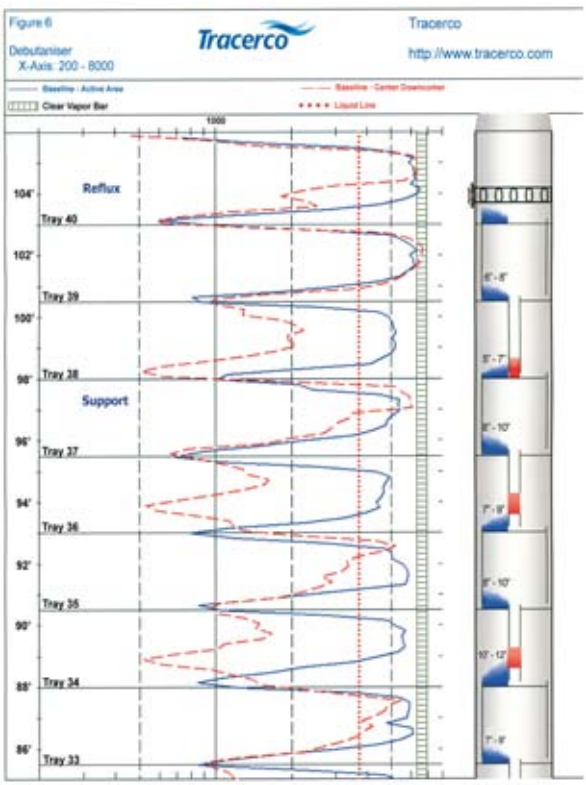

Figure 6 – *The first scan of the Debutaniser revealed that the top centre downcomer below Tray 39 looked normal, but the rest of the centre downcomers had the layer of more dense, less aerated liquid suspended in the middle rather than in the bottom of the downcomer.*

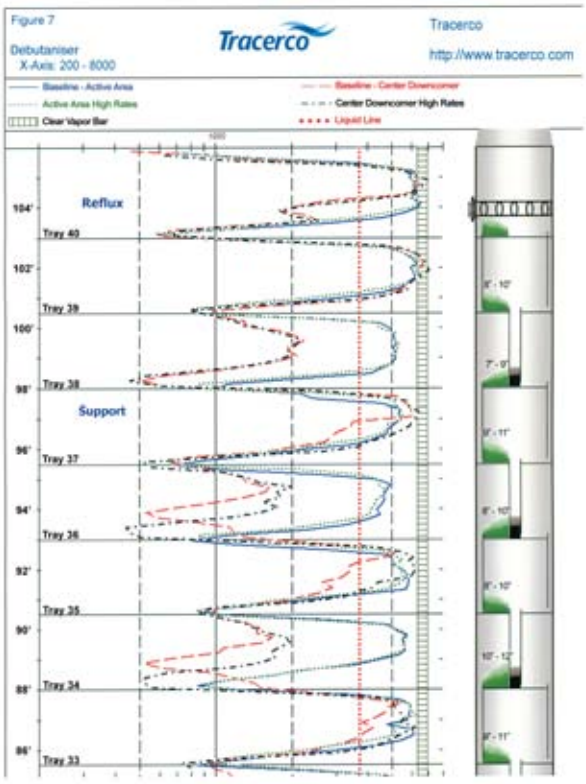

Figure 7 – *After an increase in the reflux flow, the second scans showed that the layer of denser, non-aerated liquid was located at the bottom of the downcomer providing a liquid seal as should be. The downcomer scan showed a problem, easily remedied by a change in operating procedures and assisted operations in their decision on revamping the column.*

TRACERCO™ Radiation Monitor Services

For Use In Potentially Explosive Environments

Radioactive materials are employed routinely in industry to facilitate a wide range of measurements including process level control, fluid separation and non-destructive testing. In order to protect the workforce from exposure and to ensure compliance with relevant legislation, radiation dose rates must be carefully monitored and controlled.

The TRACERCO™ range of personal radiation monitors are certified for use in zones 0, 1 and 2 and specifically designed to meet the challenge of combining operational reliability under adverse conditions with excellent sensitivity and robust but lightweight, ergonomic construction. These instruments have enhanced functionality including a number of additional key features, which simply make life easier for the operator.

Tracerco provides a professional service for the testing and re-calibration of gamma dose rate and alpha/beta contamination monitors to ensure compliance with relevant legislation.

A DVD is now available which provides details on the correct operation of the various monitors and offers practical advice on typical measurement applications.

Tracerco will also be introducing a Personal Dosimeter in the next few months. Apart from measuring radiation dose the unit has several unique features that make it stand out when compared to other systems. These include:

- Suitable for use in potentially explosive environments.
- Task mode settings allowing operators the ability to assess dose for a given task without loss of ongoing data collection.
- Vibrate and voice alarm.
- Multiple languages.
- Advanced AMOLED display providing clear graphics - a first for radiation monitors.
- Simple windows based download software to record and track received dose.

Let Tracerco take care of your personal radiation dosimetry requirements. Give us a call for additional information or to schedule a TRACERCO™ Monitor Services on-site presentation. Visit the contact us page of our website to request a copy of our Tracerco Monitor Services DVD. (www.tracerco.com)

TRACERCO™ T202 Radiation Monitor

- Certified for use in potentially explosive environments, zones 0, 1 and 2—eliminates the need for a specific hot work permit.
- Integrated dose function—allows the instrument to be used as a personal dosimeter.
- Peak doserate memory—allows maximum exposure levels to be recorded.
- Displays calibration due date.
- Back light facility, audible response.

TRACERCO™ T201 Contamination Monitor

- Certified for use in potentially explosive environments, zones 0, 1 and 2—eliminates the need for a specific hot work permit.
- Detachable radiation probe with up to 1.5 metres of extendable cable. Optional extendable probe attachment for surveying contaminated pipe work, drains, floors, etc.
- Displays calibration due date.
- Back light facility, audible response.

TRACERCO™ Radiation Monitor Services

The TRACERCO™ Personal Dosimeter

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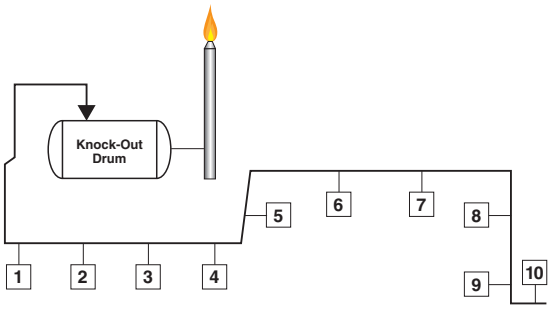
TRACERCO Diagnostics™ Scan.

Routine Maintenance Programme

Pipe scan measurements can be used within a routine maintenance programme to monitor piping, especially pressure relief and flare systems for solids build-up. An orientation diagram illustrating scan locations along with a comprehensive table of historical results are provided as part of the service. With knowledge of the thickness of the solids build-up in piping, the customer is able to optimise any treatment programme or gain an early warning if the level of solids builds up to unacceptable levels.

Conclusion

If you are looking to isolate mystery flare flows, reduce flare flow rate measurement errors or detect blockage within your flare system, Tracerco has the technology that can provide you with all the information you need. If you would like to learn more about these technologies, please contact a technical advisor in your region or visit our website at www.tracerco.com. Look to future issues of Tracerco News for additional case studies highlighting our flare system services.



Scan Location Orientation	Cnts/3 sec	X(ft)	X(in)	Density (lb/cu ft)	Density (kg/cu m)
1	9200	0.0	0.0	0.0	0.0
2	8700	0.1	0.7	2.7	43.9
3	7200	0.2	2.9	12.0	192.6
4	7700	0.2	2.1	8.7	139.9
5	8200	0.1	1.4	5.6	90.4
6	8500	0.1	0.9	3.9	62.2
7	8500	0.1	0.9	3.9	62.2
8	9200	0.0	0.0	0.0	0.0
9	8500	0.1	0.9	62.2	62.2
10	9000	0.0	0.3	17.3	17.3

Figure 5 – *A routine pipe scan programme on a regular basis can determine the average build-up of deposits. A scan orientation and results spreadsheet is provided to customers.*

Tracerco's Rio de Janeiro Analytical Laboratory Is Now Officially Operating

Tracerco is pleased to announce that it is officially operating its newest analytical laboratory in our Rio de Janeiro, Brazil base. This new laboratory allows us to offer a rapid turnaround of chemical tracer analysis providing our customers with the ability to rapidly detect the presence of very small leaks in heat exchanger systems.

For additional information on Tracerco's Analytical services please visit our website at www.tracerco.com.

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Brussels, Belgium
Tel +32 (0) 2 465 85 20

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Tel +33 (0) 4 74 94 79 88

Oldenburg, Germany
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Rio de Janerio, RJ, Brasil
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- ❑ TRACERCO™ Level gauge
- ❑ TRACERCO™ Interface gauge
- ❑ TRACERCO™ PhaseGauge
- ❑ TRACERCO Diagnostics™ RapidScan
- ❑ The TRACERCO™ SmartGauge
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If you would like to schedule an on-site presentation, please send in the attached card or contact a representative in your area.

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