

# Oil, gas and water in real time

## Flow rate: measurement becomes multiphase



ABB launches the VEGA Isokinetic Sampling (VIS) multi-phase flow meter for measuring real-time flow rates of oil, gas and water in the most difficult multiphase environments, typical of the Oil and Gas Upstream sector

**Measurement made easy**

Oil, gas and water  
in real time

### Introduction

Recently launched by ABB, the VIS multi-phase flow meter is the ideal solution for measuring and monitoring flow rates of oil, gas and water close to the wellhead. VIS enables simultaneous measurement of the three different phases with extreme accuracy. ABB's VIS multi-phase flow meter is capable of providing the same information and the same measurement accuracy as conventional test separators in a small-sized product, in real time and at a much lower cost.

This is a meter that uses a patented and exclusive technology, based on the principle of isokinetic sampling that enables the withdrawal of a small fraction of the multiphase stream and its subsequent separation into the different streams, guaranteeing the absolute accuracy of the individual flow rate measurements.

### For more information

Further details of ABB Measurement & Analytics products are available for free download from:  
[www.abb.com/measurement](http://www.abb.com/measurement)

or by scanning this code:



## An innovative tool

ABB's VIS multi-phase flow meter was developed in collaboration with TEA Sistemi, a Pisa-based company active in the research and development of advanced technologies in the Oil and Gas sectors and is designed to meet the most stringent industry requirements. It is the essential measurement instrument for well monitoring, production control and distribution and for optimal deposit management. It can operate in all types of wet-gas fields, even those where the Gas Volume Fraction (GVF) is greater than 80 % because its performance is not affected by even the most difficult operating conditions.

When the GVF is extremely high, VIS performance is unmatched. VIS is also the best way to protect investments in instruments in aging reservoirs, where the GVF tends to increase gradually and in wells subject to gas lift, where large quantities of gas are mixed with the liquid phases.

One of the biggest benefits of the ABB VIS meter is that,

unlike many solutions for multiphase flow measurement available on the market, it is not based on any radioactive component. This characteristic is of fundamental importance in shipping, customs clearance, commissioning and, ultimately, decommissioning and disposal of the instrument. It also greatly facilitates the handling of import/export permits and all maintenance actions to be performed on the meter.

The exclusive technology on which the meter is based also makes it ideal for the monitoring and optimization of gas storage fields, where it can replace the traditional calibrated orifice, enabling the detection of traces of water in the extracted gas. ABB's multi-phase flow meter has no size limitations and can be applied to pipes of all dimensions. Another unique feature is the possibility to customize the device in such a way as to increase the gas measurement turndown to a ratio of 100:1, the highest available on the market.

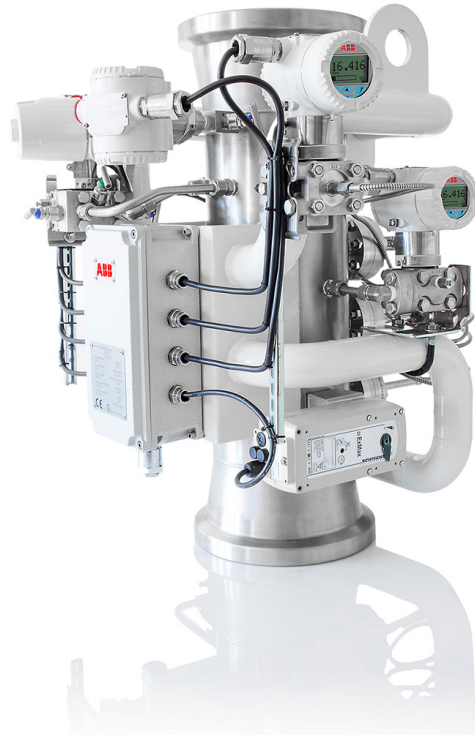
Nedcalco Plant in Manchester, UK



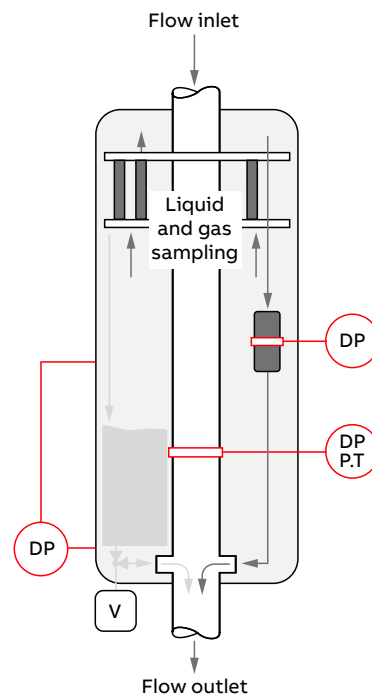
## Entirely researched and developed in Italy

Nuncio Bonavita, the Business Development Manager of ABB's BU of Measurement and Analytics – Process Automation Division, tells us: “This innovative tool is the result of collaboration with TEA Sistemi, a spin-off of the University of Pisa engaged in research and development of advanced technologies in the Oil and Gas industry and is designed to meet the most stringent industry requirements.

This is a totally Italian product born from collaboration between two companies that differ in terms of mission and size, but share the same focus on innovation and high technology. ABB has a consolidated relationship with TEA Sistemi, both at the level of R&D thanks to the competencies of the Pisan company in the field of Flow Assurance and at a business level, where for many years ABB has been providing TEA Sistemi with its advanced technologies, especially in the field of pressure measurement, that are continuously improved at our production unit in Lenno, in the province of Como. Of course, in the past few months this collaboration has been further strengthened by working jointly for the definition and ongoing improvement of the new multi-phase flow meter and for the commercial and service activities necessary to make this “made in Italy” technological excellence fully accessible at a global level”.



The VIS Multi-Phase Flow Meter for Oil and Gas applications created by ABB in collaboration with TEA Sistemi



VIS operating diagram



## Reliable and real-time measurements

For those involved in Upstream Oil and Gas, the possibility of performing multi-phase flow measurements provides obvious benefits. Bonavita continues: “In reality, hydrocarbons are not produced through the extraction of a single-phase flow, but rather a multi-phase flow where there is usually a binary liquid phase (oil and water) present as well as a gaseous phase (gas), as well as any sand or solid particles in suspension. This mixture is usually conveyed to a treatment plant under which there are multiple wells in multiple areas and at whose entrance there is a special unit dedicated to the separation of the three phases, which occurs substantially due to gravity. Once the three phases are separated, the corresponding flow rates are measured using traditional methods and instruments. Measuring the three phases downstream of the separator, however, involves several limitations, because these measurements are available with considerable delay times and provide an average value that is obviously averaged over all the contributions coming from the various wells. Therefore, this type of measurement cannot be used for the purposes of monitoring and optimization of production of individual production areas.

The situation may be further complicated if the Gas (or Oil) Processing Unit receives incoming flows from areas managed by different companies, in which case it is clearly also necessary to resolve the problems of allocation of costs, profits and liabilities.

It is precisely in these situations that multi-phase meters assume a key role; these products are able to provide the same type of information as a conventional test separator, but with the advantages arising from the ability to obtain real-time flow-rate measurements, combined with a much more compact size.

By its nature, VIS provides maximum performance precisely in the most difficult applications for traditional multi-phase flow meters, where the gas volume fraction is extremely high. In technical terms, we refer to the GVF (Gas Volume Fraction); the closer the GVF is to 100 %, the more problematic the accurate measurement of the three phases becomes. The VIS measurement system, on the other hand, is designed precisely to better manage these challenges and has no problems, even when the volumetric percentage of liquid drops below 1 % or even 1 ‰.

The tool can also be applied successfully in gas storage fields. Thanks to its particular design, it can provide bi-directional and very accurate real-time measurements of biphasic fluids during production. This can be very useful, because it enables extractions from the tanks to be optimized, minimizing the water content present in the gas”.

## Unique and innovative technology

The operating principle of VIS, Isokinetic Sampling, consists of the withdrawal of a sample of the three-phase flow in such a way that the sample taken is perfectly representative of the entire stream. Multi-phase flows are characterized by extremely complex fluid dynamic conditions, where the individual components can thicken in particular areas of the duct and/or flow at different speeds. Obviously, sampling a percentage of flow “at random” is not acceptable unless this can be scientifically associated to the real profile of the stream as a whole. The methodology used by VIS starts with an extremely sophisticated sampling system, implemented by means of specially designed and patented devices that required years of computer-based research, made possible by the expertise of TEA Sistemi in the field of Flow Assurance and the associated specialist codes, as well as years of laboratory testing.

The details of the isokinetic sampling operational are obviously confidential. In principle, we can say, however, that careful management of differences in pressure between the interior of the sample probe inserted into the main duct and the duct itself ensure the conditions of equivalence that are essential to fully representative sampling. Once a portion of the flow has been sampled, the meter performs the separation (another critical step that required the design of highly efficient components) and the measurement of the individual phases with conventional instruments, essentially pressure and temperature transmitters. Proprietary software is then able to use the information from the instruments and link them to extremely accurate measurements of the flow rates of the individual phases.

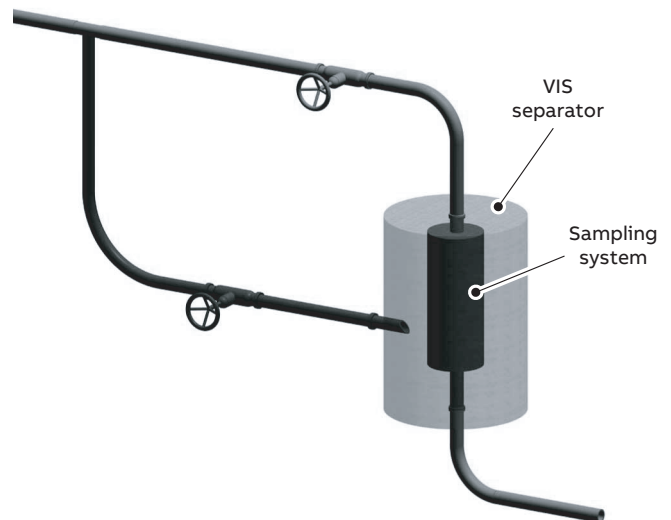


Example of installation for the measurement of wet gas in the Gulf of Mexico

## “Dual Inlet” configuration

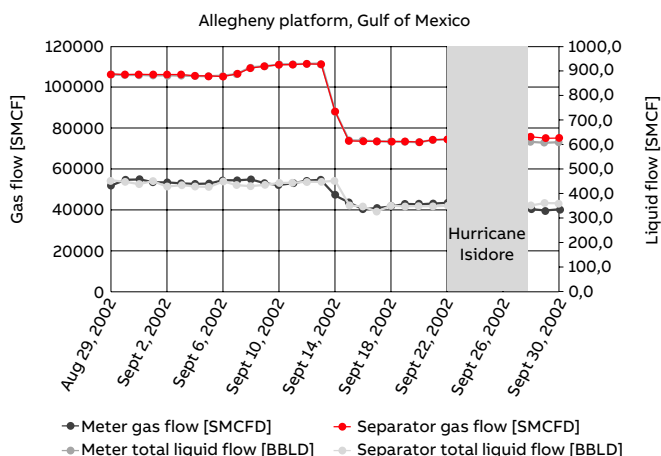
The meter can also be provided in a “Dual Inlet” configuration that enables the measurement range of the instrument to be expanded.

One of the problems that multi-phase meters have to deal with is the extreme variability of the flow rates that they may be required to measure. Therefore, one of the parameters of interest to end-users is the so-called turndown, that is, how much the flow rate to be measured (on which the individual meter will guarantee the required accuracy) can vary. Given that VIS operates, via the sampling system, on a fraction of the flow, it is clear that the operating range can be extended to much lower flow rates simply by providing a system for direct insertion into the separator that enables the sampling phase to be bypassed. Therefore, with an appropriate additional input and simply by operating the related valves, VIS can hugely expand its “rangeability”.



“Dual Inlet” configuration diagram

## ...“Dual Inlet” configuration



Measurement trends taken at the platform Allegheny (Gulf of Mexico)

## Designed for the requirements of the Oil and Gas sector

Having compact high-performance meters that can be used close to wellheads provides detailed, timely and real-time information on the production process. For exactly this reason, the market demand for meters with these characteristics is expected to grow significantly in the coming years, because they will satisfy the specific needs of end users. Let us not forget that process optimization plays a vital role in the Oil and Gas sector. The possibility of having a high-performance meter may be a determining factor for the profitability of upstream production sites. Bonavita concludes: “The creation of VIS is a notable example in which theoretical research, applied research, industrial production of devices and software development have led to the market launch of a truly innovative instrument, both in terms of performance and of design. Research and technology – all made in Italy.”

## Characteristics of the VIS multi-phase meter

### Unique and patented technology

Isokinetic sampling enables the extraction of a representative portion of the flow and accurate calculation of the flow rates of the different phases. VIS technology, with more than 40 installations worldwide, is capable of providing high accuracy in even the most challenging flow conditions. The reliability of the instrument also remains unaltered in the detection and measurement of liquid fractions below  $10^{-4}$  %.

### Totally free of radioactive components

Unlike many products available on the market, VIS is radioactive-free. This is of crucial importance in handling, shipping, commissioning and decommissioning procedures.

### Standard instruments

VIS uses only standard process instruments. This is an advantage in maintenance operations, because operators do not have to deal with complicated devices, but with conventional instruments.

### Ideal for gas storage fields

VIS is also perfectly suited for the management of natural gas storage fields where detection of the smallest traces of condensation or water during the extraction phases is necessary. VIS technology has several successful applications in this sector.

### Investment protection

VIS is ideal for applications in ‘mature’ gas and oil fields. In fact, there is a natural tendency for the GVF to increase with the age of the oil field. In this situation the installation of VIS also represents an investment protection, because over the years production conditions will tend to move towards those values on which VIS performance is particularly significant.

### Wide range of measurement

The design of VIS can be implemented ad hoc to increase the gas turndown to a ratio of 100:1, the highest available on the market, without having to replace any component. Indeed, a strategy of automation enables the management of two different routes of entry for the fluid depending on its flow rate.



## TEA Sistemi, partner in technology transfer

TEA Sistemi was founded in 1997 as spin-off of the Centro TEA (Centro Tecnologie Energetiche e Ambientali – Centre for Energy and Environmental Technologies) with the primary objective of promoting the transfer and commercialization of the results obtained in Research and Development. Through the experience of its researchers, the group offers highly specialized products and services, with a strong sense of innovation in the energy and environmental sectors.



The TEA Sistemi Research Centre in Pisa

The design methods, calculation models and software used are, to a considerable extent, developed within the group, the result of technological research and innovation. The group currently boasts intellectual property rights to numerous patents, developed both internally and through co-operation with Italian and/or foreign partners, for the protection of equipment and systems of interest both to the process industry and to environmental protection. TEA Sistemi operates across a broad spectrum in the field of research, supported by the TEA Laboratory, where experiments can be conducted on an industrial scale. Major investments were made in order to equip the laboratory with the instruments necessary for carrying out R&D, design and testing of equipment and processes for the industry.

Today the three companies of the TEA Group have more than 60 highly qualified employees and contractors, including professors and researchers from universities, the CNR (Consiglio Nazionale delle Ricerche — National Research Council) and other institutes. The headquarters of the Group and of its experimental Laboratory is located in Pisa. For further information: [www.tea-group.com](http://www.tea-group.com).



Some of TEA Sistemi's creations

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