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Specialist flow measurement engineering

Industry safety: how to prove quality

There has been a growing focus on safety issues in the global oil and gas offshore sector over recent years. It has therefore become increasingly important for manufacturers supplying to this sector to make sure that their products conform to international safety standards in order to address those issues.

Issues surrounding the environment and hydrocarbon releases, personnel protection, asset aging and life extension are driving this focus on safety. OEMs need to be able to help in the process of recognising hazards and reducing risk. They must also help engineers to take ownership of risk and asset integrity through proving assertions about the functionality and construction of the equipment they supply.

There are four ways that manufacturers can do this: applying safety integrity levels (SIL); complying with the pressure equipment directive (PED): using positive material identification (PMI): and implementing ISO17025. Although there are 'overlaps' between these activities, each has a different role to play.

Litre Meter recently undertook a series of surveys of senior design and process engineers in the oil and gas industry. When specifying flowmeters and other instruments, environmental safety was cited by 70 per cent of respondents as the main reason for safety standard compliance. This was followed by business-critical concerns including personnel safety (59 per cent) and maintaining process integrity (65 per cent).

Risks of injury to personnel (70 per cent), risk of explosion (65 per cent) and damage to the environment (50 per cent) were the chief concerns relating to the consequences of equipment failure. Business concerns – including costs of shutdown (25 per cent) and damage to equipment (15 per cent) – were considered to be of less significance.

While the majority of companies in the oil and gas sector comply with an international safety standard for instrument specification a significant number – almost 40 per cent – do not, the survey found.

However, most of these stated that they will be seeking to comply with an international safety standard in the future where relevant.

SIL: A trusted standard?

The UK's Health and Safety Executive defines asset integrity as the ability of an asset to perform its required function effectively and efficiently while protecting health, safety and the environment. Asset integrity management is defined as the means for ensuring that the people, systems, processes and resources that deliver integrity are in place, in use and will perform on demand over the asset's lifecycle.

Safety Integrity Level (SIL) is the degree of likelihood that a safety instrumented function will operate effectively when it is required to.

When asked about what level of SIL would be acceptable, almost 40 per cent of engineers polled in a Litre Meter survey said that SIL level 1 was the minimum acceptable for instrumentation in their operations with 22 per cent citing level 2, 26 per cent stating level 3 and just 13 per cent saying that the highest level (level 4) is the minimum acceptable.

By complying with SIL flowmeter manufacturers therefore have a reliable benchmark for safety and reliability. Currently, SIL affects the buying decisions of engineers and design managers in 58 per cent of cases according to the survey of engineers. Most decision makers (61 per cent) believe that SIL is a good indication of the reliability of a flowmeter.

SIL levels are not, however, taken at face value. Although 26 per cent of respondents said that they will simply ask what SIL level a product has when specifying a flowmeter, a significant number (52 per cent) will request data on specific failure rates based on Probability of Failure on Demand (PFD).

The table above shows how PFD and RRF (risk reduction factor) of low demand operation for different SILs are defined in IEC EN 61508.

SIL was considered to be an effective measure of safety performance by 70 per cent of respondents but 54 per cent believed that a lack of consistency in applying SIL across all functional safety standards significantly affects trust in products designed to work in particular SIL level environments. So SIL appears to a large extent to be a trusted standard. However, there needs to be an industry-wide focus on the consistent application of the standard in order to improve trust levels.

Levels of SIL

Four SILs are defined within the European Functional Safety standards based on the IEC 61508 standard, SIL 4 being the most dependable and SIL 1 being the least, taking into account such things as the development process and safety life cycle management.

SIL	PFD	PFD (power)	RRF
1	0.1–0.01	10^{-1} – 10^{-2}	10–100
2	0.01–0.001	10^{-2} – 10^{-3}	100–1000
3	0.001–0.0001	10^{-3} – 10^{-4}	1000-10,000
4	0.0001–0.00001	10^{-4} – 10^{-5}	10,000–100,000

The relationship between SIL, PFD and RFF.

Pressure Equipment Directive

The purpose of the Pressure Equipment Directive (PED) is to harmonise European national laws regarding the design, manufacture, testing and conformity assessment of pressure equipment and assemblies of pressure equipment. This includes pressurised storage containers, heat exchangers, steam generators, boilers, industrial piping, safety devices and pressure accessories. Such pressure equipment is widely used in the process industries including oil & gas, chemical, pharmaceutical, plastics and rubber and the food and beverage industries. Despite this being a European standard PED is relevant to equipment being supplied to international markets outside Europe.

All relevant equipment, plant and systems in the European Economic Area must comply with PED. It requires the level of hazard of pressure equipment to be assessed and classified into 1 of 5 categories labelled SEP (sound engineering practice) then categories I-IV. The higher the level of hazard, the more extensive the level of quality assurance required during the design, manufacture and testing of the equipment.

PED is considered to be an effective measure of safety performance but the industry is divided between those who think that PED requires re-evaluating and those who think it does not.

Half of the engineers questioned in a recent survey by Litre Meter felt that PED describes requirements for vessels and pipework satisfactorily. Where a need to re-evaluate PED was identified it was felt that misinterpretation of the directive causes problems and unsafe systems and therefore PED needs further clarification or simplification.

There are still inconsistencies in the way that standards are applied and these variations undermine trust in PED. There is therefore a need for further standardisation to be applied and PED is sufficiently supported by industry standardisation bodies to make this happen, particularly in the oil and gas sector.

Notwithstanding these issues there is significant confidence that equipment tested and rated to the relevant PED standard is safe and reliable.

PED concerns

A number of respondents to the Litre Metre survey feel that there is a danger that some companies will deviate from PED because of inadequate or vague safety evaluation planning. This could mean end-users taking all the blame for a failure in a system they considered to be acceptable as it had PED certification. There are also concerns that suppliers in some countries purport to be compliant but in practice ignore the protective intent of the directive.

One of the ways in which PED could be improved, according to the survey, is by enhancing traceability using name, address and number information to link pressure equipment to documentation. Over half of respondents (53 per cent) believe this is necessary – and it is something that Litre Meter has recently introduced in its own online labelling systems.

Labelling

Litre Meter uses an electronic project documentation system that includes details of each meter which the company supplies as part of a single project – for example, all the meters supplied for a particular chemical injection skid – held at a unique URL. The website includes items such as calibration certificates, PMI certificates and material certificates as well as specifications, manuals and instructions.

The address of the website is printed on a chemical and wear-resistant label securely attached to each meter. The label also carries a QR code linking to the website in order to make it easy for service personnel on site to call up all the documentation on a smart phone by simply pointing it at the label.

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Positive Material Identification

Positive material identification (PMI) is a well accepted analytical materials testing and materials identification technique used within the metal alloy industry. It guarantees the materials' chemical composition as required for quality control.

PMI testing allows the manufacturers to ensure that every part in a process system conforms to specification, identify the correct alloy grade where a critical part is to be replaced and to facilitate inward goods inspection to ensure all bought-in materials are to specification.

Using PMI correctly can help avoid the potential failure of a critical component which could lead, in the worst case, to a catastrophic failure of a process and loss of life.

It is a widely held belief that PMI testing avoids the failure of critical parts and ensures the safety function of a component within it. PMI is also essential in certifying that instruments comply with specification standards and plays a central role in the purchase decision making process.

In terms of ongoing routine maintenance, using PMI at the manufacturing stage and the provision of historic data is an effective way of tracking specified components during replacement and routine repair work.

Good data provision ensures that identical components in different materials are not cross-contaminated. Knowing what the system started with and the status of the system at any point in time enables effective decision-making in the maintenance lifecycle of a process system. In addition, the PMI process helps in reducing installation and maintenance costs.

However, PMI is not a 'magic bullet' and cannot be used in isolation to tackle issues such as corrosion resistance or the identification of products which may or may not be fit for purpose.

International standards

The widely accepted standard to prove competence in test and calibration is ISO17025. It is applicable to all organisations performing tests and/or calibrations. These include, for example, first-, second- and third-party laboratories and facilities where testing and/or calibration forms part of inspection and product certification. Most establishments carrying out test and calibration work are required to hold ISO17025 accreditation but not all do.

The ISO/IEC 17025 standard comprises five elements; scope, normative references, terms and definitions, management requirements and technical requirements. The most important of these are management requirements and technical requirements.

Management requirements are primarily related to the operation and effectiveness of the quality management system within the laboratory. Technical requirements include factors which determine the correctness and reliability of the tests and calibrations performed in the laboratory.

Laboratories use ISO/IEC 17025 to implement a quality system aimed at improving their ability to consistently produce valid results. It is also the basis for accreditation from an accreditation body. Since the standard is about competence, accreditation provides formal recognition of a demonstration of that competence. A prerequisite for a test facility to become accredited is to have a documented quality management system. The contents of the quality manual usually follow the outline of the ISO/IEC 17025 standard.

Meeting the requirements of ISO17025 can help avoid the potential failure of a critical component which could lead, in the worst case, to a catastrophic failure of a process and loss of life.

According to a survey of engineering and technical managers in the oil, gas and processing industries carried out by Litre Meter, ISO17025 is an essential element in proving competence in safe and accurate test and calibration.

Confidence

A Litre Meter survey has shown that industry professionals would not be confident that the testing and calibration for their instruments was carried out to the required standards by a firm without ISO17025 – even if it held other certification.

Confidence about the correctness and reliability of testing carried out by an ISO17025 accredited organisation is universal, highlighting the importance of international standards in the field. It is critical to have recognisable standards in order to engender confidence in a company's abilities.

Conclusion

Manufacturers which adopt best practice and adhere to safety standards to prove their assertions about the manufacture and functionality of their equipment are genuinely able to help in the process of recognising hazards and reducing risk as well as helping engineers to take ownership of risk and asset integrity.

The four safety standards discussed here each have a role to play in achieving higher standards of safety. If used together, and with a higher degree of international standardisation applied to their use, confidence in equipment manufactured in accordance with them would be even greater than it is.

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