

Session Six: **Are You Competent to Assess Competence?**

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Abstract

Ultimate responsibility for the safety of an industrial process plant is placed upon the owner. Where Hazardous Areas are present owing to the use of flammable materials, plant personnel require additional technical and managerial competence to deal with that specific aspect of risk. Management of organisations must assess personnel competence to ensure safety. This should be developed from a mix of plant-operational experience and appropriate training. Training must be given at a detailed technical level that management often does not have. Neither does it have the time nor the competence to handle. Many ask how should such competence be assessed and managed. This paper explores the aspects of training for technicians and engineers, debating how their management must organise and participate in assessment and the assurance of competence.

Introduction

The running of a modern process plant in which potentially flammable materials are used in any part of the process, poses risks which must be assessed and adequately controlled. Plant personnel require additional technical and managerial competence to deal with this specific aspect of risk. A mixture of plant-operational experience and appropriate training will be part of that competence.

Experience in itself covers a number of engineering disciplines from electrical and mechanical through process, chemical and civil technologies, all of which support the management of the plant operation through the stages of design, construction, commissioning, inspection and maintenance. All of these aspects have an important input on all aspects of safety.

How should such competence be assessed and managed? Very often management has neither the time nor the skill to provide the detailed technical training required.

This paper explores the aspects of training for technicians and engineers involved in hazardous area applications, debating how their managers can organise and participate in assessment and assurance of competence.

Exploration of Competence

So what is “competence”?

In researching this, a number of definitions have been proposed by different individuals and organisations. Some informal ‘definitions’ have been humorous. It is with no surprise that

commerce, the Law, linguistics and medicine all have quite specific applications for the term ‘competent’. A more general definition was initially sought.

General definition of competence

Competence, in general terms, is:

- The ability to perform a specific task, action or function successfully;
- A standardised requirement for an individual to properly perform a specific job;
- The state or quality of being adequately or well qualified.

An industry-accepted Definition

The definition¹ given below was developed by the UK’s Health and Safety Executive (HSE)’s Construction Division Technical Unit (CDTU) Corporate Topic Group (CTG) in consultation with industry technical experts for use in technical documents. It has been adopted by a number of industry groups, trade associations and British Standards Committees in their publications, and is used informally within CDTU. It has been found to be an appropriate base statement to allow competency in a particular circumstance to be assessed.

It is stressed that the wording in the box should never be altered.

A competent person is a person who can demonstrate that they have sufficient professional or technical training, knowledge, actual experience, and authority to enable them to:-

- Carry out their assigned duties at the level of responsibility allocated to them;
- Understand any potential hazards related to the work (or equipment) under consideration;
- Detect any technical defects or omissions in that work (or equipment), recognise any implications for health and safety caused by those defects or omissions, and be able to specify a remedial action to mitigate those implications.

This definition applies equally to any job function. It includes the specific requirement for an aptitude towards understanding the implications for safety that is especially required for the purposes of this document.

¹ Developing guidelines for the selection of designers and contractors under the Construction (Design and Management) Regulations 1994 Prepared by jzcarpenter Limited for the Health and Safety Executive 2006.

Observations on competence

The above definition identifies some key attributes that a competent person must possess; namely, sufficient:

- Training
- Knowledge
- Actual experience, and
- Authority

It states, “at the level of responsibility allocated to them.” This important qualification on the “assigned duties” implies that an authority, namely the employer, which for the purposes of this paper means the plant owner, must have already decided what tasks that person must be able to do and also how well the tasks are to be performed. The latter is not directly measurable so there must be some stated achievement which serves as a benchmark. The statement implies that employer of a competent person shall define the level of competence within the structure of the work expected to be done. Further, that the responsibility taken is to be delegated to the competent person who shall carry a defined level of authority.

Here, the management responsibilities begin to be revealed in terms of their requirement to define necessary skills. Where hazardous areas are present, the Standard IEC60079-14:2007 Appendix F² adds specific areas of responsibility that bears further discussion.

Gaining Competence

To understand how to gain competence it is helpful to understand the learning process. Attaining a level of competence can be directly attributed to understanding arising from the success of learning.

One useful tool to explain this effect is the “Four Learning Stages” model³.

For the purposes of this paper, the ideas expressed in the traditional model have been modified below to suit the engineering discipline concepts that are being discussed by the addition of an extra stage to be discussed later. The wording has also been modified to suit.

² Standard is entitled ‘Explosive Atmospheres’. Part 14 Electrical installations design, selection and erection’.

³ Dr Thomas Gordon founded Gordon Training International. An employee, Noel Burch, is credited with developing this model in the 1970’s. It is now well-known in management training courses!

<p>1. Unconscious incompetence</p> <p>The individual neither understands or knows how to do something, nor recognises the deficit.</p>
<p>2. Conscious incompetence</p> <p>Though the individual does not understand or know how to do something, he or she does recognise the deficit, without yet addressing it.</p>
<p>3. Semi-conscious competence (?)</p> <p>The individual understands or knows how to do something. However, using the skill or knowledge requires concentration and may require some additional guidance or supervision at an appropriate level.</p>
<p>4. Conscious competence</p> <p>The individual understands or knows how to do something. However, using the skill or knowledge requires concentration but no supervision.</p>
<p>5. Unconscious competence</p> <p>The individual has had so much practice with a skill that it becomes "second nature" and can be performed easily and consistently.</p>

Any industry with safety related issues cannot afford to tolerate incompetence. Thus, the conscious learning part must be instilled with the knowledge and the discipline to be able to make safety related issues a priority.

The plant owner has to employ workers and bring them to an appropriate level within the model, depending on the management structure, which may, in turn, depend on strategic, commercial, financial and technical considerations. Where the plant owner tries to bring all employees to level 5, they may be expensive to employ and they just might get bored!

Classification of Competence

From the definitions and from consideration of the needs of industry it is suggested in the HSE document that there are three classifications for competence that are useful in industry.

- **Uncertified Competence Requirements:**

These are skills that stem from common sense, basic training or experience of on the job learning which means essentially copying the actions and responses of other workers

- **Certified Competence Requirements:**

These are skills that are sufficiently complex to warrant voluntary accreditation or registration of competence for example “Non-Vocational Qualifications” (NVQs). In this case a balance of theory and practise is provided through a non-academic route of training at an adult level.

- **Mandatory Scheme Requirements:**

These are skills in which the area of work is sufficiently risky to warrant a mandatory or statutory scheme that is backed at government level by requiring organisations to train to specific standards. National exams are sat and assessed and certificates of registration are issued that can be accepted and transferred between employers.

In the UK the “City and Guilds” (or C&G) 2382-10 is a nationalised course that trains and examines on BS7671:2008, known as the 17th Edition of the wiring regulations. A second course known as 2391-10: Fundamental Inspection, Testing and Initial Verification are good examples of these mandatory schemes for commercial and domestic work. There is, however, no national or international prescribed level at which industrial technicians and engineers are required to achieve before they can be let loose on electrical equipment in a factory setting!

Assessment of Competence

- To “assess” an entity is to ‘estimate’ or ‘judge’ the quality (or quantity) of an entity.
- To assess competence, then, is to judge the quality of an individual’s capability to perform a task, action or function successfully.
- In order to make such a judgement, a clear set of parameters must exist against which to make the judgement.

Assessment Criterion

The HSE document and other papers on this subject refer to four dimensions to assessment. These are listed below.

- The knowledge and understanding required to carry out a task
- The performance indicators to be looked for
- The scope or range of situations across which an employee is expected to perform
- Any particular evidence requirements.

NB: In the above a ‘performance indicator’ is defined as a numerical measure of the degree to which the objective is being achieved. Usually a quantity of a resource is referred to but in the context of this discussion performance within an expectedly adequate period of time for the task may indicate a degree of competence.

Any process of assessment will be subjective by its nature since little or no measurement in absolute terms can be made. It is only comparative either with the skills and judgement of the assessor or where stated guidelines are given upon which any assessor, suitably trained, can base their judgement.

HSE Related Guidance

The Health and Safety Executive has issued general ‘competency and resource’ related guidance in a number of related publications. These give example questions that may be posed to prospective individuals in order to ascertain competence. It is suggested that the questions posed to any individual being assessed, in any examination format or even just dialogue, and where appropriate cover such issues as:-

- Specific task experience
- Knowledge of policies and practices
- Historic performance (accidents etc)
- Qualifications and skills
- Knowledge of safety methodology and statements
- Membership of trade or professional bodies
- Training and supervision
- Consultation experience
- Selection of sub-contractors
- Independent assessment
- Utilisation of passport schemes

The guidance then suggests that answers to these questions may help to decide how much reliance on other evidence (e.g. references) needs to be made. The responses themselves may be further questioned and may reveal levels of confidence or indeed overconfidence, diligence or complacency. The interviewer must assess the answers.

Professional Bodies

Help is also at hand from the approach that the professional engineering institutes (or ‘bodies’) take in assessing applications to join as new members. Some companies look to their guidance and adopt their approach to assessment. It is more complex and formal but highly robust.

Membership of such a body confers a level of professionalism on a person in order to get into the ‘Institute’ as a member at an appropriate level. This in itself is a good indicator to a plant owner that a person is tending to competence in outlook but the owner still needs to ensure that competence is adequately specific to the specific issues and conditions on a given plant. The assessment of ‘core’ competence is to some extent carried out by the professional bodies that are required to assess evidence of training and experience as part of their entry conditions. Such conditions were laid down in the SARTOR⁴ requirements and are now replaced by the UKSPEC⁵.

The UKSPEC document says “Applicants to professional bodies have their competence assessed through a process known as ‘professional review’. The assessment is by practising engineering professionals, trained in this kind of assessment. Applicants are assessed against the competence standards listed in this document, which may be adapted by the

⁴ See References

⁵ See References

institution to relate specifically to the particular technology or industries with which it is concerned.”

Competence and commitment will be developed through a combination of:

- Underpinning knowledge and understanding, generally acquired through educational programmes;
- Professional development and experience.

These elements, or parts of them, may be integrated or undertaken simultaneously.⁶

The “Competence and Commitment Standards” are listed in five parts and cover different aspects of engineering development:-

- Use engineering knowledge and understanding to apply technical and practical skills
- Contribute to the design, development, manufacture, construction, commissioning, operation or maintenance of products, equipment, processes, systems or services
- Accept and exercise personal responsibility
- Use effective communication and interpersonal skills
- Make a personal commitment to an appropriate code of professional conduct, recognising obligations to society, the profession and the environment.

Guidance is given on examples of activities that could be used to demonstrate that the Standard has been achieved. This is mentioned here because it adds one more dimension to the four dimensions to assessment listed above, i. e., a need to demonstrate behaviour and attitude as part of the professional approach. In professional status this is considered to be an important part of upholding engineering values. Responsible behaviour and having the right attitude to safety must be part of an employer’s evaluation for the sake of competence.

Assessment Techniques

In a practical sense assessment always begins by asking appropriate questions of an individual being assessed, as is suggested by the HSE documents.

This can be done with varying degrees of formality. Simple discussion, say, during the course of everyday work, is an informal and a very effective means of contributory assessment at one end of the spectrum. At the other end is a formal interview and a written test or examination. This gives more authority to the importance of the assessment but the person being assessed must be given the opportunity to prepare themselves. Examination results can be recorded as evidence of competence.

Assessment must not rely on allowing an individual’s confidence (or indeed lack thereof) to speak for their competence. An example here is where technicians that had been servicing equipment for many years came across, during initial interview, as being extremely confident, but because they could not explain why procedures they were asked to carry out should be followed, they were considered technically ‘incompetent’ and were deemed to require additional training.

⁶ Taken from the UK SPEC Regulations for Registration, 2008

Interaction with others, as part of communication requirements, is an important part of the assessment. This includes for example, using the correct terminology to describe equipment and its operation in an appropriate way. If electrical equipment does not work then according to many inappropriately trained people who perhaps should know better, then it is often described as just having an 'earth fault'!

Asking personnel to find a fault on equipment is an excellent way of discovering how they apply their thinking processes and logic. Watching individuals approach such a problem whilst asking them to talk through their thinking, formulating a diagnosis and then developing a test method to prove a fault remains one of the best techniques for assessment of engineering competence. Conditions can be controlled to set the level of complexity of an induced failure. In such a case the assessor must remember that there is usually more than one way of fault finding, depending on the individual's experience.

Training

Training related to Hazardous Areas followed by a formal assessment is becoming a popular approach in the UK. The training provider must have a track record of consistency.

In one training course, in which the author takes part as a trainer and assessor, two or three written assessment papers are given to delegates at periods throughout the sessions. These are of a multi-choice format. All attendees are then 'interviewed'. If good marks are attained, it is necessary to ascertain if they have guessed the correct answers, or if they have worked out the correct solutions. Where marks are low, the assessor must search for reasons why the delegate is unable to answer the question correctly. Such reasons may vary from simply not understanding what the question is asking, through to not having understood the explanations given during the course. This to some extent can compensate for the nervousness and the tendency to rush the exam paper where attendees are not used to sitting on courses and taking exams.

The interview is kept as informal as possible, as is the questioning process, to keep delegates at their ease whilst allowing them to explain their understanding of concepts learned in their own terms. This approach is time-consuming and must be done on an individual basis but is a proven way of assessing technical understanding.

This particular format has been used for approximately ten thousand delegates to date since its introduction in 1985. Analysis of which questions were answered incorrectly by individuals guides the assessor to determine how to approach finding out what caused the delegate to answer in a particular way.

Some trends inevitably emerge from the long-term use of this approach. Issues, such as the belief in the need for a gap in a flameproof enclosure or that inserting an Ex i interface into a loop makes it automatically intrinsically safe, may be finally dispelled in a one-to-one discussion if it is needed!

An 'assessment' of technical understanding of course content still does not assess an individual's competence to perform a task. Knowing that the individual does understand the subject can be used as evidence of the capability to be competent when an individual's records are scrutinised by the plant owner.

This upsets some managements who consider that they have called in training companies in the belief that when they leave, the workforce who have undergone the training will automatically and suddenly become competent to work as they have never done before! This is another myth which has to be dispelled.

It can only be the employer who can state what an employee should know and how an employee should go about using that knowledge. When a task involving knowledge, skill and judgment is to be done which involves aspects of safety then part of the responsibility of management is to assess the attributes of the person assigned the task. Safety and operational aspects of work are sometimes totally inseparable. The other aspect to this is that the plant owner must provide tools for the employees to use, specialist to their plant and circumstances of plant operation. Only they can specify how equipment should be used, and how to interpret the results of such testing.

Vocational qualifications for a wide range of jobs in the United Kingdom are based on a set of occupational standards that sometimes contain these elements. This helps a plant owner, other than that, specialist training provided by equipment suppliers to the industry may be needed.

Externally sourced training courses which cover safety related issues can state what policies should be in place, according to the Law and various Standards. They cannot normally state what policies are actually in place unless specifically commissioned by management to deliver such information. It is for this reason that on some in-house courses, representatives from the management and/or safety departments are requested to be present during an open forum at the end of a course where these policies and procedures can be explained and discussed. This request is often initially declined or side-stepped. A more diligent management will seize the opportunity to show how they are committed to safety and they are normally currently “updating the company procedures”!

One approach that the author would like to see more of is the opportunity to encourage personnel within an organisation to help train their peers. This works very well if set up with the appropriate management style. Staff with a flare and some small encouragement can share their experience with others. This promotes good teamwork and peer communication. The individuals do not have to suddenly become teachers (unless they wish to try the approach) but the information can be released through discussion and guided by management.

Internal training forums are being encouraged in many industries. Particularly in large companies there is a tendency for certain individuals to become familiar with specific parts of the plant or pieces of equipment for which they earn the title of ‘local expert’. This gives them the perceived status of being ‘indispensable’. There is then the threat to management that the ‘expert’ will get another job! Management should always be aware of attitude and try to encourage the spread of knowledge. This must be encouraged through a suitable management style.

Comp-Ex Training

The “Comp-Ex” course has been adopted in the UK as one of the most basic training courses a technician should complete before being allowed to work without close supervision in a Hazardous Area. It is a practical course with an apparent emphasis on installation skills. The name is derived from its wish to promote personnel competence in ‘Ex’ protected environments. The course can only confirm that the course content has been understood and that practical work has been undertaken correctly, according to a national syllabus.

Knowing the credentials of those individuals that provide training should be at the top of any assessment list for management embarking on using a training provider.

Direct Observation

Recent years have seen a dramatic rise in the use of ‘direct observation’ techniques at work. Trained assessors in certain industries and workplaces act as an observer, sometimes referred to as a ‘ghost’ or ‘shadow’ to an ‘Observee’. The concept is said to have originated in the office-worker environment. In some cases the assessor can listen in to phone conversations to determine how efficiently and politely the call was handled. All require the careful review of work behaviour against a set of indicators that have been clearly shown to be associated with successful performance.

The principle is very good in that the assessor observes first hand, how the observee behaves and deals with actual situations in a hands-on context. The assessor must be cautious so as not to bias, interfere with or prejudice the observee’s natural ability to work by making them conscious of their observer.

Where work in hazardous areas is concerned, observation and supervision can be one of the same thing and this practical approach is encouraged and indeed practiced by some larger organisations.

Clearly the assessor must have a considerable level of technical expertise as well as a good style of supervising and observing. These skills can be developed and there is much argument to support the idea that this type of practical assessment, on site with realistic operational conditions is the ultimate way of determining if someone really knows what they are doing and can do it safely.

Passport Schemes

A scheme, originally promoted by the UK’s Health and Safety Executive (HSE) in October 2003, refers to the issue of a “passport” to workers who have been given training in H&S matters. The HSE’s document IND(G)381 outlines the scheme.

The construction industry was one of the first to use the passport scheme voluntarily as a way of controlling access to work sites. Large numbers of workers would migrate from one site to another as labour requirements peaked and fell. If a worker had successfully received certain training on H&S issues then the new employer did not need to provide re-training and could allow the worker on site with some assurance that he was up to date.

The intention was that the passport was a of credit-card size with a photograph of the holder and a signature on it.

The principal issues are knowledge of:-

- Hazards and the risks they may face
- Hazards or risks they can cause to others
- How to identify relevant hazards and potential risks
- How to assess what to do to eliminate hazard and control risk
- How to take steps to control the risk to themselves and others
- Safety and environmental responsibilities, and those of the people they work with
- Where to find additional information
- How to follow a safe method of work

The HSE recommends a syllabus that any training provider, be it a company itself or a third-party training company, should follow.

HSE Core Syllabus

The Health and Safety Executive has issued a syllabus for what organisations should cover when acting as training providers for the Safety Passport. It is provided in short form in the Appendix for reference.

Examinations are based on the subject matter expected to be covered by the training provider. Monitoring of the provider is a part of the overall scheme assessment which is internal to the HSE. There is also an environmental core syllabus that follows the same lines which can be appended to the course where appropriate.

Current status

This passport scheme is very flexible in its application and can be adopted to suit the needs of virtually any industry.

If a task is to be undertaken in a particular part of the plant, the job must be done by someone who has the necessary skills to do that job. The passport is endorsed to show a level of pre-assessed competence. This therefore satisfies quality assurance requirements that adequate management control of access exists on that site.

Forklift truck, crane and hoist drivers were amongst the first groups of workers to use the passport system. The International Association of Oil and Gas Producers suggested a reconciliation of training given in Norway, the Netherlands and the UK to allow workers trained in one country to work in another using the same qualifications and experience.

At present there is no nationally or internationally accepted scheme.

Many sites have a safety induction course requirement for new employees and contractors. The induction level depends on whether the person is visiting merely the offices or more critically will be undertaking any work within the industrial plant. In the opinion of the author, the quality and effectiveness of these 'experiences' vary dramatically!

Technical Passport

Although the original passport scheme was conceived for safety training, it has been used as a framework for the recording and monitoring of technical training attainment.

Schemes have been considered and partially adopted for internal use by some pharmaceutical companies as it helps them to satisfy the stringent control requirements of organisations such as the Food and Drug Administration (FDA).

If, for example, a particular alarm was raised on a control system, the Operations Management would know that a maintenance technician was required and at what skill grade was needed to address the problem. Operations would only let a passport holder with that required grade (or a higher one) onto the site (or that specific area of the site).

In such a system there may be a number of modules which a passport holder needs to achieve to be allowed to perform certain functions. These are only listed here at general heading level;

Mandatory

- Site safety induction
- Basic plant safety rules
- Fire fighting training
- Risk assessment methods
- Site layout familiarity
- Operations management structure and authority levels
- General operation procedures
- Basic electrical theory
- General electrical safety rules
- Fault reporting
- Hazardous area basics
- Explosion Protection basics

Skill based, task specific modules can be added under sub headings so that for example, Instrumentation might feature modules such as;

- **Instrumentation**
 - Calibration
 - PID setting
 - Test equipment operation
 - Diagnostic capabilities of equipment and procedures
 - Loop testing
 - Intrinsic Safety Principles
 - Intrinsic safety Systems
 - etc

Thus, if a technician is asked to perform calibration tasks in a hazardous area then training or supervision should be given with a required calibration tool concentrating on safety and accuracy issues. This goes down on the technician's individual record when it has been successfully completed. Refresher or update training can be given at intervals to ensure skills have not degraded where it is considered appropriate.

The range of technical functions will depend, of course, on the type and complexity of the plant. This is where direct observation combined with supervision from an experienced 'assessor' will monitor progress and help management to award passport endorsements based on task achievement. The assessor can be the management itself or a third party that the management considered competent to do the assessment.

In discussion with companies and individuals that have started to use the passport system, initial concerns were that it would be expensive and very time consuming to implement; it would be open to misuse and abuse as it would present a further layer of bureaucracy into a situation which required quick action if, say, responding to a breakdown situation.

In fact, planning the implementation was found to be helpful to management and the workforce. In working together to map out the skills that were needed for certain situations, deficiencies in training, test equipment and document access were revealed. The technicians were also able to show how poor the quality of plant documentation was. Now the management understood the problem they could address the issue. Another improvement could be made to the antiquated system for response to plant maintenance requests.

The best people to know how to map out the skills needed are very often the people who used the skills. Those same people could be encouraged by management to provide the necessary internal training and supervision for others. This can work extremely well and with effective management, promote good teamwork and relationships.

Skills Training Matrix

One mapping technique that helps to reconcile the required skills of personnel to operate and maintain a plant with the skills available from the workforce is to create a "Training matrix". This management tool is easily held on a database such as a spreadsheet and is a flexible way of laying out criteria to determine skill needs in a very simple format.

A matrix plots individuals name against the skill levels needed. A second matrix will plot the different plant areas and tasks against the training and skill levels that are deemed necessary for individuals to work in those areas. By matching the plant skill level against the personnel skill level, the management will know who is able and considered safe to go onto a plant to do a certain task. It is, after all, only the formal recording of an assessment and decision making process which any manager would make, taking into account his knowledge of his workforce and the plant condition.

There are several ways of doing this and no one way is considered better. The level of detail appearing on the matrix would depend on many factors and separate matrixes can be developed over time at increasing levels of detail, as befits the organisation to which it applies.

It is interesting to note that many formal qualifications assume some very basic knowledge and skills, for example, with the use of electrical test equipment. The use of a "multi-meter" such as an "AVO" is never formally taught and so often an acquired skill. Technicians and engineers sometimes do not take into account the impedance of voltage measurement or the volt-drop of current measurement which can give confusing results to diagnosis! The

question arises as to what real level of detail must be included in any competence assessment planning system.

Passports which could be issued to personnel working on electrical equipment in hazardous areas would therefore need a syllabus which covers H&S issues at a basic level, explosion protection issues and electrical issues with additional specific knowledge of the plant operation. Such a syllabus would be derived from the needs identified by the plant management.

Management Issues

From experience in the construction industry, the original and traditional industrial “passport” scheme operation works wonderfully well because it upholds and unites the common interest of “safety” between Management and Workers.

For the passport scheme to work successfully when operated to include a technical level, the management culture must be one in which information is freely shared.

Tragically, there are management structures, e.g., those subject to tight financial control or perhaps operating within highly competitive industries, which promote the attitude that “knowledge is power”. This destructive ‘separatist’ approach in a management culture will jeopardise any system which relies on the free flow of technical information. Managers of different departments within the same organisation can sometimes exhibit non-cooperative behaviour.

Situations within companies have arisen which make it difficult for any training to be provided. Such situations are disagreements between senior people with engineering departments as to what level of training is needed. Then there may be a situation where no-one wants the cost on their budget! Sometimes the training department, normally human resources will try to dictate what training is needed rather than deferring to the engineering departments responsible.

In the experience of the author, the “us-and-them” mentality introduced when the culture of an organisation allows this polarisation makes training difficult. More recently, managers have been encouraged to sit in at the end of courses so that they may answer questions on policy and company approach that third party trainers cannot provide. This can have two possible effects. It can galvanise the management and the workforce into realisation that the management is providing training and has full support for it. Alternatively the management realises that it cannot answer questions and needs some training itself. The latter situation is quite common, embarrassing to watch unfold but rewarding where the management takes its responsibilities seriously!

Management Information

The management must have adequate technical and organisational information at their disposal on which to make decisions on issues such as plant operation, maintenance, inspection and the safety of the plant during these actions.

All too often management rely on the memories of long-term workers who “know the plant like the back of their hand” to provide the knowledge needed for many diagnostic requirements. This should not be the case, particularly in a world where the workforce is

not stable and can change at an alarming rate. According to various Human Resource data sources, the average time in the UK for an individual remaining in the same job is about 4 years at present as compared with that of about 25 years going back to the 1970s. The author cannot vouch for the accuracy of these figures but it illustrates that staff turnover in most engineering job functions is now far greater.

Project managers might rely on their equipment suppliers to provide adequate information of a suitable quality and quantity. Also they may rely on the skills of contractors and their tradesmen to complete installations without knowing whether it is correctly installed and adequately safe. They have not specified in the contract of supply what information is needed for safety justification purposes. Project management should be assessing the competence of their suppliers and contractors.

Management itself must be competent to manage at a technical and organisational level. The following list is a suggested sequence of events through which an organisation should go to define and record useful data from which competence requirements may be derived. It is not exhaustive.

- List all the equipment on the site
- Ensure that Area Classification Drawings are current and up-to-date
- Ascertain what equipment is within a Hazardous Area
- Determine what general requirements for such equipment
- Determine what specialist requirements for such equipment
- Break down requirements into individual tasks
- Determine what skills are needed to install, inspect and maintain equipment
- What training is required
- Group skill levels into similar 'discipline' areas
- What specialist training from manufacturers
- What additional training is required, internal or external

It is quite likely that such information already exists in one form or another. For example, a plant inventory often originates from a Fixed-Asset Register. (No self-respecting accountant would be without one of these!) Further, Regulations, such as the ATEX Directive in Europe, require an owner to identify all equipment in a hazardous area in order to state if it is ignition-capable. If so, then the Directive requires the owner to record how it is explosion protected. The "inventory" is necessary so that this evaluation can be completed.

Construed in Law in most countries is the requirement that plant must be maintained in a safe condition. The mandatory requirement for Inspection to be carried out and Maintenance performed in any and every Hazardous Area leads to the inevitable conclusion that, from the same inventory, the requirements for maintenance will be discernable from the manufacturers' instructions. The Maintenance Planning would be greatly assisted. Inspection schedules are drawn up from knowledge of what is on the plant, where it is located and what must be inspected in order to keep it operating in a safe condition.

Management Involvement and Activity

Guidance is given in the IEC60079 series of Standards on what aspects of safety require management involvement and activity. IEC60079-14 Appendix F defines responsibilities at various levels. The skilled work-force should have the breadth of knowledge and experience to keep the plant running safely. Good co-operation and communication between them is therefore essential.

In relatively small organisations where communication is easy, the management and maintenance may be very closely associated so it is easy to monitor competence as an ongoing issue. It is when organisations get larger and more complex that more formal systems must be set up. Tragically this always seems to increase the bureaucracy when it comes to getting things done!

From experience, the most effective approaches to monitoring competence seem to be where small teams are put together with team leaders that are given the responsibility for their team members' development and training. In working within these teams, the plant personnel do seem to become more involved in the planning and the maintenance. Competence is monitored closely because the teams work closely together and almost automatically share experiences. The team members get to know each other's technical strengths and weaknesses as well their personalities.

With a little encouragement and the right management style, the workforce can be encouraged to assess their own and other colleagues' competence in a positive and constructive manner. As a side issue, this activity can promote good teamwork. It can help management to identify good technicians and engineers. It possibly could be an opportunity for identifying plant operators who could re-train as technicians or identify technicians for promotion to engineer level.

Larger organisations often already have staff appraisal systems. The traditional 'performance appraisal' does not always include a Technical Appraisal. Quite clearly, this becomes an important part of the requirement for continuous assessment and development or retraining where needed.

Good supervision, which is the best way to monitor real competency, can and should be developed as a culture within an organisation. Where individuals show that they have the necessary technical skills, they may be encouraged to train others by being temporarily appointed as a specific "task-supervisor". Thus encouragement for some staff to informally train other staff can work well as a motivator in these circumstances. The original apprenticeship scheme of 'on-the-job' training has always employed this philosophy.

It is worth emphasising that the management style has to be appropriate to allow the above scenario to work properly. The line management must have the authority and the budget devolved from a senior level to promote and control this type of working arrangement. All too often the middle management is working within too great a constraint and defers to senior management before it can act. This is evident in many organisations particularly during an economic decline.

Any good management will automatically monitor the progress of its workforce to the extent where competency is always being considered.

Hazardous Area Assessment

Owners of plants involving hazardous areas are required to provide for periodic inspections and maintenance in order to ensure safety of plant and personnel. It is logical that this expertise is cultivated from within the organisation where possible. This is, of course, dependent on the size and scale of the plant. For a number of technical and commercial reasons, the owner may decide to call in the assistance of external specialist organisations to examine aspects of their installations for safety compliance purposes.

The main areas in which plant owners appear to require external assistance can be listed as:-

- Examination of the condition of plant equipment
- Looking at the state of the installation
- Reviewing Area Classification
- Developing safety rules and work-permit systems
- Looking at the completeness of procedures
- Ensuring documentation is adequate
- Maintenance planning

Often these activities do not set out to assess competence of personnel working in these areas but flaws are inevitably due to oversight or misunderstanding of what is required which impacts on competence.

Assessments are often performed at three principle levels listed below.

Inspections, Surveys and Audits

The following tentative definitions are offered for the purposes of further discussion.

An Inspection is an action comprising careful scrutiny of equipment in order to arrive at a reliable conclusion as to the condition of that equipment.

A Survey is an action comprising the collection of information about equipment in a given location, the inspection of that equipment and the comparison with existing information made available by the owner in order to arrive at a reliable conclusion as to the correct placement and safe operation of that equipment. It may include the results of inspections.

An Audit is a comprehensive and detailed examination of the internal control exerted by management over all technical and organisational measures to preserve the safety of a hazardous area. It may include the results of surveys and inspections.

Scope

For any external assessment it is necessary to define the purpose and the scope of the work before it starts. Such questions as:

- Who requires the assessment and why has it been commissioned?
- What is the expected outcome?
- What areas are to be covered?
- How are problems found to be reported and to whom?
- What action will be taken?

- Who is responsible for that action?
- To whom should any recommendations be made?
- How technical knowledgeable are those that have commissioned the work and those that will receive the report?

Findings

In aiming to perform one type of activity, issues may arise that fall within the remit of the others. For example, in attempting to inspect certified equipment, it may be necessary to have sight of the Explosion Protection Certificates. If these documents are not available then it may reveal that the site has no provision for the compilation of such certificates and has therefore inadequate safety documentation. Alternatively the documentation may be within the organisation but there is no provision to distribute it or make it available to those that need sight of it. These omissions reveal serious management shortfalls which should have been picked up during an audit but they may become evident during an ordinary inspection.

Competence issues are very often picked up during such external examinations. When examining procedures during an audit, it is appropriate to ask what training and supervision is given to those who do the work AND who manage or supervise such work. This reveals a great deal about the philosophy of the management.

The Audit will look specifically at the management's control of competence in the workforce.

In some cases it works the other way round when a request for external assessment reveals the need for training. It is sometimes easier for a third party or external assessor to pick up on problem areas and point the plant owner in the right direction to improving the level of safety.

One important question to ask of personnel is should they have a technical problem with which they need help, to whom would they ask for assistance from within their own organisation? This inevitably starts a discussion as to how the workers and management relate to each other; who is trusted and who is to be avoided. Reporting this important disclosure requires tact and discretion! But it is an indicator that cannot be ignored where safety issues are concerned.

In those organisations which encourage interaction and discussion over technical problems amongst the peer groups, they often show an open style of management and communication.

During training courses the question is often asked of delegates as to whether any of the training provided has surprised them. The reply to this is very often that it is simply the level of detailed knowledge needed to retain safety in Explosion Protected equipment. The reply also comes with the comment that the delegate wishes that this could all be explained to their boss so that they could understand what the delegate was expected to do in all its detail. The 'My boss hasn't got a clue' syndrome is sadly rife within many companies to whom training is provided. This divide does not inspire confidence in their management. Colleagues in the training industry also report the same situation in relation to Functional

Safety Systems so it makes one ask how many other engineering issues may not be adequately understood by management?

Conclusion

It is construed in the Law of most countries that it is the responsibility of the plant owner to assess and monitor the competence of employees and contractors. Appropriate members of the owner's management team therefore have to understand the technical issues involved so they can fulfil their obligation of ensuring that safety is preserved throughout the life and operation of the plant.

Assessment of personnel competence is principally on peer judgement but should be evidence-based by compiling the results of education and learning programs together with practical accomplishments observed through work done by each individual.

The management consultant, Peter F Drucker said, "No institution can possibly survive if it needs 'genii' or 'supermen' to manage it. It must be organised in such a way as to be able to get along under the leadership composed of average human beings".

As average human beings we learn to assess situations and tasks. Risk Assessment should be a natural process that we cultivate⁷. Parenthood often focuses this skill!

A wise management will use the skills that its workforce possesses effectively by understanding those skills and developing them appropriately. Management must be seen to get involved in training, endorse it and own it.

The communication of concepts and instructions is at the heart of any organisation: "One should not aim at being possible to understand but at being impossible to misunderstand", was a statement made by the Roman rhetorician, Marcus Fabius Quintilian, over two thousand years ago. This is according to the eminent British broadcaster, John Humphrys, whose book, "Lost for words", is a passionate but very entertaining plea for the correct use of the English language.

Training is part of the development of competency and is not just about explaining technology, it's also about explaining how people should relate to the technology. Safety within technology interacts with other people. The current Explosion Protection Standards include the indisputable need for management to establish and maintain an appropriate level of competence. Management must be competent to do this!

⁷ See Appendix article on 'Get A Life!'

APPENDIX

IEC60079-14: 2007

This International Standard is entitled: “Explosive Atmospheres”. Part 14, issued in 2007, covers “Electrical installations design, selection and erection”. Annex F (normative) states the knowledge, skills and competencies of responsible persons, operatives and designers. It is reproduced here for ease of reference of the above text.

- **F.1:** This annex specifies the knowledge, skills and competencies of persons referred to in this standard.
- **F.2:** Knowledge and skills
 - *Responsible persons*

Responsible persons who are responsible for the processes involved in the design, selection and erection of explosion protected equipment shall possess, at least, the following:

- General understanding of relevant electrical engineering;
- Understanding and ability to read and assess engineering drawings;
- Practical understanding of explosion protection principles and techniques;
- Working knowledge and understanding of relevant standards in explosion protection;
- Basic knowledge of quality assurance, including the principles of auditing, documentation, traceability of measurement and instrument calibration.

Such persons shall confine their involvement to the management of competent Operatives conducting selection and erection duties and not engage themselves directly in the work without ensuring their practical skills at least meet the requirements given in F.2.2 below.

- *Operatives (selection and erection)*

Operatives shall possess, to the extent necessary to perform their tasks, the following:

- Understanding of the general principles of explosion protection;
- Understanding of the general principles of types of protection and marking;
- Understanding of those aspects of equipment design which affect the protection concept;
- Understanding of content of certificates and relevant parts of this standard;
- General understanding of inspection and maintenance requirements of IEC 60079-17;
- Familiarity with the particular techniques to be employed in the selection and erection of equipment referred to in this standard;
- Understanding of the additional importance of permit to work systems and

safe isolation in relation to explosion protection.

▪ *Designers (design and selection)*

Designers shall possess, to the extent necessary to perform their tasks, the following:

- Detailed knowledge of the general principles of explosion protection;
- Detailed knowledge of the general principles of types of protection and marking;
- Detailed knowledge of those aspects of equipment design which affect the protection concept;
- Detailed knowledge of content of certificates and relevant parts of this standard;
- Understanding of practical skills for the preparation and installation of relevant concepts of protection;
- Detailed knowledge of the additional importance of Permit to Work systems and safe isolation in relation to Explosion Protection;
- Detailed knowledge of the particular techniques to be employed in the selection and erection of equipment referred to in this standard;
- General understanding of Inspection and Maintenance requirements of IEC 60079-17.

● **Competencies**

▪ *General*

Competencies shall apply to each of the explosion protection techniques for which the person is involved. For example: it is possible for a person to be competent in the field of selection and erection of Ex i equipment only and not be fully competent in the selection and erection of Ex d switchgear or Ex e motors. In such cases, the person's management shall define this in their documentation system.

▪ *Responsible persons*

Responsible Persons shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in F.2.1 relevant to the types of protection and/or types of equipment involved.

▪ *Operatives*

Operatives shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in F.2.2 relevant to the types of protection and/or types of equipment involved.

They shall also be able to demonstrate their competency with documentary evidence in the use and availability of documentation specified in 4.2; production of job reports to the user as specified in 4.2; practical skills necessary for the preparation and installation of relevant concepts of protection; use and production of installation records as specified in 4.2.

- *Designers*

Designers shall be able to demonstrate their competency and provide evidence of attaining the knowledge and skill requirements specified in F.2.3 relevant to the types of protection and/or types of equipment involved.

They shall also be able to demonstrate their competency with documentary evidence in the:

- production of documentation specified in 4.2; production of Designers certificates to the user as specified in 4.2;
- practical skills necessary for the preparation and compilation of relevant design details for the concepts of protection and systems involved; updated and production of installation records as specified in 4.2.

- **Assessment**

The competency of Responsible Persons, Operatives and Designers shall be verified and attributed, at intervals relevant to national regulations or standards or user requirements, on the basis of sufficient evidence that the person:

- Has the necessary skills required for the scope of work;
- Can act competently across the specified range of activities; and
- Has the relevant knowledge and understanding underpinning competency.

HSE Safety Passport Core Syllabus

From HSE IND(G)381. Introduction to Passports and their purposes

- **Organising for safety**
 - Overview of health and safety law
 - Responsibilities and lines of communication of employers contractors and individuals
 - Overview of risk assessment
 - The role of safety representatives and health and safety inspectors
- **The workplace**
 - Safe access and exits
 - Safety signs
 - Temperature, lighting, housekeeping and welfare facilities
 - Slips, trips and falls
 - Using display screen equipment and computers
 - Reporting failures and defects
 - Working at heights and falls from heights
- **Plant and Machinery**
 - Machinery
 - Electricity
 - Noise
 - Workplace transport

- **Health**
 - Personal protective equipment
 - Controlling harmful substances
 - Manual handling
 - Musculoskeletal problems
 - Health surveillance or monitoring (if appropriate)
 - Stress
- **Procedures**
 - Safe systems of work, including permits to work systems
 - Emergency procedures
 - Fire safety
 - First aid
 - Reporting accidents and incidents

Health and Safety Commission Statement

- **Article: Get a Life! 22nd August, 2006**

The Health and Safety Commission (HSC) today urged people to focus on real risks – those that cause real harm and suffering – and stop concentrating effort on trivial risks and petty health and safety. To help take this forward the Health and Safety Executive (HSE) today launched a set of key principles: practical actions that we believe sensible risk management should, and should not, be about.

Launching the principles at a children's sailing centre in north London, Bill Callaghan, Chair of the HSC, said: "I'm sick and tired of hearing that 'health and safety' is stopping people doing worthwhile and enjoyable things when at the same time others are suffering real harm and even death as a result of mismanagement at work. Some of the 'health and safety' stories are just myths. There are also some instances where health and safety is used as an excuse to justify unpopular decisions such as closing facilities. But behind many of the stories, there is at least a grain of truth – someone really has made a stupid decision. We're determined to tackle all three. My message is that if you're using health and safety to stop everyday activities – get a life and let others get on with theirs."

(This event was publicised by the IMLGroup's HazardEx Publication whose permission was kindly granted to use the text)

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