Hone your skills

Like a finely tuned instrument, investing in training and continuing professional development for plant engineers helps them to perform their roles with greater speed, accuracy and precision. Brian Wall provides some insights

An aircraft engine housing being surface scanned by a hand-held Leica T-Scan, tracked in all six degrees of freedom by a Leica laser tracker and T-Cam

Workforce training and continuing professional development (CPD) are two key considerations for any employer. But that's particularly the case in the plant sector, where employees are not only required to demonstrate engineering competence, but are also routinely exposed to a multitude of health and safety risks – operating machinery, exposure to noise, fumes and gases, manual handling, using a wide range of equipment types – and all that while wearing protective clothing.

Moreover, a combination of tasks – often the situation faced by plant engineers – gives rise to a variety of 'duties of care', under several different, but equally relevant regulations. So in terms of health and safety alone, the starting point for training is the requirements of MHSWR (the Management of Health and Safety at Work Regulations 1999), originally implemented in1992.

"Regulation 3 states that every employer shall make a 'suitable and sufficient' risk assessment of health and safety issues," says Kulvinder Clare, a solicitor covering commercial insurance at Weightmans LLP. "This is an absolute duty. Regulation 13 states that the employer shall provide the employee with adequate health and safety training. The requirement to provide training is also an absolute duty – although the training need only be adequate."

But what exactly constitutes 'adequate'? The Court of Appeal (Latona Allison v London Underground (2008) recently examined its definition. "The court held that the test for adequacy of training was what training was needed, in light of what the employer ought to have known about the risks arising from the business activities, rather than just the risks they did know about – taking professional advice where appropriate," explains Clare.

So, in the end, the onus falls firmly on the employer to get it right. Regulation 13 is repeated in the other, more specific legislation: PUWER (the Provision and Use of Work Equipment Regulations 1998), which features commonly throughout engineering (Regulation 9); PPEWR (the Personal and Protective Equipment at Work Regulations 1992, Regulation 9); and COSHH (the Control of Substances Hazardous to Health Regulations 2002, Regulation 12).

Unthinkable penalties

What are the consequences of not getting health and safety training right? "Civil liability may attract to an employer, if an accident is found to have occurred as a direct result of a failure to provide adequate training alone," states Clare. "For this reason, carrying out sufficient and suitable risk assessments is vital, as the employer can only adequately train the employee in relation to health and safety risks at work, if he/she has assessed those risks fully in the first place," she adds.

Moving on to training for professional engineering competence, though, while meeting the needs of employees according to the prevailing regulations is paramount, it is equally vital to ensure that plant

engineers are aware of – and understand – technologies, techniques and processes that might empower them to perform their roles with greater speed and precision. Ours is a constantly changing world and we need to stay appraised of what is happening, not least because useful training enjoyed by engineers should also translate into greater productivity, reduced errors and waste, and improved quality control and accuracy.

To put it another way, in the world of plant engineering, where accuracy of measurement – in relation to equipment, its proper functioning and maintenance – is essential, the importance of training engineers in the latest methodologies and practices cannot be overestimated.

Enter the National Physical Laboratory (NPL) – a world-leading centre of excellence in developing and applying measurement standards, science and technology. In November last year, the NPL launched what it calls a large volume metrology (LVM) training programme. Metrology, in this context, involves measuring and inspecting components to ensure that they are correctly assembled and aligned, and to ensure there are no inconsistencies that could affect the product. So NPL's LVM training is about the measurement and testing of large-scale products – anything that requires special equipment to examine large surfaces and joints, or anything that can't be measured within the controlled conditions of the lab – as is the case with a great deal of plant equipment which necessarily lives in the real world.

NPL's courses will undoubtedly have significant impact in a range of industries across the globe, notably aerospace, automotive and defence, but also energy and medical. Why? Because LVM presents a variety of difficult challenges, due to the scale of the equipment and its environment. Keith Bevan, training product development manager at the NPL, says that course participants learn to question, understand and plan the best way to carry out such measurements, way beyond simply being able to use measurement equipment. As a result, trained engineers are better able to build systems, for example, into manufacturing processes – which enables organisations to increase productivity, improve product quality, and respond to customers' requirements and observations more efficiently.

Demand for such training is not in question. In fact, NPL established its LVM programme following a number of calls from big businesses in the UK, Europe and America. Airbus UK, for example, is so convinced of the need for LVM training, that it committed funding to developing the programme. "We recognise the competence of the NPL in measurement science, and the need for a course in LVM," points out Amir Kayani, senior manufacturing engineer, Airbus UK. "We see a course addressing the metrology needs for large volume manufacture and assembly as being of key relevance to aerospace and other industries."

Surely such specialist work has been going on for years? Well, yes and no. Until now, this type of training has largely been developed in-house, with no independently recognised courses available. NPL's new modules are said to be the first in the world to fill this gap, providing a framework that can be rolled out to meet LVM requirements across industries and plant types. Such is the commitment to the cause from industry – including firms such as

Left: dual Leica LTD800 Laser Trackers measuring forces exerted on bulldozer track shoes and simultaneously measuring displacement (position and angle) of the track shoes to the ground

Above left, centre: robot calibration, using a retro-reflector attached to the robot's end effector and tracked in 3D by the tracker

Certification drive

NPL is currently in talks with accreditation body EAL, one of the UK's leading awarding bodies for engineering and technology, regarding turning its large volume metrology (LVM) course into a certified engineering qualification.

The NPL training courses will operate as an extension of its widely respected dimensional measurement training programme, made up of four Levels and validated by The National Skills Academy for Manufacturing (NSA-M). Level 1 was launched last November; Level 2 training courses are imminent; and more advanced Level 3 and 4 training is now in development. More details are available through the NPL website: www.npl.co.uk/training

Rolls-Royce and Boeing – that they, along with academics, have been instrumental in helping to shape this programme.

Bevan and his colleague Stephen Kyle, honorary senior research fellow at University College London (UCL), led the development. They are in no doubt of the contribution it can make. "LVM is an integral and indispensable tool in manufacturing, construction and assembly," states Kyle. "Its understanding is critical to successful application. But, until now, only isolated pockets of knowledge – such as text books and manuals – were available. NPL's new course provides structured, guided learning across the field, for both beginners and advanced users."

Critical measure

Bevan is equally convinced: "LVM affects plant engineers in so many ways – such as on assembly lines for larger equipment. It might relate to measurements involving a ship, car body or aircraft wing, for example. Getting critical measurements wrong here could mean plant or equipment not functioning correctly or breaking down quickly. It could also mean scrapping what's already been produced or major rework."

How does it work? Bevan says that plant engineers are shown how to achieve best practice in measurements and metrology, as well as how to develop a questioning culture that they can then apply in their own working environments. "Having the knowledge and skills to achieve the highest levels of precision could be the difference between a piece of equipment lasting five years, where it might have lasted 10 with greater measured accuracy."

So what are the most commonly encountered sources of error that plant engineers are likely to encounter? Well, let's look at one major factor – temperature – and specifically the influence of temperature on both the part being measured and the measuring system itself.

Most materials get longer as they are heated and shorter when they are cooled. As the NPL points out, all dimensional measurements should be reported at a standard reference temperature of 20°C, as defined in ISO 1. Although this is difficult outside the lab, there are ways to minimise the impact on accuracy of temperature – and they range from expensive solutions, such as temperature-controlled rooms, to simple solutions.

When handling components, for example, if they are at a lower temperature than yourself, invariably you induce heating. That can be avoided by using gloves, tweezers or tongs. Equally, if the component is at a temperature above ambient – for example, because it has been machined – it needs to be left to soak to ambient, normally by placing it on a steel block or surface table.

Engineers also need to consider the influence of thermal gradients, particularly on large objects. Usually the top of a component is hotter than the bottom. Also, there may be gradients across a structure, due to heat radiating from a window or a steel door.

The difference between the surface temperature of an object and the core temperature must also be taken into account. Think of a large cylinder that has been machined on a lathe: the core is hot, but the surface cools quickly. You measure it, find the size correct, let the job cool and check it – only to find that it is undersize. The solution here might be to leave the job to stabilise, or to put it in a temperature-controlled bath or air shower.

At large volumes, another aspect to the control of errors lies in the design of the measurement strategy. Taking the example of triangulation systems, such as indoor GPS and free-hand vision metrology systems, typical recommended strategies include good intersection angles that result in smaller spatial errors or, alternatively, multiple measurements that 'average out' errors. PE

Pointers

- Under the MHSWR regulations, employers must make 'suitable and sufficient' risk assessments to establish training requirements
- It's not what you know about, but what you should have known about
- Large volume metrology – measuring and inspecting components in the real world – is now being taught by NPL
- Plant engineers need to be reminded periodically of measurement best practice and how to maintain a questioning culture

Centre: Keith Bevan, training product development manager at the NPL. "Course participants learn to question, understand and plan the best way to carry out measurements"

Multi-tasking for plant engineers

In today's working environment, change is the constant. As John Saysell, business development manager, MCP Consulting and Training, states: "Companies don't know what the future may hold for them any more. Employers want their plant engineers to be as flexible as possible – for example, to know about everything that is happening on production line one and line four. So when someone is ill or away, or production requirements change, they can cover as many roles as possible. It's not about depth so much, but breadth and first-call maintenance."

For this reason alone, he says, it is vital that plant engineers are given access to the right courses, embracing such areas as maintenance training, how to develop effective preventive maintenance strategies, and workplace planning and control.

"Apart from needing this knowledge, engineers also want to be motivated and invested in. Employers who do so invariably get a higher output and greater morale. Then there are all of the regulations that might have been updated around ATEX [Appareils destinés à être utilisés en ATmosphères EXplosibles], DSEAR [the Dangerous Substances and Explosive Atmospheres Regulations 2002], Working at Height or Corporate Manslaughter. I have encountered companies that have not trained their people adequately in those areas and the implications can be very serious indeed."