



# A vital role in keeping water systems safe

Following the publication, in *HEJ*'s January 2017 issue, of the first in a planned series of articles on the role, responsibilities, and remit, of IHEEM-registered Authorising Engineers, in this second such article, Dr Nick Hill, chair of the Institute's Water Technical Platform – who has over 25 years' experience advising clients including NHS Trusts on water safety and hygiene, and served on the Department of Health's Steering Group for the production of the 'new' HTM 04-01 (*HEJ* – June 2016) – outlines the vital contribution of the AE (Water) to the safe operation of healthcare facilities. He also explains the registration process for such personnel.

The raison d'être for Authorising Engineers was eloquently described by Graham Stanton in his January 2017 *HEJ* article; to paraphrase, Health Technical Memorandum 00: (2014) *Policies and Principles of Healthcare Engineering*, recommends that Authorising Engineers are appointed for each of the disciplines described in HTMs 01 to HTM 08. Each Authorising Engineer is expected to act as an independent professional adviser to the healthcare organisation. This requirement had been stated previously in the 2006 edition of HTM 00. However, the 2006 edition of HTM 04-01, specific to water, made no reference to the Authorising Engineer (Water), although some AE(W)s were practising at that time. More recently, HTM 04-01 (2016), *Safe water in healthcare premises, Part B: Operational Management*, does make reference to an Authorising Engineer (Water), stating that the Water Safety Group (WSG) would normally include an independent AE(W), (see pages 36-38 for short profiles on five IHEEM-registered AE (W)s) – with a brief to provide services in accordance with the HTM and the Health and Safety Executive (HSE)'s technical guidance, HSG274.

## What is an AE (W)?

The difficulties start here, because the title 'Authorising Engineer', in the case of water, is a misnomer, as regards both the words 'authorising' and 'engineer'. The AE (W) does not 'authorise', and may or may not be an 'engineer', whatever that is. We can enter into a nice philosophical discussion about what an engineer is here, but the definition I like best is that an engineer is an applied scientist, in which case the AE (W) is definitely an engineer. Water is a bit of an inconvenient technical field, because to profess 'expertise' one must be able to hold one's own in microbiology, chemistry, mechanical and, process engineering, management



Figure 1: Is this a chemical, a microbiological, or an engineering problem?

systems, and risk concepts, while equally having a knowledge of healthcare provision (see Figure 1 as an illustration of why this is the case).

Bearing in mind this awkwardness, there needs to be some convincing argument for bothering to adopt the idea of Authorising Engineer (Water). It is perhaps a brave author who, as early as this, launches into some national stereotyping. Here goes, however, and let us start on the Germans and the British. In the UK, certain professions – such as barrister, solicitor, accountant, and medical doctor – are protected; only an individual qualified and registered can practise in these professions. The profession of engineer is not, however, included in that list. Many engineers and engineering bodies would dearly like the status of engineers to be protected, and have campaigned accordingly, but so far to no avail.

## A 'protected profession' – in Germany

Contrastingly, in Germany both 'engineer' and 'technician' are protected – not just anyone can use these titles. It is argued that the German system is inflexible, stifles innovation, and leads to a cartel or closed shop. Conversely, the UK system has been called 'anarchic', and is certainly based on caveat emptor '(buyer beware)' principles. In the UK, one can go straight from the job centre – having never worked before, and with no relevant qualification or background in the engineering profession

– into a job as, for example, a washing machine 'engineer', whereas in Germany that would be impossible, as indeed would calling such a person a 'technician'. In the UK, anyone can call themselves an 'Authorising Engineer (Water)'. This problem has, however, been addressed by IHEEM (see below).

## A more positive spin

The above discussion certainly describes what an AE (W) isn't, but now let's be more positive. The HTM 00 refers to the Authorising Engineer as an independent professional adviser, and HTM 04-01 provides the scope for the AE (W). It is important perhaps to differentiate between the styles that I imagine might exist between the methods of working adopted by Authorising Engineers in different technical fields. My perception is that for some risks there are 'absolute' requirements, for example for the safe management of high voltage electricity, where really there is one way of safely doing the job and one needs to know it and do it. Furthermore, there is no significant difference in vulnerability to electrocution; we are all equally vulnerable.

One can imagine that an Authorising Engineer for high voltage electricity can therefore regard the HTM for electricity as almost a rulebook and act not unlike a traffic warden (no disrespect to electrical AEs), where the focus presumably is on compliance or deviation from the HTM. In other fields, there is a perception that one





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complies with a particular HTM or seeks to agree a 'derogation' for an alternative or lesser option to be implemented, rather than 'the letter of the law' (i.e. the HTM). One hopes that to an Authorising Engineer (Water) this is an extremely foreign language.

### Varying vulnerability

In the field of 'safe water' the populations exposed to pathogens such as *Legionella*, *Pseudomonas aeruginosa* etc. have varying vulnerability. For example, the clients of a healthcare facility such as a hearing test centre may be no more vulnerable than the general public, whereas patients in a leukaemia ward may be extremely susceptible to infection, due to their immunocompromised condition. Furthermore, there are many technical and management solutions to the same aspect of risk within water systems. The number of options for eliminating or controlling the risk is very large. For example, supplementary water treatment may or may not be applied, but if it is, there are many different types of treatment. This plethora of vulnerabilities and technical/management solutions has resulted in the adoption of 'risk assessment' as a tool to understand and prioritise actions, with a risk appetite of 'so far as reasonably practicable - SFARP', also known as 'as low as reasonably practicable - ALARP'. Both HTM 04-01 and the HSE Approved Code of Practice (L8) recognise the primacy of risk assessment as the basis of legal compliance. The mindset of the AE(W) is therefore necessarily focussed on ALARP.

### What is the value of an AE (W)?

In much the same way that in the UK anyone can call themselves an engineer, it also true that anyone can call themselves a consultant. An 'energy consultant' can be someone who sells central heating, while an 'energy efficiency consultant' can be a double



**Figure 2: Where are the data for assurance that tertiary loops have the correct pipe temperature?**

glazing salesperson. Many so-called 'water consultants' or '*Legionella* consultants' have vested interests, and are, in fact, not independent consultants at all. The first value which an AE (W) brings to the healthcare provider is their independence and impartiality. Hang on, however; that is two things. In my opinion, they are the same thing, but for some people 'independence' only means 'is not an employee of our organisation', whereas for me, independence must include impartiality, i.e. an ability to advise, without vested interests, on any potential solution to a problem.

An AE (W) should also bring a depth and breadth of expertise in the water field within and beyond the scope of HTM 04-01. The AE (W) not only understands the content of documents such as HTM 04, but also the rationale behind each element of their content, and how they interlink with other relevant legislation and guidance. The AE (W) will exhibit a

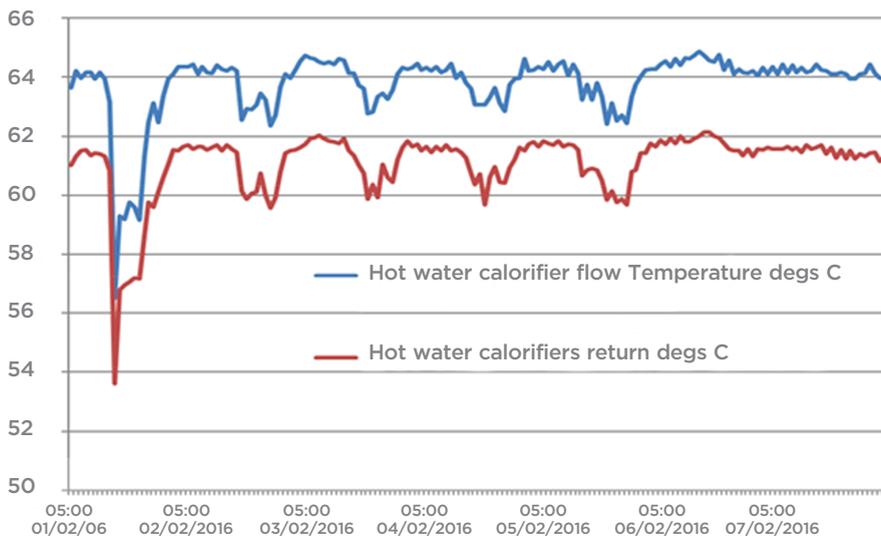
particular skill in presenting his/her expert opinion, often honed through practice as an expert witness, where evidence is key. The AE (W)'s awareness of the Premises Assurance Model (PAM) and the role/expectations of the Care Quality Commission (CQC) will often lead to a radical re-think by the healthcare client. The practice of exception reporting, whereby only non-compliant data are reported, is a common one in healthcare organisations. At face value it can appear a very efficient way of reporting the status of risk controls. In reality, we should be much more concerned with 'assurance based on evidence'.

### Assurance based on evidence

If I were a healthcare organisation, I know I would rather present assurance based on evidence to the CQC inspectors, rather than basing my 'evidence' on 'We have non-compliances and we respond to them' (I call this the 'underpants on the outside of trousers', i.e. the 'Superman' approach). The focus on exception reporting often hides the fact that nobody has proved that the correct data are being collected, that there are critical control criteria in place, and that these criteria are being met for all critical control points of all risk systems. The AE (W) can assist the organisation to transform to one where 'assurance is based on evidence'. Lack of exceptions is not necessarily adequate evidence for assurance. In order to offer this supportive advice, the AE (W) exhibits both numeracy and process skills, not just the advice that: 'That's broken, fix it.'

### Hot water temperature monitoring

A very simple example of this exception reporting versus assurance based on evidence is shown by hot water temperature monitoring. In my experience, most healthcare organisations have an imbalance between their reliance on portable thermometric equipment and building management system (BMS) sensors, in favour of the former. If an organisation adopts critical control criteria of a 60 °C hot water calorifier flow temperature, and 50 °C for the return at the calorifier (not to be confused with the 55 °C return temperature elsewhere in the system), it could monitor using portable electronic thermometers. This was the case for the Dingley Dell Hospital,\* which had no exceptions to report from its monthly temperature checks. However, when BMS trend data were sought (see Figure 3), it quickly became clear that critical control criteria were not being met, and that assurance could not be provided. On the Monday morning, the hot water flow temperature fell below 60 °C for approximately five hours. Typically, manual temperature checking is done at the same time of day, and sometimes the same day of the week, on each occasion,



**Figure 3: Dingley Dell\* hot water calorifier temperatures.**





and hence such deviations might never be found. Even if the time of testing were random, the chance of finding a five-hour deviation in a 168-hour week would be 1 in 34, and therefore with monthly checks one would expect to discover it within three years. The benefit of BMS sensors with suitable alarm settings and plots of temperature performance is very clear.

### Challenges of sampling for *Legionella*

Temperature testing may or may not be straightforward, depending on your reading of the previous paragraph, but it seems that sampling water for *Legionella* testing is rocket science by comparison. I have yet to discover a healthcare organisation with a robust strategy for water sampling for *Legionella* testing. The perception is that 'it can't be difficult; you just put some water into a bottle and send it off to a United Kingdom Accreditation Service (UKAS)-accredited laboratory'. As AE (W), I am often presented with positive *Legionella* results for my expert interpretation, which starts with my question 'Why did you take these samples; what were you trying to prove?' That's when the body language I get back is akin to 'Have you just landed from a different planet?' My task is to channel sampling strategies to the acquisition and interpretation of data which can provide answers to, and hence assurance regarding, the fundamental questions: 'Are we protecting our patients?', and 'Are our water systems operating effectively with respect to microbiological control?' In order to answer these questions, the locations, number, and type of samples can be very different. Interpretation of data to answer one question can be very weak if the samples were taken in a manner only suitable for answering the other. The absence of '*Legionella* positives' is not necessarily sufficient assurance that patients are protected (quite apart from the need for assurance based on the other aspects of control).

### Do I need to appoint an AE (W)?

I'm often asked 'Do we have to appoint an AE (W)?' The short answer is no. The longer answer, and my typical advice, is that one should only appoint an AE (W) if there is a perceived benefit. Traditionally one could use HTM 00 to justify such an appointment, since it suggests an AE for each discipline. Alternatively, one could have cited HTM 04-01 (2006), which made no mention of the AE (W) to argue against the use of such an individual. Even though the 2016 edition of HTM 04-01 describes the role of an AE (W), his/her appointment is at the discretion of the Water Safety Group. These are austere times for the health service, which should alone justify the appointment of an AE



Figures 4 and 5: Good ALARP practice for healthcare? – respectively plate heat exchangers for hot water with no storage, and flow-through type expansion vessels.



(W), since there are many opportunities for more appropriate application of resources when contractor-led activities are reviewed by the AE (W).

Although one can argue against the need for an AE (W), one should be prepared to explain that decision to the CQC inspectors when they call, since their interpretation of HTMs may be that an AE (W) should be in place. The only likely way that the CQC might be convinced would be if robust assurance based on evidence that ALARP is being achieved were to be presented.

### New entrants to the sector

It is unusual for a new healthcare organisation to enter the UK market (most 'new' NHS healthcare providers are merged or demerged organisations). However, there are some new entrants, such as overseas private healthcare companies. For these organisations, HTM 04-01 does not indicate at what point in time an Authorising Engineer – and for that matter a Water Safety Group – should be appointed. I am currently serving one such organisation, which has been enlightened enough to appoint AEs from the outset of the design process, not least briefed to ensure that the CQC registration process proceeds as smoothly as possible. It is refreshing to have the earliest possible interaction with the design team, rather than advising clients at/after handover when the money has been wasted and the designs don't meet ALARP.

The designers of water systems have yet to fully appreciate the expectations of AEs for ALARP, but rather are focused on blindly following design guides while disregarding risk assessment and ALARP, in the false expectation that their professional indemnity is protected. It is convenient to ignore the requirement of HTM 04-01 (itself surely a 'design guide') to consider risk at the earliest stage of design. A quick word count of Part A reveals the word 'risk' 87 times. Bearing in mind the title '*Safe Water in Healthcare Premises, Part A - Design, Installation and Commissioning*', it is time for designers to prove their designs are based on risk and the risk appetite known as 'ALARP'. To quote Part A: 'Where new healthcare premises are planned, or existing premises

are to be altered or refurbished, the WSG should be consulted at the earliest possible opportunity and water risk assessments be completed for all projects'.

### What does the AE (W) do?

The AE (W) is responsible for the 3 'A's described in HTM 00, namely 'Audit', 'Appraise', and 'Advise'. The Audit should be a little cleverer than a checklist, in that the auditor must have a purpose. It is a bit weak if that purpose is to prove compliance because any example of non-compliance means the objective is not met. The healthcare organisation, and its Water Safety Group, typically are seeking assurance based on evidence. The assurance they need is that there is an effective management system in place to systematically achieve ALARP. The purpose of the audit should therefore typically be to answer the question, 'Is there an effective management system in place for water safety?', with a 'yes' or 'no' answer. The key word is 'effective', not 'perfect'. As AE (W), even if the management system is effective, I will make recommendations where necessary to improve it. Clearly, in carrying out an audit, as AE (W) I have an eye for the expectations of the relevant regulator, namely the CQC.

The 'Appraisal' role of the AE (W) is to determine whether key people within the Estates/Facilities function are suitable for appointment to roles such as Nominated/Responsible/Authorised Person. In common with other technical fields, I do not appoint, since I lack the necessary authority, as a person external to the organisation. However, I can nominate or endorse an appointment. A record of the appraisal process is maintained, and re-appraisals undertaken.

### Proactive and reactive 'advice' role

The 'Advice' role that I undertake as AE (W) is both proactive and reactive. Regular advice is provided during WSG meetings. I have a particularly valuable role in changing the culture of WSGs, particularly through the improvement of communication between disparate internal experts, based on sharing of data to demonstrate assurance to each other based on data and evidence, in preparation for the day when similar





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assurance will be sought by the CQC. The reactive advice in response to queries, incidents, non-compliances, and positive *Legionella/Pseudomonas aeruginosa* counts, has been guided to a risk review and root cause analysis approach, itself requiring a cultural shift by the client.

Finally, having considered what AE (W)s do, let's finish this section with a very important example of what an AE (W) should not do, notably 'signing off designs'. There is no doubt that water system designers should consider risk at the earliest possible stage and throughout their work. Likewise, the healthcare organisation should ensure that the designers and the AE (W) interact throughout this process. However, the responsibility for design remains with the designer. I have to smile when I receive electronic copies of 200 CAD drawings and a 200-page text document describing the design, from a designer (in private practice), requesting that I 'sign off the design'. My terse email, if only I could send it - 'Remind me, who has the fat fee for design?', is unlikely to make anyone happy, but illustrates the point that while an AE (W) can look out for obvious examples of imminent danger, it is more important that the individual sees documentary evidence of the designer's risk-based approach resulting in ALARP. I have had many constructive interactions with designers on healthcare projects, once I have passed their naivety test. It is interesting to note that project managers are beginning to attend water safety training courses, but that water system designers have yet to appear in any significant numbers.

### How is an AE (W) registered?

Uniquely, IHEEM operates an appraisal and registration system for AEs including AE (W)s. The process of appraisal of AE (W) candidates is based on principles established by the other IHEEM Registration Boards and the Engineering Council. The Registration Board for AE (W)s is chaired by Bill Millar, CEng. The process is based on an application, a Practice Report, and an interview by peers selected from the Registration Board members. The register of AE (W)s is maintained on the IHEEM website. Several candidates have successfully passed through the appraisal process, and have been registered, which entitles them to use the IHEEM AE logo. In all cases the Registration Board seeks not to 'fail' candidates, but rather, where they do not meet the criteria, to explain the positive and negative aspects of their application so they can go away and take positive steps for improvement, with a view to being re-appraised. There are key criteria, which are explained in the application documentation, but often overlooked. There is a misconception that one can become an AE (W) simply based on technical expertise and experience. There

are other important aspects which are necessary, such as independence, impartiality, and so-called 'soft skills', although I would call them 'hard skills', such as communication and other social skills. Without these, the AE (W) would be knowledgeable, but unable to 'put the rubber on the road'. When a candidate attempts to bully the Registration Board members from the outset of their professional interview, it is only too obvious that the members will conclude that similar tactics would be used in the workplace.

### A 'servant of the cause'

Some perceive AE (W) as a status to be sought by anyone in the water safety field. It isn't; rather an AE (W) is a servant of the cause of water safety, for the protection of patients and others. If there are individuals who need status, but cannot meet the criteria for AE (W), there may be other ways of achieving it. Finally, as regards sufficient knowledge and experience to achieve AE (W) registration, there have been candidates who have no healthcare experience, no audit training/experience, who cannot explain ALARP, and have little or no knowledge of microbiology. It would pay any candidate to read the criteria before applying.

### Conclusions – progress in London

As an Authorising Engineer (Water) operating only in London, I can report my impressions of the progress of acute, mental health, and community health Trusts, a facilities management company, and a new private hospital developer, which form my client portfolio. Generally, their current status is that they are embracing the need for, and implementing:

- A Water Safety Group, with sharing of data for assurance (not just exception reporting) based on evidence, both estates-related and clinical;
- A Water Safety Plan (WSP), based on HACCP (Hazard Analysis and Critical Control Points);
- A water sampling strategy (within the WSP) for microbiological testing based on simple scientific principles, rather than the 'fishing trips' of contractors;
- Continuous risk assessment, based on incident/risk review reporting as part of the HACCP approach;
- The principle of ALARP.

There is more work to do, but the direction of travel will facilitate external assurance, not least of the CQC. **hej**

\* Dingley Dell Hospital is fictitious, but the data attributed to it are real.

**Author's note:** This article contains only the opinions of its author, who does not seek to represent the views of others, in particular IHEEM and its Registration Board for Authorising Engineers (Water), but also the Department of Health, the CQC, and the HSE.

## Further reading

- HTM 00: *Policies and principles of healthcare engineering (2014 edition)*. Department of Health, March 2014. <http://tinyurl.com/olws7yw>
- HTM 04-01: *Safe water in healthcare premises. Part A: Design, installation and commissioning*. Department of Health, 2016. <http://tinyurl.com/hhwp5vk>
- HTM 04-01: *Safe water in healthcare premises. Part B: operational management*. Department of Health, 2016. <http://tinyurl.com/goz8jlt>
- IHEEM list of Registered Authorising Engineers (Water) (Correct to January 2017). <http://tinyurl.com/htql05d>
- IHEEM Water Technical Platform. <http://tinyurl.com/jaxt2lm>

## About the author

Dr Nick Hill is a Fellow of IHEEM, and acts as the chair of its Water Technical Platform. He is also a member of the IHEEM Registration Board for Authorising Engineers (Water). He has worked on all aspects of water, and is director of Water Quality London. He served on the Department of Health's Steering Group for the production of HTM 04-01 (2016), having earlier assisted with HTM 2040 (1993). He has been employed by a water authority, on corrosion research, undertaken research at a sewage works, and worked for an industrial water treatment company. Thereafter he operated as an independent consultant advising organisations on borehole feasibility, process water treatment, wastewater minimisation, groundwater contamination, effluent treatment, drinking water treatment, and water quality troubleshooting etc.

For over 25 years he has advised clients on water in buildings and *Legionella/Pseudomonas* in particular.

Dr Hill has served both private and public service organisations. His role at Water Quality London includes acting as AE (Water) for several healthcare organisations, and as consultant and expert witness for those who manage properties and their water systems in London. He also presents training courses for Responsible, Authorised, Competent Persons, and others.

