

Under pressure

Boiler plant safety is generally well understood, but the demands of work may leave pressure systems exposed to danger. Brian Tinham re-examines concerns and best practice



Boiler safety – particularly where steam-raising plant is concerned – is a very well established field. Boilers are, after all, well regulated, both from control and legislative standpoints; engineering guidance is clear and comprehensive; and, after years of mainstream training, maintenance engineers and inspectors (competent persons) alike know what they are

Hot water boilers

Where hot water boilers are concerned, modern plant is widely regarded as safe – certainly without the risks or requirement for regular intervention of their steam-raising counterparts. Essentially, because of industrial plant's similarity to domestic hot water boiler technology (condensing, combi etc), boilers are highly automated, failsafe and have excellent track records.

Perhaps the key point to make, however, is that the scale of electronics and built-in sensors (automatic flow, flue and return temperature monitoring, for example) makes these boilers a great deal more complex than they used to be. That doesn't mean they're less reliable – experience says quite the contrary – but reading the instructions for installation, commissioning and periodic maintenance is important.

Beyond that, John Bailey, commercial heating and systems director for domestic and light industrial hot water boiler maker Vaillant, warns maintenance engineers to beware of dirty systems. "They are a killer of any boiler and, today, the symptom is excessive boiler tripping. Sludge or residues in the water collect in the heat exchanger; the sensors pick up hot spots and flow rate problems; and the boiler shuts down. In the old days, they would still fire, even when exchangers were largely blocked, and that could result in safety issues, but today it's more about nuisance and expense."

His advice: if you are replacing boiler plant, think about water quality – and not only its contribution to energy efficiency, but also the potential for damage. "If you know water quality is poor, your system needs flushing, inhibitors and maybe dirt separator equipment," he says.

As for safety, it's simple stuff. As Bailey outlines: "Look for signs of leakage from seals and gaskets in the combustion chamber – mostly scorching or sooting. Also, when boiler plant is stripped down for servicing, always replace them. Then again, watch out for problems on flue systems, especially those with long runs of twin fire piping: there have been problems with some manufacturers. And check that condenser outlets and traps are clear, and safety valves are operating."

doing. Or so we would like to think, wouldn't we?

Yet near misses still happen, and not just with ageing plant. Also today, plants are increasingly monitored and controlled remotely, often by third party organisations and certainly without peripatetic boiler attendants. Just as important is the fact that too many boilers are not only run sub-optimally, but in a manner that unnecessarily stresses components – imperceptibly, yet inevitably shortening plant life (due, for example, to harsh thermal cycling resulting from poor specification).

Dangerous mix

Then, at the other extreme, there are the tens of thousands of much smaller, but potentially deadly, café steam boilers in coffee shops and restaurants. Yes, they too are regulated – see SAFED's (Safety Assessment Federation) PSG 8 technical guidance. But the primary concern is not over boilers at the likes of Starbucks and McDonalds, whose equipment is doubtless properly managed and anyway turned over long before serious problems might arise. No, the question mark here hangs more over corner cafés, where few inspections and irregular maintenance may be being carried out.

Looking first at industrial boilers, SAFED CEO Richard Hulmes suggests that boiler systems generally have a good track record. "Statistically, notifications of serious defects are much lower than in any other discipline – and I mean 10 times lower," he explains. And the reason: people, not only engineers, understand the potential seriousness of failure. "Everybody knows that, if the needle is inching toward red, and plant isn't shut down, there are likely to be very serious consequences that may involve them directly. So they take notice."

It's also the case that such reasonably large plant

is difficult to hide, so unlikely to slide under the radar of the HSE or local authority, in their enforcement roles, under the Pressure Equipment Regulations 1999 (amended 2002) on the supply side and/or the Pressure System Safety Regulations 2000 (PSSR).

That said, HSE still records around 150 dangerous incidents involving steam release and, on average, six deaths or serious injuries per year. So it's worth recapping on guidance for site owners, competent persons and plant engineers. HSE's 'Pressure Systems: Safety and You' guidance should be mandatory reading here – and not just for those concerned with boilers, but also any pressurised process plant and piping, compressed air plant, autoclaves, heat exchangers and refrigeration plant, valves and steam traps, even pressure gauges and level indicators.

Engineering guidelines

HSE's guide exhorts all involved to reduce the risk of failure, firstly by correct design and installation that's fit for purpose, but also to ensure that plant can be operated safely – meaning 'without having to climb or struggle through gaps in pipework or structures'. Obvious, maybe, but older engineers will recall plenty of sites that fall foul of that. They may also have experience of situations where repair or modification to boiler plant should have resulted in whole system re-examination before being brought on line, yet wasn't – another of HSE's concerns.

The rest is largely common sense – such as ensuring that staff know the desired process conditions and operating limits (especially, but not just, temperature and pressure), and that adequate training is provided for the control equipment – absolutely including emergency situations. Then it's all about the bread and butter of fitting the right protective and warning devices, and ensuring correct set-up, maintenance and security – and that safety valves, bursting discs and the rest discharge to safe places.

Finally, the guide draws readers' attention to the mandatory requirement for a written scheme of examination, certified by a competent person (covering cold and stripped down, as well as normal running, examinations). That's as well as, not instead of, a maintenance programme and safe system of work that should be varied in accordance with the plant's age and condition. More generally, HSE suggests paying particular attention to signs of wear and corrosion, and looking for tell-tale signs of problems, such as repeated safety valve discharges.

If you're concerned about finding competent persons, look for companies that have been assessed by UKAS (UK Accreditation Service) to BS EN ISO/IEC 17020:2004. Meanwhile, for further

guidance on steam boiler operation and maintenance, see HSE documentation and look at the SAFED PSG series of downloadable guides, which cover everything from the recommended periodicity of examinations to written schemes of examination, boiler operation and in-service examination of pressure system pipework.

Most important: look out for new boiler operation and maintenance guidelines, due to be published soon, with input from SAFED, the Combustion Engineering Association (CEA) and HSE to replace HSE's PM5 and SAFED's PSG2 (which are no longer in print). We're not just talking about five-yearly ultrasonic critical weld scheme inspections.

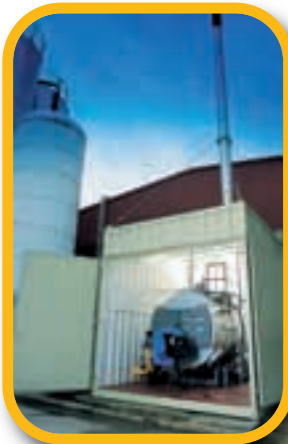
All useful stuff, but what about a steer from those who see poor practice first hand? Spirax Sarco major project manager Murdo MacDonald, himself a plant engineer of almost 30 years' standing, points to systemic failings – essentially the result either of outsourcing maintenance or of shortcuts, in turn due to excessive workloads and/or forgotten best practice. "We see engineers failing to carry out basic procedures and inadvertently creating potential hazards. For example, steam not shut down

properly when processes are closed up," he says.

"Also, some plant managers seem to have forgotten that boiler design fundamentally limits steam output. They push it too far and drag water into steam distribution services. Then you're into water hammer



Above: John Bailey of Vaillant believes hot water boilers are relatively safe
Left inset: typical containerised boilerhouse
Far left and below: classic large industrial steam-raising boiler plant



Technical pointers

- HSE records around 150 dangerous incidents involving steam annually
- However, SAFED says serious defects on boilers are relatively rare
- That said, too many boilers run sub-optimally, stressing components
- SAFED's new boiler maintenance guidelines will be published soon
- For HSE's pressure systems guide, go to: www.hse.gov.uk/pubns/in dg261.pdf

and all sorts of plant damage. Another fault we've seen is operators attempting to open boilers too quickly, ignoring the risks of thermal shocks and then siphoning the boiler. That's criminal," he adds.

Meanwhile, for Byworth Boilers sales engineer Michael Rutter, the problems are less about dangerous situations and more about suboptimal operation, caused by poor installation and/or maintenance. "The thing that kills boilers faster than anything else is water treatment – or rather the lack of it," he warns. "Often that's subcontracted, mostly to third parties that sell the chemicals. But, if the water checking procedures aren't adhered to in between visits, or the TDS (total dissolved solids) meters are allowed to go out of calibration, then boilers soon start to suffer."

He also refers to issues with regular steam boiler blowdowns, and checking flue gas temperatures, burner adjustment, site glasses, and the condition of installed pipework and ancillaries. "Many boilers – for example, in laundries, hospitals and food plants –

don't have automatic systems for blowdown. They're still manual and procedures are simply not kept up properly. A risk assessment should be carried out to establish the frequency and timing of blowdowns, which need to be strictly maintained and logged," he advises.

Hands free

SAFED's Hulmes also warns of potential problems with remote boiler management systems. "In days of yore, you'd have an experienced boiler attendant on site, who knew the plant. Now, although the health and safety culture remains good, since the boilers are operated remotely, there may be a temptation to allow continued running to keep production going, even when a boiler should be shut down. Equally, we hear reports of plant managers uprating boiler power, without adequate

consideration of the implications in terms of plant limits."

And Rutter adds: "A lot of plant managers don't survey their steam traps to ensure they're not passing steam. But if they're not functioning properly, they're not only wasting energy, but can also be causing the hot well to overheat, which can cause cavitation in the feed pump."

He also urges plant engineers to remember to isolate redundant sections of pipework – on both safety (live steam in unchecked pipes is asking for trouble) and energy efficiency grounds. And he

cautions site engineers to check that operators on shifts, when they are not present, know the procedures – otherwise you're into the accumulation of inadequate maintenance spiral.

"Although failing to top-up salt in the brine tank, or check that the chemical dosing pump is working properly, may not result in immediately obvious problems, sooner or later there will be an expensive premature failure," warns Rutter.

On one point, though, everyone agrees: busy operations engineers, who are invariably required to work on all sorts of plant, may well need a refresher course to update their boiler maintenance and operations skills. Rutter makes the point that, before long, insurers are going to require formal BOAS (Boiler Operative Accreditation Scheme) certified operators, supervisors and managers.

Spirax Sarco's MacDonald comments: "We're looking at a BOAS refresher course in line with the new HSE/SAFED/CEA guidance, covering everything from heat transfer mechanics, to pressure and temperature limits, boiler and auxiliary plant, feedwater conditioning services, control and instrumentation, as well as the plant safety."

Now that sounds like a plan. **PE**



Café boiler concerns

SAFED's advice for examining electrically heated steam café boilers is clear in its PSG8 guidelines, published in 2007. Richard Hulmes, SAFED CEO, explains that, because the majority of these boilers are under the two-litre capacity limit, the guidelines assume that they do not come under the Pressure Equipment Regulations, but do remain subject to the Supply of Machinery (Safety) regulations 2008 and PSSR, and so must be periodically examined for correct functioning and safety.

For practical purposes, the guide draws a distinction between what it terms accessible versus inaccessible café boiler internals – the obvious difference being that, for the latter, the electrical heating element and internal surfaces cannot be assessed visually – although hydraulic testing can be ordered. As for the rest, for both overall types, all protective devices – safety valves, pressure gauges, water level switch and high temperature cut-out – must be properly tested and validated.

SAFED's guide also makes the point that there have, for example, been instances where the vacuum from a boiler cooling down has drawn milk back into the boiler, leading to sludge formation. 'This may prevent the correct operation of the electronic protective devices or prevent the safety valve operating at the correct pressure,' warns the guide. It also notes that boilers are often found coated with caramelised coffee grounds and sugar, potentially leading to sticking pressure vessel safety valves.

And Hulmes adds: "We have found some with a relief pressure of 12bar, which could make a bit of a mess of the premises, if it blew. On others, you open up the back and there's the electrical supply and boiling water, but no obvious process, which is a real problem." He also reminds engineers that, as with any pressure system, many of the components are 'lived' items, and so must be replaced at set intervals.

"Our advice to engineers called in to carry out an examination is to start with a risk assessment. Check the age, make and source to get an understanding of likely usage and potential problems. Next, check to see if there has been any maintenance activity – if there has, that's a good sign. Then go for a visual examination, looking for obvious leaks or rusty parts and following the recommended processes in the guidance.

"Our concern is that things can slip through the cracks. Statistically, the risk is low at the moment – simply because we haven't had any serious incidents yet. But we have a concern and engineers can't afford to be complacent."