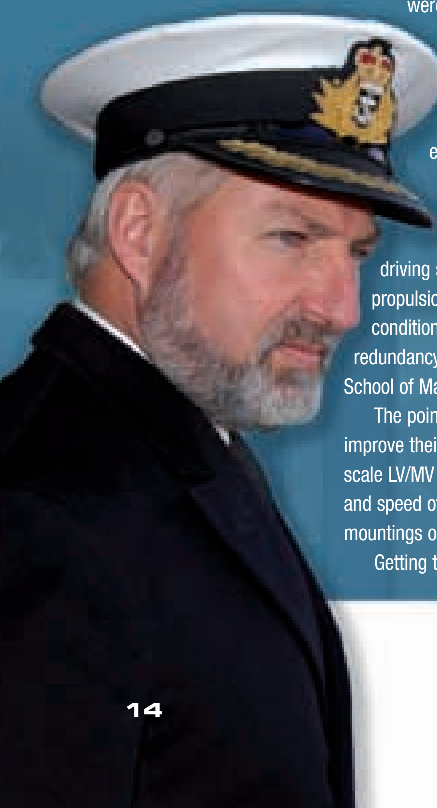
Naval sultans

The Royal Navy turns out some of the smartest, most able plant engineers on the planet. Brian Tinham takes a look at HMS Sultan and finds out the secrets of success

It's widely accepted that the Royal Navy turns out some of the best, most adaptable plant engineers in the world. Why? Because the force's entire ethos is geared towards building and rewarding multi-disciplined engineering talent. It's all about teamwork, hand-in-hand with competition, 'can-do' thinking, structure and, yes, discipline. That's a winning combination, honed over the years to equip the Navy's fleet with engineers supremely capable of handling everything active service can throw at them.

Want to be part of that process? Or would you simply like to be on the receiving end of some of that engineering ability? Either way, we need to understand what exactly is different about the Navy's training and its operating regimes, and just how much of that, if any, might be transferable.

Captain Graham Watts RNSME, who heads up the HMS Sultan engineering and artificer training centre in Portsmouth, believes a central pillar to the Royal Navy's success is the organisation's unswerving focus on selection, training and promotion. That, he says, is key to developing and nurturing all those who show not only engineering



Captain Graham Watts, head of HMS Sultan's School of Marine Engineering

Marine engineering challenges

Naval engineers have now seen two technical revolutions. First there were steam turbines; those were surpassed by gas turbines with gearboxes; and now the Navy is embracing integrated electric propulsion – with diesel and gas turbine alternators producing 440 and 6,000V ac and converted dc to power the main engines and all electrical requirements.

"Today's Type 45 destroyer has no gearbox, no direct drive from the prime mover, but full electric propulsion via large variable speed electric motors under the craft, driving short shafts to the propellers. Generated power serves propulsion, but also the low voltage ship's systems – air conditioning, lighting, weapons systems etc – with full redundancy," says Captain Graham Watts, head of HMS Sultan's School of Marine Engineering.

The point: "Youngsters who file metal into perfect squares, to improve their hand skills, also need to understand PLCs and large-scale LV/MV equipment, and be able to determine the temperature and speed of controllers delivering high pressure air to gun mountings or hydraulic fluid to weapons systems."

Getting that breadth of competence is achieved in time-honoured fashion in classrooms, workshops and engine halls, but also with Sultan's simulators. "We have three categories of machine: static training aids, machinery we can take to pieces and put fluid through, such as valves, centrifuges, pumps etc [for steam, air and water], as well as diesel engines we can take apart for propulsion [with all the lifting and slinging]; and machines we can run up to full power."

That ranges from a 22MW gas turbine, down to everything engineers are likely to encounter on ships at sea today. However, much of the more advanced training happens on the simulators.

"We can emulate a 16 cylinder diesel on screen. We can section it, look at the oil ways, see fluid running through and do stuff you just wouldn't do in real life. We can put faults on it and teach processes and procedures, without touching the real equipment. It's much cheaper, much safer and it's also a much faster route to competence.

"Ships and submarines are designed with lots of redundancy, but there are also lots of failure modes. So we need to put our engineers through realistic procedural trainers – and have them handle plafires, floods, fuel leaks etc as well. Our people need to be able to shut plant down safely while also providing alternative power to command. That might include fluid suppliers for weapons and aircraft launchers, propulsion for the main engines, or electrical power for defence."

aptitude, but also the right attitude. It's also instrumental in ensuring and sustaining excellence and succession.

Watts' own career provides an instant insight. Having, as he puts it, "screwed up A levels", he joined the Navy in 1976, because it was "the best way forward into engineering". He was schooled through ONC, which he passed with distinction and, on the strength of that success, was sent to Royal Naval Engineering college at Manadon in Plymouth, through officer selection. That led to a BSc Honours in naval engineering, but we're not just talking about a very useful degree. On top of that academic achievement, Watts also came away with full vocational craft training, as well as the Navy's world-class coaching in management and leadership.

Intense instruction

That intensity of instruction, he says, provided a solid foundation for the subsequent stages, which led to certification in boiler watch keeping, gas turbine plant, frigate and ultimately destroyer machinery. Watts then moved up to chief engineer, first on a Navy destroyer, then one of its frigates and on to the aircraft carrier Invincible, at each step progressing through the ranks to Commander.

"As with all engineering officers, my operational posts were interspersed with engineering support and management – involving everything from prioritising repairs to letting contracts for refit programmes lasting six to 14 months," explains Watts. "During that time, I also went through our higher management course, and the Navy's defence diplomacy and international defence strategy training. Out of that came a post on the defence training review team, as equipment manager, until I was promoted to captain and took over command of HMS Sultan."

As he says, it's all about those three words – 'selection', 'training' and 'promotion'. Those, and the Navy's bottom-fed hierarchy, are the bedrock of the Navy's engineering success. "Ratings and officers come in, and those with 22 years' service or aged 50—55 leave for careers in civvy street," explains Watts. "So there are no dead men's shoes; everyone moves up until they reach a position where they're comfortable. That's encouraged by a strong ethos that gives responsibility early and pushes our engineers to maximise their potential."

But it's not just about competence: it's also confidence, because all marine engineers also own and operate their equipment. "Every one of them wants to be the person who sorted that problem out, because that's the route to selection and promotion. Owning the kit and all the people that go with it is not only a really challenging position, but also what most people want to do. Till you get there, you work for people like that. So there's massive ambition and drive; you get noticed; and there are the opportunities."

What about the winning attitude? "We do a lot of work on that. Partly, it's about behaviour: no one raves over standing in line, but it breeds self discipline. Add to that the uniform, and you know who does what: it's like having an efficient rugby team around you. And the final ingredient is encouraging the mentality that says 'I'll have a go',

Pointers

- Teamwork, competition, 'can do' thinking, structure and discipline are all key
- The Royal Navy focuses on selection, training and promotion for advancement
- That environment promotes ambition: all recruits need to shine to get noticed and progress
- The Navy trains recruits for extreme situations
- Technology covered ranges from steam and gas turbines to integrated electric propulsion, LV/MV equipment and automation

Can you step up to the plate?

Think you could be a marine engineer? Here's a taste of just some of the problems you would need to solve on your feet. One of the industrial refrigerators goes down: there are chilled, cold and frozen levels in the plant and you have three fridges, but no spares. Do you turn one cold box into another freezer? Do you start thawing out ship's food and liaise with the chefs to see how they might use it imaginatively, while looking at what's wrong with the plant and repairing it. Getting this wrong affects the ship's endurance. Not acceptable.

We're talking about large-scale machinery that you have to enter and make safe, before taking apart and testing components you believe are defective, proving your suspicions and then replacing and/or repairing them. Skills required might include: pipe welding; brazing; joint fitting; maybe using flexible piping (having checked for material compatibility) borrowed or stolen from other plant. You would be managing a team of diagnostic engineers, engineering technicians and fitters around the clock, all of whom have existing responsibilities for other machinery.

No pressure, then.

Suppose that routine vibration monitoring has found a potential problem with the diesel main pump line: your reaction might be to shut down and transfer output to redundant equipment. Now you must assess the problem, maybe seeking specialist help by bouncing the vibration signal spectrum via HF or satellite communications back to the experts in Bristol. You need quickly to determine what level of vibration is acceptable, what precautions you should take, whether you should be stripping machinery down and looking for concentricity of the running parts, replacing bearings, whatever, and any implications on the electrical side.

On some newer ships, a high temperature alarm on ac to dc converters might indicate a partial short. So how do you measure that? What will be the impact of taking that equipment down? Can you isolate it safely and, if you do, what about the capacitive load? It could be a PCB problem, but diagnostics might require special test equipment or dialogue with engineers from the manufacturer or the dockyard.

At the other extreme, you might have high pressure sea water pipework that is rusty and leaking, or a hull fixture that is starting to crack. How do you stop the deterioration, so the ship can proceed? Do you weld, drill, add plastic compounds? Would you dump in some cement to prevent water ingress and maintain hull integrity? You need to assess structural integrity, taking into account bending and stressing of the framework and platework, while again considering appropriate materials for repair.

with the confidence that also says 'I'm going to get it right'. We train our people hard to take on extreme situations – so they know how to tackle machinery problems, find solutions quickly, and think about risk assessment and mitigation as they go."

So much for the ethos. Now Watts' responsibility is to deliver trained and effective engineering personnel to the surface fleet. So how does it work in practice? "HMS Sultan caters for 950 trainees. Some of them are on the conveyor belt courses – those that bring RN recruits in every two weeks for their nine-week foundation, and those on our 18-week initial engineering technician course. Together, they prepare technicians to go to sea within six months. One year later, they are ready for the vocational part of their training to NVQ Level 2, which can be improved to Level 3 and Btec national diploma. Then it's back to sea as engineering technicians in charge of a section of the ship's machinery.

"As part of our 'select, train and promote' process, they then get the remainder of their foundation degree and the craft side through City and Guilds, to Level 3 or 4. That prepares them for more serious technical issues – from managing plant, and diagnosing and repairing faults, to providing advice to command on propulsion."

That's how it works all the way up from rating, through Leading Hand (42 week course) to Petty Officer (52 week course) and eventually Warrant Officer, who may typically be the propulsion manager of a frigate or a destroyer. "At the end of each course, there's a minimum time at sea, typically 12 months, which provides the window for getting reported and selected for the next step. A chief petty officer will have had two or three tours at sea over six to eight years. If selected, he comes to us for a 20-week course, followed by two more tours so that, within four to six years, he's ready for the rank of warrant officer."

Typically then, recruits joining at 16 could be pushing for chief petty officer by the time they're 30, and then warrant officer by 35. And there's potential for 29—34 year olds to become officers – with additional training focusing on supervisory engineering, procurement and support.

And that, in a nutshell, is how you build the best plant engineers that money can't buy. PE