An Illustrious

Marine engineering, particularly in the Royal Navy, demands rather special engineers. Brian Tinham goes on board to talk to Cdr Peter Gilbert about life on HMS Illustrious

Pointers

- From a maintenance perspective, the approach with all ship's equipment is 'unmanned, but visited every hour'
- Engineering is also very proactive: because of her age, there is always something to do, so the policy is one of conducting rounds and finding the next likely defect and fixing it
- Cdr Gilbert points out that this also helps to stabilise the flow of spares inventory though the MRO stores

It takes a certain kind of person to be a marine engineering technician (ETME) in the Royal Navy – and a decidedly special engineer. Why? Quite simply, because they have to be 'can do' individuals able, practically at a moment's notice, to turn their hands to whatever ship engagements throw at them. Which also means they have to be multi-skilled, practised in stripping down, diagnosing and rebuilding a wide range of plant. And they must rise to the responsibility of a role that includes both operations and maintenance.

So says Commander Peter Gilbert, whom I met recently on the IRTE Trowbridge Centre visit to the aircraft carrier HMS Illustrious when she was berthed at Portsmouth. "When an asset like this is at sea, there are no second chances," he explains. "Reinforcements and replacements aren't just back behind the enemy lines. Engineering has to get problems sorted, or we're in trouble."

Clearly, much the same applies to their officers. Cdr Gilbert's own career speaks volumes about the kind of people the Navy wants in charge of its engineering. From Midshipman in 1984, through a range of sea- and land-based positions, he rose to Lieutenant Commander and Marine Engineering Officer (MEO) in the late 90s on HMS Liverpool, followed by a staff position at the Permanent Joint Headquarters, then promotion to Commander in 2003, leading the team responsible for submarine and surface ship propulsion gearing and shafting – and eventually to Illustrious.

It's hard not to be impressed; and it's just as hard not to be impressed by HMS Illustrious itself – both in terms of its defence and attack potential, but also its sheer size, and the scale and brute force of inter-dependent plant engineered into a single, effective fighting machine.

Serious plant

For example, this floating airfield is driven by four Rolls-Royce Olympus gas turbine engines – similar to those that used to propel Concorde – pushing a total of 110,000 shaft horsepower. And it has two of the world's largest reversing gearboxes, each the size of a small house, as well as no fewer than eight 1.5MW Paxman diesel generator sets – enough to power a town the size of Portsmouth. The list goes on and on.

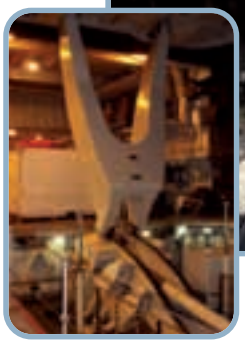
There's also its adaptability in the face of a changing military environment. "Our role was originally envisaged as patrolling the Faroes and the Iceland Gap, hunting submarines with helicopters as a contribution to the North Atlantic Treaty," explains Gilbert. "It was then designed to launch up to 16 Sea Harriers – hence the ski jump at the bow, to minimise fuel used during takeoff and maximise their range."

But that was in 1978, before Illustrious was rushed through its trials and commissioned at sea to relieve HMS Invincible at the close of the Falklands War. "There's no longer a significant role for us in submarine hunting: that's primarily for our submarines and frigates such as HMS Somerset," explains Gilbert.

"So, following a major refit in 1990 and another in 2003/4, costing more than £100 million, today Illustrious is the Navy's strike carrier, equipped for fixed wing aircraft [now ground attack Joint Task Force Harriers]. We now provide a small, but very agile attack capability, with 14 to 16 jets able to deliver precision close air support to troops on the ground. We're a big enough asset to influence people's, and governments', thinking and tactics."

So what about that plant? Looking at the gas turbines, each pair through one gearbox, with the

career



power plants offset to minimise the risk of a single strike disabling the carrier. From an engineering perspective, that results in drive shafts running though much of the ship, and access ways fitted around compartments for the ancillary plant.

To give a better idea of scale, at that last refit in 2003 the main gear wheel on one of the gearboxes had to be replaced. That wheel weighs more than 20 tons and meant a major redesign and rebuild. Although design drawings were available, it was re-engineered with 3D computer modelling and analysis software for the fabrication, dimensions and tolerances, while non-destructive testing played an important part in validating the material specification throughout the build phase.

"The power demand levers, originally on the bridge, have now been taken away, so that the Officer of the Watch can't demand too much," laughs Gilbert, commenting that it's all too easy to think of Illustrious as a souped-up destroyer. "We can manage the engines better and faster from below where we're focused on delivery of power on command," he adds, more seriously. And that's done from a modern engine control room, with a control desk and duplicate graphic monitoring and alarm panels covering auxiliary systems, fuel and oil and engine management – as well as ship's communications and side panels for the diesel engines, covering electrical generation and distribution.

Operations and maintenance

Under sea conditions, engine plant is operated fairly conservatively. "We can do 12 knots on one Olympus and that often provides enough wind over the flight deck for the modern Harriers to take off," comments Gilbert. "So it makes sense only to use the power we need – not just from the fuel perspective, but also plant maintenance, heat and habitability, at least for engineering. But if the conditions mean we need more flexibility, then we can have one turbine standing by and that can give near instantaneous extra power, if it's needed."

Much the same thinking applies to generator set operations, typically three of which are required to power all the ship's systems, providing significant redundancy and flexibility in battle conditions. "From a maintenance perspective, our approach with all this equipment is 'unmanned, but visited every hour'. Also, we're very proactive in our engineering work: because of her age, there's always something to do, so we have a policy of conducting rounds, finding the next likely defect and fixing it before it can embarrass us.

"That also helps to stabilise the flow of spares inventory though our stores, in tandem with our programme of routine maintenance, most of which is still time-based, although, because of our 75 years' experience with this class of warship, there is an element of reliability knowledge factored in, and we have to take account of planned operations. At the moment, for example, we're just completing an Olympus engine change. It was originally forecast for Christmas, but we pulled that forward to de-tune the congested December maintenance period."

Gilbert lists other major plant as including: eight chilled water plants to cool the close-in weapons systems and communications systems, and for air conditioning to keep the ship habitable; 74 air treatment units, zoned to prevent smoke and gases spreading around the ship in the event of damage; fire suppression and fire-fighting systems; and fresh water plant comprising a reverse osmosis plant and retained boilers and flash evaporator, capable of generating in excess of 250 tonnes of water a day.

But that's far from all. For example, there are also the dual hydraulic ram-powered aircraft lifts, each easily capable of raising and lowering 12 tonnes of Harrier aircraft from the hangar to the flight deck. Engineering on that plant, in particular, involves all the usual issues around hydraulics, electric motors, pumps, gears, seals, microswitches and the rest. The difference is that, when that Harrier needs to be elevated to the flight deck, there had better be as near to a 100% guarantee as physically possible that all the equipment will work properly in sync. PE

Above and left: hydraulic rams lift aircraft and equipment from the flight deck to the hangar

In a joint exercise with the US Navy, HMS Illustrious embarked 14 US Marine Corps Harrier AV8B jets, four Naval Air Squadron Sea King helicopters and 200 US marines. The ship then showed its versatility by also embarking one of the US Bell/Boeing MV-22 Osprey tilt-rotor aircraft