ARE (NAMD)

HASLAR AND PORTLAND NEWSLETTER

BY

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ABSTRACT

The work of NAMD includes endurance testing, evaluations or 'type tests', and special investigations. Nuclear steam propulsion components, safety valve testing, air compressors, pumps, reverse osmosis plants, chilled water plants, fuel treatment, waste disposal, corrosion, noise, and flow measurement have all been project subjects in the last two years.

It is time to remind the world that the Naval Auxiliary Machinery Division (NAMD) is alive and well. Somewhat strangely in these turbulent times of reorganization, neither our name nor master has changed since the last Newsletter was published in December 1984[1], although one change is in the air. It is possible that the management of the Portland site will be handed over to the adjacent ARE site to enable support facilities to be rationalized.

There have been other changes of course, particularly as the nature of the project work undertaken has evolved to match the new methods used for warship procurement, and before looking at our current work in more detail it would be as well to summarize the scope of the Division's work and the facilities available.

Project Work

Auxiliary Machinery and Systems

Current work on auxiliary machinery, for both surface ships and submarines, will normally take one of the following forms:

(*a*) *Long term endurance testing*. This will usually be in a rig which simulates service conditions and will require a plant or equipment to run for between 5000 and 9000 hours. Such a test can take between 2 and 3 years to complete but if the machine is reasonably reliable, once the initial teething problems are over (the bathtub curve plays a prominent role in our lives) such tests make few demands on manpower apart from routine checks and normal maintenance. This form of testing, for the reasons discussed below, now tends to be restricted to submarine equipments and the present endurance trials all involve TRIDENT machinery.

(*b*) *Short term evaluations*. The move towards competitive tendering and a wider use of commercial designs has produced a need for short term evaluations or 'Type Tests', either as an aid to the equipment selection process or to give confirmation that an equipment will meet the Lead Shipbuilder's tender specification. The trend towards this form of test has increased the Division's workload appreciably, as the only difference between a short and long term test is the absence of the least manpower-intensive phase, the endurance run. The tasks of rig design and build, set to work, performance test and, last but by no means least, report writing all remain and have to be performed to tight

schedules directly linked to a ship build programme. The main work in this category is, of course, for the Type 23 frigate, with the Division working in close conjunction with Yarrow Shipbuilders Ltd (YSL) and operating to their Type Test Specifications.

(*c*) *Investigative projects.* An awkward title but how else can you describe the 'what happens if' and 'what happens when' type of project. This usually involves investigating various phenomena, either those which may be giving problems in service such as noise from overboard leak-offs from firemain pumps and the effects of air ingestion into seawater systems while operating Masker belts, or those which may lead to future problems such as the trend towards an increased wax content in Dieso. Work of this nature is usually carried out at full scale using the facilities and if necessary the trials equipments already installed. This is in sharp contrast to many Research Laboratories which rely on 'table top' rigs. The investigation field is one in which we could make a larger contribution, both on a one-off basis at sea and in the test house, e.g. by proving an equipment modification as an alternative to a Minor Trial.

Nuclear Main Propulsion

This covers the Division's steam projects which usually form part of a component development or testing programme being run by an equipment manufacturer such as Rolls-Royce & Associates or GEC.

Facilities

Auxiliary Machinery and Systems

In general terms, the Division's main facility is the ability to carry out tests at full scale in purpose-built rigs which, within practical limits, can be made to simulate any actual or proposed installation and be run under both normal and 'worst case' conditions. Both sites have a plentiful supply of sea water, at Haslar for cooling and system circulation and at Portland at 'open sea' conditions suitable for desalination trials. The Auxiliary Machinery Test House (AMTH) at Haslar has facilities to handle most of the fluids found in marine systems—Avcat, Dieso, lubricating oil, hydraulic fluids and compressed air, both high and low pressure—and a 2·5 MW 60 Hz power supply.

Nuclear Main Propulsion

The two Thompson Le Mont shore boilers continue to produce up to 90 000 lb/h of steam at up to 1200 lb/in^2 and 950°F with their principal customer being the Safety Valve Test Facility (SVTF). The steam supply is also utilized in the steam turbine manoeuvring valve test rig, which has been extensively modified by the addition of vibration isolators and silencers in the main steam supply and discharge lines and an acoustic enclosure round the valve itself, to enable comparative noise and vibration testing of a range of valve trims and valve types. One interesting additional facility in this area is a large circular water tank, shown in FIG. 1, some 15 ft in diameter and 30 ft high with viewing ports at 2 ft intervals all round and up it, into which steam or a steam/air mixture can be injected—an ability which earns it the name of 'the Jacuzzi'. This has already produced extensive data on the behaviour of an underwater discharge from a primary circuit relief valve, as well as producing a very convenient method of testing pumps and eductors under high suction lifts.

Current Work

The Division usually has some 100 projects in hand, at varius stages from conception to awaiting formal agreement of completion. This is true at the time of writing, with the main contributors being 28 valves for the SVTF, 21 projects specifically for the Type 23 and 10 for TRIDENT. As it would be far too sleep-inducing to describe them all, only the highlights of the immediate past and present work will be covered.

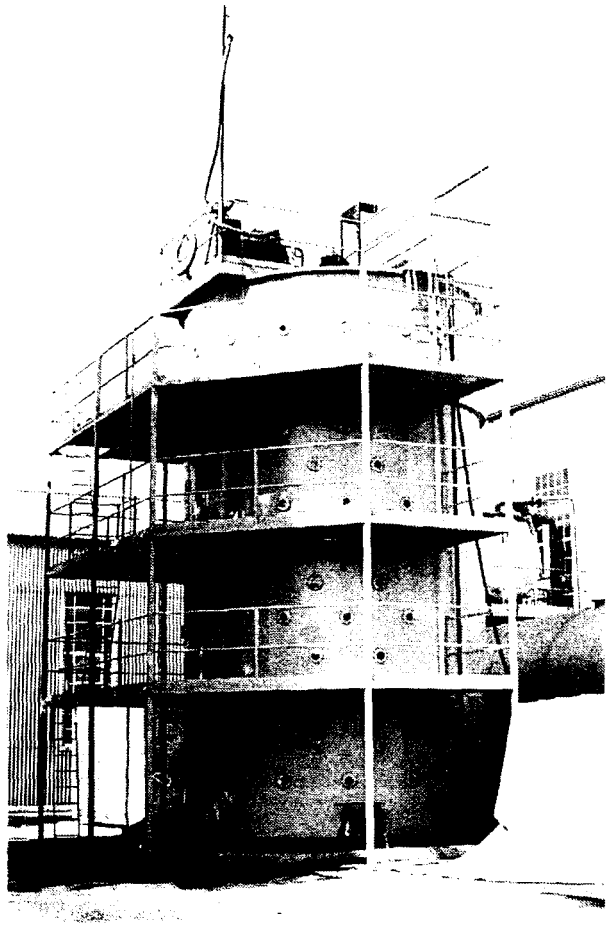

FIG. 1—'THE JACUZZI', WITH A GODIVA PUMP ON THE TEST PLATFORM

Compressed Air

Head, in a *Journal* article[2] immediately adjacent to the previous Newsletter, outlined the then future programme of work and this has largely been achieved. The navalized version of the Compair Reavell VHP 36 air compressor successfully completed 8000 hours running and has since continued to operate as a Station compressor. The Hamworthy 4TH190 compressor has been tested, first in its commercial form which had some piston seizure problems and now in a navalized form which has been selected for the Type 23. The seizure problems have been solved, and a valve life of over 1000 hours on OMD113 achieved even at 'tropical' sea water cooling temperatures, but problems with 'O'-seals in the valve assemblies and 4th stage air coolers remain to be resolved during the final 3000 hours of running with the unit now brought up to the full Type 23 production standard. On the LP side, trials continue of the Hydrovane variants for the Type 22 and Type 23.

Two LP blowers are currently on test, a Nash unit for TRIDENT, shown at FIG. 2 undergoing tilt trials, and a Howden unit to provide Masker air for the Type 23, FIG. 3. In both cases the compressors are satisfactory but their air cooling arrangements were found wanting, the Nash due to difficulty in measuring the water level in the large cyclone type separator vessels, and on the Howden it was shown that the original concept of using direct seawater injection into the discharge line was impractical.

Sea Water

The main thrust here is on pumps, their systems and the consequences of their use—e.g. radiated noise. Extensive trials have shown the effectiveness of the Yarway LARC valve as a back-pressure-controlled pump leak-off valve, and two are now in use in H.M.S. *Exeter* as a minor trial.

A project which produced some unexpected results was an investigation into the effects of starting a fire pump while it was reverse rotating. This had been suggested as a cause of burn-out of pump starters with the root cause being the failure of the pump's discharge non-return valve. The first

run, witnessed by a small gaggle of spectators from the vicinity of the remote start push behind the comforting bulk of the Nash blower, was from a moderate 500 r.p.m.—and nothing unusual happened. Soon we were starting from reverse speeds of 3600 r.p.m., equivalent to the pumps forward synchronous speed, with the starting current remaining around its normal 550 to 600 amps but with an extended duration of over 30 seconds, instead of the usual 6. A good starter will stand it, but beware the slackening connection. The search for the ideal self-contained fire pump continues, and a Godiva diesel driven pump can be seen on top of the water tank in FIG. 1.

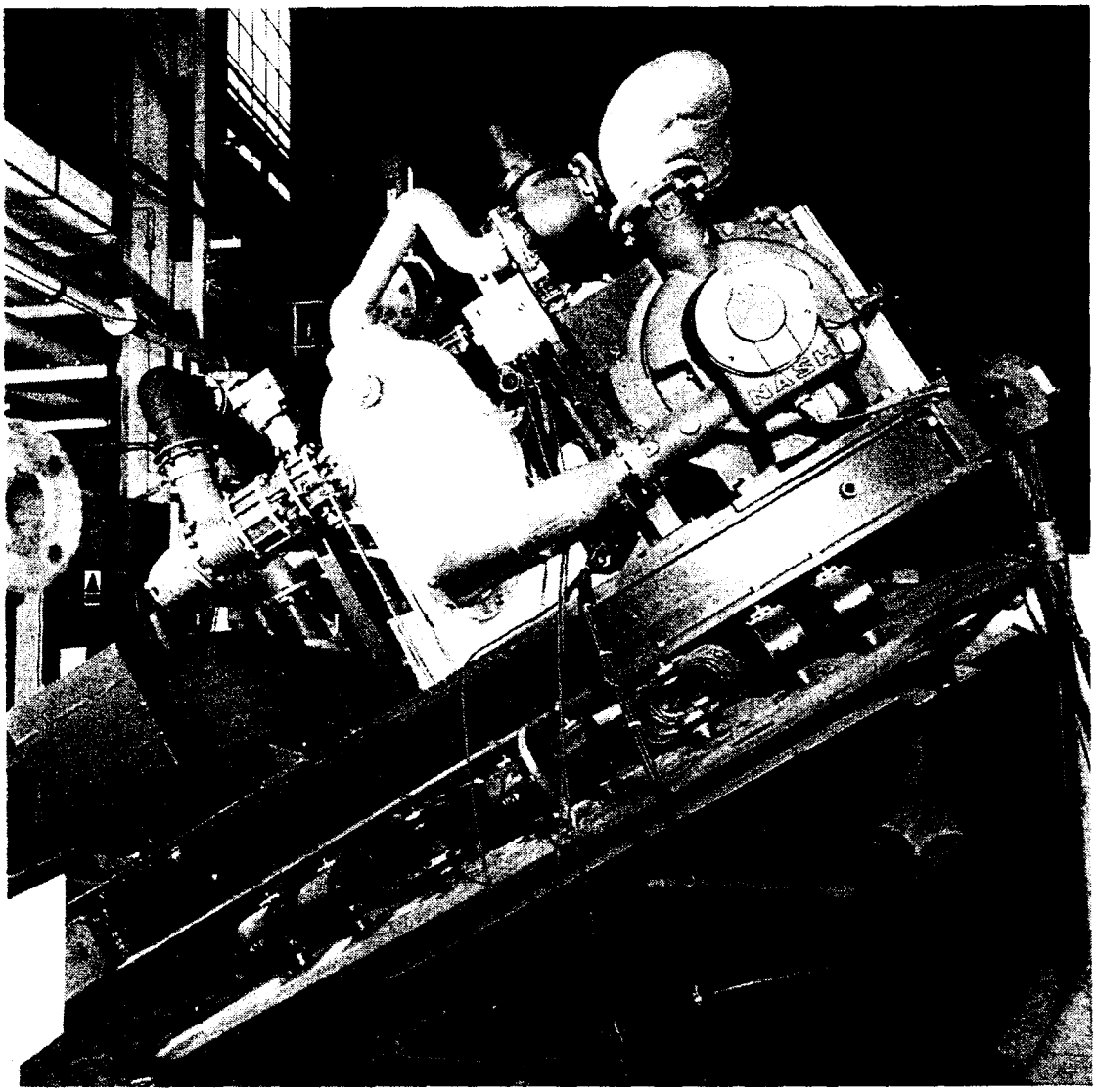

FIG. 2—NASH LP BLOWER, ON 30° TILT TEST

Fresh Water

This year has seen the completion of the Reverse Osmosis (RO) plant development programme, with plants for the Type 23 and T2400 SSK now in production and the prototypes relocated to *Sultan* and *Dolphin* respectively as training aids after some 9000 and 11 000 hours of trials. Filtration of the sea water feed remained a problem area and further trials at Portland have now proved a modified design of sand filter as satisfactory for the Type 23 (the earlier version blew its sand into the bilge when back-flushed); while the T2400 SSK will probably use a cheap disposable cartridge filter rather than the expensive back-washable version originally fitted. Reverse osmosis, being a low temperature process, does not sterilize the product water in the way

an evaporator did and, although trials have shown that a good membrane will reject virtually all the biological 'nasties' in the sea water feed, chlorination of the product water is still recommended. Testing of a chlorinator unit for the Type 23 will start shortly, in conjunction with a performance test of its fresh water transfer pumps.

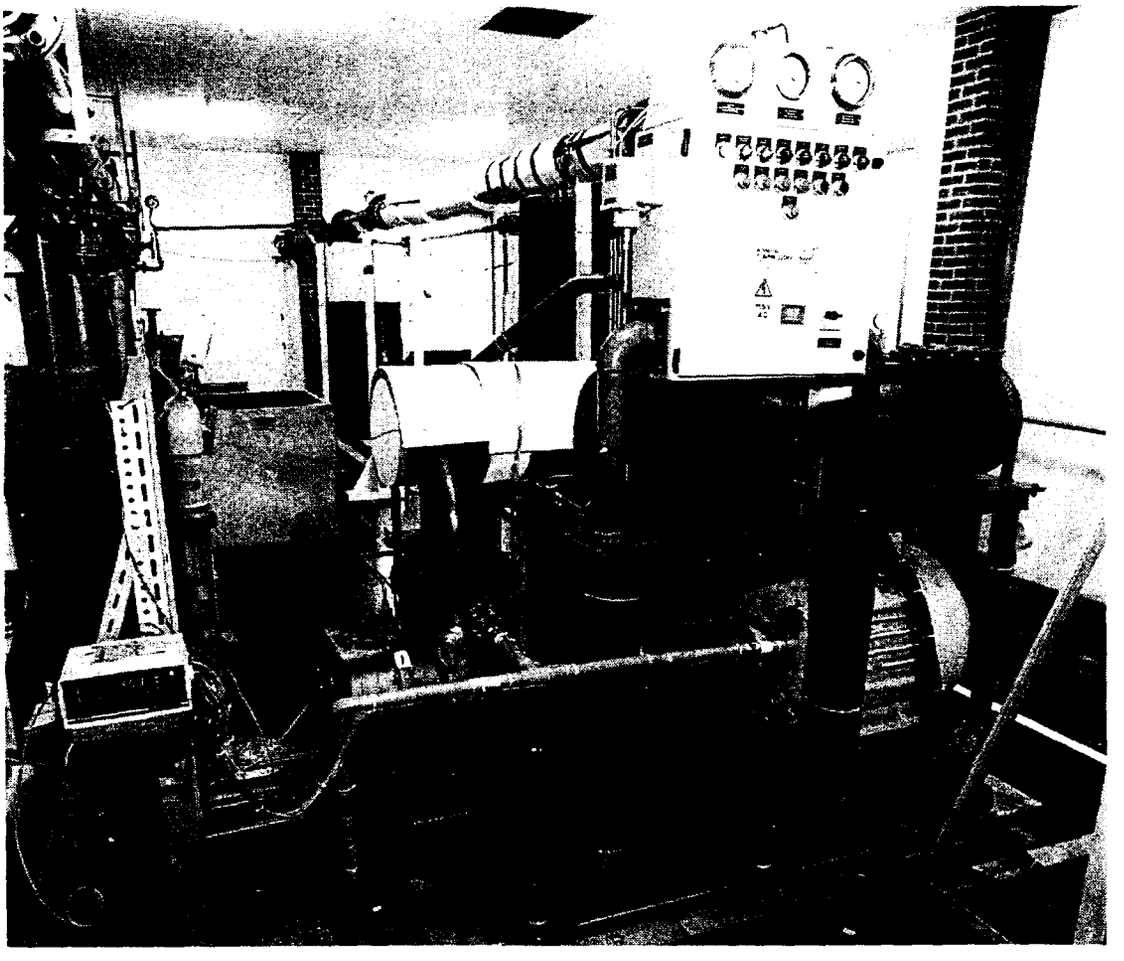

FIG. 3—HOWDEN LP BLOWER, FOR MASKER AIR SUPPLY IN TYPE 23

Feed Water

The Trident extraction pump has been running for 6 months, after being returned to the manufacturer to modify its characteristic to the falling curve needed for stable parallel operation. The main feed pump test rig is now running and tests of HP make-up pumps are becoming quite routine.

Chilled Water

The 57 kW plant for the T2400 has successfully completed its 6000 hours endurance run and has moved to *Dolphin* as a training aid. Its big brother, the TRIDENT 400 kW plant shown at FIG. 4, is half-way through its 9000 hours, with few problems to date.

Fuels

Over the last year considerable effort has gone into testing the coalescer elements specified for the Type 23 Dieso supply system. The specification seeks to limit the level of free water, which can contain sodium, to not more than 10 parts per million (ppm). This apparently simple quantity can only

be measured in practice by the difference in two parameters, the total water in a fuel sample and the level of absorbed water in the bulk fuel supply, which with accuracies of ±5 ppm on readings in the 100 ppm region give plenty of scope for discussion. The need to test other components of the fuel conditioning system led to the building of a full scale rig containing boost pump, prefilters, coalescer, back pressure valves and emergency fuel supply accumulator.

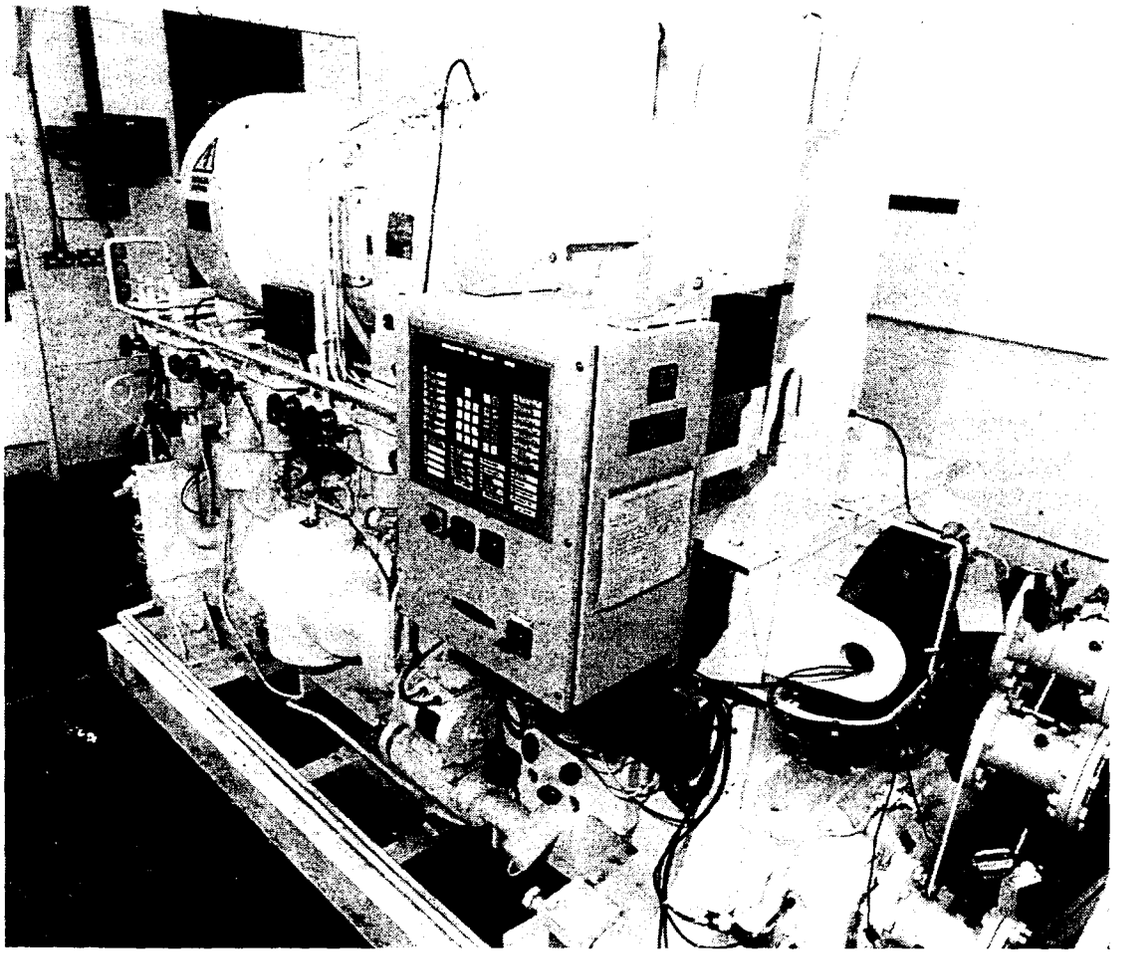

FIG. 4—400 kW CHILLED WATER PLANT FOR TRIDENT

Bilge and Waste Disposal

The arrival of the IMO regulations has made this a growth area. 'Mechanical' trials were completed on a vacuum sewage plant, and further trials are in progress under 'operational' conditions at *Sultan*. Several oily bilge water separators have been tested and oil-in-water alarm monitors are on trial. The first candidate for a bilge pump for the Type 23 was found lacking and the next contender is awaited with interest. A 'Which' test of a selection of portable air driven pumps is under way at Portland.

Oils

Both the motor-driven and the emergency air-driven lubricating oil pumps for the Type 23 have been tested, the latter a very compact Fenner radial piston design which was efficient and relatively quiet, and well capable of more than the 90 hours usage achieved here.

Corrosion

The large Materials Life Rig (MLR) at Portland is providing valuable data on the probable life of a NAB (nickel aluminium bronze) header in association with titanium, and later in the year it will double as a test rig for a SSN O7 main circulating pump fitted with a magnet drive coupling.

Noise and Vibration

The Division has been building up its instrumentation in this field, with a twin channel analyser and high speed plotters the latest acquisitions. Current work has covered an interesting investigation into fatigue failure of Olympus exhaust cascade bends in the CVS, fluidborne noise characteristics of sea water reducing valves, and an assessment of the fluid, structure and airborne noise characteristics of the TRIDENT main turbine throttle valve, using the test rig already described.

Fluid Flow

Flow measurement is a fundamental part of most projects, and we are working to upgrade and expand our flowmeter calibration facility. Work in this area has included tests on flow control valves for chilled water, flow fuses for hydraulic systems, flow visualization for corrosion studies on condenser headers and the bubble behaviour tests in the Jacuzzi.

The Future

While the work in support of the nuclear steam programme will continue for some time and, in the case of the SVTF, may well increase, the high levels we have seen in the Type Testing area will ease off as we complete the present programme of work for the first Type 23. The loading in this area is never easy to predict but it may well be that we will have the capacity to help more with the solution of in-service problems than we have in the recent past but, as we are one step back from the coal-face, we need to be pointed in the right direction.

References

1. Owen, M. R.: A.R.E.(N.A.M.D.) Haslar and Portland newsletter; *Journal of Naval Engineering*, vol. 28, no. 3, Dec. 1984, pp. 461–466.
2. Head, J. A. T.: Compressed air systems—an update; *Journal of Naval Engineering*, vol. 28, no. 3, Dec. 1984, pp. 448–461.