NUCLEAR LONG COURSE 84

BY

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To ensure realism this article concentrates on the experiences of a particular Nuclear Propulsion Long Course (NPLC) at H.M.S. *Sultan* in 1984.

The Course

The NPLC is literally a long course lasting 25 weeks which prepares ML and EL senior ratings for the rigours of Category 'B' watchkeeping in a nuclear submarine as the Reactor Panel Operator or the Marine Engineering Artificer of the Watch. Many of these will subsequently become Nuclear Chiefs of the Watch and they are prepared academically and practically up to this level. Although it is not recognized as a 'career course' it is an integral part of the submariner's career structure. Those who fail are debarred from progress to charge chief in the nuclear propulsion field and at present can only further their careers in conventional submarines or General Service. The former avenue may be closed to them in the near future.

It is clear that the onus is on the candidate to pass a demanding course and the penalties of failure, personally and financially, are significant.

The overall make-up of the course is shown in FIG. 1, and the course programme in FIG. 2.

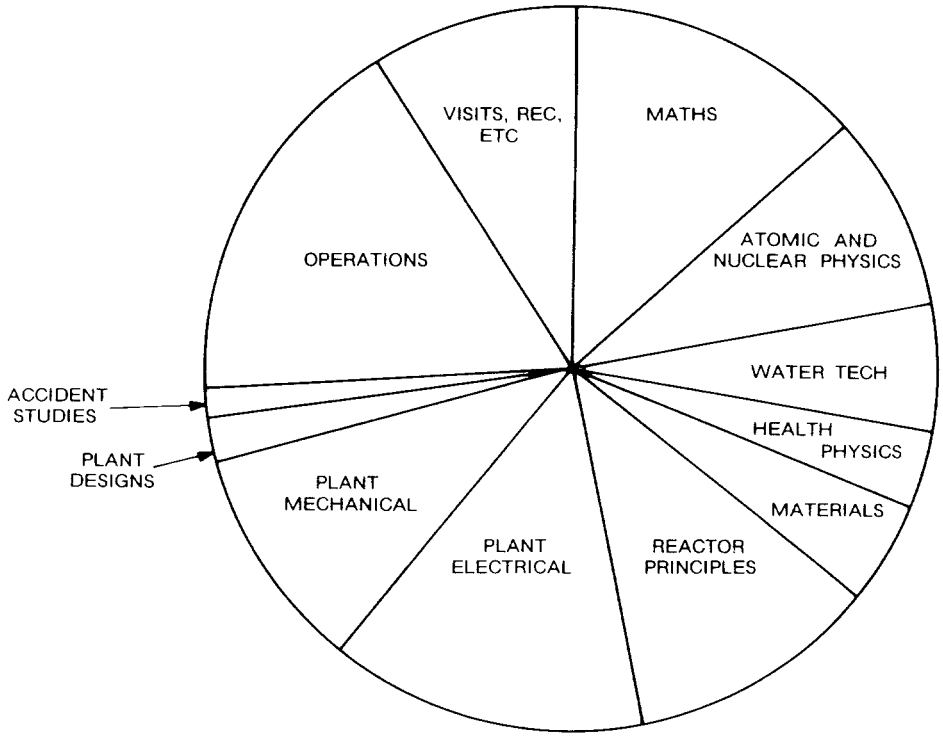

FIG. 1—NUCLEAR PROPULSION LONG COURSE CONTENT

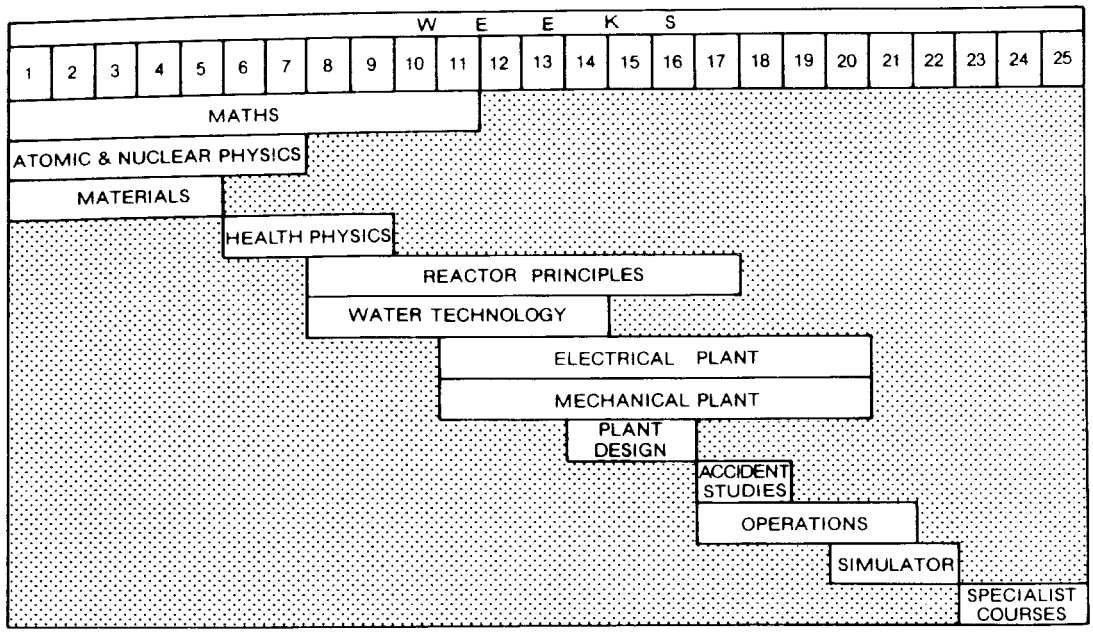

FIG. 2—COURSE PROGRAMME

The Class

NPLC 84/2 started on 26 March 1984, and with 14 in the class was slightly below average strength. One candidate was held back by his 'boat' to join a later course, and his place was taken by a rating who had been back-classed from the previous course. This happens occasionally where a man considered worthy of a second chance joins up with the next course, sometimes after a period of remedial study.

The Course consisted of 9 MEA(ML) and 5 MEA(EL) and as usual the candidates were a mixture of young ex-apprentices and rather older ex-mechanicians in the overall age range 23 to 29. All had served in nuclear submarines: 8 in VALIANT or RESOLUTION Classes and 6 in SWIFTSURE or TRAFALGAR submarines. Only 4 decided to move their families to the local area, the remainder choosing to live in H.M.S. *Sultan*.

The First Six Weeks

The first part of the course, lasting 6 weeks, is mainly academic and seeks to bring the candidates' standard of mathematics and nuclear physics up to the level needed to deal with the reactor principles which follow. In this way they acquire the knowledge and background to understand the effects and implications of their actions on the plant itself. Materials are also covered in this phase, and this subject can present a stumbling block to some candidates.

Although by no means always the case, the ex-mechanicians are usually the first to find the going difficult. Having spent several years away from the classroom they are at a disadvantage compared with ex-artificer apprentices. Those who have the time and inclination to prepare themselves before joining the course reap the benefit during these early stages.

The Second Six Weeks

The second six weeks of the course is characterized by a deepening of the academic content, with the introductory Atomic and Nuclear Physics giving way to the more directly relevant and specialized Reactor Principles. The fundamental concepts are now applied to explain the operational principles of the naval pressurized water reactor. The long mathematics phase continues and this poses problems for one or two members of the class. It is at this stage that those struggling with the mathematics find themselves spending inordinate amounts of time keeping pace with internal examinations, resitting any failures, and coping with new material which comes thick and fast. Understandably, those who are academically weak begin to fall by the wayside. The first failure was an ex-mechanician who had found the mathematics and physics increasingly difficult to comprehend. Having no wish to be back-classed he was interviewed in the normal way by the Captain, and subsequently drafted to a submarine shore billet.

New subjects are introduced at this stage. Health Physics concentrates on the dangers of radiation, the protective measures that must be taken and the organizational arrangements onboard and ashore. Water Technology covers basic chemistry theory and its application to primary coolant and secondary steam plant. Metallurgy and Materials of Construction is the last academic topic to be introduced and there are examinations in all three subjects, with papers set and marked by an external moderator.

Away from the classroom, the milder weather encouraged a good turnout for the Nuclear School Sports and Families Day. It soon became apparent that the average submariner on the Long Course is very much fitter than is popularly supposed. In this case this may well have been connected with a large majority of the class preparing themselves for the rigours of the Petty Officers Leadership Course. Several knew that they were off to *Royal Arthur* after

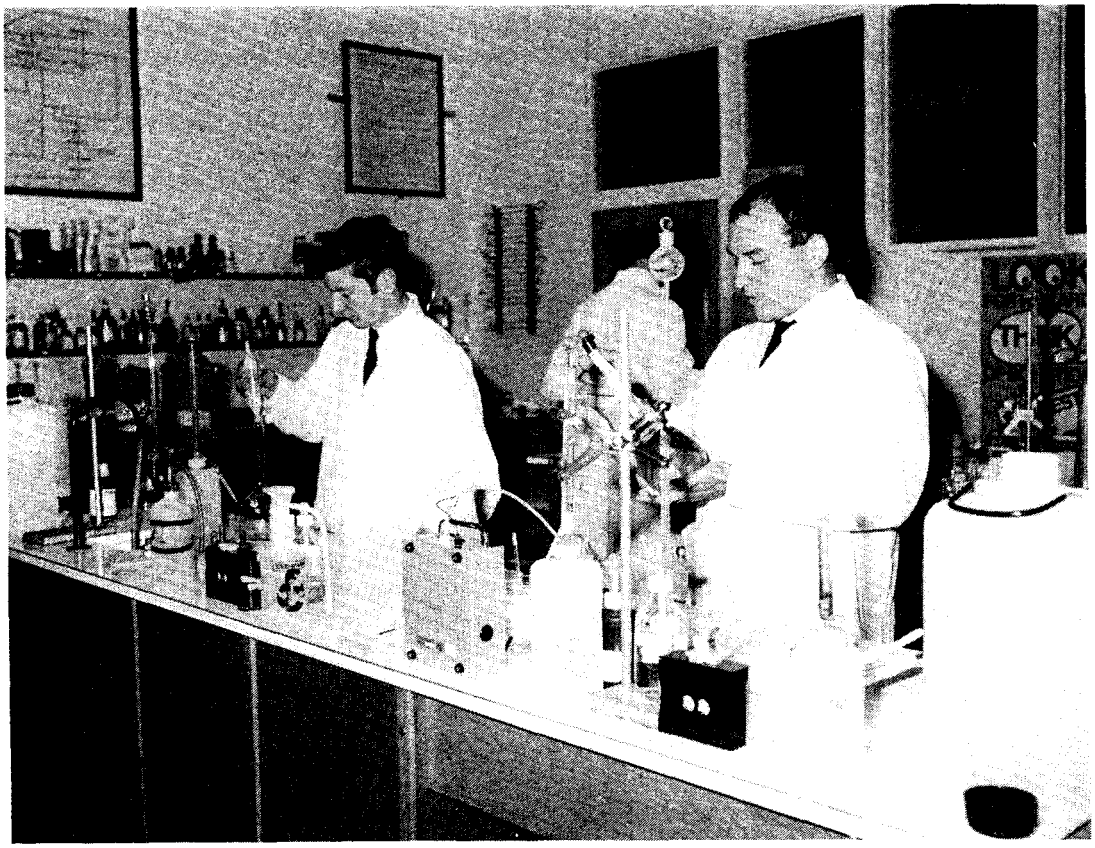

FIG. 3—IN THE CHEMISTRY LABORATORY—AN EARLY STAGE IN PRIMARY COOLANT ANALYSIS

Sultan. To add to the enjoyment of the afternoon, a lot of interest was stimulated by some enterprising wives who took on their menfolk in the track and field events to good effect. Perhaps a rather less appealing diversion from the classroom was provided by Ceremonial Divisions, for which practice was considered necessary resulting in a smart turn-out. The Inspecting Officer was prompted to remark on the suitability of the phrase 'silent service' when the Class marched quietly past between platoons of heavily booted apprentices.

The Third Six Weeks

This stage sees the climax of the academic studies with the Reactor Principles examinations which are externally set. For some students this is the most demanding part of the course and much midnight oil is burnt to ensure success. By passing these examinations the students demonstrate that they understand the principles of reactor design and operation sufficiently well to begin concentrating on the details of primary and secondary plant. As this gets under way the horizons of the course are widened by a number of lectures and visits. Firstly, a design consultant from Rolls-Royce and Associates, the main contractors for naval nuclear plant, gives the Course the benefit of his considerable experience in PWR core construction in a lively and well-illustrated presentation. This lecture is given shortly before the Class visit Derby to see R.R. & A. for themselves. This gives the students the opportunity to meet and talk with civilians engaged in design and in turn gives those who rarely see a submariner the chance to talk to the customer. A social evening normally procedes the visit and on this occasion a cricket match against R.R. & A. staff gave the course the opportunity to display some sporting skill. The Course Officer rather let the side down but walked to and from the wicket with style and panache! The following morning the formal tour of the works began with

a presentation outlining the history of the company. This was followed by a tour of the site, visiting in turn the materials laboratories, the research reactor, and the hybrid computer facilities. After an excellent lunch the day ended in the Production Testing Shop with a number of experimental rigs in action for studying heat transfer, noise and vibration, and core flow.

After a further two weeks the Class travelled to the West Country to visit Oldbury nuclear power station and the nuclear training centre where CEGB nuclear power station operators are trained. Talks were given by senior staff on reactor development and operator training and it was interesting to compare the different approaches to training and the length of courses. The Royal Navy's courses are significantly longer. This power station visit provided the students with an interesting comparison between naval and civilian reactors. The differences in sizes, power output, and general layout are an eye-opener to the submariners. While in the area the opportunity was also taken to visit Berkeley nuclear laboratories where, among other things, fuel element inspection procedures were explained. The final two weeks of this phase were spent back in the classroom. Reactor Principles were completed and Plant Design with Accident Studies introduced. Taught by submarine engineer officers on the staff, Plant Design examines the propulsion plant requirement, heat transfer, core performance, and accident studies.

Unfortunately, during these six weeks another two students were withdrawn from the course having failed more than the limiting number of examinations. As before they were seen by the Captain of H.M.S. *Sultan*, one choosing to stay in submarines as a forward systems artificer and the other deciding to return to General Service.

Towards the end of this period the members of the Class were streamed in accordance with drafting requirements and almost always in accord with personal preferences for Base Port Areas. Significant technical differences between SWIFTSURE and CHURCHILL Classes makes this arrangement necessary for instruction in mechanical and electrical systems. On this particular course one of the seven-strong SWIFTSURE Group was TRAFALGAR streamed and all except one of the CHURCHILL stream were destined for Polaris submarines. In most cases, this turn to more practical subjects is welcomed with relief with much talk of light being seen at the end of the tunnel. During this period the academic reactor principles is complementing the plant electrical and mechanical instruction and demonstrates the interdependence of the various systems on reactor behaviour.

The Last Phase of the Course

With the academics over, the Course continued with further plant instruction culminating in the final examinations. These normally produce few failures but ML candidates students sometimes struggle in electrical plant examinations. It was this very examination which proved too much for one student, a man already back-classed who had just managed to master the academics the second time around but in the end was found wanting in his plant knowledge. He decided to return to General Service.

The Class now possessed the necessary academic and plant knowledge to enter the final operator and simulator training phase. They had a sound grasp of the effects of their actions upon the plant. The operations sessions in full scale manoeuvring room simulators covered standard and emergency operating procedures ranging from reactor start-up to primary coolant and major steam leaks. At this stage the students were split up into teams appropriate to the class of boat they were about to join. This was a very busy time in the simulator because of the pressures of other parallel running courses and it was necessary to start shift and week-end working to complete the required simulator time.

Just as the academic phase proved difficult for some class members, the simulator phase proved equally difficult for others. Some of the more reticent or nervous found it hard to build up the necessary confidence to take the correct actions. It is interesting to note that, although by no means always the case, those who have difficulty with mathematics often have difficulty in the simulator. It is hard to see any obvious connection between the two but perhaps a failure to think logically is the key.

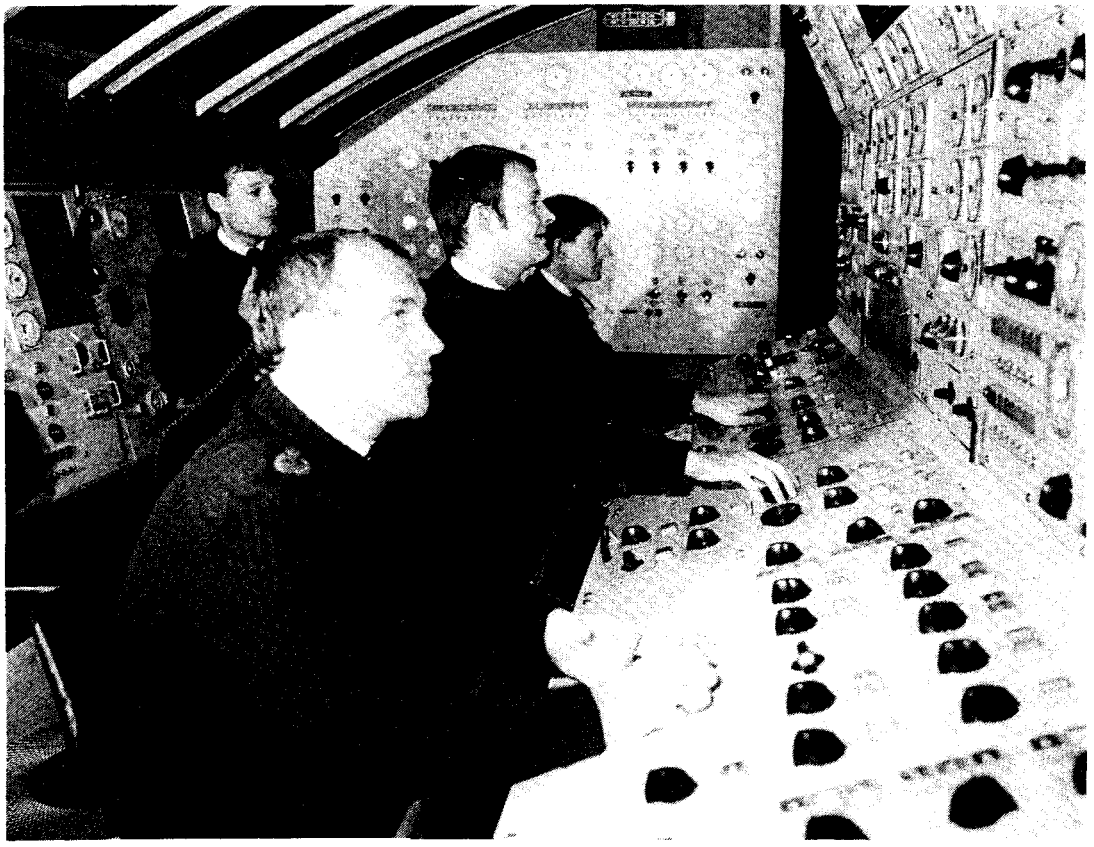

FIG. 4—IN THE 'CHURCHILL' CLASS MANOEUVRING ROOM SIMULATOR

Simulator training gives each man the opportunity to work in all the Manoeuvring Room watchkeeping positions. This is clearly necessary because the Manoeuvring Room must be fully manned, and it does give the trainees valuable general experience. They have to demonstrate whole plant knowledge and general submarine awareness as well as learning the importance of co-operation and team work in achieving the desired result. Eventually they are assessed only as Reactor Panel Operators (RPO); this is more directly applicable to electrical sub-specialists although it is by no means unknown for a mechanical man to fill an RPO's billet.

For NPLC 84/2 the simulator results were generally good, with one or two students doing particularly well while two others were rather weak. This is a fairly normal situation and in the latter cases, although the men concerned reached an acceptable standard, it was recommended that they undertake further simulator training prior to joining their boats.

At this point, which marks the official end of the Long Course, the mechanical sub-specialists moved on to a 3-week water chemistry course while the electrical sub-specialists started a course of comparable length dealing with electrical breakers and reactor instrumentation.

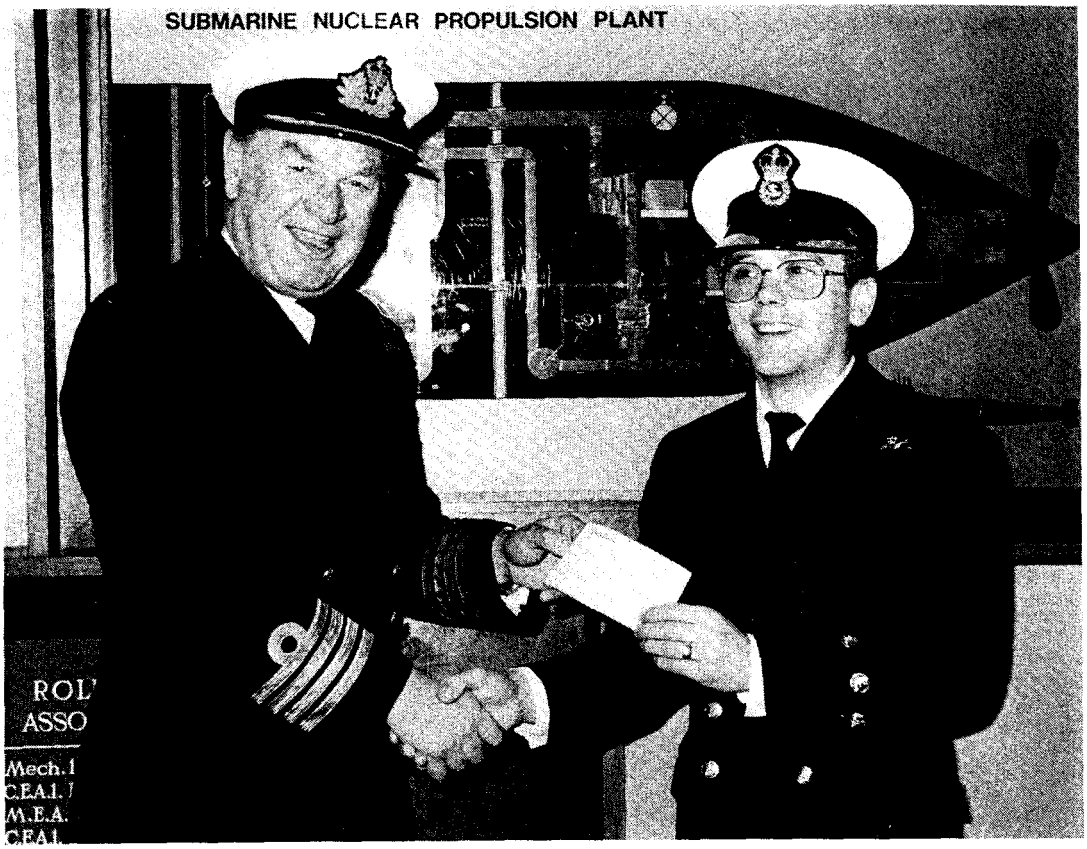

FIG. 5—TOP STUDENT: CPOMEA RATCLIFFE IS PRESENTED WITH THE HERBERT LOTT PRIZE BY CAPTAIN WORLIDGE, THE CAPTAIN OF H.M.S. 'SULTAN'

After six months of intensive and varied training the Course ended in mid-October. Out of the 14 that started, 10 had passed and as usual the top student was presented with the Herbert Lott prize by the Captain of H.M.S. *Sultan*. The Course average mark was 67% which coincidentally happened to be the average mark of all courses over the last 3 years. Four students failed and this was a significantly higher percentage than the average failure rate which stands at 11% taken over the last 15 courses. This is considered quite acceptable for a course where the maintenance of high standards is essential and nuclear safety is of paramount importance. The fact that so many pass this difficult course reflects great credit on staff and students alike and the latter can leave *Sultan* with confidence, knowing that they are well prepared to become safe and efficient nuclear plant operators.