BOADICEA

A NBCD SIMULATOR

BY

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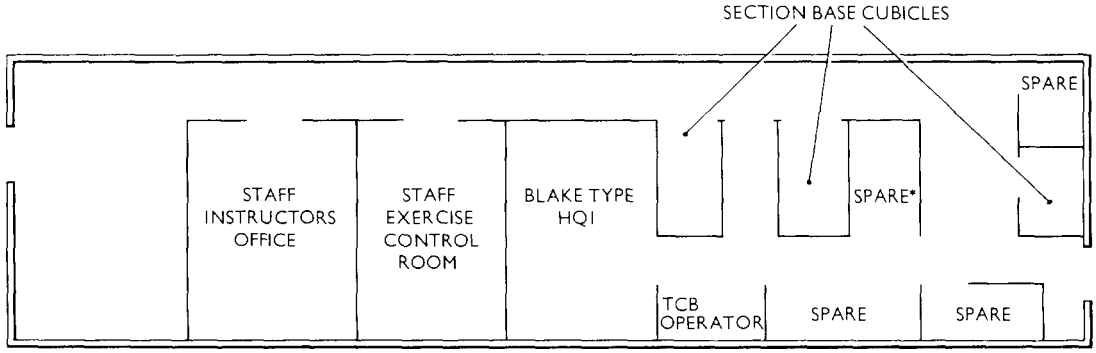
Introduction

To train classes and ships' teams in NBCD control and communications, *Phoenix* NBCD School had two regularly used exercise facilities located in separate buildings. The first, based on the *Leander* Class frigate, was built during the early 1960's and, by skilful use of the space available, two complete communication facilities were incorporated. These, named 'Castor' and 'Pollux', have been used by many thousands of students over the years and many readers of this article will no doubt have memories, affectionate or otherwise, of their own efforts within the complex. Those who do not remember 'tackling a *Leander*' in *Phoenix* may have gone through the same building in its other guise—that of County Class destroyer, made possible by rearrangement of incident boards, etc. In any event, much useful training has been, and will continue to be, provided by the 'Terrible Twins'.

In addition to the above facility, a second system based originally on the cruiser *Superb* and updated, in the early sixties, to the *Tiger* Class helicopter cruiser filled the need for the then more numerous larger ships. Whilst these units represented the arrangements in large and small ships of the Fleet, neither was compatible with recent designs having Ship Control Centres (SCC) and utilizing Rationalized Internal Communications Equipment (RICE). In 1974, an internal working party was formed to investigate the possibility of simulating such equipment by converting the existing facilities. During the deliberations it became apparent that the need for SCC training was pressing and that it was inpracticable to produce any realism by modification; however, as the cruiser facility was aging and represented only a relatively small and decreasing number of ships, it was decided to replace it completely with a new facility. A detailed examination was made of the existing (and intended) arrangements for the Types 21 and 22 frigates, the Types 42 and 82 destroyers, and the CAH, and from this it was decided to pursue the Type 22 frigate arrangement as this was fully up to date and its SCC fitted the available space almost exactly. This choice, although never regretted, was to provide many a headache for the working party because, with



* Fitted out as Main Switchboard but not used

FIG. 1—ARRANGEMENT OF CRUISER FACILITY

the introduction of RICE 2 and some other new VCS units, some items existed only as design study contracts. Planning continued throughout 1975 and a Training Equipment Proposal was forwarded stating *Phoenix*'s immediate requirements regarding the communications aspect of the project. Soon after this, a visit to the Ship Department indicated that finance was unlikely to be available before April 1977 and that delivery of equipment could be up to three years after that. Somewhat taken aback, the authors returned to *Phoenix* to find that the wooden shipbuilder's mock-up of the SCC for the first of class Type 22 was shortly to become available from Messrs. Yarrow (Shipbuilders) Ltd. who, needing the space it was occupying, wanted it removed as soon as they had finished with it. This really proved to be the turning point.

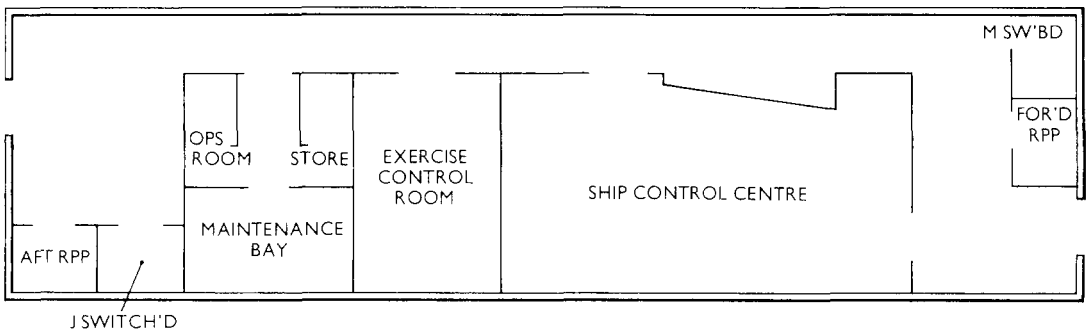


FIG. 2—RECONSTRUCTED FACILITY WITH SCC

The Task

It was clear to the working party that the opportunity to obtain the mock-up was too good to miss but, having got it, the chances of the comparatively frail structure surviving the trip down from Scotland and lying under wraps for two years were slim. Assuming that this could be achieved, the planned 'transfer supervisor' who would be on site for its dismantling and subsequent rebuild in *Phoenix* would have left the establishment. Without his first-hand knowledge the rebuild team would have to rely on much-faded and dusty alignment markings which were applied using a long-forgotten 'system'. The alternative, of course, was to remove the cruiser facility and install the mock-up on arrival; this, however, would provide the establishment with a superb example of modern naval architecture (in wood!) and very little else. As often happens, a compromise was reached and the idea of a 'do-it-yourself' SCC was born. The authors headed north to examine what, for the next thirteen months, would change the life style of one and provide a tremendous planning and control exercise for the other.

Having seen the mock-up, much more detailed planning was possible and preparatory tasks could be put in hand. The task of removing the cruiser facility commenced soon after the start of the spring term 1976. It was decided that the existing staff control room should remain for the new control facilities and should continue to function as a briefing area for students prior to each exercise. The SCC would be erected on the site of the removed HQ1, Main Switchboard, and No. 2 Section Base. The end cubicles would remain and the Instructors' Office would be replaced by two further cubicles and a maintenance bay (see FIGS. 1 and 2). Other work assessed to be necessary during the conversion was a complete alteration to the heating system and a major revision of the lighting to enable the shipboard situation of triple fluorescent tubes fed from two power sources to be represented in the SCC. The ventilation system also needed modification to fit in with the mock-up. The Area Fire Prevention Officer was consulted over the safety of the plan and it was agreed what measures needed to be implemented.

Although it proved quite feasible to remove the cruiser facility through the existing doors, it was almost impossible to break the SCC down into small enough sections to pass into the building in this way. Thus, once it was known when the first part of the mock-up was arriving, an enlarged temporary opening was made in the end of the building, and storage facilities were provided under cover for the items not immediately required. Fortunately there was storage space in the demonstration area of one of the Damage Repair Instructional Units. A 'transfer supervisor', as already mentioned, was sent from *Phoenix* to oversee the dismantling of the mock-up but, unfortunately, had to be withdrawn half way through the process for other service requirements. With foresight and imagination, however, he managed to arrange a logical loading and despatch schedule with the shipbuilder for the two loads necessary. The first, containing the all-important floor sections, arrived on time and installation work started immediately. Despite clear marking by the shipbuilder, the 'link man', who had only managed to arrange one short visit to view the first load and start the team off on the right foot, was sadly missed. His absence and a very long delay before the second load arrived undoubtedly affected the eventual completion date.

During the visit to Glasgow, it became apparent that much work would need to be done to make the mock-up into a working unit. It was also obvious that the use of a temporary sound-powered communications system would not produce sufficient realism even for an interim facility. As the self-help talent on the project team included an amateur radio enthusiast who was prepared to swap adze for soldering iron and who could hardly wait to try his hand using new rather than second-hand components, the communications problem was, at least in theory, solved. He set himself the task of doing a 'proper job'; and it developed into a mammoth one with every unit on every console fully workable 'just like the real thing'.

The requirements were seen as:

(*a*) The system must be an effective and reliable training aid.

(*b*) It must be easily maintainable by naval ratings from the training staff on an 'as-and-when-available' basis.

(*c*) It should be as near as possible to the real thing, and where differences did occur they should not provide facilities not to be found on the real thing.

(*d*) It should be produced in modules so that, if the production team should 'break up', the stages completed would be operational and useful.

(*e*) It should be produced using patternized items readily available through Naval Stores.

(*f*) It should use the minimum of 'electronics' and rely on switches, wire, and incandescent lamps.

(*g*) It must be fully documented to facilitate fault finding.

(*h*) It should operate on low-voltage d.c. supplies for safety reasons.

(*i*) It should be inexpensive to produce/install and also be operable from the Staff Exercise Control Room (SCR) preferably by one man.

(*j*) It should be available for training as soon as possible.

From these requirements, it was decided initially that the system should be based on the RICE 1 system as fitted in the Type 21 frigates and Type 42 destroyers and not the RICE 2 equipment to be fitted in the Type 22 frigate, as more information was available on the former. As initial production gained momentum, however, it used some features of each.

The first stage and minimum requirement was seen as communication between:

(*a*) the NBCDO in the SCC;

(*b*) the forward and after repair party posts in the out-station cubicles:

(*c*) the incident-board operators in the out-stations and the SCC;

(*d*) the exercise control room (which should have a main broadcast facility).

This would put the unit, effectively, back to the same training value as the old cruiser layout. Once this was achieved, it was planned to take the project somewhat further as outlined below:

(*a*) To provide a good direct communication system between:

(*i*)	NBCDO	(SCC)
(*ii*)	NBC Protection Officer	(SCC)
(*iii*)	SCC Watchkeeper	(SCC)
(*iv*)	J and M Switchboards	(Separate cubicles)
(*v*)	For'd and After Repair Party Posts	(Separate cubicles)
(*vi*)	Primary Electrical Control Position	(SCC—MECCA)
(*vii*)	EOOW	(SCC behind MECCA)
(*viii*)	WEO in operations Room	(Separate cubicle)
(*ix*)	All Incident-Board Operators	(Open line)
(*x*)	Exercise Control Room	

(*b*) To provide a simulated automatic alarm unit to the SCC watchkeeper.

(*c*) To provide main broadcast ability to those who should have this facility.

(*d*) To provide a Main Exchange telephone facility to those so equipped.

(*e*) To provide a '999' telephone system through the main exchange.

(*f*) To provide relevant 'damage control' alarms on the MECCA console.

Unfortunately, the majority of the small components were not available immediately through Naval Stores and authority had to be obtained to purchase non-patternized items. As these arrived (from various suppliers), assembly commenced and large numbers of 6-inch square console front panels were made. Before insertion in the consoles, electronic layouts were built on these panels similar to the shipboard equipment. In parallel with the construction (completed on a one-off trial basis initially) drawings had to be produced before the constructor had moved from the establishment to enable subsequent essential maintenance to be undertaken. On completion of successful prototype trials, one-man mass-production was applied to identical follow-on units.

The most important of the varied tests evolved for the prototype units were the functional endurance tests. A typical trial of this type involved coupling units in their final arrangement and inviting the local school children to 'play' with the set-up. Once through this stage, successive duty watches were given a similar directive to try 'to beat the system'. The duty watches also had to check periodically on alarms left functioning for prolonged periods and indicator lamps which were left burning or had to be switched on or off at irregular intervals. As a result of these tests, a very few minor modifications were made but, much to the credit of their designer/builder, no major problems occurred.

As the mock-up unit had not travelled well, much more strengthening than was originally planned was necessary. In the process, the opportunity was taken to build simulator cableways into the false deck of the SCC and to provide easy access to the dummy cable trunks to allow their use to house runs if subsequently required.

The rebuilding of the compartment followed the obvious order and, relative to the ship, was—after bulkhead, ship's side, false deck, inboard bulkhead including the access passage (shortened because of lack of space), deckhead, and finally the forward bulkhead. It was decided early on to replace the hardboard cladding of the compartment with fire-resistant plywood using the shipbuilder's framework suitably stiffened, and this system proved to be highly successful. Discussion with the Area Fire Prevention Officer indicated the need to provide a

second exit and this was done in the form of a kick-out panel on the forward bulkhead. Once the basic box was manufactured, the addition of dummy frames, stringers, and beams began, the deckhead being completed first to enable work to proceed on the installation of the ventilation system. This was also to be the method of heating the compartment, and a redundant heat exchanger was transferred from another building and incorporated into a copy of the original trunk fabricated from aluminium. Outside the compartment, the trunking was led from an existing fan. The water side of the heat exchanger was then connected into the modernized central heating system.

After the ventilation trunking was rigged, the dummy cable-trunks were manufactured and fitted. Again, these were made stronger than the shipbuilder's structure so that, if necessary, they could be used for actual cable runs and also to support the lighting fitments as required. The lighting fitments themselves proved rather a problem as the 'as-fitted' units used were 115 volts working; however, a suitable transformer, again redundant in another building, was fitted by DOE. Wiring these to the ship system proved impossible so a modification was accepted such that alternate complete fittings will go out rather than individual tubes when one power source is 'interrupted' during exercises.

At this stage, the SCC was painted out whilst the NBCD consoles were being made up (from an extruded angle framework and aluminium panels) ready for the electronic panels to be fitted. The latter were not secured until the console assemblies were installed in the ship control centre and the exercise control room. Once all NBCD sections were in place, inter-unit wiring commenced and final fitting out of the SCC started. The programme of installing the dummy pipework had to be interrupted whilst tiling of the false deck took place. The completion of the SCC tiling and the covering of the rest of the building floor was somewhat delayed by the tiling contractors going into liquidation. Work, however, proceeded with growing momentum as the designated opening day approached.

At a very late stage of construction, it was decided that the plywood and hardboard construction of the MECCA was insufficient either for long-term durability or for supporting the small quantity of communications and indicating equipment required for use in NBCD exercises. Principally, these included the primary electrical control position communications, the fire-pump state lamps, and the high bilge-level warning lamps. Some parts of the MECCA had also been damaged in transit and in store so approval was sought and obtained to construct a new MECCA in a similar manner to the NBCD consoles. Apart from the few items already mentioned, none of this unit was to be operational and thus the expense of full instrumentation could not be justified. The console fronts have, therefore, been reproduced from photographs taken of the assembly as installed in the first of class. The photographs were suitably modified to show readings as if the vessel was underway. Owing to the late decision to proceed in this manner, the MECCA panel fronts were not completed in time for the formal opening and full-size enlargements of the photographs were used instead.

Again at a very late stage, it became known that the official incident boards and other NBCD boards would not be available until well after the chosen opening date. Drawings were therefore made locally from the information which was available. The local markings, compartment designations, and NBCD arrangements (as it is thought they will occur onboard ship) were worked out so that interim incident boards and a door-and-hatch board were available for the opening ceremony. These enable most general familiarization exercises to be carried out, but all the correct 'as-fitted' drawings will be needed before detailed training can proceed. The lack of the main-service board, ventilation board, and electrical information board will be a considerable handicap to the training of ship's teams, and their arrival is keenly awaited.

FIG. 3—GENERAL VIEW OF PRODUCTION PROTOTYPE UNITS BEFORE INSTALLATION

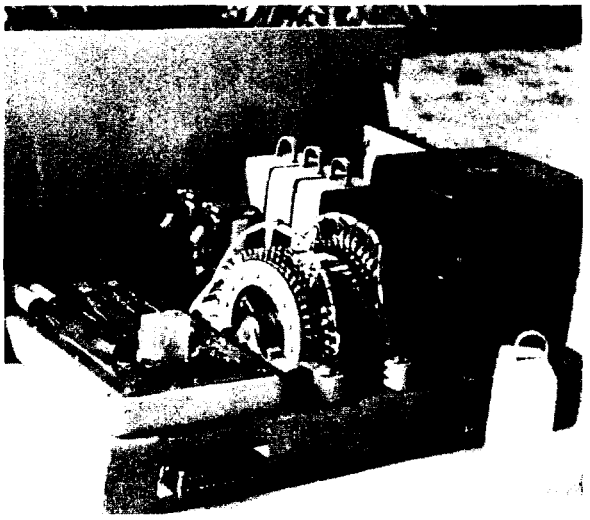


FIG. 4—REAR VIEW OF AUTOMATIC TELEPHONE EXCHANGE

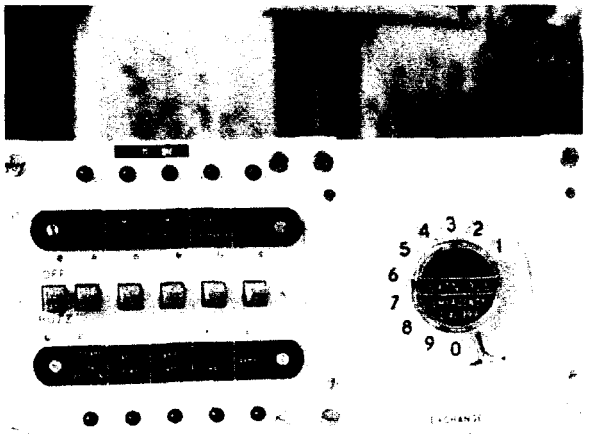


FIG. 5—TELEPHONE DIAL UNIT AND COMMUNICATIONS MASTER UNIT (SIMULATING VCS UNITS 370 AND 701)

The two weeks before opening were devoted to as much staff training as possible with finishing work and final cleaning taking place at the same time. Formal familiarization was difficult as there were still classes to be taught in the lecture rooms but sufficient knowledge was gained to enable a staff demonstration to be given to the Commander-in-Chief, Naval Home Command, Admiral Sir Terence Lewin, G.C.B., M.V.O., D.S.C., A.D.C. when he officially opened the facility on 15 February 1977. Launched would, in fact, be a better description as it was decided early in the reconstruction that a suitable ship's name should be given to the facility. After due consultation, *Boadicea* was selected to seem in keeping with the planned Type 22 Class names.

By the time the simulator was opened, complete confidence in the finished product had been gained and so a decision to cancel the approved training equipment proposal was made. When the project was discussed in January 1976, it was expected that, without inflation, the electronics alone would cost £40–50 000 and that the earliest it could be brought into use was late 1979. Although the cost of the routine painting and building maintenance (which

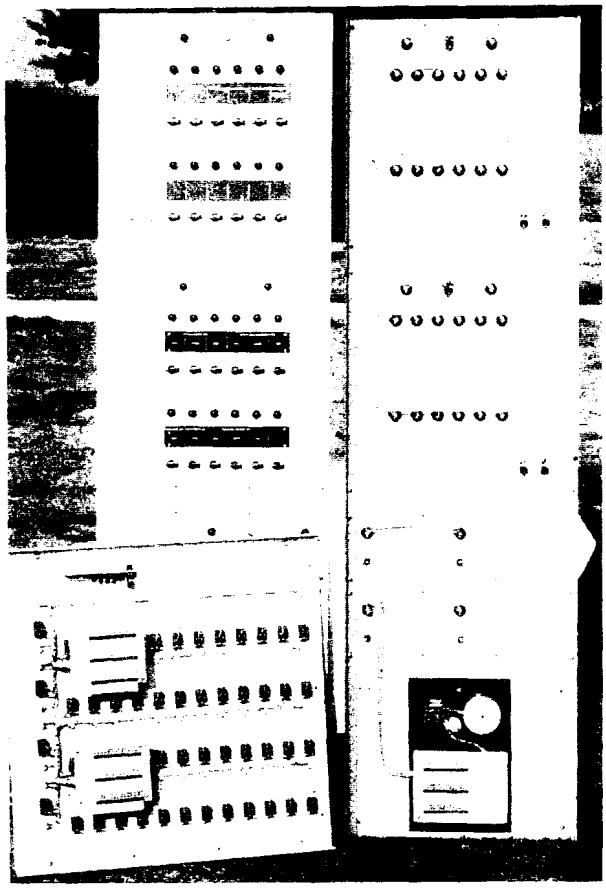


FIG. 6—MOCK MINERVA FIRE ALARM CABINET FRONT PANELS AND REAR OF CONTROL UNIT

was in any case planned to be undertaken) and also the cost of materials used in the mock-up modifications have been excluded, it is estimated that the net cost of the project completed on a self-help basis will be about £6000. Thus a good increase in availability and considerable saving in money has resulted. Clearly, the production of the equipment (some of which is shown in FIGS. 3 to 9) which was all home made was not carried out over two weekends! The total spare time involved in its production approached 2500 hours which, in just over one year, left little time for much else.

The facility so produced and which is now available to classes and to ships' teams fulfils all the major aims of the project in that it is suitable for the training of teams from Type 21 frigates, Type 42 destroyers, and the through-deck cruisers plus, of course, the Type 22 frigates. The only obvious visible difference from the Type 22

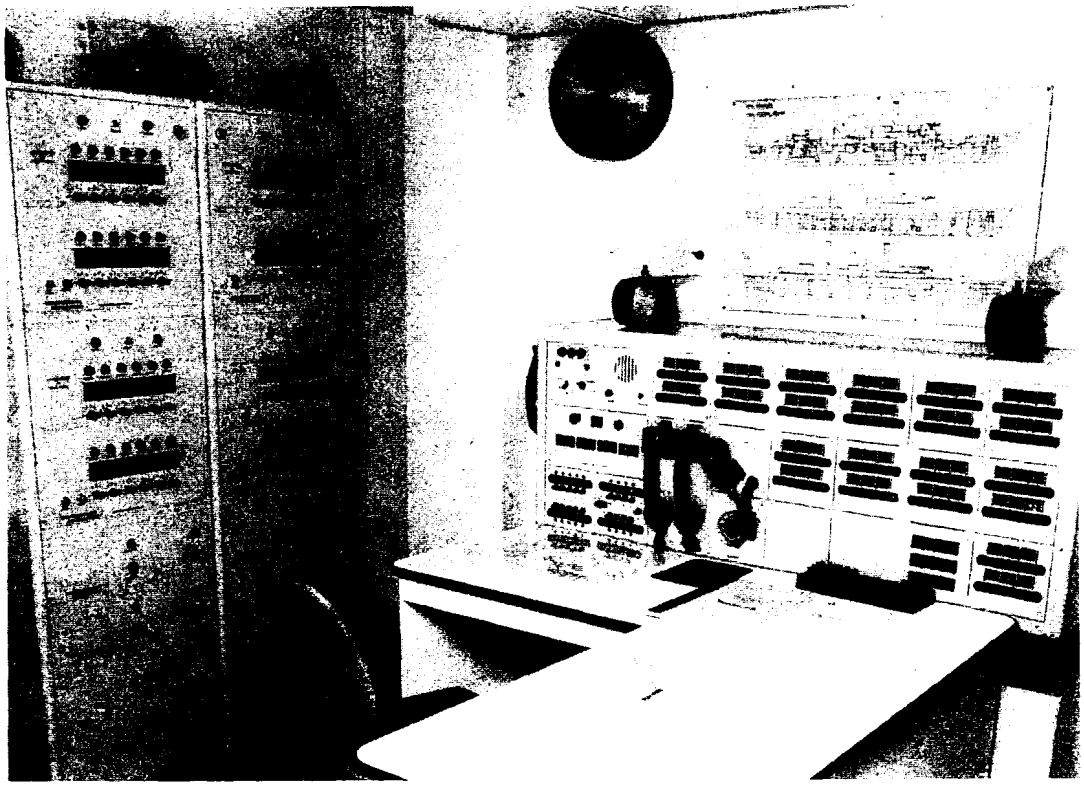


FIG. 7—SHIP CONTROL CENTRE—NBCD WATCHKEEPER'S CONSOLE

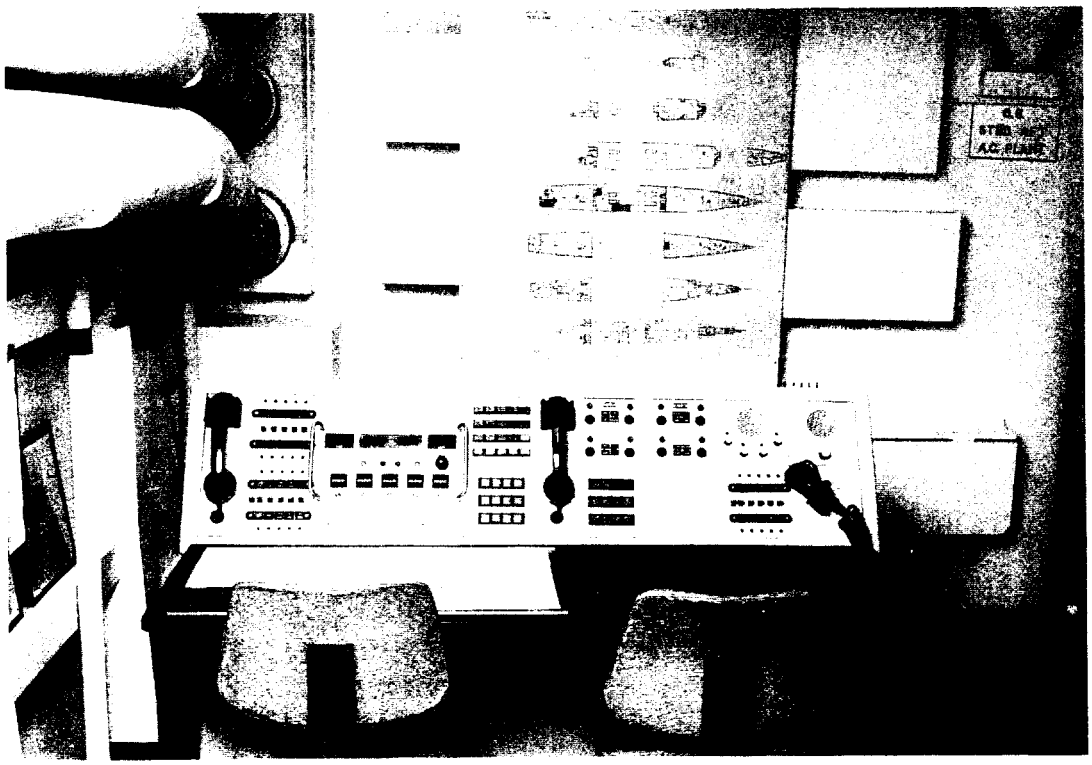


FIG. 8—SHIP CONTROL CENTRE—NBCDO AND NBC PROTECTION OFFICER'S CONSOLE

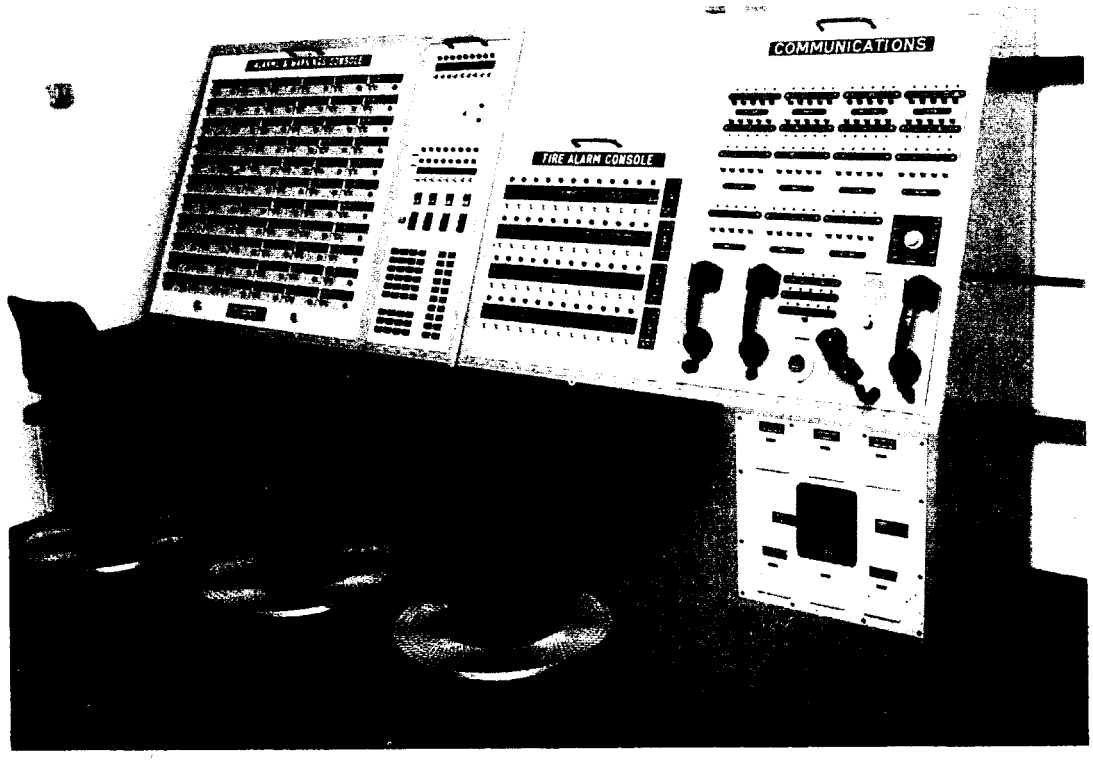


FIG. 9—STAFF OPERATING CONSOLE

design is the use of telephone rotor dials instead of patchboard push-buttons and omissions from the AAU front panels of system check switches, both of which were avoided to reduce the load on what must be a part-time maintainer.

This article would not be complete without acknowledging the assistance of a large number of personnel and authorities, uniformed and civilian. To the

various Sections of D.G. Ships, Portsmouth Dockyard, and D.O.E. Stamshaw who advised us, worked for, with and around us, we are most grateful.

During the detailed construction work much help came from Portsmouth Dockyard shipwright's weapons shop. The inspector's expression when asked to produce the MECCA from a heap of plate and aluminium extrusion in less than a month was unforgettable; however, as with all the other assistance they rendered, it was a 'proper job' and arrived on time. Likewise, the Dockyard's stove enamelling shop made a sterling contribution. The inspector will long be remembered, standing amid his vast ovens and spray plants with one six-inch square panel gripped between thumb and forefinger, saying, 'Just the one, eh!—light admiralty grey—by tonight'!! Our entry in the directory against his telephone number was 'Instant Painting'. The weapons engraving shop met the most outrageous target dates during the year superbly, and great credit is also due to the Y.S.M. staff for ensuring, during the inevitable chaos of the fortnight before opening, that a most complicated SIRS training system was wired in. The efforts of the D.O.E. staff were magnificent: it is doubtful if they have ever had the internals of one of their buildings so abused and yet still be expected to patch it up afterwards. The final appearance of the building is to their everlasting credit. Much work was also undertaken in the Whale Island maintenance workshop whose beautifully made square punching jig kept being dragged out from under the bench for 'yet another plate' and whose small engraving shop coped with a continuous flow of small tallies that inevitably were required 'yesterday'. Special mention must be made of those who actually did the various jobs. They often worked from hastily prepared sketches with a minimum of briefing and still, by understanding, imagination, and sheer professionalism, produced most creditable results. This could become many times longer if a full account of the assistance received during the project was included but, without wishing to seem ungrateful by not mentioning them individually, to the many other people who helped us we offer our sincere thanks.