THE INSTALLATION DESIGNER'S VIEW OF SYMES

BY

J. NEUMANN and G. J. OSBORN

Introduction

The article 'SYMES—A Progress Report' by Lt.-Cdr. Reed in the December issue of the *Journal of Naval Engineering* talks about the SYMES range and comments on its aims and objectives, on its development and on its documentation by means of SYMES Dossiers.

The object of this article is to enlarge a little on the effect, so far, of the SYMES range on the design of machinery installations for surface warships.

The very title, Systematic Machinery and Equipment Selection, suggests that part of the reason for the existence of the SYMES range is to assist the installation designer in his initial machinery deliberations. It is comforting therefore to be able to confirm, from recent experience with the preliminary design of the machinery installations for the Type 42, Type 22 and CAH, that the overall effect of the SYMES range does indeed appear to be beneficial.

Naturally, there are advantages and there are disadvantages. The main disadvantage is that, as might be expected, in some cases the SYMES equipment's size or shape or other characteristic is not quite ideal for the particular application. Equipments are no longer specially designed and tailored to each major application, and even handing options are often limited, so that the installation designer's licence to 'play tunes' with the equipments is most severely restricted. The penalty for these restrictions can be increased weight and space or reduced performance of the whole installation.

Having made reference to the disadvantage, it now remains to outline the advantages to machinery installation design, which have been grouped under the heading of:

(*a*) Space Assessment and Allocation

(*b*) Model Techniques.

Space Assessment and Allocation

The installation designer is always called upon to make an initial assessment of the space required for the machinery compartments, and as the ship design is developed it becomes on the one hand progressively more important that the space allocation is correct, and on the other hand progressively more difficult to obtain any changes (usually increases!) to the space allocation.

In the days B.S. (i.e. Before SYMES, for the uninitiated), when equipment was specially designed for each application, only the broadest outlines were available in the early design stages. Even later, at the time when machinery installation guidance drawings were being finalized, particulars of the intended equipment often remained only tentatively defined and not infrequently were relatively fluid and subject to change. In these circumstances, it was neither practicable nor cost effective to try to design in any reasonable detail the various systems of pipes, trunks and conduits which traverse and criss-cross the machinery spaces. After all, if a prospective manufacturer is busy considering, say, the basic overall design of a new generating set, he will not have the time or inclination to consider the exact expected location of a particular pipe flange; and even if he did consider it, his conclusions at such an early stage in the design would be subject to alteration (and sometimes quite radically) during subsequent detailed design.

Despite these difficulties, the installation designer, when preparing the guidance drawings, used his utmost effort, perseverance and intuition to ferret out the likely particulars of at least the large flange connections to equipments, so that he could design the appropriate major pipe runs for inclusion in the drawings and possibly in a scale model, all the time keeping his fingers crossed hoping that time and development would not bring any major upset. For the smaller piping, he had to 'allow space in his mind's eye' for the systems which he knew would be required but the estimated details of which—in their numerous uncertainty—it was not really practicable even to try to ascertain. The installation designer did draw down quite early the expected runs of ventilation, combustion air and exhaust gas trunking; in the event however, relatively major changes to these, caused as a consequence of other necessary changes to equipments and piping systems, were not uncommon very late during the design.

The result of these procedures was congestion and lack of access for operation and maintenance. Often it was noticeable that, had the access problem been diagnosed early enough, a satisfactory and elegant solution could have been found by resiting of equipments. However, at a late stage the choice was usually either to 'grin and bear it' or to accept considerable disruption elsewhere in order to solve a particularly important and awkward arrangement problem.

With the advent of SYMES, it has been found that, provided the machinery is selected from the range, an accurate machinery space assessment can be made early in the installation design using the available information which is now being documented in the SYMES dossiers and which includes:

(*a*) A true shape of the equipment.

(*b*) The locations of all terminal points.

(*c*) An access and maintenance envelope.

(*d*) Mounting arrangements.

The availability of this detailed information on the equipments permits the adoption of a true systems approach to the whole installation design Trunking, piping and cabling need no longer be 'guestimated', but can be designed in an orderly fashion. The ability to do this has become even more important now following the adoption of the 'upkeep by exchange' principle for most of the machinery. The intention to 'upkeep by exchange', combined with a reduction in the engineering complement, has made the provision of clear removal routes for the equipments a vital necessity without which the ships would not achieve the planned and expected high ship availability. It is the existence of a standard range of machinery which helps the designer to ensure that his paper estimates in the early design stages will bear a close similarity to the hardware reality in the ship.

To illustrate this point, one need only consider two recent machinery installation designs. When the machinery installation for the Type 42 Destroyer was conceived and its preliminary design was proceeding, the SYMES range was still in its infancy. Whereas correct details were available for some equipments, very many more were still being designed and developed. As an example, it is salutory to compare the outlines available for a typical important equipment, viz. the steam distilling plant, at various stages of the Type 42 machinery installation design. Such a comparison is shown in FIG. 1, which also shows the corresponding comparison in the much more recent design time scale of the Type 22 machinery installation. As can be seen, the latter shows a highly satisfactory situation.

As a simplification, it can be said that preliminary work now tends to be just less detailed than the later more final work; whereas in the past the preliminary work was not only much less detailed, it was also based on information which was subject to very significant change.

Model Techniques

The use of a small-scale machinery space model as an installation design aid is a practice that has been gaining support over the years, partly as a three dimensional illustration of the machinery installation and partly as a design aid for the preparation of working drawings. Past modelling efforts in the early and middle stages of the design, however, were burdened by the lack of information on equipments already mentioned and in most instances the machinery space model became principally a record of events rather than the working tool which is its ideal function.

The existence of standard machinery permits the construction of a feasibility-stage model to establish the adequacy or otherwise of the overall space allocation for the machinery spaces. The first endeavour of this type was tried in the preliminary design stages of the Type 42, but in retrospect the projected

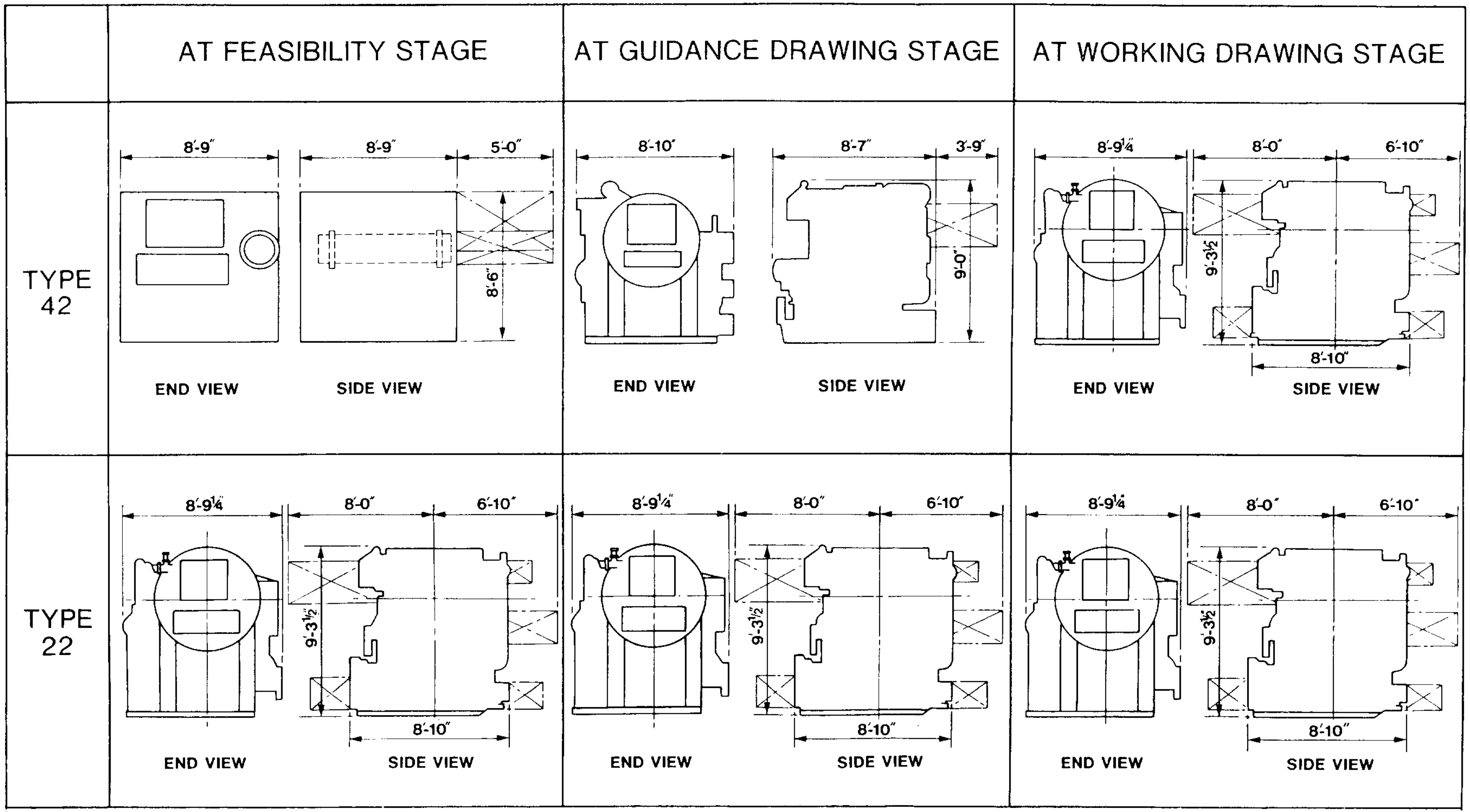

FIG. 1—DISTILLING PLANT—BEST OUTLINE AVAILABLE

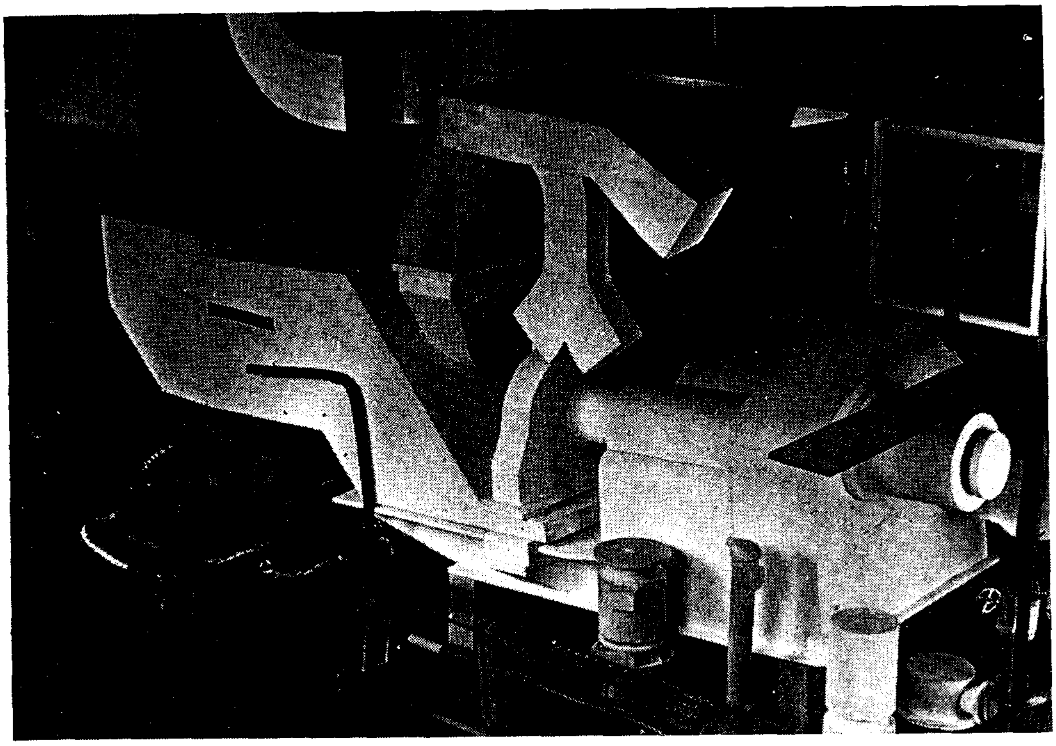

FIG. 2—TYPE 42 FEASIBILITY STAGE MODEL—TYNE GAS TURBINE MODULE AND GEARBOX

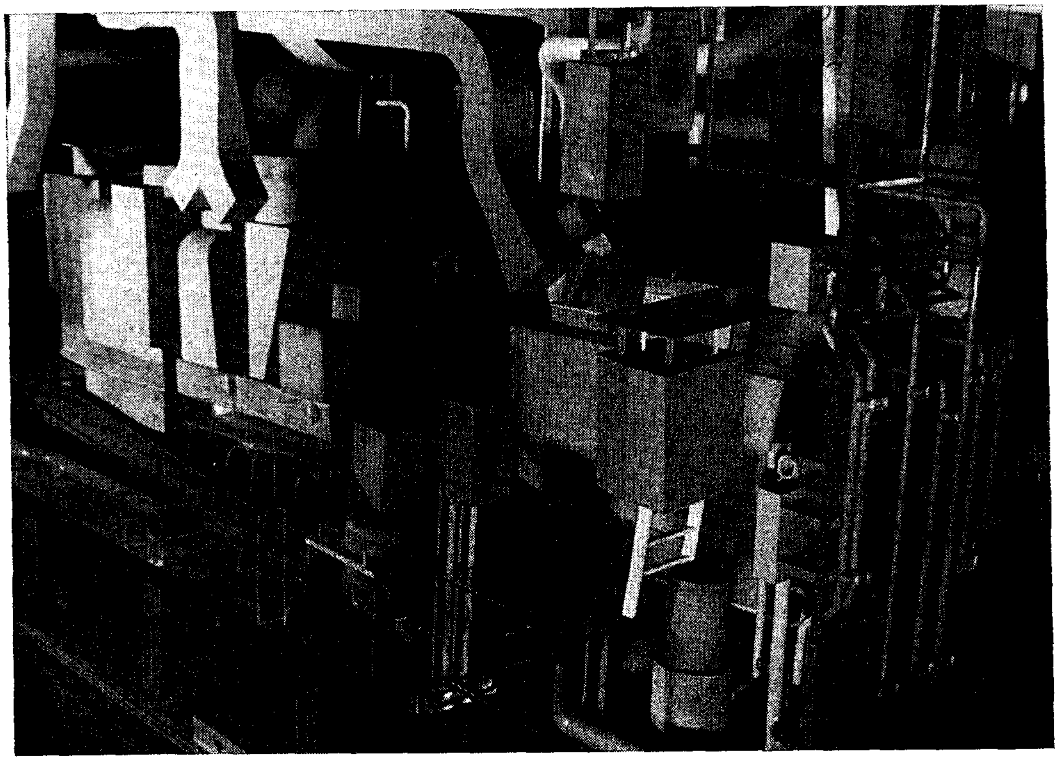

FIG. 3—TYPE 22 FEASIBILITY STAGE MODEL—TYNE GAS TURBINE MODULE AND GEARBOX

SYMES range equipments were at that time (1967) still being designed and their particulars were inadequately defined. In consequence although the model was of some use, it was not really representative of the installation as later designed in detail.

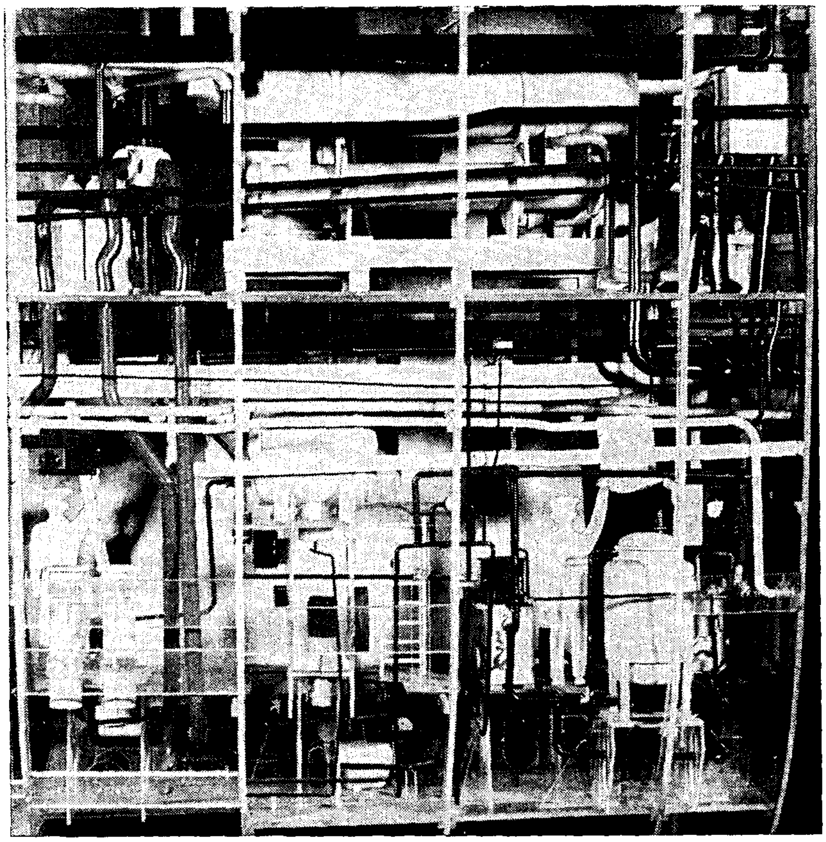

FIG. 4—PART OF TYPE 22 GUIDANCE DRAWING STAGE MODEL—TYPICAL AREA OF MODEL SHOWING EXTENT OF PIPING AND FITTINGS

By contrast, the corresponding exercise in the Type 22 which was carried out in 1971 has resulted in a much more realistic model. This was really useful in determining the overall machinery space block and in pin-pointing those parts of the installation where access problems and congestion were a particular hazard. To illustrate this point, FIG. 2 shows the Tyne/gearbox assembly as it was envisaged in the Type 42 feasibility-stage model, while FIG. 3 shows the corresponding assembly, now based on known data, as built into the Type 22 feasibility-stage model. As can be seen, in addition to showing more correct outlines of equipment, the feasibility-stage model of the Type 22 also offered considerably more scope for the inclusion of piping and fittings.

The ability to make sensible and quantitative early space assessments on a machinery space model has a spin off in permitting earlier firming up of many ship structural details, and hull and electrical arrangements. This acceleration of part of the design process has beneficial effects on the balance of the overall design and must result in ultimate savings of time and cost.

The emphasis on system piping, ducts, fittings, etc. has been carried to a much greater extent in the second model constructed for the Type 22; this was used throughout 1972 in optimizing the layouts during the preparation of the machinery installation guidance drawing. The ready availability of correct information on SYMES equipments has really paid off here and the model has been used as a true design aid. To indicate the degree of detail included, FIG. 4 shows an area of the machinery space model which is built to a scale of 1:10.

Conclusion

The effect of the SYMES range on the installation designer is complex. On one hand there is the discipline, the restraint, and the curtailment of the designer's freedom. On the other hand there is the ability to consider the design of the machinery installation in adequate detail early in the overall time scale, so that trade-offs can be effected to best overall advantage.

The standardization and thorough testing and development of equipments, which are an integral part of the SYMES concept, promise increases in reliability and reduced maintenance requirements. It may well be that, in the future, the beneficial effects of these advantages may be reflected in less need to duplicate equipments, thus saving costs and reducing the tendency to increased overall machinery weight and space referred to in the Introduction.

Contrary to initial impressions, the existence of the SYMES range makes the installation designers' task more demanding, more interesting and more satisfying. It facilitates the application of increased design effort in the early stages, and makes such effort cost effective.