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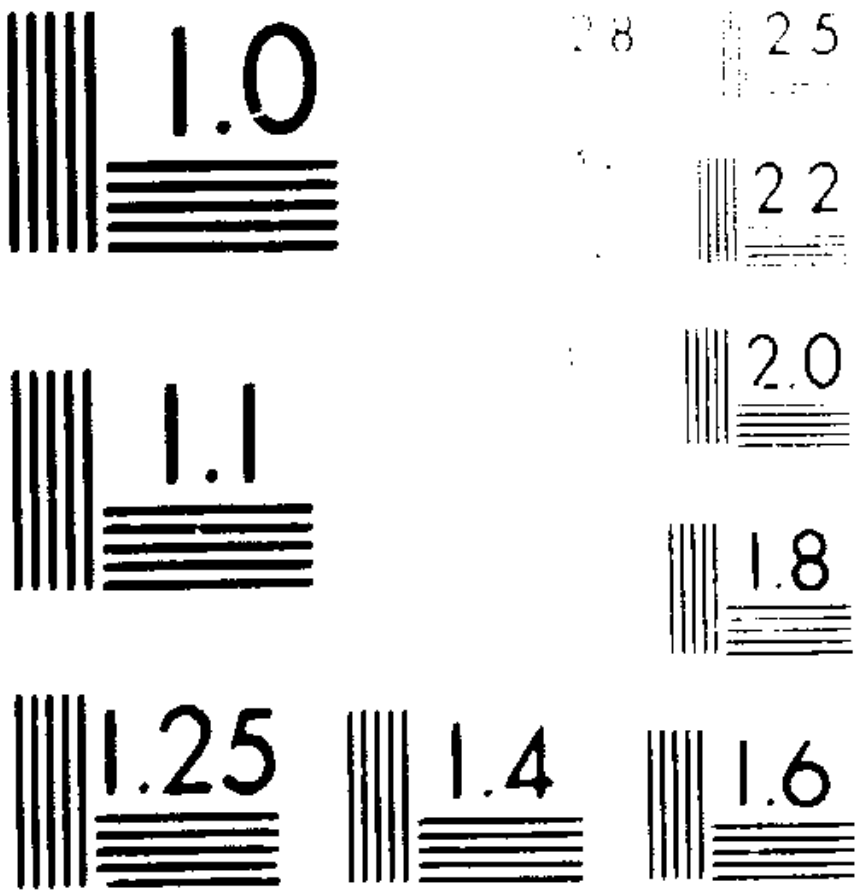
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DEVELOPMENT OF WELDING TECHNOLOGY AT MALTA DRYDOCKS

ID/MAT/79/001

MALTA

Terminal Report *

Prepared for the Government of Malta
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of D. Cuthbert,
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United Nations Industrial Development Organization
Vienna

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EXPLANATORY NOTES

During the term of this project the local currency £M has fluctuated from 2.79 to 2.36 US dollars.

Unusual technical abbreviations are:-

D.W.T.	Deadweight Tons (a measure of ship size)
C.F.T.C.	Commonwealth Fund for Technical Cooperation
ASME IX	American Society of Mechanical Engineers (a code for the training and testing of welders)
S.A.L.S.	Single Anchor Leg Storage mooring system
M.I.G.	Metal Inert Gas (Argon or Argon rich gas shielded welding)
M.A.G.	Metal Active Gas (CO_2 shielded welding)
T.I.G.	Tungsten Inert Gas (Argon shielded welding using a non consumable tungsten electrode)
A.B.S.	American Bureau of Shipping (a survey authority)
A.P.I. 6G	American Petroleum Insitute (a test piece inclined in the 45° or 6G position)
B.E.F.A.	Beratungstelle fur Autogentechnik (German acetylene gas welding equipment company)
M.M.A.	Manual Metal Arc welding (stick electrodes)

ABSTRACT

Development of Welding Technology at Malta Drydocks

DP/MAT/79/001

Development objective

To increase the efficiency, productivity and competitiveness of an industry that is changing over from naval repair work to merchant shipbuilding and repair and construction of offshore equipment.

Duration of Project

One year eleven months.

Conclusions

The Maltese craftsmen are receptive to new ideas and the development objectives were largely met. Too much time had to be spent on developing specialised welding procedures and training welders for oil rig work at the expense of instruction in the more general field of ship repair.

Recommendations

A further training programme is required in the ship repair section.

(1) To bring welders of below average skill up to an acceptable standard.

(2) To train welders of above average ability in the use of low hydrogen electrodes and new techniques.

(3) To instruct ship repair burners in the correct setting and handling of equipment, this is the programme already being carried out with new construction burners.

It is considered that the welding manager and foremen of the ship repair section are quite capable of conducting this programme without further assistance.

TABLE OF CONTENTS

INTRODUCTION

Project Background

Malta Drydocks is the largest single industrial employer in Malta with a labour force at the end of 1980 of 4900 workers out of a total national gainfully occupied population at the end of the same year of 118,832.

Six drydocks are in operation, the largest of which will accommodate vessels of 300,000 DWT and a seventh shallow basin dock of about 3000 DWT came into use in November 1981.

Overall sales for 1981 were about £M27.5million with an operating profit approaching £M2 million.

The workload through 1980 and 1981 continued to consist mainly of ship-repair work but the new construction division concentrated its attention on oil related fabrication and a series of single point mooring buoys was built followed by part of a multi-national project, a Single Anchor Leg Storage mooring system for the Tazerka field, offshore Tunisia. Malta Drydocks built the sea bed, a high tensile steel fabrication more sophisticated than the mild steel buoys and necessitating a complete re-qualification of all welding procedures and re-training and testing of all welders employed in the project. Further ventures into offshore work are anticipated including a jack up drilling platform, submersible and semi-submersible drilling rigs.

Throughout 1981 the drydocks were fairly heavily occupied even to the extent that double dockings were necessary and new construction had to be removed from No. 1 dock and carried out on a wharf within reach of the 150 Ton crane. In 1982 there was a sharp fall off in new construction due to the general world recession and ship repair work also became less plentiful.

The welding and gas cutting force has risen slightly from the figure quoted in the project document and a quality control team has been added. The current figures are as follows:

Labour force	550 men
Chargemen	28
Foremen	6
Welding Manager	1
Q.C. Manager	1
Welding Inspectors	4

The Government of Malta requested assistance in the fields of welding and gas cutting technology in order to improve the commercial viability of an organization that had changed from naval repair work to the highly competitive field of merchant shiprepair and new construction.

As far as is known no other work has been done in this particular field although assistance has been provided in the design and estimating section for several years by C.F.T.C. who have given the services of one expert.

Official Arrangements

Assistance was requested early in 1979, the project document was signed by G. Borg Caruana, Principal Assistance Secretary on behalf of the Malta Government on May 25th 1979. Agreement on behalf of U.N.I.D.O. and U.N.D.P. was signed by Mr J.C. Petitpierre on July 3rd 1979.

The estimated starting date for the project was July 1979, however, the actual starting date was February 2nd 1981 and the mission will terminate on December 31st 1982.

Contributions

The contributions stated in the Project Document were UNDP $ 69,700. Government Input LM29,000. It was pointed out when organising the fellowship programme that there might be a small overspend on the $ 12,000 allowed for this section mainly due to the rise in cost of travel.

In January 1982 a 5 month extension for the project was arranged at the request of Malta Drydocks and a further 6 month extension was granted in June 1982. This has increased UNDP expenditure to a planned $ 147,283 for the complete term of 1 year 11 months.

Objectives of the Project or Mission

The immediate objectives of the project to secure improvement in welding and gas cutting have been largely met. A big proportion of the new construction welding force has been trained in the use of low hydrogen electrodes and qualified to weld High Tensile Steel to ASME IX requirements in 4 positions, unlimited thickness. This utilised all training resources for a considerable time and hindered the development programme and general training of ship repair welders and burners. When training resources were available during an extension of the project ship repair workers were fully occupied and could not be released. The effect of re-training on new construction has been very satisfactory and as these welders now hold internationally recognised qualifications of a high order there should be no necessity for further training for a long period. Re-testing, however, will be required if no work of the required standard is carried out for six months.

The second part of the objective has been met in full. Four key foremen were sent to the Welding Institute at Cambridge for a three week intensive training course in inspection and control of high quality fabrication followed by visits to a modern welding electrode factory, Babcock & Wilcox Ltd. pressure vessel works and the Philips marginal field oil rig which is building at Hunterston in Scotland.

In addition some 64 supervisors and key welders were given a series of formal lectures at the Drydocks on the prevention and repair of various modes of weld failure.

As far as new construction is concerned the objectives of the mission have been met in that quality is greatly improved and productivity should show an increase because of the reduced repair rate and the

use of higher efficiency electrodes and submerged arc welding procedures.

The decision to concentrate first on new construction, that was forced on the Drydocks by circumstances, has proved very beneficial in that extensive "on the job" training was immediately available after qualification in the welding school. This is an essential part of any training programme and something that is difficult to provide in the repair section because of the diverse and intermittent nature of the work. If a later training programme to extend the skills in repair work is contemplated it may be advantageous to practice new techniques in new construction first, until the method is established.

Training

As mentioned in the preceeding section a fellowship course was arranged for four key supervisors in the welding section.

As Malta Drydocks was undertaking a high quality type of fabrication (oil rig work) that is not practiced by many shipyards it was felt that a short intensive specialised course should be arranged at the Welding Institute near Cambridge rather than attempt an "education by observation" fellowship at another shipbuilding establishment. In this way one could be sure that the syllabus would fit the immediate requirements of the Drydocks.

Other formal training in the Drydocks was provided by a series of lectures for supervisors and potential instructors covering the avoidance and rectification of major weld defects. By far the largest part of the training effort involved the qualification of 115 welders to ASME IX standard out of a total of 133 trained, plus the approval of more than 30 new welding procedures for high tensile steel.

Informal training was carried out on a day to day basis as problems occurred, mainly with chargemen and burners, explaining the reasons for defects and the remedies to be taken.

During the extension period of the project training continued on new techniques, underwater welding, stellite facing of exhaust valves and some testing of welders for another company was carried out. A one day seminar was held for 20 instructors from Government trade schools and lectures were given to apprentice welders, covering subjects not normally included in their training syllabus. Also underway are training courses for burners from the new construction section and hopefully courses for pipeworkers on pulsed T.I.G. The ship repair section remains a problem. Each time a course is organised a heavy workload seems to occur in that section, making the release of trainees difficult.

Positive aspects of training were the willingness to learn and the high pass rate on a rigid inspection standard.
One negative aspect of the training programme is the tendency to drift back to old methods if constant supervision is not maintained, however, this tendency is not limited to Maltese craftsmen.

Recommendations

1. A suitable opportunity for commencing the training of ship repair welders and burners has not occurred. The welding manager who will be in charge of ship repair training is quite capable of carrying out that programme as and when the trainees become available.
   It is suggested that, due to the high number of workers in repair work with lower than average skill rating, two separate programmes will be necessary for welders.
   (a) A course for lower skilled welders to bring them up to average ability using normal rutile electrodes.
   (b) Another course for better than average welders, teaching them to use low hydrogen electrodes and new techniques such as one side welding, use of high recovery iron powder electrodes and vertical down welding.
   (c) A separate programme should be arranged for ship repair burners designed to teach them to use smaller nozzle sizes and lower oxygen pressure. Oversized nozzles and excess pressure are the cause of most burning defects observed in Malta Drydocks.

2. During the training of new construction burners it was noted that an immediate improvement in quality resulted when the trainees used a simple guide strip to assist them. It would be very advantageous to supply each burner with a simple guide, consisting of a 25 mm wide strip of thin stainless steel about 450 mm long. This is attached to the work by two small pot magnets.

   The Handy Auto semi automatic burning torch (modified to run on dry batteries) gave very satisfactory results, particularly in the hands of younger burners with some automatic machine experience. This tool should be given a wider use and more should be purchased as the cost is only in the region of £M150 each.

3. A considerable amount of poor burning coming from the Condor machines and the flame planer is the result of using untrained or improperly trained operators. This is due to pressure on management to share the overtime work on these machines among a wider field of operators. It would be sensible to limit changes of operator as far as possible and to institute a test which must be passed before an operator is permitted to use the machine.

   Preventative maintenance on a regular basis to check alignment, freedom of movement etc. is essential, rather than the present overhaul after break down method.

4. The pipe shop in Malta Drydocks is one of the worst equipped sections. When the new pipe shop is completed efforts should be made to introduce better pipe end preparation equipment. The pipe welders have demonstrated their ability to produce good workmanship on satisfactory preparation in new construction but the preparation on most pipework in the repair section is totally inadequate for M.I.G. or T.I.G. welding or even for good quality manual welding. When the special electrodes ordered for the repair of cracks in exhaust valves are received, efforts should be made to qualify the TIG stelliting procedure recently developed.

5. Forty eight single operator air cooled transformers fitted with remote control have been purchased for trial in the No. 7 dock area. If these prove satisfactory a decision to eventually replace oil cooled equipment with air cooled should be taken immediately and allowance for extra room for air cooled units should be incorporated in the development plans for re-wiring around No 2 & 3 dock areas. Seventy square millimetres single welding cables, fed through cable ducts in looms of six cables, are recommended for distributing power from the transformers to the dockside rather than using multicore cable. With this method a damaged cable is easily replaced at low cost and cooling is also somewhat better.

6. Before purchasing a new gas cutting machine a decision should be taken to change to numerical control rather than attempt to continue with 1/10th scale optical control and purchase conversion equipment later. Optical control is inherently less accurate than numerical control and the cost of the optical follower, currently £M18,000 as compared with a numerical control cost of £M16,000 would probably pay for the drawing office software necessary for producing and checking numerical tapes.

   Co-operation with Marsa shipyard is essential to ensure that both installations use the same system and language. This will make work and tapes fully interchangeable in the event of joint ventures or breakdown of either plant.

7. The quality control department in Malta Drydocks demonstrated its usefulness during the construction of the Tazerka base and the Marsa shipyard dockgate. There seems to be reluctance to apply full quality control on repair work where only welding is checked. As more Continental shipyards are entering the ship repair field and offering quality assurance as well as good delivery dates, Malta Drydocks would be advised to commence fuller quality control on repairwork now in order to gain experience.

7. Continued
It is not necessary to apply the same standards as used for new construction but even to monitor quality against cost for a time will prove that poor quality workmanship is often the most expensive.

8. In ship repair work it is poor quality of burning and poor fit up of steelwork that is creating problems rather than careless welding. There is no possibility of producing good quality welds on many side shell and bottom shell panels currently presented to the welders by the shipwrights. A serious effort must be made by foremen and managers of shipwrights to improve this section if delivery times are to be reduced. At the time of writing this report one side shell repair was cut and re-adjusted twice before owners and surveyors were satisfied with the quality of the steelwork.

9. If more oil rig work is undertaken foremen and managers must pay particular attention to quality aspects such as the drying and handling of low hydrogen electrodes, drying submerged arc welding flux, minimising fairing aids or attachments and using correct welding sequences to reduce distortion. Suitable drying ovens and electrode storage quivers are now available at the Drydocks but there was little indication on previous work that men or management treated many of these matters seriously.

10. It is recommended that the Drydocks welding manager takes a good look at the syllabus of the welder/burner 3 year entrants course with a view to suggesting changes to bring it in line with new production requirements.
Areas in which UNIDO could effectively offer further assistance are (1) Sponsorship of M.D.D. supervisors at refresher and specialised courses at the Welding Institute or other technical education centre. (2) Assistance with upgrading of overall Maltese welder/burner training facilities to cope with the advance of industrialisation in the island.

MAIN REPORT

Activities will be analysed in the order in which they appear in the bar graphs (Annexe 1). There were two unanticipated factors which have made it impractical to carry out the original programme in the time scale allocated.

The long delivery dates offered on equipment ordered from Britain, Sweden, Germany and Japan. Gas cutting equipment ordered for test purposes in early August 81 did not arrive from Japan until Feb 1982 and welding tractors from Britain, ordered in March 1981 and promised in Aug 81, arrived 9 months late with many parts missing.

New construction work at the Drydocks in 1981 was mainly connected with the offshore oil industry. A single anchor leg storage mooring system for the Tazerka field offshore Tunisia, of which Malta Drydocks built the anchor base, caused problems. All welding procedures had to be re-qualified for higher tensile steel and all welders re-trained and tested to international ASME IX requirements before work could commence.

Activities under section (a)

These have suffered most from the change of emphasis in the programme.

New submerged arc welding procedures using only two passes and square edge weld preparations were fairly rapidly approved and have now been adopted even on the high tensile steel base. Production is increased and distortion and repairs have been considerably reduced. Two new submerged arc tractors were ordered to further improve the quality in this field but delivery of these items is very extended and they may not be operational until the end of the present project.

New consumables for test were delayed until July 81 though a considerable quantity of 200% recovery low hydrogen electrodes was air freighted to speed up the welding on a large bottom damage repair. Productivity was increased by about 150% but the fume extraction problem necessitated the design of extraction shoes to improve the efficiency of the very low water gauge extraction fans used at the Drydocks.

A very lightweight submerged arc welding tractor has been suggested as a better alternative for such confined work, unless the drydocks is prepared to invest in much more powerful fume extraction systems.

A technique for automatically flame cutting weld preparations on the ends of bulb flats using the Condor machine has been demonstrated, although there is no immediate use for this preparation since tanker construction has ceased. An attempt to qualify a one side welding system using local materials was abandoned temporarily as a welding process not in common use was involved. Recently two semi automatic M.A.G. welding machines have been brought into action again and a backing system using window glass has been demonstrated.

The pipe shop at Malta Drydocks is probably the worst equipped section of the shipyard. A new shop is to be built near the No. 7 drydock and it is recommended that semi automatic MAG welding be put back until the new shop is completed.

MAG welding was recommended mainly for low pressure pipework on new ship construction. The present shop output falls into two categories, repair of heavily painted or corroded pipework from ships and high quality high pressure new pipework for oil related fabrication. Neither of these is really suitable for MAG technique.

In place of M.A.G. we have substituted some excellent Japanese low hydrogen electrodes (Kobe LB52U) for root runs in the larger diameter pipes and T.I.G. welding has been qualified for mild steel pipes and stainless steel pipes in the 1" to 4" dia. range.

A considerable amount of stainless steel piping was required for the SALS rooring system. New TIG welding procedures were qualified for this work.

Early in the programme a check was made on the tolerances of plates from the flame planer and Condor machines. Errors of 5 mm in 10 metres were found on the planer and 5 mm in 1 or 2 metres on the Condor machines. These errors were due to three causes:-

1. Misalignment of the rails on which the burning carriages run.
2. General slackness in bearings, wear and in the case of the Condor excessive friction in parts driven by a rather delicate electronic mechanism.
3. Plate movement caused by heat distortion of the burning tables, which were in very poor condition. A fairly comprehensive overhaul of all three machines by the plant department has reduced these errors considerably.

Much remains, however, to be done. Maintenance at the Drydocks is not done on a preventative basis, only actual breakdowns being attended to. Monthly checking and preventative maintenance is essential for quality flame cutting. Too many operators are being used in order to spread available overtime over a larger number of workers. Many of the operators have only a vague idea of the correct operating conditions. A qualification test for machine operators has been recommended to the management.

The "Handy Auto" and "Circut " semi automatic burning machines ordered for trial have been demonstrated as part of the training programme and will be tested in production on suitable projects. The Handy Auto has been modified to run on dry batteries in order to increase its flexibility.

Activities under section (b)

These were completed on schedule as far as production of standards was concerned. Application of these standards may have to wait some time for the following reasons.

1. New construction at Malta Drydocks in 1981 was to AWS requirements regarding both fit up and radiographic acceptance.

2. Repair work is carried out to the requirements of either Lloyds A.B.S., Bureau Veritas, Det Norske Veritas or Germanischer Lloyds. These survey authorities will not readily endorse "in house" standards but reserve the right to apply their own judgement according to the application involved.

3. There was a manpower crisis in Malta Drydocks quality control department during much of 1981 due to a requirement on new construction for continuous inspection on three shifts.

It has been suggested that initially these "standards" be called a "code of practice" - something that the Drydocks is trying to achieve but not necessarily guaranteeing to the customer.

Activities under section (c)

Actual testing of some 600 welders and burners was considered too time wasting and costly. A subjective assessment of each man across a range of skills was to be made by departmental foremen or chargemen just as a basis of determining where broad divisions of strength or weakness lay in each department. In this manner we hoped to plan an overall strategy for training in welding and burning activities.

Initially the union objected strongly to this policy and some months elapsed before their consent was obtained. Charts for ship repair burners and welders were completed in August 1982. The charts for new

construction were not necessary as almost all welders were formally tested and coded for oil rig work.

At the commencement of this project the Drydocks was just starting a training exercise in which 86 new construction welders were coded to A.B.S. requirements for a single point mooring buoy. Unfortunately there was no indication at that time that high tensile steel fabrication would soon be required or the later, higher grade training programme, with unlimited thickness coding and full mechanical testing would have been brought forward. This initial training exercise (which was omitted in error on the six month report) served to give an indication of the high skill levels available in the new construction welding sector and uncovered weaknesses in the available training facilities.

After its completion in May 81 there was a short lull in training while we assessed the new situation arising from the possible use of high tensile steel in future orders and a new programme of training and testing to ASME IX requirements in three positions on H.T. steel was introduced. This gave all those welders who passed the test an internationally recognised certificate of high standard, acceptable to future customers.

Ten new booths were built in the existing welding school plus an external facility for arcair gouging. At the height of the programme the apprentices in the original section of the school were temporarily sent to "on the job" training and the whole 20 booths were used for adult welder training and testing.

The oil rig work introduced two new requirements.

1. All welders to qualify if possible in three positions, using basic low hydrogen electrodes.

2. To avoid the extensive use of pre-heat, welders were trained to work with very short electrode deposit lengths (about 2.4 Kilojoules per mm heat input). This caused some problems in the vertical and overhead positions as all their previous training had been on low heat input stringer bead technique.

In all, on H.T. steel to ASME IX standard, 122 welders have been trained in Manual Metal Arc welding with only 18 failures, 6 on submerged arc welding (two pass and multi-pass) with no failures and 5 to A.P.I. 6G position on pipework with no failures.

On special "Uranus 50" pipework 4 welders were qualified for fillet welding and 2 for T.I.G. welding.

More than 30 welding procedures have been written and qualified for high tensile steel fabrication or pipework. The whole training and testing exercise has involved the preparation of over 700 machined test specimens, to date, quite an achievement in an organisation that has no specialist testing facility.

At this stage of the project burner training was limited to informal "on the job" instruction, however, during the second extension a formal programme was instituted see section (i).

Activities under section (d)

The in house lectures prepared and delivered in July and August 1981 seemed to generate a better spirit in the supervisors for whom they were designed. Sixty four people attended, divided into 4 sections to keep the talks on a personal basis and the text was modified slightly to suit the needs of each section. Supervisors on new construction for instance had particular attention paid to the elimination of defects due to bad fit up or incorrect handling of electrodes. Repair supervisors were instructed mainly on the identification of reasons for failures and the correct repair techniques to prevent a re-occurance. Fairly comprehensive printed lecture notes were given to those attending as a permanent reminder.

Each course lasted three half days and an abbreviated version of the welding defects section was delivered to a combined meeting of the Institutions of Marine Engineers and Naval Architects by request.

It was noticeable that once the supervisors understood the reasons why failures occured they took considerable trouble to eliminate the causes of fractures on new construction work. The S.A.L.S. base was built to a much higher standard than previous oil rig work at Malta Drydocks.

Activities under section (e)

Four very good welding foremen were selected for the fellowship course quite early in the programme. They are the people who have most direct influence on weld quality so the in house lecture course and the fellowship programme are complementary and designed to teach the fellows how to identify potential problem areas in new construction and avoid the major hazards of hydrogen cracking, fatigue failure and brittle fractures.

They were also shown how to cope with the ever increasing demands for documentation and certification that make oil related fabrication so difficult for the smaller fabricator.

The Welding Institute at Abington near Cambridge was chosen because of its reputation for teaching quite high technology in a very simple and practical manner. The school of welding technology, in which the fellows received instruction, can call on the services of experts from the main research organisation which has a vast store of up to date information in all branches of welding.

The first two weeks of their course was a standard syllabus (W.I.S.5) used for the training of welding inspectors. The final week was a tailor made syllabus for the four fellows only and use was made of the W.I.'s specialist knowledge by analysing recent oil rig failures and pointing out the lessons to be learned from these.

After the formal lecture course, visits were arranged to Philips electrode factory at Glasgow to receive instructions on the care and handling of welding consumables also to Babcock and Wilcox Ltd

of Renfrew to learn something of high quality pipe fabrication. The final day was spent on an oil rig site at Hunterston in Ayrshire to see at first hand the quality control necessary when building a large oil production platform.

As the fellows returned to Malta on December 9th 1981 there was ample opportunity to utilise their training on the S.A.L.S. base then under construction. Subsequently Philip Fenech supervised the in dock assembly of the S.A.L.S. base, Joseph Aquilina was in charge of repairs on the oil rig "Penrod 70" anchored in St Paul's Bay off Malta, John Vassallo was responsible for extensive repairs on the oil rig "Ocean Voyager" and the drilling ship "J.W. Bates" and Paul Galea was appointed welding manager in charge of the ship repair section.

At the time of writing this report Malta Drydocks are considering sending three or four other foremen to a similar course in November 1982 at the Drydocks expense.

Activities under section (f)

Work in the unschedules activities catergory has tended to occupy a fairly high proportion of available time. Due to the nature of work in the Drydocks, repair problems arise frequently that require attention. Discounting these items there were other activities that will not appear on the bar chart.

1. Attending meetings at request of Drydocks' Management to discuss new projects with customers representatives.
2. An abortive two week development programme to try and obtain specific low hardness values in fillet welds on H.T. steel (This resulted from a mistake in the interpretation of a specification by a customer's representative).
3. Visits to Malta Shipbuilding Co (Marsa Shipyard) to offer advice on plant and equipment. A report on the Marsa equipment schedule (welding and cutting section) was submitted to shipyard management.
4. Ten days at Essen Fair and Cockerills Shipyard at Antwerp inspecting possible new welding and cutting equipment for the Drydocks.

5. Preparation of a welding equipment survey for the Drydocks management with recommendations regarding a future purchasing policy. This was extended after the visit to Essen to include some new equipment for both repair work and oil rig contracts.

Items that do appear on the bar chart are as follows:-

Heat line straightening

It was observed that attempts were being made to straighten fabrications with heat but the method used was ineffective. Three foremen and the Q.C. manager as well as a number of burners were instructed in the AGA heat line straightening system which is based on a technique developed by B.E.F.A. in Germany. The deck of a barge was used as a first training exercise and subsequently the method was utilised to level the deck of a single point mooring buoy and the internal bulkheads of another buoy. Whereas the original method of correction often involves splitting and re-welding sections of fabrications it was found that errors of ± 25 mm could be rapidly removed using heat only. Heat line straightening was used to hold the Marsa shipyard dock gate to a ± 4 mm tolerance.

Fume Extraction

Severe fume problems threatened to prevent the use of high recovery iron powder low hydrogen electrodes. A self powered auto extractor was developed for open shop work with these electrodes and a fan assisted version for use in tanks or double bottoms.

The auto extractor utilises the thermal energy of the arc (about 12 Kilowatts for Philips C6H electrodes) to create a powerful jet effect that throws fume well clear of the welder. In confined spaces fume is collected by normal extraction hose and the auto extractor is used only as a collection "shoe" to improve the efficiency of the extractor system.

Building up of worn piston ring grooves

There has not been much necessity for work of this type in the past year and nothing was done to develop a suitable machine.

Stellite facing of exhaust valves

At the request of Malta Drydocks an investigation was made of severe cracking in repairs done on stellite faced valves. A complete change of method from manual metal arc welding to oxy acetylene welding with pre heat and post heat treatment was recommended and later a simpler method using the T.I.G. process was tested after discussions with Stellite representative. This method may be adopted for production after the Drydocks have obtained the special electrodes necessary for repairing cracks in the heat resisting valve steel.

In the meantime valves that are free from cracks in the parent material have been successfully stellited and heat treated to make the deposit machineable.

Welding of stainless steel piping

Initially it was planned to commence training on 316L piping for a possible contract involving a reverse osmosis desalination plant. In fact it became necessary to train operators for welding "Uranus 50" pipework, a rather specialised type of stainless steel used on the S.A.L.S. Base. Procedure tests were qualified and 6 operators trained, 4 on manual metal arc fillets and 2 on T.I.G. butt welds.

Stud fairing

The Drydocks are anxious to try and reduce the number of "fairing aids" and other temporary attachements on critical offshore oil fabrications. Suitable equipment for utilising the "Scotsman" system of stud fairing has been selected but it is unlikely that this will arrive before the project terminates.

Extension of original project from end Jan 1982 until end Dec 1982

In order to keep the report in reasonable cronolgical order the extension activities are treated separately as an extension of the orgional report.

Activity (g)

In March 1982 a development programme was commenced on one side welding techniques and vertical down welding. The "Varios" ceramic tiles were selected as the most suitable for Drydocks use although a very cheap home made system using window glass was tested and abandoned because it requires M.I.G. welding for satisfactory operation. This method was revived again in September 1982 when two M.I.G. welding machines were repaired and operational. Both Philips type 27 electrodes and Kobe Zerode 6V were found suitable for vertical down welding.

Three welders were trained as possible instructors for this work. Later a fairly extensive test programme for "gravity" and "auto contact" electrodes was carried out. Suitable electrodes for each equipment have been selected but work shortage in new construction has prevented the introduction of the method. Vertical down welding is not readily usable on repair work due to the wide fit up of the steelwork.

Activity (h)

After the visit to the Essen Fair in Sept 1981 Malta Drydocks was able to borrow a demonstration model "Segarc" electro gas vertical welding machine by Kobe of Japan. Tests were carried out and a report was issued. The machine was found to be too sensitive in operation for ship repair welding, however, this may be due to a faulty or unsuitable power source and the method itself was very rapid and satisfactory, about 6 times as rapid as manual welding.

Activity (i)

Training was continued in the extension period. As mentioned above 3 operators were trained in new techniques, one side welding and vertical down welding. Six divers were trained in underwater welding to carry out some repairs on a large oil rig.
Six welders from an outside company were tested before being sent overseas on oil refinery work. Twenty instructors from government trade schools were given a one day seminar using the syllabus designed for the Drydocks foremen in 1981. Two operators were trained in Stelliting exhaust valves using the T.I.G. process. At the time of writing this report 24 burners from new constructions have had a 4 day course on hand burning and the use of the "Handy Auto" machine. This is a practical course carried out, 8 at a time, in the apprentice training school. It will continue, work load permitting, until some 90 or 100 burners from new construction and repair have been re-trained.
In October a lecture series was completed for apprentice welders covering subjects like design and use of stick electrodes, properties of welds, welding sequences to avoid fractures, control of distortion , weld failures and their prevention and automatic welding techniques. About 18 apprentices attended four 2 hour sessions.

Activity (j)

Remaining items are listed as unscheduled activities. An 8 welder fume extractor fan was developed for shipboard use and a commercial high suction low volume fan system by Securus of Norway was purchased for comparison. Seven of the Drydocks built fans are to be ordered after tests proved them more suitable.

Some time was spent evaluating various electric preheating and stress relieving equipment quotations in view of possible oil rig orders. A flexible system has been worked out to cover probable types of structures and enough equipment for one or two joints will be purchased. The thermocouples and recording pyrometer associated with this equipment have already been delivered and used to monitor the heat temperature of small weldments.

The dockgate for Marsa shipyard was built and tested in the early months of 1982. Line heating was used to control distortion and a tolerance of $\pm$ 4 mm was achieved on a working face of 48 metres x 9 metres. As this small irregularity can be accommodated by the flexible rubber seal no packing strip or "chockfast" seating was necessary beneath the seal, which was bolted directly to the steel gate.

Discussions regarding the possibility of taking out a licence in Malta Drydocks to use the "Fleet fusion" process for repair of worn parts took place in June 1982. Low workload at that time made the proposal financially unattractive but the situation may alter.

Two items on the list of new equipment recommended for purchase have required quite alot of investigation, mainly because of the wide variety of options available and the difficulty in comparing specifications that emphasise different features. One brand of remote control single operator air cooled welding transformer has been selected and 48 units are on order for trial. The unit is the ESAB THF 630, chosen for its high efficiency and reasonable cost.

A decision regarding a new multi-head gas cutting machine has not yet been reached. Basically Malta Drydocks would prefer to purchase a 1/10th scale optical machine with the option to convert to full numerical control later. As optical control is inherently less accurate and the conversion cost excessive, it is recommended that numerical control be purchased in the first instance, saving £M18,000, which will probably be sufficient to purchase most of the drawing office software necessary to produce tapes. ESAB Numorex PA5-500 equipment appears to be most suitable but several meetings with the manufacturers will be necessary to settle details about the numerical control system.

Two "Hilarc" pulsed T.I.G. welding sets are due in Malta in October 1982. These should considerably improve the flexibility of repair welding on ships boilers, they are also particularily suitable for stainless steel welding in the pipe shop. A brief training programm in the use of this equipment is scheduled before this project terminates.

Since the Drydocks now have efficient fume extraction fans the auto fume extractors have been adapted to power extraction. Couplings for both Drydocks built and "Securus" fans are provided.

Achievement of immediate objectives

Immediate objectives have been satisfactorily met. As explained in the text, training has not gone according to the origional work plan but this was largely due to change of emphasis in the Drydocks' work-load in 1981. With the limited facilities available more than 115 welders were qualified to a high standard and should be usable on sub-sequent contracts. The fellowships programme was judged very satisfactory by the four participants and the formal "in house" lecture programme, delivered at mid term, was well received and seems to have had a good effect on quality, which was the object of the exercise.

Results have failed to meet the missions training requirements only in the ship repair field due to the Drydocks inability to release men for instruction. Ship repair is an easier field in which to effect improve-ments as it is not subject to the rigid qualification standards of oil rig work and hopefully the Drydocks will complete this training using their own staff. They may use the oil rig procedures on repair work if high tensile steel is involved.

Utilisation of Project Results

One of the most satisfactory aspects of the mission is the manner in which improved techniques are immediately adopted for production use. Two pass submerged arc welding techniques have been used consistently, all new high tensile steel welding procedures are in use and all welders tested to ASME IX were fairly continuously employed during 1981 on work requiring coded welders.

It was hoped that the same procedures and coded welders could be immed-iately employed on a follow up project, a jack up oil rig. As long as the welders are employed on coded work within a six month period their certificates will be renewed without further testing. Unfortunately more oil rig work has not materialised and the certificates have lapsed

but the drydocks keep welders in practice by using low hydrogen electrodes where possible.

Findings

A high proportion of Maltese craftsmen are in the above average skill category. They also have fewer prejudices against the use of new consumable or techniques than workers in many other countries.

Provided that sufficient work is forthcoming to effectively employ the trainees for a reasonable period on the new techniques these methods will remain in use and the mission will be effective. The Malta Drydocks management are also receptive to change which is another necessary factor in making new technology operational.

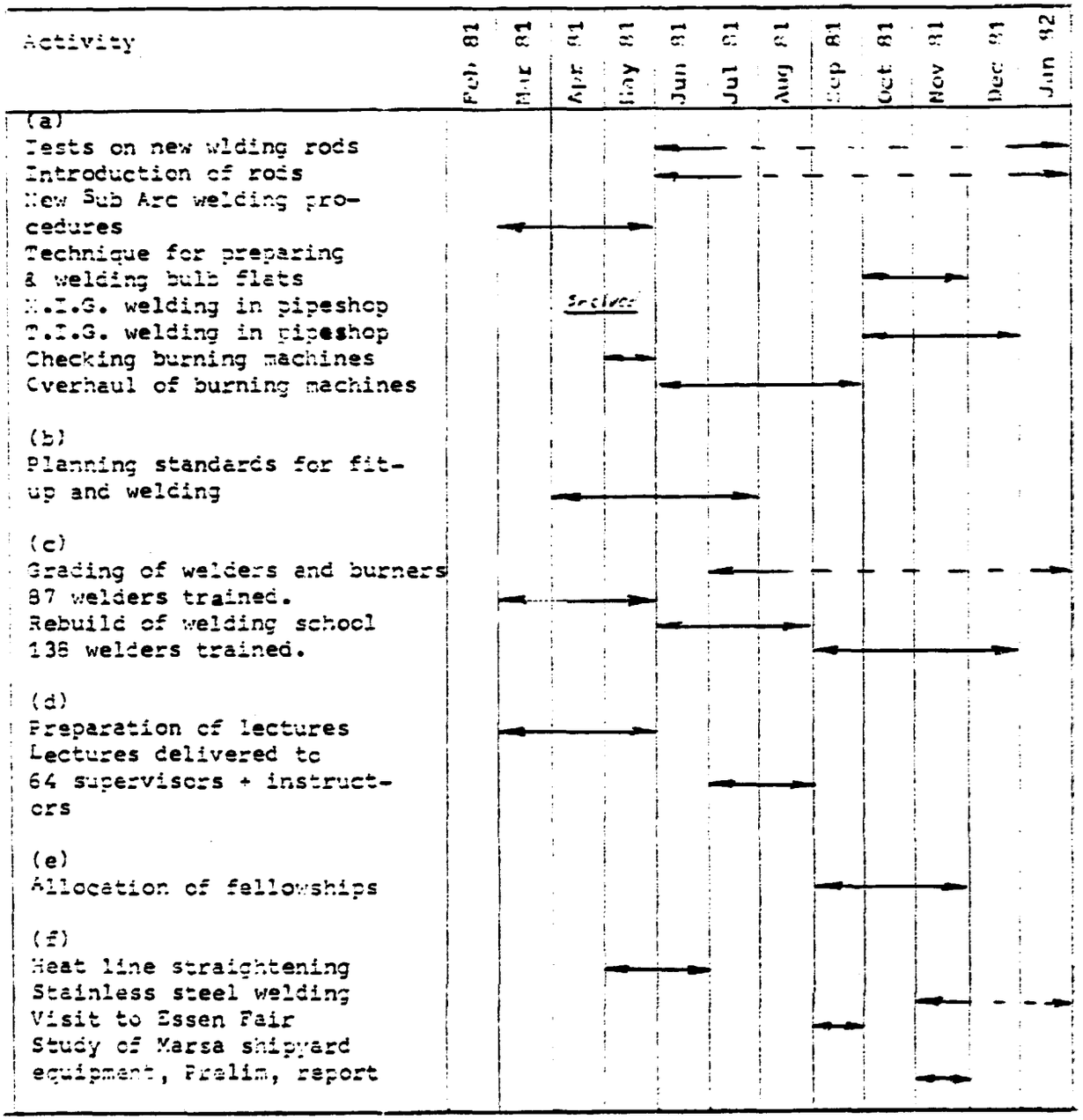
Two of the Drydocks staff Paul Galea and Carmel Azzopardi have an excellent understanding of welding technology and have been of great help in carrying out the project. Paul Galea has been promoted to welding manager (ship repair section) since returning from the fellowship programme. He will still retain responsibility for adult welder training and testing. Mr Azzopardi is a well qualified young welding engineer (Dip Eng) who returned from Germany about 3 years ago and is now in charge of quality control. With a further year's experience in management he will be most useful to Malta Drydocks.

Another young graduate, Mr Kenneth Abela, has recently returned from Britain with an MSc Degree in Welding Engineering from Cranfield Institute of Technology. It is a little early to assess his ability and he has to spend some time learning the work of the various departments as a management trainee.

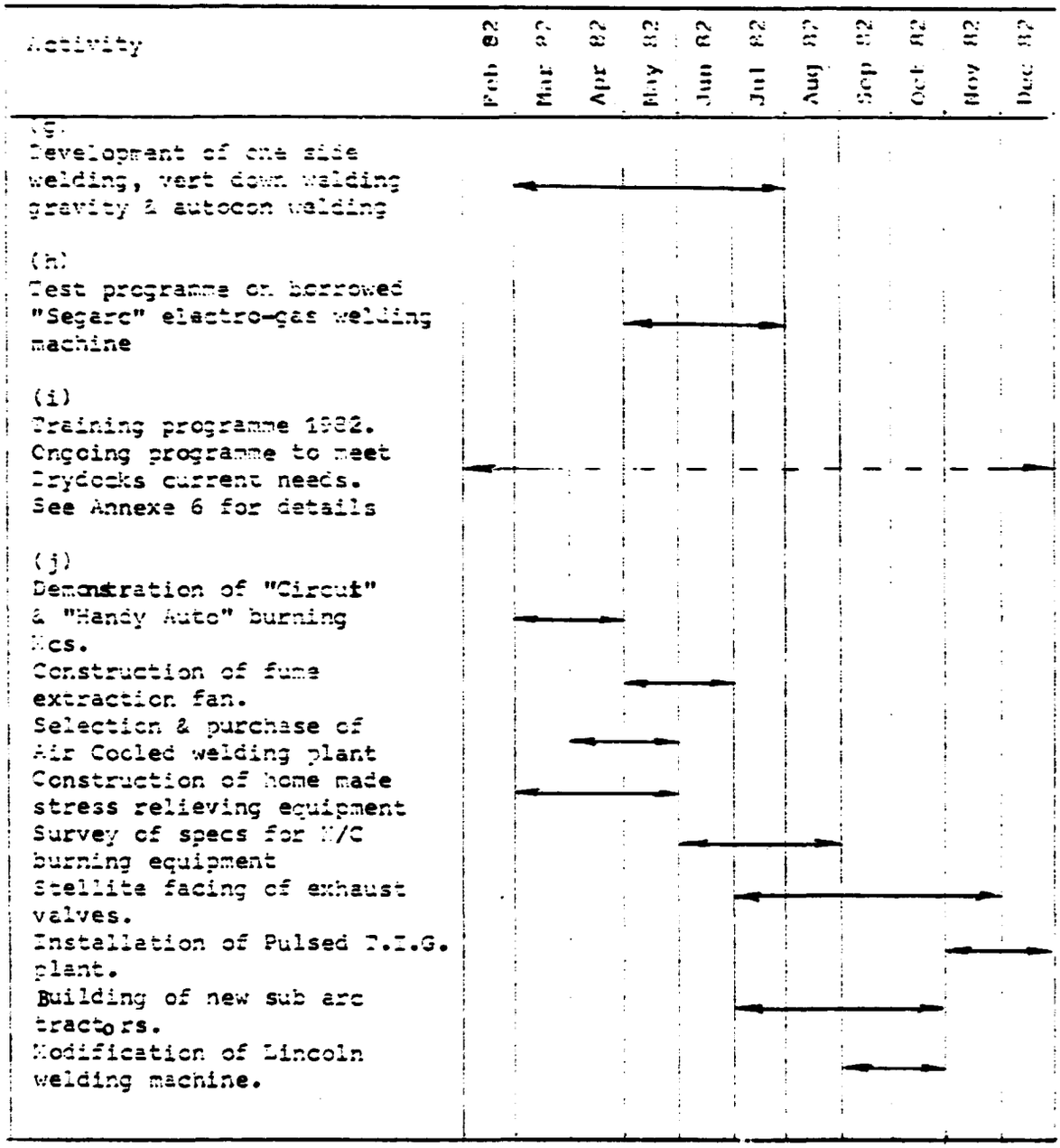
At the time of writing this report the Drydocks management appear to be considering Mr Abela f . the position of welding engineer. He will probably be quite suitible for this post after some experiance. In any event the problem at Malta Drydocks is not lack of welding expertise, for all three of the staff mentioned above are quite competent by any European standard. There is a tendency for the largely ship-wright biased management in ship repair to ignore the requirements of the welding section (see recommendation No. 8). This makes both quality and productivity difficult to achieve. Fortunately the new construction management are now much better in this respect as shown by the very successful S.A.L.S. base for the Tazerka field.

ANNEX 1

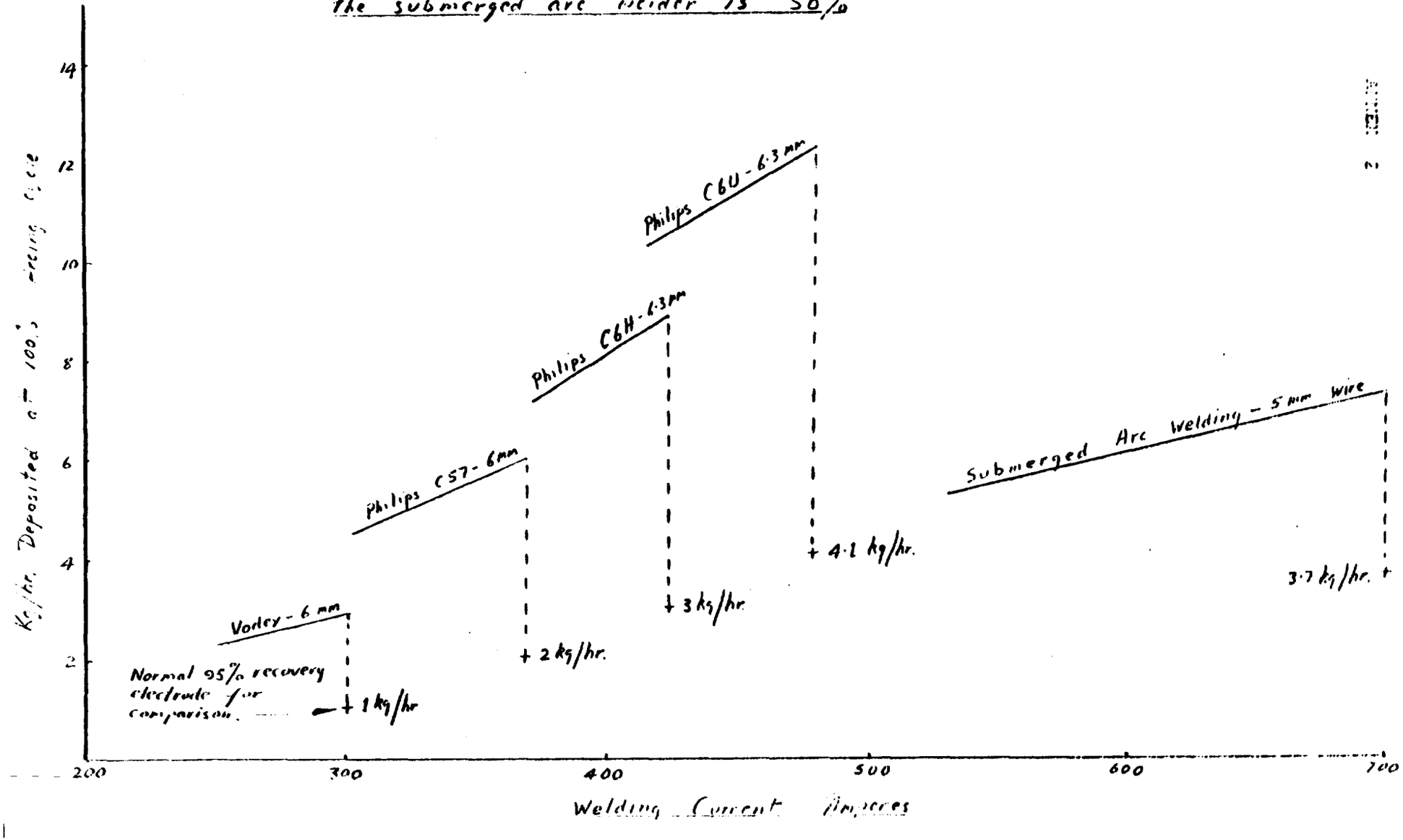
Bar Graphs of Activities in Main Report



ANNEX 1 (Continued)



Comparison of High Efficiency stick electrodes with Submerged Arc Welding.
Duty cycle of the manual welders is taken as 33⅓% while that of the submerged arc welder is 50%



ANNEX 3

Senior Counterpart Staff

Mr L.J. Ellul - Dep. Gen. Manager - Head of production team responsible for project at Malta Drydocks throughout the year.

Mr P Galea - Acting Head Quality Control, now Welding Manager (ship repair) - In charge of development, welder training and testing and procedure testing throughout the project.

Mr C Azzopardi - Manager Quality Control - In charge of quality aspects, formal records of welder qualification, documentation and preparation of welding procedures for 18 months of project.

Mr F Portelli - Foremen of New construction (shops), New construction
Mr P Fenech (afloat) and ship repair respectively - Main contacts
& for d[illegible]o day advisory work concerning working methods,
Mr J Vassallo quality standards, repair procedures etc. throughout the term of the project.

Mr [illegible] Montfort - Manager pipeworkers - Main contact for training of pipe welders, T.I.G. welders and stelliting of exhaust valves.

ANNEX 4

Fellowships Awarded

Three foremen and one chargeman (foreman designate) were chosen for an intensive three week course at the Welding Insitute, near Cambridge. Their names were:

Paul Galea - Quality Control - now promoted to Welding Manager (ship repair)

Philip Fenech - Foreman (new construction afloat)

John Vassallo - Foreman (ship repair)

Joseph Aquilina - Chargeman (ship repair)

The foreman of new construction was unable, for both production and domestic reasons to attend this fellowship course.

As may be seen from the attached syllabus (Annexe 5) the training covers a wide field in the control and inspection of welded fabrication. It is designed to improve the judgement and increase the confidence of supervisors who have to work largely without technical backup in the difficult field of ship repair.

The course at the Welding Institute lasted from Nov. 16th until Dec. 4th 1981 and was followed by three works visits.

1. Philips electrode factory (Glasgow) to study the manufacture and correct handling of low hydrogen welding electrodes. Most important for oil rig fabircation.

2. Babcock & Wilcox Ltd (Renfrew) Nuclear and conventional boiler manufacturers. To study modern welding techniques for stainless steel tubing, which is incorporated in recent oil rig contracts.

3. A visit to an oil rig construction site to get some idea of the problems of quality control on a large and difficult fabrication. The rig was the Phillips Petroleum marginal field platform, building at Hunterston Ayrshire.

SCHOOL OF WELDING TECHNOLOGY

THE WELDING INSTITUTE
ABINGTON HALL · ABINGTON
CAMBRIDGE CB1 6AL
Telephone CAMBRIDGE (0223) 891162 Telex 81183

GCWR/SA"/2909

21st July 1981

Mr. D. Cuthbert,
Flat 4,
Planet Court,
Tigne' Sea Front,
Sliema,
Malta

Dear Mr. Cuthbert,

The following is the outline syllabus for the proposed UNIDO training programme. Mr. R.P. Newman's telex of the 17th July was abstracted from this information.

Weeks 1 and 2

The course would be our standard course WIS 5, "Welding Inspection, Part 1 - Steels". This course is an in-depth treatment of the use of inspection as a quality control tool. The ccurse content for week 1 would be generally as follows :-

Day 1
Would deal with the use of correct terminology and would cover standard ways of imparting information to both national and international codes.

The use of codified welding symbols would also be covered and in particular UK, ISO and USA methods would be illustrated.

A period would be devoted to the use of recognised quality control standards and comparisons would be made.

The day would conclude with a detailed examination of one of a number of welding and cutting processes and the effects of maladjustment would be covered. These sessions would be in the Training Workshop. Each student would study one welding/cutting process per day in a sub-group, the subjects being cutting, gouging, gas shielded arc welding, manual metal arc welding and submerged arc welding. Evening work would be provided for assessment on Day 2.

Day 2
Would commence with a very detailed study of those parameters in MMA welding which directly effect the maintenance of weld quality. In addition, the factors which effect electrode type selection will be dealt with in some detail and the standards which govern electrode classification will be explained in detail.

Part of Day 2 will also be concerned with defects which occur in parent metal and how they can be recognised and assessed. In particular, lamillar tearing will be fully covered. The day concludes with the sub-groups continuing the

..../CONTINUED

work on welding process control. Evening work will be provided for analysis on Day 3.

Day 3

The principal subject for Day 3 is a study of the operating characteristics of the gas shielded metal arc welding process (MAG, CO_2 and Flux Cored wire welding). Controlling standards will be described.

The day will continue with an extensive study of the factors which control the "weldability" of carbon and carbon manganese steels and will conclude with the sub-group activities for welding process control and the usual evening work will be set.

Day 4

This day starts with further work on the weldability of carbon and low alloy steels and in particular HAZ defects will be dealt with. The employment of weld procedure documents to ensure in-house control will also be covered.

There will be an extensive session on the effective employment of mechanised arc welding, the effect of malpractices and the attainment of essential mechanical properties. The principal topic will be submerged arc welding and the selection of parameters to ensure properties.

The day will conclude with the final sub-group work on practical welding process control. The evening work will reflect the tuition on process control and defect origins.

Day 5

Starts with sessions which explore the fabrication of corrosion resisting steels and the special problems associated with the maintenance of properties in the weld area.

A simple exploratory mid-course test will be given at this stage to test the effectiveness of the teaching carried out so far.

Week 2

Day 1

The first sessions will be devoted to an extensive study of weld shape defects as noted by visual inspection methods. The probable origins of these defects will be discussed and an appraisal will be made of likely corrective measures.

The rest of the day will be given over to a detailed survey of the common non-destructive testing methods, where they can be employed and what can be expected from them.

Day 2

The value of heat treatment for enhancing the properties of steel weldments will be dealt with at length. Included in these sessions will be the practical aspects of distortion control and prevention. Systems of distortion control will be discussed with emphasis on prevention rather than correction.

The rest of Day 2 will be concerned with an appreciation of the value of mechanical test results and particular attention will be given to the importance of sub-zero impact properties. Students will be shown how to carry out simple calculations.

Day 3
The previous day's work on mechanical testing will be completed with a comprehensive study of site and workshop testing methods and the interpretation of results from these tests.

The day will continue with an appreciation of the role of other, less common welding and cutting techniques and how they have been adapted by the fuel technology industries. In particular, the quality control measures for the less common processes will be explored.

We will conclude with a session which looks at the creation and implementation of welding and the welder procedures. The requirements of the various classification organisations concerning procedure testing will be covered.

Day 4
Will start with a group syndicate exercise which will examine weld and parent metal defects, apportion probable origins, discuss acceptability and examine corrective measures. The day will conclude with a session which will show how defective weldment reports should be set out and how critical dimension control should be practiced.

Day 5
During Day 5 students will sit a simple examination to check the effectiveness of the teaching programme. A discussion session will follow to clear up outstanding questions which have arisen from the examination.

Week 3

Day 1
Will start with a detailed study of international quality control standards (eg. API 1104, ASME IX etc.). The objective will be to highlight similarities, explain anomalies and generally provide an interpretitive guide.

Students will be given a project to plan using one of the quality control documents as a guide.

Day 2
A comprehensive study will be made of materials behaviour when influenced by welding and cutting. The study will refer to ship and rig building and repair and particular attention will be given to the means whereby the correct information can be incorporated into a weld procedure.

Day 3
Materials behaviour will be continued with work on short term fatigue failure probability and brittle fracture risk assessment. Again the importance of procedural control will be emphasised. The importance of avoiding seemingly innocent non-authorised welds will also be dealt with and reference will be made to case history.

Day 4
Students will be required to demonstrate that they know how to convince a labour force of the necessity to control all aspects of fabrication by welding if assured quality and a safe working life are to be guaranteed. This will be done as a syndicate exercise with SWT staff acting as a labour force.

Day 5
This final day will be used to present to the students the case histories of major ship and rig, and other structural failures and to discuss the lessons to be learnt (included will be notes on the Kings Bridge failure, Sea Gem and the Alexanda Keiland collapse).

I hope that this follows the requirements set out in your note of the 30th March to your satisfaction. We will, of course, be very willing to discuss any modifications you think appropriate. As Mr. Newman said in his telex of 17th July, one problem is going to be setting the date as our Autumn Programme is fairly full and the difficulty of attaching the extra week to the end of course WIS 5 makes the available slots even fewer.

I was somewhat flattered to see you have referred to the course at Babcock's. It was one of the more readily remembered outside courses for me.
I have located a slide of the M.S. Schenectady failure which I enclose with our compliments.

I look forward to seeing you.

Yours sincerely,

G.C.W. Read
Head of School of Welding Technology

ANNEX 6

Training Courses and Curriculum

Completion of Drydocks programme started Feb 1981

86 - Manual Metal Arc welders trained and tested on Mild Steel to ABS & AWS requirements
(No physical tests required, X Ray only) 3 day course — Feb - May 1981

6 - Submerged arc welders trained on 2 pass technique, (Square edge preparation) 10-16 mm Mild steel
3 day course — Mar - May 1981

10 - Burners and supervisors trained in heat line straightening (decks and bulkheads) 2 day course — Apr - Jun 1981

2 - Additional instructors trained in new high heat input welding technique for H.T. steel 2 weeks course — Jul 1981

64 - Supervisors attended lecture course to prepare for changeover to high tensile steel construction
1½ days — Jul - Aug 1981

122 Manual Metal Arc welders trained and tested to ASME IX requirements in H T Steel 2G, 3G and 4G positions, (physical tests & X Rays) 5 day course — Sep - Dec 1981
(High heat input technique)

6 Submerged Arc Welders trained and tested to ASME IX in two pass and multi pass techniques on H.T. Steel
2 days — Sep - Oct 1981

5 Pipewelders trained and qualified to API 6G standard Mild Steel unlimited thickness
5 day course — May - Jul 1981

ANNEX I

Continued

2 - Pipewelders trained and qualifed to weld "Uranus 50" stainless steel. T.I.G. butt welds. 1 week course	Nov-Dec 1981
4 - Pipewelders trained and qualified to weld "Uranus 50" stainless steel M.M.A. fillet welds 2 day course	Jan - Feb 1982
3 - Welders trained on development of one side welding, vertical down welding, iron powder electrodes 3 week course	Mar - Apr 1982
6 - Divers trained in underwater fillet welding 1 week course	May 1982
20 - Instructors from Govt trade schools 1 day seminar on weld faults and their prevention, automatic welding and oxygen cutting	May 1982
6 - Welders tested for outside company - 1 day	June 1982
2 - Welders trained in stellite facing of exhaust valves by T.I.G. welding 2 - weeks intermittent training	July - Oct 1982
24- Burners trained in use of smaller nozzles and lower gas pressures also "handy auto" semi automatic hand torch 4 day course	Oct 1982 continuing

ANNEXE 6

continued

18 - Apprentices attended lectures on design and properties of welding electrodes, welding sequences to avoid fracture, control of distrotion, weld failures and their prevention and automatic welding techniques
4 - 2 hour sessions. Oct 1982

ANNEX 7

Project Documentation

1. Survey of welding equipment in Malta Drydocks, suggestions for additions and future purchase policy. Modifications to power supplies in fabrication areas.

2. Report on inaccuracies in flame cutting and its effect on the quality control programme.

3. Quality control in Malta Drydocks. A statement of present drawbacks, suggested remedies and a "Code of Practice" for structural steelwork fit up, weld inspection and pipework inspection - with record sheets.

4. Form for the subjective assessment of all burner/welders in Malta Drydocks.

5. Welding of Uranus 50 pipework - Sixteen steps in the production of high quality welds in special stainless steel tubing.

6. Relative advantages of Acetylene and Propane as fuels for oxy-cutting. Specimen calculations to demonstrate how cutting fuel costs are affected by the price of oxygen.

7. Recommended Welding Equipment seen at the Essen Fair. Details of nine pieces of equipment recommended for use in Malta Drydocks (Supplement to welding equipment survey).

8. Malta Shipbuilding Co. Ltd. Welding and gas cutting equipment. A preliminary survey of the present welding and gas cutting equipment schedule, with suggestions for changes in the light of current cost comparisons.

9. Printed lecture notes for supervisors on the following subjects:

ANNEX 7

9. (Contd.)

(a)	Weld failures (Part 1)	Hot and Cold Cracking
(b)	Weld failures (Part 2)	Fatigue failure
(c)	Weld failures (Part 3)	Brittle fracture
(d)	Weld failures (Part 4)	Lammelar tearing
(e)	Automatic Welding	- the effect of various parameters
(f)	Oxygen cutting	- the causes and prevention of defects

10. New simplified record sheets for ASME & AWS qualification tests - Welding procedure specification, Welding procedure qualification test and Welder performance qualification test.

11. S.A.L.S. Anchor Base. A memo to Malta Drydocks management regarding discussions with a customer before quotation.

12. Low hydrogen electrodes and distortion. A report on the factors effecting distortion in fabrication.

13. Licence to use "Helifusion" process in Malta Drydocks. A memo to M.D.D. management on the pros and cons of taking up a licencing agreement for specialised repair by welding.

14. Electrodes for gravity welding. A survey of the performance of several available types with recommendations.

15. Tests on "Segard" electro-gas vertical welding machine. A report on tests carried out using a borrowed equipment.

16. Survey of Gas Cutting Machine quotations. A final assessment of 3 quotations.

ANNEX "F"

continued

17. Hard facing exhaust valves with Stellite using the T.I.G. process. A welding procedure with notes on reasons for earlier failures.

18. Preheating of oil rig leg joint. Technical report on the calculations for electrical preheating elements.

19. Conversion of Lincoln Tractor to spring loaded steering mechanism. A sketch showing proposed modifications.

20. Perma Electrodes. Memo to Deputy Gen. Manager regarding possible agency for special electrodes.

21. Lecture notes for apprentices on the following subjects:

(a) Welding electrodes
(b) Electrodes for semi-automatic and automatic welding
(c) Properties of weld metal
(d) Welding sequence

22. Modifications to auto fume extractor adapting it to power extraction. Sketch of modifications.

23. Simple Burning Aid. Sketch of magnetically attached burning guide.

24. Fume extraction for welders & burners. Recommendations for fume extraction equipment and sketch of 8 welder extractor using economical axial flow fans.

ANNEX 8

Malta Drydocks Expenditure on Training and Equipment for Project DP/MAT/79/001

TRAINING

No of Trainees	Wages & overhead	Radio-graphy	Material	Test Specimens	Totals
1981					
87 Welders	£M5,200	£M696	£M783	-	£M6,699
122 Welders	12,200	1,464	1,830	£M6905	22,399
2 Instructors	640	128	100	-	868
64 Supervisors	1,920	-	-	-	1,920
			1981 sub total		£M31,886
1982					
3 Welders	£M900	-	£M180	£M300	£M1,380
6 Diver Welders	600	-	120	100	820
6 Welders for test	120	-	24	72	216
2 Stellite Welders	80	-	16	20	116
6 Pipeworkers ("Uranus 50")	600	100	200	100	1,000
20 Govt Instructors (1 day seminar)	400	-	-	-	400
24 Burners	480	-	150	-	630
18 Apprentices	153	-	-	-	153
			1982 sub total		£M4,715
			Total		£M36,601

$ 91,525
at 2.5 $ per £M

ANNEX 8

Continued

Expenditure on equipment recommended for project

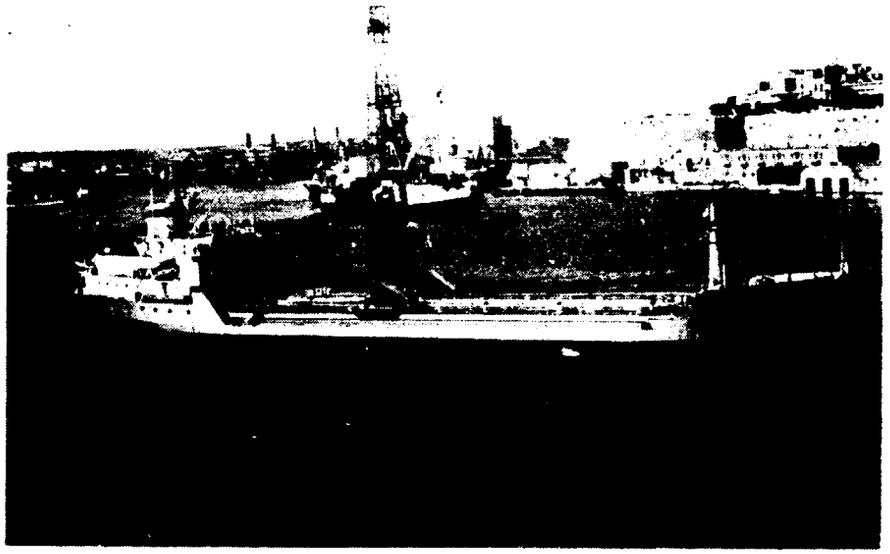
2 Heated quivers	£M 55
3 Electrode drying ovens	1,401
2 "Circut" burning machine)	1,067
1 "Handy Auto" burning machine)	
2 Sub arc tractors	3,000
1 Ventilating fan (8 men)	500
1 Ventilating fan (5 men)	2,550
2 "Hilarc" pulsed arc T.I.G. sets	2,170
1 Flux drying oven	548
48 - 650 Amp ESAB air cooled welding sets	18,576
	£M28,867
	$ 72,167
	at 2.5 $ per £M

Total Drydocks input training plus equipment = $ 163,692

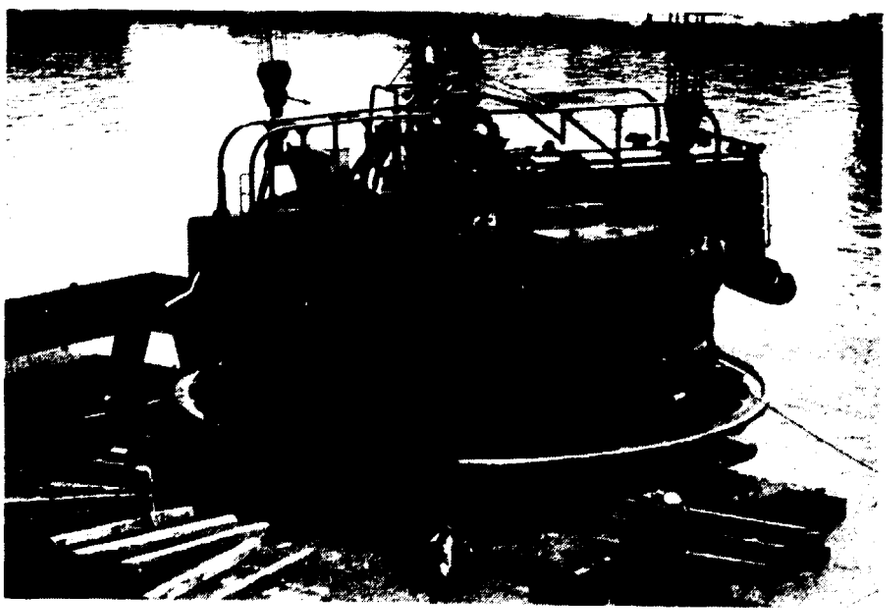
ANNEX 9

General view of Malta Drydocks showing Nos. 4, 5 & 6 docks also the partially completed No. 7 dock.

ANNEX 9 (Continued)

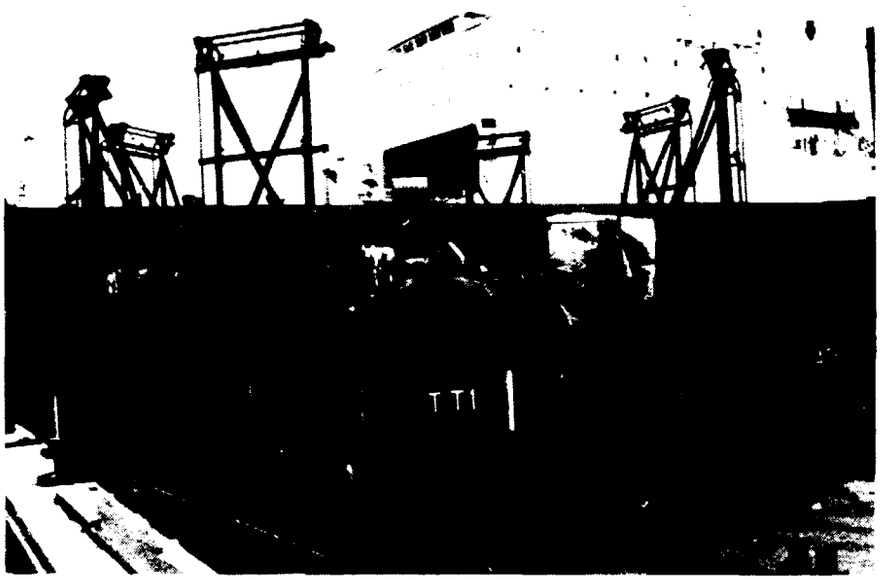


6,000 Ton Tanker built for China

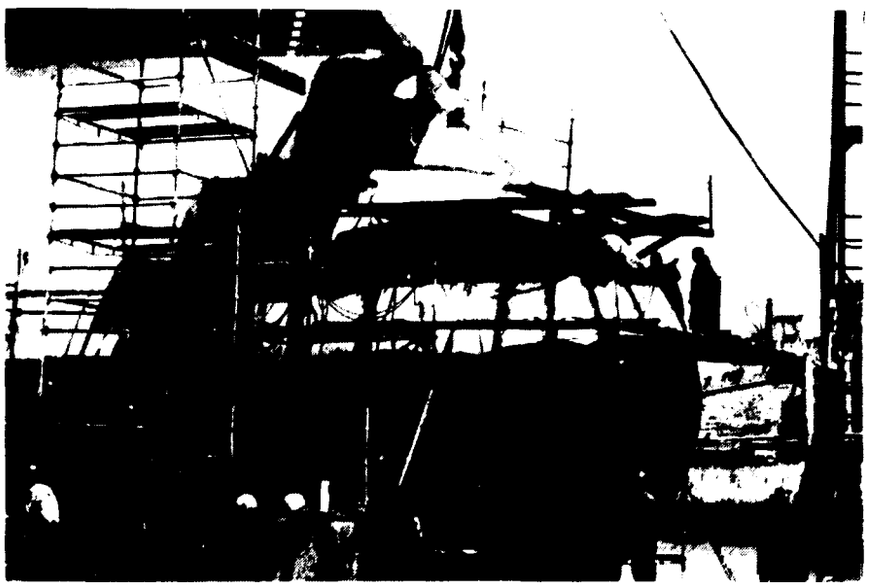


Single point mooring buoy

ANNEX 9 (CONTINUED)



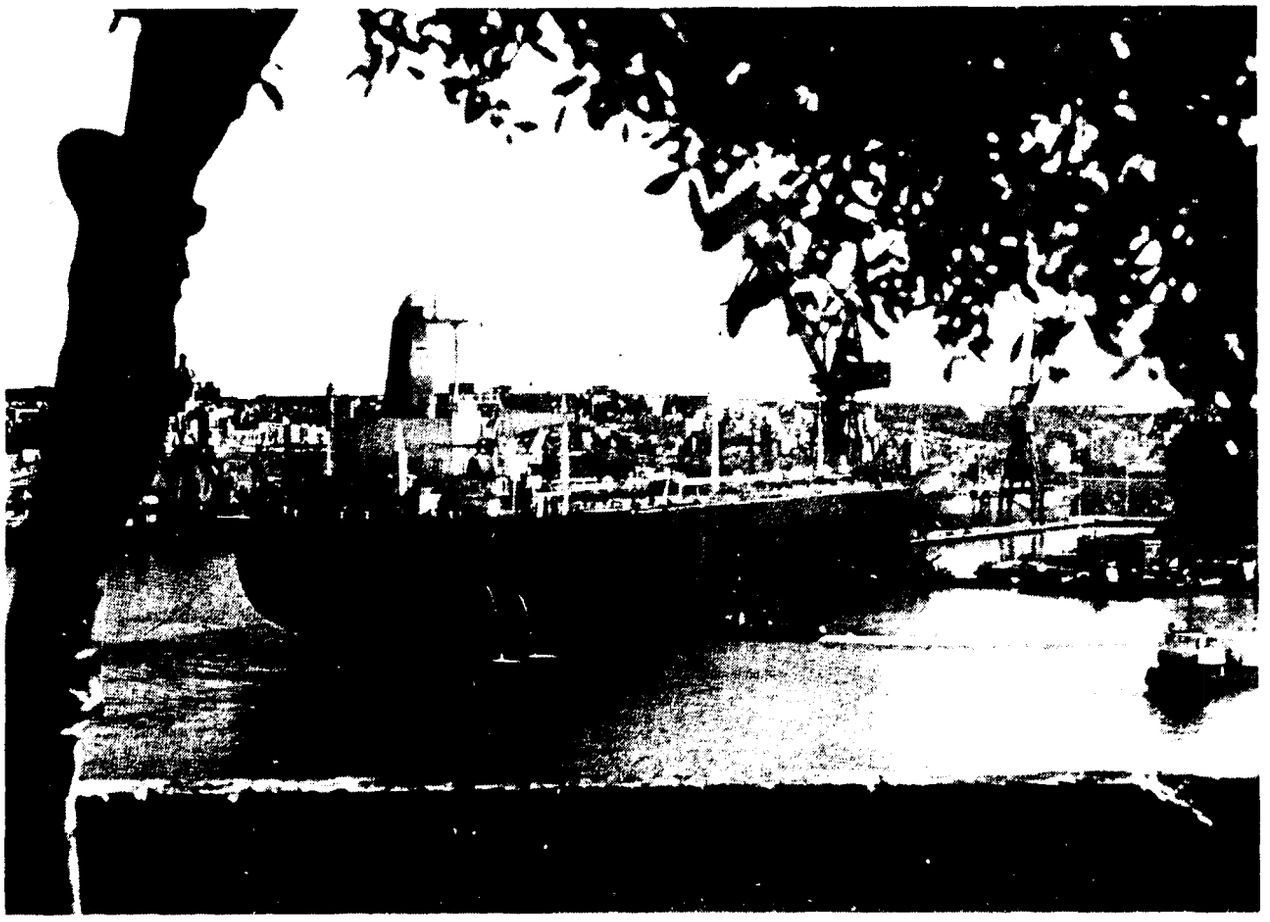
High Tensile Steel Base for Tazerka S.A.L.S.



Typical Ship repair - New Bulbous bow being fitted on damaged tanker

MALTA DRYDOCKS

REVIEW OF ACTIVITIES



NEW 300,000 DWT CAPACITY DRY DOCK

The highlight of 1981 was undoubtedly the official opening by the Hon. the Prime Minister Mr Dom Mintoff and H.E. Mr Zhang Wenjin, Vice Minister of Foreign Affairs of the People's Republic of China of the China-Malta Friendship Dock (No. 6) on October 9.

The commissioning of the new dock, which has a capacity of 300,000 dead weight tons, not only placed Malta Drydocks in the ranks of VLCC-ULCC capacity dock operators but also gave the shipyard a far greater flexibility in dock usage than ever before.

A new wharf, 450 metres in length and serviced by one 150 ton crane and one 30-ton crane, has also increased the yard's wet berthage capability. The wharf has a water depth of 10.5 metres and is equipped with 50 ton mooring bollards and two 200 ton storm bollards.

The following are the details of the new dock:

LENGTH:
360.0M

INSIDE BEAM:
62.0M

DEPTH
10.72M
9.25M (from top of keel blocks at dock entrance)

(Cont. on page 8)

UGANDA IN HAND FOR NINTH CONSECUTIVE YEAR

The first major job of the year undertaken by Malta Drydocks was the annual repair of the twin-screw, 16,907 gross tons British passenger ship UGANDA, owned by the Peninsular & Oriental Steam Navigation Company, of London. This was the ninth consecutive time that UGANDA had entered the yard before commencing her cruising programme.

The work carried out was varied and extensive, ranging from grounding damage repairs involving the renewal of 34 tons of steel to the ranging of the chain cable for survey and the installation of new dish-washing equipment.

A special survey on seven lifeboats, including davits and winches, was carried out while 22 liferafts were surveyed. Forty freshwater tanks were cleaned and coated with cement and 50 cabins were completely re-decorated.

The starboard tailshaft was withdrawn for survey and re-wooding. As the rudder stock was found to be twisted, the complete rudder was removed, aligned and checked.

The stock was then stress relieved and new sleeves fitted. A new key way was cut and the tiller shrunk back on stock. The port H.P. and L.P. turbines were opened for survey while both port and starboard condensers were opened for survey and cleaning.

The port, centre and starboard boilers were opened for annual inspection and cleaning. Work carried out included a survey on the starboard boiler, modifications to boiler fuel oil burning equipment, repairs to the brickwork of the three boilers and the renewal of 900 air heater tubes. Various pumps, valves, pipework and ancillary equipment were opened for repairs.

Extensive electrical work carried out included the opening for overhaul of two DC generators and two alternators, the cleaning of both DC and AC switchboards; the servicing of six lifts; the overhaul of various motors, and the megger testing of all electrical equipment. The work also included the installation of new navigational lights.

THE S.T. ROBERT MAERSK – THE LARGEST VESSEL TO ENTER MALTA DRYDOCKS DURING THE YEAR

The 289,166 dwt Danish steam tanker ROBERT MAERSK (A.P. Moller, Copenhagen) was the largest tanker to enter the yard in 1981.

On arrival, the vessel was berthed at the Ricasoli tank cleaning installation to discharge slops after tank washing. The vessel then entered No. 6 Dock for sea valve inspection and cleaning, vulcanizing of inner and outer Simplex seals in situ and inserts in bottom plating. The hull was hp washed and scraped and painted from keel to deckrail.

Other work carried out included extensive cleaning of sludge and other sediment in all the cargo oil tanks and slop tanks as well as repairs to bottom plating.

Some 70 cargo and ballast butterfly valves from the cargo oil tanks and pumproom, ranging in diameter from 4" to 32", were removed to the shop for overhaul and machining of valve bodies to suit new inserts. The valves were then re-installed and tested.

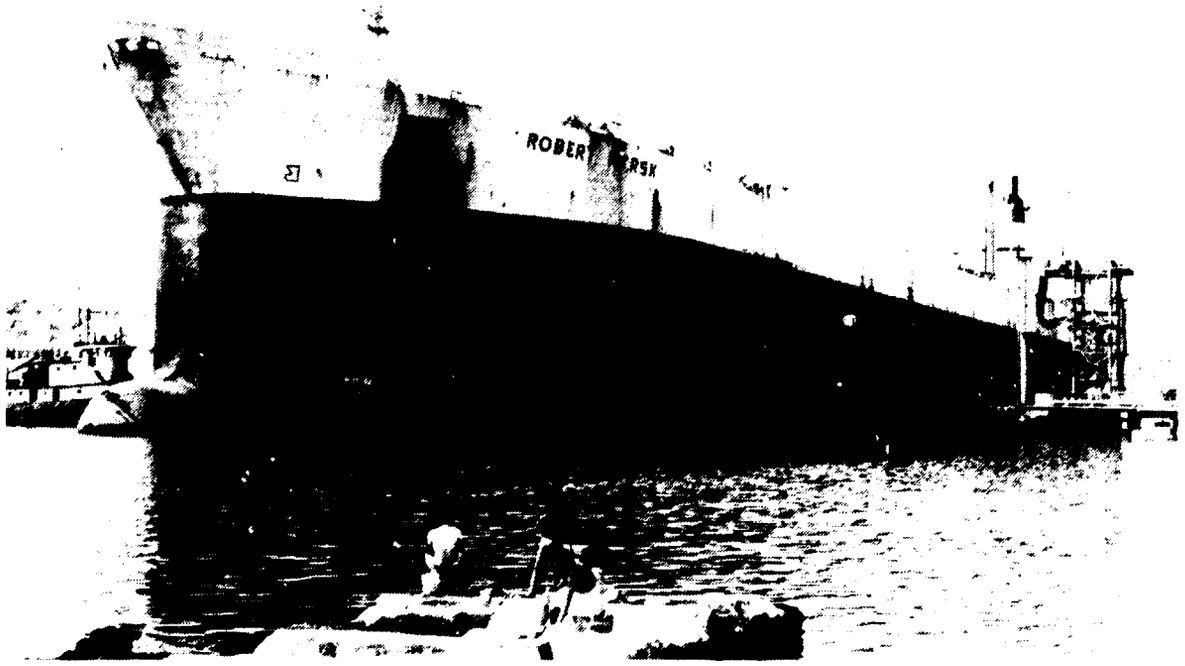
Picture below shows the ROBERT MAERSK at the Ricasoli Tank Cleaning Installation.

Malta's tank cleaning installation accepts cleaning for drydocking, repairs and survey and for the ugrading of tankers.

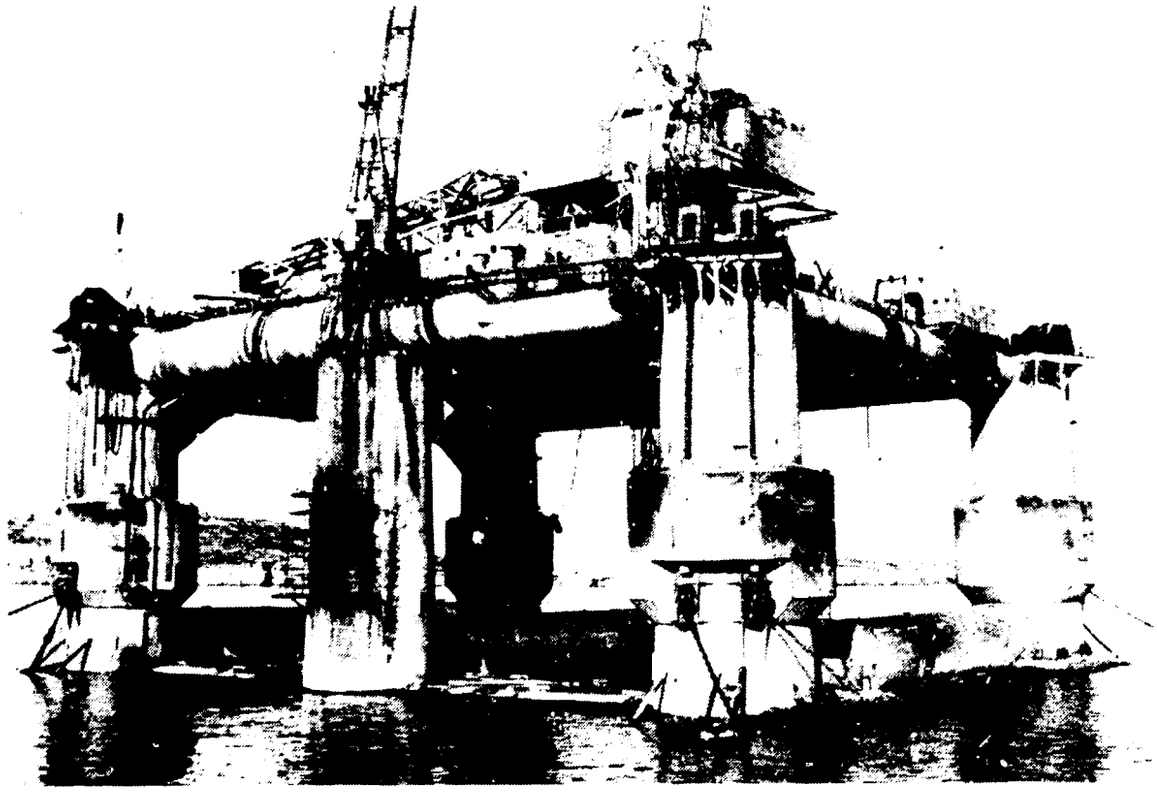
Vessels are assured of immediate attention on arrival from a trained crew of tank-cleaning personnel. Work is continuous 24 hours per day from the time of arrival of the vessel together with a 24 hour security watch.

The installation was designed to be perfectly safe and is to the standards laid down by the Institute of Petroleum Safety Codes for Installation Storing Class A Petroleum.

Strict safety regulations are applicable to the whole plant and the tank-cleaning crew have been thoroughly trained in these matters.



OFFSHORE OIL INDUSTRY



Malta Drydocks has been regularly handling oil rigs and other vessels connected with the offshore oil industry. Among the rigs handled were the WODECO V, which called for grit blasting of hull and tanks, shell plating renewals, stiffening and renewal of deck crane and repairs to the galley.

Repairs were also carried put by a yard travelling repair party on the rig PENROD 70. Nine time plates were renewed as well as 24 internals of the P & S centre columns.

SINGLE POINT MOORING BUOYS

The construction of Single Point Mooring buoys has become a very important facet of the Newbuilding Division of Malta Drydocks.

During 1981, no fewer than seven examples were produced and shipped out. Of these, four were 12m in diameter of a total weight of approximately 290 tons involving very close tolerance and sophisticated machinery in way of product piping.

Of the other three buoys, two were 12.5m in diameter weighing approximately 265 tons and one, with a diameter of 8m, weighed approximately 90 tons.

To date, two customers have been placing orders for single point mooring buoys with Malta Drydocks – Single Buoy Moorings Inc. of Monaco and IMODCO, of Los Angeles, California.

T./S.V. INDEPENDENCE SERVICE

Zapata Marine Service, Inc. tug/supply vessels were frequently to be seen undergoing repairs at Malta Drydocks during the year.

Amongst these was the INDEPENDENCE SERVICE for which a special survey of the port and starboard main engines was carried out.

Other work included the changing of the starboard generator and the overhaul at the shop of the port and starboard alternators.

The auxiliary machinery and ballast and fuel tanks were surveyed and repaired as necessary.

Two other Zapata tug/supply vessels entered the yard for repairs during the year. They were the PIONEER SERVICE and the STATESMAN SERVICE.

CUNARDERS AT MALTA

The Cunard motor tanker LUCERNA (25,883 dwt) underwent extensive steel renewals and damage repairs during her stay in the yard. Areas affected included bottom in way of forepeak, oil fuel tanks, pump room, cofferdam and No. 1 centre cargo oil tank, shipside plates port and starboard, bulkheads between No. 5 and 6 and No. 6 and 7 centre cargo oil tanks.

All welded butts and seems of the new plates were gritbalsted internally and externally and coated.

The tailshaft and stern tube were surveyed. Main engine parts, including pistons, main bearings, crosshead bearings and crank pin bearings were opened up for survey. Surveying and repairs on auxiliary machinery, including pumps, heaters, coolers, boilers and valves were carried out. Various pipe sections were also renewed.

Extensive renewals were made of hydraulic lines operating cargo valve actuators in pump room and on main deck.

Electrical equipment was surveyed and repaired as required.

Another Cunard tanker – the LUMINETTA – as well as the cargo vessel MATANGI also repaired at Malta during the period under review.

M.B.C. VENTURE ITALIA

Amongst the most interesting jobs undertaken during the year was the installation of a COW system on the Liberian motor bulk/oil carrier VENTURE ITALIA (World Wide Transport, Inc., Monrovia). The system included 18 retractable washing machines, 10 bottom washing machines and all piping systems. The jobs necessitated alterations to hatch covers to permit the storage of the washing machines.

Other work included steel renewals in the summer tanks and extensive pipework in the engine and pump rooms.

The main engine and auxiliary engines, including alternators, were overhauled and surveyed. Heating coil testing and repairs were also carried out while the main and auxiliary boilers were surveyed. Cargo and ballast valves were overhauled and tested, auxiliary pipes surveyed and cargo and stripping pipes overhauled.

'Watercraft' lifeboats and davits were installed and an emergency steering gear unit was fitted. All insulation and heating on main engine exhaust trunk was renewed.

SINGLE ANCHOR LEG STORAGE (SALS) MOORING SYSTEM

Malta Drydocks, under contract for Single Buoy Moorings of Monaco have just completed the construction of a gravity base for a Single Anchor Leg Storage (SALS) System.

This will be used to moor a tanker based floating production system over the Tazerka Field, Offshore Tunisia, where SHELL TUNIREX is the operator for a joint venture with AGIP and ENTERPRISE TUNISIENNE D'ACTIVITES PETROLIERES.

The base, an octagonal structure incorporating a central universal joint, involved the use of some 400 tons of high tensile steel.

Eight buoyancy tanks, each 3.8M in diameter by 6.5M in height and weighing 20 tons, were also constructed. These tanks were built to withstand very high deep water pressures.

Other work carried out on this project included the hydraulic system for remote controlled valves, the product piping system and the ballast piping system for installation purposes.

Quality requirements were extremely stringent, calling for the use of classified and approved welders and welding procedures.

TEXACO LONDON IN NO. 6 DOCK

One of the largest tankers handled by the Yard during the year was the 272.739 dwt. British vessel TEXACO LONDON (Texaco Overseas Tankship. Ltd. London).

Work carried out included the fitting of some 2.000 anodes in cargo oil tanks. steel repairs and fitting of chocks on side longitudinals in cargo tanks and the fitting of single point mooring cable stoppers. A survey on the tail shaft was also carried out.

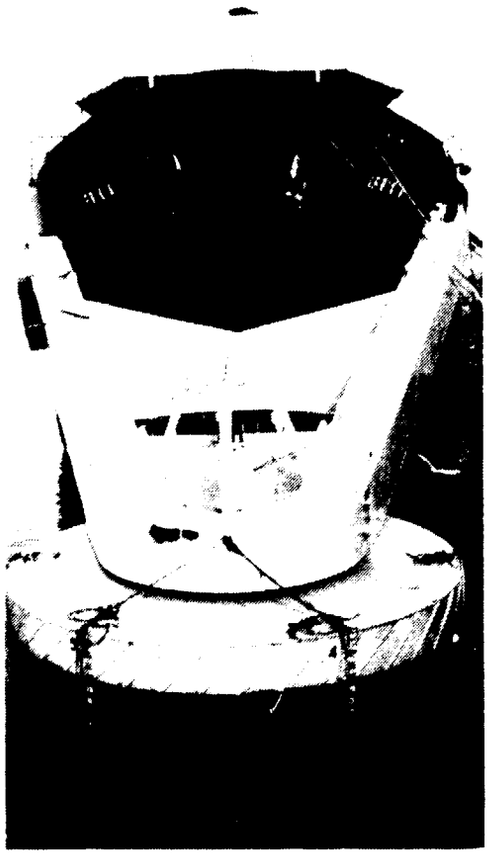
The turbine generator drives, cargo and ballast pump turbines and H.P. turbine were opened up for survey. An emergency fire pump sea chest was fitted in the pump room.

The main boiler steam valves. evaporators and auxiliary machinery were extensively overhauled. Cargo lines in cargo oil tanks were renewed while cargo valves were repaired and overhauled. Four Grove surge relief valves were installed on cargo lines in the pump room.

A survey. upgrade repairs and overhaul were carried out on the inert gas system. A new oily water separator. a Ballart oil monitor. a Texion II sea water treatment system and a MARISAT ship terminal were also installed.

An area of approximately 4500m² was grit blasted and the vessel was painted from deckrail to keel.

S.V. IFRIKIA



Hull damage repairs involving some 130 tons of steel were carried out on the storage vessel IFRIKIA. In addition, extensive steel renewals and stiffening were undertaken on all cargo tank bulkheads for 5th special survey. All tanks were tested and approximately 400 tons of sludge were removed from the tank bottom.

All motors, including starters, were removed to shop, overhauled and re-assembled in place. In addition, all pumps and cargo and stripping pipes were overhauled for survey.

M.V. BAGHDAD

A regular visitor to the Yard, the Iraqi motor vessel BAGHDAD called again during the year under review. She is owned by the Iraqi Maritime Transport Co., Ltd.

Work carried out on this vessel included the general overhaul of the main engine and repairs to the main crankcase.

Twelve cranes were overhauled and tested, together with the ship's 60-ton derrick for Lloyd's design approval. All electrical motors and generators, including governors, were overhauled.

Other vessels owned by the Iraqi Maritime Transport Co. Ltd., which entered the Yard last year were the M.V. BASRAH and the M.V. KHALDOON.

Two Iraqi tankers – the AIN ZALAH and ABU HALIFAH – owned by the Iraqi Oil Tanker Enterprise of Basrah, also carried out repairs at Malta Drydocks during 1981.

M.T. MOSTOLES

The 102,956 Spanish tanker MOSTOLES called for damage repairs to its bulbous bow which called for the renewal of 120 tons of steel. The unit was prefabricated in the shop and fitted in situ. The work also included forepeak internal renewals and the fitting of zinc protection at various places.

Other work included the complete overhaul of a diesel generator and the general overhaul of various pumps, including cargo pumps.

Two main engine units were opened for survey and various electrical motors were taken to shop for overhaul. Two coats of paint were applied to the underwater area.

M.B.C. AMSTELBRINK

Work carried out on the 27,312 Dutch bulk carrier AMSTELBRINK (Nedlloyd Bulk B.V. Rotterdam) included major steelrepairs in the aft peak and steel renewals in the fresh water tank and in the double bottom tanks.

Pipe repairs were carried out in the double bottoms and top tanks while the double bottom tanks were also cleaned.

Repair work was undertaken on the main engine and turbocharger while various pumps in the engine room were also overhauled.

(Cont. from page 1)

CRANES:
1 x 150 tons – All cranes lifting
2 x 30 tons – capacity from a radius of 1 metre beyond centre line.
ELECTRICAL SUPPLIES:
3.3 KV 50 Hz
110V 50 Hz
380/440V 50-60 Hz
110/220V DC
SERVICES:
Compressed Air – 120 m^3/min at 8kg./cm^2
Steam – 7.5 Kg/cm^2
Fresh/Salt Water
Piped Oxygen/Propane System
Salt water ballasting at 100m^3/per hour
All welding facilities.

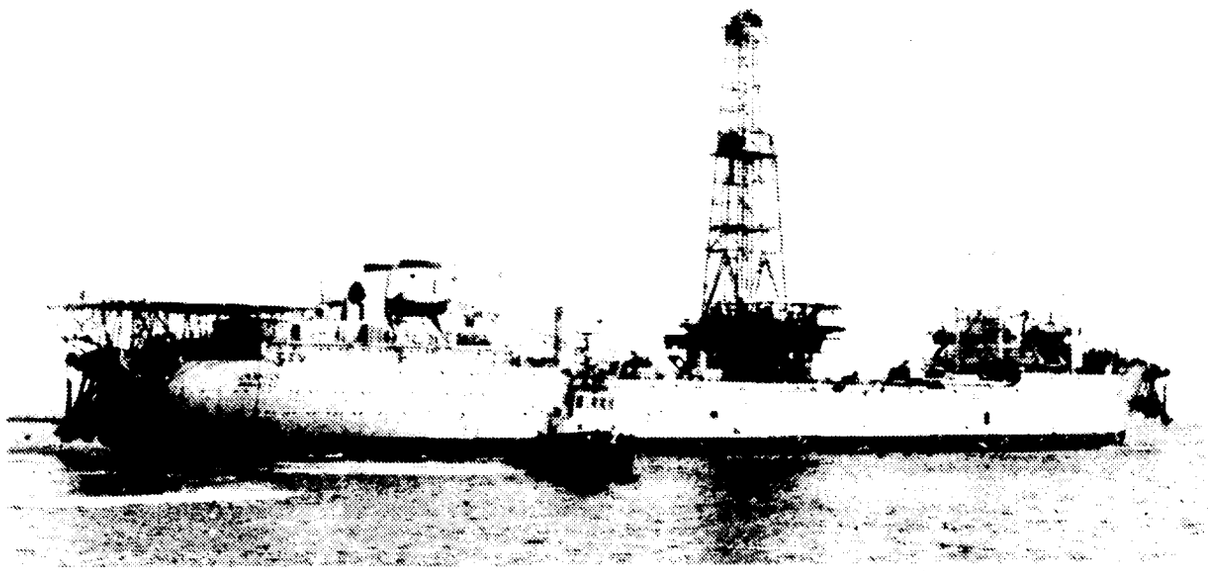
DOCK PUMPING:
ARRANGEMENTS:
Three axial flow pumps each having a capacity of 17,460m^3/hr.
Two centrifugal pumps for drainage of dock.
The emptying of the dock from full to empty – 3 hours 30 minutes (approx).
DOCK GATE:
Flap Gate type (length 64.5M) single skin pneumatically operated and can be closed/opened in 7 minutes.
CAPSTANS/WINCHES:
Two 20-ton 3 speed capstans at the entrance to assist docking of vessel.
Two lead-in trolleys with 20-ton pull running along the dock coping at speeds of 5/10/20 metres per minute assisted by two 20-ton double drums frictional winches for pulling vessels in dock.

Pictured below is the 270,702 deadweight tons steam tanker COALINGA (West Coast Shipping Company, Los Angeles) entering No. 6 Dock on the day of its official inauguration.

MALTA DRYDOCKS

REVIEW OF ACTIVITIES

1982



The drilling vessel J.W. Bates leaving the yard after completion of repairs.

MALTA DRYDOCKS AWARDED MAJOR CONTRACT IN FACE OF STIFF INTERNATIONAL COMPETITION DRILLING VESSEL J.E. BATES

Malta Drydocks has just completed one of the most extensive repair jobs entrusted to the Yard since it began commercial operations in 1959.

The contract, won in the face of stiff international competition, involved the 18,360 gross tons drilling vessel J.W. BATES, owned by the Reading and Bates Corporation of Houston, Texas. The vessel was built by Burmeister and Wain, Copenhagen, in 1948.

In addition to the normal work carried out, during normal drydocking and repairs, the following modifications were also taken in hand:-

Accommodation

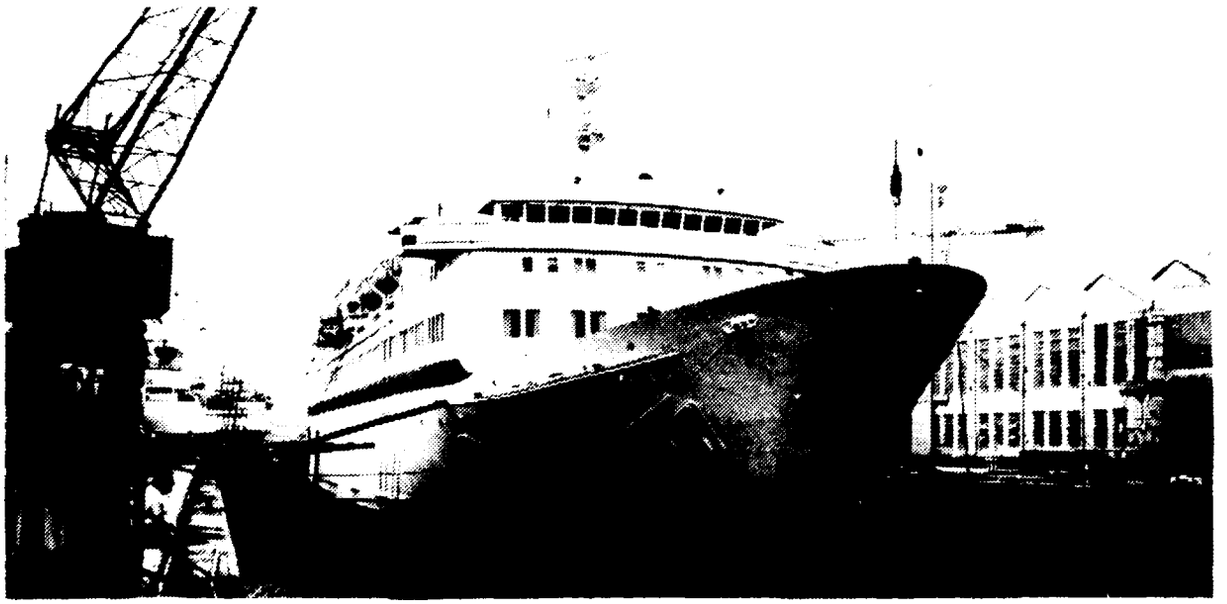
The accommodation area of this vessel is situated forward and consists of six decks and housing 126 persons.

Renovation work involved the removal of all previous partitioning, insulation, cables, pipework, furniture and flooring. The area was completely rebuilt to modern standards. The galley was completely stripped down and area enlarged to accommodate new electric equipment to the level of that of a modern hotel.

All piping systems were renewed and air conditioning trunking was partly renewed and re-routed to suit the new quarters. All ventilation trunking had to be insulated.

Two air handling and air conditioning units were installed in a soundproofed compartment.

(Cont. on page 6)



POSIDONIA 82

Malta Drydocks was one of the hundreds of companies from 46 different countries which participated at this year's edition of POSIDONIA, the bi-annual international shipping exhibition staged at Piraeus, Greece.

This year nationally organized stands were much in evidence and Brazil, Denmark, West Germany, Finland, France, East Germany, Italy, Japan, the Netherlands, Norway, Sweden and the United Kingdom featured their contributions to the world of shipping.

Every sector of the marine industry was represented and exhibitors ranged from shipbuilders, shiprepairers and engine manufacturers to banks, finance corporations and shipbrokers.

The Malta Drydocks stand was in a very prominent part of the exhibition and its colourful design elicited favourable comment. The yard personnel manning the stand were kept busy dealing with questions relating to the services offered by Malta Drydocks, its facilities and activities.

Very satisfying was the appreciable number of engineering superintendents who at one time or another supervized repairs at Malta who made it a point to visit the stand.

The importance attached to POSIDONIA may be gauged from the fact that the exhibition is sponsored by the Greek Ministry of Mercantile Marine; the Union of Greek Shipowners; the Greek Chamber of Shipping; the Association of Shipowners of Greek Passenger Ships and the London-based Greek Shipping Co-operation Committee. In addition various individual companies give their support.

It is to be noted that Greek owned or managed vessels form an important part of the shiprepair work load handled by Malta Drydocks.

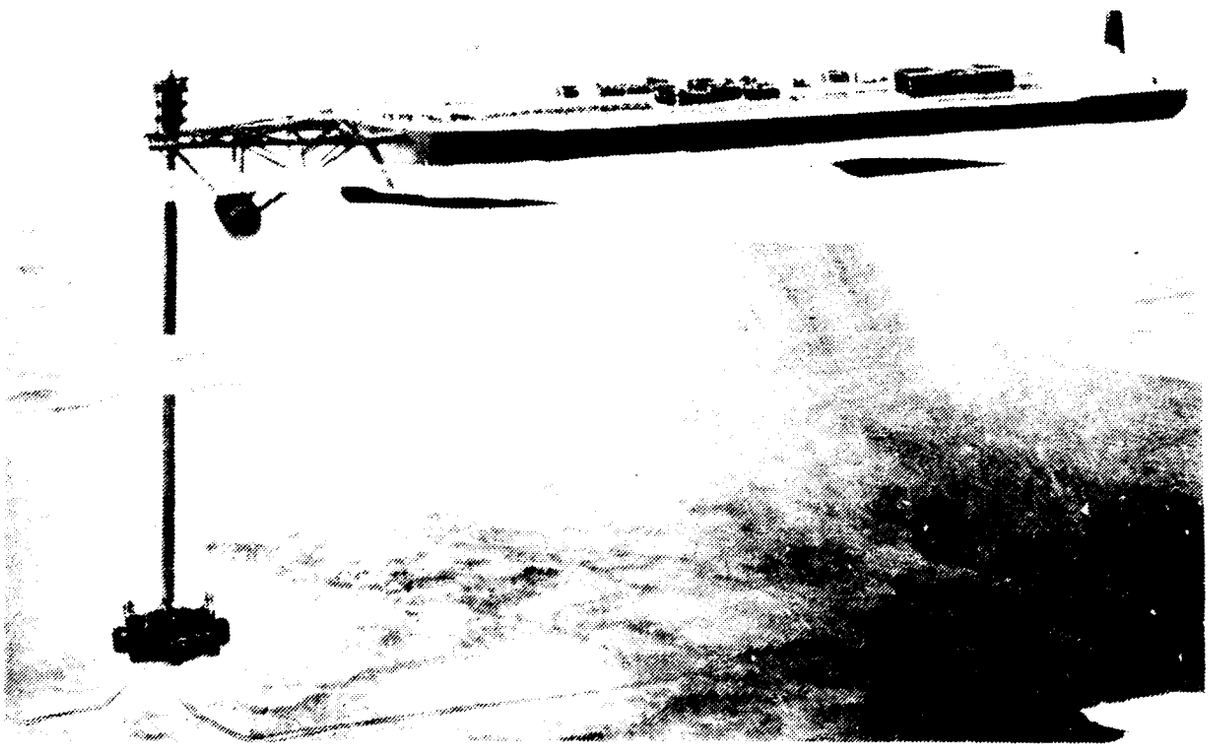
M. RO/RO GARNATA

The Libyan twin screw motor RO/RO GARNATA (above) entered the Yard for drydocking and repairs, which included tailshaft surveys, the opening up of sea valves, the polishing of the propellers and survey of the bow thrusters.

The outer bottom and part of the boot-top were grit-blasted to SA 2½ and four full coats of paint were subsequently applied.

The exhaust gas boiler coils were tested and repaired as required while the mountings of the auxiliary boiler were surveyed. Various pipework was carried out and the SW pipe system was opened up and cleaned.

Electrical work carried out included the rewinding of the CW pump motor, the overhaul in the shop of two motors, the cleaning of five alternators and the servicing of the Sal Log.



Artist's impression of the Tazerka Field Development.

MALTA DRYDOCKS' PART IN DEVELOPMENT OF NEW OILFIELD

Malta Drydocks has played an important part in the construction of equipment of the Tazerka oilfield situated 42 kilometres off the coast of Tunisia.

The field is being developed by Shell Tunirex as operator for a joint venture with AGIP of Italy and the Enterprise Tunisienne d'Activites Petrolieres (ETAP).

Production, due to start towards the end of 1982, will be through a new system which has the specially converted 212,421 dwt tanker Murex as the floating production and storage unit.

The tanker, which is being fitted in France with a yoke on her bow, will be held on station by a single anchor leg system (SALS) the gravity base of which was built by Malta Drydocks. The system incorporates a riser through which oil can be produced from the satellite seabed wells.

The riser has towed to Malta from France for connection to the base at Malta Drydocks. Owing to its length, the riser was connected in a horizontal position and was then tilted to the vertical in deep water off Malta.

The assembly was then towed to the field and ballasted down on the seabed in 140 metres of water.

The tanker will be connected by its yoke to the mooring system on top of which a manifold chamber will then be installed.

In this chamber will be the piping and swivels which will enable the produced oil to pass from the riser piping and through the yoke to the tanker.

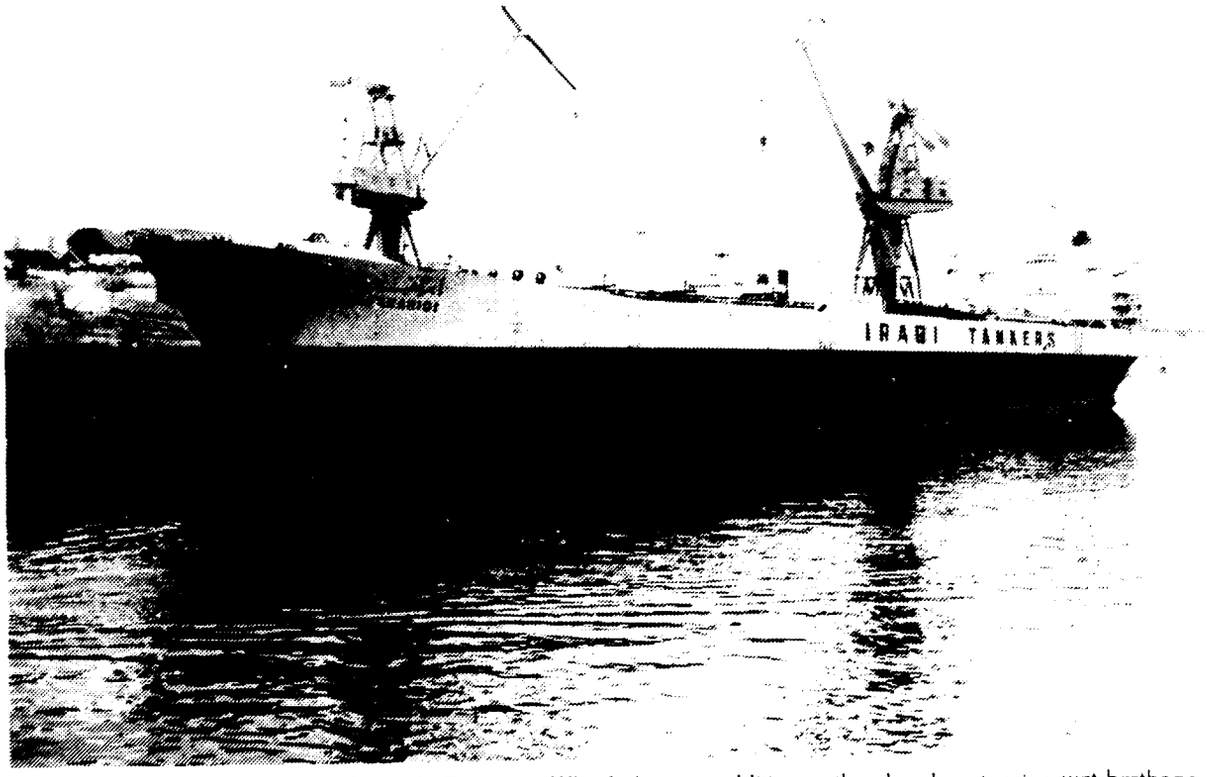
The Murex will be used both for the treatment and the storage of oil. It will have the capacity to store in excess of 80,000 ton parcels of oil.

The base built by Malta Drydocks is an octagonal structure incorporating a central universal joint.

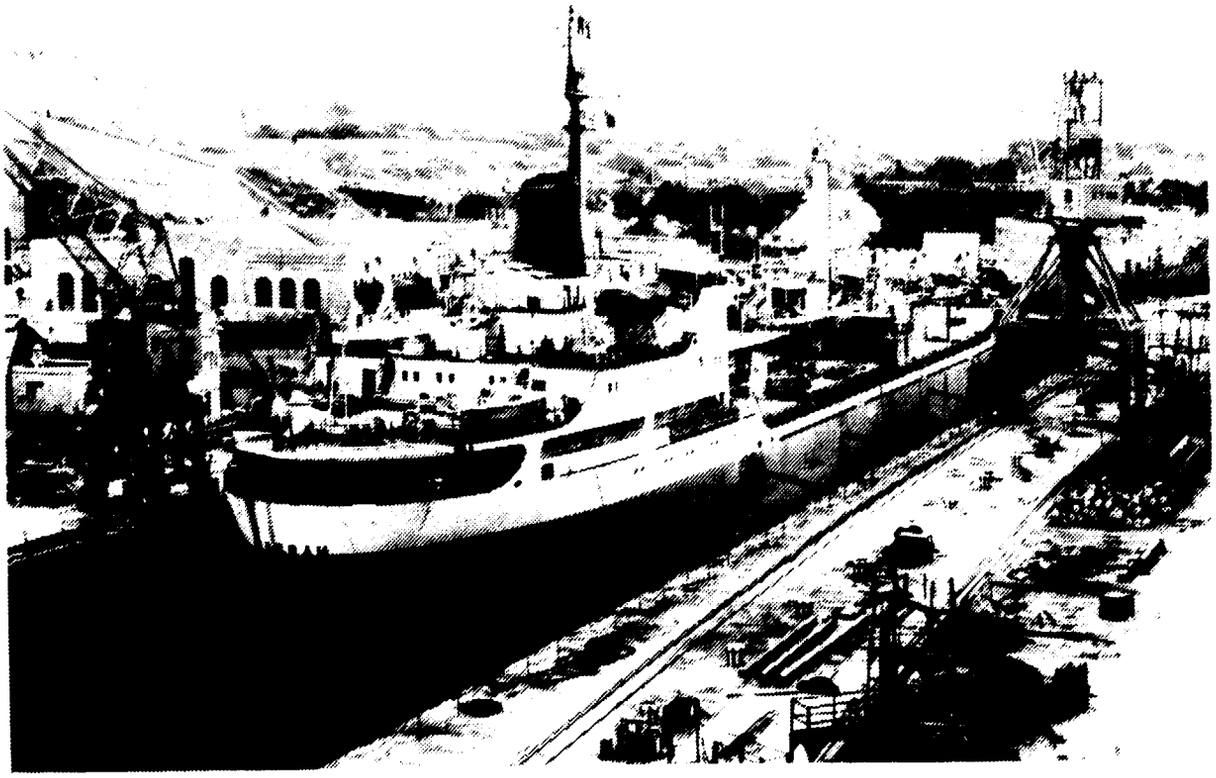
It involved the use of some 400 tons of high tensile steel. Eight buoyancy tanks, each 3.8M in diameter by 6.5M in height and wieghing 20 tons, were also contructed. These tanks were built to withstand 140 metres deep water pressures.

Other work fabricated for this project by Malta Drydocks included the hydraulic system for remote controlled wells, the product piping system and the ballast piping system for installation purposes.

Quality requirements were extremely stringent, calling for the use of classified and approved procedures.



The "ALFARAHIDI" (above) alongside Parlatorio Wharf, the new addition to the already extensive wet berthage facilities at Malta Drydocks. Below is the "BASRAH" in dry dock.



SIMULTANEOUS REPAIRS ON THREE IRAQI VESSELS

Three Iraqi vessels have carried out simultaneous repairs at Malta Drydocks. They were the 147,080 DWT motor tanker "ALFARAHIDI" and the 9,859 gross tons motor cargo vessels "SINBAD" and "BASRAH".

Work carried out on the "ALFARAHIDI" included the fabrication and installation of a COW system; extensive pipework in the engine room; a survey of auxiliary and exhaust gas boilers; the testing of heating coils and the installation of zinc anodes in the cargo tanks. In addition, the main engine and various auxiliary machinery were overhauled, including the survey of boilers. Deck machinery and pumphouse equipment were opened up for survey and repairs.

Electrical work carried out included the overhaul of the main switchboard; the FD fan motors, steering gear pump motors and radio equipment.

The "SINBAD" entered dock for rudder and shaft inspection; survey of all underwater fittings; cleaning and painting; the renewal of all 140 zinc anodes and the replacement of damaged shipside plating.

Besides the repair and replacement of cargo hold hydraulic control boxes, the renewal of hatch runner rollers was also undertaken.

The deck cranes were inspected and necessary repairs were undertaken prior to testing of cranes to new classification requirements.

The "BASRAH" entered the Yard for docking and annual repairs and the underwater inspection of rudder, tail-shaft and skin fitting was carried out and passed class inspection. The underwater hull was gritblasted and painted.

Quadrennial survey of cargo gear and 50-ton jumbo derrick were also carried out during the vessel's stay in the Yard.

The main engine was opened up for inspection and repairs. The engine was tested satisfactorily during basin trials prior to sailing.

(Cont. from page 1)

Dry Docking

In dry dock, the vessel's hull was completely grit blasted and painted with 'International' coating systems.

Both propellers and shafts were removed for survey and stern bearings were re-wooded. The rudder blade was also removed and the pintles re-bushed.

Anchors and Cables

The anchoring system of this vessel consists of eight chains and anchors. Each 3" chain is 3000 ft. long and takes a 15 ton anchor.

All eight chains were ranged ashore and high pressure washed. All shackles were disconnected and renewed by patent links. Two new chains were fitted forward.

Eight new anchors were assembled and re-stowed in position. The old anchors were stowed on deck.

Deck Machinery

Both forward and aft windlasses were completely overhauled. Old wild cats were gouged out by arc welding and new ones fitted.

Eight disc caliper brakes were removed and overhauled in the shop prior to re-installation. The old shafts for the wild cats and gearbox sprockets were removed.

Fixed Rowntree deck sheaves and Pusnes swivel arm fairleads for the 3" chains were removed. Broken fairleads were removed and new bushes fitted.

Derricks

All 10-ton derricks were overhauled for quadrennial survey and tested.

Helicopter Platform

The poop deck helicopter platform originally in wood was replaced by a new steel platform. The job involved the fabrication of some 50 tons of steel.

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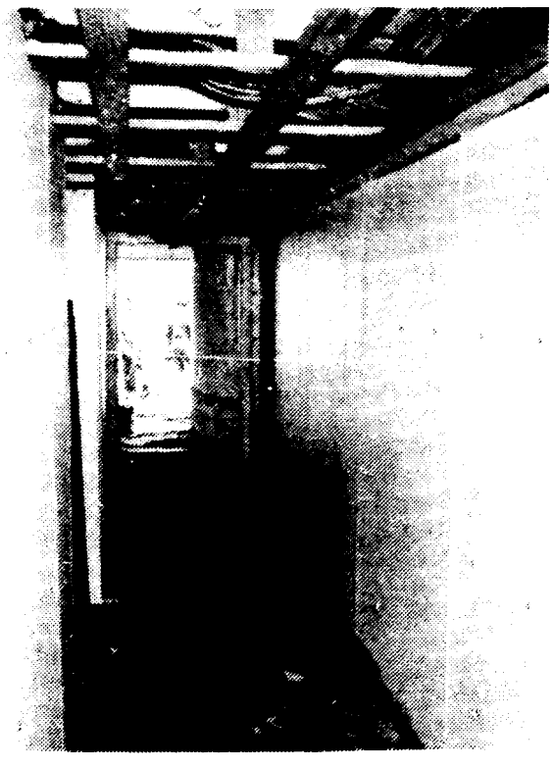
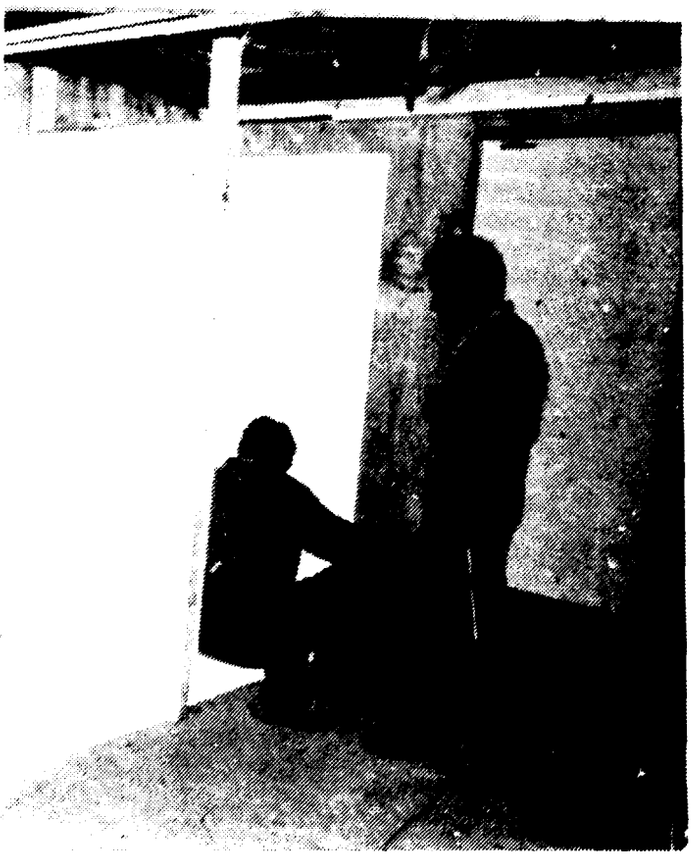
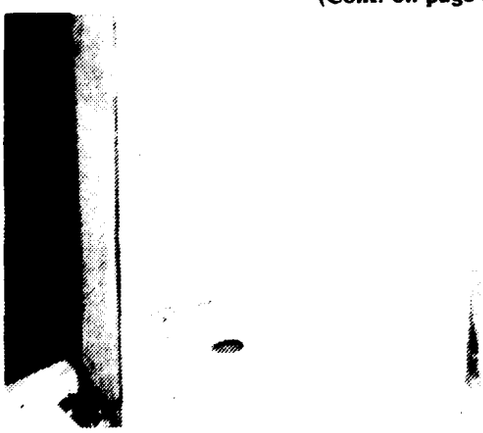


New alleyway in accommodation area under construction.

Showers under construction in new washplace.





CHANGE OF FLAG, NAME OR OWNERS

Various vessels enter the Yard bearing a particular name and flying a particular flag only to leave with a different name and flag as a result of a change of ownership.

The "GLOBE COMET", for instance, left as the "THOS ASGAARD" flying the West German flag instead of the Panamanian ensign she flew on arrival.

The "VIKING" changed flag, name and owners. She was bought by Fratelli D'Amico Armatori, who renamed the vessel "MARE NORDICO". Instead of the Liberian flag, she flew the Italian tricolour when she left Malta.

The "BRITTENBURG", too, changed name to "HELENA RESTHUS" and flag from Liberian to Norwegian when she was sold by Ph. Van Ommeren (MED) to Presthus Shipping A/S.

Two vessels, the Italian flag "KUDU" and " CHERNUK" were sold by Neirede SpA de Nav. to Fairmount Shipping (UK) Ltd and renamed "RIA SOL" and "RIA MAR" respectively. Both ships are now flying the Filipino flag.

The "KING LEONIDAS", Greek flag, was bought by Yeck Fung Shipping & Enterprises Co., Ltd., renamed "FENG CHENG" and now flies the Panamanian flag.

The British flag "ARDENHALL" is now sailing as the Panamanian flag "MOOLCHAND" after having been bought by the Cross Point Shipping Corporation from the West Hartlepool Shipping Corporation.

The former West German owned "NORDWOGE" is now the "DIAMOND SUN" flying the Greek ensign.

In most cases the funnel insignia is changed as part of the work carried out by Malta Drydocks.

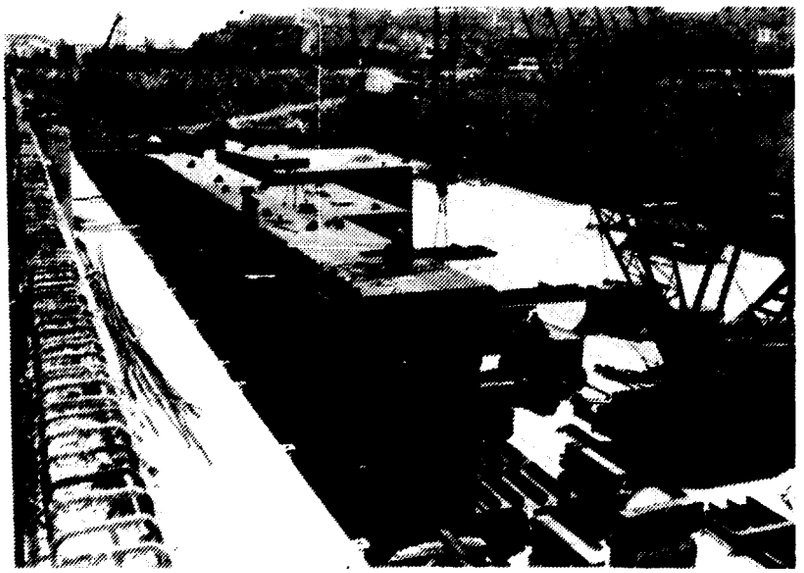
DOCK GATE FOR SHIPBUILDING YARD

Amongst the more interesting steelwork carried out by the Yard recently was the gate for the shipbuilding dock of the Malta Shipbuilding Company.

The gate, which is of the floating type, measures 48M in length x 5M in breadth and 9M in height. Its construction involved over 300 tons of steel.

The gate, which was built in 25/30 ton sections, was assembled on site, where successful tests have already been carried out.

The new shipbuilding yard, which is in the final phases of completion, has been designed to handle the construction of vessels up to 120,000 DWT.



Dock gate for Malta Shipbuilding Company being manufactured by Malta Drydocks

(Cont. from page 6)

Lifeboats

Existing lifeboats complete with davits were removed and after necessary deck stiffening, four new 58 passenger boats complete with Watercraft davit sets (Miranda type) and Titan gear were installed, together with new boarding platforms, power supply and controls.

Blow off Prevention (BOP) System

The moon pool was modified to take a new BOP system. This invilved extensive steel fabrication for trollies, winch stools, hosereels and additional monorail beams.

A new accumulator system for BOP control was installed complete with power supply, pipework and hydraulic bottle rack, together with driller console.

Chloropack System

A new Chloropack system as an anti-fouling device in the marine salt water system was fitted involving an amount of fibreglass piping connecting engine room and main pump room sea chests.

Steam Driven Equipment

Originally, the vessel was equipped with a Scotch type boiler to run auxiliary machinery.

This boiler was eliminated and all pumps were changed to electric driven units. New stools were constructed for these pumps and power supply fitted.

Air Compressors

In lieu of the existing air compressors which were removed, three new 75hp, 300 CFM Ingersoll Rand compressors were fitted, complete with dryer unit.

Fresh Water Generator

A new reverse osmosis type fresh water generator was installed to supplement the 'Atlas' F/Water generator.

Steelwork in Ballast Tanks

All ballast tanks steelwork was ultrasonically tested and 304 tons of scattered steel renewed. This required the cleaning of tanks of preser- 'servative coatings in preparation for hot work.

Electrical Work

DC power was originally supplied by three diesel driven generators. These were eliminated and three rectifiers (800 amps each) were installed and fed from two new generators.

The first, a "Cat. D398" radiator cooled emergency generator was fitted on deck. A new compartment was built to house this unit.

This required extra deck stiffening and new foundations. Pipework was fitted to service this generator.

The second, a "D399 Caterpillar" generator, was installed on the second deck.

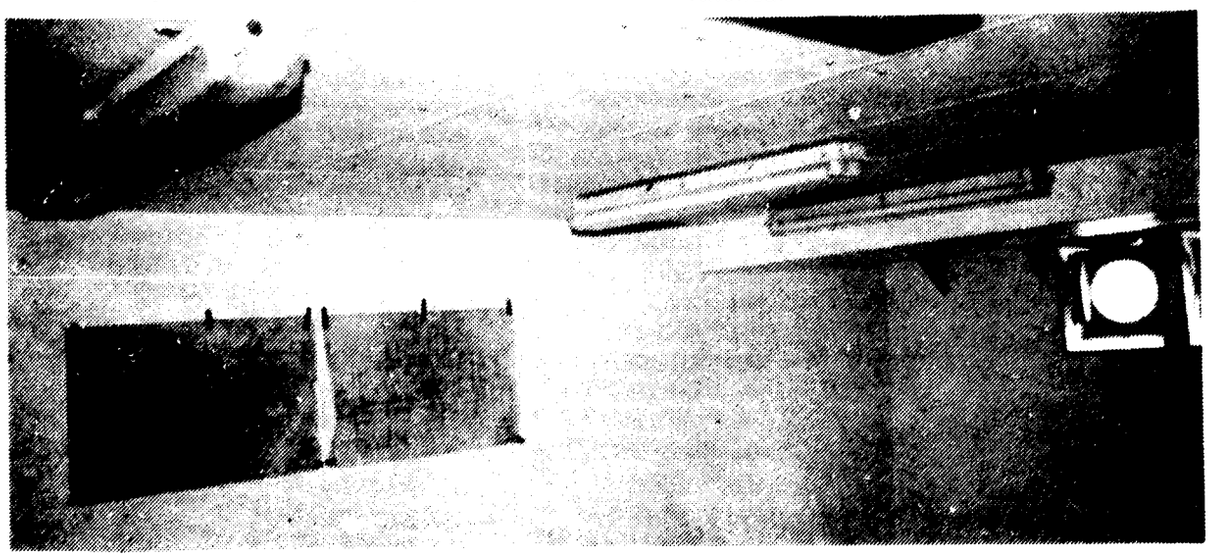
An access plate on the upper deck was cut to pass the generator. Since the foundation of the "D399" was above two fuel tanks, they had to be cleaned for hot work. Under deck stiffening was also required in these bunker tanks.

Three new motor control centres (MCC) were fitted, complete with new cables. One was fitted forward and two in the generator room.

Four windlass motors were removed to shop and overhauled.

A new impressed curre.. ystem and a new navigation lights system were fitted.

All hold lights were overhauled and cable renewed.



Renewal of accommodation.