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ASSISTANCE TO PENDIK SHIPYARD

DP/TUR/81/007

TURKEY

Terminal report

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

Based on the work of M. Kotecki, expert in shipyard operation

United Nations Industrial Development Organization
Vienna

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Explanatory notes

The monetary unit in Turkey is the Turkish lira (LT). During the period covered by the report, the value of the Turkish lira in relation to the United States dollar was $US 1 = LT 245.9.

dwt deadweight tonnage. The carrying capacity of a ship in tons of 2,240 pounds (1,016 kilograms)

t tonne, metric ton (1,000 kilograms)

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ABSTRACT

The project, "Assistance to Pendik Shipyard" (DP/TUR/81/007), has been carried out for the Government of Turkey by the United Nations Industrial Development Organization (UNIDO), acting as executing agency for the United Nations Development Programme (UNDP). Under this project, an expert in shipyard operation was appointed to the Pendik Shipyard for the period 5 September 1983 to 28 August 1985. The purpose of this mission was to advise on the organization of the shipyard and its production; to identify weaknesses; to recommend improvements; and, generally, to assist the management in the introduction of new technology and improved organization.

In this terminal report on the project, the expert describes the achievements of the project, reports on progress made in the first stage of the shipyard's development, outlines the shipyard's current shipbuilding programme and work-force and what is planned for the second stage of development. The expert draws attention to various improvements which need to be made in the areas of manpower recruitment and training, organizational structure, material-supply system, organization of work in the shipyard and the introduction of new manufacturing processes, and makes recommendations for all of these, including a detailed work programme for building the 26,300 and 60,000 dwt bulk carriers.

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INTRODUCTION

The project, "Assistance to Pendik Shipyard" (DP/TUR/81/007), has been carried out for the Government of Turkey by the United Nations Industrial Development Organization (UNIDO), acting as executing agency for the United Nations Development Programme (UNDP). Under this project, an expert in shipyard operation was appointed to the Pendik Shipyard for the period 5 September 1983 to 28 August 1985. The purpose of this mission was to advise on the organization of the shipyard and its production; to identify weaknesses; to recommend improvements; and, generally, to assist the management in the introduction of new technology and improved organization. This report is the expert's terminal report on the project.

Project background

The Pendik Shipyard and Heavy Industry Plant is one of the largest shipyards owned by the Turkish Shipbuilding Industry (Türkiye Gemi Sanayii), a state enterprise.

The shipyard was established in order to meet the domestic shipbuilding requirements and to develop the Turkish marine fleet and shipbuilding industries as foreseen in the Second Five-Year Development Plan (1968-1972). In 1968, a project proposal for the shipyard was prepared by a Polish company in accordance with the Turkish Maritime Bank's Execution Plan of 1968 which complied with the principles of the development plan. Construction was started on 20 May 1969.

While the construction work was proceeding, there were financial problems and, acting with a view to providing foreign capital and technical co-operation, Turkish Maritime Bank started negotiations with Ishikawajima Harima Industries Co. Ltd. for a new proposal on a partnership base. The second design for the shipyard was made in 1971 and the erection work was continued according to this second design. However, previously, buildings to a value of 1.5 billion Turkish liras had been completed according to the first design. The two designs differ in the layout of the shipyard and in the capacity of the shipyard's marine structures.

Since some major alterations in the second project for the shipyard came up for study and discussion during the negotiations, a great part of the construction contracts could not be awarded. Negotiations were never satisfactorily concluded, the partnership negotiations were abandoned at the end of 1973 and the erection works were stopped.

The Turkish Government then decided to construct the shipyard with its own resources. New design work was deemed necessary to change the proposed structure of the slipway and dry dock as well as other maritime buildings. It was decided that the shipyard should be completed in two stages:

(a) The first stage. Construction of a semi-dock-type slipway, 38 x 92 m (with the possibility of extension up to 275 m) with a steel-working capacity of 16,000 tonnes a year;

(b) The second stage. Construction of a dry dock 300 x 70 x 8.5 m with a steel-working capacity of 48,000 tonnes a year.

In 1974, construction of the shipyard was started again and, in July 1982, structures in the first stage of the plan had been brought into a condition where they were partly ready to be put into operation.

In June 1983, the shipyard launched its first 5,500 deadweight tonnage (dwt) container vessel for a domestic owner (Türkiye Denizcilik Işletmeleri).

The services of a UNDP/UNIDO shipbuilding consultant had been provided under SI/TUR/80/801 and then DP/TUR/80/013 to investigate the prevailing situation and prospects for future developments in all the Turkish Maritime Bank's shipbuilding facilities including the Pendik Shipyard. The present assistance to the Pendik Shipyard under DP/TUR/81/007 is a follow-up to the UNDP technical assistance provided earlier.

Project achievements

Details of the project activities and achievements have already been presented in the following reports:

Preliminary report - 5 October 1983
Periodic report - 10 January 1984
Progress report - 2 March 1984
Periodic report - 8 June 1984
Progress report - 17 September 1984
Progress report - 15 March 1985
Work programme - March 1985*

These reports show, among other things, the total results of the shipyard's production in 1983-1985, which reflect the major positive influence of the project's implementation during the expert's appointment.

In pursuit of the project's objectives, work in the shipyard has been organized in such a manner that improvements in production, organization and documentation have been planned with the effective participation of the yard's technical staff. These have been prepared jointly with the yard's management and taking into account the particular knowledge and skills that individual members of the technical staff have acquired and with a view to providing on-the-job training. The recommended and jointly-agreed improvements have been introduced into the yard's practice step by step as particular production needs were identified and dealt with.

It should be said, however, that there is still room for further improvements. The organization must reflect the basic needs of the yard and its building programme and, as the yard together with the building programme is a growing and changing organism, the organization must be capable of changing also. It is with this in mind that the expert's final report sets out the major findings of the mission and recommends to all the parties involved further actions which might be taken. The report deals with the Pendik Shipyard from the following points of view:

(a) Existing facilities and possibilities of extension;

(b) Shipbuilding programme;

(c) Organization;

(d) Necessary improvements connected with the shipbuilding programme.

The recommendations and propositions made are not intended as definitive but may be the subject for further discussions.

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*This should be considered as an integral part of this terminal report and is given in full in the annex.

SUMMARY OF RECOMMENDATIONS

The recommendations summarized here are given in detail in chapters I-V of the report and the annex.

Improvements to facilities in the first stage of the shipyard development

1. The setting up of a sub-assembly area, at first in the platers' shop, and then between the assembly shop and the outfitting shop is recommended. It should be equipped with a 10-tonne gantry crane, light moveable sheds and a transportation system.

2. A pre-erection stage should be set up in the area of the outdoor extension of the slipway, which would combine two or more assembly blocks into bigger units. This would reduce the amount of erection work on the slipway and optimize labour utilization.

3. Pending the construction of a full dry dock, envisaged for stage two of the development plan, it is recommended that the present slipway should be extended either to 238 m or to 274 m so that either the semi-tandem system of building can be used or two ships can be built at the same time. This is an essential in organizing a proper balance between outfitting and hull-construction work in the yard.

4. A new design should be drawn up for launching equipment and supporting systems.

5. A new design layout should be made for the pipe shop to make possible the introduction of new pipe technology.

The shipbuilding programme and the work-force

6. It is necessary to take special measures to increase the production work-force because of the shipyard's expanding shipbuilding programme.

7. A training course for welders, leading to a professional certificate, should be run.

8. On-the-job training and seminars should be provided to train an adequate number of foremen to supervise the increased work-force.

9. An immediate and continuing increase in the number of well-qualified technical staff is essential.

10. Since the work-force problem may not be so easy to solve, a revision of the current shipbuilding programme is recommended, particularly with regard to the ships to be built in the dry dock. The revision should be based on the experience gained in 1985-1986.

The second stage of shipyard development

11. Although construction of the second stage of the shipyard development is very necessary and the moment seems very favourable, a detailed technical and technological proposal must be worked out and submitted which deals with all the actual and potential production problems.

12. Before the dry dock is built, adequate studies must be made of the soil conditions, optimum depth and floor-loading requirements.

13. The erection of a shot-blasting and painting hall with two cells is very necessary for the protection of hull sections and assembly blocks and should proceed as soon as possible.

Organization

14. It is essential, first of all, to increase the number of technical staff and supervisors in the technical and production departments.

15. Many organizational problems could be helped by having a "chief builder" to take overall responsibility for the completion of a vessel, co-ordinating all the necessary activities of the various units or shops.

16. Co-ordination within the shops could be improved by basing the organization on work-stations, the smallest plannable unit of production where a group of men and machines turn out a definable product with restricted variety.

17. To improve material procurement, the job-order system currently used has to be modified, and eventually replaced by advance material ordering when computer facilities for production planning are available.

18. The development of a design office for design and production planning is essential.

19. A quality-control organization has already been started in the hull shops. It is necessary to establish this also in the outfitting shops.

20. It is necessary to rationalize and standardize production of outfitting equipment among the four yards of the Turkish Shipbuilding Industry in Istanbul.

21. The introduction of a simple but more effective wages system, which would take into account the quantity and quality of work of the individual worker and his level of qualification, is recommended.

Work programme

22. For the shipyard to undertake successfully the construction of the 26,300 and 60,000 dwt bulk carriers, it is necessary to implement all the steps given in detail in the work programme in the annex.

I. COMPLETION OF THE FIRST STAGE OF THE SHIPYARD DEVELOPMENT

As described in the introduction, the shipyard went into operation in a partially-ready state. Some of the new facilities therefore cannot be used properly and some of them are not suitable for the introduction of modern technological processes. The first stage of construction has not been completed yet due to financial and other problems.

However, much progress has been made in the last two years in completing various structures. The following equipment came into service during this period:

- Jib crane, 30 tonnes capacity, which has to serve the area along the slipway
- Straightening rolls, shot-blasting-painting-drying equipment for plates and profiles
- Plate-marking-off shop
- Conveyor system between the steel stockyard and the surface-treatment equipment for plates and profiles
- Conveyor system between the surface-treatment equipment and the platers' shop
- Conveyor system between the platers' shop and the assembly shop
- Automatic flame-cutting machine (1:10) including all necessary cutting tables
- Electro-hydraulic pipe-bending machine
- Vertical electro-gas welding machine
- Three overhead travelling electromagnetic cranes, 15 tonnes total capacity, serving the steel stockyard, platers' shop, and panel line

These have made it possible to introduce some improvements in the work and material flow, mostly in the hull shops. But, in general, the production capacity of the shipyard is determined by the speed of erection of the assembled blocks out on the slipway. Therefore, the recent development of the shipyard, based on the use of a semi-dock slipway, requires the installation of a gantry crane which has to serve the area of the slipway as well as the slipway extension area. A gantry crane with a lifting capacity of 300 tonnes and a distance between wheels of 73 m was chosen. The supplier of this crane is the company, Mague (Portugal). The construction of the steel structure and crane foundations, including all the necessary fittings and foundations, will be carried out by Karabük (Turkey). It is planned to complete the gantry crane in the first quarter of 1986.

Other shipyard structures and facilities are in the following stage of construction:

Slipway. A new tender document has been prepared for the 80-tonne jib crane.

Steel Stockyard. The overhead travelling electromagnetic crane of five tonnes capacity is under construction. It is planned to complete the crane in the third quarter of 1985. Meanwhile, mobile cranes serve the area.

Unloading quay. A hammer-type electromagnetic crane of 15 tonnes capacity is under construction. It is planned to complete it in the third quarter of 1985.

Oxygen generating plant and acetylene generating plant. Contracts have been signed for supplying the equipment. It is planned to complete both plants in the first half of 1986.

An analysis of the first stage of the shipyard development leads to certain conclusions and recommendations on the capital investment side, which could be the subject for further discussion during the completion of the first stage and the preparation of the second stage of the shipyard plan.

Conclusion

After completion of the first stage of development (assuming sufficient equipment and staff), the shipyard will be able to build:

(a) From one-and-a-half to two vessels of 50,000-70,000 dwt, with a steel-working capacity of about 24,000 tonnes a year; or

(b) From two-and-a-half to three vessels of 20,000-35,000 dwt, with a steel-working capacity of about 18,000 tonnes a year; or

(c) From five to six vessels of 6,000-12,000 dwt, with a steel-working capacity of about 15,000 tonnes a year.

Recommendations

1. On grounds of efficiency, consideration should be given to introducing, between the assembly and prefabrication stages, an intermedidate sub-assembly stage where smaller units, panels, blocks etc. can be pre-assembled before reaching the assembly area. In the process of sub-assembly, larger parts such as web plates and panels are usually laid horizontally and smaller pieces such as stiffeners, brackets and face plates are arranged, fitted and welded onto the large members. The assembled units are then overturned onto a raised open jig platform where welding distortion is eliminated by line heating and the pieces for the reverse side are then fitted and welded. Each unit so assembled is usually less than 10 tonnes.

The sub-assembly area can be easily arranged in the platers' shop (first stage) and then between the assembly shop and outfitting shop. It should be equipped with a 10-tonne capacity gantry crane, light moveable sheds and a transportation system (pallets for easy storage and transportation are usually used).

2. Between the assembly and erection stages, consideration should be given to introducing an intermediate pre-erection stage whereby two or more assembly blocks are combined together into yet bigger units up to 300 tonnes so that the erection work and schedule can be reduced. The slipway extension area outdoors under the gantry crane could be used for this purpose. Another advantage of this system is that labour which is surplus from the early and later stages of erection can be used for the pre-erection work.

3. It is generally very difficult to balance hull construction work in the shipyard based on the use of only one building berth. In case the dry dock planned in the second stage of shipyard development does not materialize in the near future, it is recommended to consider and study the possibility of extending the length of the slipway from 202 m to 238 m or to 274 m to enable the building of two ships at the same time or to use the so-called semi-tandem system of building. In this method of building, the first ship and the aft part of the second ship are built. The aft part is then shifted to the same position previously occupied by the first ship and the rest is built. At the same time the aft part of the third ship is built next to the second ship. It would be necessary also to equip the slipway with a sufficient capacity of equipment for lowering blocks. Using both these methods in a flexible way, a

proper balance of outfitting and hull-construction work is maintained leading to higher operational efficiency.

4. Working out a new design for launching equipment and supporting systems (centre support and bilge blocks) is recommended. The new design should fulfil the following requirements:

(a) All of the equipment should be suitable for supporting and launching ships up to 75,000 dwt;

(b) The sliding ways should be of the pontoon type and easy to dismantle after launching;

(c) The slipway should be equipped with suitable mechanical stoppers.

5. A new layout should be designed for the pipe shop taking into account the possibility of introducing the new pipe technology according to the engine room model (scale 1:10) and the single pipe sketches. The project should include the engine room model shop and the pipe store. The following major items should be installed:

(a) A straight-pipe-segments line including cutting, flanging, welding and finishing equipment;

(b) A bended-pipes flanging and welding installation;

(c) Equipment for tightness tests of straight-pipe segments, bended pipes, valves and fittings;

(d) Storage of pipes and transporting system between the individual installations.

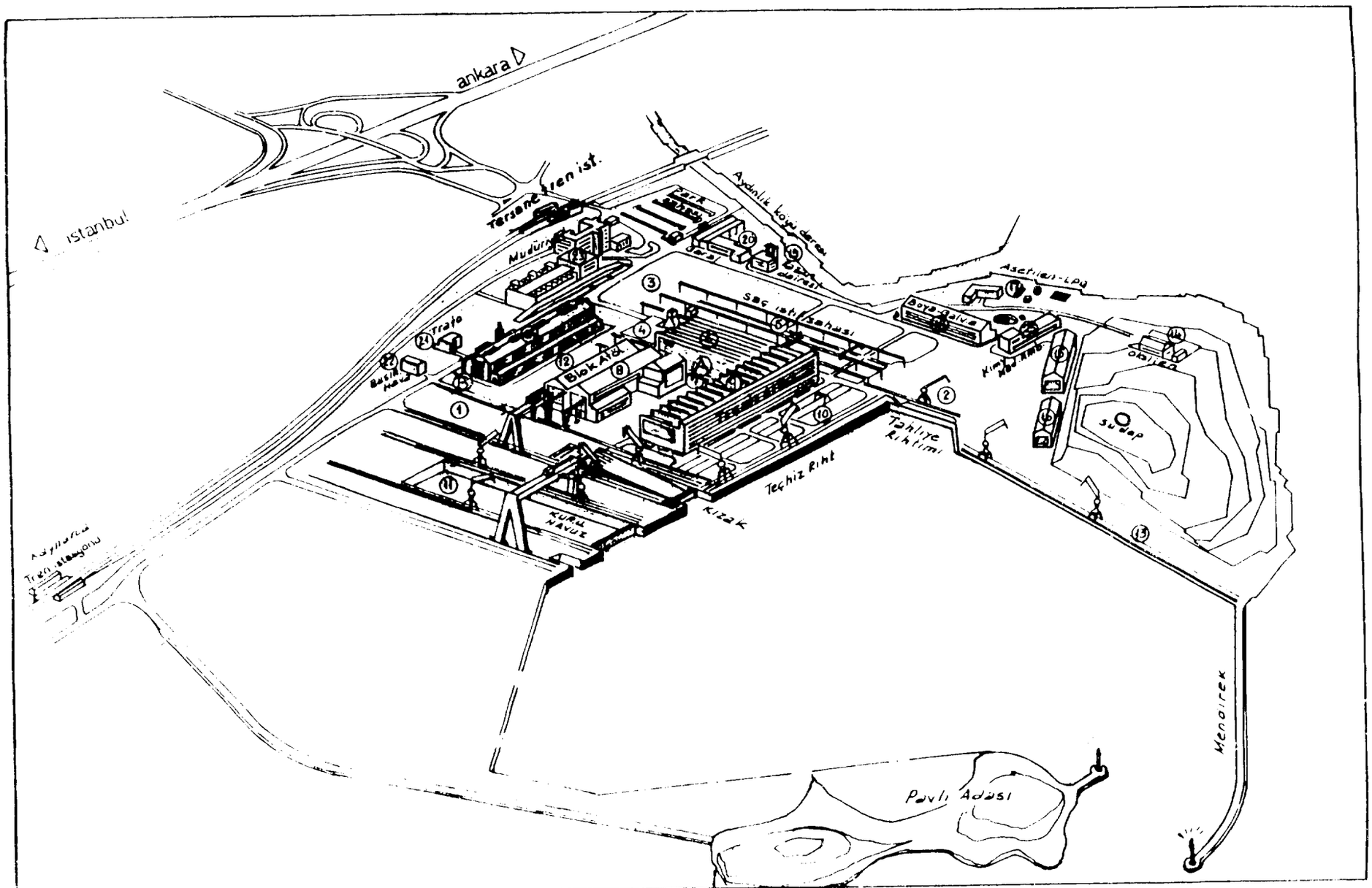
The planned layout of the Pendik Shipyard is shown in figure 1. The key to the numbers and letters in the figure is as follows:

1. Semi-dock slipway
2. Unloading quay
3. Steel stockyard
4. Straightening, shot-blasting and painting equipment for plates
5. Shot-blasting and painting equipment for profiles
6. Platers' shop
7. Buffer store for prefabricated parts
8. Block-assembly shop
9. Outfitting shop
10. Outfitting quay, 310 m
11. Dry dock
12. Block-assembly shop
13. Outfitting quay, 440 m
14. Oxygen-generating plant
15. Joiner's shop
16. Subcontractor's shop
17. Acetylene-generating plant/ liquid-petroleum-gas storage plant
18. Galvanizing shop
19. Central heating plant
20. Garage and fire house
21. Main transformer station
22. Compressed air plant
23. Offices and social buildings

A Paint factory
B Diesel engine factory

Figure 2 shows the design for the 300-tonne gantry crane.

Figure 1. Layout of the Pendik Shipyard and Heavy Industry Plant



Note: See text to key to numbers and letters.

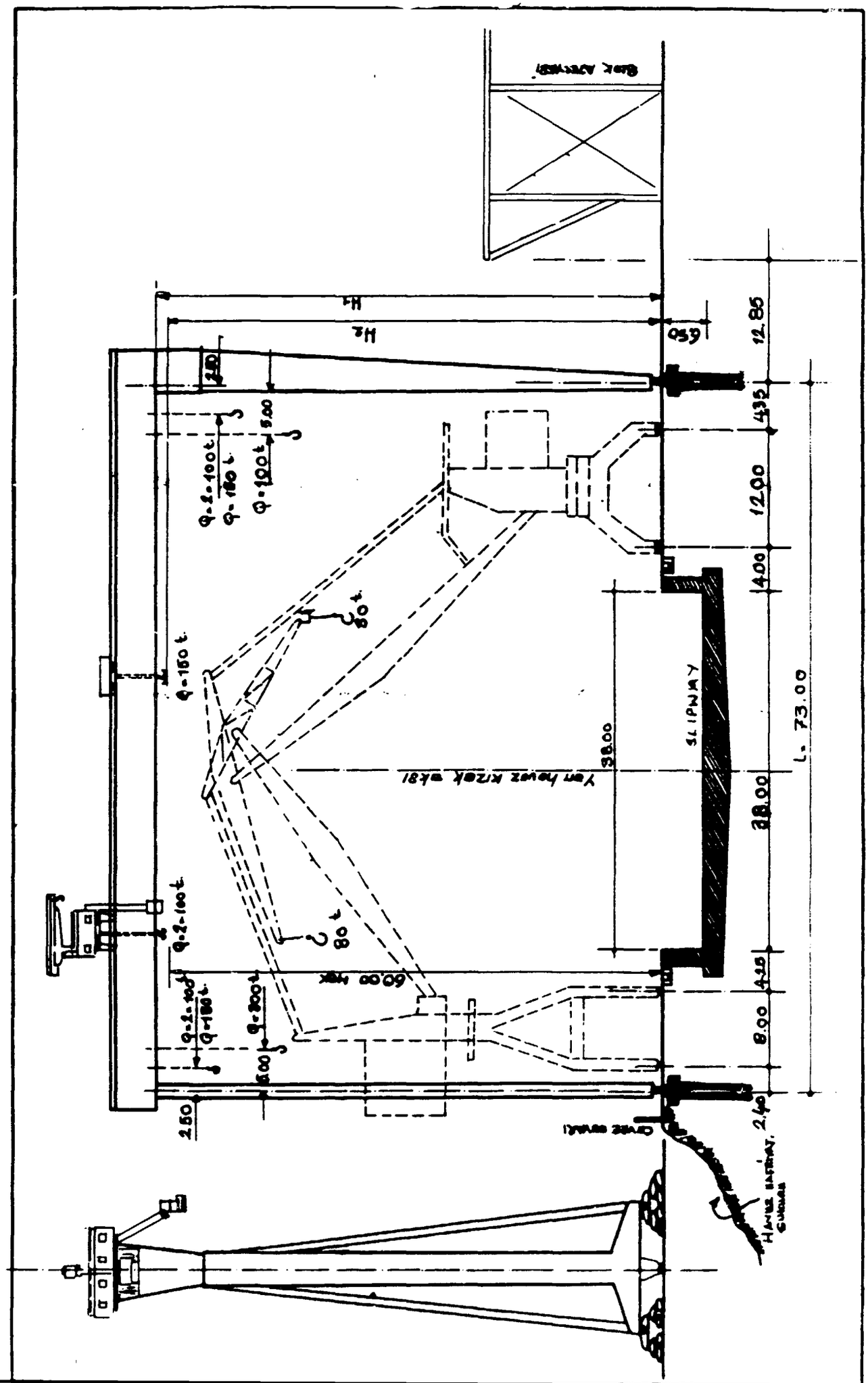


Figure 2. Plan of the 300-tonne gantry crane

II. THE SHIPBUILDING PROGRAMME AND THE WORK-FORCE

The efforts made to bring in more and larger shipbuilding orders have achieved the desired effect. As a result of negotiations between the Turkish Shipbuilding Industry (Türkiye Gemi Sanayii) and the Polish Steamship Company, an agreement and contract have been signed for Pendik Shipyard to build three bulk carriers of 26,300 dwt capacity each. The number of ships may be increased to eight in the event that the foreign-made material required by the shipyard can be supplied from Poland against the export credit created by building these ships (shipyard option). The order is part of a bilateral deal between the two countries. The contract came into force in June 1985 and the first vessel will be delivered 39 months after the contract came into force i.e. November 1987. Delivery times for the subsequent vessels will be at six-month intervals.

D.B. Cargo Lines (D.B. Deniz Nakliyat T.A.S.) placed an order with the yard for two 60,000 dwt bulk carriers. The first vessel will be delivered in the first quarter of 1989.

The yard also has an order for six car ferries for the Turkish Maritime Lines (Türkiye Denizcilik Işletmeleri). Two of them have already been launched and four others are under construction. The yard is also building a 250-tonne floating crane for one of the railway authority ports (T.C. Devlet Demir-yollari Işletmesi) and two 350 dwt barges for Turkish Maritime Lines.

In addition, in the longer term, D.B. Cargo Lines is planning to place orders with the shipyard for two multi-purpose cargo ships (11,500 dwt each) and for two tankers (85,000 dwt and 130,000 dwt).

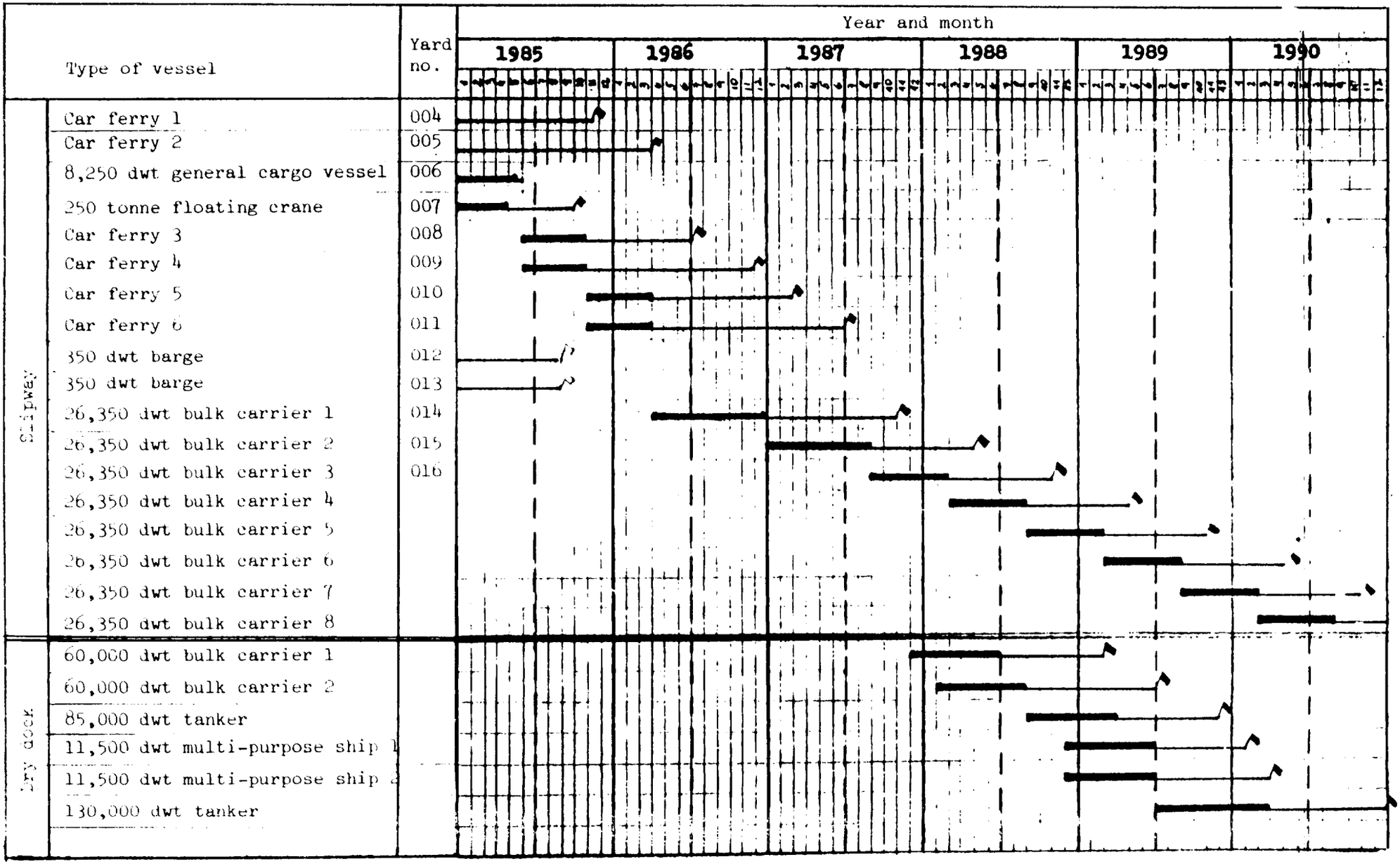
As a result, the following ships are to be built in the yard:

One floating crane, 250 tonnes
Six car ferries, 110 cars capacity each
Two barges, 350 tonnes each
Eight bulk carriers, 26,300 dwt each
Two bulk carriers, 60,000 dwt each
Two multi-purpose cargo ships, 11,500 dwt each
One tanker, 85,000 dwt
One tanker, 130,000 dwt

In the current year and the first quarter of 1986, the yard is planning to launch four car ferries and to deliver two car ferries and two 350 dwt barges for the Turkish Maritime Lines. Following completion of these, the yard is to start construction on the first of eight 26,300 dwt bulk carriers for the Polish Steamship Company to be built using Polish materials and technical assistance. It is planned to start cutting the plates towards the end of this year and to launch the first vessel in December 1986. (See figure 3 for the time scale of the shipbuilding programme.)

In summary, Pendik Shipyard cannot complain of lack of orders. Its portfolio of orders is fully filled for a few years and will keep the yard employed until 1990 when the last of the vessels is due for delivery. Furthermore, it is a fact that the large orders for six car ferries and eight bulk carriers will help the shipyard in developing skills and experience. Vessels built in large series are the ideal setting for gaining experience and for stimulating technical progress as well as gaining a reputation in the world's shipping circles. Nevertheless, Pendik Shipyard has to face an uneasy period and has many difficulties to overcome. Of particular importance is to

Figure 3. The shipyard's building programme, 1985-1990



tackle the increase of work-force necessary for the realization of this programme and to ensure that the work-force is appropriately trained.

About 400 direct workers are currently employed at the yard in the hull and outfitting shops. To be able to implement the shipbuilding programme planned for 1986, it is necessary to employ about 1,000 workers. In the hull shops, which currently employ 250 workers, it is necessary to increase the number of workers up to 350 in the first half of 1986. At the outfitting shops, which currently employ 150 workers, the numbers are to be increased to 550.

The table shows the increase in the shipyard's workload between 1982 and 1986.

Vessels built or planned, 1982-1986

Year	Type of order: Vessels launched (number)	Vessels launched (dwt)	Steel hull only (without outfitting) (number)	Vessels Outfitted and delivered (number)
1982	-	-	-	-
1983	2	12 700	1	-
1984	3	15 200	1	-
1985	4 a/	19 250	1	2 a/
1986	3 a/	34 300	-	3 a/

a/ Planned.

These figures indicate an enormous increase in the capacity needed. To reach this capacity will be a problem requiring special study and management effort.

To increae capacity at the hull shops will not be such a problem in that, during the past two years, considerable progress has been made in the hull shops, particularly in developing and applying new technological and organizational methods of hull construction. The production quantity and quality has increased. The shops have also achieved better accuracy of workmanship and more efficient operation. However, it is suggested that a training course should be run, or intensive on-the-job type of training and in-class type seminars for foremen to prepare a sufficient number of foremen and to develop their skills. This will prevent in advance low accuracy in workmanship occurring in the process of hull construction when the number of workers are increased. It is also recommended to run a course for training welders to improve their technical quality and to award the certificates required by the classification societies.

The worst situation is with the outfitting shops. The shipyard has not had enough experience in outfitting the vessels or in outfit manufacturing, because up to date it has built only steel hulls (except for the outfitting of m/s "Kilis") with the outfitting being carried out elsewhere. There have not been enough outfitting jobs during 1984 and the first quarter of 1985 to

justify increasing the number of workers. Also the existing outfitting shops are not well enough equipped and methods of design, material procurement and production engineering are not adequate. But, for the time being, the bottlenecks are being identified which will show where improved facilities and methods are most required. Outfitting work which will be carried out in 1985 and 1986 during the construction of the 250-tonne floating crane and the car ferries will give an opportunity to use some new methods and on-the-job training for workers, foremen and technical staff. However, inspite of this, the different types of training to develop the skills of new personnel will probably not be sufficient and it is suggested that some of the experienced foremen, workers and engineers from the other shipyards belonging to Türkiye Gemi Sanayii A.S. should be transferred to Pendik.

To solve the problem of the work-force, consideration could be given to the use of sub-contracted labour which is easily available on the Istanbul shipbuilding market. But to use this to a large extent does not solve, in the long term, the yard's work-force problem because it carries its own drawbacks, as experienced by many shipyards. While the sub-contracting system cannot be totally eliminated for various reasons, the extent of reliance on sub-contractors should be minimized.

In addition to the above, it must be said that the number of technical staff is still not adequate for carrying out the current scope of activities. It should be increased as soon as possible and go on increasing gradually.

The above-mentioned increase in the work-force in 1985-1986 will continue in 1987-1988 if the construction of the dry dock begins in 1985-1986. But it is doubtful whether the shipyard can achieve such a big increase in capacity at this time without special measures to develop skills and technical qualifications of workers and technical staff.

With the completion of the first stage of shipyard development (including the planned improvements) the yard would be able to carry out the shipbuilding programme for 1985-1987 with the existing facilities. To realize the programme for 1988-1990, the completion of the second stage of shipyard development (with dry dock) will be necessary. (See figure 4 for an estimate of the number of workers directly employed which will be required by the currently-planned building programme.)

Recommendations

1. It is necessary to take special measures to increase the production work-force.

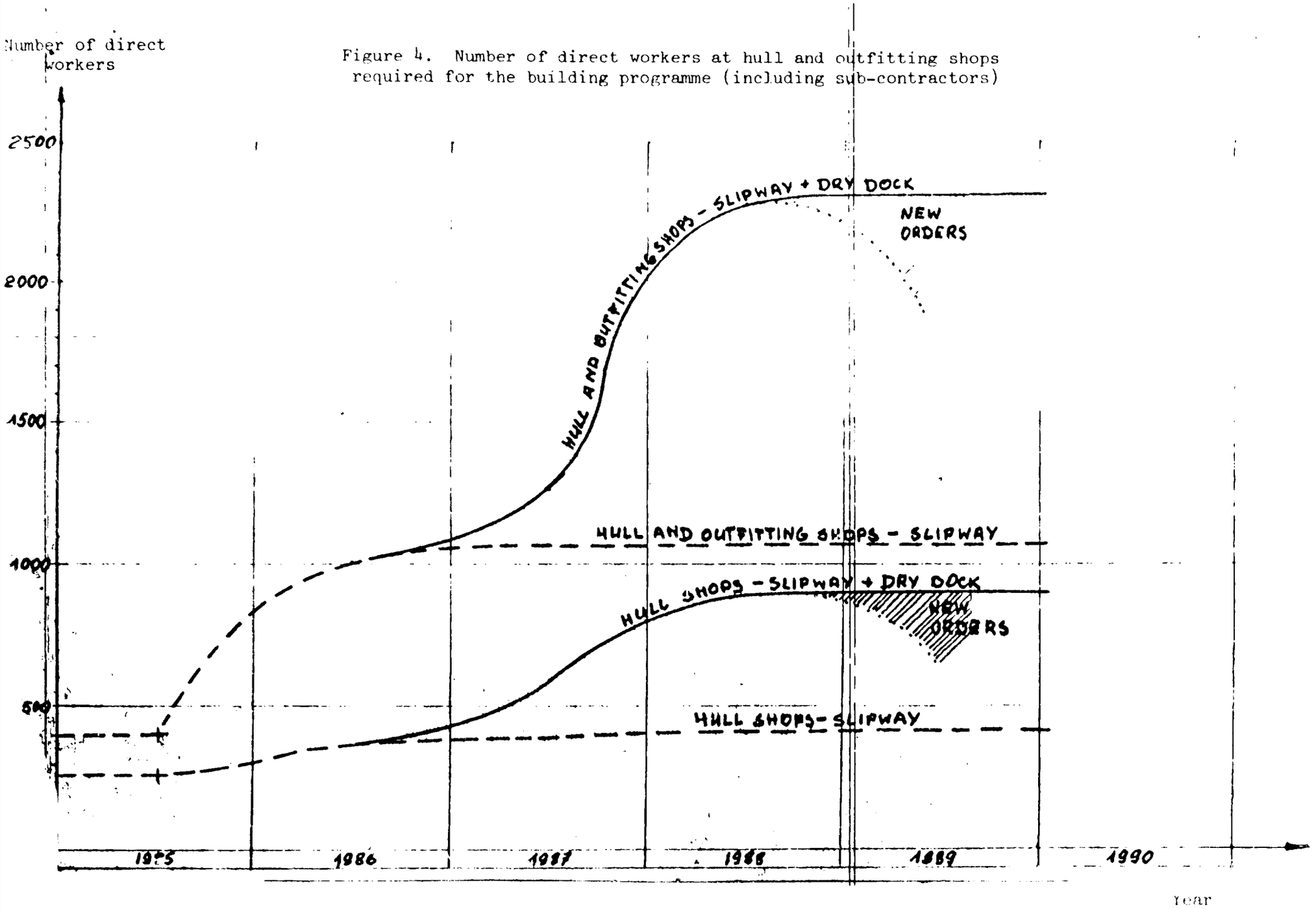
2. A training course for welders, leading to a professional certificate, should be run.

3. On-the-job training and seminars should be provided to train an adequate number of foremen to supervise the increased number of workers.

4. An increase in the number of well-qualified technical staff is essential.

5. Since the work-force problem may not be so easy to overcome, a revision of the shipbuilding programme is recommended, particularly with regard to the ships to be built in the dry dock. The revision should be based on the experience gained in 1985-1986.

Figure 4. Number of direct workers at hull and outfitting shops required for the building programme (including sub-contractors)



III. THE SECOND STAGE OF SHIPYARD DEVELOPMENT

According to the project proposals, after completion of the second stage of the shipyard development, the yard capacity will be as follows:

Steel-working capacity	48,000 tonnes a year
Shipbuilding capacity	240,000 dwt a year
Largest ship which can be built	170,000 dwt

It is planned to construct the following new units and installations:

- Dry dock, 300 x 70 m, served by two jib cranes of 80 t capacity each and two gantry cranes of 450 t capacity each
- Block-assembly shop
- Outfitting quay, 440 m
- Sub-contractor's shop
- Self-propelled trailer, 300 t, and other equipment for hull and outfitting shops

Some of the units completed in the first stage of shipyard development have been installed and equipped to a capacity commensurate with the objectives of the second stage (steel stockyard, platers' shop, outfitting shop, panel line, auxiliary units and installations and social buildings). Therefore, the remaining construction of the second stage is very important and is an element in the thrust towards high productivity.

In addition, and independently of the above, it was planned to arrange some sub-industries such as a paint factory and a diesel engine factory in the Pendik Shipyard and Heavy Industry Plant.

The paint factory already entered into service in 1982. It is designed to produce three tonnes of paint per day. Up till now, it has produced conventional paints with its own technology and is at an experimental stage in marine-paint production, in co-operation with a well-known paint maker.

The diesel engine factory started production of Sulzer diesel engines up to 4,000 hp in 1982 in co-operation with H. Cegielski/Sulzer (Poland). The local participation is about 60 per cent, using the existing facilities in the outfitting shop and other tools and machinery at Pendik and other shipyards and local sub-contractors. In the face of these developments, a licence agreement was signed for the manufacture of low- and medium-speed marine diesel engines (4,080 and 48,000 hp) with Sulzer Brothers of Switzerland, and construction of an independent diesel engine hall was started. It is planned to complete the construction of the diesel engine factory in the first half of 1986. To comply with the shipbuilding programme, the assembly and tests of the first RTA-58-type engine for the second bulk carrier of 26,300 dwt can be made by using, at the beginning, components supplied from abroad.

An analysis of the project proposals indicates that some details of this stage have not yet been finally worked out. If the proposed layout of the shipyard is an optimum one from the point of view of the structural design, the production technology design of the shipyard should in this case be revised. In general, a very detailed technological proposal should be prepared, taking into consideration the different ships to be built on the slipway and in the dry dock. It should deal with the main questions concerning flexibility of the shipyard structures in relation to exact technological processes and technical know-how, as well as the organization of work so that both facility utilization and labour utilization are optimized.

Concerning production-technology details, the first suggestion would be to include in the investment programme the construction of a shot-blast and paint hall as a part of the shipyard's production line. This very important problem area has not been tackled in the existing project. A shipyard's ability to construct hull sections and blocks demands an equivalent ability to protect them from corrosion. The sections must be blasted to achieve a suitable surface to take either conventional or modern, sophisticated coatings. The under-cover painting concept, involving the erection of a shop-blast and paint hall, containing two or more paint cells should be considered. In practice, sections will usually be blasted and painted in the same cell. This is permissible because of the highly-effective means adopted for recovering the spent abrasive and for dust and paint-fume extraction. And it is desirable because heat would be lost and the risk of rain damage to the cleaned surface increased if sections were taken from the blasting cell to another for painting. The normal procedure is therefore to move crews from cell to cell in rotation so that blasting takes place in one cell as the abrasive recovery, painting and curing processes are taking place in the second. Blasting may, however, proceed simultaneously in adjoining cells if required.

An analysis of the proposal for the second stage of shipyard development including all the units made in the first stage permits the following conclusion and suggestions to be made, which may be the subject for further discussion during the design, construction and operation period of the particular units.

Conclusion

The shipyard's shipbuilding programme indicates that the situation is very favourable for starting completion of the second stage of shipyard development. The completion of this stage is an important element in the thrust towards high productivity. In this case also, the diesel engine factory now under construction in the shipyard area, will play an important role in developing and expanding the shipbuilding capacity.

Recommendations

1. Before final decisions are made on the second stage of the shipyard's development and before construction begins, a detailed technological proposal should be drawn up. This should include a detailed service plan showing the actual location of buildings and units. The proposal should cover production methods and engineering of the work-stations, location of assembly and outfitting area and shops, space between areas, location of cranes, reach and lifting capacity of jib cranes and gantry cranes and should take into consideration the material flow for hull construction and the level of technological process and technical know-how envisaged. Consideration should also be given to the new balance of facilities so that rates of throughput are matched to the demand.

2. Before execution of the final design of the dry dock, it is necessary:

(a) To collect all the results from the soil investigations in the area of the dry dock and block-assembly unit. Special attention has to be paid to the permeability of the soil to decide on the drainage of the excavation for the dry dock;

(b) To study the requirements for the depth of the dry dock, taking into consideration the possible ship repairs which may have to be made;

(c) To study the loads on the dry-dock floor. Different possibilities of ship arrangements in the dry dock as well as types of ships with highly concentrated loads have to be settled to ensure an adequate floor-loading scheme.

3. It is recommended to include the erection of a shot-blasting and painting hall in the second stage of shipyard development as part of the shipyard's production line. Indeed, in view of the fact that, after completion of the first stage, the shipyard's ability to construct hull sections and blocks will depend on an equivalent ability to protect them from corrosion, the erection of the paint hall, containing two cells, should really be done immediately before execution of the second stage.

IV. STRUCTURAL ORGANIZATION AND SUGGESTED AREAS OF CHANGE

The organization chart of Pendik Shipyard is as shown in figure 5. In general, this form of organization, with the improvements already introduced, is adequate for dealing with the current shipbuilding programme. The distribution of tasks and responsibilities related to various activities among the units of the yard, as well as the forms, cards, and other software essential to the smooth running of the shipyard has been described in previous reports. Some of this has been changed and improved during the last two years. But to achieve the best results, it is necessary, first of all, to increase the number of technical staff and supervisors in technical and production departments. On the shop floor, the number and variety of workers will determine the number of assistant foremen needed (a ratio of about 1:10) and this in turn will determine the number of foremen needed (a ratio of about 1:4). The number of assistant managers at the next level will be determined by a combination of factors including related trades, number of foremen and the amount of help and assistance the shop manager needs. This is the most important factor that management must consider in order for further improvement to take place in the organization. As the organizational structure must reflect the basic needs of the yard and, as the yard is a living and changing thing, the organization must also be capable of changing.

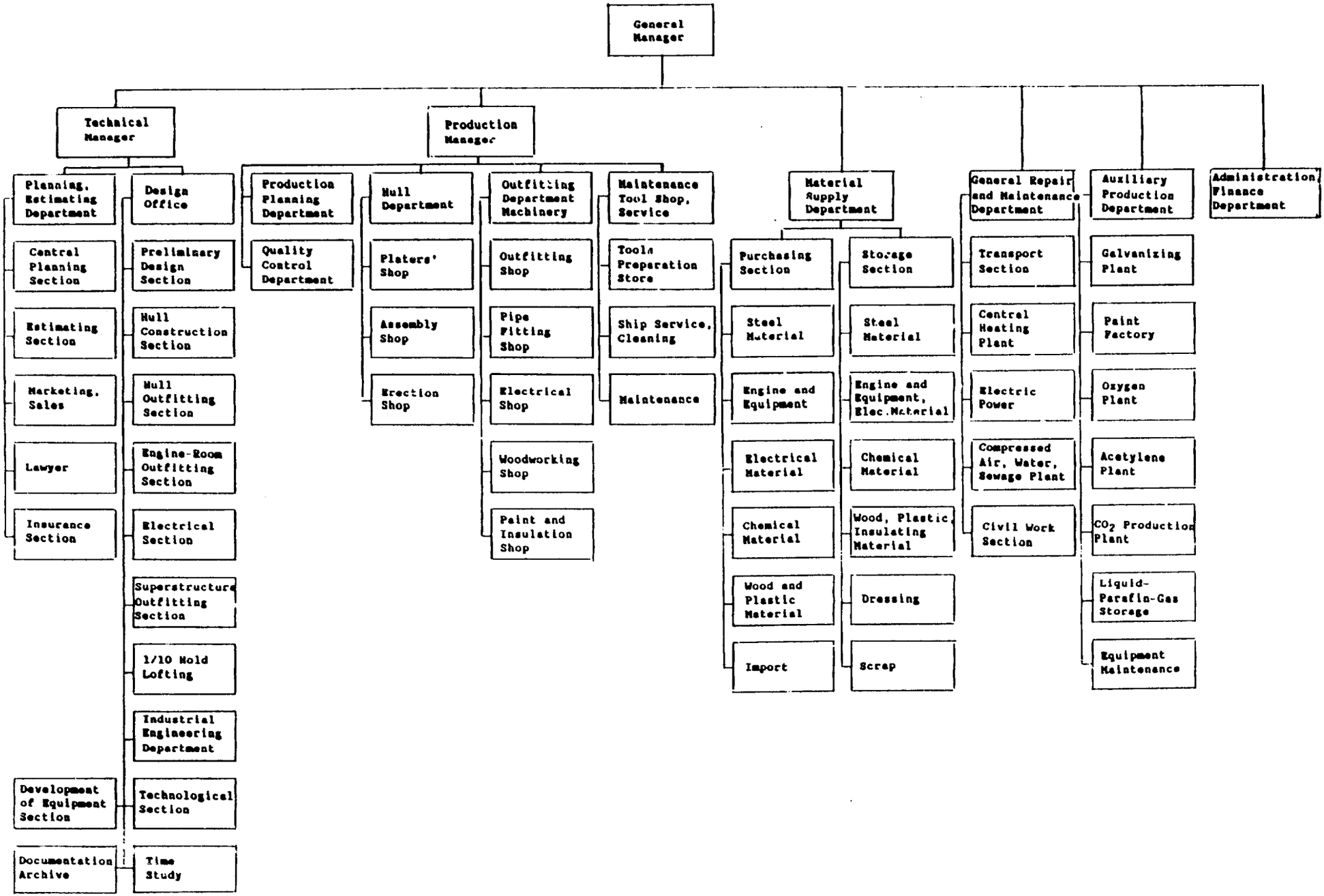
There are, however, still a number of disadvantages in this form of organization, which it was impossible to improve during the expert's mission, for various reasons. The most important disadvantage is the difficulty, often experienced, of co-ordinating the activities of different shops and trades during the outfitting of a vessel without interfering with each unit's completion of work on schedule.

Taking into account the fact that the number of vessels being outfitted is still growing, it is of fundamental importance to find a method of solving this problem within the existing form of organization. Various suggestions have been made as to how the yard's organizational structure could be modified to advantage. After experience in outfitting m/s "Kilis" and the 250-tonne floating crane as well as the ferries it can be suggested that one method of solving this particular problem is by employing the concept of the "chief builder" (ship manager) to co-ordinate the outfitting process. His responsibility is the co-ordination of all activities necessary for completion of a particular vessel on time, whereas the shop managers are responsible for the control of equipment and facilities, allocation of manpower and overall planning of the activities under their respective areas.

The chief builder's office will play the very important role of control, co-ordination and communication during outfitting on a vessel-to-vessel basis. Each chief builder will be the centre of control, co-ordination and communication for a particular vessel under his charge. He will be responsible for the total planning, scheduling, control and safety of the appointed vessel. He will also be the counterpart of the shipowner's supervisor and will deal with the classification society's surveyor and other external contacts. In this way, clear and quick communication, effective co-ordination within and without will be achieved. It is also recommended to place the chief builder's office under the direct control of the General Manager.

The other important disadvantage with the existing organization, in particular in the outfitting shops, is the co-ordination within the shops. Therefore, it is proposed to break down the manufacturing process at the outfitting shops into outfit production and ship construction. The outfit production can, most easily, be organized on a geographical basis and the

Figure 5. Organization chart



whole production system can be broken down into work-stations which are the smallest plannable unit of production. The work-station consists of a group of men and machines which has a definable product with restricted variety.

The experience of the hull shops, where the shipbuilding process has already been re-organized into separate work-stations, shows that this concept is best and most efficient in production where considerable control and measurement has been achieved. For the time being, this is the direction currently being followed by the hull shops and it should be extended to the outfitting shops. If the work-stations principle is adopted, the organization structure can be built up from the shop floor to the middle management and thus help ensure the relevance of the organization structure. There are also a number of important problems the solution of which would be aided by the use of a work-station organization. These are:

(a) Work-station drawings can be prepared. These drawings provide all information, no more, no less, required by any particular work-station for the manufacture of a particular item. They may often be standard drawings and also show in detail the process to be used;

(b) Production engineering and manpower planning is simplified and helped;

(c) The organization and control of material flow is simplified. This enables material to be routed to the specific address where it will be used, thus avoiding wasteful movement of material and unnecessary intermediate storage;

(d) Training is significantly simplified by only having to train initially for specific work-station tasks, rather than the traditional broad craftsman's training;

(e) A foreman will be responsible for one or more work-stations or, depending on the size of the work-station, a logical grouping of work-stations.

Another problem connected with the smooth running of the yard is material procurement which is one of the few major factors which have a direct bearing on the length of the construction period and on keeping to delivery times. Also, an effective scheduling and control system must take this factor into consideration. Currently, the yard uses the job-order costing system which is one of the simplest systems. At present, this system is used in some repair yards. For the shipbuilding industry the job-order costing system is sometimes used as a necessity rather than as a management option. In this system, the emphasis of control is on the cost of specific job orders, rather than on departments, work-stations or cost centres. When the company uses the job-order system, no production can be started without a formal job order. There are a number of disadvantages with this form of costing, the most important being the difficulty in advance material ordering and proper material procurement. Using this system, materials were ordered after the completion of design and job orders, and material bills have often to be gathered from a number of job orders and the relevant information must be sorted out from that which is not required. Errors can be made and time can be wasted.

Therefore, on the way to improving the material-supply system, some modifications have been already introduced into the shipyard practice. Currently, the bills of materials for steel hulls (plates and profiles) and lists of machinery and equipment are being prepared at the planning stage by

the design office. This enables completion of purchase ordering specifications at an earlier stage. But raw materials, some equipment, fittings and other accessories for outfitting the vessels are still ordered when the job order is completed. It is of fundamental importance to change this method and adopt the advance material-ordering system using the material bills prepared by the design office. At present, the job-order system can only be modified, but it can be changed when the computer facilities for design and production planning are introduced in the shipyard.

Another point which should be mentioned is that, at the end of June 1985, the management of Turkish Shipbuilding Industries introduced a new organization chart for organizational structures of all their yards.

In the new organizational structure, the position of the technical manager has been taken away. The design office has been shifted under the direct control of the general manager, and the central planning and estimating department is under the control of the material supply manager. Also, some new managers have been established as shown in figure 6. Taking into account the fact that Pendik Shipyard is a developing yard in which technical activities are of fundamental importance, it is recommended that the function of technical manager should be revived again and that he should be an assistant general manager as shown in figure 7.

In addition to the above recommendations, other major factors which need to be considered for further development of the yard's organization and for further improving and expanding the yard's shipbuilding capacity are contained in the following recommendations.

Additional recommendations

1. A design and production-engineering capability is essential from both organizational and production points of view. Therefore, it is necessary to develop the design office including the installation of computer facilities for design and production-planning purposes. In achieving this objective, the agreement for technical co-operation in the form of technical assistance entered into with Polish Shipyards (included in the contract signed for construction of the 26,300 dwt bulk carriers) will be very helpful. The design office could also work in close co-ordination with the other design offices belonging to the Turkish Shipbuilding Industry as well as with local research organizations to achieve optimum results.

2. A quality-control organization has already been established at the hull shops and started operation at the end of 1984. The establishment of the quality-control organization was preceeded by drawing up technical instructions covering the activities to be carried out, the control procedures as well as standards of accuracy and workmanship in hull construction, and introducing standard range and tolerance limits for each process. The necessary training for shop managers, foremen and chief workers was also given. In the same way, a quality-control organization should be established in the outfitting shops.

3. At present, each of four yards located in the Istanbul area and belonging to Turkish Shipbuilding Industry is manufacturing some outfitting elements for itself (bollards, ladders, small hatches, davits etc.). In an effort to increase efficiency and improve the organization, these elements should each be manufactured in only one shipyard and delivered to all the other shipyards. It is felt that this will produce a large number of cheaper and better products. Increased standardization will make it possible to introduce this idea into shipbuilding practice. More attention should be paid to setting up each yard's internal standards.

Figure 6. Organization structure introduced in June 1985

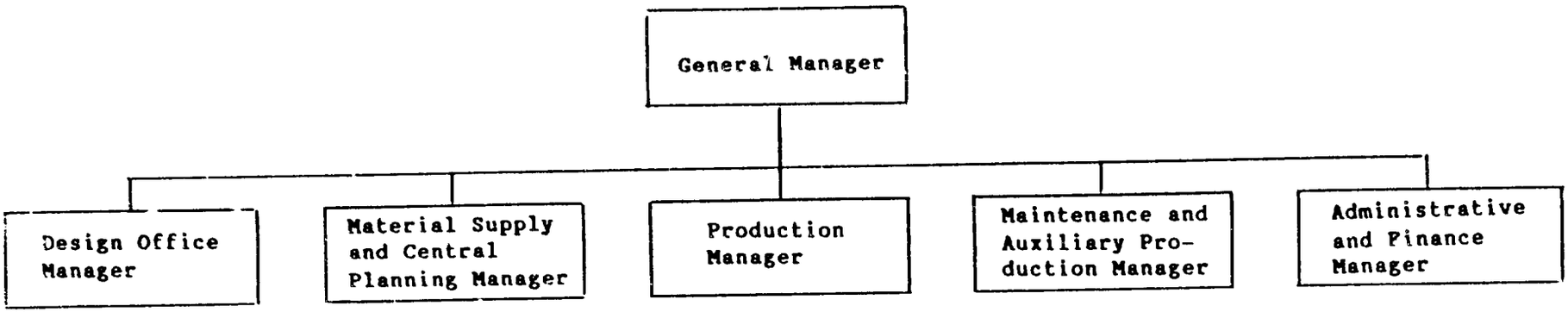
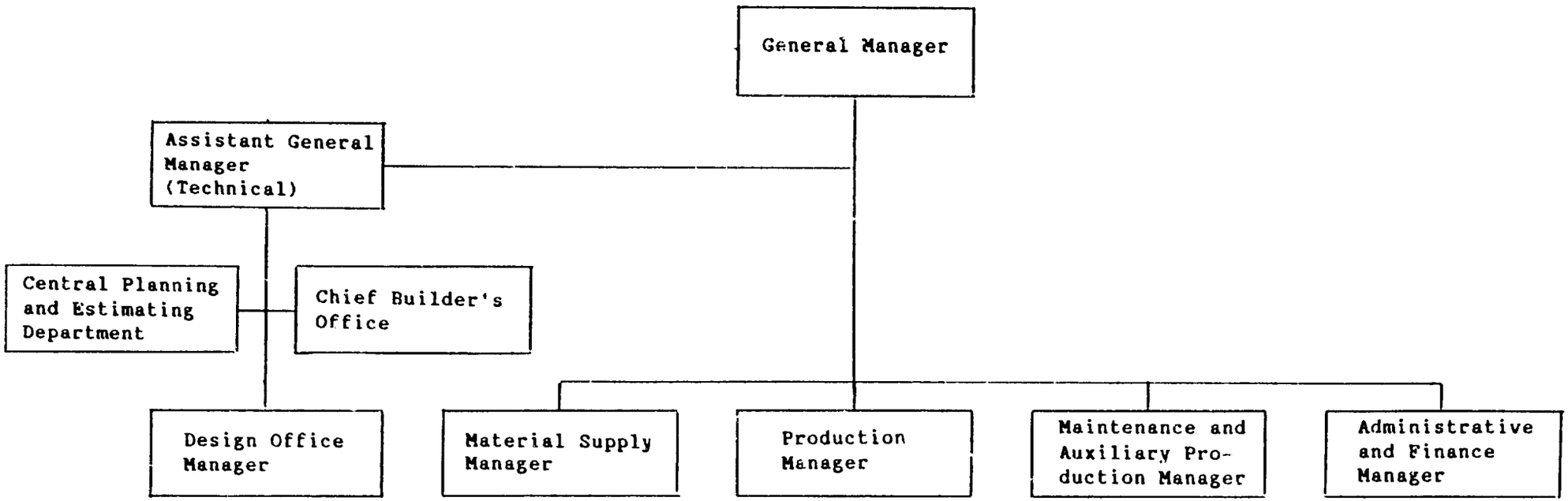


Figure 7. Proposed organization structure



4. Measures should be taken towards greater productivity through human-resource development. Shipbuilding is labour-intensive and, to achieve cost effectiveness, not only is upgrading and training of employees necessary, but also the quantity and quality of the work of the individual worker and the level of his qualifications should be reflected in the wages. Therefore, the introduction of a simple but more effective wage system for direct workers is highly recommended.

V. IMPROVEMENTS IN FACILITIES AND ORGANIZATION NEEDED FOR THE CONSTRUCTION OF THE BULK CARRIERS

During the period of this project, attention has been concentrated mainly on steel-hull construction. This is due to the fact that in most cases Pendik Shipyard has only built the steel hulls and the outfitting has been carried out elsewhere. Many improvements in work-flow and production-planning organization and modern technological methods of constructing the vessels have been introduced into the shipyard's practice, but there is still room for further improvement in steel-hull construction.

In 1985, the management and the expert have also been concentrating on the outfitting work and trying to achieve good work co-ordination by introducing proper production-planning methods and also using advance outfitting in blocks and on the slipway which reduces the construction time. Furthermore, a study has been carried out on whether the outfitting shops can reach a sufficient level of productivity and whether the existing facilities are sufficient to carry out the new shipbuilding programme in 1986-1987 for the construction of 26,300 dwt bulk carriers.

As a result of this, a detailed work programme has been drawn up which contains the improvements necessary to meet the requirements of the construction of bulk carriers. The work programme shows the major principal activities for the shipyard and ships to be built, includes a timetable for each activity and also serves as a control document as far as technical activities are concerned. Furthermore, to achieve optimum output of each outfitting shop, the work programme identifies the bottlenecks where improvements in facilities themselves, methods and equipment used are required.

The carrying out of this programme is essential and will make it possible to start the construction of the first 26,300 dwt bulk carrier in a proper and safe way.

The work programme is attached as an annex.

Annex

WORK PROGRAMME

General remarks

This work programme was drawn up at the end of last year, after working out the shipyard's shipbuilding programme for 1984-1989. It was intended as a working document for co-ordination purposes for the shipyard management and project staff. It also gives the possibility of monitoring the work progress at various stages and thus enabling counter-measures to be taken where necessary. All the schedules are geared towards meeting the target dates as laid down in the shipbuilding programme.

The work programme has been revised after the signing on 19 February 1985 of the new agreement between the shipyard and the shipowner, and it is subject to further discussion and alterations.

It should be stressed that it is not a new version of the project document, but it does indicate also the scope of the work to be organized and supervised by the expert within the framework of this project up to September 1985.

In the following pages, the activities to be carried out will be presented as follows:

1. Master schedule (a) for the 26,300 dwt bulk carrier, (b) for the 60,000 dwt bulk carrier
2. Indispensable investments
3. Modifications and improvements on the slipway
4. Improvement to steel-hull production methods and organization
5. Preparation of steel-hull surfaces and paint application
6. Outfitting: improvements to outfitting shops and organization of work-stations
7. Processing methods for pipe segments and organization of the pipe-outfitting shop
8. Programme of technical assistance for the 26,300 dwt vessels

Background

There has been a considerable delay in putting the contract for construction of the 26,300 dwt bulk carrier for the Polish Steamship Company into force. In the meantime, the shipowner has worked out an improved design for this ship. She will have an asymmetrical aftbody, will be fitted with 4 RTA-58 main engines (instead of 6 RTA-58) and the hull will be treated with self-polishing paints, which require special technology. An adequate addendum to the technical specifications as well as to the contract has been drawn up during February 1985 and signed with the shipowner on 21 February 1985.

The latest plan is that the contract will come into force by the end of April 1985 and the first material (for the hull structure) will be supplied from Poland in August 1985.

The first vessel will be delivered 29 months after the contract comes into force (i.e. September 1987). Delivery time for the subsequent vessels will be at six-month intervals. The first ship will be built according to the enclosed master schedule for the construction of the 26,300 dwt bulk carrier (no. 1A).

The contract for the construction of 60,000 dwt bulk carriers for T.D.B. Cargo Lines has not been signed yet. In the meantime, the basic design of this vessel has been worked out and handed over to the shipowner. The technical design will be done taking into consideration the shipowner's comments on the basic design. It is planned that the contract will be signed in the second quarter of 1985 and the first ship (according to the shipyard's offer) will be supplied in 1988. The first ship will be built according to the enclosed master schedule for the construction of the 60,000 dwt bulk carrier (no. 1B).

Both these contracts also provide a very good chance to start manufacturing marine diesel engines in the diesel engine factory which is under construction in the Pendik Shipyard and which will be completed at the end of this year. According to these contracts, Pendik Shipyard has the right to build the RTA-58 main engines (for the 26,300 dwt and 60,000 dwt bulk carriers) as well as the ATL-25 auxiliary engines (for the 60,000 dwt bulk carriers) in co-operation with H. Cegielski/Sulzer (Poland). It is the intention of the diesel engine factory (as a first step) to produce locally about 40 per cent of the value of these engines, including the engine components, erection and bed trials.

According to the above-mentioned contracts, possible inputs from Poland include also ship-design documentation and technical assistance. The ship's basic design and classification documentation will be drawn up in Poland with the participation of designers from Pendik Shipyard. The working drawings will (in the main) be prepared by the Pendik Shipyard design office.

Technical assistance and advice on the designing and on construction processes is also envisaged. Design engineers and shipbuilding experts will be deputed to the shipyard to provide guidance, advice and supervision on completion of the working drawings and to give advice concerning fast erection and outfitting of the ship.

Technical assistance also includes supervisory services related to the installation of the machinery and equipment supplied.

The amount of technical assistance and services will be up to a total of 300 man-months altogether for the three vessels of 26,300 dwt and 250 man-months altogether for the two vessels of 60,000 dwt. The number of persons and professional specializations will be agreed later on in the light of the exact schedule of the building programme.

1. Master schedule

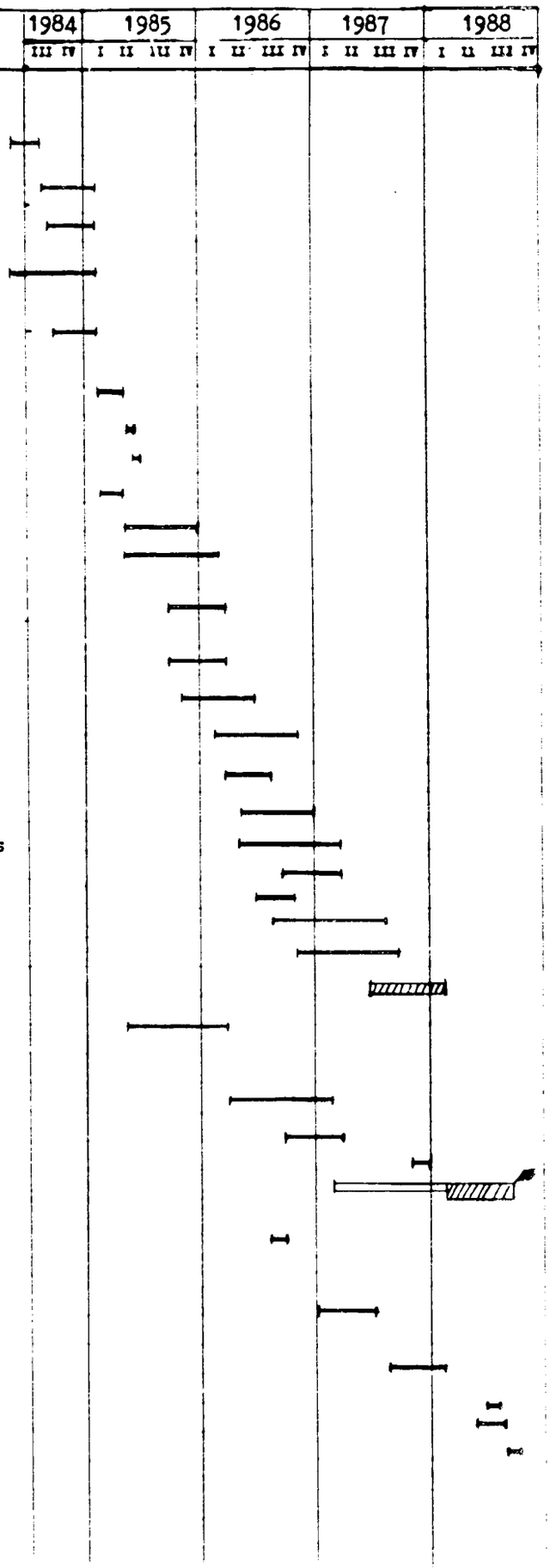
A. For the construction of the 26,300 dwt bulk carrier

Item	Activity	1984 III IV	1985 I II III IV	1986 I II III IV	1987 I II III IV	1988 I II III IV
1.	Preparing the basic design of the vessel					
2.	Making preliminary manpower calculations and cost estimates					
3.	Preparing th contract for supply of material, machinery and equipment					
4.	Preparing the draft contract with shipowner and handing it over together with basic design documentation					
5.	Approval of the basic design documentation by the shipowner					
6.	Preparing the contractual documentation					
7.	Signing the contract with shipowner					
8.	Putting the contract with shipowner into force					
9.	Putting the contract for material, machinery and equipment supply into force					
10.	Ship model tests					
11.	Preparing the classification documentation					
12.	Approval of the classification documentation by classification soc. and/or shipowner					
13.	Correction of material bills and delivery times					
14.	Preparation of hull working drawings					
15.	Preparation of hull technological drawings incl. nesting and cutting planes					
16.	Building the engine-room model 1:10 scale					
17.	Preparation of engine-room working drawings and single pipe sketches					
18.	Preparation of remaining outfitting drawings					
19.	Correction of material bills					
20.	Hull material supply (f.o.b. shipyard)					
21.	Steel preparation and sub-assembly					
22.	Hull sections and blocks assembly and outfitting					
23.	Construction of superstructure blocks up to 300 t weight					
24.	Outfitting of superstructure blocks					
25.	Installation of superstructure blocks on slipway					
26.	Hull construction on slipway					
27.	Main diesel engine supply					
28.	Sub-erection of main diesel engine in diesel factory up to 150 t weight					
29.	Main engine installation on board the ship					
30.	Outfitting and accommodation works					
31.	Machinery, equipment and material supply group I which are fitted on blocks (f.o.b. shipyard)					
32.	Machinery, equipment and material suppy group II which are fitted before launching (f.o.b. shipyard)					
33.	Remaining outfit equipment and material supply (f.o.b. shipyard)					
34.	Inclining test					
35.	Dock trials					
36.	Sea (acceptance) trials					

B. For the construction of the 60,000 dwt bulk carrier

Year and quarter

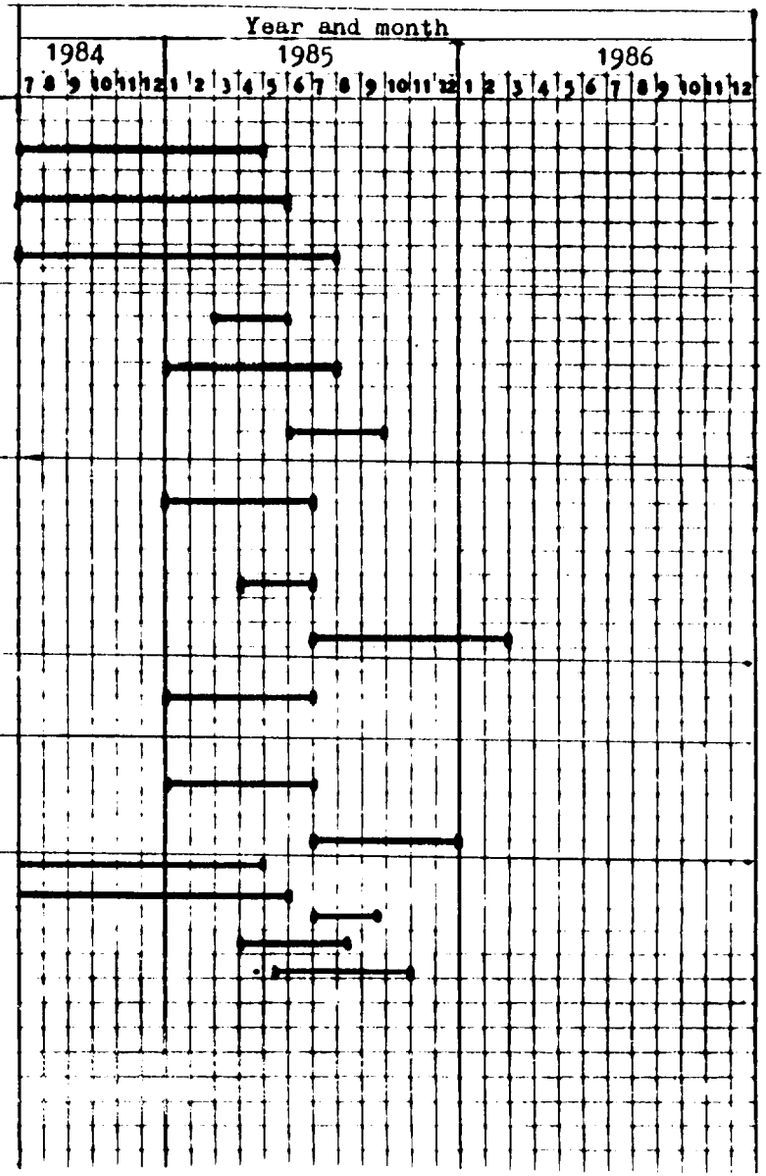
Item	Activity
1.	Getting D.B.T. Cargo Lines requirements and recommendations to the existing proposal for 60,000 dwt bulk carrier
2.	Preparing the basic design of the vessel
3.	Making preliminary manpower calculations and cost estimates
4.	Preparing the contract for supply of material, machinery and equipment
5.	Preparing the draft contract with shipowner and handing it over together with basic design documentation
6.	Approval of the basic design documentation by the shipowner
7.	Preparing the contract
8.	Signing the contract with shipowner
9.	Putting the contract for material, machinery and equipment supply into force
10.	Ship model tests
11.	Preparing of classification documentation
12.	Approval of the classification documentation with classification soc. and/or shipowner
13.	Correction of material bills and delivery time
14.	Preparation of hull working drawings
15.	Preparation of hull technological drawings incl. nesting and cutting planes
16.	Building the engine room model, 1:10 scale
17.	Preparation of engine room working drawings and single pipe sketches
18.	Preparation of remaining outfitting drawings
19.	Correction of material bills
20.	Hull material supply (f.o.b. shipyard)
21.	Steel preparation and sub-assembly
22.	Hull sections and blocks assembly and outfitting
23.	Hull construction on building berth
24.	Drawing up exact building programme for main engine manufacture in Pendik diesel engine factory. Production engineering Main engine parts and accessories supply and/or manufacture in D.E.F. Main engine erection and tests
25.	Main engine installation on board the ship
26.	Outfitting and accommodation works
27.	Machinery, equipment and material supply group I which are fitted on blocks (f.o.b. shipyard)
28.	Machinery and equipment supply, group II which are fitted before launching (f.o b. shipyard)
29.	Remaining outfit equipment and material supply
30.	Inclining test
31.	Dock trials
32.	Sea (acceptance) trials



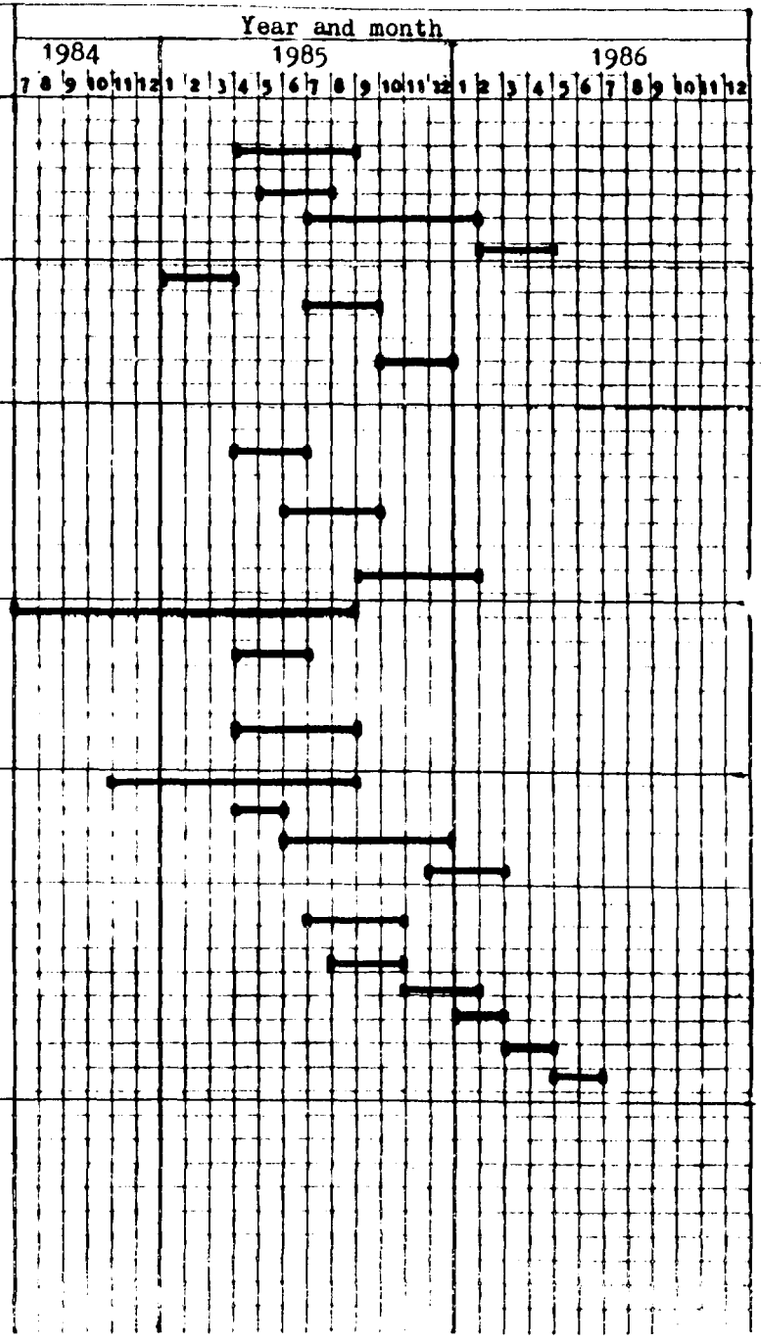
2. Indispensable investments

These investments refer to work which needs to be done to complete the first stage of the shipyard development. Work planned for the second stage of development is not included here.

Item	Activity
1.1	Checking the crane-supporting structure (including rails) in steel stockyard and making necessary corrections
1.2	Putting into operation 15 t electromagnetic overhead crane in steel stockyard
1.3	Putting into operation 5 t electromagnetic overhead crane in steel stockyard
2.1	Checking the rails installed for 15 t electromagnetic hammer-type crane on unloading quay and making necessary corrections
2.2	Putting into operation 15 t electromagnetic hammer-type crane on unloading quay
2.3	Work out a method of unloading and transferring profiles from unloading quay to steel stockyard and define required accessories and equipment
3.1	Extending the 30 t jib-crane foundations and rails (about 110 m). This crane has to serve the assembly and outfitting area in prolongation of the slipway
3.2	Prepare the technical design for electrical connection of crane to enable the extension of crane working area along the new work-station (electric cable and cable drum)
3.3	Procurement of the necessary electric equipment and installation
4.	Extending the 80 t jib-crane foundations and rails (about 200 m). 80 t crane has to serve the assembly and outfitting area in the prolongation of the slipway
5.1	Lay first part of foundations and rails for 300 t gantry crane (gantry crane erection area) including all necessary foundations and fittings for gantry erection purpose
5.2	Lay remaining part of foundations and rails for 300 t gantry crane
6.1	Steel procurement for 300 t gantry crane, steel structure
6.2	Steel fabrication including nesting, cutting planes etc.
6.3	Assembly of pendular leg
6.4	Assembly of rigid leg
6.5	Assembly of girder



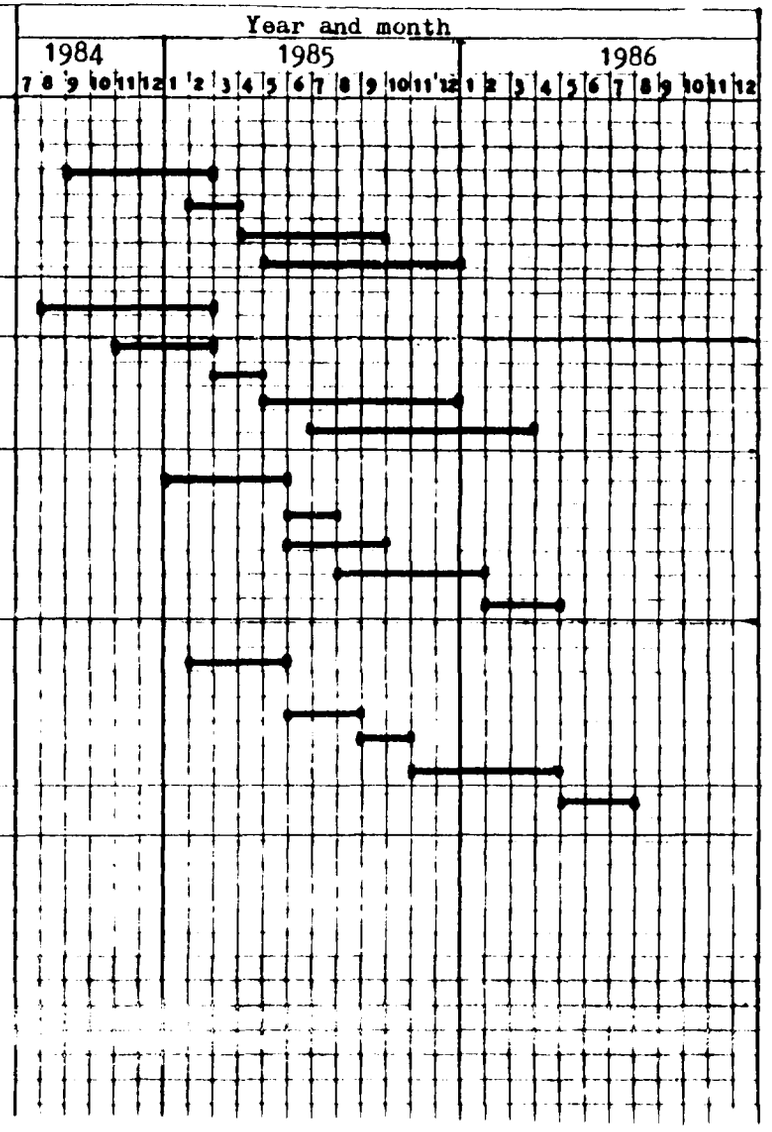
Item	Activity
6.6	Manufacturing and supply of trolleys and cabins with accessories (Karabük Factory)
6.7	Delivery of mechanical, electrical and electronic equipment
6.8	Outfitting and erection works
6.9	300 t gantry crane commissioning and tests
7.1	Preparation of tender invitation for 80 t jib crane
7.2	Selection of successful bidder
7.3	Signing the contract for 80 t jib crane supply and erection and working out the exact time-table for all activities in order to put it into operation as soon as possible
8.1	Review the proposal for the lay-out of the assembly and outfitting area under the gantry crane (10,000 m^2) and prepare necessary corrections. Define each work-station's requirements
8.2	Prepare working drawings, material and equipment lists. Material procurement
8.3	Installation of all energy systems and equipment according to approved layout
9.1	Put the galvanizing plant into operation
9.2	Establishing the chemical laboratory (including needs connected with paint production)
9.3	Making studies of the material flow in galvanizing plant including storage of galvanizing element before and after galvanizing process. Define necessary modifications
10.1	Construction of oxygen-generating plant building
10.2	Machinery, equipment and accessory supply
10.3	Installation of machinery and equipment
10.4	Oxygen generating plant commissioning and tests
11.1	Prepare necessary working drawings for modernization which should be made in connection with installing the new machinery and equipment
11.2	Dismantling the existing equipment from acetylene-generating plant
11.3	Carry out all necessary foundation and installation work
11.4	Machinery and equipment supply
11.5	Installation of machinery and equipment
11.6	Acetylene-generating plant commissioning and tests



3. Modifications and improvements on the slipway
(connected with supporting system and launching equipment)

The existing supporting and launching equipment (except ground ways) are not sufficient for building and launching the larger ships. It is recommended to design and prepare new supporting and launching equipment which can be used in supporting and launching smaller vessels as well as larger ones, up to Panamax size, using the same equipment. The sliding ways should be steel, displacement type.

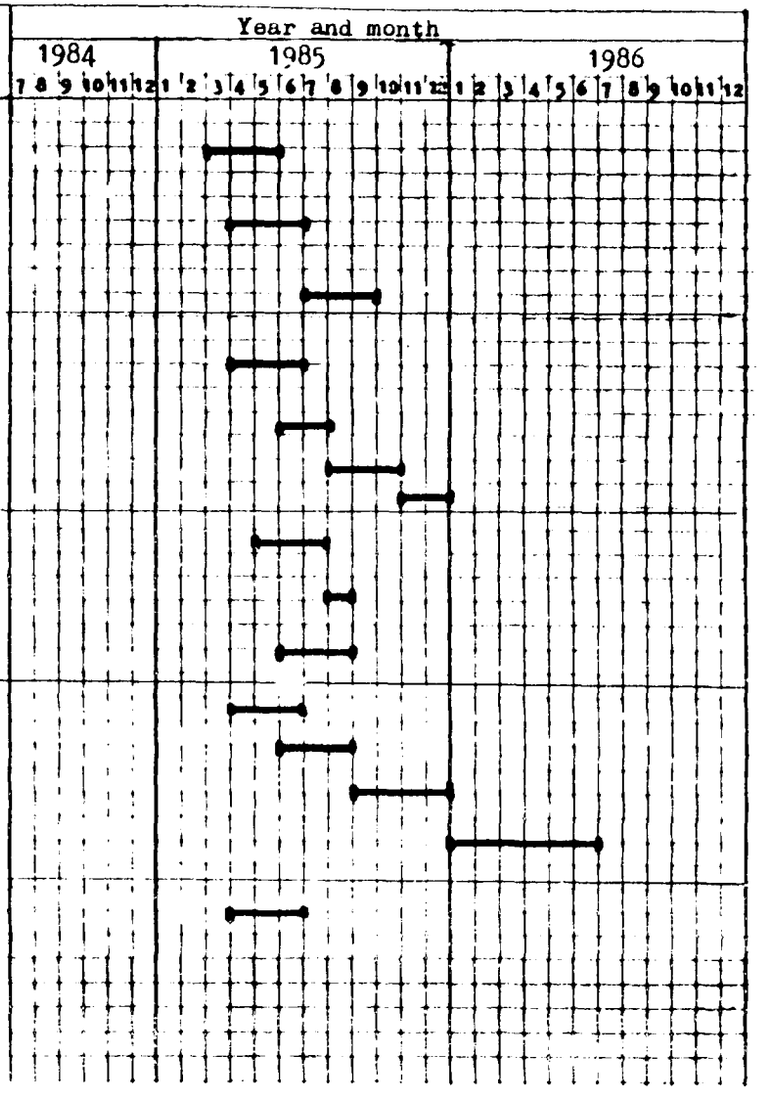
Item	Activity
1.1	Design hull-supporting system incl. working drawings for centre support, bilge blocks etc. plus material list
1.2	Prepare calculations, flow cards, job order
1.3	Material supply
1.4	Make all necessary equipment for supporting system
2.	Prepare the launching studies for different ships and work out the exact launching method in Pendik Shipyard
3.1	Prepare working drawings for sliding ways incl. material list
3.2	Prepare calculations, flow cards and job order
3.3	Material supply
3.4	Make sliding ways
4.1	Prepare working drawings of mechanical stoppers for launching ways incl. material list
4.2	Prepare calculations, flow card and job order
4.3	Material supply
4.4	Making the mechanical stoppers
4.5	Fitting the stoppers on slipway, including tests
5.1	Prepare general arrangement plan for launching equipment of 26,300 dwt incl. working drawings for fore poppet and all remaining elements. Material list
5.2	Prepare calculations, flow cards and job order
5.3	Material supply
5.4	Making all remaining elements
6.	Launching preparations for 26,300 dwt bulk carrier



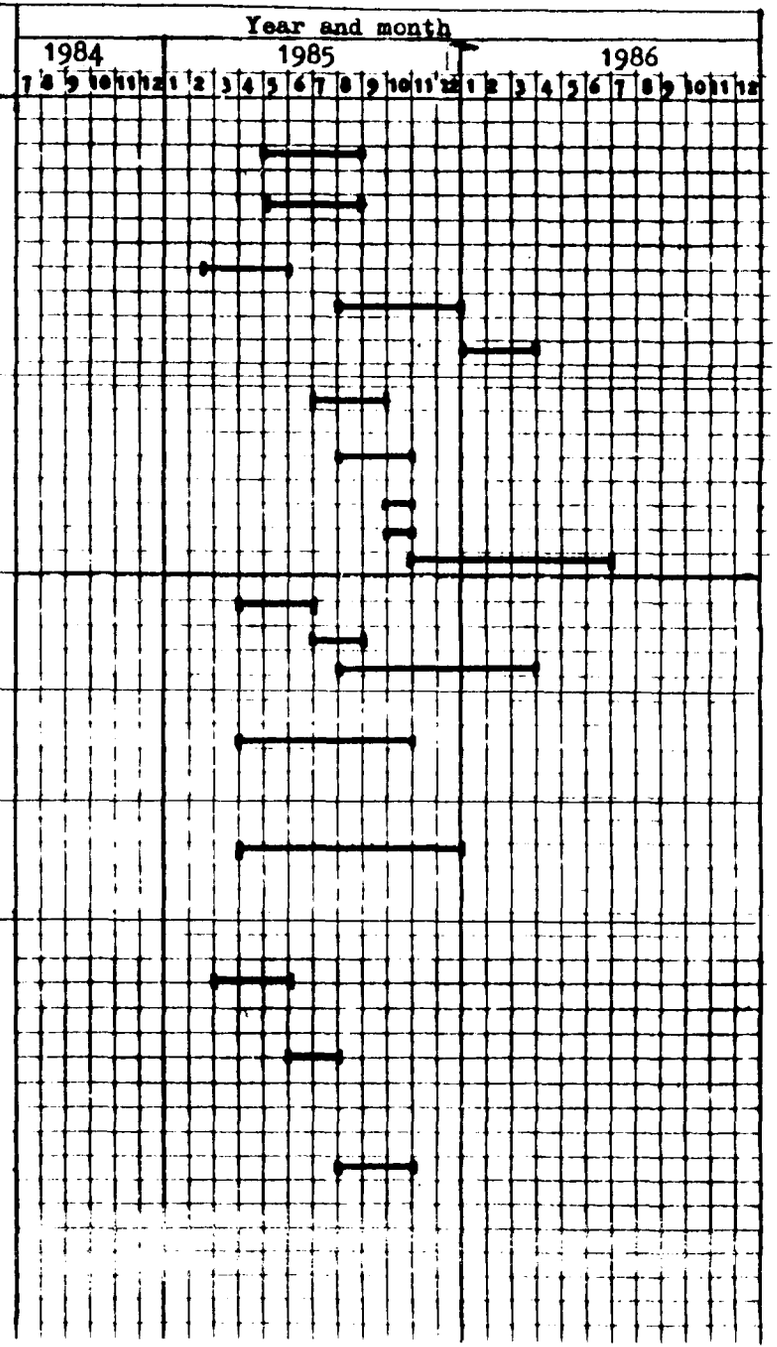
4. Improvement to steel-hull production methods and organization

Considerable progress has been made recently in the hull shops, in particular in developing and applying new technological and organizational methods of hull construction. The quantity and quality of production is still on the increase. The steel consumption of about 6,000 tonnes in 1984 will be increased to about 11,000 tonnes in 1985. The shipyard achieved better accuracy and workmanship and more efficient operation, but there is still much room for further improvement. Of particular importance are the improvements mentioned below.

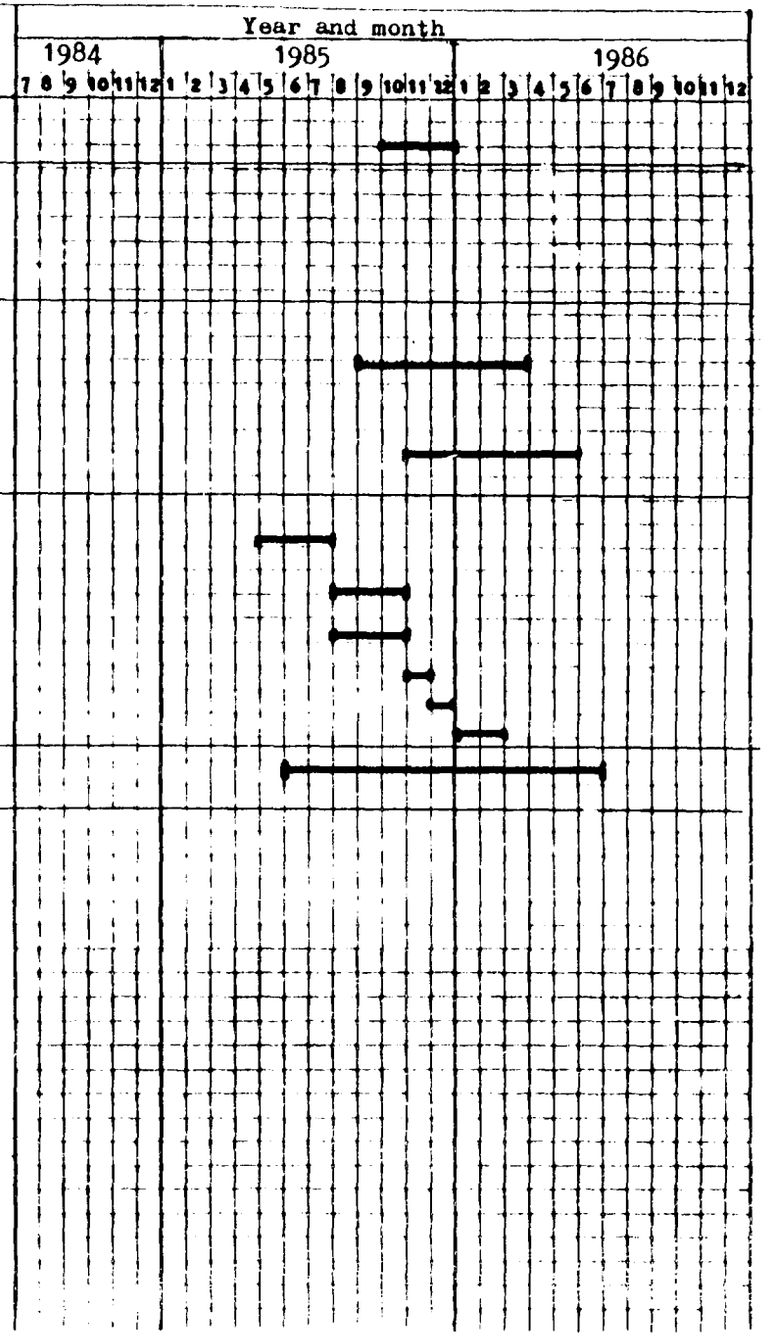
Item	Activity
1.1	Analyse the existing instruction on steel-stockyard organization and prepare modifications
1.2	Analyse the existing system (information flow) for plates and profiles classification certificates. Prepare the new information flow chart according to the new requirements
1.3	Introduce the corrected organization of steel stockyard and information flow of class certificates into the shipyard's practice
2.1	Make studies and prepare new layout of profile area in platers' shop taking into consideration introduction of new work-station for sub-assembly
2.2	Define work-station requirements and specifications and detailed production method
2.3	Introduce all necessary changes in this area
2.4	Introduce the pre-assembly method for next new ship to be built
3.1	Design changes in profile-bending methods as well as profile-marking system and material flow
3.2	Introduce the new bending and marking method into the shipyard's practice; better workmanship should be achieved
3.3	Design necessary equipment (pallets) for transporting profiles to panel line
4.1	Define requirements for organization of hot-bending plates (line-heating method) work-station in platers' shop
4.2	Arrange all necessary equipment, tools and accessories
4.3	Arrange the training for the workers and foreman in shipyard when these methods are used
4.4	Introduce the method into the shipyard's practice (technical assistance is necessary)
5.1	Work out necessary modification to the existing stiffeners fitting and welding work-station in platers' shop taking into consideration the improved material flow



Item	Activity
5.2	Make necessary maintenance and welding tests of the existing CO^2 automatic arc-welder and conveying tables (repair if necessary)
5.3	Arrange all necessary modifications in connection with the new organization
5.4	Specify all house walls for car ferries (nos. 008, 009, 010, 011) which can be made in this work-station
5.5	Introduce the method for the above-mentioned car ferries
5.6	Introduce for next ships to be built taking into consideration also point 2.1 (pre-assembly)
6.1	Perform analysis of the new building programme and design work-station in block-assembly shop necessary for this programme
6.2	Make working drawings (and material list) of steel flat stands for assembly of double bottom, bulkheads and other flat sections
6.3	Prepare calculations, flow card and job order
6.4	Material supply
6.5	Making all necessary stands
7.1	Draw up the technological instruction for straightening of ship construction with thermic methods
7.2	Arrange on-the-job training for workers and technical staff
7.3	Introduce this method into the shipyard's practice
8.	Work out modifications to the quality control procedure, to ensure that each element, section or block, before reaching the erection stage, will fulfil the quality requirements as stipulated in the quality standards
9.	Define requirements and production methods to reduce the amount of alignment and finishing work as well as reduce surface defects in steel plates and profiles. Do this separately for block-assembly shop and for slipway (this improves quality and saves man/days)
10.1	Study and identify modifications which should be introduced to the agreements (contracts) between shipyard and sub-contractors concerning hull work quality, and acceptance procedures
10.2	Draw up and introduce the new draft contract, between shipyard and sub-contractor, which will include all the quality requirements as in the agreed quality standards and shape-control procedure
10.3	Draw up and introduce the new inspection and acceptance procedure for each element, section and block before it is fitted on the slipway. Final inspection and acceptance on the slipway after erection should also be planned. Shipyard's quality-control certificates should be required for each stage of construction (sub-assembly, assembly, erection)



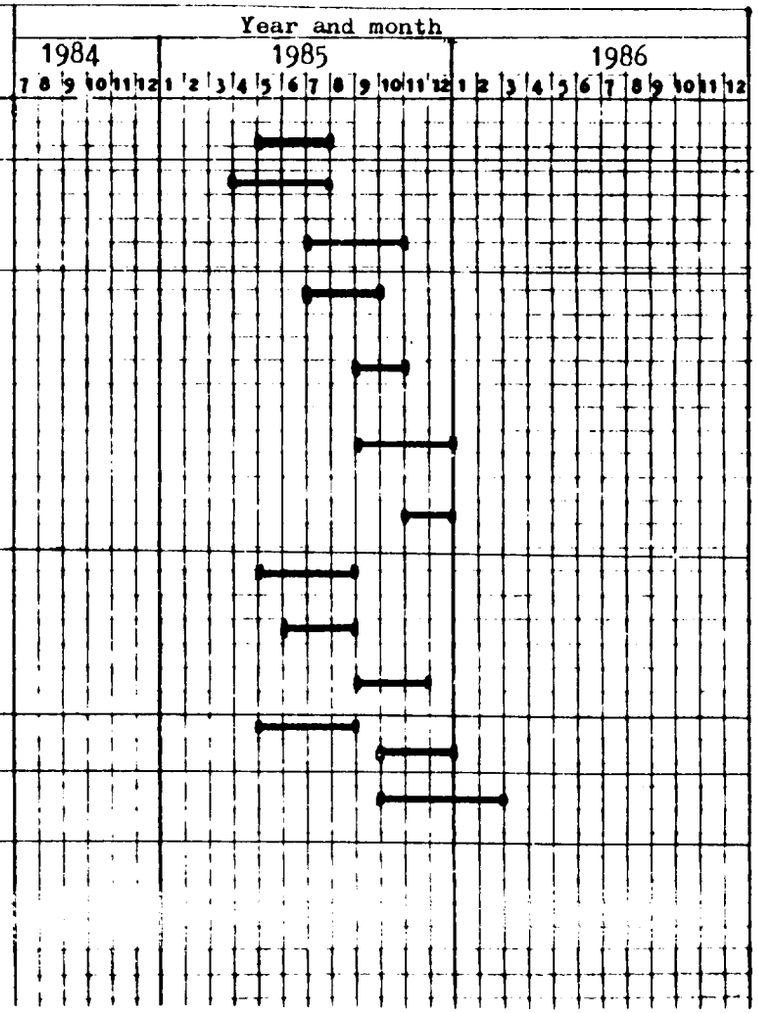
Item	Activity
10.4	Introduce the above-mentioned procedures into the shipyard's practice
11.1	Prepare studies concerning types and kinds of scaffolding necessary for the erection and welding works on slipway
11.2	Prepare calculations, flow card and job order
11.3	Material supply
11.4	Make all necessary scaffolding
12.1	For 26,300 dwt vessel, work out an exact programme for each stage of ship construction (fabrication, pre-assembly, section assembly, block assembly). Define introduction method for each work-station in the block-assembly shop and platers' shop (for pre-assembly)
12.2	Identify new material (equipment, stands) required for each stage of construction and prepare an exact programme with timetable to fulfil the requirements
13.1	As the superstructure for 26,300 dwt vessel will be made as a separately-built block or blocks up to 300 t weight, define production method, erection stand required as well as transporting system
13.2	Elaborate working drawings for erection stand
13.3	Elaborate working drawings for attachments and other transporting accessories, if necessary
13.4	Prepare calculations, flow card, job order for item 13.2 and 13.3
13.5	Material supply
13.6	Make the necessary equipment
14.	Prepare programme and run the course for training welders to improve their technical quality



5. Preparation of steel hull surfaces and paint application

The shipyard has all the necessary facilities for preparation of steel plates and steel-profile surfaces and for the application of primer. This fulfils all the recommendations of the paint makers and requirements of the shipowners. This equipment came into operation early in 1984 and to date some ships (where shipowner required) have been built from shot-blasted and primered plates and profiles. Unfortunately, so far the shipyard does not clean the surfaces well enough after assembling the plates and profiles into the sections as well as hull-section welds on slipway, where the primed surface is damaged mechanically and also by welding seams and burns. The investment programme for the second stage of shipyard structure doesn't include an under-cover cleaning and painting facility for hull blocks. Usually any design involves the erection of a paint hall as part of the shipyard's production line.

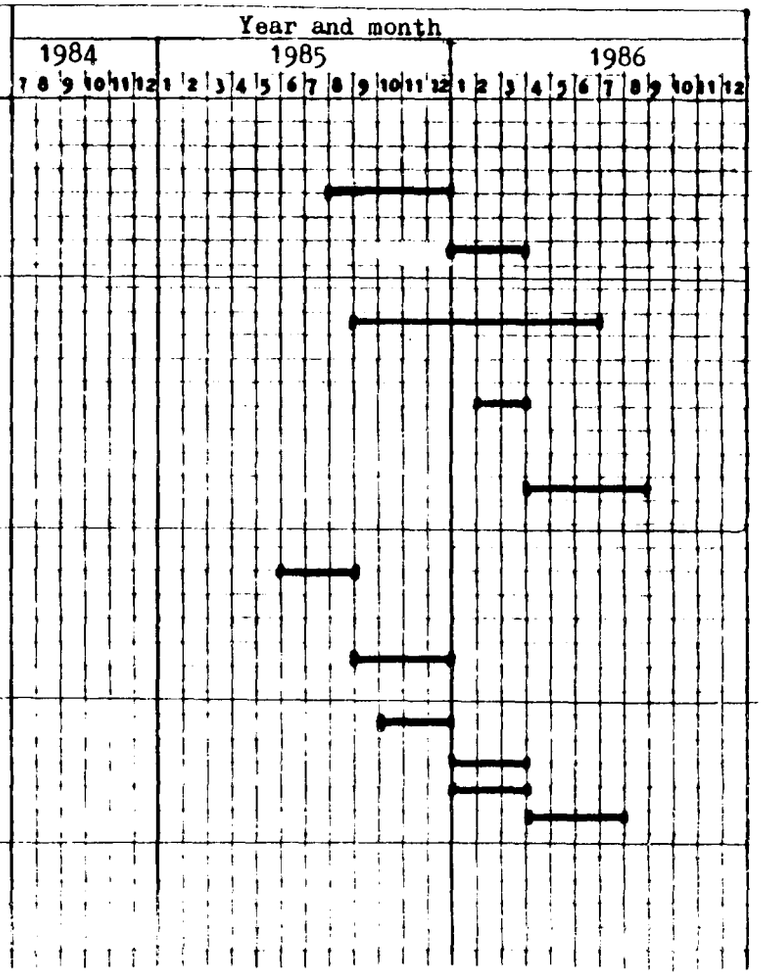
Item	Activity
1.	Establishing the hull-painting division as a part of paint shop
2.1	Collecting the vacu-blast units and accessories which are in shipyard store
2.2	Giving the necessary training for workers and technical staff to gain experience in using this equipment
3.1	Supplying locally-available power tools equipped with emery discs and rotary steel-wire brushes
3.2	Providing necessary training for workers and technical staff to gain experience in using this equipment so that work complies with shipowner's and paint makers' requirements
3.3	Introduce into shipyard practice, during construction of car ferries no. 010 and 011, the method that all the sections and blocks will be cleaned and primed before erection on slipway
3.4	Introduce the same method on slipway, organizing the cleaning and painting works along with the hull-construction flow
4.1	Prepare assumptions for establishing an outdoor sand-blasting work-station for sections and blocks
4.2	Arrange offers for supplying sand-blasting equipment including personnel-protection (safety) clothes
4.3	Supply equipment and establish work-station for sand-blasting sections and blocks
5.1	Study the question of painting equipment taking new needs into account
5.2	Supply painting equipment
6.	Make studies for the under-cover cleaning and painting facility and include it in the investment programme



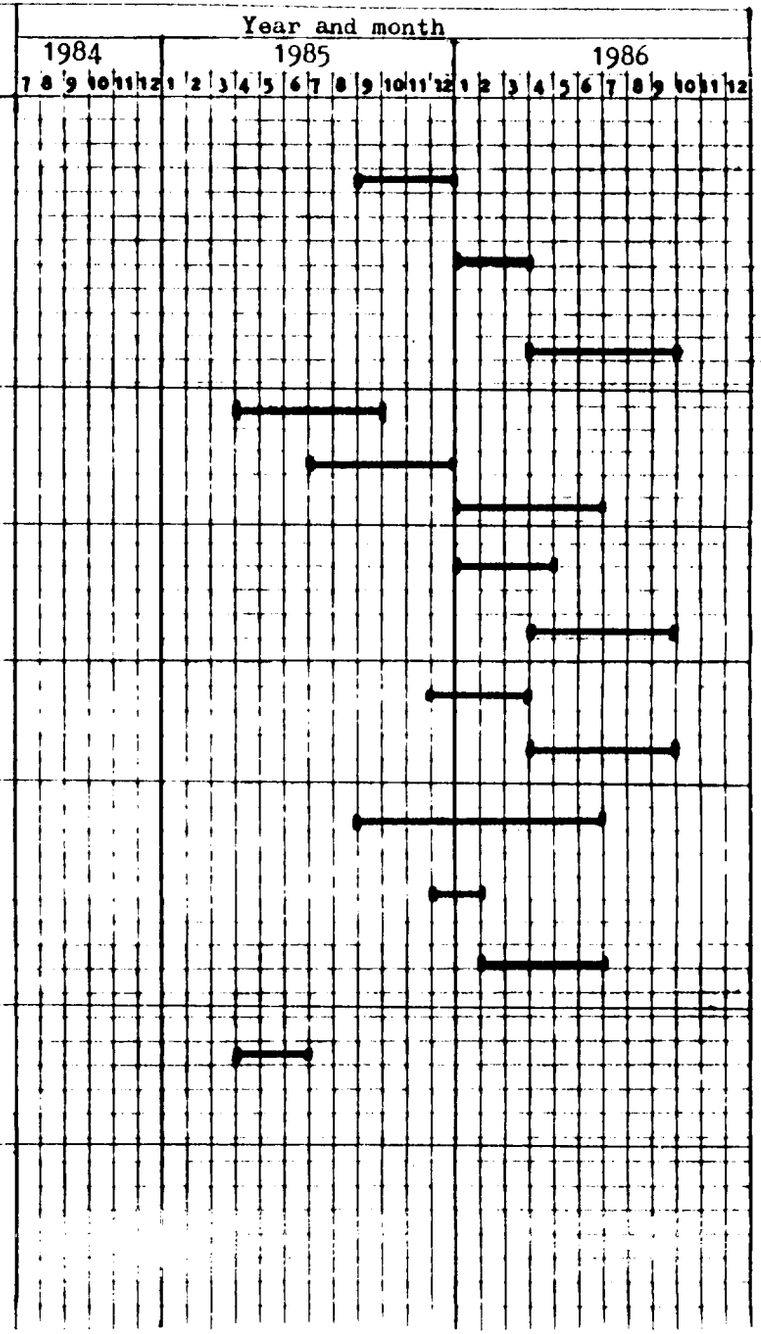
6. Outfitting: improvements to outfitting shops and organization of work-stations

As mentioned before, the shipyard has not enough experience in outfitting the vessels or in manufacturing equipment due to the fact that some of the steel hulls were supplied to the shipowner for outfitting elsewhere. Therefore, lack of outfitting jobs during 1984 and the first quarter of 1985 made it impossible to increase the quantity of workers in the outfitting shops, where about 160 workers are currently employed. After the shipyard was awarded a long-term contract for car ferries and bulk carriers, it became necessary to increase the quantity of workers in the outfitting shops to about 500 (excluding sub-contractor's labour) in the first half of 1986. These figures represent an enormous increase in capacity. To reach this level, special measures should be undertaken and this problem should be the subject of separate study and activity. It will be necessary to make some improvements and modifications to the organization of shops and work-stations. Of particular importance are the improvements mentioned below.

Item	Activity
1.1	Make studies and prepare layout of electric shop taking into consideration further shipyard development (second stage) as well as the work-stations mentioned below
1.2	Prepare an exact programme with timetable for supply of equipment and tools and their installation
2.1	Prepare working drawings and technical specifications for the standard fittings, elements, attachments etc. which are necessary for the electrical systems
2.2	Delegate the engineer responsible for this job to the marine consultants (in the framework of signed agreement) for training and co-ordination
2.3	Organize the manufacture of these elements by the shipyard and/or the sub-contractor. Prepare layout and organization of the work-station including equipment and tools necessary for manufacturing these elements
3.1	Agree with marine consultants on the design and specification of electric cables and on methods of cable preparation and marking (cable prefabrication in electric shop)
3.2	Prepare layout and organization of the work-station for cable prefabrication and marking, including cable-store area. Specify necessary equipment and tools
4.1	Prepare working drawings of generator test equipment (resistor), including material list
4.2	Prepare calculations, flow cards and job order
4.3	Material supply
4.4	Making and testing the equipment



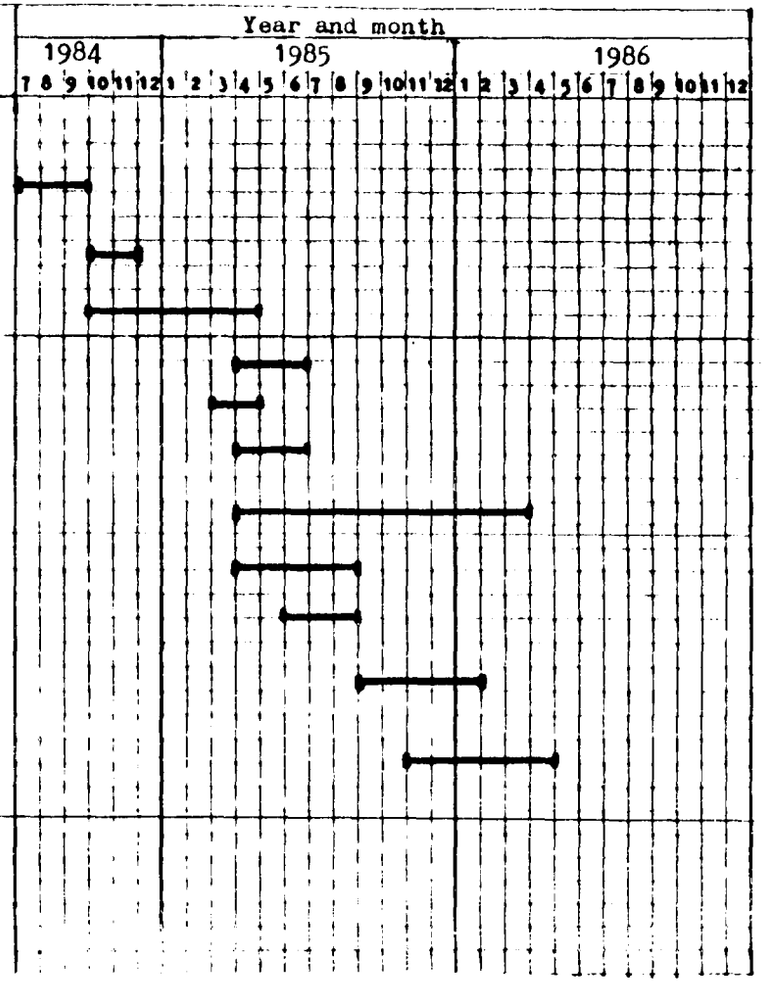
Item	Activity
5.1	Compile the technical specifications, maker's addresses and offers for necessary reading and measuring equipment (noise, vibration, ventilation, lighting, micro-wave, torsion meter and others)
5.2	Work out the organization of the measurement and control processes during the ship's construction to fulfil the requirements of the technical specification for 26,300 dwt vessel
5.3	Supply equipment and/or make a preliminary agreement with sub-contractors who are well-equipped and able to make the required measuring instruments
6.1	Supply portable milling machine for preparation of the main engine and auxiliary engine foundations
6.2	Prepare all necessary technological instructions, quality requirements etc., and arrange on-the-job training
6.3	Introduce the new method of preparing foundations on the car ferries
7.1	Work out the method of main engine installation taking into account the possibility of assembling the main engine up to 150 t in diesel engine factory (for the first 26,300 dwt) and up to 300 t for second vessel
7.2	Prepare drawings for necessary equipment and tooling (instrumentation) and manufacture it
8.1	Review the proposed method for installing the propeller shaft, propeller and rudder and prepare necessary changes to this instruction
8.2	Prepare drawings for new equipment and tooling (instrumentation) required and manufacture it
9.1	Prepare working drawings and technical specifications for standard fittings, elements etc. which are needed for deck and accommodation work (outfit steel shop and fitting shop)
9.2	Send the engineer responsible for this job to the marine consultants (as in the signed agreement) for training and co-ordination
9.3	Organize the manufacture of these elements in the shipyard and/or by sub-contractors. Prepare layout and organization of the work-station including equipment and tools necessary for manufacturing these elements
10.	To improve the material procurement for the outfitting shops it is recommended to establish a standardization, unification and material section in the design office. All the activities mentioned in points 5.2, 5.9, 6.4 as well as the technical assistance mentioned in point 7.11 should be under the direct control of this division



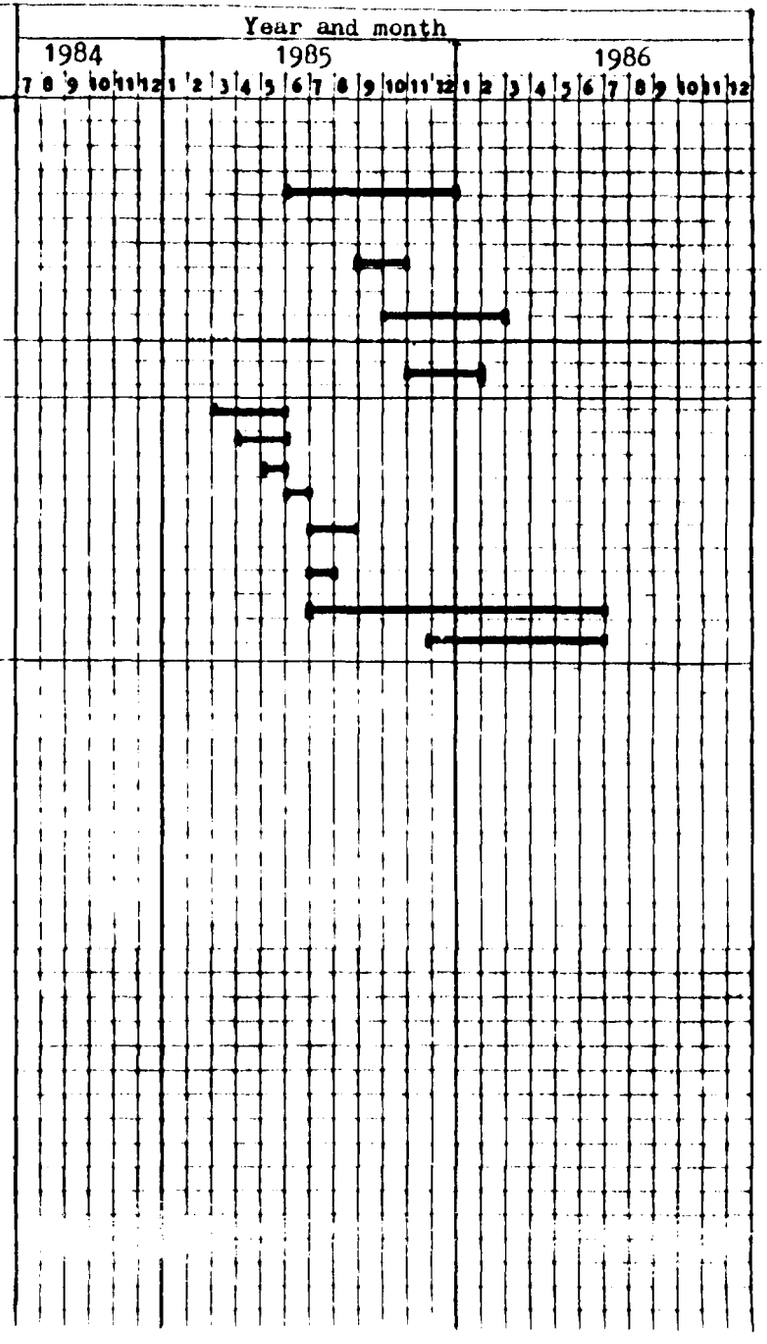
7. Processing methods for pipe segments and organization of the pipe-outfitting shop

The shipyard does not have experience in pipe works because, up to now, it has only built steel hulls (except for outfitting m/s "Kilis") with the outfitting being carried out elsewhere. Also, the existing pipe-outfitting shop is not well-enough equipped and methods of design and production engineering are not adequate. The processing of pipe segments should be organized according to the sequence of assembly-block production so that pipe pieces and fittings that go to a particular block can be fitted on that assembled block on the ground before reaching the erection stage. To enable use of this method, it has been decided that for the 26,300 dwt bulk carrier engine room, a 1:10 scale model will be made for design and production engineering purposes. The outfitting work which will be carried out in 1985 during the construction of the 250 t floating crane and car ferries give a possibility for using the new methods and providing on-the-job training for workers and technical staff.

Item	Activity
1.1	In the outfitting schedule for the 250 t floating crane, about 80% of outfitting work (including piping systems) should be planned to be done on the blocks or on slipway before launching
1.2	Establish the Chief Builder (co-ordinator) on board the crane to co-ordinate the above-mentioned work programme
1.3	Realization and resolution of any problems on board the ship and in the pipe-outfitting shop
2.1	During the outfitting of the six car ferries, new methods of piping works can be used. It should be decided which of these will be applied
2.2	Establish the Chief Builder (co-ordinator) on board car ferries
2.3	Work out the outfitting schedule for each car ferry taking into consideration the decision made in point 2.1
2.4	Realization and resolution of any problems on board the ships and in the pipe outfitting shop
3.1	Make studies and prepare layout of pipe outfitting shop taking into consideration further shipyard development (second stage)
3.2	Prepare an exact programme with timetable for equipment and tool supply and installation
3.3	Prepare temporary methods for production of straight pipe segments and introduce into shipyard practice (if programme in point 3.2 proves impossible)
3.4	Prepare temporary methods for tightness tests of pipes and valves and introduce into shipyard practice (if programme in point 3.2 proves impossible)



Item	Activity
4.1	Prepare all standard working drawings for fittings, elements, attachments etc., necessary for the piping systems (incl. technical specifications)
4.2	Send the designer responsible for this job to the marine consultants (according to the signed agreement) for training and co-ordination
4.3	Organize the production of these elements in shipyard and/or by sub-contractor
5.1	Work out technology for the cunifer pipes which will be used for seawater cooling systems
6.1	Prepare the layout of the engine-room model shop
6.2	Prepare list of tools, equipment and material for engine-room model shop
6.3	Establish the engine-room model shop technical staff
6.4	Supply equipment, tools and materials accessories to point 6.2
6.5	Prepare engine-room model of hull part for 26,300 dwt bulk carrier
6.6	Provide models of machinery, equipment and accessories as well as technical assistance (for model and design purpose)
6.7	Build engine-room model 1:10 scale for 26,300 dwt bulk carrier
6.8	Prepare single pipe sketches (technical assistance necessary)



8. Programme of technical assistance for the 26,300 dwt vessels

This proposal has been prepared in accordance with the technical agreement signed 24 June 1984 and the shipyard's needs. According to the agreement, design engineers and shipbuilding experts should be deputed to the shipyard to provide guidance, advice and supervision on completion of the working drawings. They should also advise on the fast outfitting of the ships. The extent of technical assistance will be up to 300 man-months altogether for the three vessels of 26,300 dwt. Required language: English.

Item	Post (preliminary job description)	Professional specialization	Number of persons	Period (man/ months)	Time required 1985 III IV	1986 I II III IV	1987 I II III IV	1988 I II III IV
1	Team for building engine-room model, preparing single pipe sketches and co-ordinating drawings together with shipyard's team	Experience in engine-room model building and preparation of pipe sketches and co-ordination drawings	Team	27				
2	Technical co-ordinator for hull design, hull planning and organization as well as hull construction	Experience in design, lofting and nesting/cutting planes, hull construction, planning and hull-shop organization	1	27				
3	Hull production engineer who takes a part in preparing hull technology, manpower calculations, and planning for ship and hull shops	Experience in hull production engineering	1	6				
4	Welding engineer who takes a part in preparation of ship's welding technology and on-the-job training shipyard's welding engineers	Experience in shipyard welding technology, theoretical welding problems and welding equipment	1	6				
5	Plater/foreman. Hot-bending methods for steel plates, on-the-job training	Experience in hot-bending methods for plates	1	6				
6	Chief Builder (co-ordinator) working together with shipyard's builders	Experience in co-ordination of work on board the ship during the outfitting, trial and ship commissioning period	1	24				

Item	Post (preliminary job description)	Professional specialization	Number of persons	Period (man/ months)	Time required
7	Outfitting production engineer who takes part in preparation of outfitting technology, manpower calculations, and planning for ship and outfitting shops	Experience in outfitting engineering	1	9	
8	Pipe-shop assistant working together with shop manager, introducing the technology and organization in pipe shop and on board the ship	Experience in pipe manufacturing and pipe-shop organization	1	15	
9	Electric-shop assistant working together with shop manager, elaborating and introducing technology and organization in electric shop and on board the ship	Experience in electrical work and electric-shop organization	1	15	
10	Outfit-designers co-ordination group, supervising the completion of working drawings and construction of first ship	Specialized design experience in this field	Team	18	
11	Outfit-designers group for preparation of unification and standardization of outfit elements	Designers of different specializations experienced in unification and standardization of outfit elements	Team	15	
12	Outfit designers co-ordination group, supervising any changes in the working drawings and construction of second and third ships	Specialized design experience in this field	Team	18	

Time required: 1985 III IV | 1986 I II III IV | 1987 I II III IV | 1988 I II III IV

Item	Post (preliminary job description)	Professional specialization	Number of persons	Period (man/ months)	Time required 1985 III IV	1986 I II III IV	1987 I II III IV	1988 I II III IV
13	Supervision of the installation of main engine and auxiliary-engine, including dock and sea trials	According to HEP practice	Team	96		———	———	———
	Supervision of the installation of propeller and propeller shaft					—	—	—
	Supervision of the installation of other equipment					———	———	———
	Guarantee engineers on board the ships						———	———
14	Other			18				
			Total	300				