ROYAL INSTITUTION OF NAVAL ARCHITECTS

AUSTRALIAN BRANCH - WHYALLA SECTION

NOTICE OF TECHNICAL MEETING

ON

MONDAY 24 MAY 1976

S.A.I.T THEATRETTE - NICOLSON AVENUE

AT 8.00 P.M.

Mr. T. Oayama, General Manager of the Yokohama Shipyard of Ishikawajima - Harima Heavy Industries, Japan, will speak on

"I.H.I.'s SHIPBUILDING METHODS"

I.H.I. is one of the world's leading shipbuilders. The Yokohama yard was built in 1964 and was one of the first shipyards built especially for large tankers.

Supper will be served after the meeting.

Bryan V. Chapman,
HON. SECRETARY.

P.O. Box 349,
WHYALLA S.A. 5600.

Phone 458555 Ext. 39 (S/Y 313)

M. O'Pearson
F. Ierenyi

ROYAL INSTITUTION OF NAVAL ARCHITECTS

AUSTRALIAN BRANCH - WHYALLA SECTION

PAPER GIVEN BY MR. T. AOYAMA,

GENERAL MANAGER, SHIPBUILDING DIVISION,

I.H.I., TOKYO

Entitled

"I.H.I.'S SHIPBUILDING METHODS"

On

MONDAY, 24TH MAY, 1976

S1 Gentlemen,

It is my greatest pleasure to have this opportunity to present you our shipbuilding methods and practices.

Introduction

S2 IHI has 5 shipyards in operation. The oldest is the Tokyo shipyard, established in 1939, which is now building the "Freedoms" and the "Fortunes" under mass production system.

S3 Yokohama shipyard is building VLCCs of 230,000 (two hundred and thirty thousand) ton deadweight, in series.

S4 Aioi shipyard is expert in building sophisticated vessels like container carriers and liquified gas carriers.

S5 Kure shipyard is the leader of ULCCs, and has built the world's largest tanker, the "Globtic Tokyo", having a deadweight of 480,000 (four hundred and eighty thousand)
S6 tons, and the newest is the Chita shipyard, established in 1972.

Despite the differences in origin and capacity of the shipyards, they are all endeavouring to materialize the common ideal, that is, furnish to their customers with ships meeting their customers' specifications and demands in the most economical way.

S7 The phylosophy in IHI is based on the concept that, to maintain safety in construction works will easily lead to improvement in product quality and reduction in construction cost.

From our long experiences in shipbuilding, it is considered that the most effective way to realize this phylosophy, is to build "standardized ships".

At present, we have developed several types of standardized ships, and in principle, these ships are distributed to appropriate shipyards and built in series.

By adopting this system, we could immediately modify and improve the defects, feed-backed from the construction site or the ships in service, and by this procedure, it leads to grade-up in quality and functioning of the productions, and easiness in construction works.

As a summary, the engineering cycle starting from development and design of a new type of ship and followed-up by improvements, based on feed-backs from construction site and ships in service, is the basic principle of IHI shipbuilding technology.

Of course, this principle is the backbone even for the old-aged shipyards, but it is rather difficult for these shipyards to eliminate hard, dangerous and dirty labours due to their obsolete facilities and layout.

So, to realize this phylosophy in the most ideal way, IHI established Chita shipyard in 1972 as the most modern shipyard in the world for construction of ultra-size ships.

Now, I would like to introduce you the recent shipbuilding technology of IHI, taking Chita shipyard for example.

1. Features of Chita shipyard's facilities

1-1 Basic concept in planning

S8 In planning the facilities of Chita shipyard, we started with complete engineering of the software before digging into the hardware, taking into consideration of the ship's size and amount of output, expected for this shipyard. As a result of these studies, we concluded that this shipyard should have following outstanding features, when comparing with the existing shipyards.

S9 1) To minimize hull erection works by applying large block system.

2) To minimize outfitting works in erection stage by applying in-shop outfitting system.

3) Adoption of "hull construction work units" in hull erection works.

4) Adoption of "acid cleaning system" in hull block surface treatment.

5) Study of layout to minimize material handling and transportation.

6) Application of mechanization and automation.

S10 Chita shipyard was designed and constructed incorporating all these features, as you can see in the layout plan, and we may say that it symbolizes all of IHI's know-hows in construction of ultra-size ships.

I would like to introduce you the features of this new shipyard, which is namely, the know-how of IHI's shipbuilding technology.

1-2 <u>Large block system</u>

S11 The most efficient way to reduce the total amount of works such as gas-cutting and welding lengths, and also to transfer the works to the preceding stage, such as from erection stage to assembly stage, or from assembly stage to sub-assembly stage, is to apply maximum size blocks, using biggest steel plates which can be rolled by the steel-mills at present and in the near-future.

S12 This slide shows the block arrangement of a 270,000 DWT tanker, which is the main product of Chita shipyard.

The largest block for this ship is 24 by 21.2 meters in size and it weighs about 240 tons. These blocks are assembled in the shop.

S13 To transport these blocks, two goliath crames of 350 tons lifting capacity, built by ourselves, and three sets of

S14 200 tons heavy duty trolleys, connectable in two sets, are being used.

1-3 <u>In-shop outfitting system</u>

S15 There are three ways to improve the productivity of outfitting work by applying in-shop outfitting system to the furthest extent.

The first application is the "unit assembling method" to assembles the fittings such as pipes, valves and supports into one larger unit and then install it on the ship.

The second is the "block outfitting method" to fit such fittings to the hull construction block on ground.

The third is the "giant block outfitting method" which is applied to very dense and functional outfitting compartments like the engine room, pump room, accommodation superstructures, etc.

These methods are not new for the Japanese shipyards, but there are restrictions in facilities to apply the "unit assembling" or the "giant block outfitting" methods, and also the outfitting in the "block outfitting method" had to give priority to the hull structural works. So, in order to give liberty in time and space for the outfitting works, we have established four outfitting shops.

No.1 and No.2 Pre-outfitting shops are used for "block outfitting method", and the unit assembly shop and No.3 Pre-outfitting shop are used for the "giant block outfitting method". No.3 Pre-outfitting shop is also used for applying the "unit assembling method" in parallel.

S16 No.1 Pre-outfitting shop is used for applying the "block outfitting method" to panel blocks, excluding those for
S17 Superstructures, and in this shop, large pipes, such as cargo pipes, are inserted into the block by using the pipe inserting trolley.

S18 No.2 Pre-outfitting shop is used to apply "block outfitting method" to superstructures, in tiers.

S19 Unit assembly shop is specially applied for hull construction and outfitting of giant block units like the engine room and pump room, which occupies a long construction time within the ship's total construction period. Among these giant blocks, typically, the pump room bottom,
S20 engine room bottom, combined unit including the lower engine flat, upper engine flat and the control room on
S21 top, etc., are assembled here, and then transferred directly to the building dock by 2 goliath cranes, working in combination, lifting the blocks through the movable roof. The largest block weight ever built up to this date was 680 (six hundred and eighty) tons.

S22 No.3 Pre-outfitting shop is used to outfit most of the accommodation quarters on ground, consisting of six tiers, and it is equipped with working platforms, stores (including elevators) and so on. For the case of a 270,000 DWT tanker, the whole superstructure is divided into two units due to the crane's lifting capacity.

S23 The typical "unit assembling method" is applied to units such as the pipe and grating units behind the boiler, on-deck cargo pipe units, etc.

S24 One compartment is prepared in the unit assembly shop for this purpose.

By applying these "in-shop outfitting" methods, the outfitting on board the ship becomes merely of about 10 percent of the total outfitting weight.

1-4 <u>Adoption of "Hull construction work units" in Hull erection works</u>

S25 The aim of the "hull construction work unit" is to convert the hull erection work to a "flow-conveyor system" or to a "shop fabrication system".

Several types of specialized "hull construction work units", incorporating scaffolding, fitting jigs, welding equipments, etc., are used for the mid-part of the hull structure which normally consists of repeatable works of same pattern.

These giant mobilized units will finish all erection works by moving from the aft part to fore part of the ship, inside the hull structure, and this appears as a "moving factory".

By applying these units, we can firstly delete assembling and disassembling works of scaffolding, which is said to be one of the most dangerous work in shipbuilding, and accordingly, all works which were done on scaffolds can now be handled on safe working platforms.

Secondly, mechanization and labour saving in erection and welding works, which were practically impossible on highly erected scaffolds, could be realized on these units.

Thirdly, the control of erection works, which in the past was difficult as the works could be carried out at random time and sites, became now become easier through the application of work units which do not permit much freedom in scheduling the works. And finally, as a by-product of the aforementioned factors, we cannot overlook the merit of grade-up in quality.

S26 This slide shows the overall view of a 270,000 DWT tanker, and you can see the NT-unit in the wing tank and the NM-unit on the dock side.

S27 The NT-unit travels on the bottom transverses of the wing tank, and is used to fix the block butts of side shell and longitudinal bulkhead, and the block seams between the side and bottom shell plates.

S28 The NM unit travels on the bottom transverses of the wing tank, following the NT unit, and is used to fit the cross-ties.

S29 The NU-unit travels on the cross-ties in the wing tank, and is used to connect the block butts and seams of the upper deck.

S30 There are other types of "hull construction work units", not shown in these slides, to be applied for other locations of the same ship, and for other IHI shipyards, we have other specialized type of working units to match with their ships, basing on the same concept.

S31 For example, this slide shows the working unit for a 150,000 DWT tanker, used in Aioi shipyard.

1-5 <u>Adoption of acid cleaning system for surface treatment</u>

S32 Usually, painting works, similar to the outfitting works, had to duck through the hull steel works.

In Chita shipyard, we built a shop exclusively for painting works, and made a drastic try to perform all painting works in-shop.

The "acid cleaning system" is applied to descale the rust of a complete block by using phosphoric acid.

In general, mechanical descaling, using wire brushes and disc sanders, is the usual practice in Japanese shipyards, to descale the steel surfaces, and it is evident that these works will require a great amount of man-powers, and the working environment is very unhealthy.

The "block acid cleaning system" is the unique solution for these problems.

S33 The hull block is transported into the "acid cleaning shop", and then, the phosphoric acid is sprayed to the block surface by multiple sprinkler nozzles. The shower is continued for one or two hours, and by this system, a perfect surface treatment quality can be obtained without using any man-power, and needless to say, a drastic improvement was achieved in product quality, productivity and working environment.

1-6 Rationalization of material handling

S34 There is a saying that "Shipbuilding industry is a transportation industry". In fact, transportation and material handling occupy a great proportion in ship's construction work. So, in planning a new shipyard, improvement in this field is the first subject to be considered. Of course, this is not a different story for Chita shipyard.

The definition of "material handling" is usually considered to include "stocking" of objects.

At the time we planned Chita shipyard, most new shipyards, planned by other Japanese firms, took the policy to apply "stage control" in individual stages, and accordingly, the basic layout was to place the hull fabrication shop, hull sub-assembly shop, flat block assembly shop, curved block assembly shop etc., in separate locations, and stock area for the elements and parts between these shops.

Contrary we considered it more feasible to minimize the stocks between stages, which consequently leads to rationalization in transportation and material handling works, reduction of unfinished works, and reduction in loan interests.

S35 From this point of view, the production flow starting from the steel material stockyard, fabrication, sub-assembly, assembly, painting and finally to block outfitting works was arranged in one through line.

All types of conveyor lines, specialized rail trolleys, cranes, trailers were well arranged, and as a result, the rationalization of material handling work was successfully achieved.

1-7 Mechanization and Automation

S36 Mechanization and automation are the indispensable factors to modernize the shipbuilding industry, which in fact, is a typical sample of labour intensive industry.

Application of these means are the only way to release the burden of hard, dangerous and unhealthy labours from the human workers. It also results in uniformity of production quality and elevation in productivity. Basing upon this concept, Chita has applied all means of mechanization and automation techniques, incorporating new technologies developed at the time of its planning stage.

I will introduce some of these facilities which were not presented yet.

S37 This picture shows the steel material stockyard.

The kinds of steel plate dimensions are being reduced, and are stocked in one pile for each sort, so that the crane-man can issue or receive the material by means of "pile number order indication" addressed by the mini-computer at the control center. By using the lifting magnet, there is no necessity of crane riggers.

S38 The two machines shown in this slide are the NC-cutters, and each machine can cut 2 plates up to 5 meters width, simultaneously in "symmetric form" or in "identical form". Also, by combining these two machines, it is possible to cut four plates simultaneously, under the control of one director. These machines are mainly used to cut transverse webs in the midship parallel body.

S39 This is the high speed NC-marking machine. This machine is mainly used for marking inner structural elements of the fore and aft ship.

Generally, in Japan, this kind of work is done by EPM (namely, the Electro-Photo-Marking) system or the photo-marking system, but in Chita, considering that the accuracy is most important, we ourselves developed and installed this NC-marking machine, which is the first of this kind in Japan.

S40 This shows the bending of bilge shell plates by using the 1,000 tons press, developed by ourselves, too.

The cylinder and the bed of this press can move horizontally or rotate, so it is not necessary to move the object. The machine is operated by two men.

S41 This slide shows the welding process of built-up longitudinals, composed of face and web plate, cut by the parallel cutter.

There are three sets of trolleys incorporating MISA (The micro-submerged arc welding) equipments in twin-tandem arrangement, and in the preceding stage, there is a fitting apparatus.

On the successive stage of this equipment, there is a cold straightening machine. By combination of these equipments, we can produce 35 to 40 longitudinals of about 20 meters length in 8 hours.

S42 This picture shows the "sub-member automatic supplier", placed in the fitting area of the sub-assembly line.

By this equipment, stiffeners and brackets, which were previously sorted and stacked on small trolleys, can be transported and positioned in their designated places. Tack welding is done manually.

S43 This picture shows the MISA welding equipment which is used for welding sub-assembly members, which tack-welded at the "automatic sub-member supplier", previously explained.

In Chita, semi-automatic gravity type welders are converted to MISA, and consequently, we could protect the welders from arcs and welding fumes.

S44 This shows the "longitudinal member fixing device" which is used to form the egg-box, consisting of sub-assembled transverse members and built-up longitudinals.

The old method of forming egg-box, was to place the transverse web after arranging the longitudinals, so at the cross points, it was necessary to cut a open slot, having the width larger than that of the face plate, and then fitted with a collar plate, but by applying our method by which the longitudinals are inserted to transverses through key-hole slots on them, we can dispense with the collar plates.

S45 This shows the "vertical fillet automatic welding equipment", which is used for welding cross points of the longitudinals and transverse webs of egg-box. Fillet welding in four-rows can be performed automatically by this welding machine, by just setting the machine at the cross point.

S46 This is the "FCB (the Flux copper backing) one side automatic butt welding equipment", which is used to weld flat skin plates. We have three sets of this equipment, each composed of a 3-pole submerged arc welder, a backing equipment and a removable weight beam to prevent deformation.

S47 This is the picture of the MISA welding equipment, used for connecting the egg-box to the skin plate.

As the block moves below, the equipment is designed as a hanging type, so that the welding machine approaches from the top.

S48 This is the offset jig for curved shell plates, where the jigs are of screw type, and could be set in required position, automatically, by NC-tape s.

S49 This is the "block turn over equipment", placed between the painting shop and the No.1 Pre-outfitting shop, in order to turn over blocks when necessary. Blocks up to 270 tons maximum, can be turned over by only one operator.

S50 To apply with the outer surface of curved side shells, scaffolding equipments like the one in this picture is used. This has the same concept as the "hull construction work unit" used inside tanks.

S51 This picture shows the final outer hull painting, performed by the tower type painting equipment.

This equipment can cover most of the outer hull surface area by vertical movement of the scaffold stage and by travelling of the equipment itself.

S52 2. Software of Chita Shipyard

2-1 General policy of the software

In the previous section, I have introduced IHI's method by presenting the facilities and equipments of our Chita Shipyard. Following these, I would like to introduce IHI's software to back-up and manage this shipyard by taking Chita shipyard as example. The reason is, that Chita has adopted the most advanced technology of IHI's software.

S53 Now, what we call "software" here, is,

- o Phylosophy of production system
- o Control technique
- o Organization
- o Standardization and
- o Computerization

These factors are combined integrally to form IHI's software system.

S54 The production system of shipbuilding is composed of a massive combination of system industries, and before applying computerization, IHI has rationalized the shipbuilding process by totalizing these softwares.

S55 2-2 Phylosophy of the production system

Now, what is the phylosophy which forms the back bone of IHI's software?

S56 Our answere is, that production system will "start with and end by design". What we call "design" has a wide definition in planning, which includes "production engineering" as well as the "products specification". In other words, it includes the designation of construction method and its process, and it means the unification of design and production engineering.

S57 So, IHI's phylosophy is to include all production activities in the wide sense of design, and according to this phylosophy, it is essential to keep a close tie-up between the designing department and the material purchasement, scheduling and production activities.

The planning and realization of the gigantic product flow system applied in Chita shipyard, is based upon this basic phylosophy which has been achieved in the past.

Now, let we explain how this phylosophy has been materiali zed in Chita.

S58 2-3 <u>Control technique</u>

The production control is devided into "stage control" and "compartment control", in line with the construction process. This method is now widely applied. "Production engineering" was useful to divide the "functional engineering" into these two sectors, whereas, the production engineering is coincident with the control activity.

S59 In connection with the control activity, the control parameter of labour is computed, and the budget is distributed and checked in accordance with control activity. As macromatic control parameter we choose the divisional weight and as micromatic parameter choose the number of pipes, welding lengths, cutting lengths, etc., according to the nature of the works. After that, the production planning is established, based on each control activity, and adjusted to match each other. The achievement is followed up and checked.

S60 The productivity is checked by manhours of each control
S61 parameter, corresponding with each control activity, and the progress is checked by time advance of each control activity in consistence with the construction schedule.

S62 The "division of production stages and/or compartments" which forms the elements of the production activity, are decided synthetically to match with the characteristics of the ship's type to be constructed, and the layout of the shipyard.

The production engineering will follow these two kind of elements "stage and/or compartment" very precisely, and specify the contents of the works and will support the production control.

S65 2-4 Organization

In Chita, the functional organization has not been adopted. For instance, the pre-outfitting shop section becomes independent because they possess complete pre-outfitting shops.

S66 No.1 Pre-outfitting shop has only one organization which covers:

- o Block outfitting works of piping and steel outfits, and also
- o Hull steel fitting works after turn over

This shop also has its own warehouse of the fittings and equipments which they will use, so the issue and receipt control is taken care by this shop. In order to operate such a large shipyard like Chita, it is really inefficient to apply the conventional functional

S67 organization. Also, considering the fact that the shipbuilding labour works are becoming stabilized, and that most of the workers are graduates of high school, it is now inavoidable to apply "autonomous work group" system to maintain their moral which we think is consequently connected to the increase in productivity.

This system is organized by a group of workers, working in the same production area, and production control is left to their autonomous management.

The background which made this system feasible, is due to the fact that the workers are being educated to multi-functional workers to comply with compartment control organization.

The hull construction work unit, used in the erection stage, is based on application of these small groups of multi-functional workers.

S69 7-5 Computerization

IHI has already completed computerization to its full extent to grade-up independent technical calculations, such as structural analysis, etc., and to reduce clerical works, such as personnel management, financial affairs, cost analysis, etc. But another great feature of IHI's computerization is the application to enrichment of production control, which is the basic phylosophy of IHI.

That is, to synthesize the

Production engineering system, and the Material Control system.

S70 7-5-1 <u>Outfitting system</u>

As you can see in this slide, IHI's "outfitting total system" is to combine:

the Outfitting design system

the Outfitting scheduling system, and

the Pipe fabrication system

in correlation with the "Material control system", and totalize them as a synthetic system.

S71

Material control is computerized:

1) to feed accurate and timely material information,

2) to computerize clerical works

3) to decrease material stocks, and

4) to decrease indirect works for material preparation

The outline of this system is as follows:

(1) <u>Input of material information and production information from design system</u>:

The "material information" means the species of required fittings and their fitting allocation, and the "production information" means their fitting schedule and the assembling method of fittings for each unit outfitting work.

The assembly of fittings is called the "pallet", and naturally, these pallets are to be prepared to accord with their compartment and their fitting schedule.

S73 Usually, the purpose of computerization in design is to improve the efficiency of engineering itself, but in IHI, computerization of design is also used as a supply source of inputs to other systems.

This process realizes what we call "production system will start with design".

S74 In Chita shipyard, files of these input informations are constantly up-dated from the design section by means of the display terminal.

S75 (2) Input of material delivery time based on scheduling system

In order to perform shipbuilding works efficiently, it is necessary to modulate the interventions between hull structure works, outfitting works and painting works. For this purpose, we first fix the schedule for "major events" such as shaft center sighting and launching and then adjust these works minimizing adverse intervention

Following these nodal points of total construction schedule, inputs of production informations are given by the design section, which includes the amount of work parameters.

This scheduling system designates the delivery date for the "material control system".

S76 In Chita, the issueing date of production drawings are regulated by this scheduling system.

S77 (3) <u>Monistic management of material control informations, such as purchase order, acceptance, issue and receipt, adjustment of stocks, etc.</u>

The material is divided into "allocated material" and "stocked material", and controlled respectively by appropriate methods.

For this purpose, material standards are established, and "outfitting modules", consisting of composed parts as will as single parts, are established to simplify handling.

S78 (4) <u>Output of pallet supply order</u>

The material is gathered in compliance with each unit outfitting job of respective control activity such as stages and/or compartments.

Pipes which should be fabricated in the shipyard, are issued and fabricated in separate fabrication lines, such as straight pipes, curved pipes, branch pipes, etc., and stored in pallets when transported to the construction site. So, in IHI, material control and production control is inseparable, and their source is originated from the production engineering.

S79 (5) Input delivery to financial and account system

The processed results of the material system are statistically compiled, and utilized to evaluate the production schedule in comparison with the budjet, and also utilized as estimation data for continual orders.

S80 7-5-2 Hull system

Comparing with the outfitting works, which consist mainly of assembling of parts, installation, and adjusting, the hull construction work majorly consists of fabrication of members.

Owing to this feature, the flow from design process to production process is easily tied and synthesized, but the control systems of the construction schedule and the material, which is steel material in this case, do not have correlations as much as outfitting works.

The nesting of steel material from the designed drawings, is decided in accordance with the policy of the fabrication scheduling. Accordingly, the nesting must be adjusted to meet the shipyard's circumstances at the time of construction, even in the case of a sister ship.

So the nesting stage is not appropriate for computerization.

S81 Such being the case, the hull steel material system only controls material orders, issue and receipt.

I have already explained that, in Chita, the material handling from the steel stockyard is automated.

S82 By this system the purchase order, is recorded in a magnetic tape, including detail of sizes, and delivered to the steelmill two months before the designated delivery time. The receipt information is received from the steelmill in punch cards, and are input into the regular "financial and account system".

I will now explain the hull design integrated system" which, in fact, is the realization of the phylosophy to "start with and end by design".

S83 This system covers from structural design to digitation of part data of structural members, monistically in one continuous flow, so the input in the upstream is effectively utilized as integrated information processing.

S84 The features of this output for production can be expressed as follows:

1) <u>Can adapt to every facility and system</u>

IHI is operating shipyards which adopt complete NC as Chita to a complete hand-making yard, but the part data digitized by this system can be used in common for either shipyard.

2) <u>Can be edited to suit the fabrication line and processes</u>

The code of hull structural members shows the production stages, so the output of every kinds of information can be obtain as the piece table sorted by specific construction stage, or by fabrication shops, etc.

3) <u>Includes know-hows of every procedure</u>

The system incorporates programs, such as to compute the neutral axis for bending, to select the variation of edge preparations at ends of members subject to the angle of inclined fillet welding, and so on, and the output is expressed to meet the marking sequence.

S85 IHI not only utilizes computer digitation of structural members for automating the fabrication process, but also utilizes it to improve the quality and accuracy of the hull members.

S86 7-6 Standardization

As you may understand, IHI are utilizing computerization as a tool to rationalize the whole shipyards.

To achieve this prospect, standardization is applied as basis. The major part of standardization was already prepared before we started computerization.

S87 (1) Standardization of workmanship

This distinguishes the partition of stages and establishes the control activity and its parameter.

It establishes the production procedure,

It decides the flow of material and members, to adapt with the shipyard's layout. And it decides the flow and form of informations to suit the control activity.

(2) Code system

This establishes the code of material and members, activities, schedules, and other necessary items for control.

The code is made as simple as possible and synthetically, not contradictory.

(3) Standardized design

The standardization is executed not only for specific material, but also with their combinations, and by lesser standards, we can achieve variations in design. Also, the design method, calculation method, design procedures, checking method is also standardized. By this procedure, a high level and well balanced design can be achieved.

S88 The standardization mentioned here, is not only applied to Chita shipyard, but unified and applied throughout IHI.

8. Conclusion

S89 I have explained the phylosophy and attitude of IHI to cope with the shipbuilding circumferences, taking Chita shipyard as a typical sample.

Since the oil crisis, and due to the depression in world's economy, Chita shipyard is without exception forced to build smaller vessels as well which was, of course not anticipated at the planning stage.

We are now making our efforts to study the most suitable way to build smaller vessels.

Presently, we are quite confident that the shipyard can overcome and extend their high efficiency as well as for construction of smaller ships by applying the in-shop outfitting and shop fabrication system developed for VLCCs, although some of the specialized facility cannot be utilized, and also by our long experiences in management techniques. I hope that we will be able to present you in the near future how IHI would have successfully achieved construction of smaller vessels even at Chita shipyard.

Thank you,

ROYAL INSTITUTION OF NAVAL ARCHITECTS

AUSTRALIAN BRANCH - WHYALLA SECTION

MINUTES OF TECHNICAL MEETING HELD AT

S.A. INSTITUTE OF TECHNOLOGY

ON 24.5.76 AT 8.00 P.M.

1. PRESENT

Messrs. Hawke (Chairman), Chapman (Secretary, and 37 members and Visitors as per attendance book.

2. APOLOGIES

R. Meakes, V. Anand.

3. MINUTES OF PREVIOUS MEETING

Read by Secretary. Moved B. Chapman, seconded C. Kittel, that minutes be accepted as correct record. Carried.

4. BUSINESS ARISING FROM MINUTES

Nil

5. GENERAL BUSINESS

Nil

6. TECHNICAL BUSINESS

Chairman introduced Mr. Tetsuya Aoyama, Manager of Ishikawajima-Harima Heavy Industries Shipbuilding Division (formerly General Manager I.H.I. Yokohama Shipyard) who spoke on "The I.H.I. Method of Shipbuilding".

A vote of thanks was proposed by L. Jepp and carried with acclametion.

Meeting closed at 9.35 p.m.