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THE MULTI-SHIP REFIT PROGRAM FOR STEAM DESTROYERS

REVIEW OF RECENT EXPERIENCE

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SUMMARY

A review is made of experience in implementing the Multi-Ship program of zero-manned, contract refits of steam destroyers and of results currently being achieved. The report reviews progress made to date and mentions recent efforts and recommendations to develop further improvements in procedures, specifications and other aspects of Multi-Ship destroyer refits.

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INTRODUCTION

It has been government policy for some years to carry out refits of most steam destroyers and certain other vessels of the Atlantic Fleet by contract refits at commercial shipyards. Prior to the multi-ship concept, ship refits were contracted individually as they came due. The refits were carried out at a variety of locations by lowest-bid contractors who may or may not have had recent experience with destroyer overhauls. Provision of crews and augmented overseeing staffs, supply, technical support, and other aspects were hastily extemporized at the contractor's site, after the award of the contract. In many instances the successful contractor was only announced a few days before the refit commencement date, resulting in frantic confusion as people struggled to establish all the necessary procedures and overseeing arrangements with the contractor. It was not unknown for a ship's Commanding Officer to be ordered to sail for refit before the announcement of the contractor, not knowing whether his ship and crew were going to be located in Halifax, St. John, N.B., Quebec City, Sorel or Montreal.

The multi-ship refit program was developed in an attempt to overcome some of the problems inherent in the traditional approach. It was envisaged that a multi-ship approach would result in greater efficiency in several important aspects. For example the contractor should be able to assemble, develop and maintain a well trained and experienced work force, current in naval technology, as well as a good network of sub-contractors with recent experience in naval repairs. He should be able to develop improvements in planning and standard procedures for overhauling the complex systems, instead of relying on the "learning curve", and he should, as a result, be able to improve his performance with respect to delivery. With the stability and assurance of a long-term contract, it should be possible to develop better provisions for supply, loan tooling, and other third-line overhaul equipment, such as test and trial gear, that may be kept "permanently" at the contractor's premises. There should also be a well-developed and stable long-term liaison with DND authorities administering refits, and DSS contract management staffs. Some benefits were also expected in safety arrangements, facilities for TSD and other government staffs on-site and, possibly, more capital investment by the contractor in equipment and facilities for naval refits.

The multi-ship contract and its attendant technical arrangements constituted a major change in policy sufficient in itself to keep a project team busy, working out the procedures. However, at about the same time, there were other refit matters also being subjected to review. For example, there was the question of the ship's staff to consider. In the traditional refit system, the ship's crew was required to support the refit by providing security and other on board services, carrying out a portion of the technical repair work, and conducting set-to-work and trials. Personnel who had spent, in some instances, years of arduous sea duty, with extensive separation from their families, suddenly found themselves located in refit for several months up to 800 miles away from their homes and family responsibilities in Halifax.

The zero-manned refit concept was introduced in an attempt to overcome some of the traditional problems. Following a turnover to the contractor in the first few days of the refit the ship's staff were to return to Halifax until the trials phase at the end of the refit. The ship was to be contractually in the custody of the contractor, who would be responsible for safety and security. Overseeing of the refit work and Quality Assurance would be entirely the responsibility of the Technical Services Detachment (TSD).

To help ensure that no work would be overlooked due to the absence of ship's staffs, special attention was directed to ensuring improved pre-refit surveys, for which a greatly augmented MARCORD on surveys was developed. The results of surveys and all other known defects and deficiencies were to be incorporated into a "particularized specification" for each individual destroyer, to augment the standard specification items.

Finally, at about the same time, other major changes were being introduced, associated with OPERATION MAINTOP. The periodicity of refits was changed from 24 months to 48 months. Extra spare equipment and spare parts were purchased. The contractor's work was expanded to include comprehensive painting and retiling of internal spaces, and extensive treatment of the hull and superstructure, including much paint work that had previously been done by ships' staffs at the end of the refit. Last but not least, there was great emphasis on turning the ship over to the ship's staff in a clean and smart condition to permit the ship's staff to concentrate on trials and workups with a minimum of distractions.

To ensure reliability during the extended period of operation, there had to be high standards for Refit Quality Control, supported by comprehensive Vibration Analysis and thorough pre-installation testing at Naval Engineering Test Establishment (NETE) of all equipment overhauled by Peacock Incorporated.

It can be seen from the foregoing comments that the multi-ship refit concept embodied some very comprehensive changes from traditional refit practices. Subsequent parts of this paper will attempt to review a number of the key areas and indicate the experience gained and results achieved, with some comments on current problem areas, and possible ways in which some of the problems might be reduced or eliminated.

EXPERIENCE TO DATE

Contractual Arrangements

Multi-ship refit contracts are awarded through a competitive bid process which evolves from a Department of Supply and Services (DSS) "Request for Proposal" (RFP) submitted to potential contractors approximately 6 - 7 months prior to the commencement of work. The RFP is essentially an invitation for potential contractors to bid on the Standard Ship Repair Work Catalogue (SSRWC), on the understanding that individual ship Particularized Specification Lists

(known work) will be negotiated as net additions to, or deletions from, the SSRWC "price". The competitive bid also includes separate price quotations for anticipated arisings, a Quality Control System, and handling of Government Supplied Materiel (GSM). The traditional bidders' conference and viewing is held to assist contractors in formulating their proposals. Once bids have been submitted any or all of the contractors may be called upon to discuss or defend their proposals at "evaluation" proceedings held jointly by the Director of Maritime Engineering and Maintenance (DMEM), in National Defence Headquarters, and the Department of Supply and Services.

Refit Specifications/Pre-Refit Surveys

Simultaneous with the RFP/Bidding/Evaluation process, the first ship of the contract is tasked and assisted by the Maritime Commander (MARCOM) in converting the refit catalogue (SSRWC) to a unique work definition package, or Particularized Specification List (PSL). In the process, the ship "shops" for those items of the catalogue which are applicable, deleting those which are not, and amending applicable specifications to suit known defects. Much of the "particularization" process entails tabulation of quantities and areas to be worked (e.g. specific valves to be examined, square footage of areas to be tiled, scraped, painted, etc.). Particularization of the refit catalogue must, of necessity, depend heavily on pre-refit surveys which are conducted by ship's staff, the Naval Engineering Unit (Atlantic) (NEU(A)), and the Fleet Maintenance Group (FMG) or the Ship Repair Unit (Atlantic) (SRU(A)).

Generally, the SSRWC/PSL concept is a great improvement over the previous single ship Maintenance and Repair Specification List (MRSL). However, the new approach is fraught with a considerable number of problems stemming primarily from lack of definition of the known work, which is, in turn, attributable to weaknesses in the pre-refit survey and particularization process. The SSRWC/PSL concept has marginally reduced the tendency for refits to over-extend financially, and some measure of success has been achieved in improving the ratio of known work to arisings.

From the vantage point of the overseer, the pre-refit work definition weaknesses would appear to be caused by the following:

a. the lengthy period between the time of the survey and the commencement of refit; the ship's condition on arrival in the contractor's yard is usually considerably worse than that depicted in the PSL, necessitating additional surveys by the Technical Services Detachment (TSD), and negotiations of large, costly arisings. Typical areas which traditionally suffer from this "time lag" syndrome are structural deterioration, tiling and painting. It is suggested that allowance should be made for the time factor when conducting surveys, and that the known defects should be "extrapolated" to

anticipate the ship's condition six months later. The guesswork could be largely eliminated by judicious use of the vast historical data available on past refits;

b. the lack of thoroughness and objectivity in surveys. It is frequently apparent to the overseers that obvious defects are not recorded. This may be attributable to the fact that those who live and work in the ship may be the last to notice discrepancies they have learned to live with (why else do ships neglect to record worn ladder treads?) Once again, judicious use of historical information could easily point out defects to ship's staff that they may otherwise overlook;

c. the lack of dedicated time for pre-refit surveys. Ships' staffs may be too pre-occupied with the operational commitments of the day to adequately cater to the long-term needs of a far-distant refit. Similarly, it is the overseer's impression that pre-refit surveys are often delayed or curtailed in deference to ship's operational commitments.

Part of the overseer's responsibility during the course of any refit is to record and report specification duplications, errors or omissions. Any duplication, errors or omissions which are not peculiar to an individual ship, and which should be corrected for follow ships or follow contracts, are reported by specification deficiency reports. A total of 264 specification deficiency reports have been raised since the start of Multi-Ship III. There is evidence that the specification has improved somewhat from ship to ship, through the incorporation of these amendments; however, the process is essentially an editorializing, "fine tuning" approach to specification improvement.

In the opinion of the overseers, further improvements are necessary by the "customer" to ensure that known work is defined, so that, ultimately, less of the total work package needs to be left at the mercy of the less-competitive "arisings" (DSS 1379) procedure. Greater use of historical information, "extrapolation" of known defects, and longer, later "dedicated" survey periods have been suggested. These may not achieve quantum improvements, however, and a bolder approach may be in order. Such an approach will be discussed later in this paper.

Turnover Procedure

Following the contract award to the successful contractor, usually 10 weeks prior to commencement of work, ship refits are scheduled over the period of the contract to allow a continuous workload. Traditionally an overlap of 2-3 weeks occurs between ship refits. The terms of the contract require the contractor to assume full custody for the ship, with no ship's staff presence. The TSD assumes all technical and administrative functions during the course of the refit. The success of the arrangement is contingent on a rapid and efficient turnover of ship's custody to the contractor. Normally, the ship's company evacuates the ship within three days of

arrival, during which period all stores, portable fixtures, drawings, personal belongings, etc. are removed for the duration of the refit. The contractor formally assumes custody on completion of de-storing and evacuation of the ship's company. During the de-storing process, and for approximately 7 days following the formal turnover, a detailed compartment turnover procedure is followed, in which all compartments are inspected by a Ship/TSD/Contractor team to record their "pre-refit" condition. A photographic record is made during the process, for future reference. The compartment and ship turnover procedure is reversed on completion of the refit.

Technical Work

Arisings

Generally, the known work (PSL) presents little difficulty, since it was pre-priced and scheduled prior to the commencement of work. The arisings which spring from the "open and examine" type of known work, however, cause numerous technical, scheduling, logistics, and financial problems. It is fair to say that, after 11 ship refits under the Multi-Ship concept, there should be few surprises; nevertheless, they do occur, and very few refits have escaped their share of delays, disruptions, and frustrations. Arisings from known work could suffer from any or all of the following problems, which, albeit less common in Multi-Ship, were typical of single-ship refits:

a. late discovery, due to contractor's scheduling, which is largely out of DND's control. Late arisings may delay refit completion, or require a portion of the work to be deferred to post refit;

b. lack of spares; the contractor is reluctant to repair if a spare can be acquired. He is sometimes reluctant to supply through his own resources, and would rather rely on Government Supplied Material (GSM). This places a considerable burden on TSD supply personnel to procure non-anticipated spare parts on a short term basis;

c. lack of rapid technical support; many of the technical problems must, of necessity, be referred to the Life Cycle Material Manager (LCMM) or NEU (A) inspectors. The contractor is often reluctant to solve the problem on his own;

d. arisings, by their very nature, cannot be negotiated from a position of strength. DND is often faced with a "take it at this price" or "leave it" option, when to "leave it" would not be technically or operationally acceptable.

Repair by Replacement

A significant part of the Multi-Ship refit contract is the performance of routine Repair and Overhaul (R&O) by Peacock Incorporated and performance testing by the Naval Engineering Test Establishment (NETE). Thirteen pumps are landed early in the refit and placed in the stores R&O "circuit", from which emerge replacement components which have undergone complete overhaul and testing. The system is highly successful, and several delays and disruptions have been avoided by ensuring that "bugs" were ironed out prior to installation on the ship. The only problems encountered have been due to later delivery from the supply system due to disruptions in the R&O facility to meet pressing operational requirements. Peacock and NETE's close proximity to the current contractor have abated many such problems. The provision under OPERATION MAINTOP of many complete auxiliary machinery units for repair and replacement purposes will further improve the efficiency of the process.

Repair and Overhaul

The majority of the work performed in the refit consists of repair and overhaul of equipment in the contractor's facility. Refrigeration and air conditioning machinery, electric motors, turbo blowers, turbo alternators, valves, small pumps, etc. are all repaired in this traditional manner. Generally, these items are progressed in a routine manner, with the usual problems stemming from arisings, as discussed earlier.

Electronic Equipment

Due to the security classification and/or the electronic sophistication of weapons and operations equipment, much of it is refitted in the Ship Repair Unit (Atlantic) (SRU (A)) or by 202 Workshop Depot, (202 WD) Montreal. 202 Workshop Depot is a formerly army third-line repair facility which possesses considerable naval electronics repair capability, by virtue of the merger of the now defunct Naval Repair Facility (Montreal) with 202 WD, in 1970, as a consolidation/economy effort. The apportionment of SRU (A) and 202 WD work is determined several weeks prior to the commencement of the refit, to suit each repair facility's anticipated capacity. Generally, equipment to be refitted in SRU (A) is landed prior to the ship's departure for the refit yard, while 202 WD conducts its refit activities ashore, or aboard, as convenient. In addition to SRU (A) and 202 WD activities, the refit contractor, through a local sub-contractor, conducts repair on certain items of the ship's electronic suit, notably navigation, communications, and radar equipment. The contractor's effort, although significant, accounts for less than 5 percent of the total refit package.

DELEX (Destroyer Life Extension Programme)

Multi-Ship III refits have included a significant "DELEX" component. Various "safe for sea" and "stand alone" items have been completed as they became available, after engineering and

financial approval. The most noteworthy of these items has been the “midship repair”, which has involved extensive renewal and strengthening of the deck and superstructure in the area of the funnel uptakes and “cross-passage”. A rather awesome aspect of this repair has been the need to lower two major cableways (in the Burma Road and galley) in order to gain access to the structure. The midship repair has effectively extended the duration of the refit by three weeks. Generally, however, the DELEX portions of ship refits have been completed in a routine manner, with a minimum of difficulty.

General Refurbishment and Painting

Current multi-ship refit contracts demand a very high standard of appearance on completion; the standard which ship’s companies now take for granted on completion of a major refit is a far cry from the days of single-ship refits. Exterior hulls are blasted to clear metal from the “round-down” down, and the entire interior of the ship gets at least a cosmetic top-coat, with any additional preparation subject to PSL adjustment. Compartment photographs, taken at the start of a refit, serve as an excellent record, and a basis for judgment of the acceptability of the work. Doubtless many ships’ Executive Officers will continue to find fault with omissions or poor workmanship which are the result of inadequate specifications, poor preparation, or interference with other work. Unless properly planned and executed, cosmetics may fall short of expectations. However, it is fair to say that the state of husbandry of a ship departing the contractor’s facility is such that a ship’s company need not “start from behind”, but can maintain its appearance with “routine” maintenance.

Systems Activation

Systems activation (machinery flashup) is conducted entirely by contractor’s personnel. To date the work has been performed by sub-contract, with the caliber of personnel (all of them ex-Navy) governed by minimum qualifications established as part of the contract. The set-to-work period usually runs three weeks from “first diesel” to “contractor’s basin trial”. The set-to-work engineer and Chief ERA work directly for the contractor, and the TSD assume their usual “overseer” role. The procedure has its “anxious moments” when safety of men and machinery are in conflict with scheduling and financial expediency. However, one cannot argue with success over the last 11 ships, in which no delays or disruptions have been attributable to the set-to-work team.

Trials and Tests

Following contractor’s basin trial, the ship is normally “shut down” for approximately one month, during which the boiler room and engine room are painted and bilges are cleaned, cosmetics and compartment acceptance are progressed in the remainder of the ship, and

electronics testing/tuning/alignment are conducted by sub-contractor, 202 Workshop Depot, and NEU(A) trials personnel.

The final two weeks of the refit are somewhat hectic, when all the "loose ends" are tied, and the ship assumes custody. The ship's staff conducts a "confirmation basin trial", with contractor's assistance for minor tune-ups and repairs. The ultimate test is a two-day sea trial, conducted by the Technical Services Detachment, with ship's staff in charge of machinery (with machinery and personnel-safety "override"), and contractor's assistance. Depending on the weather (winter deliveries are subject to ice conditions) and the schedule, the final acceptance may take place at sea or the ship may return to the contractor's facility for completion of minor defects and formal acceptance.

Supply Support

Responsibility for the logistics support of multi-ship refits is vested, ultimately, in National Defence Headquarters, Directorate of Procurement and Supply Maritime (NDHQ/DPSupM). Generally, overall refit support is well administered, and a great improvement over previous refits. Refit specifications include an impressive inventory of material requirements which is designated as Government Supplied Material (GSM) or Contractor Furnished Material (CFM). In addition to requirements to support the known work, logistics planning includes the acquisition of insurance items, (GSM and CFM) which are consumed as required during the course of the contract, or which, if not consumed, become part of the DND supply inventory.

GSM stores for individual ships are marshaled in 25 CFSD (Montreal) 90 days prior to refit commencement, and are transferred to the contractor's facility, and to his charge, 30 days prior to start date. Needless to say, the logistics effort is only as successful as the accuracy of the planning stage, some of which is necessarily speculative. Generally, the marshalling and distribution processes run smoothly. However, the overall success of logistics support is influenced by weaknesses on the part of both DND and the contractor.

DND supply deficiencies can be summarized as follows:

a. traditional shortcomings, such as poor packaging, improper identification, the issue of shelf life expired stores, etc. It would be too optimistic to assume that any supply system could ever be devoid of such shortcomings. The TSD tries to do its share by reporting deficiencies, to wit 71 Unsatisfactory Condition Reports (UCR's) have been submitted on GSM shortcomings in Multi-Ship III.

b. a tendency to abuse the demand system (using a higher priority than required). It is difficult to educate technicians, however, who have been "stung" and frustrated in the past, that the system works the way it was intended (does it?);

c. by their nature, demands on the supply system for completion of work arisings are classified as “non-recurring” and therefore “one-off”. Statistics indicate that the requirements are repetitious, and that demands should be “recurring”.

Contractor material supply and handling deficiencies can be summarized as follows:

a. the lack of sufficient staff and commitment to do justice to his contractual responsibilities. Although the contractor is obligated, contractually, to assume the initiative in material procurement for work arisings, there is every indication that his efforts are generally inadequate. The tendency is to shift the requirement to the Crown, on the premise that material is not available commercially. The onus for expediting, and the consequences of late delivery then remain with the Crown;

b. minimum (lowest cost) efforts in handling and controlling GSM, and heavy reliance on Technical Services Detachment supply technicians to ensure compliance with the material handling aspects of the contract. In spite of the Technical Services Detachment’s close scrutiny, however, many areas require improvement, which hopefully can be implemented for future contracts. Such areas include more stringent documentation of requests for DND supply, and more accurate accounting of stores issues to improve traceability.

QUALITY ASSURANCE ARRANGEMENTS

Contractual Requirements

Multi-Ship contracts include a “Contractor’s Quality System Requirement”, (CQSR) which, in Quality Assurance parlance, is similar to a DND 1016 standard. In essence, the requirement is for a contractor’s system of procedures, inspection plans, and inspectors to ensure that the quality aspects of the refit are maintained. The requirement is not as “all-pervasive” as the DND 1015 standard, but nevertheless requires a commitment to a quality control programme, and assurances that work is being performed under controlled conditions, and is being inspected for compliance by an internal organ of the company which is not subservient to production.

Considerable progress has been made over the course of three multi-ship contracts, in establishing the bulk of the “inspection plan” for ship refits. That is to say, the tremendous volume of specifications has been duly annotated, through the efforts of NEU (A) and the TSD, and, to some extent, the contractor, to denote every inspection point, requirement for records, etc. Generally, the system for ensuring all the work is done, and done correctly, is in place. Nevertheless, the contractor’s degree of compliance has fallen very short of the mark, for the following reasons:

a. a Quality Control Programme of the DND 1016 type is not a philosophy or concept which is accepted or practiced in the Marine Division, unless required by DND specifications;

b. a critical shortage of quality control inspectors, for the inspection task;

c. lack of a "dedicated" inspection system, independent of production.

The result of the contractor's failure to live up to DND expectations with respect to Quality Control has been the need for a large TSD, essentially employed in traditional overseeing duties. Rather than self-imposed discipline, the contractor's quality yardstick is: "whatever the Navy will accept". The tendency has therefore remained for the TSD to "run the show", thereby effectively carrying the responsibility for quality (and, to some extent, scheduling and production) when, contractually, the onus should lie on the contractor. The problem of TSD dependence is exacerbated by the contractor's shift schedule which provides for a 17-hour-a-day operation, and unusual demands on overseeing personnel to cover mandatory inspections.

The contractor has repeatedly expressed his stand on Quality Assurance. He is not a "believer", but is willing to provide the number of inspectors the Crown specifies, and is willing to implement the Crown's procedures, provided the requirements are sufficiently detailed and specific that they can be priced on exactly the same basis by each competing contractor. Obviously, such an arrangement would be advantageous to competing contractors, but does not ensure the sense of commitment which is so essential to any quality programme. It is hoped that the evolutionary process will continue, and that the responsibility for quality will be increasingly accepted by the industry.

Personnel

201 CFTSD's establishment for overseeing of Multi-Ship refits is as follows:

a. Detachment Commander (Cdr/MARE);

b. Project Officer (LCdr/MARE);

c. Marine Systems Division:

1. Lt(N) MARE (MS),

2. (6) MAR ENG T,

3. (1) TI-3 (MECH),

4. (3) E TECH,

5. (1) TI-3 (ELECT).

d. Hull Systems Division:

    1. Lt(N) MARE (NARC or CONST),
    2. (5) H TECH,
    3. (1) TI-3 (HULL).

e. Combat Systems Division:

    1. Lt(N) MARE (CS),
    2. (1) SONAR TECH,
    3. (1) RAD TECH SEA,
    4. (1) COMM TECH SEA,
    5. (1) TI-4 (ELECTRONICS).

f. Supply and Administrative Support:

    1. Capt Logistics,
    2. (4) SUP TECH,
    3. (1) Clerk Admin,
    4. (1) Secretary,
    5. (3) Clerk Typist.

The TSD establishment has fluctuated over the years. When the Multi-Ship concept was introduced, the TSD was grossly undermanned, and an overworked staff was burdened with much of the "pioneering" effort involved in establishing inspection plans, amending specifications, and carrying out inspections. Manning levels increased to deal with the problems, by which time the work load had reached a reduced "steady state" level. The current establishment is considered adequate for the tasking, given the contractor's level of quality control. Further reductions in personnel could only be achieved by increased commitment and effort on the part of the contractor.

Although current TSD staffing is adequate for the task, it has not escaped the consequences of severe personnel shortages being experienced in sea-going trades. Although there are no vacancies, 14 positions are under-ranked, thereby significantly reducing the experience level of inspectors, and prejudicing the TSD's credibility in the eyes of the contractor. Generally, sailors like the work in a TSD, although they are not enamored with the location (Montreal) for

socio/economic reasons, and are somewhat frustrated by their inability to use tools and do the job themselves. All inspectors consider their tour in the TSD as excellent experience, and naval overseeing should never be underestimated as a valuable "training" vehicle for our tradesmen.

One of the "risks" associated with zero-manned refits was expected to be the inherent reduction in "tender loving care" to refitting which would have been expected of the ship's staff, who, it was thought, would take a more genuine interest in machinery and equipment they would have to contend with later. In fact, the fears were unfounded, (in the opinion of the overseers) and the continuity provided by regular TSD personnel has been a significant factor in ensuring quality refits. This continuity of employment of TSD personnel has allowed overseers, as well as the contractor's personnel, to conquer the learning curve, and to reap the benefits of past experience. It is the opinion of overseers that the experienced, objective eye of an overseer is more effective, in the long run, than the inexperienced, subjective viewpoint of a member of the ship's staff. Furthermore, successful handling of the contractual "chicanery" of this type of work requires training, aptitude, and experience.

Inspection Procedures/Techniques

All refit specification items are annotated to indicate the following, as appropriate:

a. mandatory inspection points (requiring TSD personnel);

b. contractor inspection points;

c. points at which measurements and/or records have to be taken and passed to the TSD.

Generally, these "marked up" specifications form the essence of the "inspection plan". The contractor is required to pre-inspect all work prior to presentation of the work to the TSD. However, in view of the limitations of the contractor's quality assurance programme, it is not surprising that the contractor's inspection usually occurs simultaneously with the TSD inspection, and that the contractor's representative is prepared to pass whatever judgment is made by the TSD. Wherever possible, acceptance criteria are defined, but a large proportion of inspections require an experienced, critical, subjective assessment. Vibration analysis is used extensively in acceptance/rejection of electric motors, and a post-installation check on machinery as it is set-to-work or trialed at sea.

CONTRACTOR'S PERFORMANCE

Strengths

In spite of various shortcomings and frustrations alluded to in this paper, the performance by the current contractor in Multi-Ship refits has been generally satisfactory. Few, if any delays in

deliveries have been attributable to contractor's performance, and, if warranty claims can serve as a measure of success (there is some doubt), the paucity of post-refit claims speaks well. Members of the rapidly-depleting group of officers who recall dockyard or single-ship contract refits are quick to concede that the quality of the refits has greatly improved. The success is due in no small measure to the competence of the contractor, which is attributable to the following:

a. "conquering" of the learning curve; it is not surprising that success should follow in the wake of 11 destroyer refits;

b. a steady, skilled work force; proximity to a large population centre, as well as continued involvement in commercial marine repair has ensured adequate numbers of required tradesmen;

c. a minimum of labour disruptions in the past six years, in spite of rising union control of the labour force (by a traditionally militant union);

d. a unique management system in which authority is vested at a high level, in which supervisory levels are highly motivated to produce and in which capital investment and "frills" are minimal. The attitude which prevails is almost one of ruthless disregard for non-productive and non-profitable undertakings, and a sixth sense for contractual "avenues" for maximizing profit. (Is there a Canadian ship repair yard that does not fit this description?). Though some may consider the approach "old fashioned", it has produced results to date. One cannot but wonder, however, how much longer "old fashioned methods" can survive in a world of escalating technological complexity.

<u>Weaknesses</u>

Notwithstanding the competence demonstrated, and the successes to date, there are certain problems for TSD personnel:

a. the ruthlessly competitive bidding process tends to force the contractor to spread his labour force and supervisory staff very thinly. Although it is difficult to substantiate any reduction in quality or quantity of the work in DND refits due to the "stretching of resources", the "frustration level" within the TSD rises considerably, as does the contractor's reliance on TSD personnel to close the gaps in his supervisory staff;

b. another general problem is the difficulty of keeping the contractor's work schedule up to date, in the light of current delays, increases in scope of work, and other factors which combine to destroy the viability of the original work schedule tabled by the contractor at the pre-refit meeting. Experience to date is that the contractor's staff has been reluctant to sound the alarm on schedule slippage until it is quite manifest

to all that the refit completion date cannot be met. Happily, recent multi-ship refits have been completed essentially on time. However, the contractor does not have a great deal to lose by late completion. It is perhaps surprising that a "timely completion bonus" has never been considered feasible;

c. perhaps the biggest problem of this traditional management system is the extent to which the contractor must lean on the experience, technical and QA knowledge, and management capability of the TSD staff, to make up for gaps or limitations in his own supervisory work force. The result is very marginal, and sometimes leads to inadequate coverage of refit management. Typical examples are:

    1. a very limited Quality Control Organization by DND standards,

    2. "bare bones" purchasing staff (for contractor supplied material and handling facilities (for GSM),

    3. a tendency to deviate, from time to time, from the details of DND Specifications or method, in favour of his own traditional techniques, where the latter are cheaper.

The result has been a very strong dependence on the TSD for technical and logistics support; the contractor has publicly voiced the TSD's role in ensuring quality and quantity of work. Although the relationship between the TSD and the contractor often assumes one of adversaries, there is an underlying spirit of respect and mutual co-operation to get the job done. The frustration arises when the TSD expects more than what the contractor intended in his bid.

Reliance on such a relationship between the contractor and the TSD, for all its strong points, is nevertheless indicative of the failure by the contractor to assume greater responsibility for inspection, scheduling, and control of quality. If DND is to get its own way, <u>some</u> means has to be found to "make it worth his while".

<u>DSS – DND ARRANGEMENTS AND CO-OPERATION</u>

DSS maintains a full-time contracts officer on site, whose function is to act as the "contractual expert", in matters of contractual dispute, and negotiation of 1379's. A recent study conducted jointly by DND and DSS has indicated a need for closer integration of on-site operations. Co-operation "at the coalface" between DND and DSS has never been a problem, but there is little doubt that, generally, the two departments should demonstrate greater cohesion in the day-to-day work relative to the contractor.

Efforts to improve DND/DSS "unity" include the following:

a. co-location of the TSD and DSS principals (adjacent offices);

b. sharing of documentation;

c. increased TSD involvement in support of DSS negotiations;

d. regular joint DND/DSS meetings with contractor's representatives;

e. regular consultation at senior DND/DSS management levels to resolve contractual and procedural problems.

It is generally accepted that the DND/DSS Memorandum of Understanding (MOU) which dates back to 1970, is outdated and unwieldy, and ill-suited to extensive, complex ship refits. The most difficult aspect of the MOU to enforce is the requirement that no work on arisings commence until the 1379 has been negotiated and signed by all three parties. The tremendous volume of 1379's and the consequence of delays in commencing work make the rule virtually unenforceable. The result is that the contractor, the TSD, and the resident DSS Officer are faced with a choice of applying the letter of the law, and being "stifled" by bureaucracy, or "living in sin" and allowing work to proceed. The element of risk is understood by all parties, but is essential if the refits are to complete on time. Clearly, the MOU has to be reviewed, with a view towards greater recognition of the realities of ship refits.

AREAS FOR IMPROVEMENT

Specifications and Surveys

201 CFTSD, in addition to overseeing the work in progress during a refit, must continuously provide feedback in order to correct deficiencies in specifications, GSM, etc. As previously mentioned, the 264 Specification Deficiency Reports and 71 Unsatisfactory Condition Reports raised to date testify to this vital ongoing function. In addition to these routine submissions, the TSD has documented several areas of concern, which require particular attention. The following is a summary of some of these areas of concern:

a. valve and piping fasteners:

- specifications are inconsistent in their application of CDA/MS/GENL 11-0-2 for replacement fasteners; also, specifications encourage waste of expensive fasteners. Contractors are unwilling to abide by the letter of the requirement for replacement fasteners since B-16/GR-4 and phosphor bronze components are long lead items, and expensive, and the lack of known quantities makes it difficult to bid competitively;

b. valve repair and overhaul:

- current practice does not make adequate use of production line runs, repair by replacement, and established R&O procedures. Authorization of valve repair by 1379 action is not cost effective, and is "inspector intensive";

c. painting and preservation:

- PSL's vary considerably in areas to be treated, although the actual conditions of the ships, generally, do not reflect the variance. More thorough surveys and greater use of statistical information are required to ensure the work is included in the known work package;

d. Lagging:

- PSL's vary considerably; there are indications that entire PSL items are omitted, either by accident or by design. Ships tend to require similar quantities of work, and PSL discrepancies have to be made up by 1379 action. More thorough surveys and greater use of statistical information is necessary;

e. Habitability and cosmetics:

- there is a need to include habitability and cosmetic items to a greater degree, in order to avoid last-minute arisings during the Admiral's walk-around at the end of the refit, and to ensure ships' staffs are handed a ship whose upkeep they can maintain. Specific items of concern have been: superstructure painting, tiling, wardroom/CO/s cabin, furniture painting, and machinery painting.

Quality Assurance

The Marine Industry would appear to be one of the last frontiers in the defence industry for the implementation of Quality Assurance philosophy and procedures. It is probably unfair to blame this inertia entirely on the reluctance or unwillingness of ship builders and ship repairers, for it is also shared b some naval engineering officers, particularly those with no personal experience in modern Quality Assurance methodology.

Quality Assurance, if it must be applied to the marine environment, must be tailored to its needs, and its idiosyncrasies. The uniqueness of the environment is generally recognized by senior QA management, as is the inevitability of some degree of QC/QA in the construction or repair of ships. Concern has been expressed for the lack of policy and guidance to overseers in the implementation of QA/QC, and the paucity of such documents is well recognized. However, the evolution of a unique marine QA policy is contingent on acceptance of the concept by the

industry, in order that benefit may be gained from field experience. The following are areas which should be pursued if any progress is to be made:

a. commitment by senior DND/DSS management to the aims and benefits of QA in the ship refit field;

b. more stringent application of QA requirements;

c. increased training and awareness of QA/QC at the inspector level (the majority of overseers have no formal QA training);

d. increased discipline at the TSD level in applying QA; the present overseeing approach tends to be unsystematic;

e. greater liaison with the industry, to promote the concept of QA.

Contractual Methods

It is in the area of "traditional" refit work that improvements have to be made if we are to progress to the next degree of efficiency in ship refits. In the opinion of the overseers, some means must be found to reduce the volume of arisings, which are costly, disruptive, and "inspector intensive". A disproportionate effort is required to process routine "production line" repairs, due to inadequate contractual arrangements which place the onus on the Crown rather than the contractor. The current "modus operandi" of virtually 100% inspection and individual processing of approximately 1000 1379's per ship is neither cost-effective nor efficient in terms of manpower.

A new approach to ship refits is in order; the naval approach is out of step with the remainder of DND Repair and Overhaul philosophy, which is governed by CFP 184 (Special Instructions for R&O Facilities), and which relies on greater use of controlled procedures and greater participation by contractors in the engineering and logistics aspects of repair. The concept, currently in vogue in the repair of steam turbine auxiliaries (at Peacock Incorporated) is essentially a "pipeline" operation which reduces the work of the refit contractor to that of "repair by replacement". Also, components are repaired under a contractor-enforced Quality Control system, on which DND inspectors exercise Quality Assurance surveillance.

There is some doubt that older ships could be entirely refitted using the "hands off" approach, with overseeing reduced to a pure surveillance role, and in which the contractor assumes greater responsibility for quality, engineering, spares back-up, etc. Also, a "purist" R&O programme is heavily dependent on adequate provisioning plans, which in turn may not be cost effective to modify late in the life of a ship class. Nevertheless, considering the present commitment to extending the life of the steam destroyers to the 1990's, there is potentially a strong argument for "getting in step" with the forces-wide Repair and Overhaul philosophy, in order to introduce

greater “repair by replacement” into ship refits, thereby, reducing the volume of non-competitive arisings.

Many aspects of current multi-ship refits are already running relatively “trouble-free” The repair and testing of pumps in Peacock and NETE are a case in point. The repair and overhaul of electric motors is, generally, a “hands off” operation, with balancing and V/A as repair and acceptance criteria. (That is not to say that the refitting of electric motors is not in need of improved standards and procedures, and greater effort on the part of contractors to comply). There are other areas, however, which could be better “automated”. The repair of valves is the classic example: while the contractor is now told to “remove, open, examine, close, test, and re-install” valves, could he not be told to overhaul as well? Our experience is, that for many fluid systems, it is more costly to resort to arisings on valves, than it would be to specify full overhaul in the contract specification. That is because pre-specified contractor work subject to competitive bidding and proper planning is cheaper than arisings negotiated in the unfavourable negotiating climate of mid-refit. Various refinements can be “built-in” to such a “total overhaul” system, such as repair-by-replacement (R&R) when “maximum repair cost” (MRC) has been exceeded, and the establishment of material and performance standards which the contractor is required to meet, and on which acceptance criteria can be based. The R&O concept can, to some extent, be extended to the repair of turbo alternators, turbo blowers, air conditioning and refrigeration machinery, etc. Rather than leave much of the work to arisings, it is considered that rotors/impellers/bearings/baffles/etc. should be replaced, with spare components supplied through a “repair and overhaul” system which is either separate from, or which forms part of, the multi-ship contract. In essence, for these components which do not lend themselves to “repair-by-replacement”, the proposal is to resort to repair by replacement for sub-assemblies. Such sub-assemblies could be maintained through a system of accountable advance (AA) spares, and contractual arrangements which place greater responsibility on contractors for engineering and logistics support of pipeline components. Such an approach would permit DND to devote greater technical and logistics effort to operational support, as well as reap the benefits of a reduction in work arisings.

CONCLUSION

The Multi-Ship program for steam destroyers was introduced as a radical departure from traditional single-ship refits which was expected to reap benefits from economies of scale, and enlightened personnel, technical, and logistics management. Throughout this paper, a conscious effort has been made to draw comparisons between various aspects of Multi-Ship zero-manned refits and single-ship manned refits. It would be appropriate, therefore, in conclusion, to “take stock”, and to summarize the successes and failures of the program:

AIM	ASSESSMENT
1. Improved delivery performance.	Successful.
2. Ability for contractor to assemble, develop, and maintain a trained, experienced, and current work force; good network of sub-contractors with recent experience in naval repairs.	Successful; the success of this aspect is somewhat contingent on the work force available in the area.
3. Ability for contractor to develop improvements in planning and standards procedures, without reliance on the "learning curve".	Successful.
4. Better provisions for supply, loan tooling, test gear, etc.	Successful.
5. Well developed and stable long-term liaison with DND/DSS authorities.	Successful.
6. Better TSD facilities.	Successful.
7. More capital investment by contractor.	No significant progress has been observed; the contractor considers a two-year term inadequate for purposes of large investments in capital equipment.
8. Shore time, at home, for ship's company, with opportunities for leave, training, etc.	Successful.
9. Relinquishing entire responsibility for safety and security to contractor, and for overseeing and QA to the TSD	Successful.
10. Improved pre-refit surveys, implementation of the catalogue/PSL concept	Marginally successful; although the concept is an improvement over previous arrangements, the "particularization" process is weak.
11. Dovetailing with OPERATION MAINTOP.	Generally successful.
12. Expanded requirement for cosmetics to reduce burden on ship's staff.	Successful

13. High standards for refit quality control.	Very limited success with implementation of QC procedures, although good quality has been achieved.
14. Use of comprehensive V/A and pre-installation testing.	Successful.

It would appear, from the above assessment, that the majority of the aims of the Multi-Ship program have been achieved. However, having achieved these improvements, we have reached the point where we can see clearly the opportunities for further measures to further increase the cost-effectiveness and general efficiency of the refit process. There is now a need, not only to implement further improvements to the DND technical policies and procedures, but also to encourage current and potential future refit contractors to make progress in refit management methods and associated Quality Assurance procedures.

Repair and overhaul (R&O) of ships and their equipment has not kept pace with R&O in other industries and other elements of the Canadian Forces. In spite of the great strides made in the introduction of the specification catalogues, zero-manning, etc., ours is the one R&O activity which remains out of step and is falling behind other disciplines. The primary cause of our antiquated approach is the painstakingly slow rate of technological and managerial change in the marine industry, primarily due to the lack of any incentives to the contrary, as well as a lackluster DND performance in the introduction of innovative change. However, the day must certainly be approaching when we as the “customers” will be able to adopt a “hands off” approach to ship refits, in which the provisions of DND 1016 (Inspection Standard) and CPF 184 (Spec Instructions for R&O Facilities) can be applied. To those who look upon such a suggestion with incredulity, let us remind ourselves of our reaction, not so many years ago, to the proposition that “the ships’ staffs leave their ship in someone else’s custody, and pick it up when it’s ready”. Such a routine is now second nature. What will we be taking for granted in 1990?