66th COMMONWEALTH ENGINEER OFFICERS' CONFERENCE

Held at INS SHIVAJI, LONAVLA, INDIA 14–17 November 1995

ROLE OF THE MARINE ENGINEER OFFICER IN THE 21st CENTURY

The 66th Commonwealth Engineer Officers' Conference was held at INS Shivaji, Lonavla (India) on 15 and 16 November 1995. The theme of the conference was *Role of the Marine Engineer Officer in the 21st Century.* In addition to Indian delegates, eleven naval officers from the UK, Australia, Bangladesh and Nigeria also attended. Thirteen papers were presented and time was allocated for questions after each presentation. The conference programme was as follows:

Welcome address
COMMODORE S.K.K. KRISHNAN, IN
Commanding Officer, INS Shivaji

Opening address
VICE ADMIRAL A. BRITTO, AVSM, VSM, CENG, MIMAR E
Chief of Material

Key note address
VICE ADMIRAL M.G. RUTHERFORD, CBE, BSC, CENG, FIEE
Chief Naval Engineer Officer (Royal Navy)

Session—I

Engineering logistics and cost control
COMMODORE R. MATHEW, IN—Chairperson
COMMANDER V. DHANDA, IN—Secretary

Procurement strategy
CAPTAIN M.A. HAQUE (Bangladesh Navy)

Cost effective warships in the next century
LIEUTENANT K. VENKATESH, IN

Engineering logistics and cost control
COMMODORE M.A. LAWAL (Nigerian Navy)

Engineering logistics and cost control
CAPTAIN S.M. WILLIAMS, RN

Session—II

Total productive maintenance
COMMODORE P.K. PURINM, IN—Chairperson
COMMANDER P. TRIPATHI, IN—Secretary

Review of maintenance
CAPTAIN S.M. WILLIAMS, RN

Control of pollution and waste management in the Royal Australian Navy
CAPTAIN D.G. MIERS, RAN

Total productive maintenance
COMMANDER P. Roy CHOWDHURY, IN

Session—III

Future propulsion and machinery systems
COMMODORE Y. PAL, VSM, IN—Chairperson
COMMANDER S.R. DESHPANDE, IN—Secretary

The Electric Ship
COMMANDER D.J. MATTICK, RN

Future Machinery Systems
COMMANDER P. BAHRI, IN

Neural network and Fuzzy logic control systems
LIEUTENANT M. RAGHUNANDAN, IN

Session—IV

Changing role of the MEO
VICE ADMIRAL A.S. KRISHNAN, AVSM, VSM, IN—Chairperson
COMMANDER G. VINOD, IN—Secretary

Changing role of the MEO
CAPTAIN JASBIR SINGH, VSM, IN

The changing maintenance role of the RAN Engineer Officer
COMMODORE C.J. ELSMORE, RAN

Changing Role of MEO as influenced by the evolution of control technology
CAPTAIN Ian BRANNAM, RN

The conference concluded with closing remarks by the Director of Systems (Engineering). Abbreviated versions of the addresses are given below.

Welcome address by the Commanding Officer INS SHIVAJI

COMMODORE S.K.K. KRISHNAN

Chief of Material, ADMIRAL BRITTO; Chief Naval Engineer Officer of the Royal Navy VICE ADMIRAL RUTHERFORD; Flag Officers, foreign delegates to the conference and friends.

It gives me great pleasure to welcome you all for the 66th Commonwealth Engineer Officers Conference at Shivaji today. The last time we had the privilege of hosting this event was in 1983, when we held the 55th conference at the same venue. I must thank you all for being with us today.

The brotherhood of Naval Engineers amongst Commonwealth navies has been a strong one. We have been regularly exchanging notes and ideas and have greatly benefited from the experience. This mutual bond has been made stronger by training officers and men in each other's countries. Even in a small gathering such as todays, we have two senior officers who had done their dagger 'E' together and one foreign captain who has graduated from our Naval College of Engineering. During the next two days we will have a number of technical papers presented on the four important themes, that are closest to the naval engineers' heart.

May I take this opportunity to briefly introduce INS Shivaji to you all. Started as a mechanical training establishment in 1945, Shivaji has now grown into a full fledged campus with three independent streams of training. We have the Naval College of Engineering which runs an under-graduate programme for cadets and officers leading to a degree in mechanical or electrical engineering. Then we have the Centre of Marine Engineering Technology, which conducts the branch training for all marine engineering officers and sailors. We also have the NBCD School which trains all naval officers and a variety of sailors. Concurrent functioning of these three independent streams of training from the same campus has greatly enhanced optimal utilization of training assets and has resulted in a cost effective way of managing training in the Navy.

Gentlemen, today we have amongst us two eminent engineer officers to initiate the proceedings. I am thankful to VICE ADMIRAL BRITTO, Chief of Material, who has kindly consented to inaugurate the conference and to VICE ADMIRAL M.G. RUTHERFORD, Chief Naval Engineer Officer of the Royal Navy who has agreed to deliver the key note address.

Inaugural address by the Chief of Material, Indian Navy

VICE ADMIRAL A. BRITTO, AVSM, VSM, CENG, MIMarE

Gentlemen, I am particularly happy to be here this morning when the 66th Commonwealth Engineer Officers' Conference gets underway. We last met in India in 1983 at this very location for the 55th Conference. I was present at that time and amongst the many views shared were the experiences of the Royal Navy in the recently concluded Falklands war—which touched on a variety of points but most importantly on the subject of 'Survivability'. I am sure that with the presence of specialists and decision makers from 4 navies in our midst—Australia, Bangladesh, Nigeria and the UK—we would be able to review the scene in our respective navies in the field of marine engineering and also exchange ideas on the future. A warm welcome to all of you, particularly to our friends from abroad. Our deliberations, I am sure, will be enriched by the presence of ADMIRAL RUTHERFORD, not only with his specialist but also his wide ranging experience. On a personal note, I am also delighted to meet again CAPTAIN Ian BRANNAM, after our days of 1968–69 on the ME Dagger course at Greenwich.

Coming now to the subject of our meeting, the theme of the conference is *Role of the Marine Engineer Officer in the 21st Century*—A rather apt theme considering that we are at the turn of the century, a rapidly changing engineering scene in the face of shrinking defence budgets. This naturally places extra-ordinary demands in the management of technology as a whole and on the engineering department on board ships in particular.

By and large all navies have similar problems, namely keeping pace with:

- Technology
- Spares planning and availability
- Maintenance
- Training and manpower.

Besides, some important factors which we have to contend with are:

(*a*) On-going review of defence forces in the post cold war era.

(*b*) Resource constraints and spiralling costs.

(*c*) Industrial base to support warship building capability.

(*d*) Promise of the next century to be a century of 'Quality'.

I shall now take a broad sweep of the technological scene affecting naval engineers. Though steam turbines have largely given way to diesel and gas-turbines, I cannot visualise their total extinction. Fossil fuels may run out by

the year 2050 but in the foreseeable future diesels and gas turbines will continue to exist side by side with an increasing emphasis on better efficiencies. An all-electric ship is also under experimentation. Likewise, whether concepts of Magneto Hydro-Dynamic propulsion (MHD), super conductivity or a technology like cold fusion become a reality, remain to be seen. Underwater propulsion is likely to see the growth of Air Independent Propulsion (AIP), the Stirling cycle engines and fuel cells. Looking at hull forms, SWATH ships are receiving attention on grounds of better sea-keeping and providing better windows for helicopter operations. Yet, the mono hull is not likely to lose its dominance. The most profound impact, however, in recent times has been due to the advent of digital technology. This technology has got well embedded in hardware on board, especially in controls and communication. The micro processor and mini-computer have led to increased flexibility and reliability of controls and surveillance systems. Recent success of the integrated machinery platform concept for management of propulsion machinery, power and survivability systems has come to stay. Whatever be the technologies under consideration, the cost of technology and its support merits utmost consideration in the face of shrinking budgets. The steep cost of acquiring modern hardware and its support would no doubt be offset to an extent by other factors:

- Through-life costing
- Reduced on board engineering complements
- Limited role ships
- Use of well proven equipment to commercial standards
- Fuel efficient systems
- Modularity
- Standardization of equipment
- Repair-by-replacement.

Coming to personnel and training, what would be the effect of emerging technologies on personnel? As platform systems move towards greater automation, there is a place for 'Expert Systems' using artificial intelligence to provide assistance to the operators and maintainers of future ships and which will revolutionize decision making process with further reduction of reaction time. At the same time, the costly process of hands-on-training and increased complexity of propulsion systems will necessitate land based simulators. A natural follow on to this is the 'On board Embedded Trainer' with the same simulation capability at perhaps lesser cost.

Maintenance, is becoming more difficult in a fiscally controlled environment and is now less of an art than it was. It has become a technology, the size of which is increased in a dimension of reduced funding. With real-time monitoring and trend analysis becoming powerful tools, philosophies of condition based maintenance, predictive maintenance and repair by replacement facilitated by high standardization and modularity are likely to gain ground and minimize down times.

A necessary adjunct to supportability is that of logistics. In the Indian Navy today we have a proliferation of some 7,000 types of engineering systems and equipment in our acquisitions from abroad. Having been involved in the running of our two major dockyards that do most of the refitting, you might wonder how I am still sane. Whilst the problems of logistics may be less severe in the more developed navies, there is little doubt that the management of logistics is of crucial significance, again in the context of escalating costs. The 'Product Support' factor must, therefore, necessarily address the 'Make' or 'Buy' decision of our navies, more judiciously than hitherto. Rationalization of logistics support necessitates more uniformity in the

design, equipment selection, core electronics and reliable equipment, may be to commercial standards. Likewise, off-loading of refit packages to industry may well improve efficiency and effectiveness.

Lastly, innovation, creativity and improvisation can convert anything to a resource. With the present day assortment of technologies, shortage of resources itself can be an opportunity and challenge for any enterprising group—leadership and commitment being the key. Also, world economy has become truly global or international. Consortium approach to pooling technological strengths in future defence programmes is there for all to see. Even the argument of release of technology to a possible adversary has been tempered by realisation that export orders reduce cost and make the product affordable to the domestic customer.

On this note of a consortium approach, I should think that a continuing union and interaction of Commonwealth navies would be a profound driving force in the field of our activities. May we continue to cooperate, collaborate and share our knowledge and experience for the common good.

Key note address by the Chief Naval Engineer Officer—Royal Navy

VICE ADMIRAL M.G. RUTHERFORD, CBE, BSc, CENG, FIEE

Mr Chairman, VICE ADMIRAL BRITTO, other senior officers, fellow engineer officers, It is an honour and a privilege to have been invited to give the key note address at this, the 66th Commonwealth Engineer Officers' conference.

Seeing such a fine collection of marine engineers reminds me of an unfortunate incident in a ship, many years ago, which resulted in three of the ship's officers; the Executive Officer, the Supply Officer and the Marine Engineer Officer, being sentenced to death. The XO, being the born leader, was led to the guillotine first. To the rolls of drums, the executioner pulled the lever, releasing the blade, which stopped a hair's breadth before it would have drawn blood. The XO was released. The SO, seeing this, leapt ahead of the Engineer to kneel down at the guillotine. To his utter relief, exactly the same happened and he was a free man. The Engineer, did not kneel but lay facing upwards on the guillotine block, scrutinizing the travel of the blade as it was returned to its release position. Just before the executioner released the blade, the Engineer cried out:

"STOP..... I think I can see the problem"!

Personal experience is invaluable. It helps clarify and cement ideas, but takes time. It is therefore usually beneficial to both the individual and his organization, to exchange experiences and ideas with peers, facilitating the transfer of lessons learnt and providing alternative perspectives on a topic. The Commonwealth Engineer Officers' Conference provides an excellent opportunity for such discussions. It is heartening to see commonwealth nations represented here today and I encourage you all to maximize the use of this occasion to expand your personal experience.

Our conference theme is the *Marine Engineering Officer of the 21st Century.* This is a timely and certainly for the Royal Navy, a particularly apt theme. I recently completed a study into the future of the Royal Navy's Engineering Officer branch, driven partly by the volume of change that has affected the RN, as well as concern within the Engineering Branch over its future role in the Service. One of the major conclusions of my study was that the career structure for the marine engineers, in particular requires attention.

On a broader perspective, the world has undergone major changes in the recent past, principally with the end of the cold war but also with an increase in regional conflicts. Technology continues to advance at a terrific rate, offering the potential for improvements in capability and efficiency which demand

continual re-assessment to ensure that we maintain adequate capability in the most cost effective manner possible.

Before expanding further on the three themes of technology, finance and legislation, all of which I believe will have particular impact on marine engineers in the next century, and in accordance with established 'good engineering practice' I would like to review briefly the history of naval engineering based on the Royal Navy.

In 1805, NELSON wrote to the Admiralty Board on the future of steam. With steamships commissioned in 1827, there were no naval engineers to support them. The engine builders provided both technical support and spare parts. Some of you may recognize an early form of Contractor Logistic Support. Service engineers appeared in the Royal Navy in 1828 as apprentices. The need for a dedicated engineering branch and associated training establishment was already being discussed in 1830. A LIEUTENANT Robert WALL published a paper *Suggestions for the establishment of a Naval University with some observations on the formation of a Corps of Naval Engineers*, in 1831. The central tenet of his proposals was the use of Buckingham Palace for the training of naval engineers.

Engineers gained official recognition in 1836 via an Order of Council; the branch was placed next below carpenters. By 1863 the student engineers, aged 15 were recruited offering an entitlement to 4 days leave per year and in 1870 the Royal Naval College of Greenwich commenced the training of engineer officers. Time moves on and only one month ago the Royal Naval College was advertised for sale by one of the UK's leading Estate Agents. Our ancestors will be turning in their graves.

We have progressed a long way from the relatively simple support required for the original coal fired, steam reciprocating engines. These were replaced by more efficient and logistically friendly superheated steam system burning oil. A number of fleets have developed a comprehensive capability to support nuclear powered steam plant, particularly in submarine fleets. Although officially a weapons engineer, I cross-trained as a nuclear power plant operator and have 12 years experience of trying to keep steam in pipes—so I do not feel too out of place in this august company of professional 'steamies'.

Gas Turbines, based on aero-engine technology, also have a place in many warship fleets. Maritime specific gas turbines are now starting to be developed, diverging from aero-engines technology, due to the differing design. Environmental legislation has become one such driver for maritime fleets. Diesel technology too has been applied in warships, for both primary propulsion and electricity generation. Possibly the most recent innovation is electric propulsion which has found popularity with merchant fleets, with their focus on financial benefits. Reductions in the size of the motors through advanced technology will make integrated electric propulsion more suitable for warships.

Technological advances, is the first of my three themes. In the 150 years of service by engineers, there has been significant diversification from the original remit to support steam propulsion in surface ships; we now not only have to consider propulsion technologies but also we must have the capability to support a vast array of weapons, sensors, command, control, communications and intelligence systems.

This expansionism through specialisation may now be approaching an end, with the invasion of the microprocessor into more and more systems, and engineering systems becoming more and more reliant on microprocessor based architectures, providing monitoring and control, as well as the interface between man and machine.

The self diagnosis capabilities of processor based systems are also improving and becoming more comprehensive. When coupled with the reducing cost

of microprocessors making functional redundancy affordable along with overall improvements in reliability, the need for dedicated, highly trained, skilled and experienced engineers to support naval systems is further reduced. I stated that there are financial pressures which support the adoption of technology to replace people. People, especially technicians, are becoming even more expensive, absorbing an ever larger proportion of defence budgets.

The impact of financial pressures is my second theme. With the end of the cold war and also partly in response to today's large demands on finite national resources, tax payers are demanding the realisation of the so called peace dividend. Indeed the cost of maintaining the technological advantage played a significant part in the ending of the cold war.

Now, we all have to do 'more with less' and, quite rightly, must ensure maximum value for money. This together with the reduction in numbers of service personnel, is leading to many innovative approaches to procurement and in particular, logistic support.

Naval engineers have a proud history of being able to support complex systems in remote locations, away from land-based expertise and facilities. However, large elements of our infrastructure requirements now align with international business activities. Commercial logistic support chains offer the prospect of a cheaper, adequate alternative to specialist service ones. The luxury of the security offered by service manned repair yards is being questioned as jobs for civilians become more pressing and the threat of industrial action appears to be receding, certainly in the UK. Contractor support is appearing as a financially attractive alternative but brings with it its own distinct problems. I believe that there is great risk in over-reliance on civilian support, which may not be so readily available in times of tension or war.

My final theme is the impact of legislation on our business. For the RN, the withdrawal of crown immunity coupled with emerging international legislation, particularly environmental, will also result in significant changes in the way we approach our business. Both will have a major impact on future peace time operations. The US/UK WR21 marine gas turbine programme has been established partly as a result of impending Maritime Pollution legislation. Disposal of ship waste when operating in coastal waters has become a significant issue for ship designers.

I have no doubt that the role of Marine Engineer Officer in the 21st century will be very different from that which we have undertaken. I have raised three issues which I believe will feature strongly during the conference. We have an obligation to our tax payers to meet their maritime defence needs in the most cost effective way and to prepare for the future. I very much look forward to exploring and discussing with you all potential solutions to tomorrows' problems over the next few days.

Concluding remarks by the Director of Systems (Engineering), Naval Headquarters, New Delhi

COMMODORE A.M. TELANG, VSM, BE, ME+, AMIE

ADMIRAL BRITTO, VICE ADMIRAL RUTHERFORD, and distinguished delegates. As the saying goes all good things must come to an end and so is this conference. Trying to conclude these vibrant technology sessions is not an easy task. It perhaps calls for focusing attention on some of them and perhaps in what directions we should steer the future course of marine engineering. As we all know the traditional role of marine engineer officer angles all facets of management, operation, maintenance and training. This role is further influenced by emerging challenges such as developing technologies, financial constraints and new legislations. Technology amongst us is developing at galloping strides and there is always a race to keep ahead for the fear of being left behind. If you don't change you will vanish.

Over the last two days, the dialogue has been of very high standard. As all the areas are inter-related I shall try to cover the gist of the issues which surfaced during the deliberations. The changing role of warships, ever increasing sophistication of defence machines and sensors, shrinking defence budgets and new environmental legislations have brought new technologies into play and forcing designers and operators to improve upon existing designs. Advancements have been made to increase power densities of prime movers as well as to improve the maintainability, fuel consumption and signature management. Artificial neural networks and fuzzy logic controls are two new approaches gaining importance for solving the problem of uncertainty and non linearity and provide an answer to the future ships which will be expected to perform in more diverse conditions.

Provision of electronics below decks and machinery spaces, the beginning of which was marked in the 70's have changed the whole complexion of marine engineering. This creates the need for integrated technology and a sea change in the MEO's role. What has changed is the method as to how we discharge the primary duty as engineer officer which is to assure the Command that the equipment in the ship will achieve its expected performance. This is not different from responsibilities of late 19th century, but the tools have drastically changed.

At what cost are these technology inductions and maintenance? Some argue that such high levels and highly trained manpower groups will actually generate high dividends. It has been stated in recent years that the largest savings in the marine engineering world have not come from automation to more energy savings, but in ambitious efforts to get into high technology. Basic assumptions traditionally have been a prerogative of the ship designer. Hence in shipbuilding the true life cost which encompasses acquisition operation, up-gradation cost, plays an important role. The number is going to shrink whether it is ship or men and the emphasis will be quality rather than quantity all over the world. The industries are changing over to ISO 9000 and we in the navy have to get tuned to that concept. Though the Navy is developing the perfect in house quality assurance system, but in future, more dependence on industries for maintenance and repair of ships and equipment is expected.

During the deliberations another key factor envisaged is the effect of legislations on our existing and future aspects. An example is the material protocol and ozone depleting substances and MARPOLE conventions on environmental pollutions and affluent disposal. Strict legislations on effluent disposal have made the installation of sewage treatment plants, oily water separators, incinerators, mandatory on each ship. So tomorrow the marine engineer officers cannot remain unaware of all the relevant ISOs and other regulations.

The integration of technology of marine engineering is in the hands of all of us. What is more important is the fusion of minds. In my opinion this takes precedence over fusion of technology. Diverse disciplines of engineering are being conceived and it is essential to have a consortium approach for sharing experience. It is to have mutual consolidations on common issues.

Papers are only catalysts for generating thoughts and future ideas. All the papers stimulated meaningful discussions and I am sure we go a long way for providing a good interface between the designer and the operator, after all, the wearer knows where the shoe pinches.
