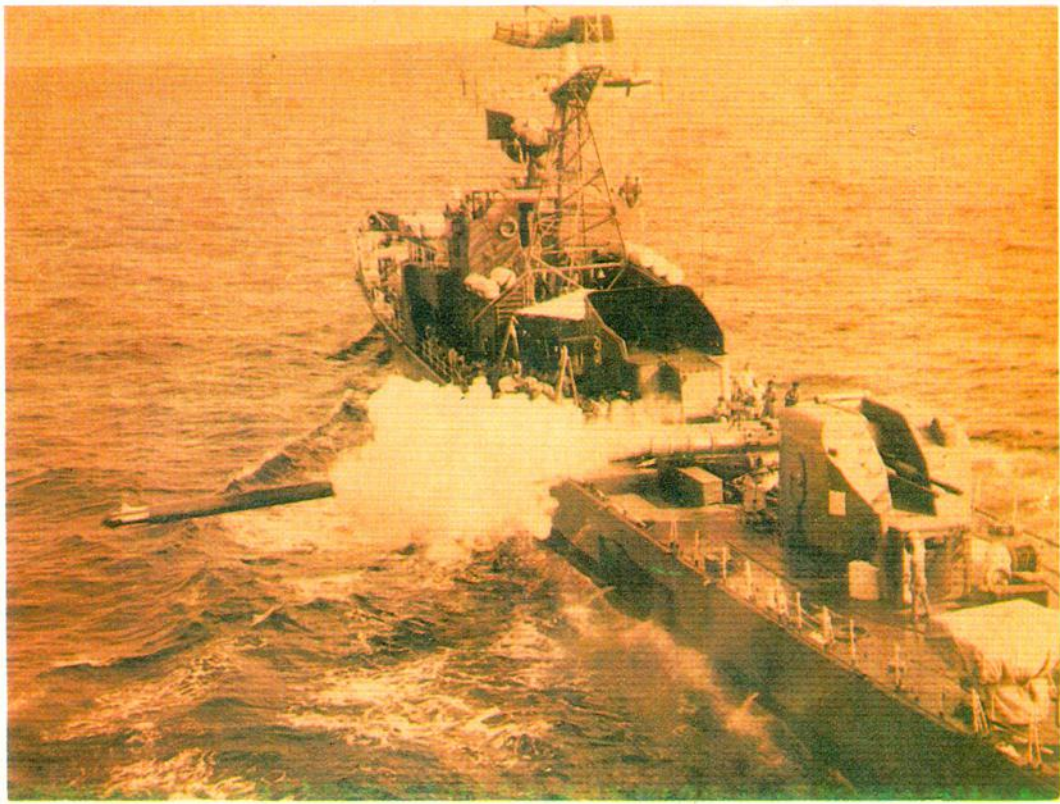


INTRODUCTION TO TORPEDO TECHNOLOGY



Rear Adm (Retd) NK Ramanarasaiah, VSM

**DEFENCE RESEARCH & DEVELOPMENT ORGANISATION
MINISTRY OF DEFENCE, GOVT OF INDIA
NEW DELHI-110 011**

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Cover Photograph (Taken by the author) : The firing of a practice torpedo from a Kamorta class ship.

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Author receiving the 'Scientist of the Year' award from the then Prime Minister Smt. Indira Gandhi - 1984.



Author with Shri R Venkataraman, the then Defence Minister when he visited NSTL in the early eighties.

FOREWORD

Oceans have always fascinated man and he has, from early days of civilisation, turned to them for adventure and exploration. Indeed, they have been his 'main highways' for extending his 'empire' and 'trade'. Over the last century, he has been exploiting the waters of the ocean for resources— living and nonliving—and to fill his unsatiating need for energy. With such a role to play, oceans have been the arena where man has been waging wars to protect his sovereignty over the resources and to subjugate his enemies resulting in 'Armadas'—from Spanish wars to the present. It would not be an overstatement to declare that the 'sea power' to a large extent dictated the outcome of many wars upto and including the World War II

The most potent weapon the seagoing ships of this century have been carrying is the 'torpedo', be it for antiship warfare or antisubmarine warfare, the latter being dominant since the World War II. Though, of late, other long-range weapons have broken-in in the arena, torpedoes still remain one of the main weapons carried by ships and submarines. Design and development of torpedoes is a multidisciplinary activity involving acoustics for homing heads, mechanical engineering and hydrodynamics for shell design, chemical technology for warheads and explosives, power sources and batteries for propulsion and electronics and software for guidance and control. It can well be said that the *raison d'etre* for Naval Science and Technological Laboratory (NSTL) at Visakhapatnam is to establish a centre of excellence in this complex torpedo technology. Over the last couple of decades NSTL has been deeply involved in establishing such a technology besides other activities in ship design and related hydrodynamic facilities. Notwithstanding its work in ship design, fire control systems and simulators, torpedoes remain the *sine qua non* of NSTL.

It is then appropriate that the first book to come out of NSTL should be on torpedoes and the first book to be written on torpedoes in India should come from NSTL. It is also appropriate that this book be written by the man who himself was at the centre of torpedo technology by being a scientist at the developmental stage, a project leader and finally the Director of NSTL.

Rear Admiral N.K. Ramanarasaiah spent over two decades in defence research and development involving himself with various phases of the developmental work on underwater weapon systems at NSTL and then building NSTL to its present status. It is rather unfortunate that this book on science and technology of torpedoes could not be published during his life time. Due to the sad and sudden demise of Adm. Ramanarasaiah, this book is being published posthumously.

This book does not provide any mathematical analysis of the algorithms used in the design of a torpedo or provide a cook book for the design. On the other hand, the intent is to provide a resource book to the new entrants of R&D and the Services by providing an overview on the various aspects of the weapon system itself. I do believe that this book admirably fills this crying need. The editing of this book has received immeasurable help from DESIDOC and NSTL, especially from Shri Kondal Rao of NSTL.

I do hope that this book would give as great a pleasure to a reader as I have had in writing this foreword to the book by a very close colleague Adm. Ramanarasaiah.

New Delhi
17 November 1993

VK Aatre
Chief Controller(R&D)
Defence R&D Organisation

PREFACE

During a span of more than three decades and more of teaching and research in the Indian Navy and the Defence Research and Development Organisation, I had often felt the need for an introductory book on the most important tactical weapon of underwater warfare, the Torpedo. I was given the privilege of working in this field and often it was found that knowledge of a new entrant to DRDO, posted to the establishment concerned, was practically nil in this area. There are no books of references or text books for a Sub-Lieutenant undergoing preliminary training to get at least a basic knowledge of torpedoes before venturing into the subtleties of underwater warfare.

This book has been written with the very specific aim of catering to this need apart from being an information source for the other Services as well as for the general public. I have deliberately avoided mathematical approach for a beginner tends to shy away from hard texts. It is proposed, however, to cover this gap in a separate volume.

Bangalore
22 November 1992

NK Ramanarasiah

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CHAPTER 1

THE WAR AT SEA

From time immemorial the sea has been the gateway as well as a barrier for the invading forces of any nation with coastline. The destinies of many a nation have been shaped by invading forces from across the sea. The primary role of a nation's Navy is to safeguard it from invasions. Depending on the geopolitical environment and the length of the coastline a nation has, the size of its Navy may vary from a few small frigates to an armada consisting of hundreds of warships ranging from aircraft carriers to minesweepers and missile boats.

The warfare at sea, which effectively means the projection of an offensive capability of the Nation out at Sea, can be broadly described as a battle between groups of surface crafts or between aircrafts and surface crafts or between submarine and surface crafts. Hence it is said that the Navy operates in '3 dimensions'.

There has been a tremendous influence on the design and functioning of naval crafts as a result of very rapid scientific and technological progress, especially in electronics and materials science. The operational capabilities and effective deployment of these crafts have been very greatly influenced by the advent of satellites, exotic communication systems, longer ranges of weapons and sensors.

Surprise is an important and essential ingredient in any warfare and the sting of this element seems to have been somewhat blunted as a result of incredible technological advancements in detecting the presence of the enemy, whether it is from a satellite or from a long-range sensing device. The strategy and the tactics, apart from the design of more modern sea-going crafts, have had to undergo a vast change compared to what was adopted during World War II. Emergence of powerful computers and

realistic simulations have in no small measure influenced the decision-making process in the higher commands of the Navy.

As stated earlier, satellites with multiple kinds of sensors which are impervious to atmospheric conditions and with extremely high-resolution viewing devices have made the atmosphere totally transparent. This, in effect, nullifies the advantages that the surface forces have had in countering the enemy. Light or any form of electromagnetic radiation has a very high attenuation rate in sea-water. It was thought, with the perfection of laser devices, that the window in the blue-green region would make the ocean transparent to the surveillance by a satellite. But, even in this window the attenuation is fairly high and is not effective at distances or depths greater than 100 m. As the technology stands today, the ocean, being opaque to many kinds of devices, is still able to contribute, to a large extent, the element of surprise and stealth to the submarines, which have thus become the most potent offensive crafts for war at sea.

The deployment of a weapon depends on the characteristics of the weapon and the tactics adopted. The tactical doctrines that are employed are governed to a large extent by the parameters of the weapons and sensors. For example, the tactics by which a long-range weapon is deployed will be at total variance with that of a shorter-range weapon. The parameters of the weapon and the tactics that are adopted in deploying them are highly interdependent. It will be interesting to see how the concept and design of any weapon originate. The user, based on the emerging threat perception of the future, feels the necessity of a weapon which can either be an offensive or of a defensive type. The initial qualitative requirement which arises out of this necessity defines broadly the required capabilities of the futuristic weapon, methodology of deploying the weapons and the types of platforms that are likely to exist when these weapons come into service, are all taken into account. The feasibility of designing and also ensuring production of the weapon that has met the qualitative requirement of the user, should be commensurate with a large number of technological factors that are at that time in vogue and the capability of the industries to meet the requirements of these newer technologies. Much can be written about the requirements that are to be met, as per the requirement of the three Services vis-a-vis the technological capability of the design department and the industrial infrastructure of the country. What is important to remember is that inducting a new weapon system in the Services is both complex and challenging.



About the Author

Born in 1932, Rear Admiral Namakkal Krishnarao Ramanarasiah obtained his post-graduate degree in Radar and Communication from the Annamalai University. He joined the Indian Navy in 1955 and did a special course in torpedo anti-submarine warfare. Subsequently, he joined DRDO in 1972 and was the Director, Naval Science and Technoloical Laboratory (NSTL), from 1985 to 1989. During his tenure with DRDO, he was responsible for building up a school of scientists and engineers to work in underwater weapon technology. The in-house knowledge developed under his leadership, guidance and inspiration is largely responsible for the country attaining self-sufficiency in torpedo development. Rear Admiral Ramanarasiah has won several distinctions including Lt Jain Memorial Gold Medal (1974), Commendation from the Chief of the Naval Staff (1975), Vishisht Seva Medal (1978) and Scientist of the Year Award (1983). He was a member of the Institution of Electronics and Telecommunication Engineers and the Board of Studies for Marine Engineering and Computer Sciences of Andhra University. He was Chairman of Computer Society of India (Vizag Chapter) during 1986-87.