

# ROLE OF PRECISION CLOCKS IN FUTURE UNDERWATER TRACKING SYSTEMS

by

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## Abstract

The purpose of the paper is to provide information on Navy underwater three-dimensional tracking ranges, and to look at future ranges in terms of precise timing requirements.

The paper is divided into three sections. The first, entitled "Development of Three-Dimensional Underwater Ranges," historically brings the reader up to date on how the Navy tracking ranges, (of which there are five) evolved. It discusses the commonalities of these ranges and their differences. The subject of hydrophone configuration; e.g., short and long baseline systems, is discussed, as well as the rationale for selection of tracking frequencies. The timing requirements and error budgets are also explored. The second section, "AUTEK Weapons Range," describes in detail a modern underwater tracking range. Its capabilities, uses, and limitations are pointed out. The last section, "Future Underwater Tracking Systems," points out the need for much larger and deeper ranges. The cost for such future ranges is a problem and indicates that novel approaches and new concepts will be required. One particular concept which would be highly cost effective utilizes bottom-mounted beacons instead of hydrophones as in the conventional approach to tracking. The success of this concept is dependent upon obtaining

clocks that are highly reliable, stable, and use little DC power. The concept and clock requirements are discussed in detail.

This complete report is classified SECRET and can be obtained only by written request to the U.S. Naval Observatory, Technical Officer, Washington, D.C. 20390.