Guest Editor's Introduction

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This is the first of three *Johns Hopkins APL Technical Digests* devoted to the Air Defense Systems Department (ADSD). This issue outlines the history of the Standard Missile (SM) and the science, technology, and operational requirements that have driven the development of SM variants. Throughout this period and for over 50 years APL has functioned as the Technical Adviser, Technical Direction Agent, and Trusted Agent of the Navy in every major missile development used by Navy surface ships.

The second issue is devoted primarily to ADSD's role and responsibility in the development of air defense combat systems. The Aegis Combat System, ship self-defense, NATO Seasparrow weapon system, and other related projects are all covered in the second issue.

The third issue is concerned with force-level engineering and the Department's role in Joint and Allied operations. Here you will find articles on the Cooperative Engagement Capability Program, the Area Air Defense Commander, and related articles. The last section in the third issue, "The Road Ahead," identifies the future threat (Table 1) as projected by the Office of Naval Intelligence (ONI) and some of the Laboratory's anticipated development activities to counter this future threat.

There are four major sections in this first issue that relate to all three issues. The Foundation provides a context for the remaining articles. It contains a letter from RADM Cobb that speaks of the Laboratory's current and past contributions to missile development, a vision of the Navy's needs, and APL's role in achieving that vision. R. W. Constantine provides an overview of ADSD's main activities, while W. H. Zinger describes how science and technology are used to meet Navy requirements, and J. A. Krill discusses, in specific detail, the systems engineering process used within the Department to solve urgent Navy problems.

The section on Theater Air and Missile Defense Programs contains four articles that discuss SM programs, past and present. The first article chronicles the history of SM, the motivation for major developments, and the principal science and technology brought to bear on these developments. The second and third articles describe the endo-atmospheric Block IVA Program and the exo-atmospheric SM-3 Program, respectively. SM-3, a four-stage version of SM, will be used to intercept tactical ballistic missiles above the atmosphere. The last

Table 1. Threat technologies (2015–2025).

Trend	Projected	Technically feasible
Speed	Mach 0.9, largest group Mach 5 at high altitude Mach 3, low-altitude approach	Mach 6–8, high altitude Mach 3+, low altitude
Altitude	40,000–80,000-ft high-altitude cruise 6-ft calm-sea sea skimmer	150,000-ft hypersonic scramjet Below 6 ft theoretically possible, but not practical/necessary
Manuevering	8–10 *g* subsonic 15 *g* supersonic	30–50 *g*
Maximum range	100–150 nm	380 nm possible (market-limited)
Radar cross-section	–40 dBsm	–50 dBsm using smart skin, in-flight shaping, active cancellation technologies
IR signature	3–5 μm, ≈1 W/sr 8–12 μm, ≈10 W/sr	3–5 μm, ≈0.1 W/sr 8–12 μm, ≈1 W/sr Using gas turbine engines, very low emissivity coatings, plume reduction technology
Guidance and control		
Advanced radar (AR)	Traditional I-/J-band long-range, all weather Increased use of spread spectrum techniques Advanced target discrimination logic Micromillimeter wave band possible	Synthetic aperture radar techniques possible
Antiradiation missile (ARM)	Wideband seekers Loitering ARMs Hybrid seekers (seeker handoff)	Programmable ARMs
IR	Two-color and image processing alone and hybrid combination	Increased sensitivity (long range)
Hybrid seekers	ARM or AR I/J band with imaging IR or ladar	Other combinations
Penetration aids		
Missile-borne systems	Jammers, towed decoys, IR decoys	
Salvo tactics	Coordinated, nearly simultaneously multiple missile attacks from different directions or in streams	

Source: Office of Naval Intelligence, ONI-1271-002-96 (Oct 1996).

article addresses the Navy Theater Wide Ballistic Missile Defense Program as a Joint family of systems providing "defense in depth" to protect an entire theater of operations. All programs are being pursued to address immediate air defense requirements to counter cruise missiles and ballistic missiles.

Special Topics pertaining to SM are presented next. The articles in this section cover a variety of themes: the application of computational fluid dynamics in the missile design, engineering, and testing process; SM-3 and kinetic warheads; an engineering approach developed to assess the comprehensiveness and adequacy of a system-wide ground test program; the use of the Guidance System Evaluation Laboratory; high-fidelity image-based simulations; the effects of noise on missile performance; and the blast initiation detector/hit panel standoff measurement test.

The final section, Applied Science and Technology, introduced by J. Frank, describes some ongoing scientific and technological investigations being considered for future integration. These articles consider the culling of fuel debris measurements for reentry vehicle identification, laser radar in tactical ballistic missile defense, and protective infrared windows.

In summary, this first ADSD issue of the *Technical Digest* provides a history of Standard Missile, its current developmental activities, and several projections where research may lead.

THE AUTHOR

ROBERT T. LUNDY is the Chief of Staff for Air Defense Programs in the Air Defense Systems Department and is a member of APL's Principal Professional Staff. He has extensive experience in anti-air warfare with 25 years as both a project and program manager. He received a B.S. in chemistry from Northwestern University and has done graduate work in communication engineering and operations research. Mr. Lundy served 29 years in the Navy as a surface line officer, commanding two surface combatants and two naval research and development laboratories. He retired as Captain in 1972. He spent the next 5 years with ITT Electro Physics Laboratory developing an over-the-horizon radar. He joined APL in 1977 as Project Manager of the Taskforce AAW Coordination Program developing incremental capabilities in air defense that resulted in the Cooperative Engagement Capability Program. He was Program Manager for the CEC Program from its inception in 1987 to its initial operational capability in 1996. He has been in his current position since that time. His e-mail address is robert.lundy@juhapl.edu.