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OPNAV INSTRUCTION 9070.1

Subj: SURVIVABILITY POLICY FOR SURFACE SHIPS OF THE U. S. NAVY

Ref: (a) OPNAVINST 3401.3 (NOTAL)
(b) OPNAVINST 9600.1
(c) OPNAVINST 3541.2
(d) OPNAVINST 9072.2
(e) OPNAVINST 8010.13A (NOTAL)
(f) OPNAVINST 5420.2P (NOTAL)

Encl: (1) Weapons Effects and Environmental Considerations
(2) Definition of Survivability Levels for Surface Ships
(3) Survivability Protection Requirements by Ship Class

1. Purpose. To establish policy and assign responsibility for incorporating survivability features in new surface ship designs, overhauls, and new/existing combat systems and equipments.

2. Background

a. Congress enacted Public Law 95-485 on Navy Shipbuilding Policy out of concern for the ability of combatant forces to withstand battle damage. In response to that Public Law, the Navy addressed vital elements of ship survivability in separate directives.

b. Reference (a) requires that nuclear hardness be included in ship design and acquisition, and that hardness levels be maintained. References (b), (c) and (d) establish policy and assign responsibility for implementing the Passive Fire Protection Program, Damage Control and Firefighting (DC/FF) initiatives and shock hardening of surface ships, respectively. Reference (e) provides additional policy relative to insensitive munitions requirements.

c. While references (a) through (e) provide essential guidance, none sufficiently integrate the broad aspects of survivability into a comprehensive policy directive for surface ships. In that context, this instruction addresses those fundamental design considerations and associated protection level requirements to enhance readiness and warfighting sustainability.

3. Discussion

a. For the purposes of this instruction, survivability is defined as the capacity of the ship to absorb damage and maintain mission integrity. The ability to effect major survivability improvements becomes difficult once the fundamental design trade-off decisions have been made. These decisions usually occur during the early design phases of the ship acquisition process. Since the installation of survivability improvements into existing ships has proven very expensive, a forward fit strategy is necessary to achieve high pay-off results. Focus on incorporating survivability features in the early phases of ship design will ensure an affordable balance of desired upgrades in the Top Level Requirements (TLRs) for each new ship class.

b. Warships are expected to perform offensive missions, sustain battle damage and survive. As such, the total ship, comprised of combat systems and vital hull, mechanical and electrical components, must be sufficiently hardened to withstand designated threat levels. Enhancement techniques, such as equipment separation and redundancy, arrangements and personnel protection form an integral part of this effort. DC/FF training and associated maintenance of ship survivability features are also essential elements to ensure sustained capability.

4. Objective. To implement definitive policy and operationally relevant requirements for surface ships that:

a. Emphasizes the need for incorporating survivability features early in the ship design process for new construction and accomplishing priority alterations within the Fleet Modernization, Service Life Extension and Weapons Improvement Programs.

b. Establishes minimum levels of ship survivability for use in the development of Top Level/Operational Requirements, design specifications, preliminary design reviews, evaluation of change proposals and the procurement of shipboard equipment.

c. Provides the basis for developing an investment strategy to relate affordability and mission effectiveness issues and for applying priorities to implement survivability enhancements in new construction and critical equipment/system upgrades.

5. Applicability and Scope. This instruction applies to all surface ship classes described here and encompasses mission essential combat systems, equipment and personnel protection features developed throughout the ship design, procurement, operation and life-cycle support phases.

6. Policy

a. Survivability shall be considered a fundamental design requirement of no less significance than other inherent ship characteristics, such as weight and stability margins, maneuverability, structural integrity and combat systems capability. The Chief of Naval Operation's (CNO's) goal is to maintain ship operational readiness and preserve warfighting capability in both peacetime and hostile environments.

b. Ship protection features, such as armor, shielding and signature reduction, together with installed equipment hardened to appropriate standards, constitute a minimum baseline of survivability. These shall be implemented through appropriate ship and equipment specifications and the application of the principles of separation, redundancy and arrangements of critical components and systems. Enclosure (1) describes in general terms the survivability weapons effects and operational environments that shall be considered during the ship design process.

c. Major overhaul and modernization programs shall incorporate survivability enhancement features wherever practical and affordable.

d. The levels of survivability defined in enclosure (2) shall be incorporated in the designs for ship classes identified in enclosure (3).

e. Procurement practices for outfitting ships, mission essential equipment and crew shall invoke survivability specifications and standards under the protection levels set forth in enclosure (3).

7. Responsibility and Actions

a. Chairman, Ship Characteristics and Improvement Board (SCIB) is the CNO's Executive Agent for implementing surface ship survivability initiatives. In addition to the SCIB responsibilities set forth in reference (f), and in conjunction with the warfare sponsors, the Chairman shall:

(1) Provide continuous coordination, direction, management focus and control to ensure effective implementation of surface ship survivability requirements.

(2) Ensure planning, programming, staffing and budgeting to support development, procurement and installation of survivability design features.

(3) Issue directives to ensure surface ship survivability implementation, accountability and funding across warfare/platform sponsors and Fleet commands, especially including the need to address survivability considerations in TLRs.

(4) Solicit input, develop and periodically update survivability briefings and progress reports.

b. Deputy Chief of Naval Operations (Naval Warfare) (OP-07) shall exercise primary responsibility and authority for the coordination, direction and development of naval warfare survivability guidance and shall provide management focus to ensure balance among mission effectiveness versus projected threat, platform commonality and affordability issues.

c. Assistant Chief of Naval Operations (Surface Warfare) (OP-03) shall implement the responsibilities of the CNO with regard to the determination of survivability requirements and characteristics of surface ships, and shall direct appropriate programming and budgeting actions to ensure ship survivability initiatives are supported to the maximum extent feasible.

d. Assistant Chief of Naval Operations (Air Warfare) (OP-05) shall coordinate with OP-03 to implement the responsibilities of the CNO with regard to the determination of survivability characteristics of aircraft carriers and shall direct programming and budgeting actions to ensure ship survivability initiatives are supported to the maximum extent feasible.

e. Commander, Naval Sea Systems Command (COMNAVSEASYSCOM), in support of and in coordination with the CNO shall:

(1) Provide the focus for comprehensive development, assessment and implementation of surface ship survivability.

(2) Ensure state-of-the-art awareness, transfer of technology, responsive test and evaluation capability and implementation of cost-effective improvements. These functions shall include but not be limited to the considerations of enclosure (1) and the following items:

(a) Develop appropriate methodologies and perform assessments of survivability features, such as reduced observables, arrangements, fire loading, ventilation and materials for application into new design characteristics and TLRs.

(b) Determine the desirability, feasibility, benefits and costs associated with implementing/developing survivability improvements.

(3) Establish and validate survivability performance and test standards, specifications and procedures matched to actual and anticipated threat effects.

(4) Ensure all applicable military and federal specifications, standards, manuals and other directives are updated and/or developed as necessary to reflect survivability performance requirements.

f. Chief Engineer of the Navy (CHENG) is the Ship Survivability Advocate for the U.S. Navy and, in coordination with the CNO, shall develop appropriate programmatic and budgeting plans to implement all surface ship survivability requirements in the ship design and equipment procurement/installation processes.

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WEAPONS EFFECTS AND ENVIRONMENTAL CONSIDERATIONS

The numerous weapons effects and operational environments associated with survivability dictate the need to reduce ship vulnerability through various protection features such as armor, shielding, shock hardening reduced fire loading, redundancy, separation of vital systems and the use of damage control and firefighting techniques. The following is a brief description of these considerations:

a. Nuclear and Conventional

Airblast. The shock (blast) wave and associated phenomena produced by an explosion in air, resulting in the propagation outward of a sharp pressure front accompanied by subsequent air motion.

Airblast Induced Shock (ABIS). The shock wave from a nuclear detonation impact on the ship causing dynamic deformations of the deck and is transmitted through the foundations. Topside exposed equipment experience this shock loading as well as that resulting from the direct airblast pressure. Internal equipment, however, experience only the first effect of blast-induced shock. In contrast to the vertical shock motions from underwater explosions, those of airblast-induced shock are predominantly in the horizontal direction.

Cold Weather. Severe environmental conditions that impact ship operations, including topside icing, heavy seas, floating ice and extreme cold air temperatures.

Debris. The parts of an aircraft or unexploded missile, rocket or similar device, either disintegrated or intact, which strikes a ship. It is specified by weight, dispersion of parts and velocity.

Electromagnetic Environment. The electromagnetic fields produced in the ship operating region. Specifications include peak field strengths, frequencies, duration and pulse characteristics.

Electromagnetic Pulse (EMP). A very short pulse of electromagnetic radiation from a high altitude nuclear explosion given as a time signature with a peak electric field amplitude and parameters defining the time dependence.

Fire. Flame, heat, smoke and toxic products of combustion resulting from enemy weapons or accident. Related factors may include location, number and type of compartments affected, the type of incendiary materials used, fire loading, temperatures, rate of spread and smoke density. Also included are effects of unexpended missile fuel and munitions.

Fragmentation. Shattering of a projectile or warhead into many irregular metallic pieces (shrapnel) or shaped pieces (controlled fragmentation) by the detonation of an explosive charge.

High Energy Laser (HEL). An intense collimated beam of coherent electromagnetic radiation capable of physically damaging hardware. Specification include beam frequency, intensity, pulse characteristics, if appropriate, and cross section dimensions.

Initial Nuclear Radiation. Neutron and gamma radiation emitted during the first minute after a nuclear explosion. It is specified as the total energy absorbed in a standard material along with rate of energy absorption. In the case of neutrons, the number of particles incident per unit area is also specified.

Internal Burst. A rapid pressure rise inside a ship compartment caused by the explosion of a penetrating warhead. Parameters specified include peak pressure and the ratio of charge weight to compartment volume. Fragmentation may also be included.

Mechanical Shock. An acceleration or step velocity change of ship structure caused by the incident shock wave. Shock spectra defining the frequency response of a mass-spring oscillator to the shock motions is specified along with shock factors which are in index of severity and proportional to the energy content in the shock wave.

Overpressure. The transient pressure, exceeding the ambient pressure, manifested in the shock (blast) wave from an explosion in air.

Residual Nuclear Radiation. The nuclear radiation which persists for an extended time following a nuclear explosion. The radiation is emitted mainly by bomb residues in the fallout and other materials in which radioactivity has been induced.

Semi-Armor Piercing Warheads. The warheads are designed to penetrate into the target and detonate, posing a blast/fragmentation threat to ship structures and vital systems.

Shaped Charge Warheads. These warheads produce a high velocity metallic jet, in addition to blast/fragmentation, upon impact with the target. This jet is designed to penetrate through ship structures and impact stowed munitions or vital systems.

Signatures. Various forms of energy radiated or reflected from a ship. While they do not constitute weapons effects, they serve as homing signals for enemy weapons. Signatures include Radar Cross Section (RCS), Infra-red (IR), Optical, Acoustic, Magnetic, Electromagnetic emission and Hydrodynamic Pressure.

Surface Waves. Waves generated by a nuclear explosion and expressed as wave height.

Thermal Pulse. A surge of radiant energy from a nuclear device with a specified intensity and duration.

Transient Radiation Effects on Electronics (TREE). Caused by initial gamma and neutron emissions from a nuclear burst. These emissions result in the failure or degraded operation of sophisticated solid state circuits. (See Initial Nuclear Radiation).

Underwater Shock. One or more pressure pulses which follow an initial shock wave resulting from an underwater explosion. The peak pressure is defined along with the period of time between pulses.

b. Chemical, Biological, and Radiological (CBR). Agents and residual radiation capable of incapacitating or killing personnel and/or impairing equipment performance. They are specified by defining agents, concentrations and levels of impairment. (See Residual Nuclear Radiation).

c. Other Weapon Effects. These include effects from directed high energy weapons emitters with sufficient energy to disrupt electronics or cause more permanent equipment damage and personnel injury. They can be tuned to selected frequencies and can exceed the frequency range of an EMP. Specifications include the size of the attack region, frequencies, intensities and polarization.

DEFINITION OF SURVIVABILITY LEVELS FOR SURFACE SHIPS

Survivability weapons effects and operational environments are categorized in terms of the three levels of severity described below. They provide a basis for establishing survivability performance standards and are not intended to describe conditions of readiness or mission impact. Definitive engineering design values shall be developed to characterize the degrees of severity relative to the weapons effects identified in enclosure (1). Ship survivability features shall provide affordable protection at the levels specified in enclosure (3) to support sustained mission capability:

Level I - low
Level II - moderate
Level III - high

Level I represents the least severe environment anticipated and excludes the need for enhanced survivability for designated ship classes to sustain operations in the immediate area of an engaged Battle Group or in the general war-at-sea region. In this category, the minimum design capability required shall, in addition to the inherent sea keeping mission, provide for EMP and shock hardening, individual protection for CBR, including decontamination stations, the DC/FF capability to control and recover from conflagrations and include the ability to operate in a high latitude environment.

Level II represents an increase of severity to include the ability for sustained operations when in support of a Battle Group and in the general war-at-sea area. This level shall provide the ability for sustained combat operations following weapons impact. Capabilities shall include the requirements of Level I plus primary and support system redundancy, collective protection system, improved structural integrity and subdivision, fragmentation protection, signature reduction, conventional and nuclear blast protection and nuclear hardening.

Level III, the most severe environment projected for combatant Battle Groups, shall include the requirements of Level II plus the ability to deal with the broad degrading effects of damage from anti-ship cruise missiles (ASCMs), torpedoes and mines.

SURVIVABILITY PROTECTION REQUIREMENTS BY SHIP CLASS

The operationally relevant ship survivability protection requirements presented below incorporate the severity levels and conditions described in enclosure (2) and shall be implemented in concert with applicable TLRs and associated design standards and performance specifications.

PROTECTION REQUIREMENTS BY SHIP CLASS

SHIP CLASS	NUCLEAR/CONVENTIONAL WEAPON PROTECTION LEVELS		CBR PROTECTION LEVELS	NUCLEAR/ CONVENTIONAL PROTECTION LEVELS (1)
	SHIP	EQUIPMENT	SHIP	PERSONNEL
AIRCRAFT CARRIERS	III	III	III	III
BATTLE FORCE SURFACE COMBATANTS	III	III	III	III
FRIGATES	II	II	II	II
AMPHIBIOUS WARFARE SHIPS	II	II	II	II
UNDERWAY REPLENISHMENT STATION SHIPS	II	II	II	II
SHUTTLE SHIPS	I	I	I	I
PATROL COMBATANT AND MINE WARFARE SHIPS	I	I	I	I
NAVAL STRATEGIC SEALIFT	I	I	I	I
MATERIAL SUPPORT SHIPS	I	I	I	I
ALL OTHER AUXILIARY SHIPS/CRAFT	I	I	I	I

NOTE: (1) Personnel hazard environments include fragments and debris, thermal radiation, initial and residual nuclear radiation, chemical and biological agents, temperature extremes, fire, smoke and toxic products of combustion and laser irradiation.