



Standard Practice for Human Systems Integration Program Requirements for Ships and Marine Systems, Equipment, and Facilities¹

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1. Scope

1.1 *Objectives*—This practice establishes and defines the processes and associated requirements for incorporating Human Systems Integration (HSI) into all phases of government and commercial ship, offshore structure, and marine system and equipment (hereafter referred to as marine system) acquisition life cycle. HSI must be integrated fully with the engineering processes applied to the design, acquisition, and operations of marine systems. This application includes the following:

1.1.1 Ships and offshore structures.

1.1.2 Marine systems, machinery, and equipment developed to be deployed on a ship or offshore structure where their design, once integrated into the ship or offshore structure, will potentially impact human performance, safety and health hazards, survivability, morale, quality of life, and fitness for duty.

1.1.3 Integration of marine systems and equipment into ships and offshore structures including arrangements, facility layout, installations, communications, and data links.

1.1.4 Modernization and retrofitting ships and offshore structures.

1.2 *Target Audience*—The intended audience for this document consists of individuals with HSI training and experience representing the procuring activity, contractor or vendor personnel with HSI experience, and engineers and management personnel familiar with HSI methods, processes, and objectives. See 5.2.3 for guidance on qualifications of HSI specialists.

1.3 *Contents*—This document is divided into the following sections and subsections.

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1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Human Systems Integration

2.1 *Definition of Human Systems Integration*—HSI is a systematic life-cycle engineering process that identifies and integrates human considerations into the design, acquisition, and support of marine systems through the application of knowledge of human behavior, capabilities, and limitations. The goal is to optimize human performance, including human capability, proficiency, availability, utilization, accommodation, survivability, health and safety by influencing

design, construction, and operations through the integration of requirements that rely on the expertise found in the following HSI domains:

2.1.1 *Manpower*—Establishing the number and type of personnel needed to operate and maintain the marine system.

2.1.2 *Personnel*—Determining where the people with the required knowledge, skill, and abilities (KSAs) required to fill marine system billets will be drawn.

2.1.3 *Training*—Establishing and providing the training requirements for the personnel selected.

2.1.4 *Human Factors Engineering*—Designing and assessing user interfaces between humans and hardware, software, firmware, webware, courseware, information, procedures, policy and doctrine, documentation, design features, technology, environments, organizations, other humans, and (co) robots.

2.1.5 *Safety and Occupational Health*—Providing a safe and healthy working environment.

2.1.6 *Personnel Survivability*—Providing a platform that maximizes crew survivability.

2.1.7 *Habitability*—Providing the characteristics of systems, facilities, personal services, and living and working conditions that result in high levels of crew morale, quality of life, safety, health, and comfort.

2.1.8 Government-oriented definitions of the HSI domains are provided in **Table 1**.

2.1.9 It is understood that not all HSI domains will be involved in every marine system design project. For example, in the commercial maritime setting, design requirements affecting several HSI domains (for example, manpower, personnel selection, and training requirements) are set by entities other than the procuring organization. This does not diminish the fact that inattention to these HSI domains can lead to the increased likelihood of human error, accidents, and incidents. Therefore, the procuring organization must exert maximum effort to ensure that all HSI domains are considered in the design, construction, and operation of any maritime system.

2.1.10 HSI fundamentally involves engineering processes and program management efforts that provide integrated and comprehensive analyses, design and assessment of requirements, operational and maintenance concepts, and resources for system manpower, personnel, training, human factors engineering (HFE), safety and occupational health (SOH), personnel survivability, and habitability. These seven HSI domains are interrelated and interdependent, and they are primary drivers of effective, affordable, and safe design concepts and deployed systems. HSI relies on a concurrent engineering process to perform co-operative trade-offs among the seven HSI domains to achieve effective system performance levels and affordable life-cycle costs, but does not replace individual domain activities, responsibilities, or reporting channels.

2.1.11 The HSI framework for organizing and integrating of human considerations into marine system design represents a system-level engineering approach. HSI uses the results of its technical domain analyses and tradeoffs to integrate them into the systems engineering and design processes. In the government environment, other HSI domains provide insights, data,

TABLE 1 Description of Government-Oriented HSI Domains

Domain	Description
Manpower	Manpower is the number of personnel (military, civilian, and contractor) required, authorized, and potentially available to operate, maintain, train, administer, and support each ship, offshore structure, system, or combination thereof.
Personnel	Personnel is the source, in terms of people, for the human knowledge, skills, abilities, aptitudes, competencies, characteristics, and capabilities required to operate, maintain, train, and support each ship, offshore structure, marine system, or combination thereof, in peacetime and war.
Training	Training is the instruction, education, assessment, resources required to provide ship and marine facility personnel with requisite knowledge, skills, and abilities to operate, maintain, and support ship, offshore structure, marine systems, or combination thereof.
Human Factors Engineering	Human factors engineering is the comprehensive integration of human characteristics and capabilities and limitations into system definition, design, development, and evaluation to promote effective human-machine integration for optimal total system performance.
Safety and Occupational Health	Safety is the process for hazard identification, risk evaluation, design analysis, hazard mitigation, control, and management. The process manages the design and operational characteristics of a system to eliminate or minimize the possibilities for accidents or mishaps caused by human error. Occupational health is the systematic application of biomedical knowledge, early in the acquisition process, to identify, assess, and minimize health hazards associated with the system's operation, maintenance, repair, storage, or support.
Personnel Survivability	Personnel Survivability is the how the system design minimizes medical implications when humans are injured, provides escape and evacuation routes for crew, and minimizes human mental and physical fatigue.
Habitability	Habitability is the ship, offshore structure, and system characteristics that provide for environment control of living and working conditions (temperature, noise, vibration, and space attributes); and provides accommodations and support facilities (berthing, sanitary, food service, exercise, training, laundry, medical, dental, administrative, ship stores, and community or lounge facilities). Habitability is concerned with the level of comfort and quality of life that is conducive to maintaining optimum crew performance, readiness, and morale.

TABLE 2 Key Interactions Among HSI Domains

Domain	Interactions
Manpower	Personnel – Qualities and quantities of personnel required versus availability in inventory and pipeline Training – Qualities and quantities required versus ability to train to meet requirements HFE – Qualities and quantities of personnel required versus ability of system design or redesign to support manpower, task complexity, and workload SOH – Qualities and quantities of personnel required versus ability to safely perform tasks, particularly in a reduced manpower environment Personnel Survivability – Quantities versus availability of personnel protection equipment (PPE) and designs that support survivability Habitability – Quantities of personnel and workload required to perform tasks versus habitability support requirements such as berthing, food service, laundry, administrative, postal, ship stores, and other habitability support spaces
Personnel	Training – Availability in the inventory or in the pipeline of quantities of personnel required versus ability to train required knowledge, skills and abilities (KSAs) HFE – Availability of quantities and qualities of personnel required versus complexity of task and system design
Training	HFE – Complexity and duration of training and training system design versus task/design complexity and the ability to train KSAs versus complexity of tasks and design Personnel Survivability – Transfer of information on training requirements for PPE and other emergencies
HFE	SOH – How does design avoid or mitigate risks to safety and occupational health; Risks versus ability of design to mitigate risks Personnel Survivability – Emergency egress and personal protection versus design's ability to support Habitability – How do habitability facilities support the ability of users to safely and effectively inhabit space and perform tasks
SOH	Habitability – Reduction of safety and health risks through the design of environmental control (temperature, noise, and vibration levels) and habitability facilities and working spaces not under habitability purview (work shops, machinery spaces, etc.)
Personnel Survivability	Habitability – Ensure that requirements for PPE and survivability are integrated with the overall design of habitability facilities and working spaces
Habitability	All HSI Domains – Ensure domain concerns are addressed in habitability facilities, e.g., address the manpower or training implications of a food service facility

and design considerations that HFE translates into hardware, software, workspace, and task design. This is a more formal government process. In the commercial environment, HSI relies heavily on HFE, assigning it responsibility of being

aware of considerations associated with manpower, personnel, training, safety, and habitability and representing those as part of a human-centric design process.