



DEPARTMENT OF THE NAVY

NAVAL SEA SYSTEMS COMMAND  
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IN REPLY TO

NAVSEAINST 3900.8A  
Ser 03/011  
20 May 05

NAVSEA INSTRUCTION 3900.8A

From: Commander, Naval Sea Systems Command

Subj: HUMAN SYSTEMS INTEGRATION (HSI) POLICY IN ACQUISITION AND  
MODERNIZATION

- Ref:
- (a) Chief of Naval Operations Guidance for 2004
  - (b) NAVSEANOTE 5400 Ser 10/251 of 15 Oct 2002, Establishment of the Human Systems Integration (HSI) Directorate (SEA 03)
  - (c) DoD Instruction 5000.2 of 12 May 2003, Operation of the Defense Acquisition System
  - (d) SECNAVINST 5000.2C ASN (RDA)ACQ of 19 Nov 2004 Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System
  - (e) Virtual SYSCOM Joint Instruction VS-JI-22 of 3 Jan 05, Virtual SYSCOM Engineering and Technical Authority Policy
  - (f) NAVSEANOTE 5400 Ser 03/010 of 18 Mar 2003, Technical Authority Warrant
  - (g) NAVSEAINST 8020.6D Ser N00/02 of 15 Jan 97, Navy Weapon System Explosives Safety Review Program
  - (h) NAVSEAMEMO Ser 03/010 of 17 Jul 2003, Navy Ship System Program Manager's Human Systems Integration Guide
  - (i) COMFLTFORCOM Norfolk VA 231400Z May 03, Fleet Response Plan (FRP) Implementation
  - (j) OPNAVINST 1000.J of 6 Jan 1998, Manual of Navy Total Force Manpower Policies, and Process
  - (k) OPNAVINST 1500.76 of 21 July 1998, Navy Training System Requirements, Acquisition, and Management
  - (l) OPNAVINST 9640.1A of 3 September 1996, Shipboard Habitability Program
  - (m) COMSC Instruction 9330.6D, Accommodation Standards for Military Sealift Command (MSC) Ships

- Encl:
- (1) Program HSI Criteria
  - (2) Top-level Human Performance Metrics

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1. Purpose. To establish policy and responsibilities within the Naval Sea Systems Command (NAVSEA) enterprise, including affiliated Program Executive Offices (PEOs). To incorporate Human Systems Integration (HSI) principles, methods, tools, and data in all aspects of business operations. To embed the Human Performance Systems Model into every NAVSEA acquisition, modernization and R&D program.
2. Cancellation. NAVSEAINST 3900.8 Ser 55W54/109 of Mar 1985.
3. Scope
  - a. This instruction applies to all Acquisition Category (ACAT) programs; new weapon system procurements; hull, mechanical and electrical (HM&E) procurements; and modernization programs. Furthermore, this instruction applies to all aspects of acquisition, including preliminary concept development, product design, production, test and evaluation, service introduction, modernization and disposal and demilitarization. Non-ACAT efforts such as Abbreviated Acquisition Program (AAP) and Science and Technology (S&T) efforts are included.
  - b. This instruction does not apply to Naval nuclear propulsion plant systems and equipment under the cognizance of the Director, Naval Nuclear Propulsion (SEA 08).
4. Background. Total system performance enables superior war fighting capability. Warfighter performance is a critical element of total system performance, and is derived through the application of HSI principles and the Human Performance Systems Model. Chief of Naval Operations Guidance, reference (a), directs the Human Performance Systems Model be embedded in every acquisition and R&D program. By reference (b), COMNAVSEASYS COM established the HSI Directorate (SEA 03) to focus on Warfighter performance and provide technical assistance to PEOs and Program Managers (PM) to enhance mission capability by improving total system performance and reducing life cycle costs. Total system elements include hardware, software, and human end users (e.g. operators, maintainers, support personnel), and shore-based support infrastructure required by the ship or ship system being built or modernized. Reference (c) requires PMs have a comprehensive HSI plan in place to optimize total system performance, minimize total ownership costs, and ensure that physical and cognitive characteristics of the Warfighters using, operating, maintaining, and supporting the system are accommodated. Reference (d) issues mandatory procedures for

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incorporating HSI into all Navy and Marine Corps acquisition programs. By references (e) and (f) COMNAVSEASYSYSCOM established HSI technical and certification authority in SEA 03, and appointed SEA 03TD as the warranted HSI Technical Authority. This authority complements the technical authority vested with the Weapon System Explosives Safety Review Board delineated in reference (g).

## 5. Discussion

a. As COMNAVSEASYSYSCOM's HSI technical and certification authority, SEA 03 is responsible for certifying that the ships, combat systems, and HM&E systems delivered to the Fleet enhance Warfighter performance; optimize manpower, personnel, training and human reliability; and promote personnel health, safety, survivability, and quality of service. Reference (h) provides guidance to PEOs, PMs, and those charged with the execution, design, and modernization of Navy ships and ship systems to ensure these acquisition and modernization programs successfully meet DoD and Navy HSI requirements. SEA 03 teams with Technical Warrant Holders in SEA 04 (ESOH) and SEA 05 (Personnel Survivability and Habitability) when exercising its HSI Certification responsibility.

b. SEA 03 has developed program HSI criteria and top-level human performance metrics in order to exercise technical authority and perform certification functions. Human system integration criteria for certification are derived from the criteria and metrics specific to the program:

(1) Program HSI assessment criteria helps PMs in determining how well their programs are implementing and executing HSI. These assessment criteria are program specific and tailored to system complexity, type of acquisition, ACAT level, and program maturity. Enclosure (1) provides program HSI criteria.

(2) Top-Level Human Performance Metrics, enclosure (2), measure human performance as an integral and critical element of total system performance. These metrics help PMs in measuring how well their ships and systems meet the system performance component of the war fighting requirements.

6. Responsibilities. The following specific responsibilities apply to NAVSEA and affiliated PEOs.

a. NAVSEA 03 shall:

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- (1) Exercise HSI technical authority in the HSI domains of human factors engineering, manpower, personnel and training, and exercises HSI certification in conjunction with support from SEA 04 (Environmental, Safety and Occupational Health (ESOH)) and SEA 05 (Personnel Survivability and Habitability). SEA 03 is the NAVSEA Deputy Warranting Officer for HSI.
- (2) Establish program HSI certification criteria. For Modernization programs, HSI certification criteria shall be established within the SHIPMAIN and C5I Modernization processes in support of the Fleet Response Plan (FRP) as promulgated by reference (i).
- (3) Certify in writing that new acquisition programs have carried out effective HSI activities in advance of major acquisition milestones or events.
- (4) Provide technical assistance to PEOs, PMs, Ship Design Managers and Warfare Centers to interpret human performance requirements and to develop and incorporate human performance metrics.
- (5) Provide assistance to PEOs, Ship Design Managers and PMs to identify program HSI tasks and activities that PEOs and PMs should be performing given the complexity of the ship, system, selected ship development approach, ACAT level and maturity of the program in the acquisition or modernization processes.
- (6) Provide personnel resources and information, including information on applicable HSI tools, processes, methods and data, to support PEO development and execution of program HSI criteria requirements.
- (7) Monitor HSI implementation across NAVSEA, Affiliated PEOs and Warfare Centers to determine and report the aggregate benefit accrued through the use of HSI metrics.
- (8) Coordinate HSI policy implementation and integration across NAVSEA systems engineering processes.
- (9) Educate the NAVSEA workforce about HSI requirements and policy.
- (10) Represent COMNAVSEASYSKOM in forums resolving

Navy-wide HSI policy issues.

(11) Provide assistance in determining the maturity and potential availability of research program products consistent with ship development or system development.

b. PEOs and PMs shall:

(1) Establish an HSI Point of Contact (POC) for each PEO and every major acquisition program.

(2) Ensure that HSI requirements identified in the Initial Capabilities Document (ICD) and Capability Development Document (CDD) or predecessor documents are met through the systems engineering process.

(3) Apply HSI principles to optimize human performance as a part of total system performance, system effectiveness, sustainability, survivability, safety and affordability.

(4) Verify HSI requirements in acquisition requirements documents and identify resource shortfalls to specific resource sponsors and NAVSEA 03.

(5) Include HSI requirements in performance specifications. When system level performance is directly or significantly influenced by human performance, system level performance measures shall be defined and assessed with operators and maintainers in the loop. The potential use of human modeling and simulation shall be reviewed as a part of this process.

(6) Develop, resource and sustain an HSI Plan that supports all phases of system acquisition or modernization.

(7) Conduct a Top-Down Requirements Analysis (TDRA) as part of the systems engineering process to determine manpower and human performance requirements in terms of Warfighter functions, tasks, and required knowledge, skills and abilities for system users, operators, maintainers, and support personnel.

(8) Conduct manpower, personnel, training (MPT), and supportability analyses as parts of the systems engineering process beginning with concept refinement and continuing throughout program development.

(9) Design, develop, prototype (for systems) and test

the system being acquired or modernized to meet human performance requirements. PMs shall consider human performance testing within their Test and Evaluation Master Plan (TEMP). For modernization efforts that do not require a TEMP, PMs shall integrate human performance testing throughout the test and evaluation process.

(10) Define program appropriate human performance metrics to measure and track improvement of Warfighter performance. Use enclosure (2) to identify and incorporate these metrics.

c. Warfare Centers shall:

(1) Establish an HSI point of contact within each Product Area.

(2) Assist in the implementation of HSI on NAVSEA acquisition and modernization programs.

(3) Maintain proficiency in applying HSI practices and procedures to acquisition and modernization programs.

d. Supervisors of Shipbuilding, Conversion and Repair and Naval Shipyards shall:

(1) Establish an HSI Point of Contact.

(2) Maintain proficiency in applying HSI policies and procedures.

(3) Ensure that HSI principles, policies and procedures are applied to the shipbuilding, conversion and repair programs to meet each program's requirements.

e. COMNAVSEA Deputy Commanders (SEA 04, SEA 05, SEA 06, SEA 07) shall:

(1) Designate a single HSI point of contact for each Directorate to coordinate HSI efforts and to ensure that the Directorate's HSI responsibilities are carried out.

(2) Ensure that systems and equipment are designed in accordance with the HSI requirements and criteria of references (b) and (c), and designed to match the performance capabilities and limitations of the personnel who will operate, control,

maintain, manage, and support them.

(3) In support of the PEO/PM develop, identify, and document ship system manpower and training requirements in accordance with references (j) and (k). Verify that these requirements for all shipboard systems and equipment are accurate. Ensure manpower and training requirements are given prime consideration during the design of ships, ship systems, and equipment.

(4) Ensure manpower and training trade-off studies are conducted and documented early in the acquisition process, and used to influence the design of ship systems and equipment to minimize manning and training costs.

(5) Ensure that the shipboard habitability and environmental control requirements of reference (l) are met in the total ship designs. Additionally, the requirements of reference (m) shall be met for Military Sealift Command (MSC) Ships.

(6) Ensure that human performance lessons learned from ships, systems, and equipment in operational use are documented and addressed early in design to prevent recurring deficiencies in HSI, human performance, and lifecycle support.

(7) Team with SEA 03 to perform HSI Assessments and Certifications - SEA 04 for ESOH; SEA 05 for Personnel Survivability, Habitability.

f. Ship Design Managers shall:

- (1) Establish an HSI Point of Contact.
- (2) Require that HSI be included as part of the systems engineering effort.
- (3) Initiate HSI at the beginning of the ship design process.
- (4) Maintain proficiency in applying HSI practices and procedures to ship acquisition programs.

7. Action. NAVSEA and affiliated PEOs shall comply with the responsibilities in this instruction, and document decisions and strategies regarding the incorporation of HSI into their programs. SEA 03 will provide additional guidance, information,

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and assistance as required to assist PMs and PEOs in meeting these requirements.

8. Review. This instruction will be reviewed annually and updated as required.



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FKP COMNAVSEASYSKOM Shore Activities (less FKP6B & FKP24)  
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A1J1M PEO LMW  
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### Program HSI Criteria

Program HSI criteria indicate the adequacy of the overall implementation of HSI actions within desired parameters. To assess the implementation of HSI within Naval Sea Systems Command programs, specific areas of compliance have been identified. These HSI program performance areas are designed to assist Program Managers (PMs) and NAVSEA 03 in identifying the strengths and weaknesses of HSI within acquisition and modernization programs.

Program HSI criteria shall be used to assess the adequacy of design concepts from an HSI perspective, to evaluate training effectiveness, and to provide dependent measures in Developmental Testing (DT) and Operational Testing (OT) test and evaluation exercises.

There is a very close and interdependent relationship between each of the HSI domains addressed below. Considerations, tradeoffs, and decisions made by a Program during the design process, particularly in iterative designs, should be assessed for potential impact to requirements across all HSI domains.

For new programs, these program HSI criteria shall be developed prior to Program Concept Decision. For existing programs, they shall be established within the context of the program documentation, but in all cases, once implemented they shall be adhered to throughout the lifecycle of the program.

NAVSEA 03 will assist PEOs and PMs in tailoring and implementing appropriate program HSI criteria. The criteria listed below provide the basis for acceptable Program Performance Certification by NAVSEA 03.

#### 1. Program HSI Management

The Program shall develop a Human System Integration Plan (HSIP). For ship modernizations, the HSIP shall focus principally on the systems being modernized and their interfaces with existing ship systems. This plan can be either a stand-alone document or a subset of the Systems Engineering Management Plan (SEMP). Guidance on the development of an HSIP document can be obtained from NAVSEA 03. IEEE Standard for Application and Management of the Systems Engineering Process (IEEE 1220-1998) can also be used.

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The Program shall demonstrate that it is executing a disciplined HSI process, in accordance with the HSIP, that includes human performance data collection and measurement. This HSI process shall be integrated with the systems engineering, total ship computing, ILS, Test & Evaluation, and risk management processes.

HSI elements shall be integrated into Program acquisition and contract documentation, such as the Acquisition Strategy and Acquisition Program Baseline. Additionally, the PM shall ensure human performance testing (including human-machine interface usability testing) is included in the Developmental and Operational sections of the Program Test and Evaluation Master Plan (TEMP).

Documentation shall be maintained concerning HSI trade-off analyses conducted throughout the lifecycle of the Program. Human systems integration Return On Investment (ROI) shall be evaluated, including noted improvement in human performance and readiness.

## 2. Program HSI Funding

Sufficient and stable resources must be available to execute all aspects of the HSIP across the program life cycle and through all acquisition, modernization and end of service life phases.

## 3. Human Factors Engineering (HFE)

For new acquisition programs, NAVSEA recognizes the American Society for Testing and Materials (ASTM) F1166 standard, and the Program is expected to meet these requirements. For existing and modernization programs, MIL-STD-1472 may be invoked in lieu of ASTM F1166. Either standard is acceptable for existing and modernization programs, and the Program is expected to meet the invoked requirements

The Program shall integrate HFE with systems engineering (to include function and task allocation) to provide efficient human-machine interfaces, meet established HSI requirements, as well as, mitigate safety and health issues. Additionally, Human performance metrics shall be developed from the task analysis conducted as part of the Top Down Requirements Analysis (TDRA).

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#### 4. Manpower

PEOs/PMS shall conduct a TDRA to support the Program's manpower estimate. The Program shall produce data to support manpower determinations (shipboard and shore infrastructure) from the allocated functions and tasks throughout the design process. The Program will show that total ship integration is taken into account in the analysis and total force manpower requirements have been addressed. The ship's crew's training workload will be considered in the manpower analysis.

PEOs/PMS shall explore options to maximize the use of technology to reduce manpower requirements throughout the program life cycle.

#### 5. Personnel

The human performance requirements of the Program's user population shall be based on the new or modernized system description, anticipated skills, projected characteristics of target occupational specialties, and recruitment and retention trends. The Program must identify skills and occupational specialties to minimize potential personnel issues. Documentation concerning trade-off analyses shall be maintained throughout the life of the Program.

PEOs/PMS shall explore options to maximize the use of technology to reduce personnel requirements throughout the program life cycle.

#### 6. Training

The required knowledge, skills and abilities (KSAs) for a new or modernized system shall be determined by workload and task analyses for appropriate missions and mission conditions (including Mission Essential Tasks) based on the TDRA. The Training Process Planning Methodology (TRPPM) / Navy Training System Plan (NTSP), reference (k), must effectively describe the training concept and how it was developed. These plans will incorporate appropriate new training technologies and fleet training initiatives, including the Total Ship Training System (TSTS) or future Total Ship Training Architectures (TSTAs).

Realistic onboard training workload shall be determined with consideration given to the media and technologies selected for

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use and the complete onboard training requirement, including training administration (planning, observing, recording, etc.), just-in-time" training, and Fleet/team training. This training workload shall be incorporated into all manpower considerations. Program test and evaluation shall include evaluation of training effectiveness.

#### 7. Personnel Survivability

The program shall address to the extent specified in program requirements documents detection of and protection against instantaneous, cumulative and residual nuclear, biological and chemical weapon effects, the integrity of the crew compartment against such effects, as well as protection against fratricide. Detection and protection against Chemical, Biological and Radiological (CBR) shall be coordinated with the Joint Program Executive Office for Chemical and Biological Defense (JPEO-CBD).

The PM shall make provisions for rapid egress when the system is severely damaged or destroyed. The PM shall also address special equipment, if any, or gear needed to sustain crew operations in the operational environment and shall take into account the degraded task times when wearing protective gear. As appropriate, antiterrorism/force protection measures shall also be addressed consistent with the KPP on asymmetric threats.

#### 8. Environment, Safety & Occupational Health (ESOH)

The program shall prevent ESOH hazards where possible and shall manage ESOH hazards where they cannot be avoided as part of risk reduction. Risks shall be identified and analyzed using MIL-STD-882 (Series) and residual risks shall be accepted at the proper level.

The PM shall eliminate or minimize hazardous materials and shall document remaining hazardous materials used in the system. The PM shall also plan for the system's demilitarization and disposal and shall also comply with ESOH statutory and regulatory requirements including 32 CFR 775.

#### 9. Habitability

OPNAV/Joint Staff shall establish threshold requirements for living and working conditions, the physical environment and personnel facilities to optimize mission readiness, crew morale, professional development, retention, and recruitment that

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support system performance. These requirements shall, at a minimum, meet the OPNAV Instruction 9640.1A (Shipboard Habitability Program) and the NAVSEA Shipboard Habitability Design Criteria Manual (T9640-AB-DDT-010/HAB).

**Program HSI Criteria References:**

- ASTM F1166-95a**, Standard Practice for Human Engineering Design for Marine Systems, Equipment, and Facilities
- CFFCINST 3501.3**, Fleet Forces Command Fleet Training Strategy (FTS)
- CNO Guidance for 2004**
- COMSCINST 9330.6D**, Accommodation Standards for Military Sealift Command Ships
- DODD 5000.1**, The Defense Acquisition System, May 12, 2003
- DODI 5000.2**, Operation of the Defense Acquisition System, May 12, 2003
- IEEE 1220-1998**, IEEE Standard for Application and Management of the Systems Engineering Process
- MIL-STD 882D**, DOD Standard Practice for System Safety
- MIL-STD 1472F**, DOD Design Criteria Standard - Human Engineering
- NAVPERS 15839I**, Manual of Navy Officer Manpower and Personnel Classifications
- NAVPERS 18068F**, Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards
- NAVSEAINST 8020.6D**, Navy Weapon System Safety Program
- NAVSEA Shipboard Habitability Design Criteria Manual (T9640-AB-DDT-010/HAB)**
- OPNAVINST 1000.16J**, Manual of Navy Total Force Manpower Policies and Procedures
- OPNAVINST 1500.57A**, Surface Warfare Training Strategy
- OPNAVINST 1500.76**, Navy Training System Requirements, Acquisition, and Management
- OPNAVINST 5100.23F**, Navy Occupational Safety and Health (NAVOSH) Program Manual
- OPNAVINST 9640.1A**, Shipboard Habitability Program

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**SECNAVINST 5000.2C**, Implementation and Operation of the Defense Acquisition System and the Joint Capabilities Integration and Development System, 19 November 2004

**SECNAVINST 5100.10H**, Department of the Navy Policy for Safety, Mishap Prevention, Occupational Health and Fire Protection Programs

Enclosure (1)

## Top Level Human Performance Metrics

**Human Performance:** Human performance (HP) is the sum of human tasks and actions in a specified environment and under specified conditions that reflect the skills required for operators and maintainers to meet total system performance parameters.

Working with SEA 03, CFFC, Fleet representatives, the Human Performance Center and the operational test community, PMS shall identify human performance requirements and determine appropriate human performance metrics; then employ them throughout program development, acquisition, developmental and operational test and evaluation and modernization processes to assess critical human-in-the-loop tasks as part of total system performance. PMS shall also recommend appropriate human performance requirements and metrics for inclusion in requirements documents such as the Initial Capability and Capability Development Documents, and as exit criteria in Acquisition Decision Memorandums. At a minimum, PMS shall incorporate human performance metrics into their acquisition and contract documentation, such as the Acquisition Strategy and Acquisition Program Baseline.

PMS shall continue to apply and refine HP metrics throughout the program's life cycle. These metrics shall be used to compare design alternatives, diagnose operational problems, provide objective analysis of subjective operator feedback, and to determine if completed designs satisfy performance requirements. System level measures of effectiveness and performance shall be defined and assessed with operators and maintainers in the loop. These metrics shall be used to track changes in human performance across baselines or spirals, for evaluating the impact of future upgrades or modernizations and for the identification of trends due to improvements, operator learning and/or fatigue, and personnel turnover.

The HP metrics described below apply to five human performance categories (Timeliness, Accuracy, Availability, Workload, and Situational Awareness) and may be applied to any particular project or program. The selected metrics must be tailored to the functions, tasks and skills of the operators and maintainers of the identified system, and specifically used to quantify performance for critical or frequent operator tasks and decisions. In addition to collecting specific human performance metrics, test plans and test procedures shall ensure that

measures of overall system performance are inclusive of human tasks and decisions.

1. **Timeliness**

- a. **Time to Complete** - The duration of time to complete a specified task relevant to mission completion.
- b. **Time to Respond** - The duration of time for the operator to initiate an action in response to a system cue or other relevant stimulus. This does not include system response time.

2. **Accuracy**

- a. **Task Accuracy** - The accuracy of responses made by the operator (correct/incorrect) under specified conditions.
- b. **Decision Accuracy** - The accuracy (correct/incorrect) of decisions made by an operator under specified conditions.

3. **Availability**

- a. **Operator/Maintainer Availability** - The percent of time an operator (or maintainer) is ready and able to carry out assigned tasks, which is a consideration for overall system availability.
- b. **Time on Task** - The percent of time that a Warfighter is conducting assigned tasks (e.g., maintenance, operations, etc.) over a specified time period (a watch, a day, a scenario). Time on Task will relate directly to manpower considerations, and shall include actual operation/maintenance actions and any just-in-time training needed to accomplish task.

4. **Workload**

- a. **Cognitive Workload** - An estimate of the cognitive effort required to complete tasks.
- b. **Physical Workload** - A measure of the degree of strength and physiological exertion required to complete assigned tasks.

Enclosure (2)



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5. **Situational Awareness.**

- a. **Objective Measures of Situational Awareness** - A quantitative comparison of an operator's knowledge and understanding of prior, current, and projected events to the information available to the operator or to real world status, and the ability to translate that information into appropriate actions required.
  
- b. **Subjective Measures of Situational Awareness** - An operator self-rating or observer rating of the operator's knowledge and understanding of prior, current, and projected events, and the ability to determine/take appropriate actions based on that information.