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This standard provides task description for conducting an integrated human factors engineering program during the development and acquisition of weapon systems. These requirements include the work to be accomplished or subcontracted by the contractor for an integrated human factors engineering program. The tasks, as tailored, will be applied to systems, equipment, software and facilities studies, concept development, demonstration and validation, design development, and test, acquisitions and modifications. Tasks described in this standard are to be selectively applied in contract-definitized procurements, requests for proposal, and contracts requiring human factors programs for the development, production, and initial deployment of systems, facilities, equipment, and software. Application guidance and rational for selecting tasks to fit the needs of a particular program are included.

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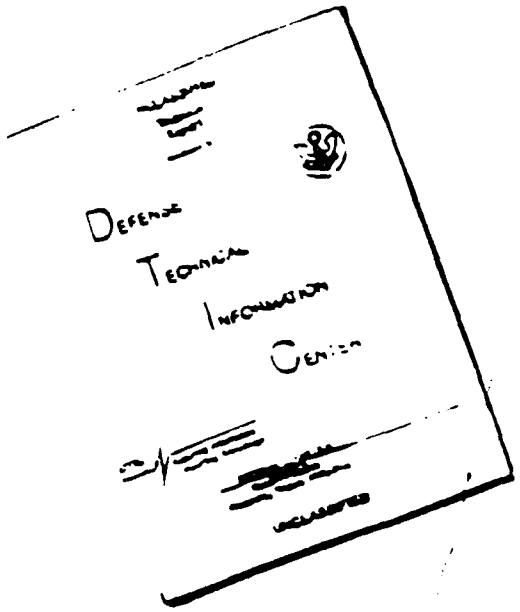

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MILITARY STANDARD

HUMAN FACTORS ENGINEERING PROGRAM

FOR

INTERCONTINENTAL BALLISTIC MISSILE SYSTEMS

AMSC NO. F 3967

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DEPARTMENT OF THE AIR FORCE
Washington, D.C. 20330

Human Factors Engineering Program for Intercontinental Ballistic Missile Systems

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2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: HQ BMO/AWD, Norton AFB, CA 92409, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

FOREWORD

The objective of a human factors engineering program is to ensure that human factors considerations are analyzed, studied and evaluated and appropriate criteria developed, and incorporated into the design of all hardware, software and facilities.

This military standard consists of basic applications requirements, specific tailorable human factors engineering program tasks for an intercontinental ballistic missile system, and an appendix which includes an application matrix and guidance and rationale for task selection.

Effective human factors programs must be tailored to fit program needs and constraints, including life cycle costs (LCCs). This document is intentionally structured to discourage indiscriminate blanket applications. Tailoring is forced by requiring that specific tasks be selected and, for those tasks identified, that certain essential information relative to implementation of the task be provided by the procuring activity.

Although not all-encompassing, the guidance and rationale provided in Appendix A is intended to serve as an aid in selecting and scoping the tasks and requirements.

CONTENTS

1. SCOPE

1.1 Purpose. This standard provides task descriptions for conducting an integrated human factors engineering (HFE) program to the development and acquisition of intercontinental ballistic missile (ICBM) systems. These requirements include the work to be accomplished or subcontracted by the contractor in effecting an integrated HFE program. The tasks, as tailored, will be applied to systems, equipment, software and facilities studies, concept development, demonstration and validation, design development, and test, acquisitions and modifications.

1.2 Applicability. This standard is applicable to all ICBM weapon systems development. The responsibility for HFE begins with the inception of the system and continues throughout the life cycle of each system. The HFE program shall apply to all system engineering analyses, studies, concepts, systems, equipment, software, and facilities for which the contractor is assigned developmental responsibility in the contract, including aerospace vehicle equipment (AVE), operational support equipment (OSE), maintenance support equipment (MSE), depot support equipment (DSE), test support equipment (TSE), special test equipment (STE), training equipment (TE), and modifications to government-furnished equipment (GFE) and commercial equipment. This responsibility must be addressed in each system management, planning, programming or contractual document.

1.3 Application. Tasks described in this standard are to be selectively applied in contract-definitized procurements, requests for proposal (RFPs) and contracts requiring human factors programs for the development, production, and initial deployment of systems, facilities, equipment and software. Application guidance and rationale for selecting tasks to fit the needs of a particular program are included in Appendix A.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

MILITARY

Standards

MIL-STD-280	Definitions of Item Levels, Item Exchangeability, Models, and Related Terms
MIL-STD-721	Definitions of Terms for Reliability and Maintainability
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities
MIL-STD-1521	Technical Reviews and Audits for Systems, Equipment and Computer Programs
MIL-STD-882	System Safety Program Requirements

(Copies of specifications, standards, drawings and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the procuring contracting officer.)

2.2 Order of precedence. In the event of conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

3.1 Definitions. Definitions applicable to this standard are as follows:

3.1.1 Acquisition phases.

a. Conceptual (CONCEPT) phase: The identification and exploration of alternative solutions or solution concepts to satisfy a validated need.

b. Demonstration and validation (VALID) phase: The period when selected candidate solutions are refined through extensive study and analysis; hardware development, if appropriate; test; and evaluation.

c. Full-scale development (FSD) phase: The period when the system and the principle items necessary for its support are designed, fabricated, tested, and evaluated.

d. Production (PROD) phase: The period from production approval until the last system is delivered and accepted.

3.1.2 Confirm. Infers a qualitative test that requires comparison of test results to an applicable requirement(s). (See Demonstrate, 3.1.4)

3.1.3 Critical task. Critical tasks are those that require human performance, which, if not accomplished in accordance with system requirements, will most likely have adverse effects on cost, system reliability, nuclear hardness and survivability, efficiency, health, or safety. Human performance shall also be considered critical whenever equipment design characteristics demand performance which approaches the limits of human capabilities and thereby contributes to the occurrence of one or more of the following conditions, but not necessarily limited thereto:

a. Jeopardized performance of an authorized mission.

b. Degradation of the circular error probability to an unacceptable level.

c. Delay of mission beyond acceptable time limits: e.g., human time to react will not meet required system reaction time.

d. Improper operation resulting in a system "no-go," inadvertent weapon firing, or failure to achieve operational readiness status.

e. The exceeding of predicted times for maintenance personnel and support equipment (SE) to complete maintenance tasks. Performance times will be considered critical if the total maintenance response time significantly exceeds maintenance analysis estimates, or affects SE quantitative requirements.

f. A significant degradation of system equipment below reliability requirements.

g. The damaging of system equipment, resulting either in a return to a maintenance facility for major repair, or an unacceptable cost, spare requirements, or system down time.

h. A serious compromise of weapon system security.

i. Injury to personnel.

j. Any unacceptable degradation of system nuclear hardness and survivability.

3.1.4 Demonstrate. Infers a qualitative test that does not require comparison of test results to an applicable requirement(s). (See Confirm, 3.1.2)

3.1.5 Design. A plan, pattern or arrangement of details/parts that make up a system, subsystem, item (hardware, software, facilities) that may exist in preliminary definition (conceptual, such as an engineers' sketch or illustration) through intermediate definition (such as engineering model or test article drawings) to final or detailed definition (operational drawings and instructions). As used in this standard, unless modified, such as concept design or detailed design, the level of definition inferred or referenced is indefinite or that level of definition in existence at the particular phase of development.

3.1.6 Determine. Infers a quantitative test that does not require comparison of test results to an applicable requirement(s). (See Evaluate, 3.1.11)

3.1.7 Development tests. Development tests are performed at the contractor's facility in support of item design activity. The tests support design, confirm compliance with requirements documents or specifications, and demonstrate CI performance. The two categories of development testing are:

a. Component development tests - The objectives are to support design tradeoffs and to demonstrate that design concepts can be translated into workable hardware and software. These tests are generally conducted after system design review (SDR) and before preliminary design review (PDR).

b. Subsystem development tests - The objectives are to verify the preliminary designs of equipment and software. These tests are generally conducted after PDR and before critical design review (CDR).

3.1.8 Development integration tests. The development integration tests complete the design development cycle. This testing evaluates functional performance including structural, mechanical, software, and electrical interaction characteristics of each subsystem when interconnected with one or more other interfacing subsystems. Some subsystem test objectives are allocated to the weapon system (WS) test for evaluation because they can only be evaluated in a WS configuration. These tests are performed at centralized locations for two or more development items or subsystems that require integrated testing to complete the individual item development. Testing in this category involves subsystems developed by two or more contractors.

3.1.9 Development test and evaluation (DT&E). The DT&E system-level tests demonstrate missile and WS integration and compatibility, evaluate system performance and effectiveness, and provide data for accuracy, reliability, suitability, and survivability studies. In some cases, these tests may include subsystem test objectives not fully verified during development integration testing. Additionally, validation and verification of technical publications/data and training are accomplished.

3.1.10 Equipment layout drawings. Equipment detail drawings include, but are not necessarily limited to:

a. A scale layout of the controls and displays for each panel or item of equipment, such as a launch control console.

b. A description of all symbols used.

c. Identification of the color coding used for displays and controls.

d. The labeling used on each rack, panel, control and display.

e. The identification of control type (e.g., for push-button switches, whether maintained or momentary contact).

f. A clear differentiation between indicators and control-indicators.

3.1.11 Evaluate. Infers a quantitative test that requires comparison of test results to an applicable requirement(s). (See Determine, 3.1.6)

3.1.12 Human engineering task analysis. A human engineering (HE) task analysis is a time-oriented description of the human-equipment interactions by an operator or maintainer in accomplishing a unit of work with an item of equipment. It defines the sequential and simultaneous manual and intellectual activities of the person operating, maintaining or controlling equipment, rather than a sequential operation of the equipment.

3.1.13 Human factors engineering (HFE) elements. These elements encompass all aspects of human performance and are considered an integral part of total system performance. Each of these elements is planned and given continuous consideration beginning with inception of the system or equipment and continuing throughout its life cycle.

3.1.13.1 Human engineering. HE is the application of knowledge about human capabilities and limitations to system or equipment design and development to achieve optimal system performance. HE assures that the system or equipment design and development, the required human tasks, and the work environment are compatible with the sensory, preceptual, mental, and physical attributes of the personnel who will operate, maintain, control and support it.

3.1.13.2 Biomedical. The biomedical element includes every area that requires provisions for the promotion of health and safety and in particular the protection, sustenance, escape, survival and recovery of personnel employed within the total system environment. This support is provided for operations, maintenance and support personnel under both normal and emergency conditions. It also includes health protection from conditions resulting from system functioning for personnel who are not included in the total system complex, but who will be affected by the system.

3.1.13.3 Manpower and personnel requirements. The manpower and personnel requirements element identifies the number of trained personnel required to operate, maintain and support system equipment in its operational environment. Efficient operation of the system, or piece of equipment, depends in part on the proper mix and skill level of military and civilian personnel. Information generated by this element serves as a basis for manpower and personnel planning and programming decisions.

3.1.13.4 Human factors test and evaluation (HFTE). This element is part of the system testing effort conducted in accordance with approved test plans. HFTE includes all testing directed toward validation and evaluation of human factors analyses, studies, criteria, decisions, and operational and maintenance design characteristics, and features. These may include engineering design tests, model tests, mockup evaluations, demonstrations, and subsystem tests conducted to verify system level requirements. Human factors tests are a part of system development test and evaluation (DT&E) and operational test and evaluation (OT&E). The OT&E is comprised of initial operational test and evaluation (IOT&E) and follow-on test and evaluation (FOT&E). OT&E is concerned with determining whether military personnel, with system training, can in fact operate, maintain, and support the system in its intended operational environment. Human factors observer/evaluator(s) (O/E) are fully qualified human factors engineers assigned by a contractor to observe and evaluate tests of equipment/material which may have some impact on human factors elements or maintainability.

3.1.14 Operator. A human performer; one who operates a (specified) item; such as a test set operator, a crane operator, a tool operator, a value operator (it is used in human factors in the conventional sense as distinguished from the operations-maintenance dichotomy).

3.1.15 System engineering. A basic tool for systematically defining the equipment, personnel, facilities, and procedural data required to meet system objectives. It is an iterative process, requiring updating and having feedback loops to insure that each component developed contributes to the system meeting mission objectives. A system engineering analysis may include, but is not necessarily limited to, the following:

a. Preparation of operationally realistic mission profiles, and mission scenarios.

b. Preparation of functional flow block diagrams for the system.

c. Functional analysis of each flow block and definition of operational and support equipment and facilities requirements.

d. Preparation of system and subsystem schematic block diagrams.

e. Study of detailed functions, environment, and technical design requirements to allocate functions to personnel, equipment, or some combination thereof.

f. Preparation of operations and maintenance timeline analyses to determine system reaction time.

g. Preparation and analysis of operational and maintenance task data to determine equipment quantities, personnel loads, and system downtime for scheduled and unscheduled maintenance.

h. Definition of training requirements.

i. Development of training equipment requirements.

j. Conduct of failure mode analysis.

k. Preparation of test planning analyses.

l. Preparation of assembly, installation, and checkout technical analyses.

m. Definition of logistics requirements.

3.1.16 System safety. The administrative and technical means by which accident prevention and policies are planned, managed, and implemented into the total program effort are established in MIL-STD-882.

3.1.17 System/subsystem/equipment. A general term referring to the end item or items to be obtained from the acquisition. The term is synonymous with the term "item" as defined in MIL-STD-280 and MIL-STD-721. System/subsystem/equipment includes the following levels:

a. System
b. Subsystem
c. Set
d. Group
e. Unit
f. Assembly
g. Subassembly

any of which may be the objective of the acquisition.

3.1.18 Tailoring. The process by which individual requirements (sections, paragraphs, or sentences) of the selected specifications, standards, and related documents are evaluated to determine the extent to which they are most suitable for a specific system and equipment acquisition and the modification of these requirements to ensure that each achieves an optimal balance between operational needs and cost. The tailoring process must, however, conform to provisions of existing regulations governing human factors engineering programs and take care not to exclude those requirements which are determined as essential to meeting minimum operational needs.

3.1.19 Task analysis. A systematic method used to develop a time-oriented description of personnel-equipment/software interactions brought about by an operator, controller or maintainer in accomplishing a unit of work with a system or item of equipment. It shows the sequential and simultaneous manual and intellectual activities of personnel operating, maintaining or controlling equipment. The following taxonomy is used to analyze tasks:

a. Task. A composite of related activities (perceptions, decisions and responses) performed for an immediate purpose, e.g., remove tire.

b. Subtask. Activities (perceptions, decisions and responses) which fulfill a portion of the immediate purpose within a task, e.g., remove lug nuts.

c. Task element. The smallest logically and reasonably definable unit of behavior required in completing a task or subtask, e.g., operate wrench.

3.2 Definitions of acronyms used in this standard. The following acronyms listed in this Military Standard are defined as follows:

a. A&CO assembly and checkout

b. AF Air Force

c.	AFLC	Air Force Logistics Command
d.	AFS	Air Force specialty
e.	AFSC	Air Force specialty code
f.	AFSC	Air Force Systems Command
g.	AFOTEC	Air Force Operational Test and Evaluation Center
h.	AMD	Aerospace Medical Division
i.	AMSDL	Acquisition Management Systems and Data Requirements Control List
j.	ATC	Air Training Command
k.	AVE	aerospace vehicle equipment
l.	BMO	Ballistic Missile Office
m.	CDR	critical design review
n.	CDRL	contract data requirements list
o.	CFE	contractor-furnished equipment
p.	CI	configuration item
q.	DCP	decision coordination paper
r.	DID	data item description
s.	DoD	Department of Defense
t.	DoDISS	Department of Defense Index of Specifications and Standards
u.	DSE	depot support equipment
v.	DT&E	development test and evaluation
w.	ECP	engineering change proposal
x.	FOT&E	follow-on operational test and evaluation
y.	FSD	full-scale development
z.	GFE	government-furnished equipment
aa.	HE	human engineering
ab.	HF	human factors
ac.	HFB	human factors board
ad.	HFDAR	human factors design analysis report
ae.	HFDP	human factors development plan
af.	HFE	human factors engineering
ag.	HFG	human factors group
ah.	HFPR	human factors program review
ai.	HFTE	human factors test and evaluation
aj.	HFTR	human factors technical report
ak.	HFWG	human factors working group

al.	HVAC	heating, ventilation and air conditioning
am.	ICBM	intercontinental ballistic missile
an.	IOT&E	initial operational test and evaluation
ao.	ILS	integrated logistics support
ap.	LED	light emitting diode
aq.	LRU	line replaceable unit
ar.	MENS	mission element need statement
as.	MSE	maintenance support equipment
at.	NH&S	nuclear hardness and survivability
au.	O/E	observer/evaluator(s)
av.	OPR	office of primary responsibility
aw.	OSE	operational support equipment
ax.	OT&E	operational test and evaluation
ay.	PA	procuring activity
az.	PCO	procuring contracting officer
ba.	PDR	preliminary design review
bb.	PMD	program management directive
bc.	PMP	program management plan
bd.	PPR	personnel planning report
be.	RF	radio frequency
bf.	RFP	request for proposal
bg.	SAC	Strategic Air Command
bh.	SDR	system design review
bi.	SE	support equipment
bj.	SOW	statement of work
bk.	SRA	system requirements analysis
bl.	SRU	shop replaceable unit
bm.	STE	special test equipment
bn.	TE	training equipment
bo.	T&H	transportation and handling
bp.	TO	technical order(s)
bq.	TPA	test planning analysis
br.	TRA	test requirements analysis
bs.	TSE	test support equipment
bt.	W/G	working group
bu.	WS	weapon system

4. GENERAL REQUIREMENTS

4.1 Human factors engineering program. The purpose of the human factors engineering program is to improve operational readiness, reduce manpower needs, reduce life cycle cost, and to provide information essential for program control. The contractor shall establish and maintain an effective human factors engineering program that is planned, integrated, and developed in conjunction with other design, development, and production functions to permit the most cost-effective achievement of overall program objectives. The human factors engineering program shall include the technical resources, plans, procedures, schedule, and controls for the work needed to assure achievement of human factors engineering requirements, including compliance with applicable criteria of MIL-STD-1472 and other human factors criteria specified by the contract. Procedures shall be established which assure that human factors engineering is an integral part of the design process, including design changes. The procedures shall identify the means by which human factors engineering contributes to the design of the system or equipment acquisition including design changes. The procedures shall identify the means by which human factors engineering contributes to the design of the system or equipment acquisition including operation, fault detection, and diagnostics subsystems at organization, intermediate, and depot levels of application.

4.2 Human factors engineering program objectives. The integrated human factors engineering program shall define a systematic approach to make sure:

a. The human role in the system is defined in order to optimize human performance in relation to that specific system.

b. Adequate crew-equipment analyses and trade studies are accomplished beginning with the conceptual phase and, as appropriate, throughout the system life cycle. These studies must consider life cycle costs, system performance requirements and complexity, and the capability of assigned personnel to perform the intended function.

c. Trained human factors engineering specialists assist in selecting and designing the equipment that personnel will be required to operate, maintain, support, and control.

d. All of the planning for workplace environments is appropriate and optimized for effective personnel contribution to system and mission performance.

e. Biomedical analysis and design support includes the environmental protection necessary to promote health and safety and the capability for safe operation and maintenance of the system or equipment item.

f. Manpower and personnel requirements represent the proper military and civilian mix, and skill levels, for optimum human performance and minimize manpower requirements.

g. Training characteristics for system personnel are identified.

h. Basic personnel data is developed to support training and technical data development.

i. Military personnel who have had system training participate in system test and evaluation to verify that they can safely and effectively operate, maintain, support and control the system in its operational environment.

4.3 Human factors engineering program interfaces. The contractor shall utilize human factors engineering information resulting from applicable tasks in the human factors engineering program to satisfy program requirements. All human factors engineering information used shall be based upon, and traceable to, the outputs of the human factors engineering program for all logistic support and engineering activities involved in all phases of the system, subsystem, equipment, software, and facilities acquisition. The human factors engineering program shall be coordinated with maintainability, reliability, manpower, safety, training, integrated logistics support (ILS), nuclear hardness and survivability (NH&S), and other related programs, and shall be integrated into the total system project. The human factors portion of any system engineering analysis, design, or test and evaluation program shall be conducted under the direct cognizance of contractor personnel assigned human factors responsibility.

4.4 Nonduplication. The efforts performed to fulfill the human factors engineering requirements specified herein shall be coordinated with, and shall not duplicate, efforts performed in accordance with other contractual requirements. Necessary extensions, reproduction or transformations of the results of other efforts for use in the human factors engineering program and repetition of tests to satisfy human factors engineering objectives shall not be considered duplication. Instances of potential duplication or conflict shall be brought to the attention of the procuring contracting officer (PCO).

5. DETAILED REQUIREMENTS

5.1 Task descriptions. Individual detailed task descriptions are provided for the establishment of a human factors engineering program for ICBM systems. The task descriptions are sectionalized as follows:

TASK SECTION 100. PROGRAM SURVEILLANCE AND CONTROL

- Task 101 Human Factors Requirements Analysis
- Task 102 Human Factors Integration
- Task 103 Subcontractors and Suppliers
- Task 104 Human Factors Group/Human Factors Working Group Support
- Task 105 Program Reviews
- Task 106 Deficiency Identification, Analysis, and Corrective Action System
- Task 107 Human Factors Technical Evaluation

TASK SECTION 200. ANALYSIS AND DESIGN

- Task 201 Human Factors Studies
- Task 202 Human Factors Models and Mockups
- Task 203 Function Definition and Allocation
- Task 204 Human Engineering Task Analysis
- Task 205 Biomedical Analysis
- Task 206 Detailed Task Analysis
- Task 207 Design Criteria
- Task 208 Design Support
- Task 209 Human Factors Design Evaluation
- Task 210 Manpower and Personnel Analysis
- Task 211 System Manpower and Personnel Analysis

TASK SECTION 300. HUMAN FACTORS TEST AND EVALUATION

- Task 301 Engineering Development Tests
- Task 302 Human Factors System Test Analysis
- Task 303 System Test Support
- Task 304 Test Results Analysis

TASK SECTION 100

PROGRAM SURVEILLANCE AND CONTROL

TASK 101

HUMAN FACTORS REQUIREMENTS ANALYSIS

101.1 PURPOSE. The purpose of Task 101 is to conduct a human factors requirements analysis which identifies all human factors tasks required to accomplish program requirements.

101.2 TASK DESCRIPTION

101.2.1 A human factors requirements analysis shall include the following:

a. Identification of how the human factors methodologies will be implemented to meet the requirements of the contract.

b. Identification of the procedures to evaluate the status and control of each task.

c. Identification of the organization with the authority and responsibility for the human factors program.

d. Identification of the human factors organization, personnel, single point of contact, and personnel qualifications.

e. Identification of functional relationships between human factors and other program elements.

f. Identification of subcontractor interfaces, monitoring and control.

g. Identification of interfaces and relationships with other contractors.

h. Identification of the technical human factors issues, concerns, and potential problems, including human engineering, detailed task analysis identification, biomedical, manpower and personnel, and human factors test and evaluation.

i. Identification of human factors studies that are proposed to be conducted.

j. Identification of the utilization of human factors laboratory facilities and mockups and engineering mockups.

k. Identification of the human factors organization interface with data requirements identified in the CDRL.

l. Identification of how human factors personnel will participate in design.

m. Identification of how human factors personnel will participate in design reviews.

n. Identification of manpower and personnel studies and analyses to be conducted.

o. Identification of the system manpower and personnel studies, analyses, and methodologies to be implemented.

p. Identification of human factors development testing requirements.

q. Identification of human factors analysis of system test requirements and the assignment of observer/evaluator(s).

r. Identification of human factors participation in system testing, test working groups, analysis of test results, identification of deficiencies, and problem resolution.

s. Identification of the human factors test sequence of events from early development tests through system tests.

t. Identification of the human factors master sequence of milestones related to program milestones.

u. Identification of the detailed human factors sequence of events covering approximately the next two quarters.

101.2.2 The contractor may propose additional tasks or modifications with supporting rationale for such additions or modifications.

101.2.3 Identification of data. See paragraph 6.2.

TASK 102

HUMAN FACTORS INTEGRATION

102.1 PURPOSE. The purpose of Task 102 is to establish the requirement for human factors integration, the establishment of integration functions with respect to assisting other contractors with interface definition and resolution and achieving standard solutions to design features that are common to several contractors.

102.2 TASK DESCRIPTION

102.2.1 Conduct an analysis of the human factors integration task to include identification of the methodologies that will be implemented to meet the requirements of this task. Identify the integration activities and the coordination with other contractors to integrate human factors requirements for the total system.

102.2.2 Provide the coordination and detailed integration of the HFE program in accordance with HFE requirements. This coordination and detailed integrating shall be accomplished by reviewing and analyzing contractor studies, plans, design concepts, detailed designs, and other data, as well as the various contractor products, to determine incompatibilities and problem areas.

102.2.3 Identify, study, analyze, construct HF mockups, conduct mockup evaluations, and resolve HFE incompatibilities, design interface and other problems, and present unresolved intercontractor problems to PA HF office of primary responsibility (OPR) for resolution.

102.2.4 Investigate and resolve HFE problems and concerns as assigned by the HF OPR.

102.2.5 Participate in human factors program reviews (HFPRs) or technical reviews convened by PA or other contractors, upon request by PA HF OPR, or the convening contractor with PA approval. Provide a recorder for such meetings, as required.

102.2.6 Convene, with appropriate advance approval of PA HF OPR, human factors meetings with other contractors as required to perform coordination and detailed human factors design integration functions.

102.2.7 Conduct system manpower and personnel analysis.

102.2.7.1 Conduct system support studies by utilizing, modifying (after PA HF OPR approval) and maintaining a government-furnished model or simulation program.

102.2.8 Perform system level and integration studies.

102.2.9 Provide assistance and guidance to associate contractors.

102.2.10 Provide system and lower level assessment of human factors aspects of the developing system for compliance with human factors criteria established in the applicable contracts.

102.2.11 Analyze, identify, and conduct an integrated human factors system test program. This shall include:

a. Identification, procurement (with PA approval) and operation of human factors test equipment.

b. Being custodian of the government-furnished test equipment, maintaining records, issuance and accountability of equipment to other contractors, maintenance and certification, etc.

c. Furnishing blank video tape to support all human factors tests.

d. Performing the video taping function for all tests.

e. Assistance to Air Force agencies and other contractor's personnel in duplicating tapes.

f. Maintenance of video tape library.

g. Overall planning, coordination and scheduling of O/E test observation dispatch, test report collection, and human factors test working group (W/G) functions.

h. Liaison with all test site organizations to accomplish resolution of test site peculiar human factors deficiencies that can be accomplished at the test site.

i. Provision of administrative support for the human factors test personnel at test sites.

j. Coordination between various contractor test personnel.

k. Provision of a recorder to the human factors test W/G.

l. Collection and maintenance of human factors static test results O/E observations and video tapes.

m. Maintenance of test site records and human factors log for human factors test working group.

TASK 103

SUBCONTRACTORS AND SUPPLIERS

103.1 PURPOSE. The purpose of Task 103 is to establish the contractor interface with subcontractor/supplier human factors programs so that timely action can be taken as the need arises and program progress is ascertained.

103.2 TASK DESCRIPTION

103.2.1 The contractor shall insure that system elements obtained from suppliers will meet human factors requirements. This effort shall apply to contractor-furnished equipment (CFE) items obtained from any supplier whether the item is obtained by an intra-company order from any element of the contractor's organization. All subcontracts shall include provisions for review and evaluation of the suppliers' human factors efforts by the contractor, and by the procuring activity at their discretion.

103.2.2 The contractor shall assure that his subcontractors' and suppliers' human factors efforts are consistent with overall system requirements, and that provisions are made for surveillance of their human factors activities. The contractor shall, as appropriate:

a. Incorporate human factors requirements in subcontracted equipment specifications.

b. Require that subcontractors have a human factors program that is compatible with the overall program and includes provisions to review and evaluate their supplier(s) human factors efforts.

c. Attend and participate in subcontractors' design reviews.

d. Review subcontractors' analyses for accuracy and correctness of approach.

e. Review subcontractors' test plans, procedures, and reports for correctness of approach and test details.

f. Review subcontractors' progress reports.

g. Require that subcontractors have, and are pursuing, a vigorous corrective action effort to eliminate deficiencies.

h. Reserve the right to send personnel into the subcontractors' facilities as necessary to monitor and evaluate the subcontractors' human factors programs and related activities.

i. Require that contractors/suppliers will provide him with the necessary technical support for the items they supply during production and deployment of the hardware. This support shall include failure analyses and corrective action.

TASK 104

HUMAN FACTORS GROUP/HUMAN FACTORS WORKING GROUP SUPPORT

104.1 PURPOSE. The purpose of Task 104 is to require contractors to support human factors groups ((HFGs), as established by the contract, and support the human factors board (HFB) and human factors working groups (HFWGs) as directed by the PA.

104.2 TASK DESCRIPTION.

104.2.1 The contractor shall participate as an active member of human factors groups scheduled by the PA, including:

a. Human factors integration group

b. Human factors manpower and personnel group

c. Human factors test planning analysis and scheduling group

d. Human factors test support and results analysis group

104.2.2 The contractor shall participate as an active member in the human factors board as requested by the PA.

104.2.3 The contractor shall participate as an active member in the human factors working groups as requested by the PA, including:

a. Biomedical and life support

b. Crew duty cycle

c. Design related groups such as crew cab working group, guidance set replacement working group, etc.

104.2.4 Participation shall include activities such as:

a. Presentation of the contractor human factor program status.

b. Presentation of studies and analyses including identification of deficiencies and problems and status of resolution.

c. Presentation of deficiency, incident, hazardous condition, or malfunction analysis results and recommendations to prevent future recurrences.

d. Presentation of meeting agendas and minutes.

e. Presentation of design study, analysis, or evaluation results.

f. Presentation of manpower and personnel study and analysis results.

g. Responding to action items assigned by the chairman.

TASK 105

PROGRAM REVIEWS

105.1 PURPOSE. The purpose of Task 105 is to establish a requirement to conduct human factors program reviews on scheduled dates in time to assure that the human factors program is proceeding in accordance with the contractual milestones and that the system, subsystem, equipment, or component requirements will be achieved.

105.2 TASK DESCRIPTION

105.2.1 The human factors program shall be planned and scheduled to permit the contractor and the PA to review program status. Formal review and assessment of human factors contract requirements shall be conducted at major program points, identified as system program reviews conducted in accordance with MIL-STD-1521, as specified by the contract. As the program develops, progress shall also be assessed by the use of additional human factors program reviews as necessary. The contractor shall schedule reviews, as appropriate, with his subcontractors and vendors.

105.2.2 At system program reviews (system design review - SDR, preliminary design review - PDR, critical design review - CDR, etc.) held in accordance with MIL-STD-1521, a detailed review shall be conducted of each item of the contractor-responsible equipment to ensure compliance with the requirements of MIL-STD-1472 and other human factors criteria specified by the contract. The PA HF OPR will conduct formal or informal reviews of the human factors technical effort, CFE, software, and facilities. As an integral function of each system review, as appropriate, the contractor shall provide a presentation, either at the main session or at a human factors side meeting. This human factors presentation shall include, as appropriate, results of human engineering task analysis, detailed task analysis, human factors studies, human factors mockup investigations, and other human factors work that has impacted the design. Resolution of interfaces and remaining issues/problems and any proposed remaining human factors effort shall be highlighted.

105.2.3 Human factors technical requirements compliance and human factors program reviews shall be conducted of each item of the contractor-responsible equipment to ensure compliance with the requirements of MIL-STD-1472 and other human factors criteria specified by the contract. At appropriate times during system development, the PA HF OPR will conduct formal or informal reviews of HFE technical effort, CFE, software and facilities. As an integral function of such PA HFE reviews the contractor shall provide a presentation of the results of HE task analysis, detailed task analysis, HFE studies, HFE mockup investigations, and other HFE work that has impacted the design. Resolution of interfaces and remaining issues/problems and any proposed remaining HFE effort shall be highlighted. As required, technical reviews shall also be conducted to address particular problems. The proposed agenda for such HFE reviews shall have prior coordination of the PA HF OPR. The contractor shall provide a recorder for the reviews.

105.2.4 The contractor shall support human factors program reviews (HFPRs) as required by the PA. At HFPRs, the contractor shall be prepared to discuss all the aspects of the HFE program. The presentation shall include current activities, problems, schedules, recommendations, including recommended tasks for detailed task analysis, and other topics as appropriate. In order to properly support these meetings, the contractor shall maintain a current file pertinent to the human factors program. Appropriate use shall also be made of contractually required data to support system reviews and technical reviews.

TASK 106

DEFICIENCY IDENTIFICATION, ANALYSIS AND CORRECTIVE ACTION SYSTEM

106.1 PURPOSE. The purpose of Task 106 is to establish a closed loop deficiency identification system of human factors evaluation results that are analyzed to provide recommended corrective action.

106.2 TASK DESCRIPTION

106.2.1 The contractor shall establish a closed loop system that identifies human factors deficiencies from the use of design tools such as illustrations, checklists, scale models, mockups, breadboards, engineering models, development models, test articles, test beds, prototype models, and operational-type models and analyze the deficiencies, identifies potential recommended corrective action and follows the design process until either corrective action has been taken or the PA has determined otherwise.

106.2.2 The deficiency identification system used to aid design shall be established and implemented early in the design process as concept development in order that both formal and informal communication paths are established between the human factors and engineering organizations at the systems, subsystems, and end item levels of design. The same deficiency identification system shall continue through the development and system tests.

106.2.3 The deficiency identification system shall be used as a means for initiating corrective actions. Such corrective actions can take the form of modifications and changes to hardware, software, and facilities including equipment fault detection and isolation subsystems (hardware and software), packaging, assembly, training, manuals, etc.

106.2.4 The closed loop system shall include provisions to assure that effective corrective actions are taken on a timely basis by a follow-up audit that reviews all open deficiencies, deficiency analyses, and corrective action suspenses, and the identification of delinquencies to management. The cause for each deficiency shall be clearly established.

106.2.5 The closed loop deficiency identification, analysis, and corrective action system shall include the necessary elaborations to incorporate the identification and analysis of deficiencies from subcontractors and from remote contractor and PA established test sites. The deficiencies from test sites during the conduct of development and systems level tests established by the ICBM system test program shall include those identified during the human factors test and evaluation program.

TASK 107

HUMAN FACTORS TECHNICAL EVALUATION

107.1 PURPOSE. The purpose of Task 107 is to conduct a periodic technical evaluation identifying the pertinent human factors program and engineering activities that occurred during the evaluation period. The status and technical progress toward human factors and program milestones shall be established.

107.2 TASK DESCRIPTION.

107.2.1 The contractor shall conduct a periodic human factors evaluation identifying progress made relative to the human factors program during the specified period and projected work for the next evaluation period. The evaluation shall include:

a. Identification of activities, progress, and status of the human factors effort in relation to the scheduled program milestones, identification of significant achievements and problems, and identification of progress toward completion of human factors milestones.

b. Identification of significant changes in design.

c. Status of all recommended corrective actions that have not been implemented.

d. Identification of program milestone changes that impact the human factors program and a detailed human factors sequence of events covering approximately the next two quarters.

e. A summary of the design and test status of each item for which the contractor has responsibility.

f. Identification of human engineering task analysis inputs incorporated into the SRA.

g. Identification of tasks for detailed task analysis.

h. Identification of human factors inputs incorporated in specification.

i. Identification of human factors deficiencies.

j. Identification of the personnel-equipment relationship between the contractor-furnished equipment/facilities and items, Air Force specialties, and the Air Force organization responsible for operation and/or maintenance.

k. Identification of preliminary numbers for each Air Force specialty.

l. Identification of all equipment and facility responsibilities for each Air Force specialty and indicate operations or level of maintenance involved. Identification of requirements for new or special skills.

m. Identification of the human factors inputs incorporated in the test requirements analysis prepared during the reporting period.

n. Identification of significant human factors studies, experiments, engineering tests, mockup evaluations, demonstrations, fit checks, simulations, recommendations to engineering or other organizations, and other significant technical reports completed.

o. Identification of human factors test reports and test logs completed during the reporting period.

p. Identification of status toward resolution of human factors issues and open items.

q. Identification of the status of each human factors task.

107.2.1 Identification of data. See paragraph 6.2.

TASK SECTION 200

ANALYSIS AND DESIGN

TASK 201

HUMAN FACTORS STUDIES

201.1 PURPOSE. The purpose of Task 201 is to assure that timely human factors studies are conducted to define the nature, scope, and resolution of human factors problems, determine the human factors impact of proposed alternate or revised designs, and provide criteria, requirements and input to the design development process to achieve an operable and supportable system.

201.2 TASK DESCRIPTION

201.2.1 Human factors studies. Starting with concept definition, and continuing throughout the program, the contractor shall conduct experiments, laboratory tests, studies, and demonstrations required to establish requirements, support concept and detail design, and resolve human engineering, biomedical, personnel, and manpower problems specific to the contractors' program development responsibilities. The studies shall include the use of computer aided design tools and human factors models, simulation design tools as appropriate to design development process. These experiments, laboratory tests, and studies shall be accomplished in a timely manner throughout the program, such that the results support SRA, criteria development, design concepts and detailed design. Study results shall be available in the contractor's human factors file.

TASK 202

HUMAN FACTORS MODELS AND MOCKUPS

202.1 PURPOSE. The purpose of Task 202 is to require that human factors models and mockups are constructed and utilized to support the design process and that human factors requirements are incorporated in the construction and utilization of engineering mockups.

202.2 TASK DESCRIPTION

202.2.1 Models and mockups. At the earliest practical point, during concept development as applicable, and well before design approval and fabrication of system prototypes, three-dimensional full-scale mockups of equipment involving human performance (such as operational and maintenance work stations, panels and ground support equipment) shall be constructed. The workmanship shall be no more elaborate than is essential to study human factors problems such as determining the requirements for, or evaluating alternate concepts or designs, or evaluating the adequacy of equipment size, shape, arrangement, interfaces and associated tasks for human performance. The most inexpensive materials practical shall be used for fabrication (e.g., foam-core, plywood, cardboard, wood). These mockups and models shall provide a basis for resolving access, work space, task numbers and skills of personnel and related human factors problems, and for incorporating these solutions into requirements, criteria and system designs.

202.2.2 System engineering and design engineering mockups. Human factors requirements shall be incorporated into engineering mockups and maximum human factors utilization shall be made of such mockups.

TASK 203

FUNCTION DEFINITION AND ALLOCATION

203.1 PURPOSE. The purpose of Task 203 is to establish a requirement for human factors participation in the definition and analysis of system functions and function allocations conducted as a function of ICBM system requirements analysis.

203.2 TASK DESCRIPTION

203.2.1 The functions that must be performed by the system in achieving its objective shall be analyzed. Human factors principles and criteria shall be applied to specify human-equipment performance requirements for system operation and maintenance functions and to allocate system functions to a) automatic operation or maintenance, b) manual operation or maintenance, or c) some combination thereof.

203.2.1.1 Analysis shall be performed to determine basic functional flow and processing required to accomplish the system objectives. The function flow and information processing analysis shall include decisions and operations without reference to any specific machine implementation or level of human involvement.

203.2.1.2 Plausible human roles (operator, maintainer, programmer, decision-maker, communicator, monitor, etc.) in the system shall be identified. Estimates of human requirements in terms of load, accuracy, rate, time delay, anthropometry, and applied force shall be prepared for each potential operator/maintainer function. These estimates shall be used initially in determining allocation of functions and shall later be refined at appropriate times for use in definition of operator/maintainer information processing and physical requirements, and the related control, display, communication, workspace and environmental requirements. In addition, estimates shall be made of the effects on these requirements likely to result from not implementing human factors design recommendations.

203.2.1.3 From projected operator/maintainer performance estimates, cost estimates, and known constraints, the contractor shall conduct analyses and tradeoff studies to determine which system functions should be machine-implemented and which should be reserved for the human operator/maintainer.

TASK 204

HUMAN ENGINEERING TASK ANALYSIS

204.1 PURPOSE. The purpose of Task 204 is to analyze the results from human factors studies and functional analysis and to make an allocation to personnel in the form of tasks or to hardware/software/facilities in the form of functional design requirements or to personnel and hardware/software/facilities in the form of tasks and concomitant functional design requirements. The analysis shall be performed for all mission phases including degraded modes of performance.

204.2 TASK DESCRIPTION

204.2.1 Human engineering principles and criteria shall be applied to analysis of each allocated human-equipment interface. The human engineering task analysis shall provide one of the bases for making design decisions; assuring, to the extent practicable, before the final design review, drawing freeze, and end item production, that system performance requirements can be met by anticipated combinations of equipment, facilities, software, and personnel. The human engineering task analysis shall incorporate human performance requirements that do not exceed human capabilities and shall optimize the utilization of the human performance capabilities of the user population. The human engineering task analysis shall be used as basic information for developing and defining communications, skills, knowledge and training requirements, timelines, procedures, preliminary manning estimates, and maintenance analysis summaries. The human engineering task analysis shall be used in the system requirements analysis. As a part of the human engineering task analysis, analyze the SRA to determine that, the task and personnel requirements information, the associated design for operability/maintainability/safety/biomedical support requirements, and the related equipment/facility requirements, accurately and adequately reflect the human-equipment requirements and interfaces of the human engineering task analysis.

204.2.2 The contractor shall identify the requirement to conduct a detailed task analysis for each task that meets any one of the following criteria:

a. Requires critical performance.

b. Reflects possible unsafe practices.

c. Is subject to promising improvements in performance efficiency.

TASK 205

BIOMEDICAL ANALYSIS

205.1 PURPOSE. The purpose of Task 205 is to require that the human factors biomedical element is developed as an integral segment of the weapon system development process.

205.2 TASK DESCRIPTION

205.2.1 All aspects of the contractors' proposed, or potential, construction or manufacturing materials, processes, consumables, and contractor-furnished equipment (CFE) and facilities maintenance, etc., shall be analyzed for impact upon operational and test personnel health and safety. Long-term, or delayed reactions, such as off-gassing shall be included in the analysis. All potential health and safety hazards, such as trace contaminants, allergens, toxic and hazardous materials and substances, and radiological, acoustical, laser, maser, electromagnetic pulse, and radio frequency (RF) sources shall be identified qualitatively and quantitatively. An analytical method and proposed criteria for each agent shall be identified. Proposed controls shall be identified for each agent exceeding criteria. Upon approval by the PA, the proposed analyses, criteria, or controls shall be implemented.

TASK 206

DETAILED TASK ANALYSIS

206.1 PURPOSE. The purpose of Task 206 is to require the detailed analysis of tasks identified during human engineering task analysis that meets any one of the following criteria:

a. Require critical performance.

b. Reflect possible unsafe practices.

c. Is subject to promising improvements in performance efficiency.

206.2 TASK DESCRIPTION

206.2.1 The detailed task analysis shall be conducted to the task element or lower levels to the depth that all human performance has been identified to the lowest applicable level.

206.2.1.1 For tasks that are primarily of a person/person or person/machine information processing iteration or, at or between stations(s) (e.g., computer/processor terminal, launch control console, electronic test equipment), the detailed task analysis shall include the following:

a. Information required - Analysis shall identify the information needed to perform the task. (Where a task or task sequence is initiated, the stimulus or input that precedes the impacted task shall be identified.) All instances of information required, but not available, shall be identified and an analysis shall clearly identify the impact on task performance.

b. Evaluation/decision - The analysis shall identify what, if any, evaluation or decision components are included in the task. Where evaluation/decision sequences are identified, the analysis shall call out the sequence the operator will have to go through in order to use the information.

c. Task (action) - The analysis shall identify the response(s) (verbal and body movements) that the operator must make.

d. Safety - Each task shall be evaluated to isolate the safety impact of the task for personnel and equipment using the following classifications:

1) NEG Negligible - condition(s) such that personnel error, deficiency/inadequacy of design or subsystem component malfunction will not result in system degradation and will not produce equipment damage or personnel injury.

2) MAR Marginal - condition(s) such that personnel error, deficiency/inadequacy of design or subsystem component malfunction will degrade system performance, but which can be counteracted or controlled without major equipment damage or any injury to personnel.

3) CRI Critical - condition(s) such that personnel error, deficiency/inadequacy of design or subsystem/component malfunction will degrade system performance by causing personnel injury or substantial equipment damage or will result in a hazard requiring immediate corrective action for personnel or system survival.

4) CAT Catastrophic - condition(s) such that personnel error, deficiency/inadequacy of design, or subsystem component malfunction will severely degrade system performance and cause subsequent system loss or death or severe injuries to personnel.

e. Task time - The time required in appropriate units shall be identified for each task/subtask/task element which is analyzed.

f. Task tolerance - Analysis shall identify unusual task tolerance requirements (i.e., reaction times, accuracy, force, perceptual requirements) and unusual stress induced by task, environment or equipment.

g. Task frequency - Analysis shall identify the number of times per M-minute, H-hour, W-week, or R-request, etc., the task is performed.

h. Task location(s) - Analysis shall identify the task/operator location and the location(s) of required information input and required information output.

i. Workspace/station required - Analysis shall identify the required workspace necessary to perform the task. This analysis shall consider, among other factors, the reach enveloped, volume, and space for torquing. The analysis shall provide both physical and visual access requirements. Environmental requirements (acoustical, A/C, lighting, etc.) shall be identified. Station equipment features shall be identified. Communications, storage, support equipment space, facility hoist points, safety belt tie-offs, utility outlets, etc., shall be specified. Requirements not provided or not to be provided shall be identified.

j. Machine data/feedback - Analysis shall identify the feedback the operator receives from interaction with machines or other operator(s) as a result of task performance.

206.2.1.2 For tasks that are primarily of physical performance at a station (e.g., missile Stage I to II assembly, removal of a guidance cooler unit, installation of an ordnance device), the detailed task analysis shall include the following:

a. Information required - Same as 206.2.1.1a.

b. Task (action) - Same as 206.2.1.1b.

c. Safety - Same as 206.2.1.1c.

d. Task time - Same as 206.2.1.1d.

e. Task tolerance - Same as 206.2.1.1e.

f. Task frequency - Same as 206.2.1.1f.

g. Task location(s) - Same as 206.2.1.1g.

h. Human physical requirements - Analysis shall specify the force, lifting and other physical requirements for the task.

i. Workspace/station required - Same as 206.2.1.1i.

j. Number of personnel - Analysis shall identify whether one (1) or more applicable Air Force Specialty Codes (AFSCs) are involved with the task. (Do not include personnel required to meet no-lone-zone requirements, etc.)

k. AFSC(s) - Analysis shall identify the Air Force Specialty Codes (AFSCs) for the personnel to accomplish this task.

l. Support equipment required - Analysis shall identify any support equipment required in order to perform this task.

TASK 207

HUMAN FACTORS DESIGN CRITERIA

207.1 PURPOSE. The purpose of Task 207 is to require an analysis to identify the design criteria that will be employed in translating the human factors requirements into detailed hardware, software and facilities designs.

207.2 TASK DESCRIPTION

207.2.1 The human factors design criteria consists of the human factors criteria given here which the contractor shall down-tailor, after analysis of the end item requirements, and include in specifications for which the contractor has development responsibility.

207.2.2 The contractor shall analyze the criteria provided in 207.2.2, for applicability to each specification being developed. The criteria for each specification shall be exactly as provided, except the criteria shall be reduced in scope as identified by the requirements analysis. No words or additional requirements shall be added without prior approval of the procuring activity human factors office of primary responsibility (PA HF OPR). The criteria are arranged by paragraph numbers that are appropriate for several types of configuration item specifications. The contractor shall identify appropriate paragraph numbers and final digit(s) of the paragraph numbers as required.

207.2.2.1 The contractor shall analyze the standard criteria to identify the documents to be used in specification paragraph "APPLICABLE DOCUMENTS," usually paragraph 2.0, based upon the citations in the requirements paragraphs.

207.2.2.2 The contractor shall identify the criteria to be used in specification paragraph "Human performance/human engineering," usually paragraph 3.3.7, by scoping the following paragraph citing MIL-STD-1472, based upon analysis of the configuration item:

> 3.3.7 Human performance/human engineering. The _____
>
> (enter as applicable: including aerospace vehicle equipment (AVE), operational support equipment (OSE), maintenance support equipment (MSE), depot support equipment (DSE), test support equipment (TSE), special test equipment (STE), training equipment, modifications to government-furnished equipment (GFE) and commercial equipment, and software and facilities) shall comply with the general requirements, control/display integration, visual displays, audio displays, controls, labeling, anthropometry, workspace design requirements, environment, design for maintainability, operational and maintenance ground vehicles, hazards and safety, and user-computer interface criteria specified in MIL-STD-1472. The requirements of the paragraphs on torque identification (5.9.10.8), connector identification (5.9.14.3), and edge rounding (5.13.5.4) are deleted. Commercially mature (see note 6.1) equipment shall not be modified unless safety to personnel or equipment is affected. The following specific requirements shall also apply.

207.2.2.3 The contractor analysis shall identify the criteria to be used in the subparagraphs of "Human performance/human engineering," by tailoring the following criteria:

3.3.7. Anthropometry. Anthropometric requirements shall be based upon the range of Air Force personnel whose body dimensions are between the 5th percentile women data and the 95th percentile aviator data provided in the anthropometry section of MIL-STD-1472.

3.3.7. Human force application. The maximum values specified for pedals, cranks, handwheels, levers, and high-force controls of MIL-STD-1472 shall be reduced to 0.67 of the values specified. This reduction shall apply to other similar applications.

3.3.7. Label types. Labels for production (operational) equipment shall be engraved, die-stamped, or chemically etched on unit surface, or shall be engraved or chemically etched, staked metal plates. Where configuration or construction does not permit application of the above label types, engraved, die-stamped, impressed (incised), or some combination thereof, on Metalcal shall be provided. As an alternative, labels for prototype, non-production equipment may be silk-screened on Metalcal.

3.3.7. High-torque fasteners, wrenching element. External-hex (Ref. A - to be specified by the PA), external-double hex (Ref. B - to be specified by the PA), or external spline (Ref. C - to be specified by the PA) wrenching element heads shall be provided on all machine screws, bolts, or other fasteners, requiring more than 14 N·m (10 lb-ft) torque. When external wrenching fasteners cannot meet the mechanical function or personnel safety requirements, or, in limited access situations, and where use is protected from accumulation of foreign material, internal-hex wrenching (Ref. D - to be specified by the PA) cap screws or Torq-Set (Ref. E - to be specified by the PA and F - to be specified by the PA, preferred) fasteners may be used.

3.3.7. Low-torque fasteners, wrenching element. External-hex wrenching head, internal-hex wrenching head, combination head (internal-hex or straight recess and external-hex wrenching head), or Torq-Set fasteners, should be provided where less than 14 N:m (10 lb-ft) torque is required. Internal-wrenching fasteners shall be provided only where a straight, or convex, smooth surface is required for mechanical function or personnel safety, and where use is protected from accumulation of foreign material. Internal straight recess or internal cross recess (Ref. G - to be specified by the PA) wrenching fasteners shall not be provided, except for wood fasteners or where provided on commercial items. Cross recess fasteners to size #10 may be used for mounting electrical components. Straight recess heads may be used for instrument adjustment applications.

3.3.7. Painted surface colors. Colors for painted surfaces shall be selected from (Ref. H - to be specified by the PA) as follows:

No.	Category	(Ref. H. No.)	Color
1	Console, rack and control, or storage cabinet exterior surface	(1) (2)	Green or White
2	Console, rack and control, or storage cabinet interior surface	(2)	White
3	Control panel: indoor, no dark adaption	(3)	Gray
	a. Pad: non-critical	(4)	Gray
	b. Pad: critical/emergency	(5)	Red
4	Control panel: outdoor or indoor dark adaption	(4)	Gray
	a. Pad: critical/emergency	(5)	Red
5	Portable MSE (equipment or case constructed of aluminum and having a clear anodized or other protective surface coating shall not be painted)	(6)	Strata Blue
6	Maintenance van or trailer and wheeled portable equipment (except emergency equipment) exterior surface	(6)	Strata Blue
7	Special operational, transportation, and maintenance vehicle		
	a. Exterior surface	(7)	White
	b. Running gear	(7)	Strata Blue
8	Special operational, transportation, and maintenance vehicle and maintenance van or trailer		
	a. Interior structure, walls and ceiling surfaces	(2)	White
	b. Floors	(8)	Gray
	c. Traffic lane edge marking	(9)	Yellow
9	Operational launch facility/launch control center and operational support facility		
	a. Interior structure, walls and ceiling surfaces	(2)	White
	b. Installed equipment and unit exterior surfaces	(2)	White
	c. Installed equipment and unit interior surfaces	(2)	White
	d. Floors	(8)	Gray
	e. Traffic lane edge marking	(9)	Yellow
10	Maintenance facility		
	a. Installed special equipment and maintenance stands	(7) (2)	White or White
	b. Interior structure, walls and ceiling surfaces	(2)	White
11	Floors constructed or reinforced with non-skid material	Not painted	

12	Commercial equipment (if, however, such equipment becomes an integral part of an assembly, the color must be identical to or compatible with that of the assembly)	Existing color
13	Anodized, conductive, or corrosion resistant surface	Not painted
14	Environmental protective material	Not painted
15	Shackles, clevises, wire rope (cables), rings, turnbuckles, pins, and other hardware	Protective coating other than paint or cadmium plating

3.3.7. Marking colors.

	Background		Marking	
No.	(Ref. H. No.)	Color	(Ref. H. No.)	Color
1	(6)	Strata Blue	(11)	Yellow
2	(1)	Green	(7)	White
3	(10)	Black	(7)	White
4	(3)	Gray	(10)	Black
5	(7) and (2)	White	(10)	Black
6	(4)	Gray (indoor panel, no dark adaption)	(7)	White
7	(4)	Gray (outdoor panel or indoor panel, dark adaption)	(2)	White
8	(5)	Red	(7)	White
9	Anodized or non-painted		(10) (7)	Black or White (whichever provides the best contrast)
10	Commercial equipment			Contrasting color

3.3.7. Connectors. Connectors for electrical, fluid, pneumatic or gas lines, wires, leads or cables shall be of the quick-disconnect type at LRU connections. Physical means shall be used to prevent incorrect or misaligned connector mating. All connectors shall be clearly labeled to facilitate the assembly task. Units shall have mounted connectors (male or female as may be required) for the termination of external power and signal conductors. Connectors and receptacles shall be provided with captive, protective covers or caps except where not required by normal function; or where connections are permanently installed at the factory, or during assembly and checkout.

3.3.7. Exposed burrs, edges and corners. Exposed or protruding burrs, edges, and corners shall be rounded or otherwise treated to preclude injury to personnel or damage to equipment.

3.3.7. Exposure to hazardous substances. Personnel shall not be exposed to chemical substances that exceed the limits specified in (Ref. I - to be specified by the PA).

3.3.7. Acoustical noise limits. Operating and maintenance personnel shall be provided with an acoustical environment which will not cause personnel injury, interfere with voice or any other communications, or cause fatigue. The _____ shall not exceed the noise limits for each octave band as specified below. The acoustical limits apply at the ear level of 5th and 95th percentile Air Force personnel (defined in the anthropometry paragraph), when located at normal work stations. FOR EQUIPMENT DESIGNED FOR INSTALLATION OR USE ON THE VEHICLES, OR IN THE FACILITY AREAS, THE LIMITS SHALL BE REDUCED BY 6 dB IN EACH OCTAVE BAND.

Vehicle/Area	Noise Limit Category
Diesel, turbine, and other propulsion, or power generation enclosures, compartments, or rooms (hazardous noise limit).	A
Special T&H, operational and maintenance vehicles (stopped, engine idle-exterior), facility equipment utility rooms, heating, ventilation and air conditioning (HVAC) equipment rooms, and launch support facility.	B
Vehicle, reentry system, missile and mechanical maintenance areas, launch facility and T&H, and operational and maintenance vehicle cabs (over-the-road operation).	C
Communication equipment rooms, electrical/electronic maintenance rooms, laboratories, general office areas, code processing center, shop offices, and drafting rooms.	D
Operations control centers, rest, mess and recreational areas, individual offices, conference rooms, classrooms, and libraries.	E
Sleeping rooms.	F

Steady-State Noise Limits (dB) (re 0.0002 microbar)

Octave Band Limits (Hz)	Center Frequency (Hz)	A*	B	C	D	E	F
44 - 88	63	101	83	77	70	63	57
88 - 177	125	91	79	71	63	56	48
177 - 354	250	84	75	67	58	50	41
354 - 707	500	78	72	63	54	45	35
707 - 1414	1000	75	71	61	51	41	31
1414 - 2828	2000	74	70	59	49	39	29
2828 - 5657	4000	74	69	58	48	38	28
5657 - 11314	8000	76	68	57	47	37	27

Column A is based upon no more than 8 hours exposure in any 24 hour period. A hazardous noise warning sign(s) shall be posted at entrances to or boarders of any area where the acoustic noise exceeds the limit for any octave band. ("WARNING - HAZARDOUS NOISE AREA MAY CAUSE HEARING LOSS -HEARING PROTECTION REQUIRED"). Each tool or equipment item that can produce sound levels greater than category "A" shall be clearly marked, except where the space is designated a hazardous noise area and the tools or equipment are not moveable.

3.3.7. Hazardous impulse noise. Impulse noise at the ear level of 5th and 95th percentile Air Force personnel (defined in the anthropometry paragraph), when located at work stations shall be limited to 135 dB peak pressure level (re 0.0002 microbar).

3.3.7. Hazardous whole body noise. The sound pressure levels (re 0.0002 microbar) at the ear level of 5th and 95th percentile Air Force personnel (defined in the anthropometry paragraph), when located at personnel work stations shall be limited as follows:

a. In the frequency range 1 Hz through 40 kHz, 1/3 octave band - 145 dB.

b. Any 1/3 octave band - 145 dB and shall be below 150 dB (A) overall.

c. High frequency or ultrasonic spectra containing discrete-frequency tones (at least 6 dB above the broad band noise), 1/3 octave band - 85 dB.

3.3.7. Protective coating. The _____, unless constructed of aluminum and/or having a clear anodized or other protective surface coating, shall be painted _____, (Ref. H) Color No. (___), and shall be marked with _____, Color No. (_____). Anodized, conductive, and corrosion resistant surfaces shall not be painted. Shackles, clevises, wire rope (cables), rings, turnbuckles, pins, and other such hardware shall be protected by a protective coating other than paint or cadmium plating.

3.3.7. Display color coding. Transilluminated, light emitting diode (LED) and incandescent displays shall conform to the following color coding scheme, except where provided on commercial equipment. No other colors or meanings shall be used without procuring activity approval.

a. **RED** shall be used to alert personnel that the system/equipment/facility, or portion, is inoperative or unsatisfactory, or that corrective or override action must be taken including, but not limited to the following: "malfunction," "failure," "error," "no-go," "danger," "stop," and "out-of-tolerance."

b. **FLASHING RED** shall be used only to denote emergency conditions where immediate action must be taken including, but not limited to the following: "emergency" and "disaster." Flash rate shall be three to five flashes per second, with approximately equal "on" and "off" times.

c. **YELLOW** shall be used to advise personnel that a marginal condition exists including, but not limited to the following: "caution," "recheck," "impending danger," and "out-of- tolerance but operable."

d. **GREEN** shall be used to advise personnel that the monitored system/equipment/facility is satisfactory including, but not limited to the following: "go," "in-tolerance," "ready," "function available," "proceed," and "safe."

e. **WHITE** shall be used to indicate selected mode or status, functions presently implemented and conditions that do not have a "right" or "wrong," "go" or "no-go," or "in-tolerance" or "out-of-tolerance" implication including, but not limited to the following: "missile #1 selected," "power on," "test A" (in progress), and "battery check."

3.3.7. Flashing display lights. Flashing display lights shall be used only to denote emergency conditions (personnel or equipment disaster) where immediate action must be taken.

3.3.7. Transilluminated indicators. A transilluminated indicator used to display system/equipment/facility status in discrete terms shall have the unit divided vertically with the "GO" legend on the top half and the "NO-GO" on the bottom half.

3.3.7. Numeric keyboards. The configuration of an independent numeric keyboard (where not included as a part of an alphanumeric set) shall be a 3 x 3 x 1 matrix, with the digits 1-2-3 in the top row, 4-5-6 in the second row, 7-8-9 in the third row, and the digit zero centered in the bottom row.

3.3.7. Test points. External test points for reference ground, other than chassis ground, shall be color coded light blue, if gray color coding is not possible.

3.3.7. Guards and barriers. An electrical guard or barrier shall be solid except that holes in the barrier may be provided for testing purposes. Such holes shall be clearly labeled as test points.

3.3.7. Critical vehicle driving station integration. Provisions shall be made for external vision planes, viewing means, and controls and displays to be visible and operable by the 5th through 95th percentile personnel (defined in th anthropometry paragraph), when located at a common optimum eye reference point.

3.3.7. Safety striping. Obstructions and projections such as columns, pillars, low beams, and pipes shall be painted in combination stripes of yellow (Ref. H, color No. 11) and black (Ref. H, color No. 10). Where protective padding is added to an obstruction or projection, or where painting is not feasible due to construction materials, yellow and black safety striped tape shall be used.

3.3.7. Attach points. Attach points for portable hoists and come-alongs shall be provided to handle replaceable units that exceed the human lifting limits paragraph (5.9.11.3.1) of MIL-STD-1472 and where there are no other handling provisions. A placard shall be installed adjacent to each attach point stating the maximum load and direction permitted.

3.3.7. Portable MSE supply outlets. Electrical supply outlets shall be provided to support the use of portable MSE having electrical power leads no longer than 183 cm (6 ft). Pneumatic supply outlets shall be provided to support the use of portable MSE with pneumatic hoses not exceeding 457 cm (15 ft).

3.3.7. Automatic fire detectors. Heat, smoke or flame-type fire detectors shall be provided in accordance with (Ref. J - to be specified by the PA).

3.3.7. Fire warning signals. Fire warning signals shall be provided in accordance with (Ref. J - to be specified by the PA). Warning signals shall conform to the requirements of the audio displays paragraph of MIL-STD-1472.

3.3.7. Automatic fire suppression system signs and annunciators. A warning sign containing a notice of an automatic system shall be located at the entrance(s) to each protected area to inform personnel of the potential toxicity of the agent employed and to instruct personnel to immediately evacuate the room and to close all doors when the system audio alarm(s) sounds. A unique fire audio alarm(s) located in the area and at appropriate remote monitoring site(s) shall be actuated upon fire suppression actuation. A unique audio alarm(s) shall provide warning of a malfunction of the automatic fire suppression system. The annunciator system shall have push-to-test provisions.

3.3.7. Launch control, launch facility and launch support facility, maintenance van and trailer interior illuminance. Installed lighting shall provide maintained illumination to support all operational and maintenance tasks performed at, or more frequently than, 360 days, and also normal and emergency personnel ingress/egress requirements. Infrequent maintenance functions that are not supported at the required level of illumination supplied by the installed lighting shall be supported by the provision of utility outlets that permit the use of portable lighting with leads not exceeding 305 cm (10 ft). Illumination circuits shall be arranged by area and activity, so only the level of illumination actually required can be selected.

3.3.7. General facility interior maintained illuminance. Except for blackout or other special requirements, installed illumination shall provide the levels specified in (Ref. K - to be specified by the PA) and shall not exceed 180 lux (75 ft-C). A dimming control from "full on" to "full off" shall be provided, where required, to support activities in a given room or area. Supplementary task illumination, where required, shall be mounted on walls or structural members and shall meet the requirements of the illuminance paragraph of MIL-STD-1472. Temporary or portable lighting shall be supported by utility outlets that permit the use of leads not exceeding 305 cm (10 ft).

3.3.7. Emergency illuminance. Emergency lighting shall be provided in accordance with (Ref. L - to be specified by the PA).

3.3.7. Blackout illuminance. Controls for blackout lighting shall preclude inadvertent actuation of illumination systems.

207.2.2.4 The contractor analysis shall identify the personnel specialties to be used in specification paragraph "Personnel," usually paragraph 3.6.1, by tailoring the following:

3.6.1. Personnel. The referenced Air Force Specialties/Air Force Specialty Codes (AFS/AFSCs) are defined in (Ref. M - to be specified by the PA) (officers) and (Ref. N - to be specified by the PA) (airmen). The _____ _____ shall be designed to be operated by:

Airborne missile operations officer/staff officer (AFSC-G1835/G1816)
Missile launch officer/staff officer (AFSC-1825/1816)
Missile maintenance officer/staff officer (AFSC-3124/3116)
Security police officer/staff officer (AFSC-8124/8116)
Administration specialist/technician (AFSC-702X0)
Missile system maintenance superintendent (AFSC-41199)
Missile maintenance specialist/technician (AFSC-411X1)
Missile systems maintenance specialist/technician (AFSC-411X0)
Inventory management specialist/supervisor (AFSC-645X0)
Maintenance scheduling specialist/technician (AFSC-392X0)
Material facilities specialist/supervisor (AFSC-675X1)
Missile facilities specialist/technician (AFSC-411X2)
Security specialist/supervisor (AFSC-811X0)
Airborne command post communications equipment specialist/technician (AFSC-A328X5)

and to be maintain at the organization level by skill level five:

Missile maintenance specialist/technician (AFSC-411X1)
Missile systems maintenance specialist/technician (AFSC-411X0)
Missile facilities specialist/technician (AFSC-411X2)
Automatic tracking radar specialist/technician (AFSC-303X3)
Missile control communications systems specialist/technician (AFSC-362X3)
Ground radio communications specialist/technician (AFSC-304X4)
Space communications systems equipment operator/specialist - technician (AFSC-304X6)
Wideband communications equipment specialist/technician (AFSC-304X0)

Cable splicing, installation and maintenance specialist/supervisor (AFSC-361X1)
Electronic communications and cryptographic equipment systems specialist/technician (AFSC-306X0)
Cable and antenna systems installation/maintenance specialist/supervisor (AFSC-361X0)
Electronic computer and switching systems specialist/technician (AFSC-305X4)
Security police officer/staff officer (AFSC-8124/8116)
Security specialist/supervisor (AFSC-811X0)

and to be maintained at the intermediate level by skill level five:

Mechanical engineer (AFSC-2835)
Missile maintenance technician (AFSC-41171)
Missile facilities technician (AFSC-41172)
Electronic engineer (AFSC-2825)
Missile systems maintenance technician (AFSC-41170)
Missile systems maintenance specialist/technician (AFSC-411X0)
Electric power line specialist/technician (AFSC-542X1)
Electrician/electrical technician (AFSC-542X0)
Corrosion control specialist/supervisor (AFSC-427X1)
Bioenvironmental engineer (AFSC-9125)
Construction equipment operator/technician (AFSC-551X1)
Pavements maintenance specialist/technician (AFSC-551X0)
Missile maintenance specialist/technician (AFSC-411X1)
Ground radio communications specialist/technician (AFSC-304X4)
Automatic tracking radar specialist/technician (AFSC-303X3)
Wideband communications equipment specialist/technician (AFSC-304X0)
Space communications systems equipment operator/specialist technician (AFSC-304X6)
Electronic computer and switching systems specialist/technician (AFSC-305X4)
Electronic communications and cryptographic equipment systems specialist/technician (AFSC-306X0)
Cable and antenna systems installation/maintenance specialist/supervisor (AFSC-361X0)
Cable splicing, installation and maintenance specialist/supervisor (AFSC-361X1)
Missile control communications systems specialist/technician (AFSC-362X3)
Airborne command post command communications equipment specialist/technician (AFSC-328X5)
Base vehicle equipment mechanic/special vehicle and base vehicle equipment supervisor (AFSC-472X0/1)
Missile facilities specialist/technician (AFSC-411X2)
Missile pneudraulic repair specialist/repair technician (AFSC-411X3)
Nuclear weapons specialist/technician (AFSC-463X0)
Munitions systems specialist/technician (AFSC-461X0)
Explosive ordnance disposal specialist/technician (AFSC-464X0)
Missile operations officer (AFSC-1835)
NCO code controller (AFSC-99603)

Instrumentation mechanic/technician (AFSC-316X3)
Bioenvironmental engineering specialist/technician (AFSC-907X0)

207.2.2.5 The contractor analysis shall identify the conformance methods to be used in specification paragraph "Quality conformance inspections," usually paragraph 4.2, by scoping the following:

4.2 Quality conformance inspections:

4.2. . Human performance/human engineering. Verify compliance with 3.3.7 by performing a combination of examinations, tests, demonstrations, or analyses, as applicable.

4.2. . Human performance/human engineering examination. An examination shall be conducted to verify compliance with 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , 3.3.7. , and 3.3.7. .

4.2. . Anthropometry analysis. An analysis shall be conducted to verify compliance with 3.3.7. .

4.2. . Acoustical noise test. Measurements shall be made of the acoustical noise to verify compliance with 3.3.7. .

4.2. . Hazardous impulse noise test. Measurements shall be made of the acoustical noise to verify compliance with 3.3.7. .

4.2. . Hazardous whole body noise test. Measurements shall be made of the acoustical noise to verify compliance with 3.3.7. .

4.2. . Launch control, launch facility and launch support facility, maintenance van and trailer interior illuminance test. Measurements shall be made of the installed and portable source illumination levels at work stations. The distance from work stations to utility outlets provided for portable illumination shall also be measured to verify compliance with 3.3.7. .

4.2. . Exposure to hazardous substances test. A test shall conducted to verify compliance with 3.3.7. .

4.2. . Personnel analysis. An analysis shall be performed to verify compliance with 3.6.1.

207.2.2.6 The contractor shall use the following note in the "Notes" specification paragraph as provided:

6.0 NOTES

6. Equipment items. "Commercially Mature" refers to a component/subassembly/equipment item that is in current competitive production and is available on the market. Sufficient units must be in use to demonstrate achievement of advertised reliability, maintainability, and functional performance parameters. Spares, capability for repair/replacement, and general logistics supportability must be readily available for a predictable period.

Shelf life, when applicable, must be compatible with AFLC requirements. Updated, current manufacturing/assembly drawings and manufacturing process specifications (including proprietary processes) must meet the commercial data requirement of DOD-STD-100C. This data and current operating manuals, maintenance manuals, reliability and failure data must be made available to the government upon request. The manufacturer must be able to supply components/subassemblies in sufficient time to meet production schedules. Spares, manuals, drawings, and data must be supplied within 30 days or less upon receipt of an order.

207.2.2.7 The contractor analysis shall identify the conformance methods to be used in specification section "Quality Conformance Cross Reference" for compliance with specification section three requirements from the following table 1:

TABLE 1. Quality conformance cross reference.

Sec. 3 Para.		Quality Conformance Method				Sec. 4 Para.
		EXAMINATION	TEST	DEMONSTRATION	ANALYSIS	
3.3.7	Human performance/human engineering	X	X	X	X	
3.3.7.	Anthropometry				X	
3.3.7.	Human force application	X				
3.3.7.	Label types	X				
3.3.7.	High-torque fasteners, wrenching element	X				
3.3.7.	Low-torque fasteners, wrenching element	X				
3.3.7.	Painted surface colors	X				
3.3.7.	Marking colors	X				
3.3.7.	Connectors	X				
3.3.7.	Exposed burrs, edges and corners	X				
3.3.7.	Exposure to hazardous substances		X			
3.3.7.	Acoustical noise limits		X			
3.3.7.	Hazardous impulse noise		X			
3.3.7.	Hazardous whole body noise		X			
3.3.7.	Protective coating	X				
3.3.7.	Display color coding	X				

TABLE 1. Quality conformance cross reference (continued).

Sec. 3 Para.		Quality Conformance Method: EXAMINATION	TEST	DEMONSTRATION	ANALYSIS	Sec. 4 Para.
3.3.7.	Flashing display lights	X				
3.3.7.	Transilluminated indicators	X				
3.3.7.	Numeric keyboards	X				
3.3.7.	Test points	X				
3.3.7.	Guards and barriers	X				
3.3.7.	Critical vehicle driving station integration	X				
3.3.7.	Safety striping	X				
3.3.7.	Attach points	X				
3.3.7.	Portable MSE supply outlets	X				
3.3.7.	Automatic fire detectors	X				
3.3.7.	Fire warning signals	X				
3.3.7.	Automatic fire suppression System signs and annunciators	X				
3.3.7.	Launch control, launch facility (except launch tube) and launch support facility, maintenance van and trailer interior illuminance		X			
3.3.7.	General facility interior illuminance	X				
3.3.7.	Emergency illuminance	X				
3.3.7.	Blackout illuminance	X				
3.6	Personnel and training					Heading
3.6.1	Personnel				X	
3.6.2	Training					N/A

TASK 208

DESIGN SUPPORT

208.1 PURPOSE. The purpose of Task 208 is to establish a requirement for personnel responsible for human factors to participate in and support design development.

208.2 TASK DESCRIPTION

208.2.1 Preliminary system and subsystem design. Human factors criteria shall be applied to system and subsystem concept documentation (concept phase) or designs (validation or FSD), represented by design criteria documents, performance specifications (concept phase), and drawings and documentation, such as functional flow diagrams, schematic block diagrams, interface control drawings, overall layout drawings and related applicable drawings. The preliminary system and subsystem configuration and arrangement, including work environment and crew stations, shall satisfy personnel-equipment/software/facilities performance requirements, and comply with applicable criteria specified in MIL-STD-1472 and human factors criteria specified in the contract.

208.2.2 Concept and detail design. Human factors specialists shall participate with other engineering personnel in the development of hardware/software/facilities configuration items from concepts and alternative concepts through the selection and definitization of a final design. The human factors criteria in MIL-STD-1472 and the contract shall be applied to the design process along with the results of human factors studies, mockup evaluations, task analyses and tests. Where commercial equipment is selected to satisfy functional requirements, the selected configuration shall satisfy human factors criteria. In no instance shall the selected configuration, when incorporated into a user-system interface, present a hazard to personnel or equipment.

208.2.3 Design drawings. Concept sketches or drawings and other preliminary drawings such as test article drawings developed during the concept, validation or FSD phases shall reflect the incorporation of human factors criteria and human performance requirements. Personnel assigned human factors responsibilities shall approve all layouts and drawings having potential operator or maintainer interface with system, hardware, software, or facilities. The release of contractor drawings to the PA for approval (project officer control or formal configuration management control) shall confirm that the design complies with applicable criteria of MIL-STD-1472 and other human factors criteria specified by the contract.

208.2.4 Engineering change proposal (ECP) evaluations. The contractor shall analyze each ECP to determine the human factors impact of the ECP on the existing system. The basis for determining that human performance degradation is introduced by the ECP must be explained and any necessary supporting evidence included in the evaluation documentation. When an ECP is determined to decrease the level of human performance (does not comply with existing human factors criteria) of the existing system, the PA must be so notified.

TASK 209

HUMAN FACTORS DESIGN EVALUATION

209.1 PURPOSE. The purpose of Task 209 is to perform a human factors design evaluation that identifies the human factors features of a design or design concept, and the studies, mockup evaluations, analysis, tests, applicable criteria, and other rationale that support the design selected from alternative designs or design concepts. It shall support design reviews, program reviews, and technical reviews.

209.2 TASK DESCRIPTION

209.2.1 A human factors design evaluation shall be conducted for each subject configuration item to include identification of the following:

a. The documents that have been approved by the contractor human factors organization.

b. The design changes since the last design evaluation.

c. The human factors design features, including biomedical considerations, design for maintainability, and removal/replacement of line replaceable units (LRUs) and shop replaceable units (SRUs).

d. The human factors rationale.

e. The human factors characteristics of alternate designs or design concepts.

f. The configuration item and interfaces.

g. Human factors design deficiencies.

h. Information flow and processing analysis.

i. Time requirements analysis.

j. Potential operator/maintainer processing capabilities.

k. Allocation of functions.

l. Operational sequence diagrams.

m. Definitions of operator/maintainer stations/positions.

n. Human engineering task analysis.

o. Detailed task analysis.

209.2.2 Identification of data. See paragraph 6.2.

TASK 210

MANPOWER AND PERSONNEL ANALYSIS

210.1 PURPOSE. The purpose of Task 210 is to identify a preliminary manning structure, identify the numbers and AFSCs required, identify special or new skills and knowledge required, and identify personnel required to support all system elements for which the contractor has development responsibility.

210.2 TASK DESCRIPTION

210.2.1 Individual and crew operations and organizational, intermediate and depot level maintenance workload studies and analyses shall be conducted in conjunction with the HE task analysis. The analyses shall include a determination of the potential requirements for new or special skills and knowledge beyond the scope of present Air Force specialties (AFS).

210.2.2 Conduct trade studies to optimize personnel deployment and minimize manpower requirements.

210.2.3 Studies and analyses, including timeline and analysis for all functions and tasks having a human interface shall be conducted to support the SRA, define all manpower, and personnel requirements and integrate these into an organizational structure.

210.2.4 An analysis shall be conducted to relate the system equipment/facilities end items, Air Force specialties, and the Air Force organization responsible for operation and/or maintenance.

210.2.5 An analysis shall determine preliminary estimates for each Air Force specialty and organization required to operate and maintain the system. Manning factors, criteria, and special conditions shall be considered in sufficient detail to establish a basis and rationale for the estimates.

210.2.6 An analysis shall identify all equipment and facility responsibilities for each Air Force specialty and shall indicate operations or level of maintenance involved. Requirements for new or special skills shall also be identified.

TASK 211

SYSTEM MANPOWER AND PERSONNEL ANALYSIS

211.1 PURPOSE. The purpose of Task 211 is to perform an ICBM system level manpower and personnel analysis that identifies the skill and knowledge requirements needed to test, conduct A&CO, operate and maintain the system, and organize the system task analysis into positions and Air Force organization structures to support the planning requirements of PA, SAC, ATC, AFOTEC, AFLC, and other Air Force agencies. The analysis shall support design reviews, program reviews, and technical reviews.

211.2 TASK DESCRIPTION

211.2.1 A manpower and personnel analysis shall identify the following:

a. The type of organization, military unit, and location for which the personnel requirements analysis is conducted.

b. Identification of the type, model, and series of the equipment to be delivered to the particular organization, military, unit, and location referred above.

c. The status of equipment development.

d. The military purpose and operational characteristics of the system.

e. The anticipated method of operation and support for the system, subsystem, and components, and the preliminary operational and maintenance concepts including organization, intermediate, and depot level maintenance performed at the operational base.

f. The development status and function of each subsystem, major set, group and unit, as contained in the system, and the functions and relation to the total system.

g. The scope of the responsibilities of the position, work areas, equipment maintained or operated to the subsystem level, associated AFSCs, team interaction, and the nature of the work performed, including time and place, and the nature of procedures.

h. Position duties and tasks by system/subsystem and equipment/facilities "operated" or "maintained."

i. Preliminary manning and the organizations responsible for implementing the operations and maintenance concepts including:

1. The methodology used.

2. Manning concept for the system, including the number of shifts required for each of the work areas identified for the system, manning factors, criteria, and special conditions.

3. Personnel-equipment relationships between the system/equipment/facilities and items, Air Force specialties, and the Air Force organization responsible for operation and/or maintenance.

4. The number of personnel required to perform the duties of each type of position per standard working shift under typical working conditions broken down by Air Force organizational structure, crews, shops and teams as appropriate to define the manning.

5. Organizational functional organizations, including composition of major organizational units, crews, shops, and teams.

j. Unusual personnel requirements problems inherent in the proposed maintenance and operational employment of the system.

211.2.2 Identification of data. See paragraph 6.2.

TASK SECTION 300

HUMAN FACTORS TEST AND EVALUATION

TASK 301

ENGINEERING DEVELOPMENT TESTS

301.1 PURPOSE. The purpose of Task 301 is to establish the requirement for the contractor to analyze the requirements for human factors engineering development tests, human factors participation in component development tests and subsystem development tests, and to conduct these tests in accordance with the identified requirements.

301.2 TASK DESCRIPTION

301.2.1 Human factors conducted tests. Analysis shall be conducted to determine the requirements for human factors tests including mockup evaluations using human factors mockups. The analysis shall identify test objectives, success criteria, test installation configuration, schedules and test methods, and implementation tasks. The tests shall be conducted in accordance with the established requirements. The test results shall be utilized to support concept, preliminary and detail design, and personnel planning. Identified deficiencies shall be integrated with the Deficiency Identification, Analysis and Corrective Action System, Task 106.

301.2.2 Human factors participation in component development tests and subsystem development tests. Analysis shall be conducted to identify the requirements for human factors participation in component development tests and subsystem development tests including identification of test success criteria, procedures, test configuration, and test schedules. The results shall be coordinated with responsible design and test organizations so that human factors requirements are integrated into the test definition and installations. Human factors personnel shall participate in the conduct of the tests to make observations and evaluations (and video tape, if required) of the performance of test subjects (test participants) performing operationally related functions and to otherwise make static human factors measurements. The results of the test activities shall be utilized to support concept, preliminary and detail design, and personnel planning and shall be integrated with the Deficiency Identification, Analysis and Corrective Action System, Task 106.

TASK 302

HUMAN FACTORS SYSTEM TEST ANALYSIS

302.1 PURPOSE. The purpose of Task 302 is to require an analysis of system test functions in order to identify human factors test requirements. The requirements analysis shall identify human factors objectives, performance criteria, and collection of human performance results by visual observation and video taping by observer/evaluators of the dynamic performance of test subjects. The analysis shall also identify the static human factors measurements (steady-state noise, illuminance access, human force, etc.) that are required in order to evaluate the conformance of the system with specification requirements and to interpret test subject performance.

302.2 TASK DESCRIPTION

302.2.1 An analysis shall be conducted of each system test [usually identified by a number such as (T-100, T-101, etc.) and test requirements analysis (TRA) description] to determine whether there is a requirement to obtain personnel-equipment-software-facilities dynamic interface observations and to video tape the performance of test subjects during accomplishment of the test functions or to make measurements of work station conditions and features (generally off-line from dynamic test). For those tests that provide an opportunity to obtain human factors observations and measurements, identify Human Factors Tests requirements (see figure 1). The Human Factors Tests may be identified in the TPA by a test number such as T11.21 (see figure 2).

302.2.2 Based upon the analytical determination that a given test presents an opportunity for observing human performance, identify the human factors standard test elements that shall be observed and video taped based upon the following element criteria (see figure 3). The HFTE standard test elements consist of the human factors objectives, criteria, and observation requirements for each of the HFTE standard elements. The HFTE standard elements shall be used in the TRA exactly as identified in this section.

302.2.2.1 Maintenance/logistics

a. Objectives:

1. Confirm that support equipment (SE) supports personnel performance.

2. Confirm that available provisioned spares, when installed in accordance with the technical data, clear the malfunction.

b. Criteria:

1. Specified SE for the system shall effectively support the requirements of operations, test, and organizational and intermediate maintenance functions.

2. Recommended spares shall permit the specified response to malfunctions, and, if provisioned and installed in accordance with technical data, shall clear the malfunction and return the equipment to an operable condition.

FUNCTION (A) NUMBER & NAME	IC IA IT IL IV I2 AF IN CA AC TA J6	FUNCTION DESCRIPTION/REQUIREMENTS 5	ALLOC (B) ITEM NUMBER / ITEM NAME	(C) C I A	PERFORMANCE REQUIREMENTS (D) TASKS	TEST INFORMATION (E) DATA REF 1	MEAS REQS 2
110.200.20 CONTINUED		Receiving ground power from the AVE.					
		2.0 OBJECTIVE: Describe timelines					
		2.1 SUCCESS CRITERIA: DETERMINE TIMELINES All activities will be timed with the most operationally performed version of each countdown segment change to place together timelines data. Timeline data will be taken on all operations.					
		2.2 for T.O.: V&V objectives and success criteria, refer to TP 11.22.					
		5.0 for human factors objectives and success criteria, refer to TP 11.21					
					2.6.1.5 Enter battery activation clock time in task log.		
					2.6.2 Transfer IFSS-AVE to A/B power.		
					2.6.2.1 Transfer TUMS to A/B power.		
					2.6.2.2 Transfer FIMS to A/B power.		
					2.6.2.3 Transfer FSAA to A/B power.		
					2.6.2.4 Transfer FSAS to A/B power.		
					2.6.3 Arm the FSS ARM/DISARM switch.		
					2.6.4 Remove ground power from the IFSS-AVE.		

FIGURE 1. Example of human factors tests identification.

FUNCTION (A)					REQUIREMENT ALLOC (B)	(C)	PERSONNEL REQUIREMENTS (D)	TEST INFORMATION (E)	
NUMBER & NAME 1	CRITLY 2	AF NU EN AC / P ER RE FQ / TM 3	REV 4	FUNCTION DESCRIPTION/REQUIREMENTS 5	ITEM NUMBER / ITEM NAME	CI NUMBER	TASKS	DATA REF 1	MEAS REQS 2
T11.21		A.	00	FUNCTIONAL DESCRIPTION:					
HUMAN FACTORS TESTS				The observations and evaluations of these tests will occur during the performance of the VAFB system tests (11.0 & 14.0 series tests). A matrix (Table 11.21-1) follows which shows the human factors elements for each specific systems test.					
(BOEING)									
INPUTS:									
MARTIN MARIETTA									
BMO/TRW		B.	02	TEST CONSTRAINTS:					
WESTINGHOUSE				1. None					
		C.	00	PRE-TEST REQUIREMENTS:					
				1. Provide MFTE Observer/Evaluators on-site.					
				2. Provide MFTE equipment.					
			02	3. Deleted					
			02	4. Deleted					
			02	5. Deleted					
		D.	00	TEST OBJECTIVES/SUCCESS CRITERIA:					
			02	1.0 As defined for each element in Table 11.21-2.					
				1.1 SUCCESS CRITERIA:					
			02	As defined for each element in Table 11.21-2.					
		E.	00	TEST CONFIGURATION:					
				1. Test Articles					
				a. Weapon System					
				b. Operating Personnel					

FIGURE 2. Example of human factors tests.

PRIME/TEST	TEST TITLE	TS DATE	FACIL	MNT/ LOG	BIO SUPP	WKSP L/O	CO/ DES MNT	TECH DATA	TIME VAL	TRNG	PERS REQ	PERS SAFTY	REMARKS
B11.1-4	LF SYS FUNCT*	02JAN86	LF-02	X	X	X	X	X		X	X	X	
M11.3-6	IFSS *	27MAR86	LF-08	X	X	X	X	X	X		X	X	
B11.4-6	LF/AVE LOCAL MODE	01APR86	LF-05			X	X	X	X	X	X		
B11.5-7	ECS	09APR86	LF-05	X	X	X	X	X		X	X	X	
B11.6-7	ELECTL PWR	24APR86	LF-05	X	X	X	X	X	X	X	X	X	
B11.7-9	ALCC	18JUL86	LF-05		X	X	X	X		X	X	X	
B11.8-7	COMMAND & CONTROL	22MAY86	LF-05			X	X	X	X	X	X	X	
B11.10-9	OB (OT&E)	15SEP86	LF-05	X	X	X	X	X	X	X	X	X	
B11.11-10	EMC (VAFB) *	05NOV86	LF-05			X	X						
B11.13(9)-3	LNCH (GND) OPNS	3QTR85	LF-08	X	X	X	X	X	X	X	X	X	
B11.13(10)-3	LNCH (GND) OPNS	4QTR85	LF-08	X	X	X	X	X	X	X	X	X	
B11.13(11)-5	LNCH (GND) OPNS	1QTR86	LF-08	X	X	X	X	X	X	X	X	X	
B11.13(12)-7	LNCH (GND) OPNS	2QTR86	LF-02	X	X	X	X	X	X	X	X	X	
B11.13(13)-9	LNCH (GND) OPNS	3QTR86	LF-02	X	X	X	X	X	X	X	X	X	
B11.13(14)-9	LNCH (GND) OPNS	3QTR86	LF-08	X	X	X	X	X	X	X	X	X	
B11.13(15)-10	LNCH (GND) OPNS	4QTR86	LF-02	X	X	X	X	X	X	X	X	X	
B11.13(16)-10	LNCH (GND) OPNS	4QTR86	LF-08	X	X	X	X	X	X	X	X	X	
B11.13(17)-10	LNCH (GND) OPNS	1QTR87	LF-02	X	X	X	X	X	X	X	X	X	
B11.13(18)-11	LNCH (GND) OPNS	2QTR87	LF-08	X	X	X	X	X	X	X	X	X	
B11.13(19)-11	LNCH (GND) OPNS	2QTR87	LF-02	X	X	X	X	X	X	X	X	X	
B11.13(20)-11	LNCH (GND) OPNS	3QTR87	LF-05	X	X	X	X	X	X	X	X	X	
B11.14-3	REFURB OPNS *	11AUG85	LF-08	X	X	X	X	X	X	X	X	X	
B11.14-7	REFURB OPNS *	11MAY86	LF-02	X	X	X	X	X	X	X	X	X	
B11.15.1-9	PCKPR SQN CODE CHG	15JUL86	LF-08	X	X	X	X	X		X	X	X	
B11.15.2-9	MM SQN CODE CHG	15JUL86	LF-08	X	X	X	X	X		X	X	X	
B11.15.3-9	ALCC SQN CODE CHG	15JUL86	LF-08			X	X	X		X	X	X	
B11.16-8	SQN OPNS	14JUN86	LF-08			X	X	X		X	X	X	
B11.17-1	ORG LVL MAINT	1QTR85	DTL-S	X	X	X	X	X	X	X	X	X	
B11.17-2	ORG LVL MAINT	2QTR85	DTL-S	X	X	X	X	X	X	X	X	X	
			LF-08										
B11.17-3	ORG LVL MAINT	3QTR85	LF-08	X	X	X	X	X	X	X	X	X	
		4QTR85	LF-08	X	X	X	X	X	X	X	X	X	
B11.17-4	ORG LVL MAINT	1QTR86	LF-02	X	X	X	X	X	X	X	X	X	
B11.17-5	ORG LVL MAINT	1QTR86	SPF, LF-02, 08	X	X	X	X	X	X	X	X	X	
B11.17-6	ORG LVL MAINT	4QTR85	SPF	X	X	X	X	X	X	X	X	X	
		1QTR86	LF-02, 05	X	X	X	X	X	X	X	X	X	
B11.17-7	ORG LVL MAINT	2QTR86	LF-02, 05	X	X	X	X	X	X	X	X	X	
		4QTR86	LF-08	X	X	X	X	X	X	X	X	X	
B11.17-8	ORG LVL MAINT	2QTR86	LF-08	X	X	X	X	X	X	X	X	X	
		1QTR87	LF-08	X	X	X	X	X	X	X	X	X	
B11.17-9	ORG LVL MAINT	3QTR86	LF-02, 05, 08	X	X	X	X	X	X	X	X	X	
B11.17-10	ORG LVL MAINT	3QTR86	LF-02	X	X	X	X	X	X	X	X	X	
		4QTR86	LF-02 05,08	X	X	X	X	X	X	X	X	X	
		1QTR87	LF-02	X	X	X	X	X	X	X	X	X	

FIGURE 3. Example of system test/human factors test element observation requirements identification.

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c. Observations:

1. Identify all faults and annotate those faults which require either the replacement of equipment or the performance of a specific maintenance task (adjust, calibrate, etc.) in accordance with technical data.

2. Identify instance when SE utilized in the maintenance function was inoperative or malfunctioned.

3. Identify instances where SE required by technical data was not used.

4. Identify instances when SE was required by technical data, but was not available.

5. Identify events where spares were required, but not available.

6. Identify events where spares were ineffective in eliminating the faults when installed in accordance with technical data.

302.2.2.2 Biomedical support

a. Objectives:

1. Evaluate local work area lighting levels and confirm that, as perceived, they support operations and maintenance tasks.

2. Evaluate work area noise levels and confirm that, as perceived, they support operations and maintenance tasks.

3. Confirm that additional biomedical provisions (such as provision of a healthful breathing atmosphere, prevention of or protection against toxic and hazardous materials, and protection against hazardous radiological and electromagnetic sources), where required, support safe, healthful, effective and reliable human performance.

b. Criteria:

1. Illumination levels shall conform to the requirements of MIL-STD-1472, as may be tailored in the applicable specifications, and, as perceived, shall support required personnel functions during operation on normal, survival, and emergency power.

2. Noise levels shall conform to the requirements of the applicable specification(s) and, as perceived, within all occupied areas, shall not preclude normal communications between personnel or interfere with the intended use of the area.

3. Other biomedical provisions, within applicable criteria limits, shall contribute to the achievement of effective system operations and maintenance functions.

c. Observations:

1. Identify instances where personnel were unable to read technical data or perform tasks because of improper illumination, including glare, in the work areas.

2. Identify instances where normal verbal communications, or other activities, were degraded due to interfering noise sources in the work area.

3. Identify task performance deficiencies that were associated with biomedical support, health hazards, and environmental provisions and describe the conditions that contributed to the deficiency.

302.2.2.3 Workspace layout

a. Objectives:

1. Confirm the adequacy of controls and displays and their integration required to operate and maintain the system.

2. Confirm the adequacy of information provided to personnel through communication systems, warning systems, and placards.

3. Confirm that all tasks can be performed by personnel whose physical size ranges from the 5th percentile woman through the 95th percentile aviator, as defined in MIL-STD-1472.

4. Confirm that adequate access exists to support the required operations and maintenance tasks.

5. Confirm that the work area supports safe and efficient task performance.

b. Criteria:

1. Workspace control/display layout relationships shall support safe and efficient task performance.

2. Information provided to personnel (excluding technical data, see below) shall adequately support operations and maintenance tasks, and provide adequate caution and warning where required.

3. Workspace accommodations and access to equipment shall effectively permit operations and maintenance tasks by personnel with body dimensions the same as the 5th percentile woman and the 95th percentile aviator, as defined in MIL-STD-1472.

4. The work area shall be free of all obstructions and hazards which hinder safe and efficient task performance.

c. Observations:

1. Identify instances of performance error or deficiencies attributable to control/display relationships between work stations or between related equipment items at a work station.

2. Identify instances where information provided through communications systems, warning systems, and placards was inadequate to support safe and efficient task performance.

3. Identify instances where task performance was impaired or made difficult because workspace configuration, layout, or provisions did not support performance of personnel from the 5th percentile woman through the 95th percentile aviator, as defined in MIL-STD-1472.

4. Identify instances where accessibility of equipment prevented or impaired performance of operations and maintenance tasks by the extreme ranges of personnel.

5. Identify instances where the work area contributed to unsafe or inefficient task performance.

302.2.2.4 Equipment design/maintainability

a. Objectives:

1. Confirm that installation and mating features allow personnel to install equipment efficiently and with minimal errors.

2. Confirm that handling provisions allow personnel to transport and handle equipment as required.

3. Confirm that equipment design facilitates the detection and isolation of faults that occur during test.

4. Confirm that control features allow personnel to operate equipment within required accuracies.

5. Evaluate personnel force requirements and confirm that they are within acceptable limits.

6. Confirm that overall equipment design supports personnel performance during operations and maintenance tasks.

b. Criteria:

1. Installation and mating features shall facilitate completion of applicable tasks.

2. Handling provisions shall be available, where required, to facilitate transportation and handling of equipment.

3. Equipment design shall facilitate accomplishment of efficient fault detection, isolation, and repair with a minimum of time and effort.

4. Control features shall allow personnel to operate equipment within minimal error and within required accuracies, safety, and efficiency.

5. Personnel force requirements conform to MIL-STD-1472 (as modified by 5th percentile woman data) and shall not exceed the capabilities of the required range of personnel (due to fatigue, marginal accessibility, etc.).

6. Overall equipment design shall facilitate accomplishment of operations and maintenance tasks with a minimum of time and effort.

c. Observations:

1. Identify all instances where equipment design contributed to inefficient, or incorrect, human performance during operations, organizational or intermediate level maintenance.

2. Identify all instances where specified maintenance support equipment failed to support organizational or intermediate level maintenance.

3. Identify all instances where additional, or modified, maintenance support equipment is required, or recommended, to accomplish defined maintenance objectives.

4. Identify instances where performance of operations and maintenance tasks was inefficient due to inadequate installation/mating features.

5. Identify instances where performance of T&H tasks was unsafe, or inefficient, due to inadequate handling features.

6. Identify instances where personnel were unable to perform maintenance functions due to a lack of fault detection and isolation by the equipment.

7. Identify instances where equipment display or control features, or control/display relationships, contribute to performance errors.

8. Identify instances where force requirements for operations and maintenance tasks exceed HE criteria or contribute to unsafe task performance.

9. Identify all instances where additional direction, caution, or warning placards are required.

10. Identify instances where overall equipment design contributes to unsafe or inefficient task performance.

302.2.2.5 Technical data

a. Objectives: Confirm that technical data supports human performance.

b. Criteria:

1. Verify that operations and maintenance technical data, when used by trained personnel, effectively supports weapon system readiness and operations requirements.

2. Verify that corrective maintenance tasks, performed in accordance with verified technical data, effectively restores the weapon system to an operable test condition.

c. Test constraints: During operational or simulated operational tests involving late prototype or operationally configured hardware, software, and Air Force personnel, only verified technical orders (TOs) shall be used to satisfy HFTE objectives involving confirmation of training received by selected Air Force personnel, or the ability of trained Air Force personnel using verified technical data to operate or maintain the system. However, if, in order to expedite testing, HFTE observations are conducted during TO verification and changes are made to the TOs during the verification activity, the HFTE data shall be invalid unless a PA test representative, an HFTE working group representative, or, in their absence, the HFTE O/E, shall certify that the TO changes, induced interruptions, or other anomalies had no impact on the validity of the HFTE data.

d. Observations:

1. Identify status of technical data: unvalidated, validated, or verified.

2. Identify instances where ineffective operations or delays occur due to ambiguities in the procedures.

3. Identify instances where technical procedures were not followed by operations or maintenance personnel.

4. Identify instances where procedures, when followed by personnel, failed to accomplish the intended operations or maintenance functions.

5. Identify all instances where additional notes, cautions, and warnings are required.

6. Identify technical data deficiencies such as omitted or incorrect procedures, support equipment or spares, or incorrect sequences.

7. Identify the impact on the validity of test observations and results for each HFTE element, including confirmation of the adequacy of the technical data. Post-test analysis may be required to fully assess this impact.

302.2.2.6 Timeline validation

a. Objectives: Evaluate the accuracy of operational and maintenance times established in the SRA and specifications and determine the performance time for tasks that do not have times so established.

b. Criteria: The actual performance time shall not exceed the established performance time.

c. Observations:

1. Identify the time required to perform operations and maintenance tasks.

2. Identify reasons for any observed timeline deviation.

302.2.2.7 Training

a. Objectives:

1. Confirm that contractor personnel are trained.

2. Confirm that special system training provided to selected Air Force personnel enables them to perform the required tasks safely and efficiently.

b. Criteria:

1. Contractor personnel are capable of performing system operations and maintenance tasks.

2. Air Force personnel, trained in their respective specialty classifications, are capable of operating and maintaining the system.

c. Observations:

1. Identify instances when the operation(s)/maintenance task(s) performed by Air Force or contractor personnel were:

a) Incorrect

b) A deviation from prescribed procedures

c) Difficult to perform because of apparent lack of proficiency.

302.2.2.8 Personnel requirements

a. Objectives:

1. Confirm that the number of contractor personnel, as specified in the SRA, are sufficient to perform operations and maintenance tasks.

2. Confirm that the numbers and types of Air Force personnel specified in the SRA, specifications, technical data, and personnel planning report (PPR) can accomplish operations and maintenance tasks.

b. Criteria:

1. The predicted number of personnel are effective in achieving operations and maintenance tasks.

2. The Air Force specialty code (AFSC) and the number of Air Force personnel, prescribed in the SRA, specifications, technical data, and the PPR are effective in achieving operations and maintenance task performance.

c. Observations:

1. Identify the number of personnel, or the number and Air Force specialty code(s) specified in the SRA, specifications, technical data, and the PPR, required to perform the operations or maintenance activities, and the numbers and/or type of personnel actually used to perform the task.

2. Identify instances where personnel performance was ineffective due to deficiency in the number of, or specialty code of, the personnel performing the operations or maintenance task.

302.2.2.9 Personnel safety

a. Objectives:

1. Confirm that emergency procedures support human performance.

2. Confirm that notes, cautions, and warnings are included in the technical data and, when necessary, information, warning and caution placards are prominently displayed on the equipment.

3. Confirm that procedures and equipment do not contribute to personnel injury or equipment damage.

b. Criteria:

1. All necessary caution, warning, and emergency procedures are identified in the technical data, and are followed without incident 100% of the time.

2. All necessary caution and warning placards are installed on equipment and followed without incident 100% of the time.

3. Facilities or equipment design does not contribute to personnel hazard.

c. Observations:

1. Identify all incidents/accidents that occur.

2. Identify all near or potential accidents.

3. Identify hazardous or potentially hazardous conditions or procedures.

4. Identify instances of personnel injury.

5. Identify instances of equipment damage.

6. Identify instances when personnel failed to comply with emergency procedures, cautions, or warnings.

7. Identify areas within the technical data where procedures, cautions, or warnings were ambiguous.

8. Identify ambiguous equipment placards.

302.2.2.10 Test anomalies. Test deficiencies which cannot be categorized as HFTE factors shall be classified and recorded as test anomalies. The anomalies shall include:

a. Administration:

1. Ineffective job control practice to dispatch.

2. Ineffective test conditions.

b. Test planning/implementation:

1. Commercial power failure.

2. Equipment failure.

3. Unexpected weather conditions, earthquakes, floods, etc.

c. Human error:

1. Ineffective test subject (test participant) due to fatigue, inattention, physiological impairment, etc.

d. Observations:

1. Identify all instances of administrative problems such as ineffective job control practices in dispatch or inadequate control records.

2. Identify all instances of test planning/implementation problems such as commercial power failure, equipment failure, unexpected weather conditions, or inappropriate or faulty test instrumentation.

3. Identify all instances of human error attributable to the test subject such as fatigue, inattention, or physiological impairment.

302.2.3 Based upon the human factors test analysis, identify the test requirements that are not included in the Human Factors Test Elements or are of such importance that special emphasis should be given the requirements (see figure 4).

302.2.4 Based upon the human factors test requirements analysis that determined the requirement for HF static measurement, identify a definitive measurement. These measurements shall evaluate the work station characteristics (lighting, noise, force, accessibility, and timeline analysis) so that noncompliance with specification or SRA requirements can be positively determined and resolved in a timely manner during the testing period. The measurement identification shall be made utilizing information available in specifications, TRAs, SRAs, and similar sources (see figure 5). The following measurements shall be included, as applicable:

a. Facility background noise at all work stations (at ear level) with all combinations of facility-installed equipment (heating, ventilation, and air conditioning (HVAC), pumps, etc.) operating.

b. Facility noise at all work stations with all equipment in the area operating.

c. Equipment noise for items that have been identified as marginal with respect to noise output.

d. Audio alarm output.

e. Facility lighting at all work stations.

INCREMENT NO. TEST FORM # NO. AND TITLE		DESCRIPTION/REQUIREMENTS	MEAS REQS
INCREMENT I	2.1	Perform emplacement and assembly activities using MSE/T&H	
T11.100.3			
Emplace Stage I	2.1.1.1	Biomedical Support	
		Illumination	IFVL 2006
		Acoustics	NSVL 2046
	2.1.1.2	Workspace Layout	
		Access	AAVL 2004
			AAVL 2017
			AAVL 2018
			AAVL 2016
	2.1.1.3	Equipment Design/Maintainability	HFVL 2014
		Force	HFVL 2016
			HFVL 2019
			HFVL 2040
			HFVL 2041
	2.1.1.4	Timeline Validation	TLVL 2057
	3.1.1	Melee Emplacer Hoist Bay Compartment (PM #3.3.13.8.1.5)	
	3.1.1.1	Biomedical Support	
		Illumination	IFVL 2007
	3.1.1.2	Workspace Layout	
		Access	AAVL 2020
			AAVL 2021
		Acoustics	NSVL 2044
	3.1.1.3	Equipment Design/Maintainability	
		Force	HFVL 2016
			HFVL 2017
	3.1.1.4	Timeline Validation	TLVL 2058
	3.1.2	Position Type II Transporter (PM #3.3.13.8.1.38)	
	3.1.2.1	Biomedical Support	
		Illumination	IFVL 2003
	3.1.2.2	Timeline Validation	TLVL 2053
	3.1.3	Stabilize Type II Transporter (PM #3.3.13.8.1.39)	
	3.1.3.1	Biomedical Support	
		Illumination	IFVL 2004

FIGURE 4. Example of unique human factors test requirements identification.

MEAS CODE (1)	ACQUISITION EQUIPMENT (2)	CONDITION/LOCATION (3)	TEST FORM B NUMBER (4)	SPECIFIED VALUE (5)	QUALITY CONTROL (6)	SPECIFICATION (7)
AAVG 2042	Tape measure	Workspace for the inspection of the canister/missile pads handling set and Retention and Release System (RRS) cable assembly. Measure workspace around inspection area.	T 11.100.19 Tasks 1.1.0 T 11.100.20 Tasks 2.2.6	Access must be within the 27 inch minimum width allowance for a 95th percentile male.		PM §4.13.14
AAVG 2044	Tape measure and Protractor	Visual access for LSG Pad Installation Measure the visual arc of the personnel installation viewing areas.	T 11.100.20 Task 2.2.6	Visual access to equipment labels must be perpendicular to personnel's normal line of sight whenever feasible and not less than 45 deg. from that line of sight. Parallax must be minimized.		PM §4.14.8
AAVG 2047	Tape measure and Protractor	Workspace for LSG Pad Installation at the SPF work platform. Measure the stage circumference and the distance from the stage to the side mobile platforms.	T 11.100.20 Task 2.2	Access must be within the 21 inch forward reach and 73 inch upward reach of the 5th percentile		PM §4.14.8

FIGURE 5. Example of human factors measurement requirements identification.

f. Facility emergency and/or survival lighting in all egress and emergency operation areas.

g. Portable lighting where applicable.

h. Accessibility where multiple equipment items (i.e., workstand and stage access port) are involved.

i. Force where personnel are to exert force, and measurements were not made during subsystem testing.

j. Timeline evaluation of established SRA times, specifications, PPR, technical data, and timeline analysis where timelines have not been established or are inaccurate.

k. Breathing atmosphere.

l. Toxic and hazardous materials.

m. Radiological and electromagnetic sources.

TASK 303

SYSTEM TEST SUPPORT

303.1 PURPOSE. The purpose of Task 303 is to perform an analysis of development integration tests and system tests in order to identify the human factors support requirements for development integration tests, if not included in system test planning, and to identify the human factors test support requirements of system level tests.

303.2 TASK DESCRIPTION

303.2.1 Analysis shall be conducted of the proposed development integration tests to define human factors test requirements. Human Factors shall participate in the development of integration test planning and test procedures. Analyses shall be conducted to determine the on-site human factors personnel required to participate in development integration tests and the administrative support required for the human factors test activities.

303.2.2 Analyses shall be conducted to determine the test site human factors personnel required to participate in development test and evaluation (DT&E), operational test and evaluation (OT&E), and follow-on operational test and evaluation (FOT&E) and the administrative support required for these activities.

303.2.3 Human Factors observer/evaluator(s) shall be assigned to test sites to support human factors tests including preparing detailed test procedures and schedules, observing tests, making test measurements, recording test results, participating in post-test activities, analyzing test results, and ensuring deficiencies are integrated into the Deficiency Identification, Analysis and Corrective Action System, Task 106. Prior to active participation during the test program, an HFTE O/E shall satisfy the knowledge and skill requirements outlined below:

a. A degree in engineering or psychology or other related academic fields, or possession of the knowledge and experience required to adequately conduct personnel performance evaluations.

b. Detailed knowledge of the development program and weapon system operational mission and maintenance requirements, including all associated AVE, SE, personnel, and related support system functional requirements. This knowledge shall have been acquired through one or more of the following:

   1. Participation in the engineering development phases of the program.

   2. Participation in the TRA development phases of the program.

   3. Direct attendance at program training courses.

   4. Individual study of specifications, engineering design data, and systems engineering analyses data.

c. Knowledge of Air Force operations, maintenance, and logistics procedures required to operate/maintain the weapon system.

d. Working knowledge of methods used in preparing SRA data (functional flows, system functional analysis, timelines, maintenance functional analysis, TRA, assembly and checkout (A&CO), etc.).

e.. Knowledge of all human factors criteria that will be used during test operations.

f. Knowledge of operation of human factors test equipment.

303.2.4 One of the contractors' human factors test observer/evaluator(s) shall be assigned lead responsibility at the test site. In this role, the lead person shall be responsible for the human factors test activity of the contractor, interface with test team personnel both Air Force and other contractors, represent the contractor on test working groups involving human factors, and liaison with the PA.

303.2.5 The observer/evaluator(s) shall be responsible for the conduct of test activities in accordance with approved test plans and procedures, including the operation of government-furnished human factors test equipment, as designated by the PA.

TASK 304

TEST RESULTS ANALYSIS

304.1 PURPOSE. The purpose of Task 304 is to analyze human factors test results, identify deficiencies, evaluate alternate corrective action, and track resolution activities.

304.2 TASK DESCRIPTION

304.2.1 The results of all human factors tests shall be analyzed, deficiencies identified, and alternate corrective action evaluated and tracked until the deficiency has been corrected or the PA has determined that no action will be taken. Post-test analysis of all test results shall be conducted by an O/E to determine the cause of deficiencies and to propose corrective action. The analysis shall be concerned with the identification of deficiencies that have an impact on personnel and their capability to operate and maintain the weapon system. Test results pertaining to the HFTE standard elements shall be analyzed against applicable system criteria. The impact a deficiency may have on HFTE standard elements shall be determined. The analysis shall include the following, as applicable:

a. An evaluation of the test results to establish spares effectiveness.

b. An evaluation of the test results to establish SE effectiveness.

c. An HE and biomedical support assessment to determine if environmental conditions are adequate for system operations and maintenance, and to determine potential performance degradation if such environmental conditions are not adequate.

d. An evaluation of performance errors or deficiencies observed during the tests to determine their relationship to environmental conditions.

e. Review of HE design criteria compliance to determine that all deviations from military standards have been identified.

f. An evaluation of performance errors or deficiencies observed during the tests to determine their relationship to identified human factors criteria changes.

g. An evaluation of performance errors or deficiencies observed to determine their relationship to equipment design criteria.

h An evaluation of the specific deviations from expected performance by correlating the specific deficiencies observed by the observer with information obtained by post-test interview. Test participant personnel historical information shall be reviewed to determine whether the deficiencies may be attributed to training, technical data, or other HFTE factors.

i. An evaluation of observed technical data deficiencies and induced delays or other anomalies to determine the impact on the validity of the test results with respect to each of the HFTE standard elements, including confirmation of the adequacy of the technical data.

j. Comparison of the observed operations and maintenance times with the times specified in the SRA or specification. Any deviations from the predicted operations or maintenance times shall be identified. An engineering assessment shall be made to determine the causes and impact on system functions of such time differences.

k. An evaluation of observed training deficiencies to determine whether they are detrimental to operations or maintenance task performance.

l. A post-test evaluation to determine consistency among the AFSCs specified in the SRA or PPR, AFSCs specified in the technical data and the AFSCs actually used.

m. An evaluation of the test participant historical information to determine whether the participants met the qualification requirements of the AFSC.

n. An evaluation of each SRA or PPR deviation that caused a deficiency to determine whether the deviation contributed to performance deficiency, whether the SRA or PPR should be changed, and whether the deviation caused weapon system degradation.

o. An evaluation of safety-related deficiencies identified during the execution of tasks and observations of all personnel injury or equipment damage to determine the cause of such safety problems or incidents.

p. An evaluation of test anomalies to determine their impact on the validity of test-observations/results for each of the HFTE factors.

304.2.2 During the system test program, all test analyses shall be included as an integral part of the test process. All problems and deficiencies, shall be exhaustively analyzed to determine all major and contributing causes and corrective action identified after consultation and coordination with other engineering organizations. Problems involving other contractor interfaces shall be investigated in concert with the concerned contractor and corrective action identified shall represent the coordinated position of both contractors, whenever possible. Where differences occur, these shall be clearly identified. Follow-up to HFTE problems shall be a mandatory effort of the total test program and all HFTE problems shall be tracked until either the deficiency has been corrected, or PA has determined that no correction will be made. HFTE personnel shall coordinate problems with design and support personnel.

5.2 Task integration. The individual task requirements provide for integration with other engineering and test tasks to preclude duplication and overlap while assuring timely consideration and accomplishment of human factors engineering requirements.

6. NOTES

6.1 Intended use. This standard contains the requirements for the human factors engineering program associated with ICBM missile systems acquisition.

6.2 Data requirements. When this standard is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of the DoD FAR Supplement 27.410-6 are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this standard is cited in the following paragraphs:

Task No.	Data Requirement Title	Applicable DID No.
101	Human Factors Development Plan	DI-HFAC-80240
107	Human Factors Technical Report	DI-HFAC-80241
209	Human Factors Design Analysis Report	DI-HFAC-80242
211	Personnel Planning Report	DI-HFAC-80243

(Data item descriptions related to this standard, and identified in section 6, will be approved and listed as such in DoD 5010.12-L, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.3 Subject term (keyword) listing.

Analysis
Design
Human engineering
Human factors
Human factors engineering
Human factors test and evaluation
System
System engineering

6.4 Identification of changes. Vertical lines or asterisks are not used in this revision to identify changes with respect to the previous issue due to extensiveness of the changes.

APPENDIX A

APPLICATION GUIDANCE FOR IMPLEMENTATION OF HUMAN FACTORS PROGRAM REQUIREMENTS

10. GENERAL

10.1 Scope. This appendix provides rationale and guidance for the selection and tailoring of tasks, and the specifying of details for the PA to fit the needs of any human factors program, and identifies applicable data items for implementation of required tasks.

10.2 Purpose. This appendix is to be used to tailor human factors requirements in the most cost effective manner that meets established program objectives. HOWEVER, IT IS NOT TO BE REFERENCED, OR IMPLEMENTED, IN CONTRACTUAL DOCUMENTS.

10.3 User. The user of this appendix may include the Department of Defense procuring activity, Government in-house activity, and associate contractor, who wishes to impose human factors tasks upon vendor(s).

20. REFERENCED DOCUMENTS

20.1 Applicability. Referenced documents are not included herein.

30. TASK SELECTION

30.1 Introduction. A major problem which confronts all government and industry organizations responsible for a human factors program is the selection of tasks which can materially aid in attaining program human factors requirements. Today's schedule and funding constraints mandate a cost-effective selection, one that is based on identified program needs. The considerations presented herein are intended to provide guidance and rationale for this selection. They are also intended to cause recall of "lessons learned" to provoke questions which must be answered and to encourage dialogue with other engineers, operations and support personnel so that answers to questions and solutions to problems can be found.

30.2 Program requirements. Each program will include a mix of human factors engineering tasks depending on the life cycle phase. These tasks shall be selected and tailored according to the type of item (system, subsystem or equipment) and for each applicable phase of the acquisition phases (CONCEPT, VALID, FSD and PROD). They will be planned, integrated and accomplished in conjunction with other design development and manufacturing functions. The overall acquisition program will include the resources, schedule, management structure, and controls necessary to ensure that specified human factors engineering program tasks are satisfactorily accomplished.

30.3 Human factors tasks. Tasks will focus on the prevention through design, detection, and correction of human factors engineering deficiencies. Human factors engineering will be an integral part of the item design process, including design changes. The means by which human factors engineering contributes to the design, and the level of authority and constraints on this engineering discipline, will be identified by human factors requirements analysis. An efficient human factors engineering program will stress early investment in human factors engineering tasks to avoid subsequent costs and schedule delays.

30.4 Human factors engineering monitoring. Tasks will focus on the provisions of information essential to acquisition, operation, and support, including properly defined inputs for estimates of operational effectiveness. An efficient human factors engineering program will provide this information while ensuring that cost and schedule investment in efforts to obtain monitoring data (such as demonstrations, evaluations, and tests) is clearly visible and carefully controlled.

30.5 Task coordination. Once appropriate tasks have been selected, the tasks themselves can be tailored as outlined in the "Details To Be Specified By the PA." It is also essential to coordinate task requirements with other engineering support groups, such as Logistics Support, System Safety, Reliability, etc., to eliminate duplication of tasks, assure compatible schedules of integrated tasks, and to be aware of any potential effects, impacts, etc., on human factors resulting from the activities of these other groups. For example, front end ILS analyses help frame the maintenance concepts to be used in the human factors program. Conversely, many of the human factors tasks provide analytical results which must be used by the ILS to serve as a basis for support and personnel resource planning. Finally, the timing and depth required for each task, as well as action to be taken based on task outcome, are largely dependent on individual experience and program requirements. For these reasons, hard and fast rules are not stated.

30.6 Selection and tailoring. Selection and tailoring of tasks, specifying human factors requirements, addition of supporting details, and establishing CDRL requirements requires a balanced approach. The emphasis on acquiring off-the-shelf commercial products and existing equipment meeting minimum form, fit, and function requirements means that extensive human factors requirements at all item levels are inappropriate.

30.7 Application matrix for program phases. Table A-1 herein provides general guidance, in summary form, of "when and what" to include in a request for proposal (RFP) to establish an acceptable and cost effective human factors program. This table can be used to initially identify those tasks which typically are included in an effective human factors program for the particular acquisition phase involved. The user of the document can then refer to the particular task if it is appropriate to identify as a program task. The use of this matrix for developing a human factors program is to be considered as optional guidance only and is not to be construed as covering all procurement situations.

30.8 Task prioritization. The problem of prioritizing or establishing a baseline group from all the tasks in this document cannot be solved unless variables like system or end item complexity, program phase, availability of funds, schedule, etc., are known. The human factors requirements analysis (Task 101) should always be considered for determining the need for this task. Individual tasks may be cited without requiring a human factors requirements analysis.

30.9 Data items.

30.9.1 Contractor originated data. Each task may involve some form of contractor prepared plan, document, statement, list, or data. If any of these are to be received by the PA they are deliverable items. Each separate identifiable data item must be included on a DD Form 1423 which must be included as part of the RFP and Contract.

APPENDIX A

TABLE A-1. Application matrix.

Task	Title	Task Type	Weapon System Program Phase				
			CON (1)	VALID (2)	FSD (3)	PROD (4)	OPR SYS MOD (5)
101	HF Requirements Analysis	PC	S	S	G	N	S
102	HF Integration	PC	N	S	G	N	S
103	Subcontractors and Suppliers	PC	N	S	G	N	S
104	HF Group/HF Working Group Support	PC	S	S	G	N	S
105	Program Reviews	PC	S	S	G	N	S
106	Deficiency Identification, Analysis, & Corrective Action System	PC	S	S	G	N	S
107	HF Technical Evaluation	ENG	S	S	G	N	S
201	HF Studies	ENG	S	G	G	N	S
202	HF Models and Mockup	ENG	S	G	G	N	S
203	Function Definition and Allocation	ENG	S	S	G	N	S
204	HE Task Analysis	ENG	S	S	G	N	S
205	Biomedical Analysis	ENG	S	S	G	N	S
206	Detailed Task Analysis	ENG	N	N	G	N	S
207	Design Criteria	ENG	S	G	G	N	S
208	Design Support	ENG	S	G	G	N	S
209	HF Design Evaluation	ENG	N	S	G	N	S
210	Manpower and Personnel Analysis	ENG	N	N	G	N	S
211	System Manpower and Personnel Analysis	ENG	S	S	G	N	S
301	Engineering Development Tests	ENG	N	S	G	N	S
302	System Test Planning	ENG	N	S	G	N	S
303	System Test Support	ENG	N	S	G	N	S
304	Test Results Analysis	PC	N	S	G	N	S

TABLE A-1. Application matrix (Continued)

Code Definitions:

S - Selectively applicable	CON - Concept
G - Generally applicable	VALID - Validation
N - Not applicable	FSD - Full scale development
PC - Program Control	PROD - Production
ENG - Engineering	OPR SYS MOD - Operational system modification

(1) Assumes a conceptual phase consisting of "paper" studies and the only equipment developed is experimental.

(2) Assumes a validation phase including the development of engineering models and flight test articles.

(3) Assumes a normal ICBM FSD program where AVE, OSE, MSE, DSE, and software and facilities are developed concurrently, although not all items are at the same stage of development but where the weapon system, with the exception of certain facilities are tested as a weapon system during system test (DT&E/OT&E).

(4) Assumes a "pure" production phase with no residual engineering or test activities from FSD. Changes with human factors impact are considered by inclusion in the ECP process.

(5) Assumes any modification from a unit such as the replacement or addition of a communications receiver to a major effort such as the Minuteman Upgrade Silo Program.

30.9.2 AF Form 585 requirements. Each AF Form 585 must refer to an authorized data item description (DID) which can be found, listed by title in DOD 5000.19-L Volume II, Acquisition Management Systems and Data Requirements Control List (AMSDL). Tailoring of the DID to meet the specific data requirement is authorized (via block 16 on AF Form 585). Each AF Form 585 must also include a specific contract reference (e.g., contract, paragraph 3.10.8) that specifies and authorizes the work to be done for each data item. Also to be filled out are blocks establishing delivery dates, delivery destinations, approval authority, and approval procedures. Refer to governing directives for specific information.

40. RATIONALE FOR GUIDANCE FOR TASK SECTIONS

40.1 Task 100 - Program surveillance and control.

40.1.1 Identifying human factors needs. The elements of a human factors program must be selected to meet needs identified by higher authority through documentation such as the Mission Element Needs Statement (MENS), the Decision Coordinating Paper (DCP), the Program Management Directive (PMD), Program Management Plan (PMP), and the result of early front end SRA efforts. Identifying these needs must be accomplished prior to release of a request for proposal (RFP) for the appropriate acquisition phase so that tasks and requirements commensurate with the needs may be included in the RFP. The tasks and requirements which are included establish the framework for the continuing human factors dialogue between the PA and the proposing contractors, one or more of whom will ultimately be selected to satisfy the procurement requirement. It is essential to make appropriate analyses in determining human factors needs.

40.1.2 Constraints and concepts. The MENS, DCP, PMD and PMP as amplified in the following postulated operational and deployment constraints and concepts represent the most fundamental statements of user needs:

a. Operating hours per unit calendar time.
b. System readiness objectives.
c. Downtime or availability constraints.
d. Mobility requirements.
e. Self-sufficiency constraints.
f. Manpower, skill and support constraints.
g. Reaction time requirements.
h. Operational environment.
i. Number and locations of operational sites.
j. Number of operational systems per site.
k. Deployment schedule.

A proper understanding and assessment of these needs is critical to all subsequent program events, including those related to the human factors program.

40.1.3 Application level. Such requirements should be levied at the equipment level or at the system level, whichever is most appropriate. The contractor generally is given system level requirements for contracted performance. As long as the requirement is given at the highest level of the system, flexibility insofar as allocations to lower indenture levels are afforded, provided they balance out to achieve the system requirement.

40.2 Task 101 - Human factors requirements analysis.

40.2.1 Scope. The requirements for a human factors requirements analysis will normally apply to the development of all systems and equipment subject to validation of FSD. As a rule, a scaled-down program for concept, production and modification phases is in order. Tasks should be identified by necessity and the scope of each task structured to its need.

40.2.2 Requirements analysis. If a requirements analysis is requested in a request for proposal (RFP), the contractor may be asked to analyze, in as much detail as appropriate, how he will conduct the human factors program. He should be asked to identify how he intends to accomplish all of the applicable and essential tasks of the program defined in the tailored version of the standard. When there is a contractor's proposal for the Validation Phase, normally a preliminary human factors program will be identified to the PA. The contractor will then be expected to expand and modify the preliminary analysis as necessary during the Validation Phase to identify a proposed human factors program that will be a guide during the FSD. Since the human factors program identifies how the contractor intends to satisfy mission human factors requirements, the requirements analysis is a factor in source selection.

40.2.3 Program tailoring. The PA must task the human factors program to be consistent with the type and complexity of the system or equipment. Insofar as the interfaces between the human factors program and other closely related programs or efforts listed in the standard, there must be sufficient coordination such that duplication of effort will be avoided. Further, the tasks to be analyzed must be tailored both with respect to type and scope to be appropriate to the needs of the particular procurement. A human factors program centers around the human factors tasks that will be utilized to control human factors throughout a system's life cycle. Every program phase has different needs with respect to the composition and scope of its human factors program. The primary objectives of a human factors program are to ensure design adherence to specified human factors parameters in an environment of maintenance and support response requirements (constraints) and of lowest life cycle cost.

40.2.4 Request for proposal. The PA should specify in its RFP the requirements for the conduct of a human factors program. It is the responsibility of the PA to identify the requirement for a human factors program and to monitor the contractor's human factors program; it is the responsibility of the contractor to establish and maintain an effective human factors program.

40.2.5 Contractor proposal. The contractor's response to the RFP should be evaluated by the PA to assure that the contractor understands and is responsive to the requirements, and to assure that the contractor has an effective, realistic set of resources and management tools to assure timely attainment of the requirements and demonstration of the attainment. The tasks making up the contractor program should be consistent with

the tasks of MIL-STD-1794. The tasks should reflect the contractor's analysis of the particular human factors program and the system requirements and will identify his human factors organization and techniques for accomplishing the tasks. The tasks, in other words, are a tailored version of MIL-STD-1794; the "how" reflects the contractor's understanding of the requirements and his capability.

40.2.6 Program interfaces. The effectiveness of the human factors effort is defeated unless the tasks within the program are completed in a timely manner in consonance with the overall design engineering milestones. All tasks should be analyzed to be completed in time to be effective in the design-making process. To be effective, the human factors organization should be in a position to recognize foreseeable problem areas, identify efforts required to investigate and correct these problems, and be timely with changes within the design phase. There must be an effective working relationship with design engineering established at the onset of the program and continued through its conclusion.

40.3 Task 102 - Human factors integration. Major programs will often have multiple contractors and an integrating contractor under contract. An integrating contractor for human factors will often have the responsibility to review human factors efforts of contractors. Task 102 provides the authority for surveillance needed to accomplish the integration function. The integrator should be tasked to conduct a human factors requirements analysis according to Task 101. The integrator should be tasked to perform analyses and assessments to cover the interfaces between the various contractors' portions of the system. All contractors should be made aware of the integrator's role of overall human factors program. The integrator needs to resolve differences between other contractors in human factors related areas. The PA will aid the integrator in these efforts to make sure all contractors mutually understand the human factors requirements, and their respective responsibilities to comply with them. The human factors integration will include:

a. Coordination and detailed integration of the human factors program in accordance with human factors requirements. This coordination and detailed integrating will be accomplished by reviewing and analyzing other contractor studies, plans, design concepts, detailed designs, and other data, as well as the various integrating contractor products, to determine incompatibilities and problem areas.

b. Identification, analysis and resolution of human factors incompatibilities and design interface problems, and present unresolved intercontractor problems to PA HF OPR for resolution. Investigate and resolve HFE problems and concerns as assigned by the HF OPR.

c. Participation in human factors reviews or technical reviews convened by PA or other contractors, upon request by PA HF OPR, or the convening contractor with PA approval.

d. Convention, with appropriate advance approval of PA HF OPR, human factors meetings with other contractors as required to perform coordination and detailed human factors design integration functions.

e. Preparation of system manning estimates.

f. Definition, planning and conduct of integrated system human factors test program, including video taping.

40.4 Task 103 - Subcontractors and suppliers. The RFPs for the validation, FSD, production and major modification phases contain system/subsystem/equipment requirements and some of the equipment will undoubtedly be designed and developed by subcontractors. Human Factors tasks, previously determined as necessary, will also be included in the RFP, and in turn must be normally levied by the contractor on the subcontractors. The contractor's human factors program, hence, must provide controls for assuring adequate human factors of purchased hardware. Such assurance is achieved through the following:

a. Selection of subcontractors from the standpoint of demonstrated capability to produce a product.

b. Development of adequate design specifications and test requirements for the subcontractor produced product.

c. Development of proper human factors requirements to impose on each subcontractor.

d. Close technical liaison with the subcontractor (both in design and human factors areas) to minimize communication problems and to facilitate early identification and correction of interface or interrelation design problems.

e. Continuous review and assessment to assure that each subcontractor is implementing his human factors program effectively.

40.4.1 Requirements. Human Factors requirements should be imposed on subcontractors and vendors on the basis of the criticality and human interface of the hardware item being supplied. Similarly, the depth of these requirements should determine the amount of effort expended by the contractor to verify that the subcontractor is performing his assurance function adequately. For vendors of major components and subsystems, the contractor should evaluate each subcontracted item independently to determine the type of human factors program needed. He should then impose appropriate requirements on each subcontractor. Each major subcontractor should submit a human factors program plan, and the contractor should monitor program implementation to assure compliance and to assess the timeliness and adequacy of individual tasks. The subcontract should contain surveillance provisions to permit such monitoring. This procedure places the contractor in a situation very similar to that of the PA in monitoring and evaluating human factors program performance.

40.5 Task 104 - Human factors group/human factors working group support. Human factors group and human factors working group are established for acquisition of expensive, complex or critical systems, equipment or major facilities. Contractor support of these groups is very useful and may be necessary to make sure procured hardware or software meets human factors requirements and criteria. The level of support desired from the contractor must be detailed in the contract through imposition of Task 104.

40.5.1 Human factors board. The human factors board ensures that:

a. All human factors are accomplished.

b. Full human factors technical support is made available.

c. All participating Air Force agencies are represented in human factors.

d. Human factors are coordinated with integrated logistics support, system engineering, system safety, and other program activities.

40.5.1.1 HF board composition. The composition and size of the board varies with the complexity and nature of the specific human factors board agenda items. Typical membership includes representatives from Air Force Systems Command (AFSC), AFLC, Air Training Command (ATC), AFOTEC, SAC, Aerospace Medical Division, and other participating organizations. At the discretion of the HFE OPR, contractor personnel may be included. Board members:

a. Represent their organizations in all board discussions and decisions.

b. Obtain technical information, assistance, or coordination of their organization.

c. Meet with contractors as part of board activities.

d. Review and analyze human factors efforts, plans, and data to assure the overall integration of the human factors program and the timely achievement of HFE goals.

e. Identify specific human factors problem areas and resolve issues.

f. Request the distribution of human factors program documents for their organizations.

40.6 Task 105 - Program reviews. Human factors program reviews should be conducted throughout the product design cycle, in accordance with contract requirements, as an integral part of the system engineering review and evaluation program. The reviews are conducted so that particular aspects of the work or the entire system can be reviewed. These reviews should be specified in the contract to ensure adequate staffing and funding. Typically, reviews are held to evaluate the progress, consistency, and technical adequacy of a selected design and test approach, (PDR), and to determine the acceptability of the detail design approach, (CDR) before commitment to production. Review may also be called for during the conceptual phase to determine general adequacy. Both the PA and contractor human factors personnel should consider design reviews as major milestones. The result of the contractor's internal, and subcontractors design reviews should be documented and made available to the PA on request. Reviews should be be conducted from time to time. Early in the program the reviews should be held frequently, as the program progresses, time between reviews may be extended. In addition to more detailed coverage of those items discussed at PDRs and CDRs, the reviews should address progress on all human factors related tasks specified in the contract. Human factors reviews should be specified and scheduled in the contract.

40.6.1 Design review (conceptual phase). The primary purpose of the design review during the conceptual phase is to make a choice from among alternative system design

approaches that may have evolved during the design process. The results of this first design review should include an understanding of the weak areas in the chosen design concept. There should be human factors criteria provided to ascertain that the elements of the system are assigned the necessary and proper human factors attributes which will satisfy the required characteristics.

40.6.2 Preliminary design review. At this point requirements have been defined, the preliminary design is in progress, and many component parts and assemblies will have undergone some development testing. Some of the human factors influencing factors to be considered at this review are final definition of requirements, adherence to criteria, operability form, fit, function, maintainability, packaging, and compatibility with design requirements documents or specifications defined in the contract. In analyzing the results of this design review, it should be determined whether decisions made in the previous design review were valid, and identify the tasks for the continuation of the design phase.

40.6.3 Critical design review. After changes as indicated in the previous design review are incorporated, the product has matured into the final stage. The purpose of the CDR is to assure that all the requirements have been met. Meeting design requirements is the prime consideration at the CDR. The results of the human factors design approach should be presented for the final detail design, and the details relating to the design - human interface characteristics. After the close of the CDR, the design of the system is essentially complete and the system is considered ready for production or prototype assembly.

40.7 Task 106 - Deficiency identification, analysis and corrective action system. Deficiencies become useful only when assembled into manageable aggregates for purposeful evaluation. The underlying objective of a deficiency identification system is to provide information by which to establish assessment of a system's human factors performance. Human factors deficiencies are identified throughout the acquisition cycle of the equipment. The deficiencies are derived from the following:

a. Human factors analysis.

b. Engineering development test.

c. System test (DT&E/IOT&E).

d. Mockup evaluations.

e. User's test (OT&E).

40.7.1 Deficiency identification. The deficiencies identified from these sources are used as follows:

a. To provide human engineering and biomedical support input to the system and detail design development process.

b. To assess the adequacy of:

1. Technical manuals.

2. Test equipment (including special and general support equipment, BITE, etc.).

3. Training (including training equipment).

4. Manpower and personnel requirements.

c. To determine deviations from established human factors practices.

d. To establish time histories for comparison and for use in prediction.

e. To determine compliance with specified human factors requirements.

f. To detect excessive amounts of, or determine frequency of maintenance time.

40.7.2 Information requirements. The deficiency identification, analysis and corrective action system should be adaptable to usage by both the contractor and the PA to aid in evaluation of equipment objectives or requirements. The system should provide for the rapid retrieval of all identified deficiencies to provide valid comparisons of results. At the same time the scope of the system should be commensurate to the needs of the acquisition program. Examples of additional information which may be appropriate includes identification of:

a. Failure symptoms.

b. Corrective actions.

c. Excessive human performance requirements.

d. Time to restore function.

e. Maintenance manhours.

f. Skill level of operations personnel and maintenance personnel.

40.7.3 Test interface. Deficiencies identified during tests should be of sufficient scope to corroborate findings and assessments. Deficiency identification may include:

a. Time and date function commenced.

b. Nomenclature of system, equipment or assembly by use of appropriate designation.

c. Ability to correctly perform the function or in event of malfunction, maintenance actions taken to affect correction.

d. Methods of fault detection and isolation.

e. Circumstances surrounding the activity, with particular reference to any abnormalities noticed.

f. Time expended by the individual or crew (in actual clock hours).

40.7.4 Deficiency analysis. A primary purpose of deficiency analysis during the development and testing phases is to assist in the design. The emphasis in such analysis is on determining if the human factors requirements will be met by the time design is completed and on providing assessment and insight into areas of the design that may require additional human factors effort. Engineering analysis of the system or subelements should be initiated on each item which fails to comply with the specified requirements. This consists of the determination of the causes leading to noncompliance and the determination of changes required in order to effect compliance with specified requirements. Analysis consists of review of specifications, design drawings, and examination of prototype or production hardware, and other efforts required to adequately determine cause of noncompliance and to identify corrective action. After the system enters its system test (DT&E), analysis is required for verification purposes. Any unforeseen problems in human factors can be detected, personnel and spares requirements can be reaffirmed, and necessary adjustments can be made.

40.7.5 Identification system integration. The deficiency identification system should be integrated as much as possible with similar deficiency identification requirements. The deficiency identification system should be compatible and capable of accepting deficiencies from other existing deficiency identification systems called for in other program areas (e.g., Reliability, Safety, etc.). Deficiency identification systems to be used in human factors assessment should be defined as early as possible, but no later than concept/validation phase and used during the FSD and operational testing.

40.8 Task 107 - Human factors technical evaluation. The human factors technical evaluation provides an evaluation of the technical aspects of the human factors program. The evaluation should be conducted in support of design reviews, technical interchange meetings, human factors program review meetings (if technical topics are to be considered) and other design or human factors events concerned with technical status, content or issues. The evaluation ensures that the contractor human factors organization keeps abreast of the evaluating system designs and understands the changing priorities of technical support related thereto. The evaluation should determine progress toward achievement of program milestones and human factors milestones. The assessment should include an estimate of the impact of proposed or actual overall development program changes on the human factors program and definition of necessary changes. In addition to the design effort, the evaluation should be applied to the manpower and personnel and human factors test and evaluation elements. Considerable emphasis should be placed upon the deficiency identification, analysis, and corrective action system.

40.9 Task 201 - Human factors studies. As stated in the task, the purpose is to analyze the requirements for, identify, and conduct human factors studies in an orderly and timely process such that the results of the studies will be available to support human factors program development. Usually, there will be a higher percentage of the human factors effort devoted to studies during the concept development and validation phases than during the full scale development phase. However, it is expected that studies will continue during the FSD in order to provide answers to problems, and to define alternate design concepts or design solutions. At times it will be necessary to study the impact of proposed designs upon a human interface such as induced vibration. In other instances it may be necessary to evaluate the threat mitigation provided by alternate designs. In any case, it is necessary to analyze the need for studies to identify, define and conduct the studies in time to have an input to the development program.

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40.10 Task 202 - Human factors models and mockups. Like studies, the requirements for models and mockups need to be determined early in the development cycle for a given phase. Depending upon the nature of the particular program, it may be appropriate to construct soft mockups during the concept phase to investigate alternate configurations or concepts. For instance, it has proven effective to construct mockups to investigate missile stage handling and missile assembly during the concept phase. Mockups of panels, consoles, racks, test sets, operational vehicle crew cabs, launch facility equipment rooms, and control center installation mockups have proven to be extremely valuable in determining the acceptability of proposed design concepts and determining the adequacy of access and interfaces. . Mockups have been used to support design reviews and have afforded using command personnel an opportunity to review and comment on a high fidelity full-size representation of the design rather than having to rely on a series of sketches or drawings. Interfaces become known that can rarely be visualized from a series of drawings. It is extremely important that all engineering mockups having a human interface incorporate the human factors requirements and criteria in design and construction.

40.11 Task 203 - Function definition and allocation. The objective of function definition and allocation is to initiate incorporation of human factors considerations, as appropriate, in the system engineering process from the top level functional flow diagrams through the allocation analysis where the functions are allocated to human or machine or some combination thereof. All ICBM functions associated with the flight mission are machine implemented. Allocations for many of the ground functions have been well established. Other functions such as the command, control and communications and fault detection and isolation are not as well established and are more dependent on the deployment concept. Thus, there are many functions that require analysis to provide a detailed identification of the functional requirements. As technology has changed, the number of options for many functions have increased. This has made the functional analysis more important than ever before as the opportunity to improve system performance at lower cost has become available.

40.12 Task 204 - Human engineering task analysis. The human engineering task analysis continues the system engineering process to the allocation of functional requirements analysis to hardware/software/facilities or to operator/maintainer or to some combination. At this level, tasks are identified, the associated required human performance and personnel requirements are identified and the related hardware/software/facilities requirements are identified. The previously conducted human factors analysis, studies, mockup evaluations, etc., support these decisions. The analysis also provides the basic identification of skill types, level of skills, training attributes, task times, and personnel numbers that are used in instructional systems development, timeline analysis, and manpower and personnel analysis. The timeline analysis often provides feedback to the human engineering analysis. As a part of this analysis, those tasks requiring a more detailed analysis are identified.

40.13 Task 205 - Biomedical analysis. The biomedical analysis serves the basic functions of supporting the human engineering and detailed task analysis and conceptual and detailed design. The analysis obviously is a continuing process starting during conceptual and validation phases at a gross level of programs where there is potential for user exposure to known sources. With increasing detail and elaboration, the analysis continues through FSD and to operational system modifications.

40.14 Task 206 - Detailed task analysis. A detailed task analysis is conducted for those tasks that require critical task performance, reflect possible unsafe practices or where there is potential for promising efficiency improvement. Several functional areas in the ICBM program development have a high content of critical tasks. The assembly of the post boost vehicle and reentry vehicle, installation of the flight safety system, installation of the missile guidance system and operations of the weapon control system. This is by no means an exhaustive list. There are many other tasks associated with the operation and maintenance of the weapon system that are candidates for detailed task analysis. However, the criteria for critical tasks provided in 3.1.3 must be applied diligently to ensure that all tasks in the system that are within the criteria are identified and analyzed, but that no other tasks are so analyzed.

40.15 Task 207 - Human factors design criteria. The number of configuration item specifications and design requirements documents developed during the development of an ICBM weapon system number in the hundreds. In the functional area of human factors, MIL-STD-1472 provides both general and specific criteria that need to be analyzed for applicability to a particular configuration item. Also, the language in the MIL-STD is permissive rather than imperative, in many instances, or permits the selection of alternatives. The PA HF OPR has determined that in order to provide a standard user-system interface across several concurrent weapon systems, it is necessary to tailor and elaborate the criteria provided in the MIL-STD. It has been further determined that due to the large number of human factors interfaces between contractor-developed hardware/software/facilities, it is beneficial to communicate these interface requirements in a common set of criteria rather than each contractor defining the same criteria differently. The standardization of applicable criteria also has beneficial results in the standardization of design and related support equipment.

40.16 Task 208 - Design support. The design support task is concerned with human factors involvement in the design development process from concept through preliminary to detail design. Where there is a potential operator/maintainer interface with system, hardware, software or facilities, human factors should have an integral role with the design team. For mature designs, human factors should participate in the analysis and formulation of ECPs having a user-system interface. Human factors needs to approve all layouts and drawings having a human interface in order to ensure implementation of human factors requirements.

40.17 Task 209 - Human factors design evaluation. The human factors design evaluation is conducted with respect to concept and preliminary designs, as applicable, and to detail designs. Alternate designs need to be characterized and compared with respect to applicable human factors design requirements, criteria and attributes. The rationale for selected commercially available hardware, software, facilities installed equipment and modifications thereto needs to be established by analysis to ensure that human factors requirements are met. Government-furnished equipment and modification needs to be analyzed to determine potential impact upon expected human performance characteristics. This analysis is typically associated with support for design reviews and technical interchange meetings.

40.18 Task 210 - Manpower and personnel analysis. The manpower and personnel analysis is conducted to identify the manpower and personnel requirements associated with the hardware and facilities for which the contractor has the definition and development responsibility. The analysis is essentially at the configuration item or

subsystem/system level. However, two analysis tasks are at the weapon system level with respect to identification of the personnel required to test, operate, and maintain the system and identification of the related Air Force organizations.

40.19 Task 211 - System manpower and personnel analysis. The system manpower and personnel analysis is an in-depth approach to personnel and manpower required to operate and maintain the weapon system. The analysis identifies the whole spectrum of manpower and personnel requirements for Air Force participation in system development such as testing and operational deployment such as support for assembly and checkout, the cadre to support initial operational capability and full operational capability. Analysis will, in many instances, identify and evaluate operational base initialization rates. The analysis will provide an identification of weapon system operational base personnel duties and tasks and organization of the personnel into operational units.

40.20 Task 301 - Engineering development tests. An analysis is conducted to identify the human factors development tests that are performed by the human factors organization with the support of engineering and other organizations. These tests include mockup evaluations using human factors mockups and other tests conducted as part of an analysis to determine requirements or resolve problems. The analysis also identifies the requirement for human factors participation in engineering component and subsystem tests. Participation in these tests often leads to the early identification of design, manpower, personnel or procedural deficiencies. It is usually less time-consuming to determine appropriate corrective action for deficiencies identified during the design development period and less expensive to implement the corrective action.

40.21 Task 302 - Human factors system test analysis. ICBM weapon system human factors testing integrates the maintainability demonstration objectives to evaluate the adequacy of maintenance support equipment, technical orders and spares and the accuracy of maintenance time estimates. The human factors system test analysis includes these requirements. The analysis of the system level tests identifies opportunities for human factors observer/evaluator(s) to obtain human performance samples from test subjects (participants) accomplishing operations or maintenance functions. Coincidental with the observations, the test subjects will be video taped. The analysis will also include the identification of static human factors measurements that can be obtained. These measurements include time, acoustics, illumination, access and workspace size, and human force. The results of the human factors system test analysis will be used in the system test requirements analysis.

40.22 Task 303 - System test support. The system test support analysis is conducted to identify the human factors requirements to support development integration tests that may be held at one contractor's facility or a government facility, but involve the participation of other contractor personnel. Development integration tests may be conducted at one contractors' facility but involve subsystems of more than one contractor, tests conducted at a civilian test company, and tests conducted at an Air Force site such as a flight test base or government agency test site. Analysis also identifies the human factors personnel required to support system level testing at Air Force facilities such as the flight test base and the operational base. Based upon the analysis, personnel are assigned to support the tests.

40.23 Task 304 - Test results analysis. An important part of any test is the post-test analysis of the test results. Deficiencies identified during human factors test and

evaluation will be analyzed to exactly and completely identify the deficiency, identify the probable cause or causes and identify potential solutions to correct the deficiency. For deficiencies that are related to test installation or test peculiar procedures, every attempt is made to resolve the deficiency with the test responsible group(s), usually at the test site. All deficiencies are analyzed by the responsible human factors test personnel to achieve a definitization of the deficiency, a probable cause(s), and recommended action for resolution or alternate approaches to the deficiency. Where there is a human factors test working group, the completed analysis is referenced to the working group for action. It is normal procedure for the responsible test person to contact human factors and design engineers during the analysis to obtain support. The test working group may pursue resolution of the deficiency or may refer the deficiency to the main deficiency identification, analysis and corrective action system (Task 106).

50. DETAILS TO BE SPECIFIED

50.1 Tailoring of task descriptions. Task descriptions contained in paragraph 5, "Detailed Requirements", are to be tailored by the PA as required by governing regulations and as appropriate to particular systems or equipment program type, magnitude, and funding. In tailoring the tasks, the detail and depth of the effort is defined by the PA and incorporated in the appropriate contractual documents. This "Details to be Specified" section of the appendix is intended to list the specific details, deletions, or options to the requirements of the task that should be considered by the PA when tailoring the task description to fit program needs.

50.2 Task 101 - Human factors requirements analysis. Details to be specified include the following, as applicable:

a. Identification of each human factors task.

b. Identification of additional tasks to be performed or additional information to be provided.

50.3 Task 102 - Human factors integration. Details to be specified include the following, as applicable:

a. Notification requirements for attendance at human factors technical reviews, program reviews, design reviews, etc.

b. Identification of additional tasks.

50.4 Task 103 - Subcontractors and suppliers. Details to be specified in the SOW shall include the following, as applicable:

a. Notification requirements for attendance at technical reviews, program reviews, PDRs, CDRs, etc.

b. Definition of requirements for subcontractor/supplier human factors tasks.

50.5 Task 104 - Human factors group/human factors working group support. Details to be specified include the following, as applicable:

a. Contractor membership requirements and role assignments, e.g., recorder, member, alternate, or technical advisor.

b. Frequency or total number of HFG/HFWG meetings and probable locations.

c. Specific HFG/HFWG support tasks.

50.6 Task 105 - Program reviews. Details to be specified include the following, as applicable:

a. Identification of the human factors technical and human factors program reviews required.

b. Advance notification to the PA of all scheduled reviews. The specific number of days advance notice should be provided.

c. Recording procedures for the results of the human factors reviews.

d. Identification of PA and contractor follow-up methods on review of open items.

50.7 Task 106 - Deficiency identification, analysis and corrective action system. Details to be specified include the following, as applicable:

a. Identification of systems, subsystems, hardware, software, and facilities and the equipment levels of maintenance for corrective action reporting.

50.8 Task 107 - Human factors technical evaluation. Details to be specified include the following, as applicable:

a. Specification of evaluation period.

b. Identification of the human factors program and technical reviews to be supported by a human factors technical evaluation.

50.9 Task 201 - Human factors studies. Details to be specified include the following, as applicable:

a. Identification of specific studies to be conducted (which may be the same as or in addition to contractor-identified studies).

50.10 Task 202 - Human factors models and mockups. Details to be specified include the following, as applicable:

a. Identification of specific mockups and models to be constructed (which may be the same as or in addition to contractor identified models and mockups).

b. Identification of particular human factors features to be incorporated in engineering mockups.

50.11 Task 203 - Function definition and allocation. Details to be specified include the following, as applicable:

a. Identification of prescribed functional allocations to either machine or personnel implementation.

50.12 Task 204 - Human engineering task analysis. Details to be specified include the following, as applicable:

a. Identification of the particular requirements to utilize the human engineering task analysis in the system requirements analysis.

50.13 Task 205 - Biomedical analysis. Details to be specified include the following, as applicable:

a. Identification of particular biomedical issues to be addressed.

b. Identification of criteria or guidance documents.

50.14 Task 206 - Detailed task analysis. Details to be specified include the following, as applicable:

a. Identification of functions, including the constituent tasks, or tasks, for which, detailed task analysis shall be accomplished (without contractor analysis and subsequent recommendation).

b. Identification of different factors for the detailed task analysis.

c. Identification of additional criteria for the performance of detailed task analysis.

50.15 Task 207 - Human factors design criteria. Details to be specified include the following, as applicable:

a. Identification of additional criteria applicable to individual configuration items.

b. Identification of the references A through N.

c. Identification of maintainability, reliability, system safety, transportation, using command, and other requirements that would impact tailoring.

50.16 Task 208 - Design support. Details to be specified include the following, as applicable:

a. Identification of applicable human factors criteria.

b. Identification of handbooks or other publications to be used as design guides.

50.17 Task 209 - Human factors design evaluation. Details to be specified include the following, as applicable:

a. Identification of the human factors program and technical reviews to be supported by performing a human factors design evaluation.

50.18 Task 210 - Manpower and personnel analysis. Details to be specified include the following, as applicable:

a. Identification of maintenance levels to which studies and analyses apply.

b. Identification of operational and maintenance concepts.

c. Establishment of PA approval requirements for use of data.

50.19 Task 211 - System manpower and personnel analysis. Details to be specified include the following, as applicable:

a. Identification of the using command.

b. Identification of operational and maintenance concepts.

50.20 Task 301 - Engineering development tests. Details to be specified include the following, as applicable:

a. Specific subsystems, equipment, software, and facilities to be tested.

b. Specification of participation in subsystem development tests.

50.21 Task 302 - Human factors system test analysis. Details to be specified include the following, as applicable:

a. Identification of system level test planning documents to be used as the basis for the human factors test requirements analysis.

b. Information relative to constraints to be considered in performing the test analysis.

c. Interface instructions to ensure that the human factors test requirements will be compatible with main body of system test planning analysis.

50.22 Task 303 - System test support. Details to be specified include the following, as applicable:

a. Identification of the requirements for observer/evaluators.

b. Identification of government-furnished human factors test equipment to be operated by observer/evaluators.

c. Identification of special human factors tests to be accomplished.

50.23 Task 304 - Test results analysis. Details to be specified include the following, as applicable:

a. Special test analysis to be performed after individual tests.

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