Downloaded from http://www.everyspec.com

DATA ITEM DESCRIPTION

Title: Nuclear Hardness and Survivability (NH&S) Design Analysis Report

Number: DI-ENVR-80266A
AMSC Number: F9757
DTIC Applicable:
Preparing Activity: AF-27
Applicable Forms: None

Approval Date: 20161209
Limitation:
GIDEP Application: No
Project Number: ENVR-2015-004

Use/Relationship: This Data Item Description (DID) contains the format, content, and outline of the schedule of delivery requirements for the NH&S Design Analysis Report (DAR) which is produced as a result of tasking in 5.3.3.1.1, 5.3.4.1.3, and 5.3.4.1.4 of MIL-STD-1766C.

This DID is applicable to system development/modification contracts for operational intercontinental ballistic missile (ICBM) hardware for which the contractor is required to conduct an NH&S program. It can also be used for any effort on ICBM hardware that makes changes to the design, thus creating a need for an updated NH&S DAR (change pages), such as during sustainment activities of MIL-STD-1766C, section 5.5.

This report documents the methodology and results of the contractor's activity to incorporate specified nuclear hardness and survivability (NH&S) requirements into the design of each configuration item (CI) and its elements. This report is used (1) by the procuring agency to evaluate the degree to which the contractor has clearly demonstrated the hardware meets the NH&S requirements; and (2) by the operating and supporting agency, to aid in the evaluation of the hardness impact of planned redesign, modification, or upgrade actions, and to support the purchase of spares, repair, and maintenance of hardness critical items.

The nature of the contract will be a factor in deciding which versions of the DAR should be called for in the contract. For development phase, design review versions and physical configuration audit (PCA) version apply. For production, a final production update version applies. For long or continuous production, intermediate production updates may apply. The design review version(s) of the NH&S DAR need to be continuously revised and modified as the design progresses so that it is ready for release at each design review, at the PCA, and at the final production version (near the end of production). This final version is then used to support the logistics support agency's implementation of its hardness maintenance responsibilities throughout weapon system operational life. The requirements for all design review versions, the PCA version, and the final production update version are the same except as noted below where early versions are not required to have certain content completed. DAR preparation begins in conjunction with preliminary design review (PDR) and may include interim versions prior to the critical design review (CDR) version depending on length of contract and scope of the effort involved.

A minimum of four versions of the DAR are needed during a program and the contract needs to be prepared to require one at PDR, CDR, PCA, and a Production Update. After the Air Force accepts the final program DAR, it needs to be continuously maintained as a 'living' document to

Downloaded from http://www.everyspec.com

reflect updates to configuration and the associated hardness assurance/maintenance performed to carry out those configuration changes. While the Air Force customarily has performed this function, if the function is contracted, this DID must be tailored for use in that type of contract using the content required in the CDR, PCA, and production types of updates.

The nature of the requirements for ICBMs will lead to a need for classification of at least part of the NH&S DAR. When classification is needed, the appropriate program security classification guide shall be used to classify the document appropriately. Use of a separate classified volume (or volumes) as a part of the overall "book" is encouraged in order to allow for easier distribution and handling of the unclassified content.

This DID supersedes DI-ENVR-80266.

Requirements:

1. **Format.** Contractor's format is acceptable except as specifically noted herein. The DAR shall consist of a single book for each configuration item (CI) separate from the DAR for any other CI (a multi-volume book may be deemed necessary or practical) and which is capable of being changed by inserting change pages. Page size shall generally be 8 ½ x 11" except where necessary, 11 x 17" may be used as a foldout (folded to 8 ½ x 11") and a larger size may be used if necessary to maintain the readability of very large diagrams, figures, or tables. The cover and title page shall appear as in Figure 1. The Table of Contents shall list title and starting page for each section, paragraph, and appendix in the report and include a separate listing of each figure and table in the report.

(Document Number)

NH&S Design Analysis Report
for
(Identify the Contract Hardware Element by CI Name and Number)
Submitted by
(Identify Contractor)
in response to
Contract No: _____
CDRL Sequence No: _____

(Date of Submittal)

Figure 1. Sample NH&S Design Analysis Report Front Cover and Title Page

2. **Content.** The report content shall be as follows but in addition the intent is for the contractor to include all information (in whatever format) he is aware of that will provide a complete picture of the hardening design features, the rationale for choosing them, and the details of

Downloaded from http://www.everyspec.com

how they were demonstrated to meet the system hardness requirements. The intent is that the government be provided with all the information necessary to completely understand and maintain the hardened design independent of the contractor.

3. **Versions and content.** Any versions of the NH&S DAR released prior to the CDR are preliminary but must reflect the state of the hardened design at that point in time. A minimum of four versions of the DAR shall be prepared which are the PDR, CDR, PCA, and Production Update versions. Each of these shall satisfy all requirements identified below.

4. **Nuclear Environments and Effects Hardware Element Matrix (NEEHEM)** . The PDR version of the NH&S DAR shall contain a NEEHEM that is a matrix showing test and analysis planned for each major hardware division within the CI. This version of the NEEHEM is adapted from the program plan version of the NEEHEM that is a matrix showing test and analysis plans for each major hardware division within the CI. The NEEHEM in the program plan is a planning tool for program scoping, scheduling, and status tracking. At PDR it shows the planned test facility and may contain samples size and other test information. Updated versions of the matrix and additional instances of the matrix are required in the CDR, PCA, and Production Updates of the NH&S DAR to include 1) a documentation organization tool to show all reports and/or other documents that fulfill the test/analysis intent of each box within the matrix, and 2) an additional version (another instance of the matrix) used in concert with the documentation organization version wherein the test results/reports and/or analysis results/reports are summarized in one or a few words (e.g., No Upset, No Damage, No Function Errors, circumvention reset (C/R) success, etc.) which highlight key pass/fail criteria. An example NEEHEM is shown in Figure 3 at the end of this DID.

5. **Hardness critical item (HCI) identification and reference.** The CDR version (and later versions) of the NH&S DAR shall contain a dedicated section titled “HCI Identification and Reference”. This section shall consist of two sub-sections entitled, “HCI Index” and “HCI Reference Documentation”.

5.1 HCI Index. Figure 2 provides an example HCI Index. This sub-section of the DAR shall provide, 1) in matrix form, a complete HCI list for the CI under consideration (in an indentured parts list structure), and 2) for each HCI listed, the following information:

a. Indenture level and quantity per indenture level.

b. Part number of item.

c. Name of item (Noun).

d. Identification of the critical nuclear environment(s) applicable to the HCI.

e. Identification of the applicable rationale(s) which justify the labeling of the item as an HCI; this identification shall consist of the listing of the identifying number of each applicable rationale, as given in section A.3.65 of MIL-STD-1766C.

Downloaded from http://www.everyspec.com

f. Identification of all location(s) within the NH&S DAR at which the HCI is discussed (by section or paragraph number).

g. In each paragraph of item f. above, identify the document reference number from the listing in the HCI reference documentation list (see 5.2 below) for all reference documents containing substantive information on the given HCI; this element of the information need not be completed in early design review version(s) of the NH&S DAR, but provision for it shall be made in the text of the applicable paragraphs to facilitate its completion in the PCA version of the NH&S DAR.

Indenture Level	Qty. per Indenture	Part Number	Noun	Nuclear Environment						HCI Rationale	Discussed in Paragraph(s)
				S&V	B&A	Rad	EMP	T	D		
01	1	01-ABCD038-3	Message Processor (MP) (CI 02222 Top Assy)	X	X	X	X			1,5	Ref. 22, para. 3.8.2
02	1	82-ABCD109-2	HOUSING (for the MP)	X						1	6.3.2.4, 8.4.1.1
02	1	71-ABCE242-1	LATCH (for the MP)	X						1	8.4.1.5, Ref. 6, para. 1.3
02	1	28-ABCE152-1	POWER SUPPLY, PS-1	X	X	X				5	7.4.2.4.1.1
02	1	06-ABCD139-3	CIRCUIT CARD ASSEMBLY, Communication Processor	X		X				1,5	7.4.2.1.1
02	1	06-ABCD139-6	CIRCUIT CARD ASSEMBLY, Controller	X		X				1,5	6.3.1.1, 7.4.2.1.4, Ref. 14
02	1	06-ABCD135-3	CIRCUIT CARD ASSEMBLY, Level Converter	X		X				1,5	6.3.1.1, 7.4.2.1.3, Ref. 33-para. 5.6
02	1	06-ABCD155-3	CCA, SDSS	X		X				1,5	7.4.2.1.5
02	1	06-ABCD163-3	CCA, MMDC	X		X				1,5	6.3.1.1, 7.4.2.1.6
02	1	06-ABCD171-3	CIRCUIT CARD ASSEMBLY, LED Montior	X		X				1,5	7.4.2.1.7,References 3, 9, 12, 21
02	1	03-ABCE400-3	COMPUTER ASSEMBLY, Halo	X	X	X	X			1,5	7.4.2.2.1
02	2	73-ABCE248-1	CONNECTOR, POWER				X			1	6.3.1.1.2 (Contains the MOV)
03	2	M835301/1-2000B	MOV				X			3	6.3.1.1.2

Figure 2. Example HCI Index

5.2 HCI Reference Documentation. This sub-section shall contain a complete listing of all hardness related deliverable documentation used by the contractor in the design analysis to demonstrate compliance with hardness requirements. Documents may be listed in arbitrary order, and each shall be assigned a reference number in serially ascending order. These reference numbers shall be included, as appropriate, in the paragraph references in the last column of the HCI Index. The HCI reference documentation sub-section need not be completed in early design review version(s) of the NH&S DAR, but the sub-section heading shall be provided, with the associated statement "To be provided" and shall be as complete as the drawing package at CDR, and entirely complete and current at PCA and for any later updates of the DAR.

6. **Text**. The body of the text shall include:

6.1 Test and Analysis Sections. A separate section shall be used for each test and/or analysis, for each major subdivision of the CI being considered, and within each such separate section, the content shall be organized by environment. Include the following as applicable and appropriate, in each section of the text:

a. Objective, purpose, and background of the analysis or test.

b. A complete description of the subdivision of the CI being analyzed, including functional and physical descriptions and performance requirements. Include drawings, schematics, etc., to support the description.

Downloaded from http://www.everyspec.com

c. Identification of the nuclear requirements imposed on the design.

d. Identification and discussion of hardness design features. Identify and discuss the hardness design features by which the CI is able to adequately withstand the effects of the specified nuclear environments, or provides hardness protection to other hardware items within the system. This discussion shall include identification of all HCIs and hardness critical processes which comprise the feature or which provide physical or function support to its hardness function, and shall provide reference to pertinent drawings, schematics, etc.

e. Assumptions imposed on the analysis.

f. Identification of source material used in the analysis. If source material is not in the open literature (i.e., readily available to the public in a reliable, long-term storage location) or in another contract deliverable item, incorporate a copy of the source material as an appendix to the report. Internet sources are not stable so include that material also.

g. Discussion of the analysis/test procedures, methods, and techniques used to establish a hardened design and their attendant accuracy. Provide sample calculations, as appropriate with reference to the documentation of the complete calculations. Provide all design analyses performed for the purpose of verifying that the final design satisfies the specified hardness requirements. Provide reference to all relevant test plans, procedures, and test result reports, so that either by reference or through explicit discussion, all data relevant to verifying that the final design satisfies the specified hardness requirements is presented.

h. Where computer codes are used for validation and qualification or other analysis, provide the code details including name, source, cost (if known), point of contact where code may be obtained, reason for selecting the code, proof of code validation (code accurately implements the desired actions, i.e., validating that the coded version is what analyst or designer intended) and verification (code is benchmarked against known and applicable test data or other such validated code(s) so that there is confidence it produced reliable results), limitations of the code (what range of environments for which it is verified and where it may produce questionable results, other rationale for selection of the particular code, computer hardware requirements (operating system, memory size, etc.) required to run the code, etc.

i. Presentation of results and conclusions, including a comparison of predicted and tested performance to the specified hardness requirements. Also, present all available data related to pertinent hardness design margins and hardness fragilities.

6.2 Trade Studies. For each trade study include the following information:

a. Objective, purpose, and background of the study.

b. A complete description of the item(s)/design option(s) involved in the trade study, including all relevant characteristics and requirements that are subject to trade-off. Identify the requirements document that is the source of each requirement listed.

Downloaded from http://www.everyspec.com

c. Identification of the parameters relevant to the trade study.

d. Identification of the assumptions imposed on the trade study.

e. Identification of the source material used in the trade study. If source material is not in the open literature (i.e., readily available to the public in a reliable, long-term storage location) or in another contract deliverable item, incorporate a copy of the source material as an appendix to the report. Internet sources are not stable so include that material also.

f. Identification of potential design approaches, their relevant characteristics, and their relationship to requirements. These data should be summarized in a matrix that compares all the design approaches considered with respect to all relevant characteristics and requirements. The matrix shall be designed to facilitate rapid comparison and evaluation of potential design approaches, and to permit preliminary screening of design approaches that are inconsistent with hardness requirements and other functional and technical requirements. Include cost-effectiveness models and life cycle cost data where applicable. To the extent possible, correlate the matrix information with the source material identified in 6.2.e.

g. Identification of the selected design approach with accompanying rationale. The statement of rationale shall include an analysis of the significant response modes of the recommended design and an estimate of its projected hardness. The statement of rationale shall also include a discussion of the effects of the recommended design on other functional and technical requirements, the expected severity of these effects, and the probability of their occurrence as a function of the severity of nuclear environments, up to the magnitudes of the specified nuclear environments.

h. Identification of problem areas associated with the recommended design approach, and related actions taken or proposed to be taken. Include a list of other design studies planned as a result of these analyses.

7. **PCA Version.** The text shall contain the entire content of the final CDR version, updated, as appropriate, to reflect any design changes made between CDR and PCA which affect hardness. The primary addition shall include all materials about hardness qualification test planning, testing, and results. If any design changes were necessary as a result of qualification, they and their design proof (i.e., how it was demonstrated to meet hardness) shall be included. The “HCI Index” and “HCI Reference Documentation” sub-sections shall be updated appropriately.

8. **Production Version(s).** The text shall contain the entire content of the final PCA version, updated, as appropriate, to reflect any design changes or design proof for part substitutions made after PCA (and/or during production) which affect hardness. The “HCI Index” and “HCI Reference Documentation” sub-sections shall be updated appropriately.

9. Example NEEHEM:

Downloaded from http://www.everyspec.com

ADD/DELETE Environment Columns as necessary to match the applicable portions of the Weapon Specification

ADD/DELETE Rows to match system configuration in enough detail to allow for all necessary tests and analyses

System Location Subindetnure	System Location (e.g., Launch Facility) (In this column, replace with specific nouns/titles and part numbes or document numbers applicable to the system)	Program Effect	Transient Dose Rate		Prompt Gamma		Total Dose		Neutron Damage		Free Field EMP		Conducted EMP		Shock & Vibration	
			Analysis	Test	Analysis	Test	Analysis	Test	Analysis	Test	Analysis	Test	Analysis	Test	Analysis	Test
ALL	HDM (add complete listing for all HDMs affected by the program - insert new rows as needed to make a complete list)	Modify														
	DAR (Existing DAR update[s] - list all DARs affected by the program OR indicate if New DAR?)	Modify														
Location 1 (e.g., Launch Support Building)	Component 1 (e.g., Air Compressor)	Eliminate														
	Component 2 (e.g., Environmental Control System)	-------														
	Component 2 subindenture item 1 (e.g., Sensors)	Replace														
	Component 2 subindenture item 2 (e.g., Controls)	Replace														
	Component 2 subindenture item 3 (e.g., Damper Operators)	Replace														
	Component 2 subindenture item 4 (e.g., Ductwork & Dampers)	No Change														
	Component 2 subindenture item 5 (e.g., Switches, Panels)	Replace														
	Component 3 (e.g., Generator)	-------														
	Component 3 subindenture item 1 (e.g., Sensors)	Replace														
	Component 3 subindenture item 2 (e.g., Controls)	Replace														
	Component 4 (e.g., Motor Starters)	Replace														
	Component 5 (e.g., Coolant Lines/Plumbing)	No Change														
	Component 6 (e.g., Supplemental Air Lines)	Abandon														
	Component 7 (e.g., Electric Heater Unit)	No Change														
	Component 8 (e.g., Remote Monitoring System)	Add														
	Component 2 subindenture item 1 (e.g., Sensors)	Replace														
	Component 2 subindenture item 2 (e.g., Controls)	Replace														
	Component 9 (e.g., Coolant Chiller - 27k BTU/h)	Replace														
	Component 10 (e.g., Ventilation Exhaust Fan)	No Change														
Location 2 (e.g., Launch Equipment Room)	Component 11 (e.g., Environmental Control System)	-------														
	Component 11 subindenture item 1 (e.g., Sensors)	Replace														
	Component 11 subindenture item 2 (e.g., Controls)	Replace														
	Component 11 subindenture item 3 (e.g., Damper Operators)	Replace														
	Component 11 subindenture item 4 (e.g., Ductwork & Dampers)	No Change														
	Component 11 subindenture item 5 (e.g., Switches, Panels)	Replace														
	Component 12 (e.g., Motor Starters)	Replace														
	Component 13 (e.g., Coolant Lines/Plumbing)	No Change														
	Component 14 (e.g., Remote Monitoring System)	Add														
	Component 15 (e.g., Air Conditioner)	Replace														
	Component 16 (e.g., Heater Assembly)	Modify														
	Component 17 (e.g., Emergency Fan Assembly)	No Change														

Figure 3. Example NEEHEM

10. End of DI-ENVR-80266A