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DOE HANDBOOK

HUMAN FACTORS/ERGONOMICS HANDBOOK FOR THE DESIGN FOR EASE OF MAINTENANCE

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FOREWORD

The purpose of this handbook is to provide Department of Energy (DOE) contractors with information that can be used to design equipment and maintenance programs in order to reduce human errors and subsequently accidents and injuries due to human errors with maintenance activities. This handbook provides human factors good practices for design of equipment, systems, subsystems, and facilities, including support facilities and equipment, as well as, guidance for maintenance support equipment and procedures, maintenance aids, and maintenance programs. This handbook is part of a series of guides designed to enhance the guidelines set forth in DOE Orders 4330.4B, 420.1, and 5480.30 and DOE Guides 200.1, 420.1-1, 421, and 452.2A.

KEYWORDS

Facility
Maintenance design
Maintenance programs
Workshops

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1.0 GENERAL

1.1 Introduction

Maintainability is that characteristic of design and installation that affects the amount of time and cost necessary to repair, test, calibrate, or adjust an item to a specified condition when using defined procedures and resources.

Design for maintainability has as a prime objective the design of systems, subsystems, equipment and facilities capable of being maintained in the least amount of time, at the lowest cost, and with a minimum expenditure of support resources. Attempts to achieve this objective have evolved into the engineering discipline of maintainability.

To realize the overall goal of maintainability, that is, to prevent failure or to restore a failed system or device to operational effectiveness easily and cost effectively, requires that maintainability and the associated human factors contributions be considered as part of the total design process. Maintainability must be designed into the system and equipment during the beginning stage of development to ensure that costly maintenance and/or redesign are avoided. Maintainability should complement operational requirements of a system. Design for maintainability is an evolutionary process that starts in the equipment concept stage and ends after the equipment has been built and tested.

This handbook provides design criteria for promoting system maintainability. These criteria are specifically compiled to assist in incorporating maintainability into new systems or for modification of existing facilities to increase their maintainability. They are not in themselves grounds for establishing the requirement to modify a facility. However they may be used to identify discrepancies with existing design criteria that may result in decreased system and facility maintainability.

This volume is an update and extension of an earlier DOE document, UCRL-15673, *Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities*.

1.1.1 Scope

This standard establishes system maintainability design criteria for DOE systems, subsystems, equipment and facilities.

1.1.2 Purpose

This document is intended to ensure that DOE systems, subsystems, equipment, and facilities are designed to promote their maintainability. These guidelines are concerned with design features of DOE facilities that can potentially affect preventive and corrective maintenance of systems within DOE facilities. Maintenance includes inspecting, checking, troubleshooting, adjusting, replacing, repairing, and servicing activities. This handbook also addresses other factors that influence maintainability, such as repair and maintenance support facilities including hotshops, maintenance information, and various aspects of the environment and worker health and safety. This standard is to be applied to the system design of DOE systems, subsystems, equipment and facilities to:

- Reduce the need for and frequency of design-dictated maintenance.
- Reduce system/equipment down-time.

- Reduce design-dictated maintenance support costs.
- Limit maintenance personnel requirements.
- Reduce the potential for maintenance error.
- Assure use of standard procedures, equipment, and tools, when possible.

This standard serves as a reference and may be cited contractually in system specification and requirements to form a basis for evaluation of the human-machine interface.

1.1.3 Application

These standards should be applied to the design and retrofitting of all facilities, systems, subsystems and equipment by elements of the DOE. Unless otherwise stated in specific provisions, this standard is applicable for use by both men and women. Design should accommodate the range from the 5th percentile female to the 95th percentile male within the user population unless alternate upper and lower limits are specified by the DOE.

1.2 Source documents (for original DOE document, UCRL-15673, *Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities*, of which this document represents an update and extension).

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