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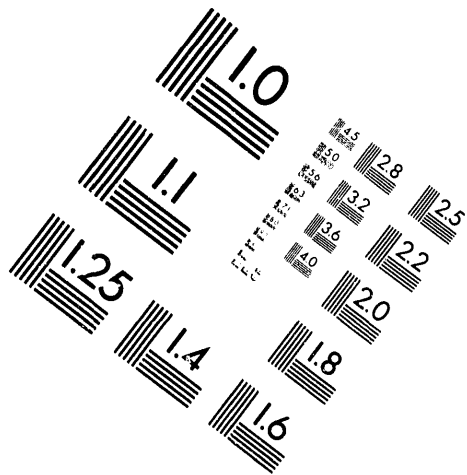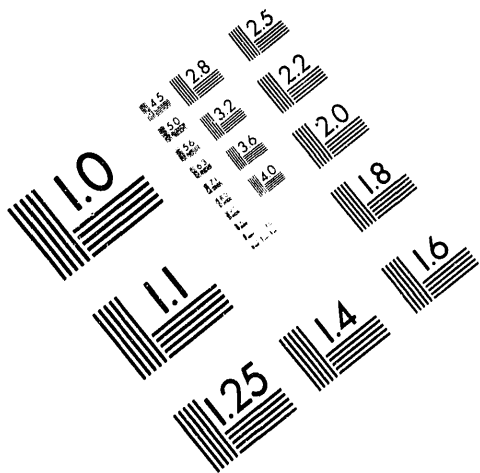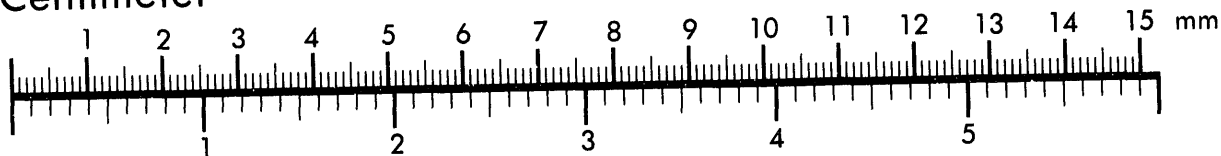
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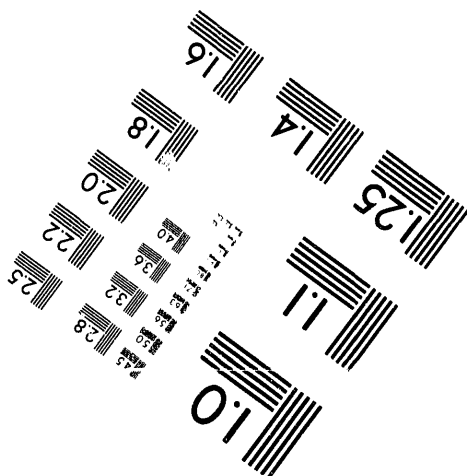1100 Wayne Avenue, Suite 1100
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Centimeter

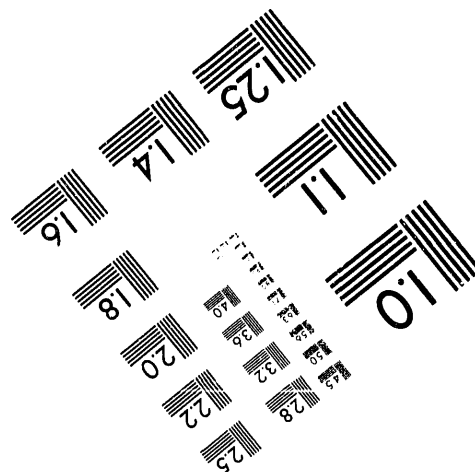1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 mm

Inches

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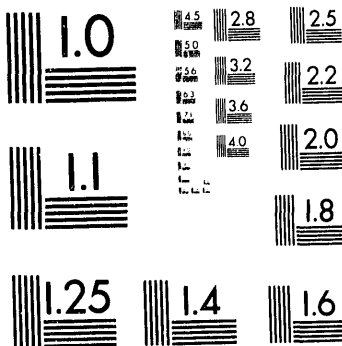
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Development of Guidelines to Review Advanced Human-System Interfaces

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INTRODUCTION

Advanced control rooms (ACRs) will utilize advanced human-system interface (HSI) technologies that may have significant implications for plant safety in that they will affect the operator's overall role in the system, the method of information presentation, and the ways in which operators interact with the system. The U.S. Nuclear Regulatory Commission (NRC) reviews the HSI aspects of control rooms to ensure that they are designed to good human factors engineering principles and that operator performance and reliability are appropriately supported in order to protect public health and safety. The principal guidance available to the NRC, however, was developed more than ten years ago, well prior to these technological changes. Accordingly, the human factors guidance needs to be updated to serve as the basis for NRC review of these advanced designs. The purpose of this paper is to discuss the development, evaluation, and current status of the Advanced HSI Design Review Guideline, hereafter referred to as the "Guideline."

DEVELOPMENT METHODOLOGY

Source material for detailed guidelines was sought from human factors guidance documents for advanced HSI's. Through a review of the human factors literature, approximately 50 guideline documents were identified. A subset of those documents were selected as the "primary sources" for the Guideline. In the selection process, a high priority was given to the establishment of document "validity"; i.e., assuring that they were based upon a sound technical basis ("internal validity") and conformed to accepted human engineering practice through peer review ('external validity"). From the source material guidelines were developed and organized into seven major sections:

Information Display - This section provides guidance in top-down fashion beginning with display formats (such as P&IDs and trend graphs), format elements (such as labels, icons, symbols, color, etc.), data

quality, update rate, and display devices.

User-System Interaction - This section addresses the modes of interaction between the operator and the HSI. Topics include dialog format, navigation, display controls, entering information, system messages, prompts, system response time, and methods for ensuring the integrity of data.

Process Control and Input Devices - This section addresses information entry, operator dialogue, display control, display-control integration, information manipulation, and system response time.

Alarms - This section will contain the results of ongoing research to develop guidance in the area of advanced alarm systems.

Analysis and Decision Aids - This section addresses the use of knowledge-based systems.

Inter-Personnel Communication - This section contains guidelines for activities related to speech and computer-mediated communication between plant personnel, e.g., preparing, addressing, transmitting and receiving messages.

Workplace Design - This section addresses the organization of displays and controls within individual workstations, control room configuration and environment.

In order to facilitate guideline access, maintenance, review planning, and in-field use, the Guideline has been developed as an interactive, computer-based document in addition to a hard-copy document. The prototype user interface provides for many document functions such as table of contents (ToC), context index, glossary, and placemarkers. Reviewers can automatically go to desired sections by clicking on the ToC or index entry. Guideline evaluation, data analysis, and reporting functions have also been developed.

GUIDELINE TEST & EVALUATION

The Guideline has been evaluated with respect to its scope and technical content (i.e., adequacy for the review of ACR technology), and usability (i.e., Guideline presentation, interactive document functionality, and user interfaces). The test and evaluation (T&E) program consisted of three methodologies: Development Test, User Test, and Peer-Review Workshop. The Development Test provided a preliminary evaluation of the Guideline and an opportunity to correct interface problems prior

to subsequent testing. The User Test was a field test of the Guideline in advanced control room environments by experienced human factors reviewers. The third evaluation was a Peer-Review Workshop. The workshop provided a different type of evaluation than the two testing tasks and addressed the broader aspects of the Guideline, such as the validity and technical basis for the Guideline.

The overall results supported the Guideline's validity. The primary source documents were considered an appropriate technical basis upon which to develop the Guideline. However, several further developments were recommended including a reduction in the overall number of guidelines, the specification of a review process or procedure to facilitate Guideline usage by a review team, and development of additional guidelines for several topics that were not adequately addressed (such as computer-based alarm processing systems).

With respect to the interactive version of the Guideline, most interface characteristics thought to be indicative of usability (such as visual clarity, consistency, explicitness, ease of use, ease of learning, low memory load, etc.) were rated highly. Some difficulties were encountered, mainly in the areas of input devices, reporting and help functions.

Based upon the results of the T&E program, modifications were made to address these considerations.

FUTURE DEVELOPMENT

The approaches established to review, develop, and integrate additional information into the Guideline will be an ongoing task in order to ensure that the document always has the most up-to-date and valid human factors review guidance. Since the technology is rapidly changing and the nuclear industry's experience (as well as that of other application areas) will be increasing, the Guideline will need to remain a living document in order to meet NRC needs.

ACKNOWLEDGEMENT

This research is being performed under the auspices of the U.S. Nuclear Regulatory Commission.

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FIN L-1317

4. AUTHORS *(If more than three, name first author followed by "and others")*

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