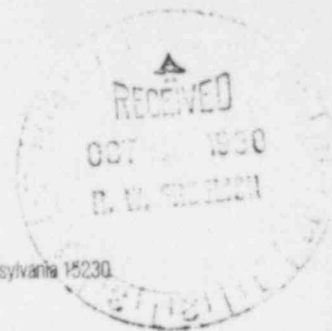


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NS-TMA-2315

September 26, 1980

Mr. V. A. Moore, Acting Deputy Director
Division of Human Factors Safety
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Moore:

Westinghouse is pleased to have this opportunity to provide the attached comments in regard to NUREG/CR-1580, "Human Engineering Guide to Control Room Evaluation" in response to the August 20, 1980 Federal Register announcement.

Westinghouse realizes that NUREG/CR-1580 was developed primarily as a guide to performing a control room evaluation, but it is prudent to recognize that this document will be used by the control room designer. The Westinghouse review of the document indicates that it could have useful applications for evaluating and designing control rooms. However, it is not possible at present to easily utilize the NUREG for design, and it is questionable whether it can be easily employed as a guide for review. The evaluation guide does not currently provide a well organized or complete base from which to perform an evaluation. Further, the NUREG does not adequately allow for the rapid development of the Human Engineering field. Therefore, Westinghouse recommends a careful review of the NUREG in light of the attached comments.

If you have any questions regarding these comments, please contact Mr. G. Butterworth of my staff at 412-373-5761.

Sincerely,

T. M. Anderson, Manager
Nuclear Safety Department

FWD/keg

Attachment

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Westinghouse General Comments on NUREG/CR-1580

1. Implementation of guidelines may be difficult.

Because of the way in which the NUREG is organized and the type of information supplied, industry personnel may find it difficult to understand and successfully implement the NUREG requirements. Even Human Engineering specialists could find it difficult to utilize this document. There is too much information about knobs and dials and not enough about an overall systems approach to human engineering. Also, little guidance is supplied to help a designer prioritize modifications. To improve applicability more examples and illustrations from control rooms, rather than cockpits and military systems, are required, and the organization and content of the NUREG should be evaluated for ease of utilization and adequacy of information.

2. Arrangement of guidelines.

The arrangement of the guidelines is confusing and difficult to use. In making a design decision (e.g., what display to use for the presentation of a specific piece of information), several guidelines from different sections have to be considered and integrated. This makes it difficult to apply the document. We recommend that appropriate cross references be included or reorganizing the section under a different classification scheme be investigated.

3. Backfit or replacement.

The Human Engineering Evaluation should identify key areas requiring modification. The checklists included in the draft NUREG are one good approach. However, one must be able to distinguish between situations that are amenable to backfit solutions versus situations where deficiencies are so great that the only solution is to completely replace the existing control board. While this issue can only be resolved on a case by case basis, some explicit discussion of the criteria for judging the severity of deficiencies is needed.

4. The NUREG does not address staffing issues.

The multi-person control room poses some unique problems related to crew assignments, movement patterns, and crew coordination. This issue of the organization of control room personnel can affect the details of control room layout, etc. This situation needs to be addressed and appropriate guidance needs to be included.

5. Human Engineering guidelines or standards.

It is not clear whether Volume II represents guidelines or standards. Human Factors is not yet an exact science, and while there may be universal agreement among experts in the field on the criteria to be met, there are often many means available to meet these criteria depending on the particular circumstances. This is particularly true of Human Factors guidelines for computer displays. It would be unfortunate if these guidelines froze development in a rapidly developing area. Also, guidelines for light emitting displays are not necessarily the same as guidelines for light reflecting displays. Character size, separation and luminance requirements are just a few of the guidelines that are different and should be addressed.

For example:

Color coding of information on CRT's needs to be addressed independent of that for reflective displays. The nature of the phosphors and the electron guns determine the most suitable colors for particular purposes. Although the stereotypical color assignments are preferred, tradeoffs must be made because of the colors available on most CRT systems today. This should be pointed out in guidelines for evaluating CRT color coding.

6. Over reliance on a few sources of information.

Large sections of the NUREG are taken essentially verbatim from a few sources. The series of EPRI reports (Project 501, Reports NP-309, NP-1118 Volumes 1 through 4), in particular, seem to be underutilized. This shortcoming is most salient in the sections relevant to computer display systems. While Engel and Granda (1975) is a good source, this is a rapidly expanding literature on man-computer interfaces (see EPRI Report NP-1118 Volume 4, 1980 for a recent compilation). We recommend that the most recent literature also be incorporated, and that allowances for future developments and better information be made.

7. Consideration of procedural requirements.

The subject guide suggests guidelines to uncover potential operator errors caused by physical characteristics of the control room, equipment, components, etc. However, it does not consider control room/control board evaluation on operating procedure requirements. Main control board layout may be developed on normal day to day and emergency operating sequence requirements. Therefore, operating procedure requirements should be considered in the evaluation.

8. Definitions of acronyms.

A list of acronyms should be provided, since a large number of acronyms are used throughout the document.

9. Evaluation team requirements.

The recommended Control Room Evaluation Team organization requires excessive manpower and the requirements for a team director plus two additional managers cannot be justified. The evaluation team should consist at most of five to six people including the team manager who should be responsible for both the data collection and the Human Engineering deficiency processing function.

10. Overutilization of aerospace and military guidelines.

Human engineering guidelines given in NUREG/CR-1580 are, to a large extent, borrowed from the military or aerospace industries. This does not allow for the fact that nuclear power plants are by design much more tolerant of human errors. Because of this most of the guidelines are over-conservative for their application to nuclear power plant systems. We recommend, because of the fault tolerant nature of nuclear power plant, that the conservatism of the evaluation criteria be carefully considered.

Westinghouse Specific Comments on NUREG/CR-1580

Phase I Page vii, Appendix I-c, "Design Features Influencing Human Errors," is omitted.

Phase I Page xi 3rd Paragraph, mention "NRC criteria or regulations" - since there are no NRC criteria or regulations in reference to control Room Evaluation, what NRC criteria and regulations are being considered in this paragraph?

Phase I Page 14 Figure 2-4, Guideline - one of the guidelines for toggle switches should be not to use them for critical applications, instead of providing guards.

Phase I Page 19 Figure 2-5, "Indication Display" - one of the "containment pressure" should be changed to "containment temperature."

Phase I Page 21 Paragraph 2.5.7.3.3, It is not necessary to photograph each Human Engineering Deficiency Report, rather a photograph of the problem should be provided for the Human Engineering Deficiency Report.

Phase I Page 22 Paragraph 3.1.2, An appendix "C" is not supplied in the NUREG.

Page 23 Paragraph 3.2.1, An interview with an operator could hardly be "anonymous input", but a questionnaire could be designed to be anonymous.

Section 3.3.1 and Appendix IV-a. Merely recording sound pressure levels with different backgrounds and in different directions is an incomplete noise survey. The purpose of the noise survey must be defined: Is it to meet OSHA standards? If this is the case, overall noise levels may be sufficient. Is it to determine if auditory warnings, such as annunciator horns and firebells, are detectable and discriminable? If this is the case, then noise levels must be broken down by spectral regions and the spectral characteristics of the auditory signals must be noted also. If the goal is to ensure adequate speech communication, then an index of speech intelligibility should be included for that sound environment.

Phase II Page 2, A definition of "5th percentile operator" should be provided.

Section CRE, Pages 3 and 5, Directional lighting can often be used to reduce ambient illumination, thereby reducing glare.

Section CRE, Page 9, Backfit displays is an alternative solution to this problem.

Section CRE, Pages 20 and 21, It is not clear why equipment failure and critical malfunctions are in the control room environment section.

Section WA, Pages 1 - 5, Additional figures would help users in this section, particularly figures on the operation of controls while standing.

Section WA, Page 23, If CRTs are incorporated into a console an angle of 15 degrees will contradict recommendations on glare reduction.

Section VD, Pages 4, 5, 8, and 9, The warning and caution, and system status monitoring display sections are very important and should be expanded.

Section VD, Page 13, The last line of the "Method of Use" subtitle contains some of the most important information in this section: i.e., "Therefore, an analysis should be made of the type of action the operator will be expected to take while receiving or after receiving information from the display." This should be expanded and given more emphasis.

Section VD, Pages 21 and 22, The figures on these 2 pages contradict each other on the difference between the horizontal and the normal line of sight. The figure on page 22 is correct (15°).

Section VD, Page 49, While many factors affect the critical fusion frequency, it is possible to specify a minimum guideline - 50 Hz.

Section VS, Page 49, Response time is important to p12; it deserves a more detailed discussion.

(See Miller, Robert B., "Response Time in Man-Computer Conversational Transactions," in AFIPS Conference Proceedings, Vol. 33, Part 1, AFIPS Press, Montvale, N.J., 1968 pp. 267-277).

Section VD, Page 54, These console designs will result in severe glare problems. They are usable only if typical lighting systems are extensively modified to prevent glare. We recommend that these figures be replaced with an illustration that does not have this problem or provide an explanation of the glare problems associated with the indicated designs.

Section VD, Page 74, A recommendation to always use percentages rather than actual RPM readings is inappropriate. There are occasions when the actual value is necessary and display clutter can be reduced by proper scales and labels (e.g., displaying RPM/1000).