



TECHNOLOGY for ENERGY CORPORATION

October 24, 1980

Dr. Stephen S. Hanauer  
Director  
Division of Human Factors Safety  
Nuclear Regulatory Commission  
7920 Norfolk Avenue  
Bethesda, Maryland 20014

Subject: Comments on Draft NUREG 0700

Dear Dr. Hanauer:

Technology for Energy Corporation has performed an extensive review of the draft of NUREG 0700 (CR 1580). The document is deficient in many areas.

CR-1580 does not appear to fulfill objectives stated in 0660 and other regulatory positions concerning control room design. In the following comments, referenced quotes 1, 2, and 3 relate to the President's Commission on the Accident at Three Mile Island, NUREG 0660, and NUREG 0585 respectively.

- There is no discussion of the "Adequacy of information provided to the control room operator" (1, 2, 3) beyond the human factors category, i.e., the only items discussed are items such as the CRT display and location, lighting, etc. There is no evaluation of what signals should be in what position or the information system as a whole.
- There is no discussion of "Information on recording and recall capability in the control room." (2)
- There is no discussion of the "Verification of the correct performance of operator activities." (2)
- There is no discussion of "Operation of the plant from the control room with multiple failures of non-safety equipment." (2)
- There is no discussion of "Adequacy of operating procedures and operating training and limitations of instrumentation displays in the control room." (2)
- There is no discussion of "Alarm prioritization." (2)

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The evaluation criteria suggested relate to simple mechanical items (e.g., increasing the light intensity or using a better meter), which are intrinsically good, but have no impact on the broad goal of improving the quality of information presented to the operator in normal or accident situations.

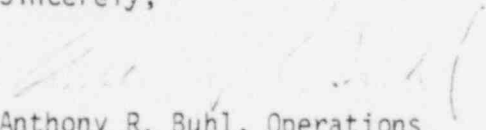
- The document only addresses problems related to human factors and is written in that language. Improvement of control room goes beyond human factors (man/machine interface). In its present form, it does not deal with evaluation of control room design but evaluation of the man/machine interface.
- There is no effective treatment of the prioritization of Human Factor deficiencies discovered during the evaluation, nor is there any cost-benefit analysis presented.
- The document should at the least define the features of a reference control room design for utilities to use as a guideline.
- There is no presentation of how computers and CRT's are to be optimally interfaced with the hardware, nor is there any evaluation relevant to the increased instrumentation being required such as the SPDS and Regulatory Guide 1.97 requirements.

Some sections of the document such as the photo survey section are very good. However, our major concern with this document is that it is neither consistent nor can it be easily understood. The document ignores a great deal of work done abroad and seems dated by about five to ten years when contrasted to much of that work.

The document as it stands reiterates existing pieces of human factors work but may have little effect on real improvements to plant safety. Our detailed comments are enclosed for your examination.

Thank you for the opportunity to comment on this important draft document.

Sincerely,



Anthony R. Buhl, Operations  
Group Vice President

ARB:dhf

Enclosure

## DETAILED COMMENTS ON NUREG/CR 1580

### "Human Engineering Guide to Control Room Evaluation"

#### INTRODUCTION

Task I.D., Control Room Design of NUREG-0660 has a stated objective "To improve the ability of nuclear power plant control room operations to prevent accidents or cope with accidents if they occur by improving the information provided to them."

To achieve part of this objective NRC: "require that operating reactor licensees and applicants for operating licenses perform a detailed control room design review to identify and correct design deficiencies."

The Essex Corporation, as contractors to NRC, have produced NUREG/CR-1580 which is intended should provide the review guidelines for the examination of all nuclear power plant control room designs.

The purpose of this review is to examine the validity of NUREG/CR-1580 in satisfying the stated NRC objectives.

#### CONTROL ROOM DESIGN

Control room design decisions should be primarily concerned with the information system centered on the control room to ensure that it is relevant, structured, and with the correct degree of availability to maximize operator perception and "feel" for the process under his control. The information system should allow the operator to develop action strategies for all operational situations, including accident management, and the interface be designed to allow him to exercise control actions with the minimum of error.

With this emphasis on the information system, and particularly the need to match the operator's information needs, it is difficult to understand the direction of the review guidelines which give predominance to what is

considered by many to be secondary task, namely the organization of components on the control interfaces, instead of the major task of defining in detail the information system to support the operators in all operational situations.

If this basic premise is accepted, then the primary task should have been to have prepared a reference design for the control room based upon present technology and incorporating existing control room design standards, specifications and guides for the international nuclear power community. The statement in 1.0 INTRODUCTION. 1.1 General, "Since no human engineering standards had been developed specifically for the nuclear power plant control room applications, military and aerospace guidelines were used," displays a lack of research both within the U.S.A. (ref I.E.E.E. Standards) and European design authorities. Incidentally, a basic objection to the Guide is the wholesale attempt to transfer military standards to nuclear control room applications. It is a matter of record that many design decisions are based upon task-specific requirements and this widespread transfer of requirement from one industry to another is not without risk. The electricity utility industry, over many years, has developed population stereotypes which have to be recognized and applied. This is not unique to this industry and caution should be taken in transferring design guidelines between industries, as has been attempted in this case.

Without some attempt to outline a reference control room design and thereby provide guidance to the utilities, the Guide provides a somewhat arbitrary review. Utilities should have some reference point as to what an "optimum control room design" might be and how their control room compares.

The biggest single criticism of the Guide is that by not placing sufficient emphasis on the information system in the control room, we have missed an opportunity for the utilities to examine this in detail and decide the optimum

system for their use including future operation of the plant.

The review guidelines could have provided an approach for the utilities in cooperation with the NRC to have investigated basic control room design decisions in a cost-effective manner and not simply to apply palliatives. In its present form, the Guide does not examine fundamental design decisions regarding the control room but instead provides a plethora of documentation which, after application, will result in the production of technically competent secondary items which will have minimal effect on improving operator performance and hence may not substantially improve reactor safety.

This document overlooks the major decisions involved in control room design and over-elaborates in areas that represent straight forward application of well-documented human engineering principles. One example to illustrate the points being made: the review does call for the examination of the information requirements of the operator for normal operations and accident situations but the form of documentation suggests that this will result in identification of needs, but without any form of prioritization. European practice for at least 15 years has based operator information requirements on examination of the operational/fault procedures using logic diagram analysis including critical path techniques which identify, prioritize, and suggest the optimum form of display and control including the level-of-automation to be applied. With an extension of the technique proposed in the Guide, the review could also have provided the data base to have allowed this to be done.

#### GUIDELINES

There are inconsistencies between various sections of the Guide, e.g., the optimum use of color coding; this probably stems from different authors producing different sections and inadequate editing.

Some of the review material is good, including some of the methods proposed

for documentation, but if the review techniques are applied assiduously then the review team is likely to soon find its task difficult due to the amount of documentation proposed. That documentation is necessary for regulatory approval is obvious, but is it not possible to make more use of the photographic survey material and less use of proformas? The use of photographs is a valid, immediate technique which has a long, proven use in control room design.

There must be serious objections to the evaluation management plan, page 7, as there is to any design program determined by committee. What is required is a multidisciplinary team of four or five conducting the review and making proposals to the utility for implementation. The major role should be taken by a system engineer (with human factors training) knowledgeable of control room operations and assisted by specialists from the I. & C., safety technology, design, and reactor operations fields.

The Guide should be presented in a form that a utility "system engineer" could immediately translate into an action plan. However, there are sections of the Guide which appear to be phrased to require a human factors specialist to encode them for general use. This should be re-examined!

It is by no means certain that the proposed mechanism for error prioritization will result in acceptable, cost-benefit analysis for proven human engineering discrepancies.

#### CONCLUSIONS

The Guide appears to be workable but in need of major revision before it can be an acceptable document for control room design review. It can provide a mechanism for improving the information system centered on the control room, and hence the reliability of operator actions but it is an opportunity lost to provide the utilities with a badly needed set of design

decisions based on best ergonomic practice from the international nuclear power community. This set should not have been constrained by historic inadequacies apparent in so many control rooms. Instead, every means should have been grasped to provide the utilities with consistent, easily understood guidelines and principles which they could have applied to their control room designs to ensure safe, efficient nuclear power plant operation.

The level of acceptance of the Guide by the utilities is not clear. They may well attempt to produce their own guidelines as more appropriate to the review task.

The main difficulty in establishing how well the Guide is likely to achieve NRC objectives is in equating the incompatibilities that exist between the objectives stated in the Guide and the NRC's own objectives stated elsewhere. The NRC objectives seem correct and appropriate following the lessons of Three Mile Island, but the Guide does not appear to satisfy them.