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Division of Human Factors Safety,
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Voss Moore

Dear Voss,

NUREG-0659

I appreciate the chance to review the NUREG and comment upon it. I have been asked by both INPO and by the Nuclear Power Engineering Committee (NPEC) of the IEEE to comment on the document. To identify myself I was the chairman of the IEEE working group that produced the first version of IEEE 566, Recommended Practices for Design of Display and Control Facilities for Central Control Rooms for Nuclear Power Generating Stations and the present chairman of IEEE 567, Criteria for the Design of the Control Room Complex for Nuclear Power Generating Stations. Because of time scale problems I have been unable to present a consolidated view of the working group but I have sent copies of the document to them and hope that they take the opportunity to comment.

I have attached my comments to this letter and I wish to emphasize that the views expressed here are mine and do not reflect those of the working group, NPEC or INPO.

However, my opinions have been forged in discussions within the working group and NPEC. As such I would expect a lot of the ideas are similar to those held by my colleagues.

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The document is made up of from parts; responses to comments on NUREG/CR-1580, Sample Check Lists, Draft Systems Review and Evaluation Procedures. My comments have been mainly directed toward the draft systems review with some discussion on the sample check lists and the Evaluation Procedure. I consider that even though it is not completed, NUREG 0700 has the promise of a document of more merit than NUREG/CR-1580.

A significant weakness in the checklists is the treatment of computers, but this probably reflects the industry's need to design computer interfaces more appropriate for the operator rather than the computer programmer.

Another area of concern is the lack of identification of an annunicator priority system, which is needed. There is a need for a more systematic technique to evaluate the impact of human factors and need for changes on the control board. It is suggested that Probabilistic Risk Techniques may be one such method but further work is needed to evaluate the changes in human error rates because of changes in the control board and equipment configuration.

I hope that my comments will aid the staff in developing a useful and constructive document which in turn will lead to better designed control rooms.

Yours sincerely,

Tony

A. J. Spurgin, Chairman of Nuclear
Power Plant Control & Protection
Working Group (IEEE)

cc: R. Pack, INPO
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4/14/81

COMMENTS ON NUREG 0659

GENERAL

The check lists should be arranged in some hierarchial order with overall systems requirements factored in first. The review process should then follow this hierarchy and thus some degree of assessment could be made as to the importance of a particular discrepancy.

Without some guidance on the importance of a particular discrepancy, the situation could occur in which meaningless changes would be carried out whereas highly significant effects could be missed.

As a minimum for operating plants, the records should be closely reviewed for possible significant accident precursors caused by operator errors induced by incorrect information, control access, etc., i.e., those which are system or hardware related.

COMPUTERS

Most important statements made are "Command Language should reflect the operators point of view," ... and "Length of Input Words (e.g. keywords) should not exceed 5-7 alphabetic characters." These place the emphasis on the design of the system on help for the operator which is correct, except I don't think that it goes for enough! The operator should not be expected to type complex statements at any time especially during high stress conditions. Selections of key displays, data and trends should be made by preselected keys.

RECORDERS

1. Use for control purposes -- need for trending and correction needs to be emphasized.

2. Speed selection and easy of selection also needs to be considered.

3. Need to arrange in order of priority.

4. Need to see initiation of transient, pen should be clearly visible and not obscured.

CONTROLS

1. Importance of system response not considered in section -- If use of indicators is used purely for control the control system response needs to be fairly rapid and closely coupled -- for temperature control this type of control may not be satisfactory

and use of a trend will be required. No system related factors have been considered in this section or only examples are considered by implication.

7.1.1.1 Availability of essential instrumentation.

(1) Is all instrumentation needed ....

This is much too simplistic a check list item. A much more detailed list is required. Each essential system should be determined and identified. After this all those instruments and controls should be identified along with the appropriate transients and emergencies. This task should be closely tied into Section I.C.1 of NUREG-0737.

7.4.1.1

(1) One should separate requirements into:

(a) easy to manipulate and (b) the system requirment is such that the operator is not unduely tied to a particular control station in a manual control action.

7.4.2.2

Item (1) grouped together should be defined, i.e. system boundaries have non-reentrant contours.

Item (5) as near as possible, "should be within 24 inches."

7.6.2.1

(1) This may cause a disagreement with location of controls by system. If taken to extreme the controls required for plant operation may have groups like main turbine controls with pressurizer controls, etc. This latter arrangement could lead to minimum movement by the operator during some conditions but would be unacceptable in other operating states.

7.8.1 <u>Labels</u>

The ability of the operator to cope with a given situation is greatly improved by the use of an appropriate labeling hierarchy especially when combined with a system related demarkation scheme. Use of such a hierarchy can lead to a more simplier and easily read system.

Comments on Section IV

This section should be the key section of the NUREG (0700) since the systems review should be the basis upon which the whole control room is designed. Especially important are the analysis described in NUREG 0660 and 0737 items I.C.1 and I.C.9. The framework laid down under this section then forms the basis for decisions to be made with regard to the check lists.

Implicit in 1.2.2 is that a continuing review function should be fulfilled, this is agreed with.

Section 1.2.3 is the review of the control room characteristics and embodies all the checklists noted earlier. As it is stated in this section this is a component level examination and as such can be carried out with reference to the system/task context. However, without the systems review, the component level review cannot set meaningful priorities or levels of importance.

Section 2. System Review Guidelines

We agree that guidelines for a review task of this nature are required, and as a minimum, the review should address plant safety. In order to adequately undertake this review, a multidiscipline staff should be assembled. It is considered that make-up of the group should be as follows:

An Independent chairman preferably with a strong systms background including instrumentation and control.

A Human Factors expert

One or two operators with at least two years operational experience on the same type of plant.

A Balance of Plant engineering expert (A.E. representative).

A Nuclear Steam Supply System engineering expert (vendor).

[both of the latter two members should be capable of answering questions about the systems or at least obtain that information.]

A safety systems expert (not licensing).

In addition to the above, secretarial services to record key points in the ensuing discussion are required.

As was stated earlier, it is essential to identify the key systems and their interactions. This would be accomplished by reviewing the responses to the requirements under Task I.C.1 in NUREG 0660 NUREG 0737.

In this we are in agreement with NUREG 0700, but the point to be clearly made is that the design basis accident concept with single failure is an unacceptable method for the design of the control room system. This point must be clearly understood since the design basis approach permiates all of the operator related aspects of training, procedures, walkthroughs, and design of support analytical systems.

To make a change of this magnitude is going to take a considerable time for industry to fully accept it, but without this change in the underlying structure, control board reviews are merely cosmetic with very little deep merit. They may help in removing some of the more obvious human factors errors.

We also see the need during the review process to answer specific questions, such as about the time taken by a particular event or it is possible to coordinate the operators on a particular task while at the "same time" taking action on a series of events. The impact of these questions is not only to question, can you see a control variable, and are you able to control that variable, but can you do the operation all without sacrificing something? Answers to these types of problems affect choice of equipment, redundancy requirements, etc. which are not addressed in the straight human factors review.

The utility can gain a considerable advantage by phasing the design construction of the site specific simulator so that a large number of these problems can be solved by the use of the simulator. The simulator would need to be fairly flexible and probably better, from the plant representational point of view, than the current set of simulators. The procedures for normal operational transients and potential accidents (multiple failures) could be written and the design of the boards and other systems could be impacted without massive delays in start-up. It is possible to work in this way, but it will call for some differences in the way in which we view the role of the control room and operator. This approach is more in line with the way the aerospace industry proceeds in the design of the cockpit.

3. HED Assessment and Backfit Design/Implementation

The basic problem with this part of the assessment is that it is dependent in the skill and attitude of the reviewing group. If the assessment is based on opinion then there is likely to be a conflict. What is required is a more equitable standard that can be applied. At present the only tool that looks to be reasonable is the Probabilistic Risk Assessment approach, however the present difficulty is recognizing the reduction in human error caused by improvements in the control boards. Perhaps on closer examination, it might be possible for a given accident sequence (involving multiple failures) to ask how would the result be impacted if the human error effects were removed? If the answer was little, then in that particular case, alteration of the control boards would bring no benefit. For the case that the human error was dominant then steps should be taken to improve the design.

It is our suggestion that more work should be done in this area to show the relationship between the "improvements" in the control boards and the reduction in risk.

For the older plants, plant operating records provide a source of information, if used carefully, on the subject of the effect of human errors on the plant. Also it should be possible to see those areas of the board or those features likely to cause problems.

It is suggested that these areas be attacked first rather than a whole scale attack on the complete control board. Modifications to the control boards of an operating plant with entrenched operators may cause more problems than they solve. A balance must be maintained between the reduction of risk by the introduction of an improvement and in the increase in risk as a result of the change.