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October 13, 1980

Dr. Voss Moore
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Dr. Moore:

It has been suggested that I write this letter to you because the information that I have is of utmost importance. I apologize that I did not respond by the deadline of September 29, and have continued to be unable to do a detailed response to the document NUREG/CR-1580.

Because of the nature of our work, we have some special information on how the mind works in high stress and extremes of low stress in the control room. The nuclear field is already aware of the impact of early programming in the mind. Swain's draft uses the phrase "population stereotype" several times. This refers to the early programming that operators receive as members of a special society. Living within that society, they absorb the population stereotypes for such things as the meanings of color and for directions of switches for on/off and increase/decrease. It has been regular experience that under high stress, the mind regresses to earlier programming. It is noted in the nuclear literature that population stereotype is one of the programs of the mind to which behavior regresses under high stress. As a result, it can be expected that the mind will move to population stereotype, and that therefore control panel design must be consistent with population stereotype.

Your document NUREG/CR-1580 does a fine job of identifying population stereotype and suggesting that design conform to this. However, there is a larger problem upon us as a result of the TMI-2 accident. Control panels presently in use are now being surveyed and evaluated, and recommendations for backfitting are being made. Our findings are that use of NUREG/CR-1580 to produce backfitting designs can be dangerous.

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Just as the population stereotype is the result of early conditioning of the mind of the operator, so it is that there is previous conditioning of the operator's mind in all presently operating nuclear power plants. This type of programming comes under the heading, perhaps, of "getting used to". The result is that the operators have learned behavior which they have "gotten used to". In exactly the same way that population stereotype becomes the programming which controls the behavior in high stress, so will the programming which is represented by "getting used to" the patterns of behavior that are necessary to run the control board being backfitted. Therefore, it is clear that operators in presently operating plants which have designs which are inconsistent with population stereotype will have two mental programs which must be related to. The first is the population stereotype, which will be the stronger, and the second is what they have "gotten used to" during their time period of operating that equipment.

A specific example of this came up during a recent lecture that I gave to the Human Factors Unity at the NRC. On hearing the information which we have to offer, one of the engineers stated that he had a plant with a gang of three rotating switches. Of these three switches, two of them operated conventionally, i.e., the "on" position is a right turn. The other operates unconventionally, with the "on" position being a left turn. Usual backfitting practice would suggest the removal of the unconventional switch and its replacement with a conventional switch. However, our findings indicate otherwise. This engineer went on to say that "If I hear what you're saying correctly, then it will be necessary for me to remove all three switches and replace them with pushbutton switches."

The point of this response is that when changes are made for backfitting in presently operating plants, it is necessary to make those changes radical enough so that the earlier programming of the operators will not come into play. Another example is a plant which I recently observed myself. In this plant, the control rod regulating system is on the right end of the reactor panel. Some distance away, beyond the left hand end of the reactor panel, is the chemical volume control system (CVCS). During start-up and certain other conditions in plant operation, both the control rods and the chemical volume need to be carefully monitored and controlled simultaneously. This is impossible with the distance

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between the two control and instrumentation systems. They will have to be more closely integrated for good plant operation. Since this is a non-operating plant, there is no problem making the integration as far as operator behavior is concerned. However, in an already operating plant, it would be likely for the engineers to move one of the two control areas to the vicinity of the other. The result of this would be that although during normal operation, individuals with the capability of aware cognitive flexibility would know that although they automatically think the controls and instrumentation in the old position, they will go to the correct position. However in high stress, they will automatically go to the old position. In an operating plant, we would recommend that backfitting include a radical change of placing both systems together, and in a different location than either of them had previously occupied.

I wish I had time to respond more fully to the document which you sent me.

Sincerely,

Tom Sargent

Thomas O. Sargent, Director

TOS/bcb