PREDECISIONAL INFORMATION

From: Eva Brown
To: Gallucci, Ray; Lois, Erasmia
Date: 4/27/04 8:29AM
Subject: Re: response to Markey Qs

Ray/Erasmia,

As Erasmia indicated we are only talking about the transmittal letter and the report.

- Eva

>>> Erasmia Lois Tuesday, April 27, 2004 8:20:20 AM >>>
No, I am talking about the first letter report prepared last fall.

Erasmia

>>> Ray Gallucci 04/27/04 08:18AM >>>
Are you talking about John and Alan's workshop material, either the original handouts or the current draft summary? I would not release either of these at this point (the former is being incorporated into the latter). For the Markey letter, only the list of references that were being reviewed should be included. If this is most easily accomplished by extracting some text from Alan and John's material, then only that extraction should be made publicly available.

>>> Erasmia Lois 04/27/04 08:11AM >>>
If NRR has no problem with it we can make it publically available.

>>> Eva Brown 04/22/04 01:16PM >>>
Erasmia,

This document is not publicly available. Do we have a public version of this? If not, when will it be publicly available?

- Eva

>>> Erasmia Lois Monday, April 19, 2004 8:42:36 AM >>>
Eva:

Sorry about that; here is the letter report where references are stated. In addition, Iyou were going to add the procedures that NEI gave us. The ADAMS no fot the letter report is: ML04002005

Erasmia
>>> Eva Brown 04/16/04 07:06AM >>>
Erasmia,

I never did get the ML's number for the stuff for the HRA stuff. I'm not talking about the procedures, I am talking about the letter, report and related references.

- Eva

>>> Erasmia Lois Thursday, March 25, 2004 9:07:30 AM >>>
You mean just make a statement that we are developing a time margin and as part of it we are examining plant procedures available at ADAMS accession no:...

>>> Eva Brown 03/25/04 08:36AM >>>
Erasmia/Ray,

CCC-18

As I understand it everything they have is publicly available, except for the new "white washed" procedures. I will be adding these to the docket as part of a meeting summary , so just leave a place holder for the accession number. Anything that you've produced is predecisional until the final report is issued, I'm not sure we should reference that. However, the HRA stuff should be publicly available shouldn't it? If so, you can reference an accession number.

- Eva

>>> Erasmia Lois Thursday, March 25, 2004 8:31:33 AM >>>
The last redline-paragraph gets to that point; if Eva agrees we could provide the list of procedures that John and Alan are reviewing. The fire requantification work is mentioned in the first para, but cannot make it available. If you think we should expand on the subject, we can do so.

>>> Ray Gallucci 03/25/04 08:25AM >>>
Would it be appropriate to also include, as a list (if not the actual materials themselves), the recent stuff that John and Alan have been reviewing for the workshop? Also, since the Letter Report used much of the knowledge John and Alan gained from their work on the Fire PRA Requant project, can the material reviewed for that in the HRA arena also be credited?

>>> Erasmia Lois 03/24/04 04:35PM >>>
attached; let me know if it is ok

thanks

Erasmia

CC: Weerakkody, Sunil

RES

Dingell Markey GT Resource Matrix

SECY 03-0100 states that the NRC Office of Research "will conduct a literature search and evaluation the currently available information and industry practices to formulate the technical bases for manual actions" Please provide copies of all such information found, as well as any NRC analyses of it.

Response:

Attached is letter report (and associated references **–I am assembling them**) provided by the Office of Research. As stated in the report it is based on reviews of selected IPEEE fire analyses and the IPEEE summary report (NUREG-1742 [Ref. 1]), previous reviews of fire-related operational events identifying important factors influencing human performance in fires [e.g., Refs. 2 - 4], and lessons learned from the development of human reliability analysis (HRA) criteria for use in the ongoing joint NRC/Electric Power Research Institute (EPRI) fire re-quantification studies-- currently not available to the public.

The work is continued to establish time margins to be included as part of the criteria to nsure that proposed human actions will be accomplished within the time frames needed. Plant procedures and expert opinion is used as a basis for the time margins-- shall we **say this just respond to what we have done so far?**

JCN W6994
Letter Report

Risk Insights Related to Post-Fire Operator Manual Actions

Date: September 19, 2003

Prepared by
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Letter Report on Risk Insights Related to Post-Fire Operator Manual Actions

The U.S. Nuclear Regulatory Commission (NRC) is in the process of revising fire protection program requirements contained in Appendix R of 10 CFR Part 50. At issue is the reliance of many licensees on operator manual actions, rather than the use of fire barriers, to maintain safe shutdown capability. That is, they rely on operators to perform field manipulations of components that would not normally be necessary if redundant safe shutdown trains were not located in the same fire area. Per 10 CFR Part 50, Appendix R, at least for plants licensed to operate before 1979 (and in practice for those licensed after 1979), operator manual actions are not permitted unless a specific exemption has been granted.

The industry and the NRC have come to believe that in most cases manual actions are a reasonable alternative to separation requirements and that most operator actions used by licensees for operation of a safe shutdown train during a fire would not involve any safety significant concerns. However, an important goal of the rule making effort is to develop criteria that will ensure that generic use of operator manual actions as an alternative to providing separation for fire protection of safe shutdown trains, does not result in any significant increases in risk.

The overall purpose of this letter report is to provide guidance for use by NRC's Office of Nuclear Reactor Regulation (NRR's) in the development of criteria for ensuring that licensees' implementation of manual actions does not increase risk and for inspecting or evaluating planned manual actions proposed by industry.

The proposed guidance is based on reviews of selected IPEEE fire analyses and the IPEEE summary report (NUREG-1742 [Ref. 1]), previous reviews of fire-related operational events identifying important factors influencing human performance in fires [e.g., Refs. 2 - 4], and lessons learned from the development of human reliability analysis (HRA) criteria for use in the ongoing joint NRC/Electric Power Research Institute (EPRI) fire re-quantification studies.

Implication of Risk Insights on the Criteria for Evaluating the Acceptability of Manual Actions

The NRCs "Rulemaking Plan on Post-Fire Operator Manual Actions" lists criteria that have been used in assessing past exemption and deviation requests from licensees involving operator manual actions. The criteria as presented are reasonable and are justified based on a risk perspective. However, these same risk insights developed from the reviews of the IPEEEs, the reviews of fire-related operational events, and the development of HRA criteria for the NRC/EPRI fire re-quantification studies, suggest that additional criteria are needed to ensure that implementation of manual actions does not significantly increase risk. Furthermore, additional considerations should be addressed by the existing criteria. That is, in some instances the existing criteria should be extended and more detail provided. Specific issues associated with each of the existing criteria are addressed first, followed by a discussion of the additional criteria that should be included.

Criterion #1. Diagnostic instrumentation utilized in support of operator manual actions should be demonstrated to be unaffected by the postulated fire and provide a means for the operator to detect whether a spurious operation had occurred. Some licensees may have protected only those circuits specified in Information Notice 84-09. Additional instrumentation may be needed to properly assess a spurious operation. Annunciators, indicating lights, pressure gages, and flow indicators are among those instruments typically not protected from the effects of a fire. Instrumentation should also be available to verify that the manual action accomplished the intended objective.

In order to ensure this criterion is met, it should be understood that for the fire in question, and the related anticipated actions that may need to be taken, one must identify what instrumentation is required to diagnose the need for the action and that the action has had the desired effect. It is then necessary to ascertain whether cables or equipment (e.g., logic cards, transmitters, power supplies, etc.) associated with this instrumentation can be affected by the fire and if so, what the effect on the instrumentation will likely be. Clearly, if none of the "required" instrumentation for the manual action can be affected by the fire in question, the criterion is probably met (but as is discussed further below, the potential for general distracting or confusing effects of the loss of other important equipment on the crew should not be completely ignored). This becomes more complicated if some instrumentation relevant to the manual action can be affected for then, depending on the effect, it may still be possible to meet (or not) the criterion. In such cases it should be recognized that more than one spurious indication may occur depending on the relationship of the fire location to the indication/alarm circuits including, for instance, lights associated with equipment status (e.g. running, stopped, open, closed, etc.). It is recognized that considerable redundancy and diversity exists in typical nuclear power plant control room designs and thus those cases where affected instrumentation could be particularly "troublesome"(and hence the criterion is likely to not be met) is best focused in three areas:

1. Where indications/alarms singularly call for an immediate action such as shutting down mitigating equipment (e.g., shutdown an AFW pump based on a high temperature alarm to protect the pump), or to not take an action, when there is no further check of a confirmatory indication either because one is not available or the procedure calls for immediate action. Such a spurious indication/alarm could cause (a) deleterious operator actions such as operator removal of otherwise available mitigating equipment thereby reducing the redundancy of safety functions because of erroneous indications or (b) inaction by the operator such as when the needed cue does not occur because of erroneous, spurious, or otherwise failed indications.

2. Where valid indications of spurious equipment operations (e.g., a valve shutting changes the indication of an open lit light to a closed lit light) would not be alarmed nor provide some other compelling signal that the equipment status has changed and is detrimental to the safety functions. In such cases, the crew is more likely to not see the change in status and therefore not respond to it.

3. Where multiple indications/alarms could be affected by one spurious fault or failure such as because of a common power supply or cascading circuit (e.g., a faulty wide range RCS pressure signal will not only affect the pressure indication but also the subcooling indication because its signal is used to calculate subcooling). Such cases may provide particularly

troublesome erroneous indications since taken together, they may appear appropriate.

In all of the above cases, if the failure of the indication is obvious (e.g., meter will go high/off-scale), it is likely that the affected indication will be easily diagnosed as erroneous and so it may still be quite possible for the desired manual action to be performed, albeit delayed to allow time for the operator to sort out that the indication(s) is(are) erroneous. Otherwise, in such cases, it should be assumed that the crew will respond to the erroneous indications or lack of an indication based on the resulting cues and the governing procedure and training in response to the cues. In these cases, the desired manual action is less likely to be taken at the appropriate time.

It should be noted that even if the above cases do not directly effect instrumentation related to the manual action, their potential effect on the availability of time and staff to diagnose and execute the manual actions could be delayed..

Criterion #2. Environmental conditions encountered by operators while accessing and performing the manual action should be demonstrated to be consistent with established human factor considerations. Radiation levels should not exceed normal 10 CFR Part 20 limits. Emergency lighting should be provided as required in Appendix R, Section III.J or by the licensee's approved fire protection program. Temperature and humidity conditions should be reviewed to ensure that temperature and humidity do not affect the capability to perform the manual action. Fire effects should be reviewed to ensure that smoke and toxic gases from the fire do not affect the capability to perform the manual action.

When the environmental conditions for where the action needs to take place clearly meet the above, the criterion is easily met. Otherwise, and of particular concern is the potential that the crew may need to wear special gear such as SCBAs, fire suits, gloves, or other protective gear to accomplish the manual actions in the fire impacted environment. The donning and wearing of such gear cannot only slow personnel down because of limited visibility or loss of manual dexterity, but can also hinder their ability to communicate effectively. Reliable communication may be essential if multiple personnel are required. A general "rule of thumb" is that if SCBAs are required, no form of communication can be assumed to be reliable and that while it may still be possible to perform the desired action, at the very least, time delays during the response should be considered.

Criterion #3. Staffing required to perform operator manual actions should be qualified and demonstrated to be available, considering concurrent demands on personnel that may be necessary to achieve and maintain safe shutdown during a fire.

This criterion contains two judgmental measures to meet the criterion; 'qualified' staff and 'demonstration of availability considering concurrent demands'. See comments under criterion #6 about training and hence qualified staff. With regard to the availability of staff, the identification of concurrent demands should at least include (where applicable for the fire and actions of interest) activities associated with verification of the availability and reliability of instrumentation and equipment, assessing damage to equipment, de-energizing critical equipment to protect it, re-energizing buses and replacing fuses, implementing fire-specific procedures (including important plant site and offsite notifications), assisting or supporting fire-fighting activities, and potentially dealing with injuries to plant personnel. Thus, judgments about the availability of the required staff

to accomplish manual actions should be based on thorough analysis and careful consideration of all the above types of possible concurrent activities and the time requirements for all relevant tasks. In all cases, judgments should be conservative and account for differences in time of day (e.g., number of day shift personnel vs. number of night shift personnel) when considering available plant-wide resources, particularly before the technical support group and other support personnel can become available.

Criterion #4. Adequate communications capability should be demonstrated for operator manual actions that must be coordinated with other plant operations. Any necessary communications capability should be protected from the effects of a postulated fire.

Coordination of multiple personnel and required communications between personnel will depend on reliable communication equipment. For the fire and actions of interest, it should be demonstrated that potential fire effects on communication equipment (e.g., electrical interference or failure such as burning of cables) will not occur, and the ability of personnel to successfully use that equipment given other factors introduced by the fire (see Criteria #2 above) will not be adversely affected . There should also be confirmation that the desired communication means will be sufficient for working in particularly noisy environments (best done by testing under the noisy condition). Moreover, personnel should have substantial training on activities that require coordination and communication, including how to clearly state important information. Further, should there be a need to setup or otherwise make the communication available, that time should be considered in the time required to implement the desired actions.

Criterion #5. Any special tools required to support operator manual actions should be available at a nearby location that has access unimpeded by a postulated fire. Controls needed to assure dedicated availability of such tools should be demonstrated.

In demonstrating that this criterion is met, it should also be shown that personnel are trained to use the special tools and equipment in the planned application and the effects of fire related gear on their ability to use the equipment should be considered (as discussed in Criterion #2). It should be confirmed that personnel are generally knowledgeable as to the location of the equipment including, for instance, keys for gaining access to or actually implementing the desired actions. It should also be routinely verified that such equipment is indeed located where it is suppose to be and has not been misplaced or otherwise moved. To the extent that the use of such equipment may slow down action implementation time, that should be considered in the time estimated to implement the desired actions.

Criterion # 6. A training program on the use of operator manual actions and associated procedures during a postulated fire should be demonstrated to be in effect, current, and adequate.

Although such training is critical, it should be kept in mind that the actual presence of the fire changes the context for the actions and therefore there may be aspects of the actions that are not the same given the presence of the fire. For example, fire-fighting equipment and personnel may be in the area, accessability to the equipment may not be the same, planned routes to the area may be blocked, and if the fire is close enough to threaten the personnel performing the actions, performance may be negatively impacted. Such aspects should be included in evaluating the likelihood of

success. Training of the desired actions should at least be covered in a classroom context on an occasional basis (perhaps once per year) with actual demonstration of proficiency demonstrated as often as other similar activities (perhaps once every two years) under conditions closely resembling those anticipated in a real fire event.

Criterion # 7. Accessibility of all locations where manual operations are performed should be assessed. Manual action locations should be accessible without hazards to personnel. If special equipment is needed (e.g., a ladder), controls to assure availability should be demonstrated.

See Criterion # 5 above. In addition, the possibility of delays in the transit time to the desired location should be accounted for given the potential for 'false starts' such as having to try another route or having difficulty with a security door lock perhaps affected by the fire.

Criterion #8. Analyses of the postulated fire time line and the concurrent thermal-hydraulic conditions of the plant should demonstrate that the operator manual actions can be accomplished before unrecoverable conditions occur.

Consistent with the discussions above, time requirements for concurrent activities and for other fire-induced actions required during the accident scenario should be part of deciding whether the manual actions can be accomplished before unrecoverable conditions occur. The number, complexity, and relative priority of other critical fire-induced actions (along with the important normal actions) that must be performed during the scenario need to be included in determining the feasibility of potential manual actions. All of the criteria bear on whether a given manual action can be accomplished and the time required to do so. They also bear on many of the concurrent activities that might be examined. In general, the time required to implement an action during a fire event should be estimated conservatively (such as an additional 50%-100%) relative to "normal" or "ideal" conditions in the plant in order to account for the possible unforeseen delays.

Criterion #9. Procedural guidance on the use of operator manual actions should be available, adequate, and contained in an emergency procedure. Operators should not rely on having adequate time to locate, review, and implement seldom used plant procedures to find a method of operating plant equipment during a fire event.

Demonstration of adequate procedural guidance should include a review for procedural conflicts. Due to the unusual demands that can be associated with a plant fire, it is possible that unrealized conflicts between procedures may exist. That is, certain conditions may make certain actions incompatible. In particular manual actions taken earlier in a scenario may render actions to be taken later more difficult or inappropriate. And as noted above, in some cases there may not be sufficient time for later actions because of the time required to accomplish the earlier actions. Further, the procedure guidance, especially for the desired manual actions, should be as specific as possible (e.g., not just "align the train") unless it can be justified that the available guidance is sufficient for the 'average' operator with typical skill-of-the-craft to implement the guidance without step-by-step instructions. Such skill-of-the-craft should be demonstrated on a periodic basis (see training section above).

Criterion #10. Capability to accomplish operator manual actions should be verified and validated by plant walkdowns using the appropriate procedure. The walkdowns should be timed to assure accomplishment within required time frames in support of the plant's safe shutdown analysis. The verification, validation, and walkdown timing should be documented.

This is a key criterion since PRA/HRA analyses have consistently shown that without such verification, oftentimes, too optimistic judgments are made. All potential influences noted in the above criteria should be considered during the walkdown and timing of the manual actions. Talkthroughs and/or simulations of at least the potentially most risk significant of the manual actions should be performed, with operational staff input, to confirm that the justification that the manual actions can be performed realistically accounts for actual operator expectations and anticipated performance in fire situations.

Additional Criteria Needed to Ensure the Safety of Manual Actions

While the above criteria can be shown to be relevant and important to crediting manual actions in fire situations, based on past risk analyses and related risk insights, the following additional considerations are offered (either as additional criteria or as additional guidance under related criteria above).

1. The assumed use of any type of plant equipment in responding to a fire should consider possible failure modes and particularly damage that may occur to the equipment such that its subsequent use is prevented or at least difficult. Credit for using equipment that may have been affected by the fire due to smoke, heat , water (such as due to fixed or manual suppression), combustible products, or spurious actuation effects should account for such possibilities (e.g., over-torquing a valve closed with a large motor on the valve because of a spurious close signal) before crediting the use of such equipment.

2. Although difficult to evaluate, team behavior, team communication strategies, general crew strategies for discussing events and implementing procedures, and general plant management and organizational factors may bear on the likelihood of successfully performing manual actions. If possible, simulations of fire accident scenarios that would require risk-important manual actions should be observed in order to assess whether the general "modus operandi" of plant crews appear to support successful execution of the manual action. For example, too much interaction with the fire brigade could reduce the time available for important actions; very methodical, patient implementation of procedures may prevent the crew from reaching the procedural steps related to important manual actions in time, or the shift supervisor may be reluctant to give up staff he or she feels is needed in the control room, even if the manual actions are also required at that time, etc.

3. It is noted that there is a general interest in the following two overall questions:

   - How many actions can be credited?
   - What is sufficient time to be able to credit the action(s)?

   There are no simple answers to either question. For example, if there are 10 staff available

to concurrently perform 5 manual actions, given all the other criteria are met, it is likely to be very appropriate to credit all 5 actions. If, instead, there is only one person available to take the same 5 manual actions in the same time period, such credit may not be able to be justified. In this example, the number of 'allowable' actions is a strong function of the number of staff available. In one case, crediting five actions is okay; in the other case crediting more than one or two actions may be difficult. Similarly, how much time is necessary to be able to credit manual actions is dependent on specifics of the fire and applicable scenario(s) of interest including such things as what actions are to be taken and how long do they take, when must they be taken, is a specific order/sequence required, how fast/slow is the scenario of interest proceeding (e.g., the same actions may not be possible in an ATWS scenario but very possible in a slow loss of heat removal scenario), how many persons are present to take the actions, etc.; in other words, all the criteria previously mentioned.

Thus, proper consideration of all the above criteria and the resulting findings of whether the criteria are met will, at the same time, answer the above two questions. It is only with such a holistic view that the above two questions can be answered since the answers are dependent on the specific fire situation(s), scenario(s), and actions of interest, and to what extent all the above criteria can be demonstrated as met.

One final thought is offered with regard to NRC's possible approving licensees' requests for crediting manual actions or auditing licensees' meeting the above criteria. Not all fire scenarios and the need for manual actions are of equal risk significance. For some fires, while the licensee may be crediting certain manual actions, it may be that even without the proper actions, the risk significance of these fires may still be low compared with other fires, other external events, or other internal event scenarios. Hence, the concern for where such actions are credited should consider the risk potential of the fire scenarios of interest if the actions are not (or cannot) be taken. Focus should be on those scenarios and accompanying need for manual actions where, without taking the actions, the fires could cause considerable damage to equipment with a relatively high likelihood and thus be potentially risk significant. Fire PRAs or other analyses should be used to help prioritize which fire manual actions are really important so that resources are not inefficiently spent on approving or auditing 'unimportant' actions (i.e., "don't sweat the small stuff"). This should be an overall guiding principle in how any resulting rule change is actually implemented.

Furthermore, it should be acknowledged that evaluating potential post-fire manual actions against the criteria proposed above could require significant time and resources. Similarly, performing the HRA for a fire PRA can also require significant resources if all potential human actions must receive detailed analysis. Thus, in the context of the NRC/EPRI fire re-quantification studies, criteria are being developed to help screen out human action events that are not likely to make significant contributions to risk. These screening criteria have been documented in the draft HRA procedure developed for the re-quantification studies and it is probably the case that these screening criteria could be adapted for use in the context of evaluating fire manual actions.

References

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3. Cooper, S.E., D.C. Bley, J.A., Forester, A.M. Kolaczkowski, A. Ramey-Smith, C. Thompson, D.W. Whitehead, and J. Wreathall, "Evaluation of Human Performance Issues for Fire Risk," *Proceedings of the International Topical Meeting on Probabilistic Safety Assessment PSA '99: Risk-Informed, and Performance-Based Regulation in the New Millennium, August 22-26, 1999, Washington, D.C.*, M. Modarres, ed., pp. 964-969, American Nuclear Society, La Grange Park, Illinois 1999.

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