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90077

Re. Comments on the meetings: ACRS Secondary and Auxiliary Systems Subcommittee, July 27 and 28, 1993; and ACRS Subcommittee on Advanced Boiling Water Reactors, July 28, 1993.

Dear Ivan:

I am pleased to provide my comments to the ACRS on issues regarding fire safety. I will address some general comments first, then I will try to be more specific to the subjects addressed.

General Comments:

The fire protection considered for nuclear reactors and the means for evaluating its effectiveness through modeling appears to be at the state of the art. Generally, this would be considered to be good. However, the state of the art in fire hazard assessment is far behind modern technologies, so there is a potential for a wide range of uncertainty in the fire analysis. I believe you introduced the meeting with a statement that the fire event in a nuclear power plant accident was likely to cause significant core damage in 20 to 40 % of the PRA's. Coupled with the confidence level of quantitative fire analysis, this could be costly in terms of both overestimating or underestimating the fire hazard and risk. There is an economic burden in the construction and maintenance of plants, and a risk to life safety. Specific improvements in the critical fire safety issues for nuclear reactors could prove to reduce costs and/or mitigate the impact of accidents. In order to bring the level of fire hazard analysis up to the demands of the nuclear reactor industry, research is needed. Although fundamental research is likely to be necessary on some issues, more applications research is necessary to examine the consequences of some operations and practices. Currently, too much is relied on by a perception of what might happen, rather than tangible results of what is possible. In this context, it was surprising to find that of the $ 95 million budget for research in the NRC, none is devoted to fire. I believe this might be a function of the priorities along with the lack of ability to define the fire problems in comparable

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terms. There is probably no scientific advocacy for the needed fire research. The FAA has a fire laboratory to test specific aircraft fire conditions, and to develop mitigating strategies for reducing the hazards. The NRC has no such laboratory.

LaSalle Analysis:

The fire PRA analysis by John Lambright was very well done. He was extremely knowledgeable and lucid. He also appeared to be very objective, and not defensive of models he used. This is an attribute. This type of presentation can be used to help in setting priorities for the needed fire research. I would recommend that this be considered.

He used COMPBRN as a fire model. This is a very old model and other models have some improvements and extensions. The NRC would need to evaluate the current models to decide on an improved strategy. The EDF (France) has developed their own model which appears to be very advanced. The NRC should consider how to establish a preferred modeling tool, and how to advance it for their needs.

Several times the COMPBRN Code was described as a fire propagation model. Fire propagation is still an area of research, and although some models exist, I do not think that COMPBRN has this methodology. Most other models prescribe the fire, and when the fire reaches the fully developed state, the current models no longer have the support of experimental confirmation.

The issues of fire barriers and smoke still continue to come up. Fire barriers address the propagation of heat and flames, but do not in their evaluation consider smoke at lower temperatures. We heard a subsequent presentation by D. Karydas on the consequences of smoke damage to equipment. This is an area of very limited knowledge. The critical aspects of control equipment in nuclear reactor facilities mandates a high priority of research in this area. Smoke is a concern for two reasons. It can contaminate and cause equipment to malfunction, and it can reduce visibility and thereby hamper fire fighting operations.

Many of the scenarios considered in the PRA have no basis in a laboratory investigation. This places a high uncertainty in the model in terms of its ingredients and its completeness. Also the data base of fire incidents is only drawn from NRC experience. This should be expanded in more generic terms as much as follows. In particular, the issue of no cable fires starting from electrical over loads compared to the COMPBRN ignition source of 700 kW, appears to lack some basis in reality.

I would like to see more scenarios studied in both theory and practice. A risk analysis can be used to identify the uncertainties in the knowledge. Simulation studies can be done in the laboratory, and models evaluated or developed accordingly. The LaSalle risk analysis methodology was well presented, but the completeness or adequacy of the fire hazard analysis is questionable.

Generic Issue 57: Effects of Fire Protection System Actuation on Safety-Related Equipment

This PRA did not appear to identify any significant problems with current plants that could not be remedied by plant specific checks. Again, I have to wonder at the lack of knowledge that is being used to reach these conclusions. I do not see how the issue of water and smoke effects can be evaluated without some very specific tests. Research on suppression is not very advanced, and although the reliability of sprinkler systems is very high, their success is based on control and extinguishment. Consequently, successful operations can still lead to considerable smoke and moisture transport. I do not believe this issue is closed.

GE Advance Boiling Water Reactor Fire Protection

The proposed fire protection strategy for this reactor is to include more redundancy in isolated controls (three compared to two), and include smoke control. Suppression is primarily manual. The presentaions made were tentative and lacking in depth. They need to perform deeper analyses for some of these issues.

A particular issue is the smoke control design. Although such designs are being used for mall and atria, they have not been tested or studied. The basis for many designs do not consider the dynamic effects of the fire. Exhaust, as well as supply are critical. With smoke control, the fire burning rate will be affected and consequently its duration. This impacts the design for fire endurance and the fire barrier requirement. Such techniques can not be prescribe without considering the entire system. Unfortunately, the state of knowledge is limited and the GE engineers are working with limited design tools. Nevertheless there is a responsibility to proceed with completeness and correctness.

Another very critical issue is the merger of all the three redundant cable systems in the floor cavity of the control, and to rely on manual suppression. A fire in this space will very quickly affect visibility in the control room, and impair the ability to find the fire. Also the use of water could impair other systems. This design needs more work.

Finally the use of a foam based suppression system in the diesel turbine room raised many questions that were not adequately answered. Although water can be use to put out diesel fires, and the foam system has a blanketing advantage over pure water, the high boiling point of the diesel fuel can cause boil-over. As the water boils, it can enhance the burning rate of the diesel fire at the same time that it is suppressing it under other mechanisms.

Closing

If I can be of further help, please let me know. I would hope that more sensitivity for fire research will emerge. This is not just for scientific adventure, but for solving tough problems of fire in modern technology and is impact on society in terms of cost and safety.

Sincerely,

James Quintiere
Consultant, ACRS Secondary and Auxiliary Systems Subcommittee