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February 29, 2000

Dr. Tom King
Office of Research
U. S. Nuclear Regulatory Commission
11545 Rockville Pike
Rockville, MD 20852-2738

Dear Dr. King:

From what I recall from some training sessions I attended while working at the Tennessee Valley Authority, when an organization is in the middle of a change process, the process almost always includes a period of intense turmoil just before the organization either moves to new practices or rejects the new practices and stands pat. The public meetings in the NRC Auditorium last Thursday and Friday certainly evidenced quite a bit of turmoil. I hope this turmoil reflects a direction of moving toward risk-informed, performance-based regulation and not toward an organization that rejects change and wants to stand pat.

Again, I apologize to you and the others present if certain words I used in the discussion on Friday seemed extreme. As pointed out in one of my slides on Thursday, one of the root causes of the problems with NRC regulations is the adversarial relationship between the staff of the NRC and the staff at nuclear electric generating stations. As you are aware, I try to avoid contributing to this adversarial relationship but there are times when I believe I must speak up. Also, my reluctance to continue the discussion I started with respect to the NRC document concerning combustible gas control was based on my belief that the discussion was starting to be based on emotions (including my own) and not on reason. I meant no disrespect to the NRC staff or consultants by my silence.

Enclosed are some written comments on the papers handed out in the meetings. These written comments hopefully complement my verbal statements made last Thursday and Friday.

Sincerely,

Bob Christie

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Comments of Bob Christie, Performance Technology, on document

"Framework for risk-informed regulations"
(handed out in public meeting 2/24/00)

1. It is very unclear what general approach is to be used to evaluate risk-informed regulations. My interpretation is that the proposal is a combination of risk-informed and performance-based approaches that depends on some form of goal allocation.

It appears to me that the proposal starts with the NRC 1986 Safety Goals for the Operation of Nuclear Power Plants: Policy Statement, and tries to allocate goals starting from the Quantitative Health Effects Objectives (QHOs). This is done even though the proposal recognizes that the Quantitative Health Effects Objectives were a measure of how safe is safe enough and not as a measure of adequate protection of public health and safety. Page 14 has the following statements: "The quantitative health objectives are the highest level quantitative goals. The QHOs were originally set as a measure of 'safe enough,' and in that sense they go beyond adequate protection. Given this position of the Commission, there are no risk arguments for setting quantitative goals more stringent than the QHOs."

The process appears to sub divide the QHOs into a Prevent (Core Damage Frequency less than or equal 1E-4/year) and a Mitigate (Conditional Early Fatality Probability less than or equal 0.01). See page 10. As I stated in the meeting on February 25, such a sub division violates the statement on page 14 because a core damage frequency less than or equal 1E-4/year is more stringent than the QHOs. As I also stated in the meeting, I do not know whether a conditional early fatality probability of 0.01 would be more stringent than the QHOs. It would depend on the nuclear unit.

To summarize my thoughts on the overall approach in the framework document, I would have to say the overall approach is not clear and certainly needs a lot of work. Any approach taken to define regulations for commercial nuclear electric power units must start using the basis of "adequate protection of public health and safety." The Quantitative Health Effects Objectives of the NRC 1986 Safety Goals for Operating Nuclear Power Plants are clearly a useful tool in determining the effectiveness and efficiency of regulations but they can not be used as the basis for regulation because as noted in the framework document, the QHOs go beyond adequate protection.

In 1997 I recommended a "Whole Plant" approach to evaluating the effectiveness and efficiency of NRC regulations in 1997 through the use of pilot plants. The

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approach that was recommended in 1997 would have evaluated the impact of the pilot plants on the health and safety of the public using the parameters of immediate fatalities and latent cancer fatalities as done in the NRC 1986 Safety Goals for the Operation of Nuclear Power Plants. The "Whole Plant" pilot program would have identified performance with respect to these two parameters and considered where the performance was with respect to the QHOs, Emergency Response, Large Early Release Frequency (Release Categories), the Core Damage Frequency (Plant Damage States), system/train conditional probability of success/failure (Top Events), etc. In the Whole Plant pilot studies, there was to be no attempt to subdivide and allocate goals to lower measures but just to know the relationship of the actual performance of equipment and people to the overall impact, from the highest measure to the lowest measure. Plant personnel were to make decisions at the lowest level that was possible and still come up with an effective and efficient decision with respect to the overall impact. I believe the framework document discussed in the meeting last Thursday and Friday could make good use of the approach recommended in 1997.

2. The framework document could be rewritten to have more emphasis on the fact that by eliminating requirements we can have a positive impact on public health risk. Any effort where we can improve the effectiveness and efficiency of regulations by eliminating requirements should be a high priority effort no matter how "small" the improvement. Along these lines, we should have a priority on eliminating requirements that don't have much impact on public health and safety either way, positive or negative.

We should have regulations that focus on the most significant equipment and practices with respect to public health risk. Less significant equipment and practices do not need regulations and NRC oversight. Such less significant equipment and practices are best left to the owners of the nuclear unit who are in the best position to make effective and efficient benefit/cost decisions in this area.

3. There seems to be a attitude in the proposed framework document that there are a lot of uncertainties in Probabilistic Risk Assessment and that we therefore have to take "conservative" measures to make up for the uncertainties. The framework document uses the terminology defense-in-depth for this belief.

There have always been uncertainties in the safety evaluations of nuclear electric generating units. In the past, the deterministic, prescriptive evaluations ignored the uncertainties because the calculations were "conservative." The accident at Three Mile Island 2 in March 1979 demonstrated that the deterministic, prescriptive evaluations which ignored the uncertainties were not as complete as Probabilistic Risk Assessments.

Probabilistic Risk Assessments identify and quantify uncertainties. This is one of the major advantages of PRA. In my opinion, we would do better in the

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framework document to state that the evaluations should identify and quantify the uncertainties. The decision process could then proceed with full recognition of the uncertainties. In my opinion, to claim that there is some defense-in-depth philosophy that will always make "conservative" decisions which will account for the uncertainties in Probabilistic Risk Assessments, is technically flawed.

The only way to handle uncertainties is to know what factors account for the uncertainties, how large are the uncertainties, and how much impact the uncertainties have on the decision process. Probabilistic Risk Assessment enables decision makers to quantitatively balance competing criteria and make a decision in the context of the overall process. Probabilistic Risk Assessment is the best tool to evaluate public health and safety. One of the reasons that this is true is that Probabilistic Risk Assessment addresses uncertainties.

4. Just as Probabilistic Risk Assessment addresses uncertainties, it also addresses the number of failures that lead to top events. This can be single failures, double failures, triple failures, etc. These failures can be combinations of equipment failures and failures by humans. Probabilistic Risk Assessment also addresses dependent failures (support system failures, common cause failures, etc.). Probabilistic Risk Assessment can also evaluate the timing of sequences of failures/successes through such techniques as recovery actions or phased approaches. All of these failures/successes can be addressed in the Probabilistic Risk Assessment and the relative importance of each failure/success evaluated.

There should be no attempt to bring over the "single-failure" requirements from design basis accident analysis. In my opinion, any effort devoted to the use or modification of the "single-failure" requirements from design basis accident analysis in this task to risk-inform the regulations will detract from the overall effort.

In the past, redundancy and diversity requirements and the application of the "single-failure" rule served the nuclear plants well but they were an "overkill" in some areas and an "underkill" in other areas. It is time to move on to better techniques.

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Comments of Bob Christie, Performance Technology, on document

"Risk-Informing 10CFR50.44"
(handed out in public meeting 2/24/00)

1. The argument in the San Onofre submittal of September 10, 1998, that the simplification of the Emergency Operating Instructions, achieved by the removal of instructions for hydrogen recombiners and purge-repressurization systems would, by itself, increase safety by removing a distraction from more critical operator actions was made with deliberate consideration of all the all relevant material at San Onofre by qualified personnel. The NRC Safety Evaluation Report written for the submittal concurred that the changes in the submittal were risk beneficial. There should be no statement in the document handed out in the meeting that this argument is questionable.

   The safety significance of the safety increase (risk reduction) from the simplification of the Emergency Operating Instructions due to elimination of hydrogen control requirements will vary from nuclear unit to nuclear unit. In the case of San Onofre, the safety significant was qualitatively evaluated by personnel at the plant. As a single stand alone item at San Onofre, in the overall context of adequate protection of public health and safety, the simplification is probably of "small" safety significance. However, as an indication of the ability of personnel at San Onofre to strive for continuous improvement in all aspects of plant operation, the safety significance is high.

   The nuclear industry should not be in the position of ignoring changes to the NRC regulations that might have a positive impact on adequate protection of public health and safety just because the change has "small" safety significance. If the nuclear industry is to survive and prosper in an economically deregulated electric power industry, any regulation that distracts plant personnel from items of safety importance at the nuclear unit must be changed. NRC personnel and nuclear plant personnel must become accustomed to the process of "continuous improvement."

2. There should be no regulation with a requirement for large dry containments to withstand a hydrogen burn from an amount of hydrogen equivalent to that generated from a metal/water reaction involving 75% of the cladding surrounding the active fuel region. This is the requirement for "glow-plug igniters." This requirement has been evaluated for large dry containments per 10CFR50.109 and found to not meet the criteria necessary to impose the requirement.

   The NRC Safety Evaluation Report for the San Onofre submittal of September 10, 1998, contains the following statement: "Although hydrogen igniter systems

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would provide added confidence that containment integrity can be maintained during hydrogen burns, Generic Issue (GI) - 121, 'Hydrogen Control for PWR (Pressurized Water Reactor) Dry Containments,' found that hydrogen combustion was not a significant threat to dry containments and concluded there was no basis for new generic hydrogen control measures (i. E., igniters).

If the staff of the Nuclear Regulatory Commission have specific concerns with any nuclear unit with respect to combustible gas control and wish to impose any new requirements, they should follow the directions contained in 10CFR50.109.

3. In my opinion, any existing regulations for hydrogen monitoring inside containment for the Mark I and Mark II BWRs should be deleted. These nuclear units have their containments inerted. To the best of my knowledge, there are no actions to be taken by the operators during severe accidents that would impact the course of the severe accident and which depend on knowing the hydrogen concentration inside the containment. Hydrogen concentration inside containment is, at best, of secondary importance with respect to the parameters that allow the operators to take appropriate action during severe accidents. Other parameters are used to instruct the operators what actions to take during severe accidents.

The existing regulations for hydrogen monitoring inside containment for large dry containments should be deleted. There are no glow-plug igniters to activate. The existing capability of the containments allows the containment to withstand hydrogen burns. The existing systems to mix the containment atmosphere and the existing systems to remove heat from the containment do not depend on the operators knowing the hydrogen concentration. To the best of my knowledge, there are no actions to be taken by the operators during severe accidents that would impact the course of the severe accident and which depend on knowing the hydrogen concentration inside the containment. Hydrogen concentration inside containment is, at best, of secondary importance with respect to the parameters that allow the operators to take appropriate action during severe accidents. Other parameters are used to instruct the operators what actions to take during severe accidents.

Without the existing regulations for hydrogen monitoring inside containment, the owners of the nuclear units will have the option of keeping and maintaining the existing hydrogen monitoring equipment, replacing the existing hydrogen monitoring equipment with more state of the art digital equipment, leaving the existing equipment in place, after proper precautions are taken, but not maintaining the equipment, or removing the existing equipment. The decision as to what course of action to pursue is with the owners of the nuclear unit who are in the best position to determine the benefit/costs of the options available. The existing hydrogen monitoring equipment has no impact on adequate protection of public health and safety. Decisions as to what to do with the existing hydrogen monitoring system is an operational decision, not a safety-related decision.

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4. The argument is made in the document that hydrogen monitoring and hydrogen recombiners could have some impact on long term hydrogen control in large dry containments following damage to the reactor core. Such equipment was used in the long term following the accident at Three Mile Island 2 in 1979.

Again, these concerns are operational concerns which have no impact on adequate protection of public health and safety. Decisions as to what to do with existing hydrogen monitoring systems, hydrogen recombiners, and hydrogen purge systems once the existing regulations are changed to make this equipment non-safety-related are best left up to the owners of the nuclear units.