NRC NEWS

U. S. NUCLEAR REGULATORY COMMISSION

Office of Public Affairs Telephone 301/415-820
Washington, DC 20555-0001 E-mail: opa@nrc.gov
Web Site: www.nrc.gov

No. S-03-019

REDEFINING THE LARGE BREAK LOSS OF COOLANT ACCIDENT (LOCA)
" . . . an Idea Whose Time Has Come"

by

Nils J. Diaz, Chairman
U.S. Nuclear Regulatory Commission

Keynote Speech

presented before the Committee on the Safety of Nuclear Installations/Committee on Nuclear Regulatory Activities (CSNI/CNRA) at the Joint CSNI/CNRA Workshop

Zurich, Switzerland
June 23, 2003

I am very pleased to be here with so many technical experts from around the world to discuss a subject which I feel very strongly about. I would like to express my thanks to the NEA committees, the CNRA and the CSNI, and to our Swiss colleagues for organizing and hosting the meeting, and for the opportunity to share my views with you. And of course, to the NRC staff, and Ashok Thadani in particular, for their work in making this meeting on this subject, possible.

Let me say from the beginning that redefining the Large Break LOCA is for me, and I hope for all of us, a significant safety initiative. I cannot stress that fact enough . . . a safety initiative. We in the US experienced our most serious reactor accident at Three Mile Island (TMI) in 1979 -- twenty-four years ago, yet still fresh in our memories. The TMI accident was not a Large Break LOCA, it was not the event that we had invested so much of our time and technical resources in. The TMI accident was a small LOCA, an event given significantly less attention because of the overwhelming amount of attention on the Large Break LOCA concern. During the four decades since nuclear power plants began operation, each of our nations has experienced important reactor safety events, yet none were Large Break LOCAs. The only power or production reactor accident - Chernobyl - that resulted in loss of life on-site and massive radioactivity releases was many things but not a Large Break LOCA. All the other reactor safety

events include occurrences such as small LOCAs, or loss of decay heat removal or fires or reactivity events. With today's improved know-how, shouldn't we be focused on the right safety issues? Shouldn't we assure the public, whom we are protecting, that our attention and the attention of our licensees is focused on the most important issues and activities for preserving their health and safety? I believe the record shows that we do a good job, but we can do a better job by using what we now know is more safety-focused, cognizant of the past and of present and future needs, and dedicated to the task at hand: protection of public health and safety and the environment.

I believe the nuclear regulatory agencies, cognizant of the present safety experiences and assessment capabilities, need to take the next step. The licensees and reactor vendors cannot change their focus until we change ours. That's a fact. Regulation and technology need to progress in parallel, in phase. And in this particular case, the regulators are currently lagging the technological capabilities. We also need to recognize, consider, and address the technical, legal, and political impediments to change, so whatever we do has to be right, scrutinized and well communicated.

Let me remind you of a quote from the well known 19th century author Victor Hugo, who said,

"Nothing else in the world . . . is so powerful as an idea whose time has come."

Well, I believe that redefining the Large Break LOCA through a risk-informed and performance-based approach, is an idea whose time has come. And I am not overestimating its importance; it plays large in many areas. The double-ended rupture of the largest pipe in the RCS should be moved from the design basis to severe accident management space. This change will not create a void, it will create the opportunity for safety improvements per se, and will establish the due process and requirements to eventually replace design bases with a better, living and dynamic safety basis.

We have a good reason for a change; we need to have the technical basis to support that change. Therefore our first expectation for this meeting should be to identify, clarify, and, if possible, agree upon the current state of knowledge on the probability and consequences of various LOCAs.

As a second expectation, and as I alluded to above, we should also explore a related question (and answer it as best we can); that is, "If we change the Large Break LOCA, what should replace it?"

There is no doubt that, we will need to consider all of the design and operational implications of redefining the Large Break LOCA, and do it better than well. These include issues such as fuel and core design; containment design basis; ECCS design; RCS supports; emergency diesel generator start time; maximum hypothetical accident for dose assessment, emergency preparedness and control room habitability. These sets of issues need to be reduced for holistic system and probabilistic analysis.

Before discussing possible changes to the Large Break LOCA, let me first speak about the current NRC regulations in this area, that is, 10 CFR 50.46 and Appendix K, which establish the requirements for Emergency Core Cooling Systems. I will also mention some of the history of these requirements.

50.46 requires that " . . . ECCS cooling performance must be calculated . . . for a number of postulated loss-of-coolant accidents of different sizes, locations, and other properties sufficient to provide assurance that the most severe postulated loss-of-coolant accidents are calculated." In this context, "loss-of-coolant accidents mean those postulated accidents that result from the loss of reactor coolant at a rate in excess of the capability of the reactor coolant makeup system from breaks in the reactor coolant pressure boundary up to and including a break equivalent in size to the double-ended rupture of the largest pipe of the reactor coolant system." In Appendix K, "ECCS Evaluation Models," the word "instantaneous" is added to the phrase "double-ended breaks" making the traditional maximum LOCA (but not necessarily the worst LOCA) the instantaneous double-ended break of the largest pipe in the reactor coolant system (usually the hot and occasionally the cold leg of the RCS).

50.46 analyses are all about consequences. And understanding consequences without understanding the associated probabilities is particularly meaningless for this case. We know that now very well, but the US Atomic Energy Commission (AEC) also knew that back in the 1970's. Qualitative judgements were made about the probability of a LOCA. That's why pipe failures are included in 50.46 but reactor vessel failures are not. The reactor vessel is the largest "pipe" in the RCS, but a judgement was made that vessel failures were so unlikely that protection was not necessary. That was a qualitative judgement about probability.

The approach to classifying events as "anticipated operational occurrences" and "postulated accident," is more than three decades old. It is a qualitative (or at best semi-quantitative) approach to event probability.

As operating experience and research data become available over time, those qualitative judgements are first validated and later replaced with quantitative information. It is a normal technical progression to go from qualitative judgements to quantitative estimates over time. That's expected progress.

In the December 28, 1973, "Opinion of the Commission," on the rulemaking hearing on 50.46, the Commission stated:

"In adopting this course [the 50.46 rule], we are not blinding ourselves to new knowledge acquired as a result of ongoing research. On the contrary, we believe that it is important that research programs - both analytic and experimental - continue, in order that we may increase knowledge relevant to ECCS performance . . . As new knowledge is acquired, the Commission will analyze it, and at the appropriate time consider the possibility of amending the rule we announce today."

The Commission expected the regulatory requirements to change and progress along with the technology. However, they probably didn't think it would take 30 years!

In developing WASH-1400, the original "Reactor Safety Study," the AEC used the best information at that time to estimate the probability of various LOCA's -- including Large Break LOCAs and even vessel failures -- that was 1974.

Following the TMI accident, the NRC undertook a deep and serious look into its regulations and regulatory practices in the "NRC Special Inquiry" often referred to as the "Rogovin Report." In that report, a number of recommendations call for the increased use of risk analysis and risk insights. These recommendations include the following:

"The best way to improve the existing design review process is by relying in a major way upon quantitative risk analysis" and added,

"What we [the NRC Special Inquiry] are suggesting is that [the existing review process] be augmented and that quantitative methods be used as the best available guide to which accidents are the important ones, and which approaches are the best for reducing their probability and consequences." and again, it included a recommendation,

"We strongly urge that NRC begin the long and perhaps painful process of converting as much as is feasible of the present review process to a more accident-sequence-oriented approach."

I agree with their recommendations and with their predictions that the transition would be "long" and "painful." It should not have been that long and that painful, but it has been. The wheels of "nuclear" progress turn slow because predictability became equated to success. I do not disagree with that; I just disagree with the interpretation of predictability and success. Predictability must be rooted in today's know-how and success (in our case safety success) has to be meaningful for 2003 and beyond.

In 1995, eight years ago, the Commission issued a formal Commission Policy Statement supporting the increased use of PRA. We have made significant progress in the use of PRA since then, but we are far from done. That's our history and we cannot change it. But we have the opportunity to change the future, and I submit to you that we have the obligation to do so.

Now, in 2003, LOCA probabilities are routinely included in Probabilistic Risk Assessments (PRAs or PSAs). They are calculated every day and all around the world and are used in operational safety decisions . . . why not in the basic design requirements too? We have a sound understanding of the probabilities and consequences sufficient to progress to the next rational level of regulation to improve reactor safety.

The changes being considered by the NRC are headed in this direction. The situation is as follows:

> The Commission has recently agreed to consider redefining the design basis large-break loss-of-coolant accident (LOCA) in view of the low risk associated with such events. The NRC staff was directed to provide the Commission a comprehensive "LOCA failure analysis and frequency estimation" that is realistically conservative and amenable to decision-making and to consider use of a 10-year period for the estimation of LOCA frequency distributions, with a rigorous re-estimation conducted every 10 years and a review for new types of failures every five years.

In that effort, the staff was directed to use Service-Data, Probabilistic Fracture Mechanics (PFM), and Expert Elicitation in a process that is risk-informed and consistent with the principles of RG 1.174. Where there is convergence, that is success, when there is divergence, there is work to be done.

The staff was also directed to credit leak-before-break where a licensee establishes a reliable and comprehensive means of detecting primary system leaks of the relevant size.

The staff was further directed to establish an appropriate risk "cutoff" for defining the maximum LOCA size and to require strict configuration controls during plant operation and a high quality PRA, including low power and shutdown operations.

These directives from the Commission to the NRC staff, highlight the two key technical issues involved with re-defining the LBLOCA; namely, LOCA frequencies and “PRA Quality”. “PRA Quality” means having the appropriate scope level of detail reliability data and realism in accident progression and success criteria to support the regulatory decisions to be made. Since the risk assessment will play a significant role in this important change (i.e., re-defining the LBLOCA), we expect the PRA to be of high quality so that the results are both reliable and convincing. The PRA does not need to be perfect, but it does need to be “good enough”. How good is “good enough” is an issue that we face for each risk-informed activity. And, as with previous activities, we will work with experts in the field to develop guidelines on “PRA quality” for this issue, and will probably use a NRC Regulatory Guide. The “PRA quality” issue will be difficult but it is well within our technical capabilities, and will be resolved in a prudent manner.

I am convinced that, as a matter of improving safety, the consideration of very low probability Large Break LOCAs should be addressed as severe accident scenarios, in the severe accident management program, rather than as the design basis accident. Effectively, the current LBLOCA would not be a design basis accident when utilizing a risk-informed approach. With an alternative definition of the LOCA, the really important, risk-significant, accident scenarios would remain within the design basis; in fact, their consideration would be enhanced by a new focus on their risk-importance.

These activities are in the formative stage; the commitment to go forward is fully formed and the NRC staff will develop proposed rule changes and associated guidance for public review and comment over the next several months. In addition, we expect one or more pilot applications which would request risk-informed changes to the Large-Break LOCA requirements through the NRC exemption process. This will provide a way of getting direct and practical experience with

some of the important decisions to be made. We have found this approach very useful in the past.

I have no doubt that some, perhaps many, of the details of the rules and guidance will change, will mature and will become clearer as the staff discusses alternatives with interested parties . . . and that is good. Some new alternative approaches may even be developed. Information from this meeting may also influence the NRC's plans -- and that would be good too.

What I believe will not change is our commitment to improving safety and modernizing the treatment of the Large Break LOCA through the use of the best available information on the likelihood and potential consequences of these events and the best available approaches. And beyond the Large Break LOCA? 10 CFR 50 Appendix A and all it touches.

Realistically: there might be a tendency to let things be; to not challenge the status quo; to think that it is "ok". This would be wrong; technically and for long-term national energy policies.

Remember:

> "Nothing else in the world . . . is so powerful as an idea whose time has come"

I look forward to working with you and to your contributions to make it happen.