Comments on Generation IV Goals and Roadmap
Public meeting, Thursday, Nov. 16, 2000
JW Marriott, Washington DC
Gary Vine, EPRI

I'd like to cite two regulatory landmarks established during the U.S. DOE/Industry ALWR Program, 1983-98, the intent of which should be incorporated into the goal setting for all future reactors. These are followed by four specific comments on the Generation IV goals.

A. ALWR goals are *Industry* goals, and must be kept distinct from regulatory requirements.

The ALWR Program was very careful to maintain and preserve clear separation between regulatory requirements and industry goals, as expressed in the EPRI ALWR Utility Requirements Document. The industry needed to decide how to comply with regulations in the most cost-effective way, and needed to strategically design-in the extra margins needed for investment protection, operational flexibility and performance, and assured licensability (e.g., margins to satisfy analysis and R&D uncertainties). The utilities chose to impose aggressive requirements on each reactor vendor that consistently exceeded regulatory requirements, sometimes by large margins. The Commission encouraged industry to adopt this approach, while recognizing the need to focus its review on those requirements needed to provide adequate protection of public health and safety.

The intent of 10 CFR Part 52 is to remove the uncertainty and unpredictability in the licensing process, by:

- resolving as many design issues as possible that are normally contentions at the construction permit stage, through the design certification process,
- defining applicable tests, inspections and acceptance criteria that when satisfied provide reasonable assurance that the plant will operate in accordance with the certified design, and thus resolve operating license contentions,
- streamlining the licensing process through the introduction of a combined construction and operating license, and
- introducing an early site permit process to codify the reactor siting process for one or more designs at a specific site, providing design selection flexibility.

The Commission consistently supported its policy position that the NRC should not codify industry requirements that go beyond the regulations. The Commission maintained consistency between regulatory requirements for future reactors and regulations for current plants, as evidenced by its disapproval of a different quantitative safety goal for ALWRs than for operating plants. These long-standing positions are clear in the Commission Policy Statement on Severe Accidents and its Policy Statement on Advanced Reactors, and in various Staff Requirements Memoranda, as documented in the Attachment. The implications of these NRC regulatory safety policies to DOE goal-setting for advanced plants are discussed later under comment #2 on the DOE Generation IV goals.

B. Goals must be technology neutral, insofar as possible

The ALWR Program placed a high priority on maintaining consistency of goals and requirements, with respect to PWRs vs. BWRs, and with respect to evolutionary vs. passive safety design approaches. The ALWR Utility Requirements Document was very careful to avoid goals or utility requirements that would have the effect of biasing the process in favor of one design approach over another.

Further, the ALWR Program went out of its way, when new or revised goals or utility requirements were considered for passive safety designs, to ask the question if those new goals should be applied to evolutionary plant designs as well. Utilities made every effort to maintain common and consistent requirements across design approaches.

Based on these two historic insights, here are four specific comments on the Generation IV goals:

1. Generation IV design goals are not technology-neutral.

We have experienced continuous shifting of definitions for advanced design concepts among Generation III, Generation IV, Generation III+, Generation IV–, etc. The problem here is not just one of academic interest. DOE plans to propose goals for some future generations but not others, to develop a Roadmap for some generations but not others, and to allocate R&D funding based on generation labels. This is not technology neutrality and has significant consequences. Without a consistent set of goals, advocates for individual design concepts can game the system by proposing modifications to generation definitions favorable to their specific situation. This situation is neither constructive to DOE's interests nor to those of any stakeholders.

Industry needs a balanced nuclear energy policy. Industry believes that all viable design options on the table should be assessed, and a market-based decision made on which ones to pursue, based on that assessment. All concepts have potential advantages. Industry doesn't care which designs succeed, as long as safe, reliable, licensable, economically competitive designs are available when needed. Most nuclear energy R&D stakeholders are confused over the flexible definitions and fine distinctions surrounding generation labels. Having separate goals for each generation (or only stipulating goals for one generation) will propagate the state of confusion. It is clear that a broad range of design options at various power ratings will be needed in the world marketplace. Energy consumers benefit from having a wide range of options, competing on an even playing field. U.S. energy policy should support market need, without biasing the process with unnecessary labels.

DOE should eliminate any unnecessary generation labeling process wherever possible, and should take the following three steps:

- Articulate high level goals for nuclear systems as applying to all future reactors, in order to make them technology neutral. There appears to be no valid basis for differentiating between generations in the setting of goals. There may be a valid basis for differentiation when developing implementation details, but that can be done from a foundation of common goals applicable to all future reactors. The fact that neither the NRC nor the industry has requested different goals for one generation over another should weigh heavily on DOE's process.

- Support the development of a Roadmap for nuclear energy R&D that is open, inclusive, fair and balanced. This means that the DOE Roadmap should apply to all potential nuclear generating options, until a thorough assessment is completed. There may be a basis for differentiating between generations when it comes to implementation strategy within the Roadmap. But a Roadmap process that excludes some generations from consideration imposes a bias on U.S. energy strategy and does not comport with a balanced approach to ensuring a range of new energy options. This is not in the best national interest.

- DOE should explicitly recognize the need for both near term and longer-term options for nuclear technology, and support this balance of near term and long term options in both its goals and its Roadmapping activity. An argument can be made that DOE's role in funding advanced reactor development and demonstration projects should trend toward longer term needs, because of their higher development risks and lack of commercial incentives for investment. But such considerations should logically come up when reactor demonstration projects are proposed for funding to Congress – not via exclusion at this early planning stage. Further, an integrated approach to both goals and the Roadmap is necessary. Establishing separate and/or competing Roadmaps for different generations would not be constructive.

2. Goals should be established in the context of facilitating market needs and industry efforts to successfully meet regulatory and economic thresholds for deployment. DOE must not propose goals that are not necessary, or that are excessive, potentially unattainable, or have the effect of establishing de facto new energy or regulatory policy.

DOE's role in advanced reactor development is to advocate for the expanded peaceful use of nuclear power, to advocate a balanced national energy strategy that properly includes nuclear energy, and to support R&D and related efforts to fulfill these vital national needs. NRC's role in this area is to certify designs that assure continued adequate protection of public health and safety. Since goals for future reactors necessarily address both safety and economic performance objectives, and since DOE and NRC, as Federal agencies, need to respect their respective roles, it is appropriate that DOE focus primarily on economic performance and other enabling goals. However, if DOE wants to include safety goals, then those goals must reflect NRC requirements. If DOE chooses to articulate safety goals that exceed regulatory requirements, it should do so in its role of facilitating industry consensus on how industry chooses to exceed regulatory requirements. This way, one federal agency (DOE) won't be setting different safety goals than the agency responsible for protecting the health and safety of the public, the NRC. If DOE goals exceed NRC requirements, then DOE's intent should be visibly and explicitly limited to facilitating an industry consensus for how industry intends to provide the enhanced safety that the Commission expects it to achieve (see App.).

The Commission's rationale for not allowing stringent industry goals to be imposed as regulatory requirements is logically founded on a consistent application of its safety goal policy, which sets surrogate numerical safety targets for all reactors (without prejudice) based on high level quantitative health objectives. The Commission recognizes that it must not differentiate regulatory requirements for different generations of reactor designs, and must not establish a double standard for what constitutes "adequate protection" – which would occur if more stringent regulations were imposed on future plants, different than current plants. Consistency in safety requirements across the range of current and future systems is essential for regulatory stability, fairness, and adherence to a defensible policy basis for regulatory requirements.

From industry's perspective, DOE should not establish different goals for different generations, and should not propose goals that aren't needed for either regulatory approval or economic competitiveness. Establishing different generic performance objectives for different nuclear designs could foster an imbalanced energy policy and R&D strategy. Further, differentiation of safety goals for different generations of future reactors could create instability in regulatory space, by leading to an unpredictable, inconsistent and incoherent regulatory process. This could confuse the public and degrade public confidence in nuclear energy and in the NRC.

Although the Commission policies cited in the Appendix did not contemplate DOE establishing goals for advanced reactor designs, the following implications logically flow from Commission policy:

- DOE goals, especially in safety or regulatory areas, should never be stated as requirements (industry recognizes that DOE goals are not now being characterized as requirements).

- DOE goals should not exceed NRC requirements, unless they represent an effort to facilitate owner-operator consensus on enhanced future reactor goals, and are explicitly presented as such.

- It is important to note that a few international participants in the DOE Generation IV initiative have a different perspective on safety policy than US policy, and support the idea of setting differing standards of safety between current and future plants. At a bare minimum, DOE must be careful in facilitating international consensus to ensure that resulting goals do not conflict with U.S. policy. A preferred approach, based on the uniform scientific and policy basis for NRC safety goals, would be for DOE to advocate for international acceptance of the U.S. approach. DOE should advocate for international support of improved performance, while maintaining a consistent regulatory basis that requires current levels of safety be maintained for all plants.

3. DOE should recognize that some goals, particularly ones related to proliferation and waste concerns, address issues that are strongly institutional in nature. DOE has not made the case that modern waste management and proliferation resistance, as exemplified by once-through LWRs & ALWRs, are not satisfactory for global deployment. Therefore, goals in these areas should focus on broader fuel cycle technical issues, and on institutional measures, including energy policies governing fuel cycles, legislative action on waste solutions, and support for the IAEA's capability to maintain non-proliferation standards and monitor compliance with them. Improved technologies to strengthen IAEA monitoring capability are also worthwhile.

Before developing goals in these two areas, DOE-NE must decide whether a Technology Roadmap, as contrasted to other vehicles, such as a National Energy Policy process, initiatives by DOE-RW, DOE-NN or Department of State, Congressional action, etc., are more appropriate means to address these concerns. If these goals are retained in a technology roadmap, then DOE should focus on the institutional solutions needed to address these issues, and work with other agencies and entities that bear primary responsibility to address these concerns. DOE-NE's technology role would then include support of potential technological contributions to strengthening those institutional barriers.

DOE's position that "there are weapons proliferation concerns that may legitimately be expressed regarding the deployment of current generation technology in developing countries" [DOE-NE Strategic Plan], is not consistent with the bipartisan conclusion of both the Administration and Congress that U.S. Advanced Light Water Reactor technology is the best solution to concerns over proliferation-prone graphite moderated reactors in North Korea. Neither Congress nor the Administration (i.e., Dept. of State) has established a requirement for DOE to develop a new reactor design to address these concerns. DOE should carefully evaluate the basis for and the likely resource requirements needed to address a unique third world issue, at the expense of U.S. vital interests in its own energy security and environmental quality and nuclear's role in addressing them.

4. Goals should support both near term and longer term needs for nuclear technology, and should take advantage of the NRC's Commission Policy Statement on Advanced Reactors to help differentiate, when necessary, between the development needs of future reactors.

The Advanced Reactor Policy Statement, in addition to encouraging enhanced margins of safety for advanced reactors, is a sound approach to distinguishing among future designs. It distinguished two different strategies for reactor designers to obtain NRC approval, which were later accounted for by 10 CFR Part 52. In order to place the Commission Policy Statement in today's context, I have taken the liberty of expanding on its brief discussion, in a manner that I believe preserves the original intent.

Advanced reactors based on proven technology:
These designs are based on proven technologies demonstrated in current operation or on systems that have some demonstrated basis for safety. They have a basis for regulatory approval in existing regulations, and have an existing basis for licensing from available testing and analysis results that can be used to demonstrate compliance with those regulations.

Advanced reactors requiring prototype demonstration:
These designs lack a sufficient basis in proven technologies and accompanying testing and analysis to make the licensing case impractical without a prototype demonstration or scaled full-system test. These designs requiring such a demonstration may also lack sufficient licensing basis in regulations for certification, and thus may need to develop that regulatory basis in parallel with a prototype demonstration or a scaled testing of critical safety functions.

Assuming this expanded discussion of the Commission Policy options is appropriate to today's situation, it follows that designers who develop concepts that are not clearly in one of these two situations would need to decide which strategy to follow. For a design based in part on proven technology but containing some unproven features, the designer must chose between a limited demonstration and/or special effects testing of certain features (with an expectation that this selective approach will be sufficient to obtain regulatory approval); or the more resource intensive (but perhaps more assured) path of prototype demonstration.

Using the distinctions above, the NRC Policy provides an equitable means of differentiating among generational differences in design approaches, without placing itself in the position of having to dictate which category each advanced concept belongs to. The Commission places the onus on the designer and not government for selecting the path to follow to gain design approval/certification.

Therefore:
:

- DOE should refrain from reactor generation distinctions except when necessary (i.e., only in implementation considerations, not in goal-setting and roadmap scope-setting)

- DOE should, in those situations requiring distinction between generations, take advantage of the impartial approach of the NRC's Advanced Reactor Policy Statement, namely a stable, process-based means of distinguishing between generations, directly linked to the practical difference these generations will face in obtaining regulatory approval. Most importantly, the NRC approach, if mirrored by DOE, would inhibit the manipulation of generation definitions, and take the government out of the business of picking which designs fit into which generation bins.

ATTACHMENT

(Following is a brief historical review of NRC Commission Policies on safety goals and safety enhancements for advanced reactors, and which entity is responsible for enhanced safety.)

Severe Accident Policy Statement and Advanced Reactor Policy Statement:
In its 1985 Severe Accident Policy Statement, the Commission introduced the concept of "enhanced safety" for future designs: "…The Commission expects that vendors engaged in designing new standard plants will achieve a higher standard of severe accident safety performance than in their prior designs…" Later, in its Advanced Reactor Policy Statement, a similar expectation was expressed: "…The Commission expects that advanced reactors will provide enhanced margins of safety and/or utilize simplified, inherent, passive, or other means to accomplish their safety functions. The Commission also expects that advanced reactor designs will comply with the Commission's forthcoming safety goal policy statement." *[Note that both policy statements challenged industry to deliver designs for review that met Commission expectations. Neither policy statement specified new regulations to force or replace industry initiative.]*

In its Severe Accident Policy Statement, "...the Commission conclude[d] that existing plants pose no undue risk to public health and safety, and sees no present basis for immediate action on generic rulemaking or other regulatory changes for these plants because of severe accident risk."

In its Advanced Reactor Policy Statement, the Commission answered two questions with similar responses that did not support new regulations, and placed the "enhanced safety" onus on industry:

"Question 2: Should the regulations for advanced reactors require more inherent safety margin for their design? ... Commission Response: The Commission encourages the incorporation of enhanced margins of safety ... To encourage such action, the Commission in its review of these advanced designs, will look favorably on designs with greater safety margins and/or highly reliable safety systems."

"Question 3: Should licensing regulations for advanced reactors mandate simplified designs which require the fewest operator actions and the minimum number or components needed? ... Commission Response: The Commission will encourage designs which are simpler and more reliable ... While current generation nuclear power plants, in operation or under construction, represent no undue risk to either the public or the environment, the Commission believes that reactors with improved safety characteristics can and will be developed."

In these cases, the emphasis is on such phases as "expects," "encourage," and "believes," not on the terms "should" or "will require". The Commission's key conclusions in its Severe Accident Policy Statement and its Advanced Reactor Policy Statement were that (i) no present basis existed for generic rulemaking for advanced plants, given that existing plants posed no undue risk to public health and safety; and (ii) that enhanced safety would be achieved via the Commission's expectation that industry would satisfy Commission policies for enhanced safety -- without any need for regulations to force or replace industry initiative.

Whether or not the Commission expected or required enhanced safety became a matter of significant discussion between the staff and Commission. The Commission reiterated its strong position that it expected enhanced safety, and did not support an interpretation of this expectation as a requirement.

SRMs on SECYs 89-102 and 89-311: Industry Goals and their use in Regulation:

The Commission provided direction to the staff in its SRMs on SECY-89-102 and SECY-89-311 that NRC will not use industry's goals that go beyond regulations as the basis to impose new requirements.

SRM on SECY-89-311:

> "Vendor or EPRI goals that go beyond our regulations should not be imposed as requirements for individual designs, but Licensing Review Bases and Safety Evaluation Reports for specific designs should include a discussion on how the design compares with the EPRI URD"

SRM on SECY-89-102 (Implementation of Safety Goals)

> "The NRC will not use industry's design objectives as the basis to establish new requirements"

SRM on SECY-90-016 (LWR Certification Issues and their Relationships to Regulatory Requirements)

> "The Commission has disapproved the use of 10 E-5 per year of reactor operation as a core damage frequency for advanced designs. As noted in the SRM on SECY-89-102 (dated June 15, 1990), the Commission supports the use of 10 E-4 per year of reactor operation as a core damage frequency goal. ... The NRC should not adopt industry objectives as the basis for establishing new requirements."