ANS SPECIAL COMMITTEE ON FUKUSHIMA

The American Nuclear Society (ANS) is an independent, scientific membership organization of engineers and scientists devoted to the peaceful applications of nuclear science and technology. ANS members come from all walks of life—academia and educational institutions, medical and research facilities, government agencies and laboratories, and the nuclear energy industry, to name a few. ANS is the responsible body for providing clear and dispassionate explanations of matters regarding the nuclear science and technology community.

As a scientific organization, the American Nuclear Society has in the past established panels of experts to examine nuclear accidents, such as the SL-1 event in 1964, Three Mile Island Unit 2 in 1979, and Chernobyl in 1986. Learning about and from these incidents is key to advancing our understanding and application of nuclear science and technology.

After March 11 of last year, ANS leaders charged the ANS Fukushima Special Committee to provide a clear and concise explanation of what happened during the Fukushima Daiichi incident. The Committee was also asked to evaluate recommendations and lessons learned based upon the examination of information and data developed over a ten-month timeframe. Our findings are contained in *Fukushima Daiichi: A Report by the American Nuclear Society Special Committee on Fukushima* (March 2012).

Key Findings

First and foremost, we have found no aspect of the Fukushima Daiichi accident to suggest that the level of safety of nuclear energy facilities in the U.S. is unacceptable.

The current level of oversight is sufficient to protect the health and safety of the American public. We are in strong agreement with the U.S. Nuclear Regulatory Commission (NRC) on this point.

Second, our analysis suggests that off-site health consequences of the Fukushima Daiichi accident may ultimately be negligible. No one has died as a result of radioactive materials released by Fukushima Daiichi, and no health consequences have been reported from health monitoring of workers and the public to date.

These findings reinforce those of the panel assembled by the Health Physics Society, which presented its findings here on March 1. We note that data collection and analyses is ongoing, and we believe that these additional studies should move forward before definitive decisions on health effects can be made.

The overall lessons learned and to be learned from Fukushima Daiichi chiefly concern a facility's response to an extreme natural events—in this specific case, an earthquake and the resulting tsunami.

Finally, our recommendations in this report are consistent with most of the regulatory issues that have been raised by national and international bodies. Unlike those bodies, however, we also focused on the key technical areas—outlined below—that would be the basis for any specific set of regulatory actions.

Risk-Informed Regulation

While today's reactors are already designed to consider a wide array of natural phenomenon hazards, we must work even harder to plan for unanticipated events. One should use a risk-informed approach, in planning for the next level of safety.

This risk-informed approach should extend to mitigation of the consequences of a severe event in addition to reduction of reactor design vulnerabilities to severe accidents.

Hazards from Extreme Natural Phenomena

Simply stated, the tsunami design bases for the Fukushima facility were insufficient. The risk informed regulatory approach we recommend would have identified that insufficiency.

Although addressing low-probability events is very difficult, it's still important to consider potential hazards from extreme natural phenomena. We must anticipate and plan for the unexpected with appropriate safety contingencies.

Emergency Planning

The need for a clear approach to emergency planning in case of a serious accident is recognized in the United States. We believe that emergency planning zones should not be based on arbitrary mileage designations, but rather a comprehensive assessment of the consequences and probabilities of various accident scenarios—in short, a "risk-informed" approach.

The NRC should work together with other agencies—including the U.S. Department of Energy—and with industry to improve emergency planning activities using appropriate risk information.

With regard to the Fukushima Daichii accident, the technical basis for the NRC's decision to issue an evacuation alert for U.S. citizens within 50 miles of the site was puzzling. The NRC News Release that provided the technical basis was based on

analysis for radioactive material releases from the reactors—not for spent fuel, which was the concern at Fukushima Daiichi. We believe the technical basis should be clarified to understand better the source of uncertainties regarding NRC's decision.

Health Physics

We only considered information that is publicly available. These sources focused on radiation exposure, release and deposition of radioactive materials, and contamination of water and food sources.

The data suggests that off-site health consequences may be minimal, but confirming health effects will take more time.

Data collection and analyses continue. As a result, it's too early to make any firm conclusions regarding the health impacts to workers or to members of the public.

Two internal dose assessment surveys were started by Japan's National Institute of Radiological Sciences (NIRS) and the Japan Atomic Energy Agency (JAEA). JAEA began internal exposure surveying of 2,800 evacuees on July 11. The United Nations Scientific Committee on the Health Effects of Radiation has also announced that it will conduct a study on the health impact to Fukushima residents.

The Tokyo Electric Power Company has been monitoring emergency workers for external doses throughout the accident and its aftermath. As of the most recent monitoring period, no observable health effects have been reported in any of the workers.

Multiple-Unit Site Considerations

Because site approval takes a lot of time, research, and resources, we recognize that multi-unit siting can be desirable.

However, the events at Fukushima have illustrated the importance of multiple unit considerations, and we recommend that a risk assessment associated with multiple units be performed by an appropriate regulatory body when a unit is added to a site.

This risk analysis should consider the extent to which multiple units increase or decrease risk. We outline a number of specific factors that should be considered.

Hardware Design Modifications

We have identified hardware-related modifications, which may be considered by near-term regulation. These modifications generally aim at ensuring:

- higher reliability of the reactor safety systems under severe accident conditions,
- enhanced reactor instrumentation that would allow operators to make better informed decisions during emergency scenarios,
- more robust delivery of makeup water to the reactor core when the safety systems are disabled for whatever reason, and
- reliable venting of the reactor containment if/when necessary.

These modifications would be plant specific and some cost-benefit analysis would ultimately determine which improvements have a real benefit on the safety of each facility.

An overall systems-interaction study needs to be undertaken when looking at the combined effect of any changes to be certain that substantial safety benefits are actually realized. In the absence of such an overview, resolution of these hardware issues may lead to unintended systems-interaction effects—in other words, without careful analysis, we do not want to fix one issue, only to create another.

Command and Control During a Reactor Accident

The Committee determined that the severity of the Fukushima Daiichi accident was exacerbated by an unclear chain of command. We believe that the Command and Control system in the United States is adequate, but we believe that a review is still worthwhile in the light of the Fukushima accident. The most important point is that necessary accident management decisions must be taken promptly at the proper operational level in order to react swiftly to an accident and thereby minimize any overall consequences.

Severe Accident Management Guidelines

The industry needs to develop a consensus with NRC regarding the intent and scope of Severe Accident Management Guidelines, including the manner in which they interface with specific plant emergency operating procedures.

To the extent that these guidelines require information regarding the status of nuclear plants, additional instrumentation—including accident diagnostics tools—may need to be installed into operating plants. Such tools could provide the operators with information regarding the accident progression (estimates of time to fuel uncover, time to reach suppression pool saturation, and time to reach

containment design pressure), which can then allow operators to identify the most effective strategy for addressing unusual operating conditions.

Societal Risk Comparison

We recommend that a quantitative assessment of the societal benefits and risks—including indirect costs and externalities—relating to all energy sources be performed.

We continue to support an energy portfolio which is diverse, but which also recognizes the vital importance of a stable and reliable base load production of electricity.

For More Information

Because the accident forensics, accident cleanup, and associated off-site health effects are ongoing, the ANS Special Committee will continue to update the information at the ANS Web site (http://fukushima.ans.org/) as new insights are gained.