January 28, 2002

MEMORANDUM TO: James E. Lyons, Director
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

THRU: Marsha Gamberoni, Deputy Director ***/RA/***
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

FROM: Eric J. Benner, Project Manager ***/RA/***
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

SUBJECT: TRIP REPORT FROM U.K. HEALTH AND SAFETY EXECUTIVE (HSE) SAFETY ASSESSMENT COURSE

On November 26-29, 2001, Marsha Gamberoni and Eric Benner of the New Reactor Licensing Project Office (NRLPO) participated in a safety assessment course sponsored by the Health and Safety Executive (HSE) of the United Kingdom (U.K.). Attached is the trip report from this activity.

cc: M. Cullingford, NRR
J. Dunn Lee, OIP
J. Lieberman, OIP
T. Rothschild, OGC
J. Shea, OEDO

Attachment: As stated

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DISTRIBUTION:
PUBLIC
M. Gamberoni
R. Borchardt, NRR

*HSE has reviewed this trip report and supports public dissemination.

ADAMS DOCUMENT TITLE:C:\Program Files\Adobe\Acrobat 4.0\PDF Output\HSE Trip Report.wpd

OFFICE	PM:NRLPO	DD: NRLPO
NAME	EJBenner	MGamberoni
DATE	1/28/2002	1/24/2002

OFFICIAL RECORD COPY

NRC Foreign Trip Report

Subject

Trip report from United Kingdom (U.K.) Health and Safety Executive (HSE) safety assessment course.

Dates of Travel and Countries/Organizations Visited

On November 26-29, 2001, Marsha Gamberoni and Eric Benner of the New Reactor Licensing Project Office (NRLPO) participated in a safety assessment course sponsored by U.K HSE in Chorley, U.K.

Author, Title and Agency Affiliation

Eric Benner
Regulatory Infrastructure Lead
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

Sensitivity

Not applicable

Background/Purpose

The objectives of the trip were for the Nuclear Regulatory Commission (NRC) to obtain knowledge of: (1) the regulatory scheme used in the U.K., (2) the U.K.'s experience with high-temperature gas-cooled reactor (HTGR) technology, and (3) the U.K.'s experience with licensing multiple facilities under one license. In addition, on November 30, 2001, the NRLPO staff met with the HSE staff to discuss these objectives further and to discuss how knowledge and experience can continue to be shared in the future.

Abstract: Summary of Pertinent Points/Issues

The basic philosophy that the Nuclear Installations Inspectorate (NII) employs is called Tolerability of Risk (ToR). The ToR philosophy divides risks into three regions applicable to all facilities. The first region includes risks that are so high that they cannot be justified except in extraordinary circumstances. The second region includes risks that are so low that they are considered broadly acceptable by society. The third region is called the tolerability region and it includes those risks that are deemed tolerable only because they provide a societal benefit. NII has developed a set of safety assessment principles (SAPs) for nuclear plants which addresses probabilistic and deterministic aspects of nuclear plant design, construction, and operation. The expected integration of deterministic and probabilistic information is accomplished by implementing the following steps: (1) identify all the initiating faults; (2) engineer out the faults if possible; (3) low consequence faults are addressed by good radiological practices; (4) the remaining faults are listed on a "Fault Schedule"; (5) faults with a frequency of greater than 10^{-5} are considered design basis accidents (DBAs) and are to have an extensive set of engineering

SAPs applied to reduce risks as low as reasonably possible (ALARP); and (6) faults with a frequency of less than 10^{-5} are considered beyond DBAs and, if the faults have associated high consequences, are to have severe accident SAPs applied to determine appropriate accident management strategies.

Discussion

1. U.K. Regulatory Structure

NII within HSE is responsible for regulatory oversight of 32 nuclear installations including nuclear reactors, chemical processing facilities, and submarine facilities. NII has approximately 280 employees divided into four divisions: (1) British Energy, (2) British Nuclear Fuels Limited, (3) Defense and United Kingdom Atomic Energy Authority (UKAEA), and (4) Research and Strategy. The license for any nuclear installation basically consists of a standardized set of 36 license conditions (LCs) which cover the nuclear life cycle. Standard LC 14 requires all licensees to have processes and organizations in place to produce and assess safety cases to justify safety during facility life cycle. As the plant goes through the stages of its life cycle, various other LCs require adequate documentation to justify the safety of the proposed activity, be it “construction or installation” [LC 19], “modification” [in design during construction - LC 20; on an existing facility - LC 22], “commissioning” [LC 22], or “decommissioning” [LC 35]. LC 23 states that the licensee shall, in respect of any operation that may affect safety, produce an adequate safety case to demonstrate the safety of that operation and to identify the conditions and the limits necessary in the interests of safety, and requires these limits and conditions to be defined as operating rules. While the license covers the entire nuclear life cycle, the licensee is not permitted to enter a stage of the life cycle until it obtains a consent from NII. For this reason, licensing multiple modules under one license becomes straightforward because the licensee must obtain a separate consent from NII for any module to enter any life cycle stage. With the promulgation of a Freedom of Information Act, NII is moving toward more openness to the public.

2. U.K. Regulatory Philosophy

The basic philosophy that NII employs is called ToR. The ToR philosophy divides risks into three regions. The first region includes risks that are so high that they cannot be justified except in extraordinary circumstances. The second region includes risks that are so low that they are considered broadly acceptable by society. The third region is called the tolerability region and it includes those risks that are deemed tolerable only because they provide a societal benefit. It is in this region that the concept of ALARP is introduced. As stated above, licensees must produce safety cases for all activities and these safety cases must show that the risk associated with an activity is either within the tolerable region or the broadly acceptable region. If the risks are within the tolerable region, the licensee has the obligation to reduce risks ALARP and demonstrate this to the regulator. If the risks are within the broadly acceptable region, the licensee still is obligated to reduce risks ALARP, but does not need to demonstrate this to the regulator. Of particular interest is that these obligations are continual. LC 15 requires that the licensee shall systematically and periodically review and reassess safety cases to ensure their continuing validity. As technology and facility conditions change, the licensee must continue to reduce risks ALARP. In addition, in accordance with LC 30, after any shutdown for examination, inspection, maintenance, or testing, licensees must obtain a consent from the regulator to restart the facility. Finally, licensees are subject to a periodic safety review (every 10 years) and must obtain a consent from the regulator to continue operation.

3. Probabilistic Versus Deterministic Methods

NII has developed a set of SAPs for nuclear plants which addresses both probabilistic and deterministic aspects of nuclear plant design, construction, and operation. The first five SAPs are called the fundamental principles and they embody the requirements for statutory radiation dose limits to be satisfied and for the ALARP principle to be applied to radiological exposure resulting from normal operation and to the risk from accidents. The remaining 328 SAPs are aimed at ensuring that, when a proposed plant comes into operation, the fundamental principles will be satisfied. The majority of these 328 SAPs are deterministic and promote good engineering practices such as: (1) conformance with applicable codes and standards, (2) assurance of adequate margins between normal operational values and values at which the physical barriers to release are challenged, and (3) assurance of temperature coefficients that ensure stable reactor behavior. The premises of these SAPs are that engineering standards need to be high in order to achieve an appropriate high level of safety and that probabilistic arguments should not be used to justify a poorly engineered design. These premises are explicitly embodied in SAPs 61 and 62 which provide a hierarchy for hazard assessment. SAP 61 indicates that the most desirable outcome, and the outcome that licensees should strive for, is that hazards should be avoided through inherent, and, where appropriate, passive features of the design without reliance on control or safety systems. Acknowledging that the use of radioactive material cannot be made hazard-free, SAP 62 indicates that the sensitivity of the plant to potential faults should be minimized with the most desirable outcome being that the fault results in a no significant operational response and the least desirable outcome being that the fault is rendered safe by the action of active engineered safeguards.

SAPs 32-55 address probabilistic safety analysis (PSAs) and associated basic safety limits (BSLs) and basic safety objectives (BSOs). BSLs are those limits which must be satisfied for the facility to be considered for licensing. Having satisfied the BSLs, the ALARP principle comes into play to reduce risk further. However, it is recognized that, at some point, consideration of future reductions in risk is not cost-effective for NII. Because of this, each BSL is complemented by a BSO which defines the point beyond which NII need not seek further safety improvements from the licensee. As an example, for what is essentially a core damage accident, the BSL is 10^{-4} per year and the BSO is 10^{-5} per year.

The expected integration of deterministic and probabilistic information is accomplished by implementing the following steps:

1) Identify all the initiating faults
2) Engineer out the faults if possible
3) Low consequence faults are addressed by good radiological practices
4) The remaining faults are listed on a “Fault Schedule”
5) Faults with a frequency of greater than 10^{-5} are considered DBAs and are to have an extensive set of engineering SAPs applied to reduce risks ALARP
6) Faults with a frequency of less than 10^{-5} are considered beyond DBAs and, if the faults have associated high consequences, are to have severe accident SAPs applied to determine appropriate accident management strategies.

4. Enforcement

HSE has recently adopted an Enforcement Management Model (EMM) to promote consistency, transparency, and targeting in the enforcement arena. The EMM is a process to assist inspectors in deciding on regulatory action. The EMM compares actual risks from an activity to risk benchmarks (from legislation, guidance and policy) to determine a risk gap.

Pending Actions/Planned Next Steps for NRC

On November 30, 2001, the NRLPO staff met with NII staff to discuss how knowledge and experience can continue to be shared in the future. Both parties agreed that future exchanges should be beneficial to both parties and that they should be based on actual work needs. NRLPO will continue to explore these information exchanges to better prepare the NRC for new reactor licensing activities.