March 4, 2003

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

FROM: Stephen S. Koenick, 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 19-22, 2002, Stephen Koenick 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
T. Rothschild, OGC
T. Bergman, OEDO

Attachment: As stated

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# 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 19-22, Stephen Koenick of the New Reactor Licensing Project Office (NRLPO) participated in a safety assessment course sponsored by U.K HSE in Whiston, U.K.

## Author, Title, and Agency Affiliation

Stephen Koenick, Project Manager
Regulatory Infrastructure
New Reactor Licensing Project Office
Office of Nuclear Reactor Regulation

## Sensitivity

Not applicable

## Background/Purpose

The primary objectives of the trip were for the Nuclear Regulatory Commission (NRC) to obtain knowledge of: (1) the regulatory scheme used in the U.K. and (2) the U.K.'s experience with licensing multiple facilities under one license. The experience gained from the training will support the staff's development of new reactor licensing regulatory infrastructure.

## Abstract: Summary of Pertinent Points/Issues

The Health and Safety at Work Act of 1974 (HSWA) provides the basic legal requirement in the U.K. for health and safety related to work activities. The HSWA places the responsibility on employers to ensure health, safety and welfare of their employees. The employer is required to ensure these duties are met "so far as is reasonably practicable[1]." To provide a general approach to implement this requirement, the Nuclear Installations Inspectorate (NII) employs a philosophy called Tolerability of Risk (ToR). The ToR philosophy introduces three zones of risk applicable to all facilities. The first zone includes risks that are so high that they cannot be justified except in extraordinary circumstances. The second zone includes risks that are so low that they are considered broadly acceptable by society. The third zone 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 address probabilistic and deterministic aspects of nuclear plant design, construction, and operation. The SAPs give guidance on the criteria which need to be satisfied in the analysis to demonstrate ALARP. The ToR philosophy and SAPs apply to the various

[1]This principle is enveloped by as low as reasonably practicable (ALARP).

types of facilities under NII. HSE expanded on the ToR philosophy in the framework document "Reducing Risk, Protecting People," which applies across the full range of risks within the scope of the HSWA.

## Discussion

1. U.K. Regulatory Structure

The Health and Safety Commission (HSC) is the statutory body responsible for the administration of the HSWA and its subsidiary legislation which includes the Nuclear Installations Acts. It is composed of nine members representing employers, employees, local authorities, and the public, and a chairman appointed by the Secretary of State for Employment. For nuclear matters, the HSC is advised by the Advisory Committee on the Safety of Nuclear Installations. The HSE is a corporate body of three people appointed by the HSC, and has some 4500 employees. Its Management Board includes the Chief Inspectors of the various inspectorates concerned with the enforcement of industrial health and safety. The HSE has the licensing authority of nuclear installations. This function was delegated to the Chief Inspector of Nuclear Installations.

NII is responsible for regulatory oversight of 32 nuclear installations including nuclear reactors, chemical processing facilities, and submarine facilities. NII has approximately 280 employees (110 of which are administrative) 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 Environmental Agency (EA) is responsible for regulating the discharges to the environment and disposal of radioactive waste on or from nuclear licensed sites, and the associated organizational management arrangements. The relationship between HSE and EA is governed through a memorandum of understanding (MOU).

Security of the civil nuclear industry is regulated by the Office of Civil Nuclear Security (OCNS), a part of the Department of Trade and Industry (DTI). HSE has an MOU with OCNS with respect to nuclear licensed sites to prevent the imposition of conflicting requirements on a licensee. DTI is proposing new security regulations under the Anti-terrorism, Crime and Security Act 2001. A provision of this act requires the Secretary of State to consult HSC and other appropriate persons before the regulations can be made.

2. U.K. Regulatory Philosophy

The basic philosophy that NII employs is called ToR. The ToR philosophy divides risks into three regions. The "unacceptable region" includes risks that are so high that they cannot be justified except in extraordinary circumstances. The "ALARP" region 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. The "broadly acceptable" region includes risks that are so low that they no longer warrant regulatory attention. While there is no longer regulatory attention, the licensees must still adhere to the ALARP concept. Applicants for nuclear site licenses and existing licensees need to be capable of satisfying the requirements of the HSWA and the

conditions on their licenses. For any nuclear installation there is a standardized set of 36 license conditions (LCs) which cover the nuclear life cycle. Most notable, 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 and 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 identify the conditions and the limits necessary in the interests of safety, and requires these limits and conditions to be defined as operating rules. Each safety case 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 is still obligated to reduce risks ALARP, but does not need to demonstrate this to the regulator.

In addition, LC 15 requires that the licensee shall systematically and periodically review and reassess safety cases to ensure their continuing validity. In particular, licensees are subject to periodic safety reviews (every 10 years). The results of the review are issued as a public report and sent to the licensee.

3. Safety Assessment Principles (SAPs)

In order to have a consistent and uniformed approach to the assessment process for safety cases, NII has developed a set of SAPs. Not all of the principles are relevant to each facility, but to the extent to which the relevant principles are satisfied is an important factor in the licensing process. The SAPs are supported by more detailed internal "Technical Assessment Guides." 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.

There are 333 SAPs. Specifically, SAPs P1-P14, "Fundamental Principles and Limits," address ALARP principles to be applied to radiological exposure resulting from normal operation and dose limits for normal operation. Also SAPs P15 - P55, cover accident analysis and include risk and dose criteria for accidents.

The majority of the SAPs involve engineering and deterministic principals. Specifically, the safety case should demonstrate how the plant mitigates the effects of foreseeable faults and hazards by a deterministic analysis—representing the design basis analysis. Some of the key principles are: avoid hazards through design; use of passive features; use of redundancy, diversity and segregation; defense-in-depth, single failure criterion; and no reliance on human action within 30 minutes. The SAPs also promote good engineering practices such as conformance with applicable codes and standards and assurance of adequate margins between normal operational values and values at which the physical barriers to release are challenged.

This deterministic approach is complemented by a probabilistic safety analysis (PSA). The PSAs rely on two thresholds, 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 further reduce risk. 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.

For siting of a nuclear facility, there are five SAPs, which to a large extent, state that the site can be considered independently of the design. The areas of review are emergency planning, topography and meteorology effecting dispersion of potential radioactive materials, and natural and man-made hazards in the area. Two interesting notes are: 1) new designs should be constructed on remote sites until experience is gained to relax siting, and 2) once a site has been approved, controls should be exercised, as far as is reasonably practicable, to ensure the local population does not grow in such a way to exceed emergency planning measures.

**Pending Actions/Planned Next Steps for NRC**

The NRC is currently exploring opportunities for international cooperation in new reactor design reviews with NII and Canada. Improved understanding of the NII regulatory infrastructure would benefit any collaborative efforts that result from this consideration.

This marks the second time NRC has participated in this course. NII has a suite of courses geared toward training with their regulatory structure. It may be beneficial to explore other courses to maximize exposure to their regulatory structure.

**Points for Commission Consideration/Items of Interest**

There are no Commission action items resulting from this trip.

**Attachments**

The author maintains all course material.

**"On the Margins"**

There was no "marginal" information resulting from the trip.