October 27, 1999

MEMORANDUM TO: C. William Reamer, Chief
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[Original signed by:]

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SUBJECT: REPORT ON PAUL DAVIS' TRIP TO MADRID, SPAIN ON June 28-July 2, 1999

Attached is a report from Paul Davis of Sandia National Laboratories (SNL) on his participation in the recent International Atomic Energy Agency's (IAEA) International Safety Assessment Methodologies (ISAM) program working group meeting in Madrid, Spain. SNL was tasked under Job Control Number 5131 to attend this meeting on behalf of the U.S. Nuclear Regulatory Commission (NRC).

The objectives of the ISAM program are: 1) to critically evaluate and enhance approaches and tools currently being used in post-closure safety assessment of near-surface disposal facilities, and 2) to provide practical experience in implementing these approaches and tools. Key areas being addressed by the ISAM program are scenario development, model selection, and confidence building. Similar issues are being considered by the NRC in developing performance assessment guidance for low-level radioactive waste disposal (i.e., the Branch Technical Position on Low-Level Radioactive Waste Performance Assessment) and decommissioning (i.e., the Standard Review Plan for Decommissioning). Therefore, Mr. Davis was asked to attend this meeting to continue our dialogue with ISAM participants on these important issues.

Attachment: Report on Paul Davis' Trip to Madrid, Spain

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TRIP REPORT
ISAM MEETING
Confidence Building Working Group
28 June – 2 July 1999
Madrid, Spain

Paul A. Davis
Environmental Risk and Decision Analysis Department
Sandia National Laboratories
October 6, 1999

Attachment

Overview

This trip report is being submitted in support of Project JCN 5131 performed by Sandia National Laboratories for the U.S. Nuclear Regulatory Commission.

Purpose

The purpose of this trip was to participate in the Confidence Building Working Group of the International Atomic Energy Agency's (IAEA) International Safety Assessment Methodologies (ISAM) program. The following sections contain a summary of the working group session, the list of participants, and the current draft of the Confidence Building effort.

Background and Status

IAEA began ISAM in 1996 with the express purpose of reviewing and enhancing safety assessment methodologies associated with shallow land burial of low-level radioactive wastes and the additional purpose of providing participates with experience in performing safety assessments. This program is a continuation of the IAEA NSARS program which NRC participated in. ISAM currently has the participation of over 30 countries and over 75 individuals. This meeting was hosted by the Consejo de Seguridad Nuclear (CSN) and CIEMAT Research Center at the CIEMAT Headquarters in Madrid, Spain.

ISAM is divided into two sub-efforts. The first effort is concentrated on issues associated with safety assessments and is organized into "Working Groups" on: 1) scenario definition; 2) models and data and; 3) confidence building. The second effort, referred to as the "Group Safety Cases" is focused on case studies. At this meeting, parallel sub-group meetings were held on the scenario definition working group, one safety case, the confidence building working, and the ISAM virtual workspace. Other than a brief summary meeting at the end of each day, these groups did not interact with each other. I participated in the Confidence Building Working Group and will report only on their efforts.

The Confidence Building Working Group has subdivided their effort into: 1) Quality Assurance; 2) Compilations of regulations and example safety cases; 3) Uncertainty and Sensitivity Analysis and; 4) Communications. Initial information on each of these sub-topics has been generated by sub-groups of individuals. The goal of this meeting was to begin organizing the input received and begin drafting the final Confidence Building Working Group report. This working group is led by George Dolinar of Atomic Energy of Canada Limited (AECL) at the Chalk River Laboratory. Participants at this meeting included Borislava Batandjieva of the Inspectorate on the Safe Use of Atomic Energy (ISUEA), Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) in Bulgaria, Elizabeth Pontedeiro of the Superintendence of Licensing & Control Comissao Nacional de Energia Nuclear (CNEN) in Argentina, and Laurent Dujacquier of the Belgian Agency for Radioactive.

Essentially the meeting was a week long writing exercise that attempted to define a template for the final report. The goal of this meeting was to integrate the results of the Confidence Building Working Group survey (which was explained and included in my last ISAM trip report) which include questions on regulations, efforts to communicate with the public and the ISAM efforts to date in quality assurance, the compilation of example safety cases, and the draft ISAM paper on uncertainty and sensitivity analysis. One of the key issues we had to resolve was whether the goal of the group was to increase our confidence in the safety assessments we performed or to increase public confidence in our assessments. This issue was not totally resolved but the general consensus seemed to be that we must address both. After much discussion about how to organize the report, we decided to follow the decision framework that was agreed upon by all ISAM participants. This framework looks strikingly like the framework provided in the NRC Low-Level Waste Branch Technical Position and the decision framework for Decontamination and Decommissioning found in NUREG-1549. In essence, the working group agreed to write something that looks a lot like the performance assessment process portion of the NRC BTP for LLW.

The difficulty with this task is that only a few of the participants have extensive experience in performance assessments for shallow land burial or previously buried material (equivalent to D&D sites). This is both an opportunity and a challenge for NRC involvement. At this point NRC could provide a lead role in writing this document which because of background and perspective would make the document look a lot like the NRC's LLW BTP. In turn, this document will not only be reviewed by this working group but also by the entire ISAM team which would provide NRC with excellent feedback on their approach to LLW performance assessment. The challenge is writing a document while at the same time bringing some participants up to speed. However, this process could also provide new insights for NRC as sometime the most enlightening comments come from people who have not formulated their opinions on how to perform these analyses. Also, participation would help to preserve NRC's reputation as a leader in this field.

At the conclusion of the meeting the group produced an outline and the start of a working draft. Since the meeting some of the group members have continued to work and produced the draft that is included in this report. They have asked me to participate in this continued effort. However, NRC has not committed to ISAM involvement except for participation in ISAM meetings. Therefore, while I believe I would have a lot to contribute, I have not been able to.

Attached you will find the current draft of the Confidence Building Working Group and the list of participants at the Madrid meeting.

CONFIDENCE BUILDING WORKING GROUP DRAFT

I. INTRODUCTION

II. COMPILATION QUESTIONNAIRE

3. SUMMARY OF THE RESPONSES AND RELATION TO THE CONFIDENCE BUILDING

3.1. REGULATORY ASPECTS
3.1.1. Acts and Regulations
3.1.2. Classification of Radioactive Waste
3.1.3. International Documents Applied in the Country
3.1.4. Requirements on the Type of Waste to be Disposed of
3.1.5. Requirements on the Facility Design and Location
3.1.6. Targets
3.1.7. Dose Limits
3.1.8. Period of Institutional Control
3.1.9. Discharges, Exempt, Clearance Limits
3.1.10. Requirements on the Monitoring
3.1.11. Public Communication

3.2. REQUIREMENTS ON THE SAFETY ANALYSES REPORT
3.2.1. Type and Content of the Safety Analyses Report
3.2.2. Period to be Evaluated
3.2.3. Risks
3.2.4. Validation
3.2.5. Verification
3.2.6. Treatment of Uncertainties

3.3. SAFETY CASES

4. CONFIDENCE BUILDING IN THE SAFETY ASSESSMENT PROCESS

A. Assessment Context

The confidence building at the stage of development of a safety assessment context is derived from the existing regulatory requirements established by the legislative basis, adopted classification of radioactive waste, requirements set by the regulatory body on the facility design, type of waste to be disposed of, the targets and dose limits to be met and defined institutional control (active and passive), as well as clearance and exempt limits.

The legal framework defined by acts and regulations defines the policy, who is responsible to implement the policy, defines the limits, requirements and the scope of radioactive waste management

The classification and the requirements on the type of the radioactive waste sets the upper limits for the repository according to which the disposal is defined. The classification establishes the boundaries of the waste inventory in terms of radionuclide content, activities, physical and chemical form, half-life, heat generation, dose (direct exposure), waste origin and ownership (e.g. defence). The waste acceptance criteria in addition defines the limits on the waste form (implicitly related to the performance of the facility), e.g. requiring container type (stainless steel, etc.), matrix type (cement), source term performance (leachability, compressive strength, solubility, etc.). Requirements on facility design are also meant to increase confidence in the overall performance of a repository. Requirements listed by participants can be classified as requirements design to address risk management and risk assessment. For example, risk management requirements include such things as retrivability, transportation considerations, acceptance of the facility by local communities, etc. Requirements directly affecting risk assessment by eliminating scenarios (FEPs), e.g. consideration of earthquakes, high tides, etc., limiting the pathways as exclusion of groundwater use, etc.

Targets, including dose and risk limits, define the acceptable level of safety. The targets set the goal of the safety assessment and the end of the pathway, the people to be protected (individual or population dose). Some countries define a specific hypothetical group (critical group) to be protected. The defining the critical group includes the prescription of the pathways and behaviour parameters.

The period of institutional control over a RAW disposal facility could be classified as active and passive. The definition of the "active" and "passive" control is required to be clearly defined, as the institutional control has direct influence on the definition of the scenarios. For example, usually it is not assumed human intrusion scenario during institutional control, because it is expected that necessary measures will be implemented during this period. The combination of the control over the facility and the radioactive decay of the waste contribute to the confidence that the facility will maintain the acceptable level of safety.

The period to be evaluated in the safety assessment is limited in some countries (from 10 000 to 100 000 years). Other countries put not such limit, requiring a calculation of either peak dose or maximum risk, regardless of the time of occurrence. In both case the objective is to assess the maximum risk or dose after withdrawing of the control from the disposal site.

The monitoring of a disposal facility aims at management of the uncertainty related to the repository behaviour. The monitoring is to be distinguished from the process of collecting data, necessary for the better performance of a safety assessment. The monitoring can be classified according to the different purposes. Almost all countries perform monitoring related to the performance of the disposal facility, which covers monitoring of the releases, where the detection of release could result in reassessment of safety or remediation. Some countries monitor to improve safety assessment, e.g. they monitor input parameters, monitor dependent parameters used for model calibration, etc.

Public communication is used mainly for the several purposes. First to build confidence in the public on the results of the safety assessment. Second to receive input (feedback) from the public on the issues of concern to be addressed in the safety assessment that could contribute to the review of the safety assessment performed.

International documents are used to define standard practices, recommendations, and guidelines for siting, design, construction, operation, safety assessment, and long-term care and monitoring of disposal facilities. With specific regard to the safety assessment process, international documents have also been used to standardise some of the key uncertainties. For example, most countries utilise internationally accepted dose conversion factors instead of directly addressing the uncertainty of the dose response model in the safety assessment process.

A. Description of the System

Building confidence in the description of the system assessed covers both the engineering and the natural aspects. The engineering aspects include the confidence of the knowledge on the design, inventory, etc. And the natural aspects include the confidence in the knowledge of the natural barriers, geology, hydrogeology, etc. of the disposal site.

At this stage uncertainty exists related to the uncertainty of knowledge (parameters, data), uncertainty of the performance of the facility as a function of time, as well as uncertainty of the natural system and variability of the system. These uncertainties could be represented either quantitatively on qualitatively depending on the safety case.

A. Development and Justification of the Scenarios

The stage of development of scenarios and their justification is an essential step in the whole safety assessment process. It has to cover development of an inclusive list of scenarios that represents the possible future evaluation of the system.

The systematic approach for including or excluding scenarios is to be very well described, together with the criteria defined for this purpose. The process of development and justification of scenarios has to be well documented, transparent, and enabling traceable.

The scenarios developed are to be justified. One of the possible measures for this purpose is to use comparison with the natural analogues.

Justification of the screening process needs to be defensible. One of the tools for tracking the screening and decisions made could be performed in detailed manner by using the matrix approach.

A. Formulation and Implementation of the Models

The first step in this process is to define the conceptual models that represent the scenario consistent with the description of the system. It also includes the representation and definition of the parameters available. The mathematical model is a representation of the conceptual model that is usually solved by utilisation of a computer code.

Building confidence in the conceptual model is first recognising that multiple conceptual models may be consistent with the description of the system. In this case the "worst case" could be selected and assessed or the conceptual models could be run in parallel and analysed.

In most of the safety cases the use of available codes takes place after developing the conceptual model. Confidence building is important to prove that the code is consistent and comply with the model.

When for a developed conceptual model a computer code is used and the safety case results as inadequate, either the model has to be approximated or the computer code and it is decided on case by case basis.

In the case when several conceptual models are developed it is important to compare them and analyse the parameter uncertainty as well as the model uncertainty. The treatment of the parameter and model uncertainties could be achieved in the same way. The conceptual models are not to be weigh in a probabilistic way.

An important aspect is the understanding of the computer code represents the mathematical model and this could be achieved through the quality assurance process by defining the strengths and weaknesses of the code used.

A. Performance of Analyses

The confidence building at this stage ensured through the quality assurance.

A. Interpretation of Results

The uncertainty has to be treated aiming at gaining confidence at the final result of the safety assessment performed. In the case when the uncertainties were not considered this has to be done at the stage of interpretation of the results (deterministic approach). In case of the probabilistic approach, the uncertainties are considered in each step of the safety assessment performed.

The uncertainty of the analysis performed has to be treated depending on the work carried out before. In case that this aspect was considered at the first steps then the uncertainty analysis is to be continued. If it was not considered then the uncertainty has to be analysed.

For the deterministic analysis a sensitivity analysis has to be carried out aiming at definition of the most important model parameters.

A. Comparison against Assessment Criteria

The confidence of the safety assessment performed relates to the compliance of the results obtained with the regulatory requirements and recommendations.

A. Adequacy of the Safety Case

At the early iteration of safety assessment when the results meet the assessment criteria, it has to be carefully analysed. In the case of running sensitivity analysis and defining the important model parameters it may be considered important to review those parameters. This could be achieved by reviewing the variability of the parameters used, by obtaining additional data, etc. which has to be decided case by case basis.

A. Effectiveness of Modifying Assessment Components

In case of non-acceptance of the safety case it is necessary to review and modify the assessment components by reviewing the waste acceptance, design, etc. The requirements on evaluation of the data are important for ensuring confidence in the effectiveness of the modifications made.

For the probabilistic analysis a sensitivity analysis has to be carried out aiming at definition of the most important model parameters.

A. Review and Modification

The review of the modifications proposed is related to the expert judgement, collection of necessary data, monitoring and assessment of the most important components to be modified and what extent.

A. Collection of Data and/or Modification of Design

This step is more applicable to the facilities where it is considered important to put more effort on obtaining additional data (e.g. through monitoring).The design modification could be more applicable for planned facilities or additional modifications of an existing ones.

A.

The first “HEADING 2” level heading

CO-ORDINATED RESEARCH PROGRAMME FOR IMPROVING LONG TERM SAFETY ASSESSMENT METHODOLOGIES FOR NEAR SURFACE RADIOACTIVE WASTE DISPOSAL FACILITIES (ISAM)

MEETING OF THE ISAM WORKING GROUPS

Organized by Consejo de Seguridad Nuclear (CSN) and CIEMAT Research Center
CIEMAT Headquarters, Madrid, Spain, 28 June – 2 July 1999

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