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Functional Theory and Information Content of New Measurements *Nuclear Waste* **Nuclear Waste Cleanup République française. C. L. N. Uncertainties and Sensitivities in the Performance of Geologic Nuclear Waste Isolation Systems Fusion-fission Systems Analysis and the Impact of Nuclear Data Uncertainties on Design Nuclear Waste Nuclear Waste A Comparison of Methods for Uncertainty Analysis of Nuclear Power Plant Safety System Fault Tree Models An Integral Approach for Calculating Uncertainties in Consequences from Nuclear Reactor Accidents Using Nuclear Theory, Data and Uncertainties in Monte Carlo Transport Applications**

This report presents the conclusions, observations, and recommendations of the Independent Technology Review Group (ITRG) regarding design features and important technology uncertainties associated with very-high-temperature nuclear system concepts for the Next Generation Nuclear Plant (NGNP). The ITRG performed its reviews during the period November 2003 through April 2004. With concerns over global climate change, U.S. policymakers are exploring ways to reduce domestic dependence on coal and natural gas. No new nuclear plants have been ordered since 1978. However, federal and state policies and legislation have attempted to reduce risks to nuclear plant developers or re-allocate them to customers and to improve expected returns from investments in nuclear energy capacity. Past regulatory decisions and court decisions also have implications for cost recovery. Investments in nuclear power plants are irreversible and involve uncertainties during both construction and commercial operation. Uncertainties confronted by developers of merchant plants and price-regulated plants differ due to the regulatory and market paradigm in which these plants operate. Texas and Florida provide useful case studies in their respective policies toward new generation, including nuclear generation. Texas has a largely restructured electricity market, and Florida's power generation is subject to traditional rate-of-return regulation. In particular, the regulatory/market framework affects both the expected returns on investment and the likelihood and timing of the recovery of investments made in nuclear plants. The effectiveness of current federal and state policies will depend on the developers' perceptions of how risks associated with uncertainties during construction (including those uncertainties surrounding changing governmental regulations) affect construction costs, how risks linked to revenue and operating uncertainties during a plant's commercial operation affect the timing and potential for cost recovery, and ultimately how these risks affect the decision to build nuclear plants. These risks undoubtedly matter to developers whose reputations may be affected by the long-term financial viability of such projects. We use an option value model developed by Robert Pindyck (1993) and extend that model to explain the uncertainties facing prospective developers of nuclear plants. We conclude with several observations about strategies states may consider undertaking to mitigate investment risk. Nuclear Waste: Uncertainties About the Yucca Mountain Repository Project Dedicated specifically to nuclear analytical techniques, this publication is intended to assist scientists using alpha, beta and gamma spectrometries, neutron activation and XRF analyses, and other nuclear analytical methods, in assessing and quantifying the sources of uncertainty in their daily measurements. This paper presents a Personal Computer-based model that uses an integral approach for calculation of early off-site consequences resulting from nuclear power plant accidents. The computing time requirements for a typical calculation on a mainframe computer using this model are two orders of magnitude lower than those of CRAC2 and MACCS codes, thus providing a valuable tool for sensitivity and uncertainty studies. The model predicts time-integrated air concentration of each radionuclide at any location from release as a function of time-integrated source strength using the Gaussian plume model. The concentration can be calculated at the centerline of a Gaussian profile or, optionally, as an average over the cross-section based on a top-hat distribution. The solution procedure involves direct analytic integration of air concentration equations over time and position. This is different from the differential approach currently used in CRAC2 and MACCS codes. The present model uses simplified meteorology. Dispersion parameters are calculated from exponential fits to the Pasquill-Gifford curves for six atmospheric stability classes designated A to F, and from an approximation as indicated in Reg. guide 1.145 for the seventh stability class G (extremely stable). 8 refs., 2 figs. Experts from science, industry, and government discuss the unresolved scientific and technical issues surrounding the Yucca Mountain site as a geologic repository for high-level nuclear waste. This report describes Kiwi, a program developed at Livermore to enable mature studies of the relation between imperfectly known nuclear physics and uncertainties in simulations of complicated systems. Kiwi includes a library of evaluated nuclear data uncertainties, tools for modifying data according to these uncertainties, and a simple interface for generating processed data used by transport codes. As well, Kiwi provides access to calculations of k eigenvalues for critical assemblies. This allows the user to check implications of data modifications against integral experiments for multiplying systems. Kiwi is written in python. The uncertainty library has the same format and directory structure as the native ENDL used at Livermore. Calculations for critical assemblies rely on deterministic and Monte Carlo codes developed by B division. It is sometimes the case in PRA applications that reported plant-specific failure data are, in fact, only estimates which are uncertain. Even for detailed plant-specific data, the reported exposure time or number of demands is often only an estimate of the actual exposure time or number of demands. Likewise the reported number of failure events or incidents is sometimes also uncertain because incident or malfunction reports may be ambiguous. In this report we determine the corresponding uncertainty in core damage frequency which can b attributed to such uncertainties in plant-specific data using a simple but typical nuclear power reactor example. Maintaining the capabilities of the nuclear weapons stockpile and performing the annual assessment for the stockpile's certification involves a wide range of processes, technologies, and expertise. An important and valuable framework helping to link those components is the quantification of margins and uncertainties (QMU) methodology. In this book, the National Research Council evaluates: how the national security labs were using QMU, including any significant differences among the three labs its use in the annual assessment whether the applications of QMU to assess the proposed reliable replacement warhead (RRW) could reduce the likelihood of resuming underground nuclear testing This book presents an assessment of each of these issues and includes findings and recommendations to help guide laboratory and NNSA implementation and development of the QMU framework. It also serves as a guide for congressional oversight of those activities. These are slides for a presentation on using nuclear theory, data and uncertainties in Monte Carlo transport applications. The following topics are covered: nuclear data (experimental data versus theoretical models, data evaluation and uncertainty quantification), fission multiplicity models (fixed source applications, criticality calculations), uncertainties and their impact (integral quantities, sensitivity analysis, uncertainty propagation). Nuclear power is one of many options available to achieve reduced carbon dioxide emissions likely to be mandated by an (as yet) undefined national climate change policy. Investment costs in nuclear power are greater than in any other conventional generating technology. They are irreversible and involve uncertainties during the project's development, construction, and commercial operation. This article extends a real-option value model (Robert Pindyck, 1993) to explain the uncertainties facing prospective nuclear plant developers and applies that model to describe mitigation strategies available for the development, construction, and operation of new nuclear plants. Reviews whether (1) the funding for the scientific investigation of Yucca Mountain, Nevada, as a potential site for a nuclear waste repository is sufficient to permit the Department of Energy (DoE) to meet its schedule and (2) initiatives by DoE to streamline the investigation could affect the investigation's scientific quality. Graphs and charts. We have pleasure in presenting Volume Fourteen to our readers. Volume Fourteen signifies a new dimension for our series, a volume devoted to the development of a single timely topic, that of sensitivity to uncertainty. This is still a broad topic and has been treated as such by the se veral distinguished authors contributing to the volume from their extensive experience both in theory and practice. While the theme running through the volume emphasizes uncertainties in areas related to reactor physics, it is true to say that this field of application has much to offer other disciplines as well. Some of the authors are engaged in ex tensions to other areas. The volume may therefore appeal to a much wider audience who will appreciate a single and compre hensive overview of a methodology that is applicable to other fields. Notable developments in the field of nuclear engineering have included the formatting in recent versions of Evaluated Nuclear Data Files (e.g., ENDF/B and its variants) of cross section uncertainty, the general acceptance of good practice in the representation of error correlation matrices, and more recent developments in the application of Monte Carlo tech niques to sensitivity analysis in complex geometries. An in-depth and balanced economic analysis of the costs, hazards, regulation and politics of nuclear power. The effects of uncertainties of nuclear data on the calculation of integral quantities for some fast breeder systems were evaluated. The integral quantities chosen were reactivity, initial breeding ratio, and initial internal breeding ratio. The fuels chosen were plutonium-239-uranium-238, both as metal and oxide, and uranium-233-thorium as oxide. The importance of propagation of errors on the uncertainty in reactivity was determined. Results indicated that because of inaccuracies in the values of nuclear parameters as known within the present state of the art'' the deviations of the calculated reactivities should be about, and possib1y larger than, 2% DELTA k/k for all the medium and large systems considered. The deviation of the initial breading ratio is 3.5%, and for the initial internal breeding ratio it is about 5%. The consequent uncertainty in the calculated critical mass is of the order of 4%. Deterministic safety analysis is an important tool for confirming the adequacy and efficiency of provisions within the defence in depth concept for the safety of nuclear power plants

(NPPs). IAEA Safety Standards Series No. NS-R-1.2 and Safety Reports Series No. 23 recommend, as one of the options for demonstrating the inclusion of adequate safety margins, the use of best estimate computer codes with realistic input data in combination with the evaluation of uncertainties in the calculation results. The evaluation of uncertainties is an issue of considerable complexity, and this Safety Report has been developed to complement the existing publications. It provides more detailed information on the methods available for the evaluation of uncertainties in deterministic safety analysis of NPPs and practical guidance in the use of these methods. In 1998, the U.S. Department of Energy (DoE) plans to begin a $19 billion program to dispose of 176,000 c.m. of transuranic waste that will be permanently stored in the Waste Isolation Pilot Plant (WIPP), a repository near Carlsbad, NM. However, DoE must first obtain from EPA a certificate of compliance with its disposal regulations for radioactive waste and meet the requirements of RCRA for handling and disposing of hazardous waste. This report assesses the prospects for opening WIPP and determines how well DoE is positioned to begin filling it in the first few years of operation and longer. The basic concepts of probability and statistics in nuclear science are explained in detail, and their applications to practical problems are illustrated with examples rather than formal proofs. An extensive bibliography is included. Statistical tools of uncertainty quantification can be used to assess the information content of measured observables with respect to present-day theoretical models, to estimate model errors and thereby improve predictive capability, to extrapolate beyond the regions reached by experiment, and to provide meaningful input to applications and planned measurements. To showcase new opportunities offered by such tools, we make a rigorous analysis of theoretical statistical uncertainties in nuclear density functional theory using Bayesian inference methods. By considering the recent mass measurements from the Canadian Penning Trap at Argonne National Laboratory, we demonstrate how the Bayesian analysis and a direct least-squares optimization, combined with high-performance computing, can be used to assess the information content of the new data with respect to a model based on the Skyrme energy density functional approach. Employing the posterior probability distribution computed with a Gaussian process emulator, we apply the Bayesian framework to propagate theoretical statistical uncertainties in predictions of nuclear masses, two-neutron dripline, and fission barriers. Overall, we find that the new mass measurements do not impose a constraint that is strong enough to lead to significant changes in the model parameters. In addition, the example discussed in this study sets the stage for quantifying and maximizing the impact of new measurements with respect to current modeling and guiding future experimental efforts, thus enhancing the experiment-theory cycle in the scientific method.

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