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Summary

- Fifty-four years of broad-based experience within the nuclear industry, including commercial nuclear power and the support of U. S. Government programs.
- Fourteen years of technical support to the U. S. Department of Energy for the production of isotopes for medicine and industry
- System design, fabrication, and testing of terrestrial and space nuclear systems, with particular expertise in the areas of neutronic and thermal-hydraulic analysis of reactor cores and systems.
- Nuclear safety, including criticality safety, radiological safety, risk assessment, and reliability of operations for power and experimental reactors and their fuel fabrication facilities
- Thirty-four years of program management and technical support to the U. S. Department of Energy, covering nuclear technologies, systems, facilities, safety, quality, and reliability.
- Policy analysis covering a broad range of subjects including nuclear site selection and compliance with the NEPA process, nuclear non-proliferation, human interference in waste repositories, and the National and international aspects of the use of nuclear power in space.

Education

Ph.D., Nuclear Engineering, Massachusetts Institute of Technology, 1962

S.M., Nuclear Engineering, Massachusetts Institute of Technology, 1958

S.B., Chemical Engineering, Massachusetts Institute of Technology, 1957

Security Clearance

DOE Q (Active)

Qualifications

Space and Terrestrial Reactor Systems – Was Program Manager and principal technical contributor in the support of DOE's space reactor power and propulsion development programs for the Department of Energy's Office of Defense Energy Projects. Support areas included program management, safety, quality assurance, and reliability, as well as technical assessment and evaluation of the technologies used for the nuclear reactor power systems. Technical areas included reactor physics, thermal hydraulics, shielding, and safety analysis.

Designed and participated in critical experiments and shielding experiments for the SNAP2 and SNAP8 projects, and was responsible for the reactor physics experimental program of the SNAP Aerospace Safety Project, including the destructive SNAP transient experiment program at the National Reactor Testing Station. Coordinated the SEFOR critical experiments at ZPR-III and was the GE on-site representative. Designed and performed critical experiments for the evaluation of BWR design methods, and developed reactor physics and core thermal-hydraulic computational methods for BWRs. Had prime managerial and technical responsibility for this work, and participated in the development of the computer programs, their experimental verification, and their application to reactor design. Supervised GE's PWR modeling and benchmarking efforts, which served as a basis for evaluation of competitive offerings. Performed diverse consulting and staff assignments, covering such areas as engineering procedures in support of licensing efforts, qualification testing of BWR hardware systems, safety review of offgas systems, verification of ECCS calculational procedures and data base, and program management for systems engineering work on advanced BWR chemical systems. Led comprehensive design reviews of fuel design and performance under normal and accident conditions, including pellet-clad interaction and fission gas release; control rod drive performance including scram rate, materials capability, fine motion control, and redundant position indication; and many other aspects of BWR nuclear steam supply systems.

Safety, Quality, and Reliability – Participated extensively in the development and execution of quality, reliability, and safety programs in the commercial nuclear sector, and in support of DOE programs and facilities. Performed numerous criticality safety calculations ranging from commercial reactor fuel fabrication, storage, transportation,

and core loading to evaluations of accident scenarios for space reactors and for RTGs. Participated in nuclear safety and licensing activities of nuclear facilities and activities within the commercial and DOE sectors. These activities included review of Safety Analysis Reports for DOE research reactor modifications and upgrades (BMRR, HFBR, HFIR and ATR) and contribution to Safety Evaluation Reports. Research Reactor experience includes membership in the ANS N-17 Standards Consensus Committee (vice chairman), which has responsibility for the ANSI/ANS 15 series of research reactor standards.

Performed studies of risks associated with isotope and reactor power sources for space applications and was Program Manager and principal contributor for reliability engineering studies for the assembly and testing of radioisotope thermoelectric generators.

Program and Business Management – Served in diverse technical, programmatic, and business management positions, primarily in the areas of reactor physics, thermal hydraulics, shielding, safety analysis, and special consulting tasks and interdisciplinary projects in the nuclear and alternative energy fields.

Policy Analysis – Was principal investigator for the major Nonproliferation Alternative Systems Assessment Program (NASAP) support contract with the DOE, having had a leading role in supporting the management of the program, the analysis of strategy options, and the development of the draft and final versions of the NASAP program report, including the incorporation of and responses to comments from the public. Participated in a study of human interference with high-level waste repositories. Supported the selection of the SP-100 Ground Reactor Test Site, including the writing of the Environmental Assessment and its approval through the NEPA process, with public involvement.

Employment

INDEPENDENT CONSULTANT, 2002-present

SCIENTECH, Inc., Senior Consulting Engineer, 1996-2002

Perform technical and program management of diverse contracts in nuclear related areas for commercial and government clients. Provided classification support to USEC regarding their SILEX program.

NUS, Senior Executive Consultant, 1980-1996

Line manager of 16 professionals including subtier managers. Program manager and principal technical contributor for a contract to the Department of Energy's Office of Nuclear Energy, providing support in the areas of facility oversight, isotope production and distribution and DOE's space reactor power and propulsion development programs. Support areas included program management, safety, quality assurance, and reliability, as well as technical assessment and engineering evaluation of facility issues and technologies used for space nuclear reactor power and propulsion systems. Managed and performed special consulting tasks and interdisciplinary projects, primarily in the nuclear and alternative energy fields.

Science Applications, Inc., Division Manager, 1977-1980

Was responsible for the financial and technical management of the Reactor Services Division, a \$2 million cost center, providing program management, power reactor design and operational support, and nonproliferation assessment.

General Electric Company, Nuclear Energy Division, Subsection Manager, Senior Engineer, 1965-1977

Line manager of over 40 professionals, including subtier managers, providing program management and technical contributions in the areas of experimental and analytical reactor physics, nuclear and thermal-hydraulic core design methods, BWR systems engineering, qualification testing, safety and reliability engineering, quality assurance.

Atomics International, Senior Engineer, 1962-1965

Managed \$1-2 million safety research program, providing technical contributions in the areas of reactor physics, shielding, and aerospace safety for the SNAP Reactor Program.

Publications

"A System Study of Bimodal Space Nuclear Power and Propulsion Technology for DoD Mission Applications" (co-author), PL-TR-96-1001, December 1995.

"NEBA-3 Pin and Cermet Hybrid Bimodal Reactor", (co-author), ASME 95-AP-0420, IECEC Conference, August 1995.

"Bimodal System Design Using a Pin-Cermet Reactor and Brayton Power Conversion", (co-author), AIAA-95-2776, 31st AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, San Diego, CA, July 10-12, 1995.

"Pin and Cermet Hybrid Bimodal Reactor" (co-author), Twelfth Symposium on Space Nuclear Power and Propulsion, DOE CONF-950110, AIP Conference No. 325, 2:741-746, January 1995.

"Radiological Risk Assessment of Potential SP-100 Use in Space" (co-author), Sixth Symposium on Space Nuclear Power Systems Transactions; 598-601, January 1989.

"Radiological Risk Analysis of Potential SP-100 Space Mission Scenarios" (co-author), NUS-5125, August 19, 1988.

"Reactor Quality--Factors Affecting Managerial and Institutional Competence of Utility Nuclear Operations" (co-author), NUS-4314, January 15, 1983.

"Reliability of Nuclear Power Plant Hardware--Past Performance and Future Trends" (co-author), NUS-4315, January 15, 1983.

"Building on Existing Institutions to Perpetuate Knowledge of Waste Repositories," NUS-3932, ONWI-379, December 1981.

"Preliminary Reliability Analysis of the Assembly and Testing of the General Purpose Heat Source and Radioisotope Thermoelectric Generator at Mound Facility" (co-author), NUS-3895, September 30, 1981.

"Advanced Boiling Water Reactor Design Study" (co-author), NUS-3775, September 30, 1981.

"Use of Zirconium Hydride in Boiling Water Reactors" (co-author), *American Nuclear Society Transactions* 38:277-278, June 1981.

"Review of ANS-19 Standards and Activities," *Proceedings of ANS-ENS International Topical Meeting on Advances in Mathematical Methods for the Solution of Nuclear Engineering Problems*, Munich, April 27-29, 1981.

"Impacts of Nuclear Power Plant Standardization on Public Health and Safety" (co-author), NUS-3676, September 30, 1980.

"Standards for Reactor Physics Design Calculations" (co-author), *American Nuclear Society Transactions* 18:336-337, June 1974.

"Physics of Non-Uniform BWR Lattices" (co-author), *Proceedings of BNES International Conference on the Physics Problems in Thermal Reactor Design*, London, June 27-29, 1967.

"Critical Studies of the SEFOR in ZPR3-Assembly 47" (co-author), ANL-1248, March 1967.

"Neutron Spectrum Measurement in a Fast Plutonium Assembly," ZPR-III Assembly 48 (co-author), GEAP-5340, January 1967.

"Three Dimensional BWR Simulation" (co-author), (Conf-690401, pp. 344-65).

"Measurement of Epithermal Spectra in Fast Assemblies Using Resonance Sandwich Detectors," General Electric Company, Pleasanton, Calif., Vallecitos Atomic Lab. (ANL-7320, pp. 535-9).

"Critical Mass of SEFOR Mockup in ZPR-III" (co-author), *Nuclear Science and Engineering* 25:442-4, 1966.

"Critical Assembly Mockup of the SEFOR Reactor in ZPR-3" (co-author), *American Nuclear Society Transactions* 9:226, June 1966.

"Aerospace Safety Program--Safe Disposal of SNAP Reactors" (co-author), NAA-SR-111353, July 25, 1965.

"Analysis of SNAPtran-3 Destructive Experiment" (co-author), NAA-SR-9780, February 1, 1965.

"Use of Energy Density Measurements to Calibrate Nuclear Detectors During the SNAPtran-3 Destructive Experiments" (co-author), *American Nuclear Society Transactions* 7:384, November 1964.

"Measurements of U-238 Capture and Fast Fission in Natural Uranium, Heavy Water Lattices" (co-author), *American Nuclear Society Transactions* 5: No. 1, 86-7, June 1962.

"Measurement of Neutron Capture in U-238 in Lattices of Uranium Rods in Heavy Water," NYO-9659, January 1962.

"Coincidence Technique for U-238 Activation Measurements" (co-author), *American Nuclear Society Transactions* 3: No. 2, 24-5, December 1960.