

Name: GARETH W. PARRY

EDUCATION

Ph.D., Theoretical Physics, Imperial College, London University, August 1972

B.Sc., Physics, Imperial College, London University, 1969

EMPLOYMENT HISTORY

U.S. Nuclear Regulatory Commission, 1996-present

NUS, 1980-1996

United Kingdom Atomic Energy Authority, 1975-1980

University of Durham, England, 1973-1975

International Centre for Theoretical Physics, Trieste, Italy, 1972-1973

USNRC - Position is that of Senior Level Advisor for Probabilistic Risk Analysis in the Division of System Safety and Analysis of the Office of Nuclear Reactor Regulation. Current responsibilities include advising the division director on the use of PRAs in the risk-informed regulation initiatives being pursued by NRC, reviewing PRA analyses performed in support of regulatory matters, and providing guidance to NRR staff in their uses of PRA techniques.

NUS - Project Manager in the Energy Risk and Reliability Department with particular interests in data analysis and parameter estimation, common cause failure analysis, external hazard analysis, human reliability analysis, and uncertainty analysis. Was a member of the project team performing a PSA for the VVER 1000, Temelin plant in the Czech Republic, with responsibility for data analysis, human reliability analysis, and external events analysis.

Participated in a number of Human Reliability Analysis (HRA) research projects, including, for EPRI, outlining an approach to developing an improved HRA methodology, and, for a utility client, defining and applying an approach to the analysis of errors of commission. Participated in the NRC-sponsored project to develop an improved HRA method, called ATHEANA, which includes a treatment of errors of commission. Was project manager for an EPRI project to provide guidelines for converting PRA results into accident sequences for training purposes. Has supported several utilities in performing Human Reliability analyses for IPEs and PRAs. Was a co-author of the SHARP1 report, which is an update of the Systematic Human Action Reliability Procedure (SHARP), and of a report presenting a cause-based decision tree approach to the estimation of cognitive error probabilities. Was an instructor at an EPRI-sponsored workshop on Human Reliability Assessment Issues and Methods, held in Charlotte in July 1990. Was NUS' project manager for the EPRI-sponsored Operator Reliability Experiments project.

Was project manager for the Individual Plant Examination for External Events (IPEEE) support being provided by NUS to Cleveland Electric and Illuminating for its Perry plant, and to Baltimore Gas and Electric for its Calvert Cliffs plant. Was the project manager for the IPEEEs performed by NUS for the three nuclear stations operated by Carolina Power and Light, and was a participant in the IPEEE projects for Surry, North Anna, and Indian Point 2. Was Project Manager for the Limerick Generating Station Severe Accident Risk Assessment, which integrated the results of the previously performed Limerick PRA with an external hazards risk

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study which addressed earthquakes, flooding, fires, tornadoes, transportation accidents, and turbine missiles, and a revised consequence and uncertainty analysis. Managed two projects estimating the frequency of damage to nuclear power plants resulting from extreme winds, and participated in a project for the Federal Emergency Management Agency on a feasibility study on the development of a methodology for comprehensive hazard analysis.

Managed the probabilistic risk assessment (PRA) project for the Peach Bottom Atomic Power Station to provide a base case model for the IPE submittal. Provided continuing support to Philadelphia Electric Company in the maintenance of their PRAs for Peach Bottom and Limerick. Managed a project to revise the event trees of the Limerick PRA model to incorporate the symptom-based emergency operating procedures, and to update the PRA and install it on the NUS PC-based software, NUPRA.

Has done extensive development work on the analysis of common cause failures. Was an author of the NRC/EPRI document "Procedures for Treating Common Cause Failures in Safety and Reliability Studies," and was coordinator of, and instructor at, a subsequent EPRI sponsored workshop. On behalf of IAEA conducted a seminar on common cause failure analysis for personnel at the Korea Advanced Energy Research Institute. Is a coauthor of an IAEA procedures guide for CCF analysis, and of a report providing an example application of data analysis for CCF model parameter estimation.

Has extensive experience in technology transfer. Managed the NUS support for the Almaraz PSA (Spain). Was Assistant Project Manager and Task Advisor for parameter estimation, uncertainty analysis, and external hazards analysis for the PRA performed by the Atomic Energy Council of the Republic of China (ROCAEC), under NUS guidance and supervision, for the Kuosheng BWR 6 Mark III reactor. Was a reviewer for and advisor to the ROCAEC in their performance of a PRA on the Maanshan PWR and the Chinshan PRA. Performed the same role for KOPEC in their performance of a PRA on the Kori units.

Was responsible for database development and uncertainty analysis for all of the PRAs performed by the Gaithersburg office of NUS including the Susquehanna (BWR) level 3 PRA, the level 2 PRA of the Ringhals 2 PWR, the level 1 PRA of Caorso, and the PRAs for Peach Bottom, Almaraz, and Kuosheng.

Was a member of a review group assessing Revision 4 of the BWR owners group Emergency Operating Procedure Guidelines with respect to their value in prevention and mitigation of severe accidents, a member of the QC team for the NRC-sponsored Risk Methods Integration and Evaluation Program (RMIEP) with responsibility for the parameter estimation and uncertainty analysis aspects, and a member of the QC team reviewing four level 1 PRAs performed as part of the NUREG-1150 Project. Has participated in reviews of several PRAs for a variety of clients. Was a member of the IAEA IPERS (International Peer Review Service) team for the Dodewaard (Netherlands) and Bohunice (Slovakia) PSAs. Was a member of a peer review group of the System Studies being performed by the Idaho National Laboratory for NRC (AEOD), and of an

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expert panel that reviewed the Quantitative Risk Analysis (QRA) of the Tooele Chemical Demilitarization Facility for the U.S. Army.

Was an Instructor of a course entitled "Issues in Reviewing and Evaluating a PRA," given to NRC staff as part of the NRC PRA training program. Was an instructor for EPRI and MIT workshops on IPE methods. Was an instructor for a summer course on Human Reliability Analysis, and a two day course on Common Cause Failure Analysis, both given at the University of Maryland.

Was a principal author of Chapter 12, "Uncertainty and Sensitivity Analysis," of the NRC/Industry PRA Procedures Guide, NUREG/CR-2300, and was a member of the review group for Chapters 5 and 6, "Data Base" and "Quantification," of the guide.

United Kingdom Atomic Energy Authority - Was Project Officer for Safety and Reliability Directorate-funded work on post-accident heat removal for liquid-metal fast-breeder reactors. Investigated fundamental aspects of quantitative risk assessment methodologies. Main areas of activity were in use of statistics to quantify risk assessments, and reliability theory.

Completed projects included a review for the Commission of European Communities (CEC) on the characterization and evaluation of uncertainties in quantitative risk assessment, and the development of a technique for handling the time structure of failure and repair processes.

As a member of the Plate Inspection Steering Committee (PISC) sponsored by the NEA-CEC, was involved in the evaluation and interpretation of the results of trials designed to establish the reliability of a code of ultrasonic inspection, which is based on the ASME XI procedure for the inspection of welds in heavy section steel plate. Also, was a member of the program evaluation group which drew up a second PISC program, with special responsibility for the evaluation method.

University of Durham - Lectured in applied mathematics and carried out research theoretical high energy physics.

International Centre for Theoretical Physics - Performed research in theoretical high energy physics as a Royal Society Post-doctoral Research Fellow.

MEMBERSHIP

American Nuclear Society

PUBLICATIONS

Journal Publications

"An Approach for using Risk Assessment in Risk-Informed Decisions on Plant-specific Changes to the Licensing Basis" (with M. A. Caruso, M. C. Cheok, M. A. Cunningham, G. M. Holahan, T. L. King, A. M. Ramey-Smith, M. P. Rubin, and A. C. Thadani), Reliability Engineering and System Safety, Vol. 63, (1999), pages 231-242.

"Use of Importance Measures in Risk-Informed Regulatory Applications" (with M. C. Cheok and R. R. Sherry), Reliability Engineering and System Safety, Vol. 60, (1998), pages 213-226.

"The Characterization of Uncertainty in Probabilistic Risk Assessments of Complex Systems", Reliability Engineering and System Safety, special issue on aleatory and epistemic uncertainty, Vol. 54, (1996), pages 119-126.

"A Procedure for the Analysis of Errors of Commission During Non-Power Modes of Nuclear Power Plant Operation" (with J. Julius, E. Jorgenson, and A. Mosleh), Reliability Engineering and System Safety, Vol. 53, (1996), pages 139-154.

"A Procedure for the Analysis of Errors of Commission in a Probabilistic Safety Assessment of a Nuclear Power Plant at Full Power" (with J. Julius, E. Jorgenson, and A. Mosleh), Reliability Engineering and System Safety, Vol. 50, (1995), pages 189-201.

"Suggestions for an Improved HRA Method for Use in Probabilistic Safety Assessment", Reliability Engineering and System Safety, Vol. 49, (1995), pages 1-12.

"An Approach to the Analysis of Common Cause Failure Data for Plant-Specific Application" (with A. Mosleh and F. Zikria), Nuclear Engineering and Design, Vol. 150, p. 25, 1994.

"Common Cause Failures: A Critique and Some Suggestions," Reliability Engineering and System Safety, Vol. 34, 1991.

"On the Meaning of Probability in Probabilistic Safety Assessment," Reliability Engineering and System Safety 23 (1988), pp. 309-314.

Reports and Books

"A Technique for Human Error Analysis (ATHEANA)" (with S. Cooper, A. Ramey-Smith, J. Wreathall, D. Bley, W. Luckas, J. Taylor, and M. Barriere), NUREG/CR-6350, May 1996, US Nuclear Regulatory Commission.

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"Process Description for ATHEANA: A Technique for Human Error Analysis", (lead author), Brookhaven National Laboratory Technical Report L-2415/95-2, December 30, 1995.

"Control Room Operations Research Project" (principal author), Electric Power Research Institute, EPRI TR-105380, December, 1995.

"PSA Applications Guide" (With D. True, J. Sursock, B. Putney, and K. Fleming), Electric Power Research Institute, EPRI TR-105396, August 1995.

"Chapter 9: Common Cause Failure Analysis", in *Cost-Effective Risk Assessment for Process Design*, edited by R. Deshotels and R. Zimmerman, McGraw Hill, 1995

"Model Uncertainty and Probability," in Model Uncertainty: Its Characterization and Quantification, A. Mosleh, C. Smidts, and C. Liu (editors), University of Maryland Center for Reliability Engineering Publication, 1995.

"Enhancements to Data Collection and Reporting of Single and Multiple Failure Events" (with D Whitehead, H. Paula, D. Rasmuson), NUREG/CR-5471, March 1993.

"Systematic Human Action Reliability Procedure (SHARP) Enhancement Project. SHARP 1 Methodology Report" (with D. Whitehead, A Spurgin, and G. Hannaman), EPRI-TR-101711, December 1992.

"Critique of Current Practice in the Treatment of Human Interactions in Probabilistic Safety Assessments," in Reliability and Safety Assessment of Dynamic Process Systems, T. Aldemir, N. Siu, and A. Mosleh (editors), Springer-Verlag Publishing, Berlin, 1994.

"An Approach to the Analysis of Operator Actions in Probabilistic Risk Assessment" (with A. Beare, A. Spurgin, P. Moeini, and B. Lydell), EPRI TR 100259, June, 1992.

"Guidelines for Conducting Common Cause Failure Analysis in Probabilistic Safety Assessment" (with S. Hirschberg), IAEA TEC-DOC 648, May, 1992.

"Nuclear Plant Reliability: Data Collection and Usage Guide" (with T. Morgan and C. Schwan), EPRI TR-100281, April 1992.

"Example Application of a Structured Procedure for Estimating Common Cause Failure Probabilities" (with A. Mosleh and T. Mankamo) draft IAEA document.

"A Cause Defense Approach to the Understanding and Analysis of Common Cause Failure" (with H. Paula), NUREG/CR-5460, April 1990.

"Operator Reliability Experiments Using Nuclear Power Plant Simulators" (with A. Spurgin, coauthor), EPRI NP-6937, July 1990, Vols. 1, 2, 3.

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"Procedures for Treating Common Cause Failures in Safety and Reliability Studies" (with A. Mosleh, K. Fleming, H. Paula, D. Rasmuson, and D. Worledge), EPRI NP 5613/NUREG/CR-4780, Vol. 1, 1988, Vol. 2, 1989.

Conference Papers

"PSA Applications: Safety Goals and Acceptance Guidelines" (with M. A. Cunningham, G. M. Holahan, T. L. King, and J. A. Murphy) in proceedings of PSA '99, Washington DC, August 22-26, 1999, proceedings published by the American Nuclear Society, La Grange Park, Illinois, USA.

"Status of Risk Informed Regulatory Activities and Guidance Development at the U.S. NRC" (with G. M. Holahan, T. L. King, M. A. Cunningham, M. C. Cheok, and M. P. Rubin), presented at the International Topical Meeting on the Safety of Operating Reactors, San Francisco, October 11-14, 1998, proceedings published by the American Nuclear Society, La Grange Park, Illinois, USA.

"Uncertainty in PRA and its Implications for Use in Risk-Informed Decision-Making", presented at PSAM IV, New York City, September 14 - 18, 1998, proceedings published by Springer.

"Standardizing Human Reliability Analysis - Issues and Suggestions", presented at PSA '96, Park City, Utah, September 29 - October 3, 1996, proceedings published by the American Nuclear Society, La Grange Park, Illinois, USA.

"A Process for Application of ATHEANA - A New HRA Method" (with D. Bley, S. Cooper, J. Wreathall, W. Luckas, C. Thompson, A. Ramey-Smith, presented at PSA '96, Park City, Utah, September 29 - October 3, 1996, proceedings published by the American Nuclear Society, La Grange Park, Illinois, USA.

"An Improved HRA Process for Use in PRAs", (with M. Barriere and A. Ramey-Smith), presented at Probabilistic Safety Assessment and Management (PSAM) III, June 24-28 1996, Crete, Greece, proceedings published by Springer.

"Procedure for the Analysis of Errors of Commission during Non-power Operation", (with J. Julius, E. Jorgenson, and A. Mosleh), PSAM III, June 24-28 1996, Crete, Greece, proceedings published by Springer.

"The Need for, and Some Suggested Characteristics of, an Improved HRA Approach for Use in PSAs", Presented at an International Workshop on Human Reliability Models, August 22-24, 1994, Stockholm, Sweden.

"A Procedure for the Analysis of Errors of Commission in a PSA," presented at PSAM II, San Diego, CA, 1994.

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"The Need for, and a Proposed Structure of, a Second Generation HRA Methodology," presented at PSAM II, San Diego, CA, 1994.

"The Meaning and Use of Probability in Probabilistic Safety Assessment", presented at PSAM II, San Diego, CA, 1994.

"Suggestions for an Improved Human Reliability Model for Use in Systems Analysis", presented at the 16th Reactor Operations International Topical Meeting, Long Island, N.Y., August 16-18, 1993.

"An Approach to the Parameterization of Judgement in the Analysis of Common Cause Failure Data" (with F. Zikria and A. Mosleh), presented at PSA '93, Clearwater Beach, Florida, January 26-29, 1993.

"Modeling of Dual Unit Interactions during a Loss of Offsite Power at Peach Bottom Atomic Power Station" (with G. Krueger), presented at PSA '93, Clearwater Beach, Florida, January 26-29, 1993.

"An Approach to the Analysis of Operating Crew Responses for Use in PSAs", (with A. Beare and A. Singh), presented at PSA '93, Clearwater Beach, Florida, January 26-29, 1993.

"An Approach to the Analysis of Operating Crew Responses using Simulation Exercises for use in PSAs", coauthor, presented at OECD/CSNI Workshop on special issues in PSA, Cologne, Germany, May 1991.

"An Approach for Assessment of the Reliability of Cognitive Response for Nuclear Power Plant Operating Crews" (co-author) in Proceedings of "Probabilistic Safety Assessment and Management," Beverly Hills, Calif., February 1991, Elsevier.

"Data Needs for Common Cause Failure Analysis" (coauthor), Proceedings of Probabilistic Safety Assessment and Management, Beverly Hills, Calif., February 1991, Elsevier.

"HRA and the Modeling of Human Interactions", (with B. Lydell), Proceedings of Probabilistic Safety Assessment and Management, Beverly Hills, Calif., February 1991, Elsevier.

"Common Cause Failure Analysis: Where Do We Go From Here?", presented at CSNI Workshop on Applications and Limitations of Probabilistic Safety Assessment, Santa Fe, N.Mex., September 1990.

"Use of Probabilistic Methods in Fire Hazards Analysis" (with Paul Guymer), in Fire Protection and Fire Fighting in Nuclear Installations, IAEA, Vienna, Austria, 1989.