ORESTES CASTILLO HERNANDEZ

PRA & NUCLEAR SAFETY ENGINEER

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PROFESSIONAL SUMMARY

PhD nuclear engineer with 8+ years of combined professional and research experience in probabilistic risk assessment (PRA), system reliability modeling, and risk-informed nuclear safety. Hands-on experience developing and maintaining Level 1 and Level 2 PRA models, including fault and event trees, common-cause failures, human reliability analysis, importance measures, and uncertainty analysis. Experienced in configuration risk management, risk-informed applications, and integrating TRACE thermal-hydraulic and MELCOR severe-accident simulations with SAPHIRE probabilistic models and dynamic PRA workflows. Developed engineering tools and automated analysis workflows using Python, SQL, and C++ to improve model integration, technical analysis, and documentation. ASME standards contributor and published researcher experienced in delivering defensible technical insights for regulatory review and risk-informed decision-making.

EDUCATION

Ph.D. in Engineering
National Autonomous University of Mexico (UNAM).
2019 - 2024

M.S. in Engineering
National Autonomous University of Mexico (UNAM).
2017 - 2019

B.S. in Nuclear and Energy Technologies Engineering
University of Havana.
2010 - 2015

TEACHING EXPERIENCE

- Adjunct Professor
- Nuclear Reactor Safety — Graduate Level
- UNAM | 2025 - Present

PRA & NUCLEAR SAFETY SOFTWARE

- SAPHIRE — Advanced
- CAFTA — Familiarity
- MELCOR — Intermediate
- TRACE — Intermediate
- SNAP — Intermediate

LANGUAGES

English: Professional Working Proficiency
Spanish: Native Proficiency

EXPERIENCE

2024 - Present **NATIONAL COMMISSION FOR NUCLEAR SAFETY AND SAFEGUARDS (CNSNS) – MEXICO CITY, MEXICO**
PROBABILISTIC RISK ASSESSMENT ENGINEER

- Develop and maintain Level 1 PRA models for Laguna Verde Nuclear Power Plant (NPP) in SAPHIRE, including fault tree and event tree construction, accident sequence development, and model quantification.
- Develop Plant Damage States and Level 2 PRA models, including containment event trees and severe-accident progression sequences, to evaluate containment performance, fission-product release pathways, and mitigation system effectiveness.
- Perform Common Cause Failure and dependency analyses and develop Human Reliability Analysis models to quantify shared vulnerabilities and operator recovery actions across accident sequences.
- Conduct Minimal Cut Set, importance measure (FV and RAW), uncertainty, and sensitivity analyses to identify dominant contributors to CDF and LERF, evaluate model robustness, and support risk-informed decisions.
- Integrate TRACE and MELCOR simulations with PRA to validate technical consistency across deterministic and probabilistic models, including event timing, system response, containment performance, and key PRA assumptions.
- Support regulatory evaluations of aging management and post-Fukushima safety strategies by producing defensible, risk-informed technical insights.
- Serve as the principal analyst for risk evaluations of proposed changes to Laguna Verde NPP Technical Specifications, independently performing the complete PRA calculations and authoring the final technical reports, including assessments of impacts on dominant accident sequences, CDF, and LERF, to support risk-informed regulatory decisions.
- Lead risk evaluations for critical plant events and operating configurations at Laguna Verde NPP, quantifying configuration-specific changes in CDF and LERF and documenting the results to support operational and regulatory decision-making.

PRA APPLICATIONS & RISK MANAGEMENT

- Generation Risk Assessment (GRA)
- Configuration Risk Management (CRM)
- Risk categorization and significance evaluation
- PRA applications for operating nuclear power plants
- Risk-informed regulatory evaluations and decision-making
- Knowledge of external hazards PRA, including seismic events, external flooding, and extreme weather
- Knowledge of Fire PRA methodology under NUREG/CR-6850

SAFETY & HAZARD ANALYSIS METHODS

- Failure Modes and Effects Analysis (FMEA)
- Hazard and Operability Study (HAZOP)
- Bow-Tie Analysis
- Layer of Protection Analysis (LOPA)
- What-If and Checklist Analysis
- Qualitative and Semi-Quantitative Risk Matrices

PROGRAMMING & TECHNICAL TOOLS

- Python, SQL, C++ for data analysis and PRA integration
- Microsoft Excel & Power BI for data visualization
- AI-enabled platforms for Python development, data analysis support, workflow automation, and technical documentation.

PROFESSIONAL ACTIVITIES

2024 - 2025 **ASME STLLC – PLANT RISK EVALUATION SUBCOMMITTEE**
PROBABILISTIC RISK ASSESSMENT ENGINEER AND SOFTWARE DEVELOPER

- Collaborated with ASME subject-matter experts on the development and application of the ASME PSD-1 Plant Systems Design Standard, integrating systems engineering, quantitative risk evaluation, and probabilistic design principles into plant design processes.
- Developed Python-based tools linking PRA models with reliability and unavailability allocation methods and multi-objective optimization to evaluate alternative plant system configurations.
- Applied risk-informed design optimization methods to PWR system case studies, balancing safety, reliability, availability, performance, and cost objectives.

RESEARCH EXPERIENCE

2019 - 2024 **UNAM**
DOCTORAL RESEARCHER — RISK-INFORMED NUCLEAR REACTOR DESIGN

- Developed a PRA-based methodology for the risk-informed design of advanced nuclear reactors, translating plant-level and Licensing Basis Event risk objectives into quantitative system unavailability targets.
- Developed fault-tree models and multi-objective optimization methods to evaluate alternative system configurations and balance safety, reliability, availability, and cost objectives.
- Produced peer-reviewed research on PRA-informed system design and optimization methodologies.

2017 - 2019 **UNAM**
GRADUATE RESEARCHER — CONFIGURATION RISK MANAGEMENT

- Conducted master's research in Configuration Risk Management (CRM), applying PRA principles to evaluate plant operating configurations and configuration-dependent changes in risk.
- Evaluated system availability, equipment configurations, and their effects on plant risk metrics to support risk-informed operational decision-making.
- Developed computational methods for applying PRA insights to the management of operational plant configurations.

SELECTED PUBLICATIONS & CONFERENCE PAPERS

Peer-Reviewed Journal Articles

- Castillo-Hernández, O., et al. "System Design Optimization Using the ASME Plant Systems Design Standard." Nuclear Science and Engineering, 2026. doi:10.1080/00295639.2026.2663243
- Castillo-Hernández, O., et al. "Risk-Informed Design: An Unavailability Allocation Approach." Nuclear Engineering and Design, 2024. doi:10.1016/j.nucengdes.2024.113611
- Castillo-Hernández, O., et al. "Risk-Informed Design of Advanced Nuclear Reactor: A Target Unavailability Approach." Nuclear Engineering and Design, 2024. doi:10.1016/j.nucengdes.2023.112787

Conference Papers

- Castillo-Hernández, O., et al. "Reactor System Design Optimization Using the ASME Plant Systems Design Standard (PSD-1)." Proceedings of the 19th International Conference on Probabilistic Safety Assessment and Analysis (PSA 2025), 2025.

SPECIALIZED TECHNICAL KNOWLEDGE.

GENERAL KNOWLEDGE OF PWR & ADVANCED REACTOR TECHNOLOGIES

• PWR primary, secondary, protection, and safety systems
• Advanced LWR, integral PWR, and SMR concepts
• Passive safety, natural circulation, and modular construction
• HTGR/TRISO, sodium- and lead-cooled fast reactors, and molten-salt reactors
• Microreactor concepts, including compact and transportable designs, long-life cores, passive heat removal, autonomous operation, and remote or industrial applications
• Technology-neutral PRA and safety evaluation principles

PYTHON & ENGINEERING SOFTWARE DEVELOPMENT

• Developed Python-based engineering tools and Tkinter graphical interfaces for PRA, reliability allocation, and multi-objective design optimization.
• Applied Python to engineering data processing, statistical analysis, technical visualization, and workflow automation.
• Implemented genetic and multi-objective optimization methods using pymoo, including NSGA-II and NSGA-III variants.
• Basic familiarity with machine-learning methods and libraries, including regression, decision trees, clustering, PCA, scikit-learn, and TensorFlow.
Core tools: Pandas, NumPy, Matplotlib, Seaborn, pymoo, and Tkinter.

LICENSING MODERNIZATION PROJECT (LMP)

- Working knowledge of the risk-informed, performance-based licensing framework established by the Licensing Modernization Project (LMP), NEI 18-04, and NRC Regulatory Guide 1.233.
- Knowledge of the integrated use of PRA and deterministic safety analysis to support LBE evaluation, SSC safety classification, and definition of performance requirements.
- Familiarity with risk-informed defense-in-depth adequacy evaluation and its relationship to reactor design, licensing, and safety decision-making.
- Applied related risk-informed design principles in doctoral research by translating plant-level and LBE risk objectives into quantitative system unavailability targets.

BOILING WATER REACTOR (BWR) TECHNOLOGY

- Advanced applied expertise in GE BWR-5 reactor technology and Mark II primary containment, developed through PRA modeling and regulatory risk evaluations for Laguna Verde Nuclear Power Plant.
- Detailed understanding of BWR direct-cycle operation, reactor recirculation and power control, reactivity control, reactor protection, steam generation, and power-conversion systems.
- Strong knowledge of BWR safety and mitigation systems, including HPCS, LPCS, LPCI, ADS, RCIC, Residual Heat Removal, containment isolation, primary containment venting, and suppression-pool heat removal functions.
- Experience modeling BWR initiating events and accident sequences, including system dependencies, common-cause failures, operator actions, recovery strategies, and accident-sequence timing.
- Strong understanding of BWR thermal-hydraulic principles, including two-phase flow and boiling heat transfer, void formation, pressure and water-level control, natural circulation, depressurization, core cooling, and decay-heat removal.
- Detailed knowledge of Mark II pressure-suppression containment behavior, including drywell-wetwell interactions, steam condensation in the suppression pool, containment pressure and temperature response, and containment heat-removal mechanisms.