GENERATION-IV INTERNATIONAL FORUM
RISK AND SAFETY WORKING GROUP ACTIVITIES
IN SUPPORT OF NON-WATER-COOLED REACTORS

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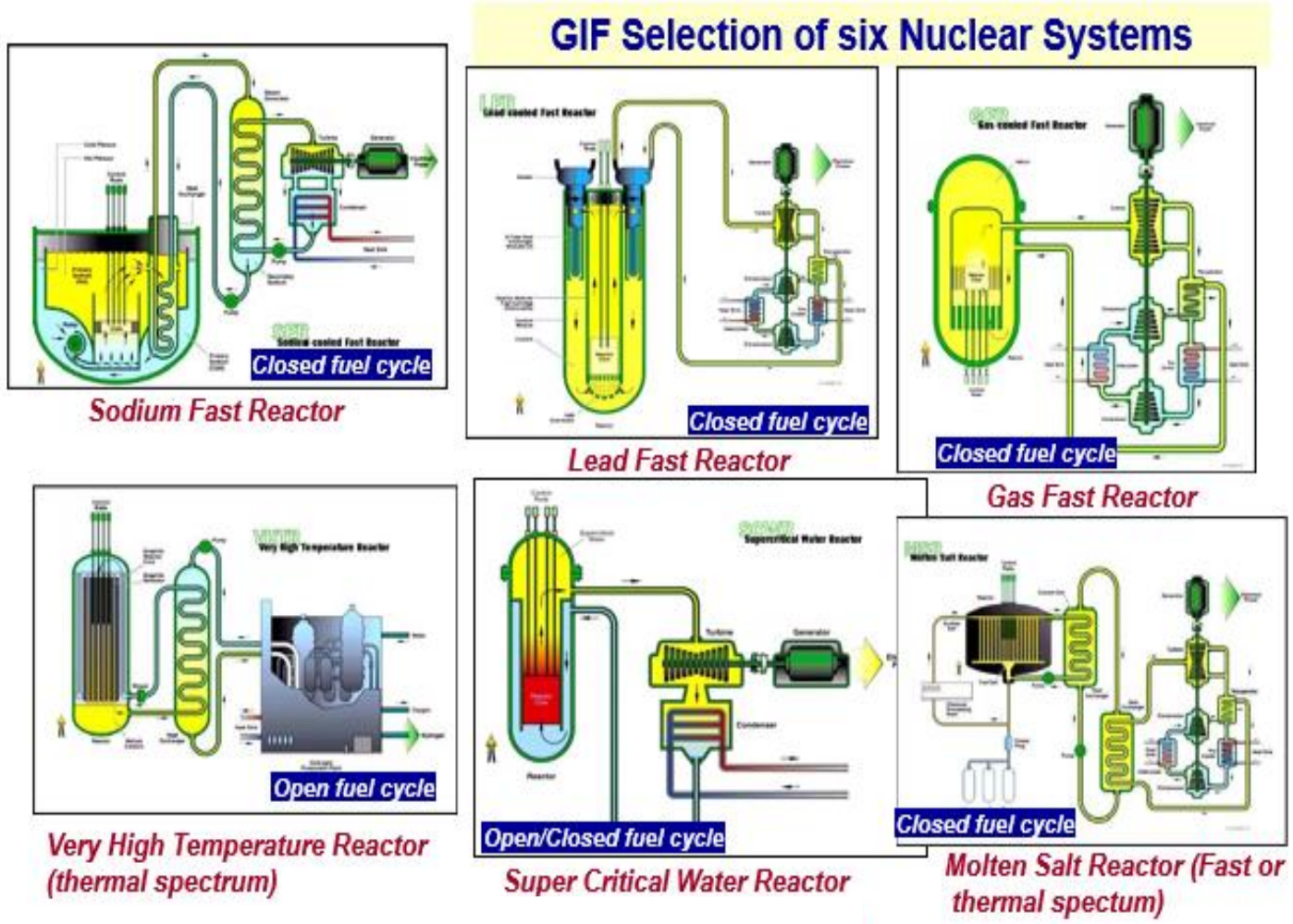
Risk and Safety Working Group

CACNEUFRJPZAKRRUGBUS

Generation-IV International Forum (GIF)

- Near term focus:
  - Strengthen the position of Generation-IV systems to have an impact on climate change
  - Support the transition from development to deployment and strengthen GIF's relevance for industry

- Design goals:
  - Sustainability
    - Long term fuel supply
    - Minimized waste and stewardship burden
  - Safety
    - Excellence in safety in reliability
    - Very low likelihood and degree of core damage
  - Economics
    - Improved life cycle cost advantage
    - Reduced financial risk
  - Proliferation resistance and physical protection
    - Unattractive materials diversion pathways
    - Enhanced physical protection



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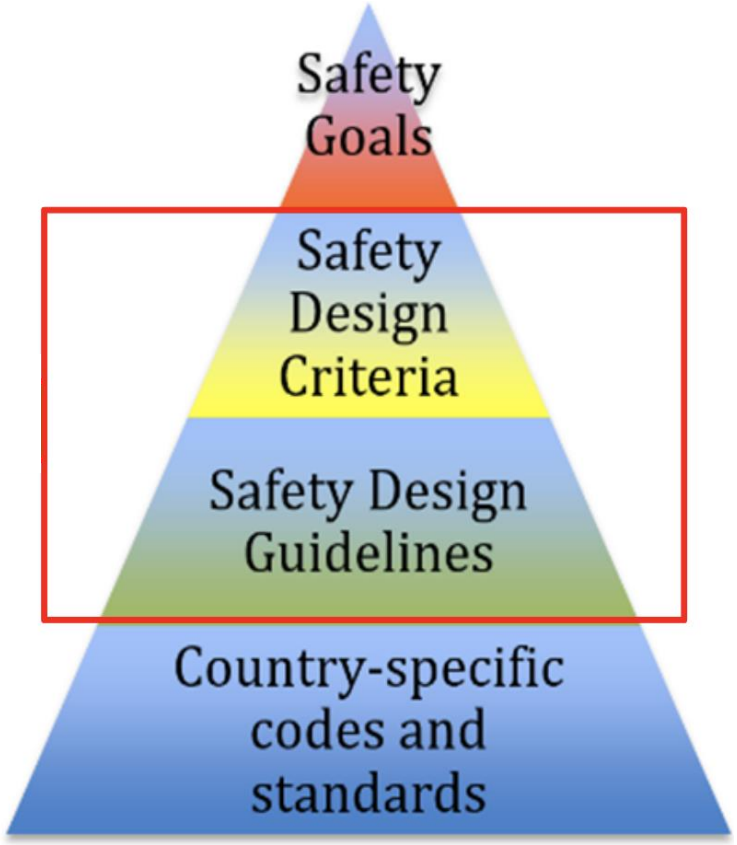
GIF Risk and Safety Working Group (RSWG)

- RSWG Mission:
  - Promote a consistent approach on safety/risk and regulatory issues between six Gen-IV systems
  - Establish safety principles, objectives, and attributes based on GIF safety goals to inform R&D plans
  - Maintain interfaces with IAEA, OECD/NEA (CNRA/CNSI), and other regulatory stakeholders on safety of advanced reactors
- Focus areas:
  - Development of safety standards for specific advanced reactor designs
    - Participation in, and contributions to, IAEA's safety standards development
  - Implementation of risk-informed approach as an overlay of technology-neutral Integrated Safety Assessment Methodology (ISAM)
  - Establishing safety and safeguards/security interfaces in collaboration with GIF Proliferation Resistance and Physical Protection Working Group
  - Development of methodologies for selection and treatment of "practically eliminated accidents" and mechanistic source term assessments

Safety Design Criteria and Guidelines for select Gen-IV Systems



- GIF RSWG collaborated with system steering committees for development of safety design criteria and guidelines
  - Requirements for design, fabrication/construction, inspection/testing, and operation of Generation-IV systems
  - Intended to fill the gap between the high-level GIF safety goals and the country-specific regulatory requirements
  - Criteria and guidelines maintain the structure of IAEA safety standards
- Accomplishments to date:
  - Requirements for SFR, LFR, GFR, and VHTR systems are completed
  - Two SFR safety design guidelines reports are also published
    - https://www.gen-4.org/gif/jcms/c_9366/risk-safety
    - https://www.gen-4.org/gif/jcms/c_93020/safety-design-criteria
- Published reports formally reviewed by NEA/WGSAR and IAEA's Nuclear Energy and Safety & Security Departments

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RSWG "Basis of Safety Approach" for Gen-IV Reactors

https://www.gen-4.org/gif/jcms/c_178828/bsa-update-v4-clean

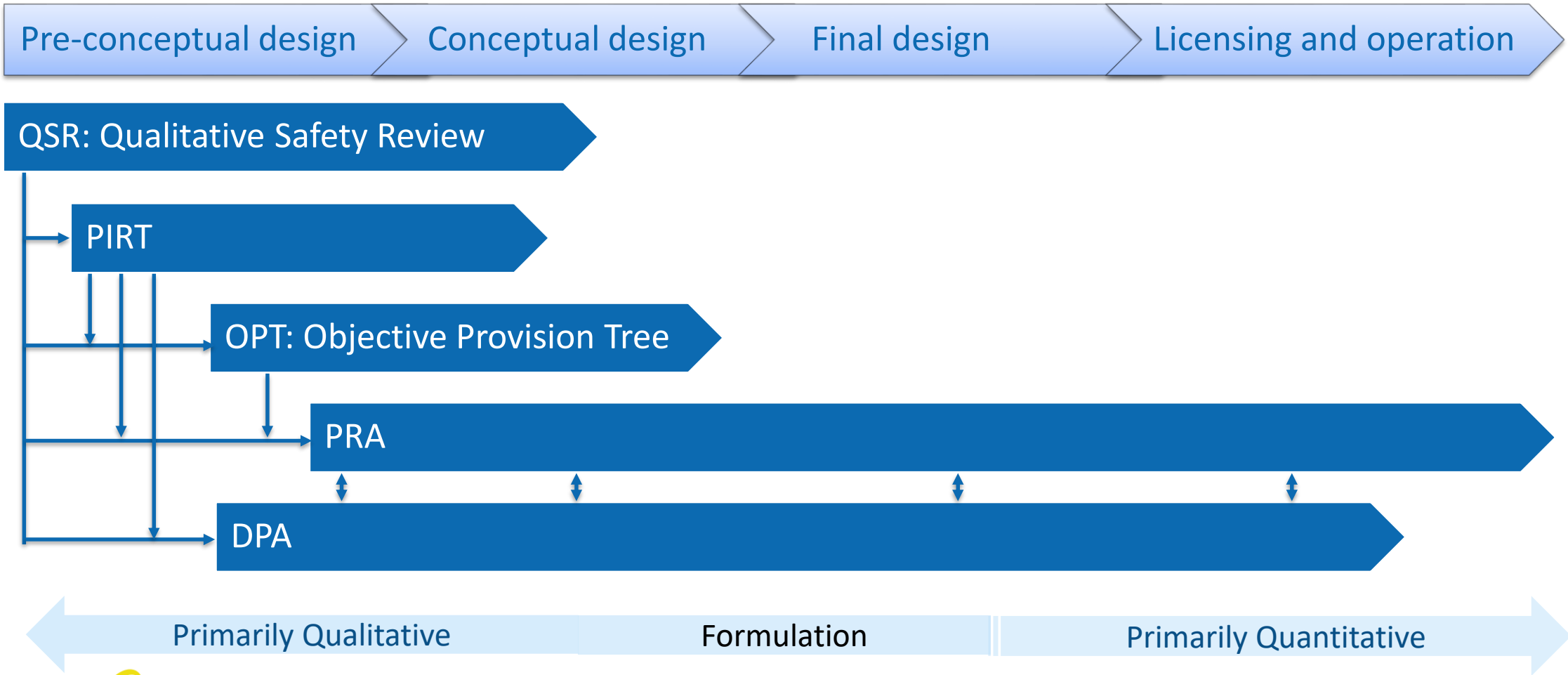
- Defense-in-depth as the foundation of Gen-IV safety approach to achieve safety-by-design (so that safety is "built-in," not "added on")
  - Reliance on inherent and passive safety principles with sufficient grace period for operator actions
  - Optimal risk-reduction to achieve robust and tolerant designs without cliff-edges
- Risk-informed approach based on deterministic and probabilistic insights over full range of plant states (including severe plant conditions) for both internal events and external hazards
  - Establish the role of plant equipment in prevention and mitigation at each layer of defense
  - Achieve a prevention/mitigation balance
  - Assure independence of safety design features at each layer of defense
  - Provide adequate design margins to address uncertainties
- Integrated Safety Assessment Methodology (ISAM) as a technology-neutral toolkit to support the design efforts, and to evaluate risk & safety

Integrated Safety Assessment Methodology (ISAM)

- Qualitative Safety Review (QSR): A “check-list” approach for systematic review of design characteristics and requirements to ensure desired safety attributes as a preparatory step
- Phenomena Identification and Ranking (PIRT): Categorization and ranking of the phenomena in terms of their importance to safety and relevant state of knowledge to identify the gaps and need for additional research/testing
- Objective Provision Tree (OPT): A tool for identifying the provisions for prevention, or control and mitigation, of accidents that could potentially damage the reactor
  - As a complimentary step to PIRT for selecting the ”Lines of Protection” against identified phenomena
  - Also, a preliminary step to PRA in preparation of event and fault trees
- Probabilistic Risk Assessments (PRA): A stochastic approach to assess risk by addressing the likelihood and consequence of event sequences to assure broader coverage of accident space
- Deterministic and Phenomenological Analyses (DPA): Traditional safety assessments for the system’s response to anticipated operational occurrences, design basis accidents, and design extension conditions

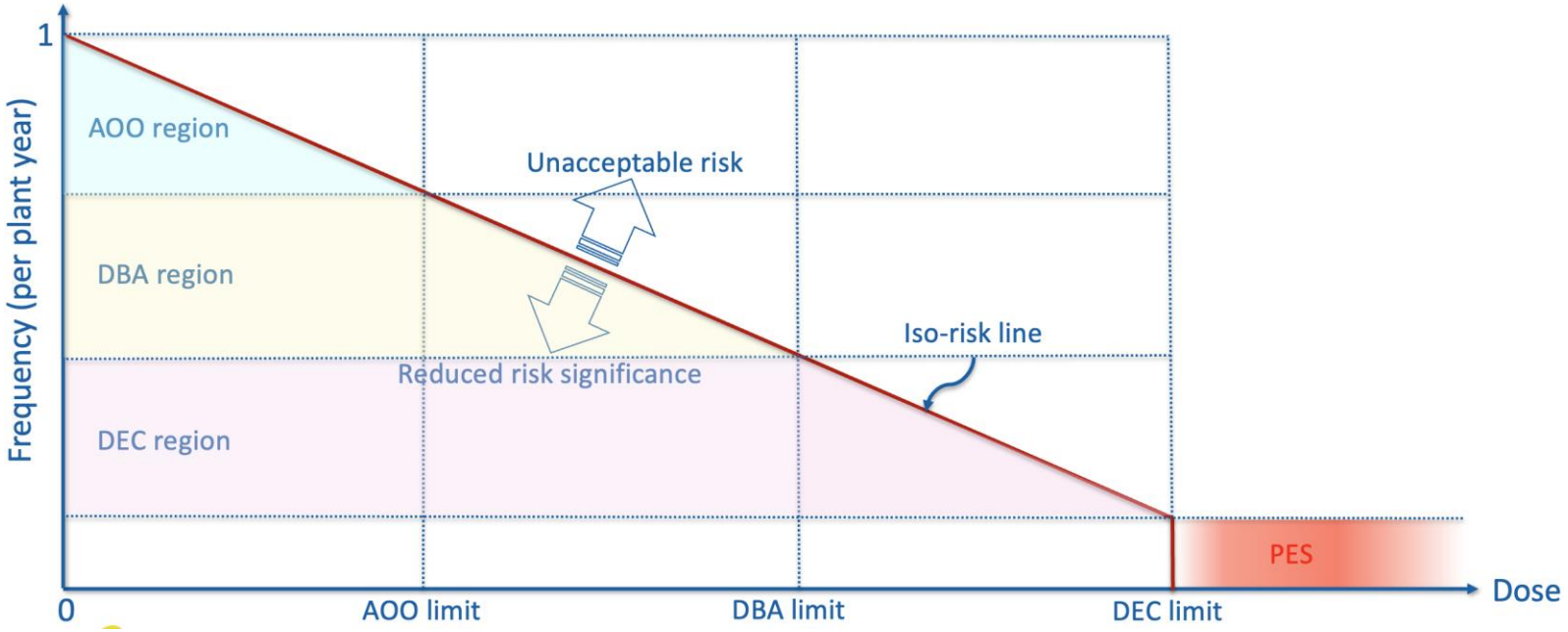
Back up pages

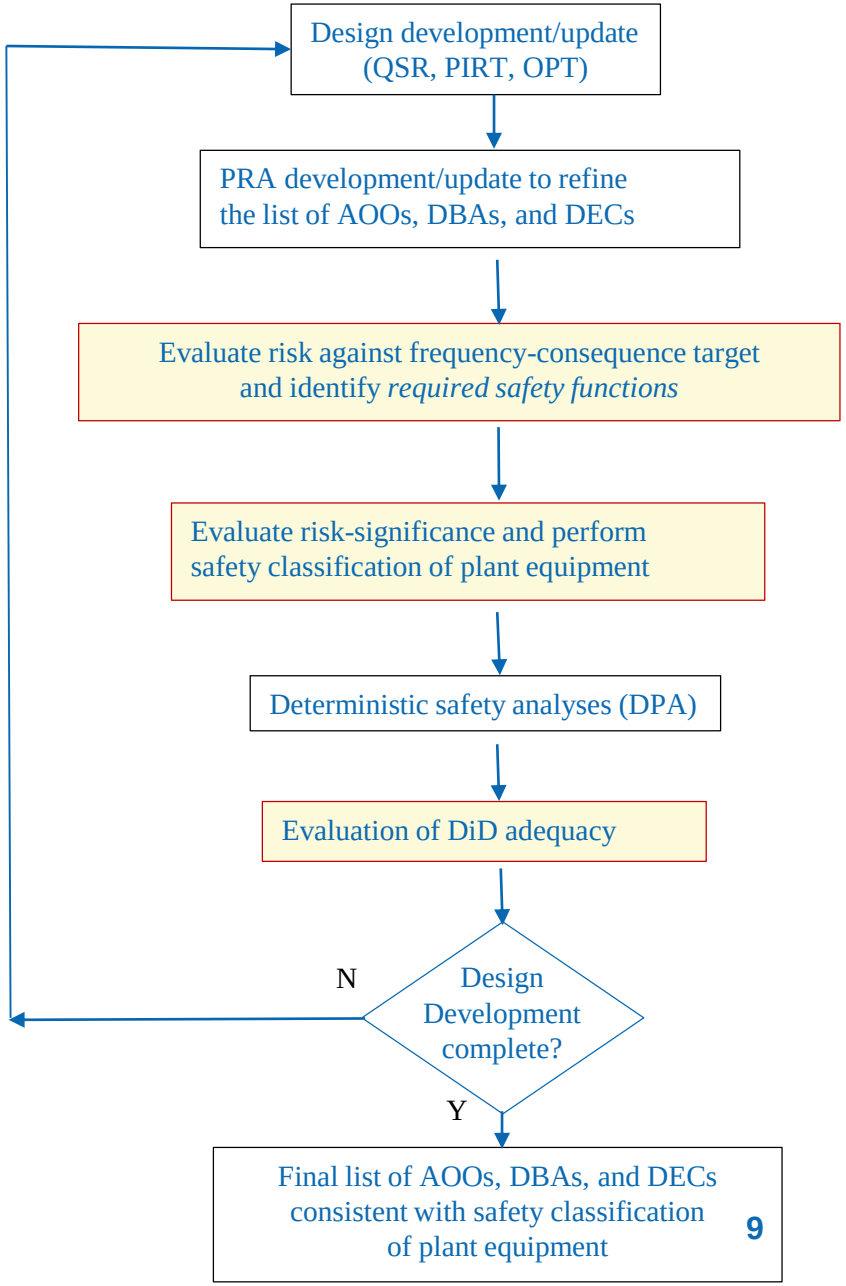
Integrated Safety Assessment Methodology (ISAM)



Risk-Informed Approach

- An iterative process, complementary to deterministic approach, for alternative searches of event sequences by examining both their probability and consequences to characterize risk





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