International Atomic Energy Agency

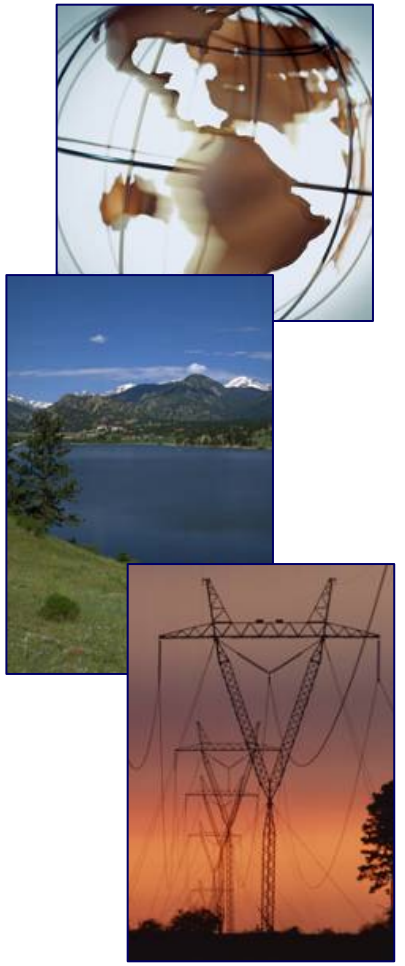
Use of EPRI Utility Requirements Document (URD) By Utilities For NPP Planning

Technical Cooperation Workshop on
Nuclear Power Plant Technology Assessment
17 to 20 November 2008, Vienna

About EPRI

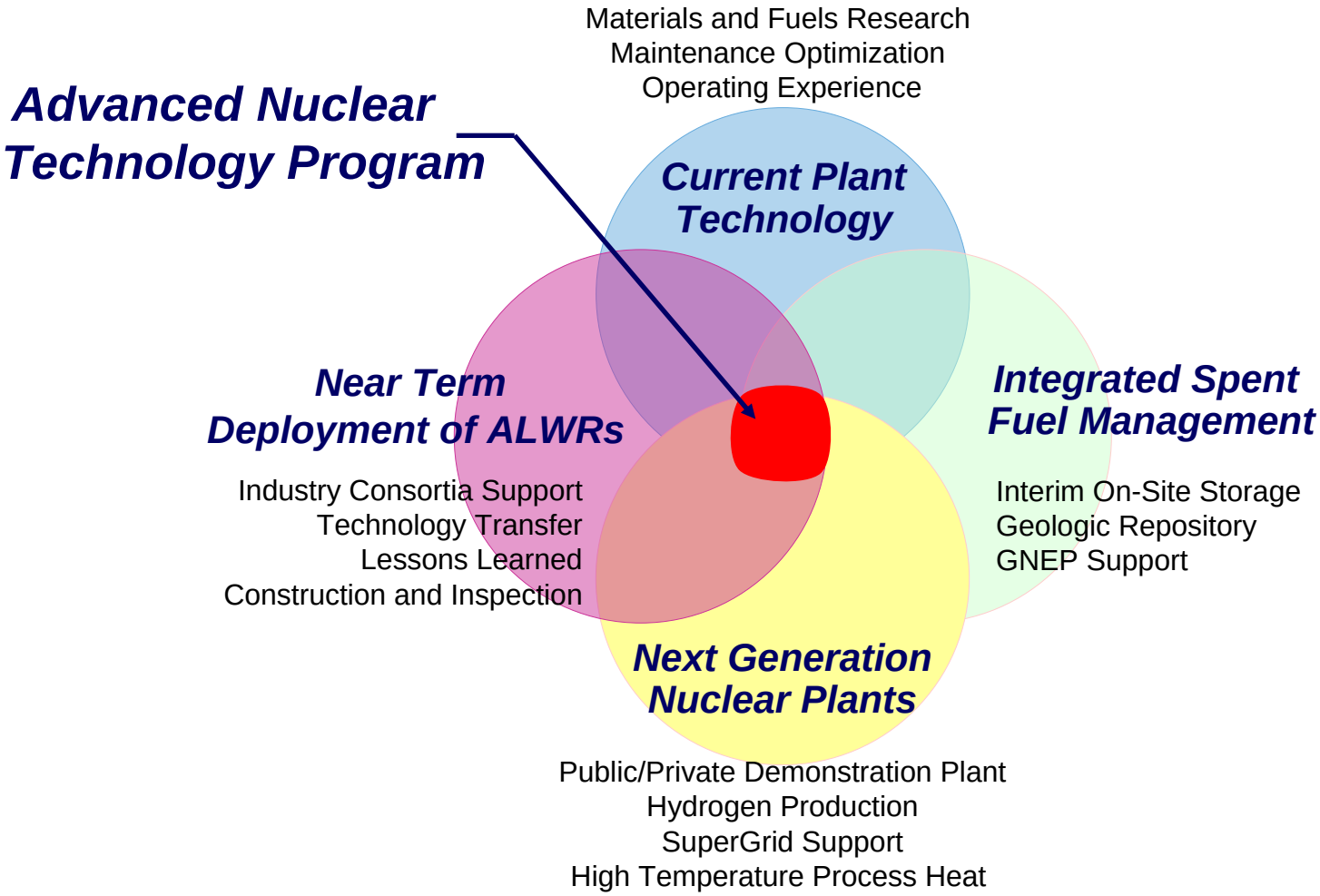
Together…Shaping the Future of Electricity

- Founded in 1973 as an independent, nonprofit center for public interest energy and environmental research.
- Objective, tax-exempt, collaborative electricity research organization
- Science and technology focus--development, integration, demonstration and applications
- Broad technology portfolio ranging from near-term solutions to long-term strategic research

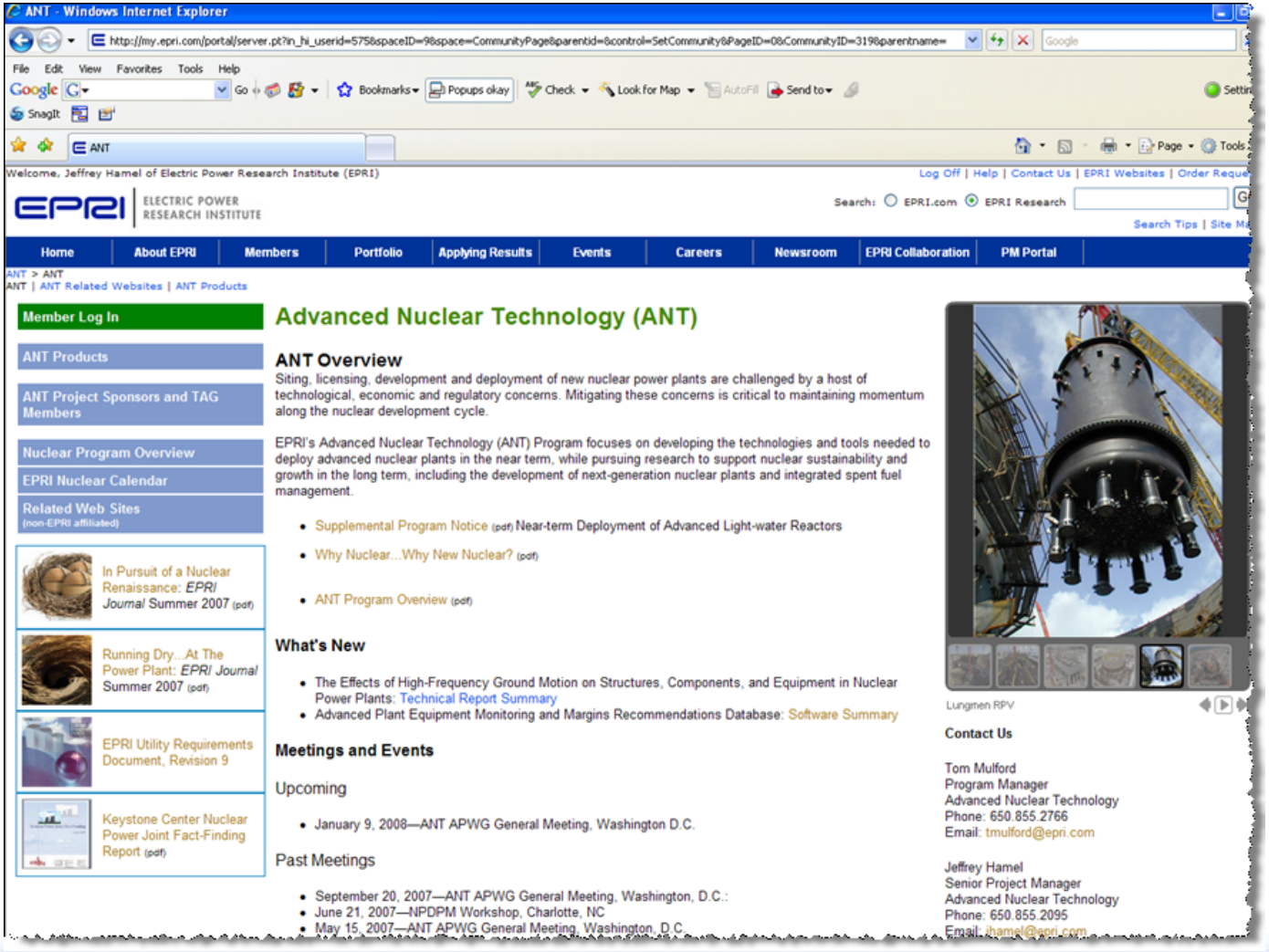


EPRI's Involvement In The Nuclear Resurgence

Linking Lessons Learned to Future Opportunity



EPRI's Advanced Nuclear Technology
http://www.epri.com/ant



About The URD

- Purpose of the Utility Requirements Document (URD) is to present a clear, comprehensive set of design requirements for the next generation of nuclear plants.
- The requirements are grounded in proven technology of 40 years of commercial U.S. and international light water reactor (LWR) experience.
- The utility design requirements build on the current LWR experience base, correcting problems which existed in operating plants and incorporating features which assure a simple, robust, more forgiving design.

Initiating Events

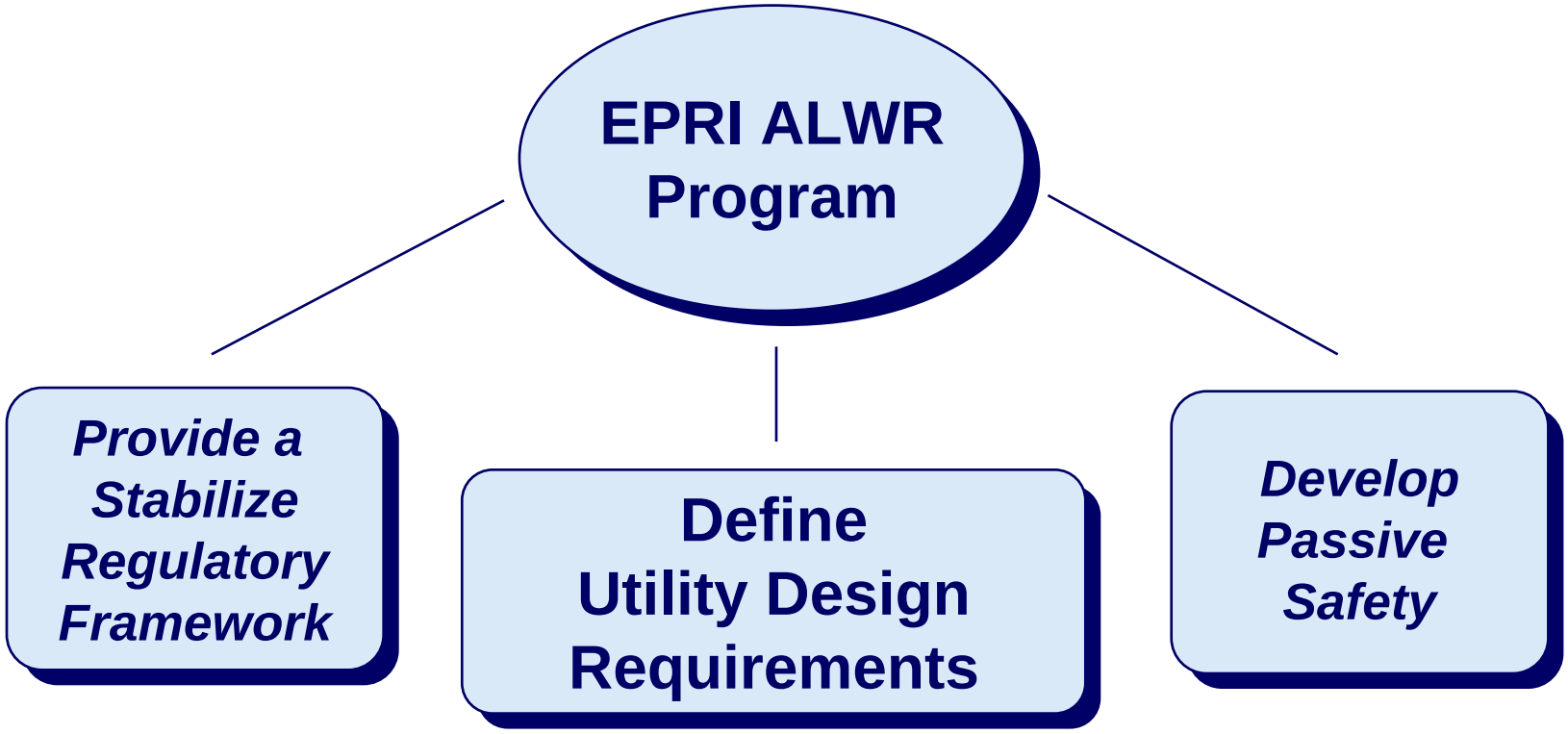
1983 - Feedback from a survey of nuclear utility executives: nuclear power plants must be:

- Safer and simpler
- Competitive
- Standardized
- Pre-licensed by the U.S. NRC

1985 - The **EPRI ALWR Program** is launched

- Initial focus of the Program was on the development of a Utility Requirements Document (URD) to facilitate standardization
- Twenty senior representatives from U.S. and international utilities provided overall direction via the Advanced Light Water Reactor (ALWR) Program Utility Steering Committee (USC)

EPRI ALWR Program Goals



Top Level ALWR Program Objectives

- Incorporate the over 5000 reactor-years of experience
- Realize significant improvements in safety
- Stabilize Regulatory basis:
  - Regulatory optimization
  - Margin to regulations
  - Resolution of state and local regulatory issues
- Promote standardization
- Reduce capital and O & M costs
- Restore investor confidence

Development of the URD

Teams organized to obtain industry consensus regarding features to be sought in the next generation of light water reactors.

- Overall direction provided by ALWR Utility Steering Committee (USC) - 20 senior representatives from domestic and international utilities

- Implementation of the URD performed by EPRI and utility staff with contractor (NSSS vendors, engineering service, consulting, architect-engineer, and construction companies) support and participation

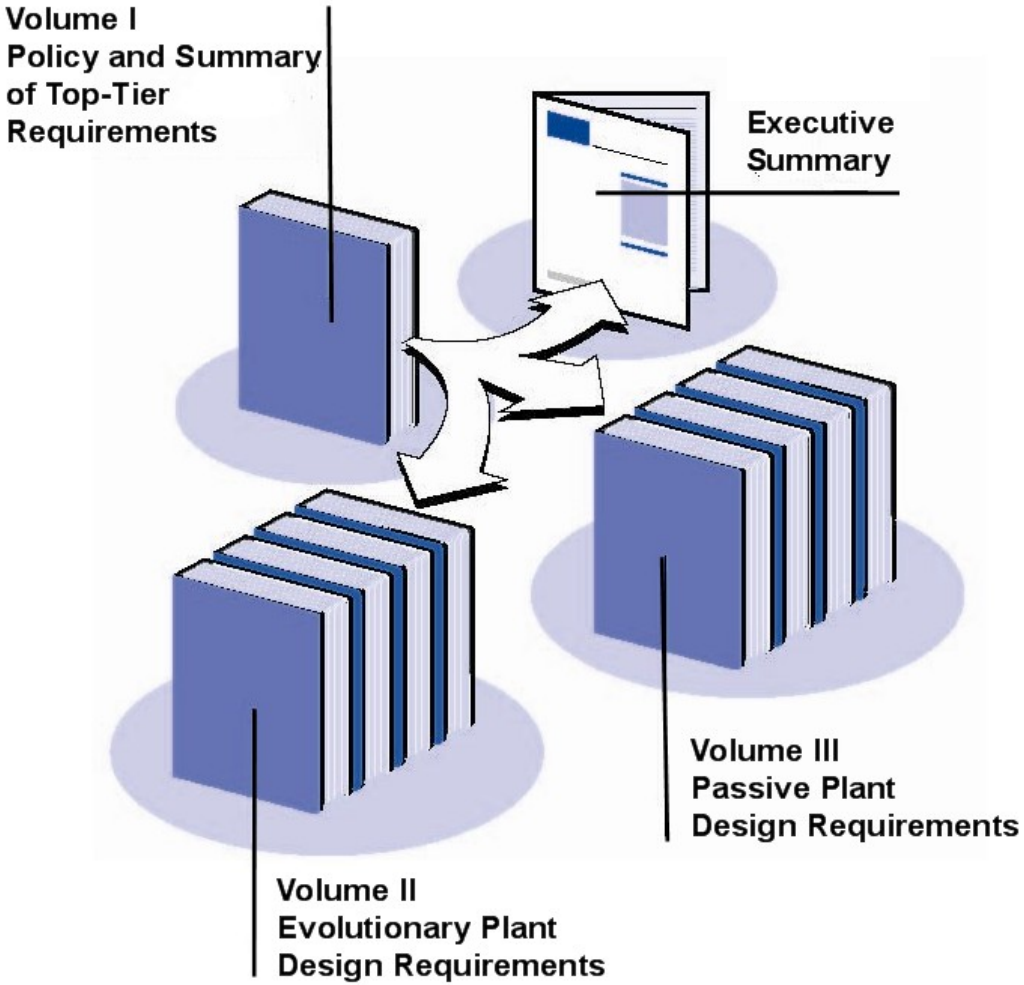
Development of the URD

- ALWR Utility Steering Committee established policies in 14 key areas to form the foundation for the requirements of safer, simpler designs with greater design margins.
  - Simplification
  - Design Margin
  - Human Factors
  - ALWR Safety
  - ALWR Design Basis
  - Regulatory Stabilization
  - Plant Standardization
  - Use of Proven Technology
  - Maintainability
  - Constructibility
  - Quality Assurance
  - ALWR Economics
  - ALWR Sabotage Protection
  - ALWR Good Neighbor

Development of the URD

- Requirement format and implications defined
  - Requirement / engineering rationale approach
  - Requirements are mandatory features and attributes directed at the plant design team (Plant Designer – NSSS Vendor)
- URD organized into three volumes based on plant designs
- URD chapters organized based on plant systems and topics
- Iterative consensus approach culminating in ALWR Utility Steering Committee review and approval

Utility Requirements Document Structure



Utility Requirements Document Chapters

Chapter/Title

1. Overall Requirements
2. Power Generation Systems
3. Reactor Coolant System and Reactor Non-Safety Auxiliary Systems
4. Reactors Systems
5. Engineered Safety Systems
6. Building Design and Arrangement

Utility Requirements Document Chapters

Chapter/Title

7. Fuel and Refueling
8. Plant Cooling Systems
9. Site Support Systems
10. Man-Machine Interface Systems
11. Electric Power Systems
12. Radioactive Waste Systems
13. Turbine Generator Systems

Utility Requirements Document - Example

Volume I >Executive Summary (High Level Requirements)

Table 1. Summary of Top-Tier ALWR Plant Design Requirements

GENERAL UTILITY DESIGN REQUIREMENTS

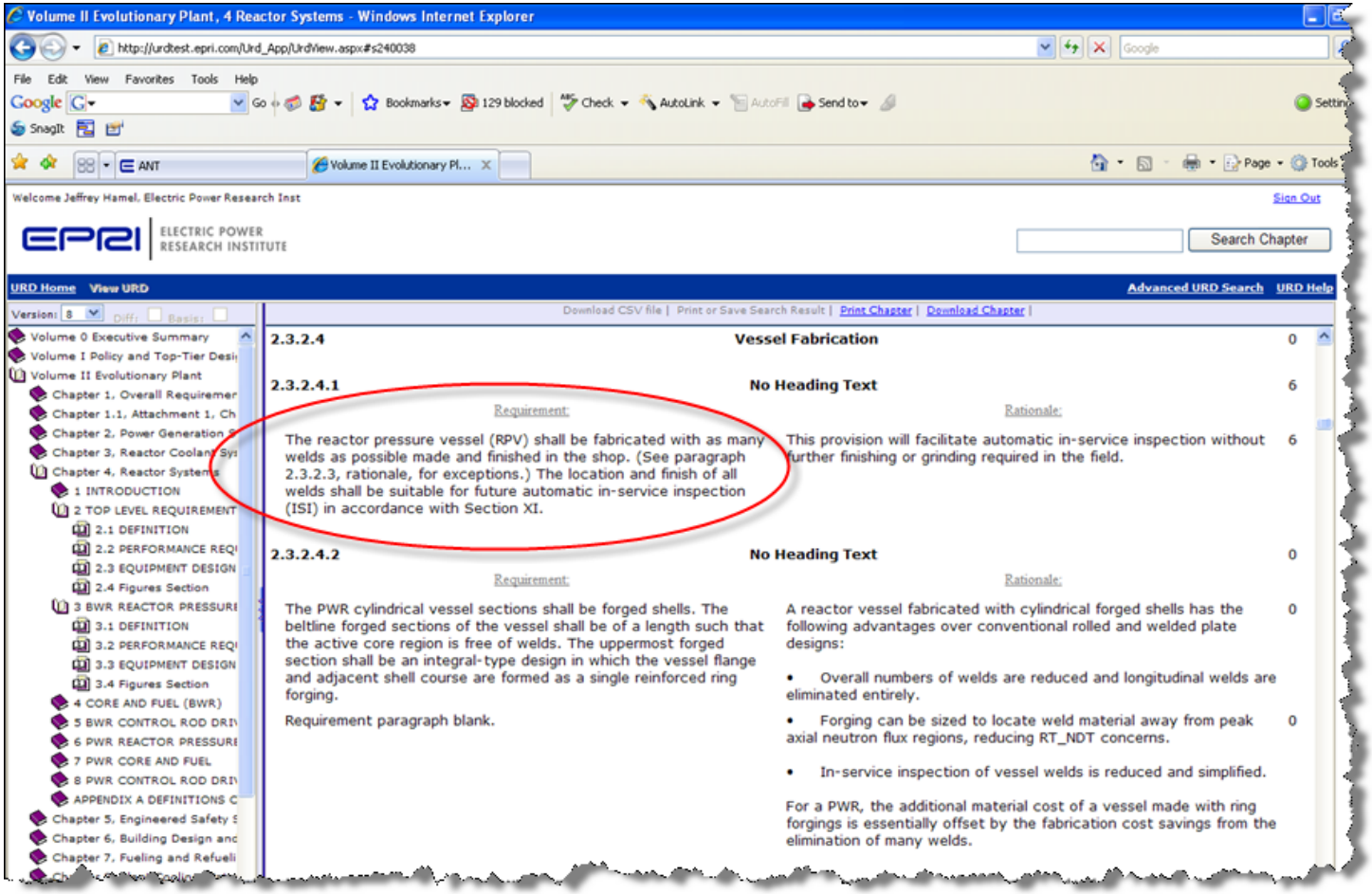
Plant type and size	PWR or BWR, applicable to a range of sizes up to 1350 MWe • Reference size for Evolutionary ALWR: 1200-1300 MWe per unit; • Reference size for Passive ALWR: 600 MWe per unit.
Safety system concept	Simplified safety system concepts: • Evolutionary ALWR - simplified, improved active systems; • Passive ALWR - primarily passive systems; safety-related ac electric power shall not be required.
Plant design life	60 years
Design philosophy	Simple, rugged, high design margin, based on proven technology; no power plant prototype required.
Plant siting envelope	Must be acceptable for most available sites in U.S.; 0.3g Safe Shutdown Earthquake (SSE).

PERFORMANCE

Design availability	87%
Refueling interval	24-month capability
Unplanned automatic scrams	Less than 1/year
Maneuvering	Daily load follow
Load rejection	Loss of load without reactor trip or turbine trip for PWR (from 100% power) and for BWR (from 40% power).
Low level radio active waste	Based on best current plants
Site spent fuel wet storage	10 years of operation plus one core off load
Occupational radiation	Less than 100 person rem per year
Operability and Maintainability	
• Design for operation	Operability features designed into plant, such as: forgiving plant response for operators, design margin, and operator environment.
• Design for Maintenance	Ready access to equipment.
• Equipment Access	Facilitate replacement of components, including steam generators.

Utility Requirements Document - Example

Volume II > Chapter 4 > Section 2.3.2.4 “Vessel Fabrication”



International Participation

Past and present participants:

- TPC, Taiwan
- KEPCO, Korea
- Kansai Electric Power Co, Japan
- GKN/KEMA, The Netherlands
- ENEL, Italy
- EdF, France
- JAPC, Japan
- VDEW, Germany
- ENDESA, Spain
- NE, England
- Tractebel, Belgium

Utility Requirements Document
Key Events

- URD first published in 1990
- URD contains
  - Over 15,000 requirements for evolutionary and passive ALWR designs
- NRC's SER for the URD (Rev. 6) completed 1994
- NSSS design teams adapt URD
  - Basis for design of their ALWR plants
  - Vendors assess conformance to the URD
- 1999 - Publication of Rev. 8
- 2007 - Web-based application launched for Revision 9 changes

Wide Application of URD

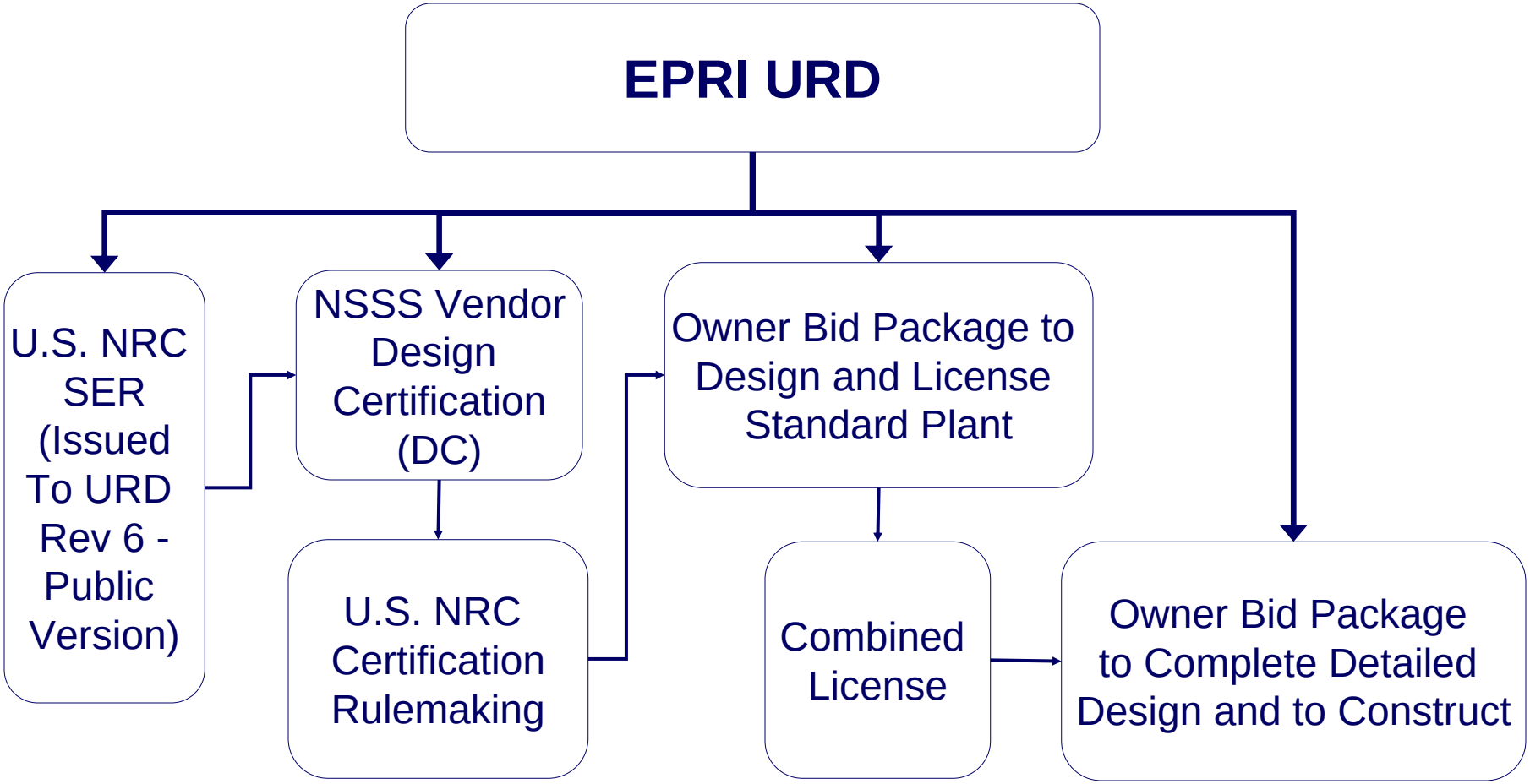
- Strategic document to enable a standardized approach
- The foundation for passive plant detailed design
- Internationally:
  - Korea Standard Requirements Document (evolutionary only)
  - Taiwan Power Company (TPC) Units 7&8 (Lungmen) Bid Specification
- Comprehensive tool for effective technology transfer and systematic documentation of current state-of-the-art

URD's Role in Current U.S. Deployment

- "In general, the first step in any review activity we do is to review the appropriate sections of the URD. Then, as part of the review activity, we continually evaluate the design against the URD requirements. A red flag goes up if any areas are identified where the design may not fully comply with the URD."

- URD is also being used today in the U.S. to support development of Engineer, Procure and Construct (EPC) contracts for new units…transferring URD requirements into contractual requirements.

Role Of URD In ALWR Implementation



URD Revision 9 Updates

- Revision 9 changes being incorporated into the document now
- Revision 9 changes will pull technical information available from last 8 years (1999-2007) of R&D Programs and Operating Experience:
  - Radwaste/ ALARA (complete rewrite)
  - Materials (ERPI BWRVIP Program, EPRI MRP Program, etc.)
  - Water Chemistry
  - Electrical Cabling
  - Equipment Qualification
  - Fuel Storage
  - Reliability/ Availability/ Maintainability

Revision 9 Example Changes to the URD

- Prohibition of Alloy 600, Alloy 82 & Alloy 182 to mitigate IGSCC (BWR) and PWSCC (PWR) of structural components & welds. Replace with higher chromium nickel alloys Alloy 690, Alloy 52 & Alloy 152
- Design, surface finish, etc. requirements to improve inspectability of internal components
- Adhere to BWRVIP-84 for carbon level control (0.02%) in BWRs for increased IGSCC resistance in austenitic materials
- Adhere to BWRVIP-84 for surface finish, cleanliness, cold work, heat treatment & ferrite level range for increased IGSCC resistance in austenitic materials & improve weldability
- Elimination of Alloy X-750 wherever possible in BWRs due to IGSCC

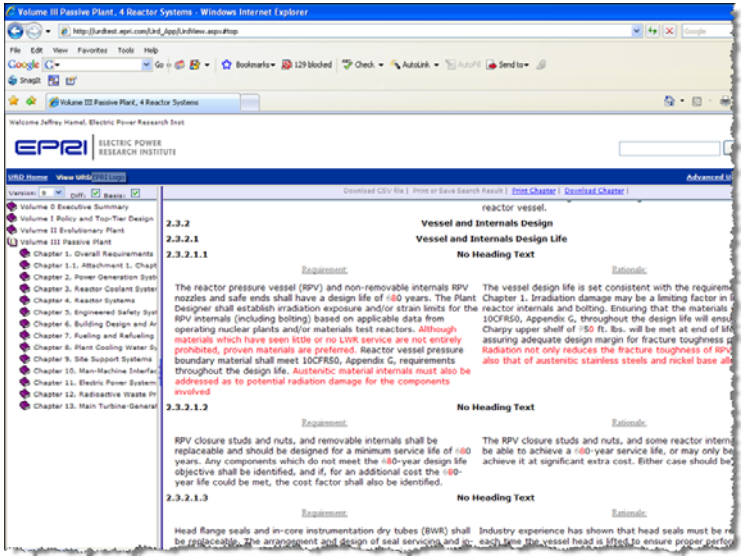
Revision 9 Example Changes to the URD

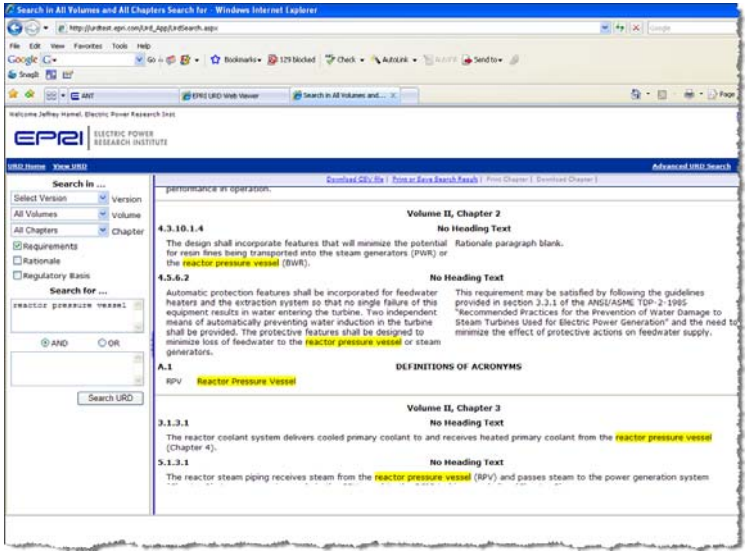
- Service water system requirements for improved reliability, flexibility & maintainability
- Provisions for zinc addition for radiation field control and primary water stress corrosion cracking mitigation
- Provisions for noble metal chemistry additions for internals cracking control
- Update processes for chemical impurity cleanup and control i.e., improved media for condensate polishing
- Fiber optics cable/ raceway & dry circuits in harsh environment requirements
- Electric cable systems, insulation, jackets, splices and penetrations
- Spent fuel storage updates for pool size, use of canisters in dry storage and transportation, and single failure-proof cranes

URD Web Based Viewer

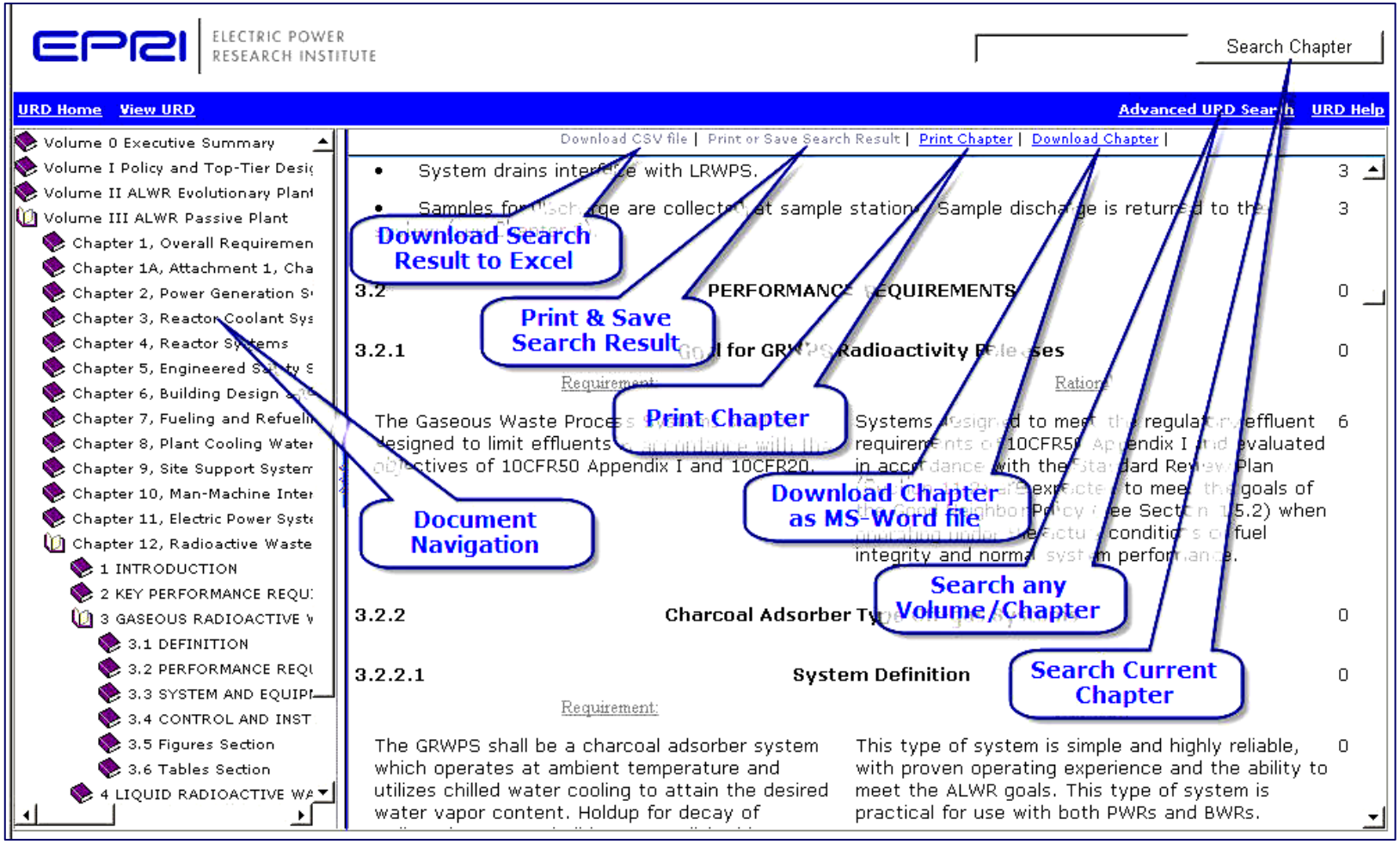
http://urd.epri.com

- Browser based tool intended to facilitate:
  - Viewing URD and associated changes between revisions (compare/view differences)
  - Enhanced search capability
  - Provide flexible database platform for large URD document to support future revisions





URD Viewer Added Functionality



URD Future Plans

- Change packages planned for Revision 10 changes in 2008:
  - Service Water System
  - Human Factors and I&C
  - Seismic Design (incorporating advanced in high frequency content)
  - Fuels
  - Chapter by Chapter review/updated of codes/standards

- Priority on effective / efficient transfer technology, collecting applicable lessons learned from industry R&D and operating experience and ensuring its availability for new plant application.

- Ongoing Technology Transfer Process:
  - Assemble updates when necessary
  - Review with industry experts, utilities & designers
  - Provide approved updates to designers for use in ongoing design work
  - Document tech transfer updates in URD