



International Atomic Energy Agency

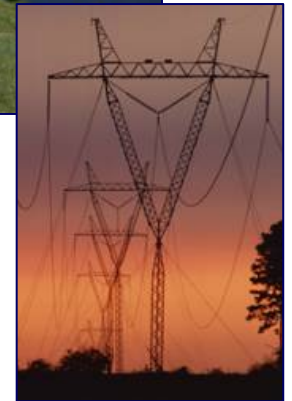
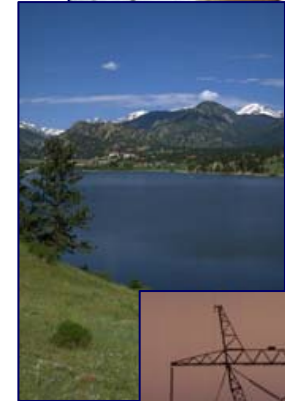
Use of EPRI Utility Requirements Document (URD) By Utilities For NPP Planning

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

About EPRI

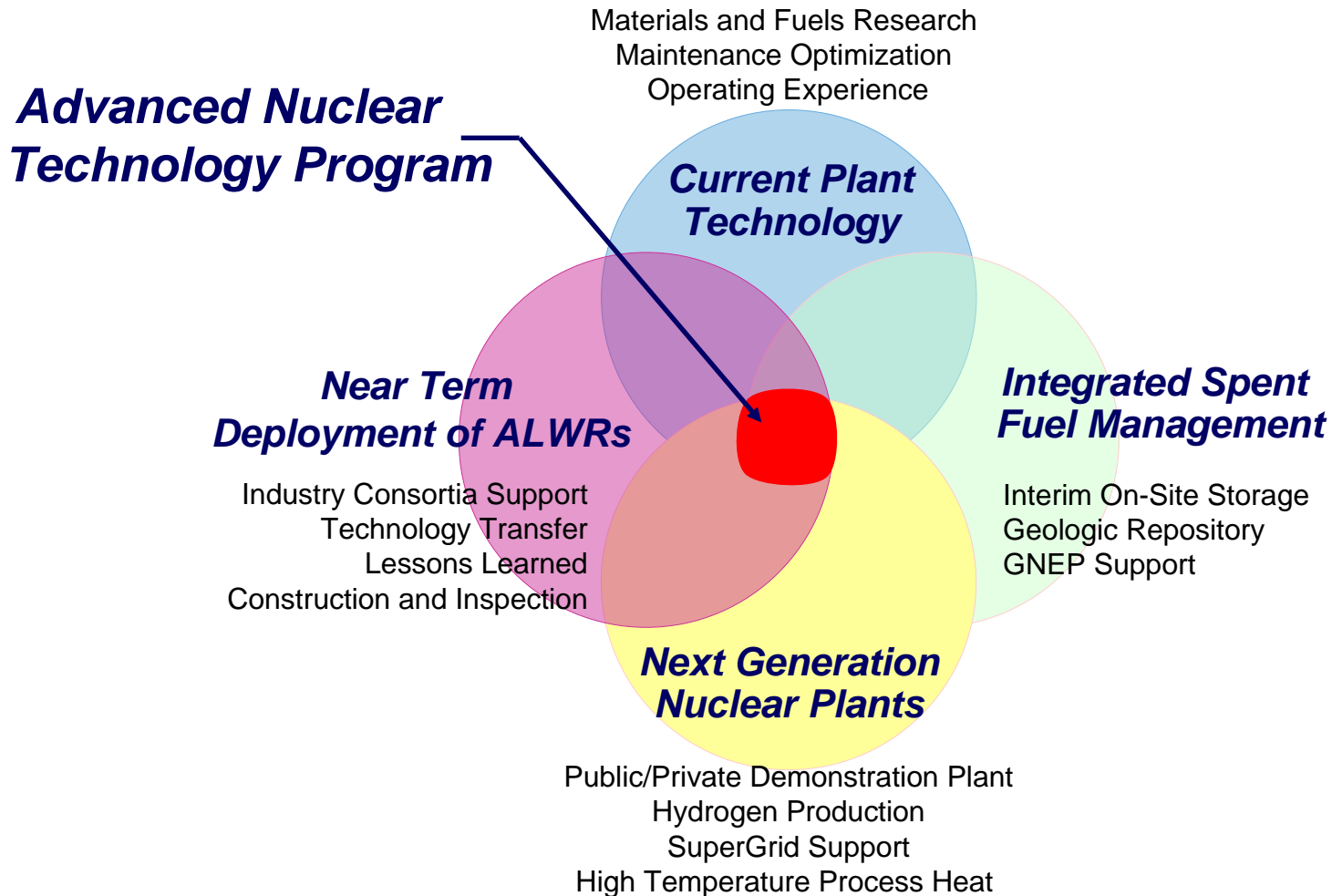
Together...Shaping the Future of Electricity

- 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>

ANT - Windows Internet Explorer

http://my.epri.com/portal/server.pt?in_hi_userid=575&spaceID=9&space=CommunityPage&parentid=8&control=SetCommunity&PageID=0&CommunityID=319&parentname=

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ANT > ANT

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ANT Project Sponsors and TAG Members

Nuclear Program Overview

EPRI Nuclear Calendar

Related Web Sites (non-EPRI affiliated)

In Pursuit of a Nuclear Renaissance: *EPRI Journal* Summer 2007 (pdf)

Running Dry... At The Power Plant: *EPRI Journal* Summer 2007 (pdf)

EPRI Utility Requirements Document, Revision 9

Keystone Center Nuclear Power Joint Fact-Finding Report (pdf)

Advanced Nuclear Technology (ANT)

ANT Overview

Siting, licensing, development and deployment of new nuclear power plants are challenged by a host of technological, economic and regulatory concerns. Mitigating these concerns is critical to maintaining momentum along the nuclear development cycle.

EPRI's Advanced Nuclear Technology (ANT) Program focuses on developing the technologies and tools needed to deploy advanced nuclear plants in the near term, while pursuing research to support nuclear sustainability and growth in the long term, including the development of next-generation nuclear plants and integrated spent fuel management.

- Supplemental Program Notice (pdf) Near-term Deployment of Advanced Light-water Reactors
- Why Nuclear...Why New Nuclear? (pdf)
- ANT Program Overview (pdf)

What's New

- The Effects of High-Frequency Ground Motion on Structures, Components, and Equipment in Nuclear Power Plants: [Technical Report Summary](#)
- Advanced Plant Equipment Monitoring and Margins Recommendations Database: [Software Summary](#)


Meetings and Events

Upcoming

- January 9, 2008—ANT APWG General Meeting, Washington D.C.

Past Meetings

- September 20, 2007—ANT APWG General Meeting, Washington, D.C.:
- June 21, 2007—NPDPM Workshop, Charlotte, NC
- May 15, 2007—ANT APWG General Meeting, Washington, D.C.



Lungmen RPV

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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

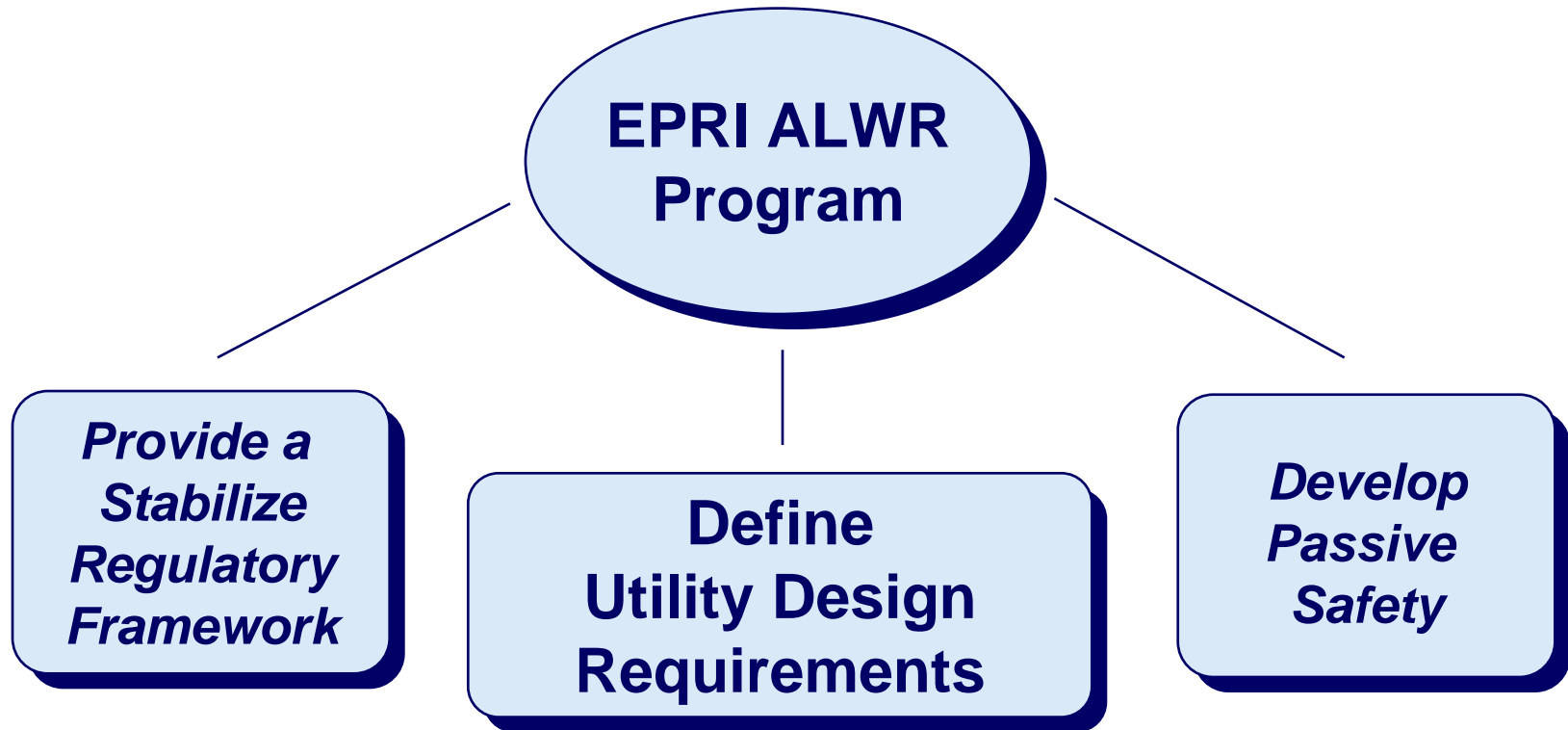
1983 - Feedback from a survey of nuclear utility executives: nuclear power plants must be:

- 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

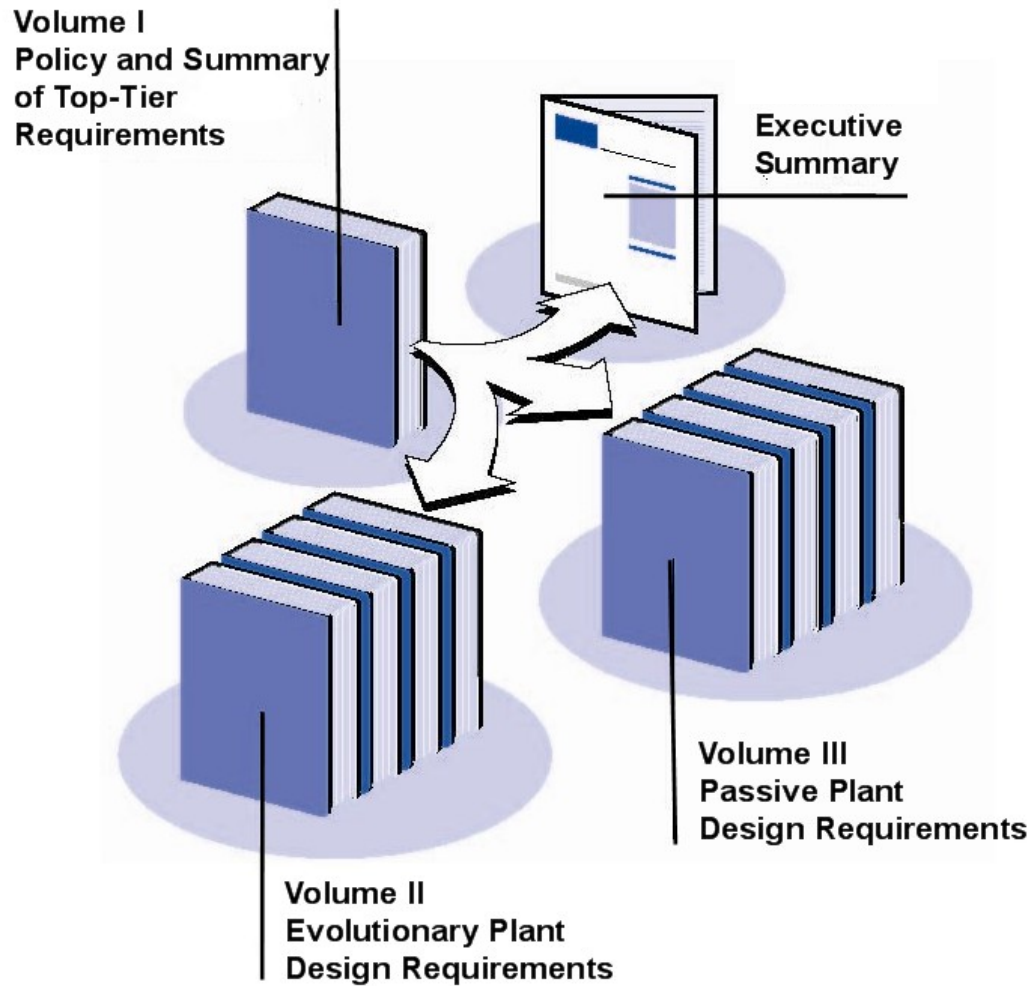
Development of the URD

- 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 <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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”

The screenshot shows a web browser window titled "Volume II Evolutionary Plant, 4 Reactor Systems - Windows Internet Explorer". The address bar shows the URL: http://urctest.epri.com/Urld_App/UrldView.aspx#s240038. The browser interface includes a search bar, navigation buttons, and a toolbar. The main content area displays the EPRI logo and a search bar. Below the navigation tree, the document content is shown in a table format. The table has columns for "Requirement", "Rationale", and a numerical value. The requirement 2.3.2.4.1 is circled in red.

Requirement	Rationale	
2.3.2.4 Vessel Fabrication		0
2.3.2.4.1	No Heading Text	6
The reactor pressure vessel (RPV) shall be fabricated with as many welds as possible made and finished in the shop. (See paragraph 2.3.2.3, rationale, for exceptions.) The location and finish of all welds shall be suitable for future automatic in-service inspection (ISI) in accordance with Section XI.	This provision will facilitate automatic in-service inspection without further finishing or grinding required in the field.	6
2.3.2.4.2	No Heading Text	0
The PWR cylindrical vessel sections shall be forged shells. The beltline forged sections of the vessel shall be of a length such that the active core region is free of welds. The uppermost forged section shall be an integral-type design in which the vessel flange and adjacent shell course are formed as a single reinforced ring forging.	A reactor vessel fabricated with cylindrical forged shells has the following advantages over conventional rolled and welded plate designs: <ul style="list-style-type: none">• Overall numbers of welds are reduced and longitudinal welds are eliminated entirely.• Forging can be sized to locate weld material away from peak axial neutron flux regions, reducing RT_NDT concerns.• In-service inspection of vessel welds is reduced and simplified.	0
Requirement paragraph blank.	For a PWR, the additional material cost of a vessel made with ring forgings is essentially offset by the fabrication cost savings from the elimination of many welds.	0

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

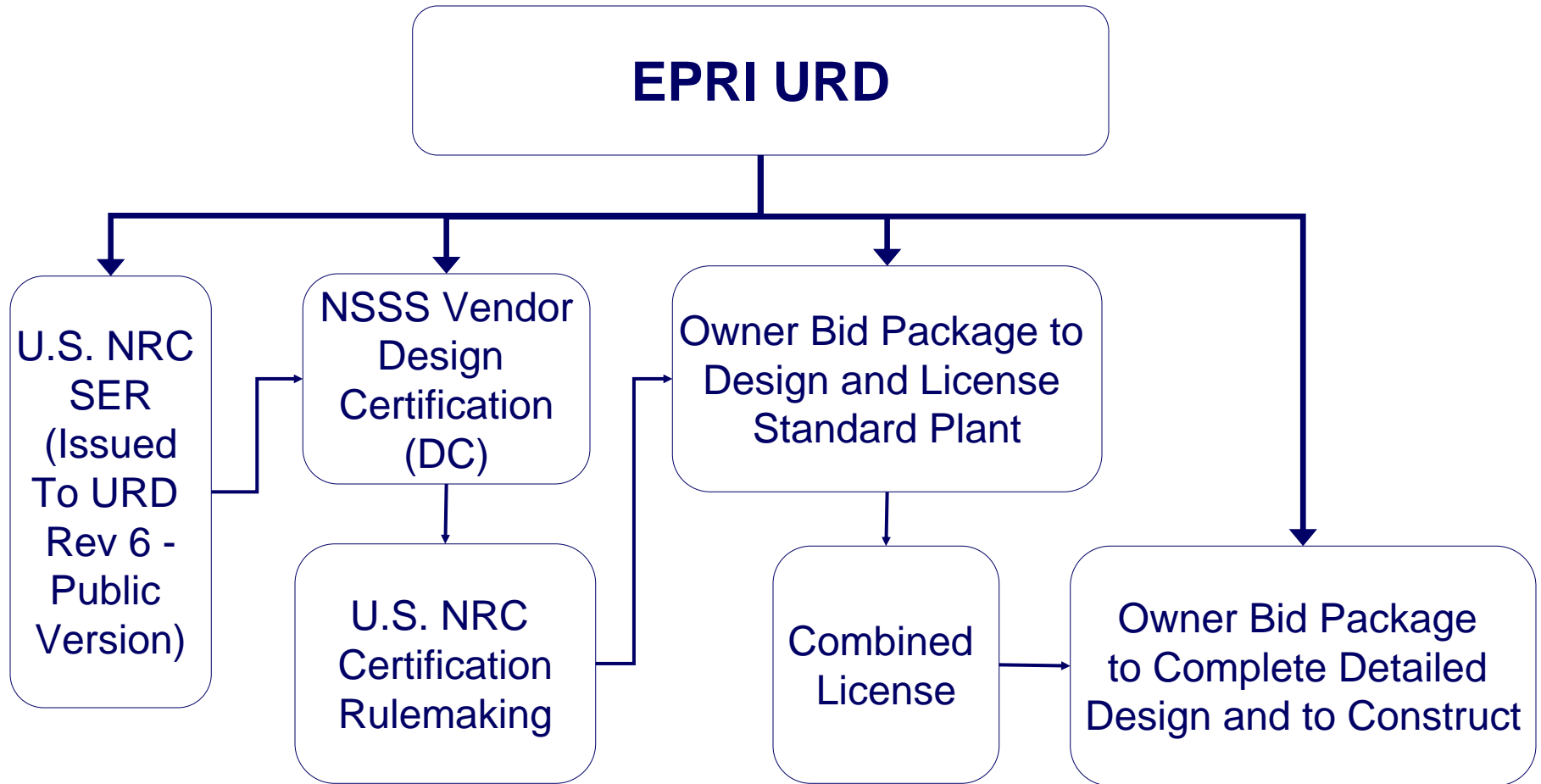
Wide Application of URD

- 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

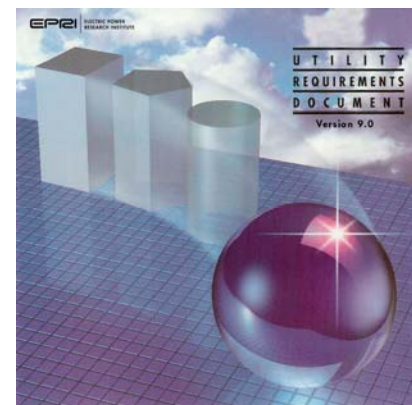
- “In general, the first step in any review activity we do is to review the appropriate sections of the URD. Then, as part of the review activity, we continually evaluate the design against the URD requirements. A red flag goes up if any areas are identified where the design may not fully comply with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

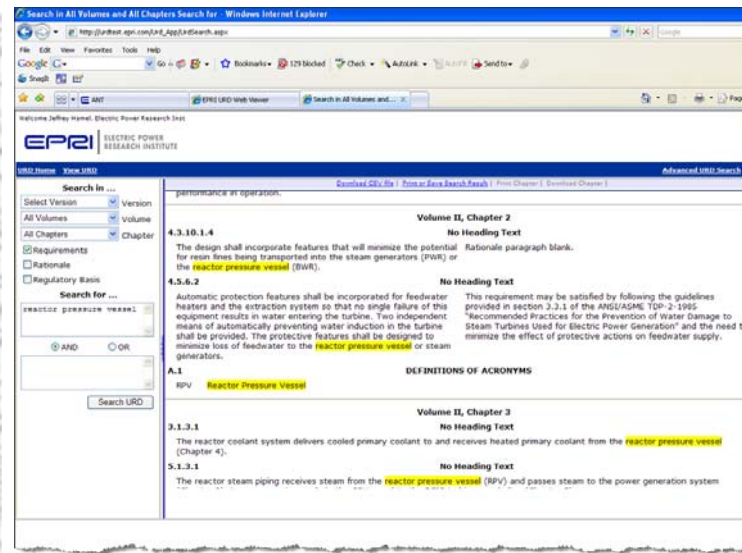
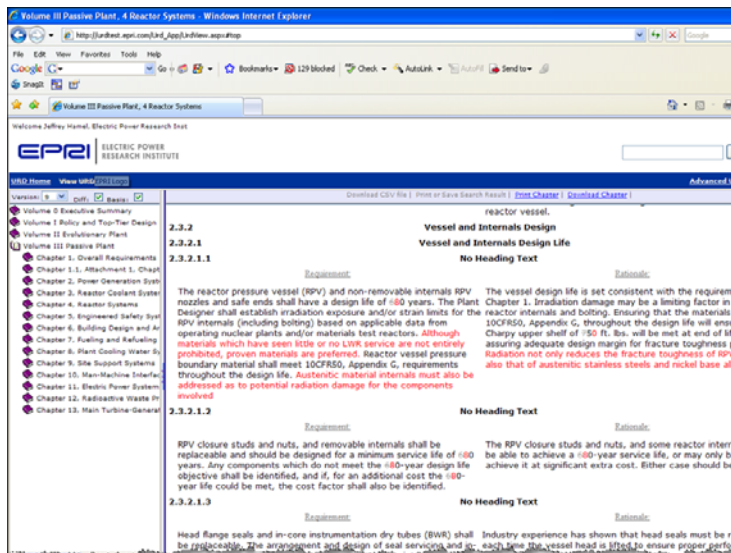
Revision 9 Example Changes to the URD

- 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

The screenshot displays the EPRI Electric Power Research Institute URD Viewer interface. The interface includes a navigation pane on the left, a main content area, and a search bar at the top right. Several callout boxes highlight specific features:

- Download Search Result to Excel:** Points to the 'Download CSV file' link in the top navigation bar.
- Print & Save Search Result:** Points to the 'Print or Save Search Result' link in the top navigation bar.
- Print Chapter:** Points to the 'Print Chapter' link in the top navigation bar.
- Download Chapter as MS-Word file:** Points to the 'Download Chapter' link in the top navigation bar.
- Search any Volume/Chapter:** Points to the 'Search Chapter' input field at the top right.
- Search Current Chapter:** Points to the search bar within the main content area.
- Document Navigation:** Points to the left-hand navigation pane.

The main content area shows a table of contents with the following structure:

Volume	Chapter	Section	Page
Volume 0	Executive Summary		
Volume I	Policy and Top-Tier Design		
Volume II	ALWR Evolutionary Plant		
Volume III	ALWR Passive Plant		
	Chapter 1	Overall Requirements	
	Chapter 1A	Attachment 1, Chapter 1	
	Chapter 2	Power Generation System	
	Chapter 3	Reactor Coolant System	
	Chapter 4	Reactor Systems	
	Chapter 5	Engineered Safety Features	
	Chapter 6	Building Design	
	Chapter 7	Fueling and Refueling	
	Chapter 8	Plant Cooling Water	
	Chapter 9	Site Support Systems	
	Chapter 10	Man-Machine Interface	
	Chapter 11	Electric Power System	
	Chapter 12	Radioactive Waste	
	1	INTRODUCTION	
	2	KEY PERFORMANCE REQUIREMENTS	
	3	GASEOUS RADIOACTIVE WASTE	
	3.1	DEFINITION	
	3.2	PERFORMANCE REQUIREMENTS	
	3.3	SYSTEM AND EQUIPMENT	
	3.4	CONTROL AND INSTRUMENTATION	
	3.5	Figures Section	
	3.6	Tables Section	
	4	LIQUID RADIOACTIVE WASTE	

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