U.S. DEPARTMENT OF ENERGY | Office of Nuclear Energy

Delivering Innovative Solutions for America's Energy Challenges

Peter Lyons

Acting Assistant Secretary for Nuclear Energy

U.S. Department of Energy

2011 Workshop on U.S. Nuclear Power Plant Life Extension and Development

February 22, 2011

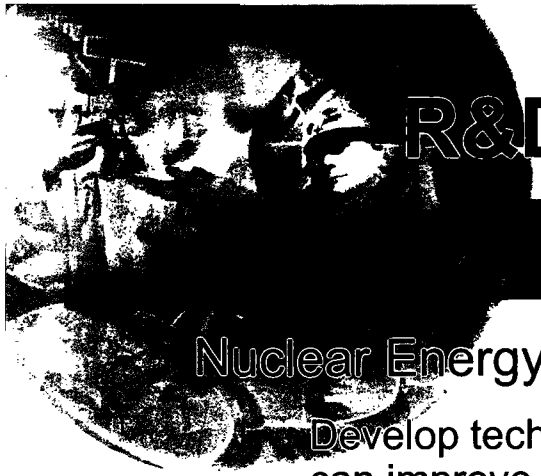
Rec'd w/ltr FSME20 FSME

Innovation and Competitiveness

"This is our generation's Sputnik moment. … We'll invest in biomedical research, information technology, and especially clean energy technology — an investment that will strengthen our security, protect our planet, and create countless new jobs for our people."

"So tonight, I challenge you to join me in setting a new goal: By 2035, 80 percent of America's electricity will come from clean energy sources. Some folks want wind and solar. Others want nuclear, clean coal and natural gas. To meet this goal, we will need them all…"

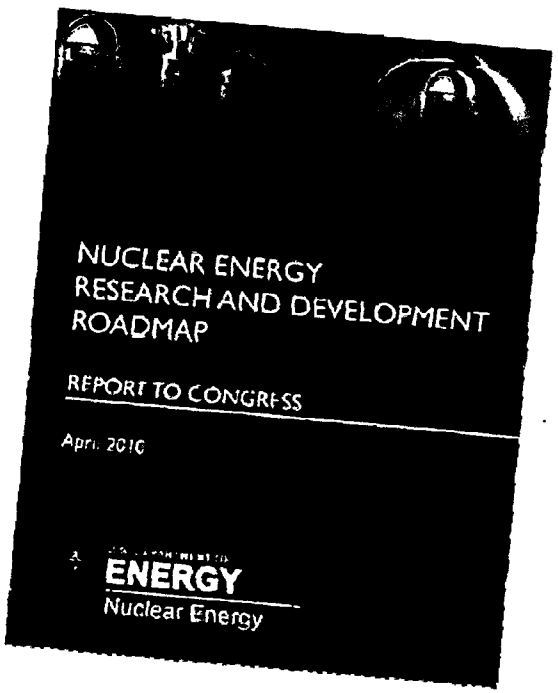
President Barack Obama
State of the Union Address
January 25, 2011



R&D in the FY 2012 Budget

Nuclear Energy R&D Objectives

1. Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors
2. Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals
3. Develop sustainable nuclear fuel cycles
4. Understand and minimize the risks of nuclear proliferation and terrorism



- Four complementary R&D programs in the FY 2012 budget
  - Reactor Concepts
  - Fuel Cycle
  - Nuclear Energy Enabling Technologies
  - International Nuclear Energy Cooperation

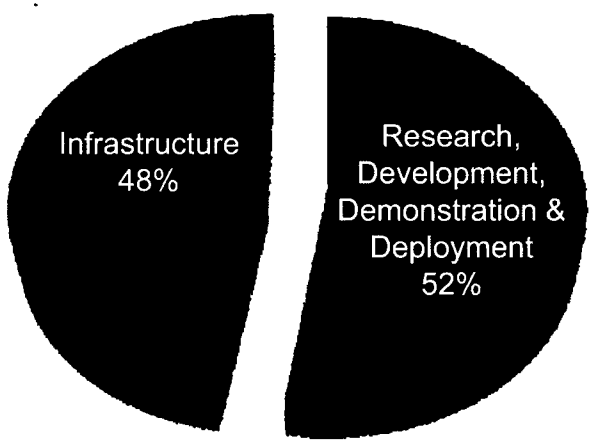
FY 2012 Budget Request Breakdown ($k)

Program	FY 2012 Request
Research, Development, Demonstration & Deployment	
LWR SMR Licensing Technical Support	67,000
Reactor Concepts RD&D[a]	125,000
Fuel Cycle Research and Development[a]	155,010
Nuclear Energy Enabling Technologies[a]	97,364
International Nuclear Energy Cooperation	3,000
Integrated University Program	0
Infrastructure	
Radiological Facilities Management	64,888
Idaho Facilities Management	150,000
Idaho Sitewide S&S	98,500
Program Direction	93,133
Use of Prior Year Balances	-1,367
Total NE:	**852,528**

a) up to 20% of R&D funds are competitively awarded to universities

FY 2012 Request

Total: $852,528



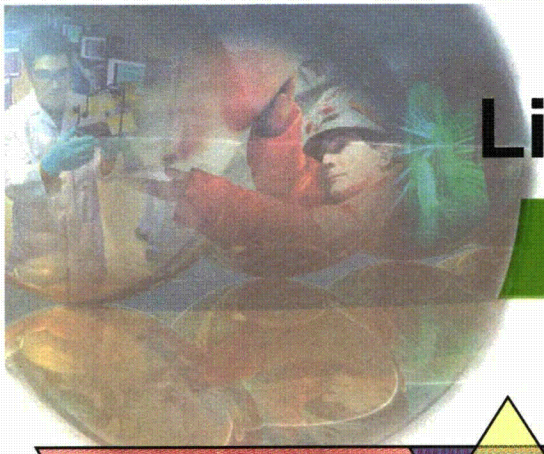
Reactor Concepts Research, Development, and Demonstration

Budget Summary

$ in thousands

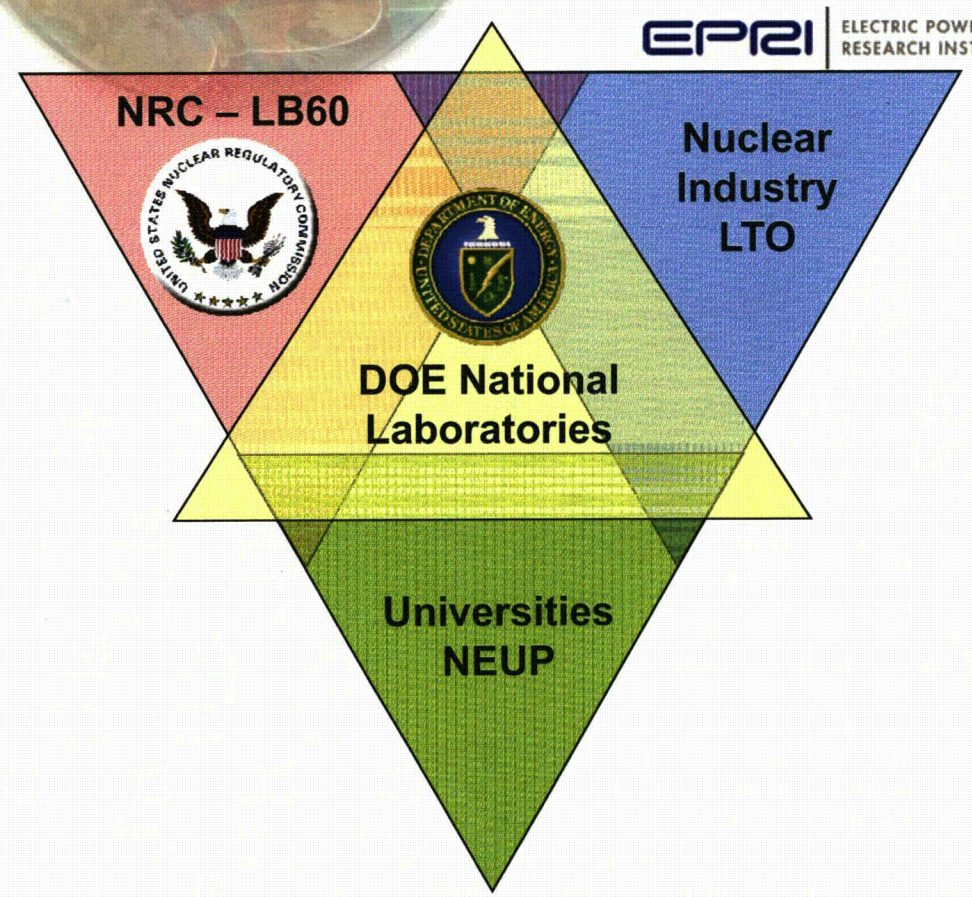
Program Element	FY 2012 Request
Small Modular Reactor Advanced Concepts R&D	28,674
Next Generation Nuclear Plant (NGNP)	49,572
Light Water Reactor Sustainability	21,384
Advanced Reactor Concepts	21,870
SBIR/STTR	3,500
Total:	**125,000**

- **Mission**
  - Develop new and advanced reactor designs and technologies that advance the state of reactor technology to broaden applicability, improve competitiveness, contribute to our nation's energy portfolio, and address environmental challenges
- **FY 2012 Planned Accomplishments**
  - Conduct R&D on advanced SMR designs
  - Establish critical path R&D activities and work with industry to establish the business plan and approach for the long-term execution of NGNP
  - Research technologies that support safe and economical long-term operation of the existing nuclear fleet
  - Conduct R&D on Advanced Reactor Concepts



Light Water Reactor Sustainability

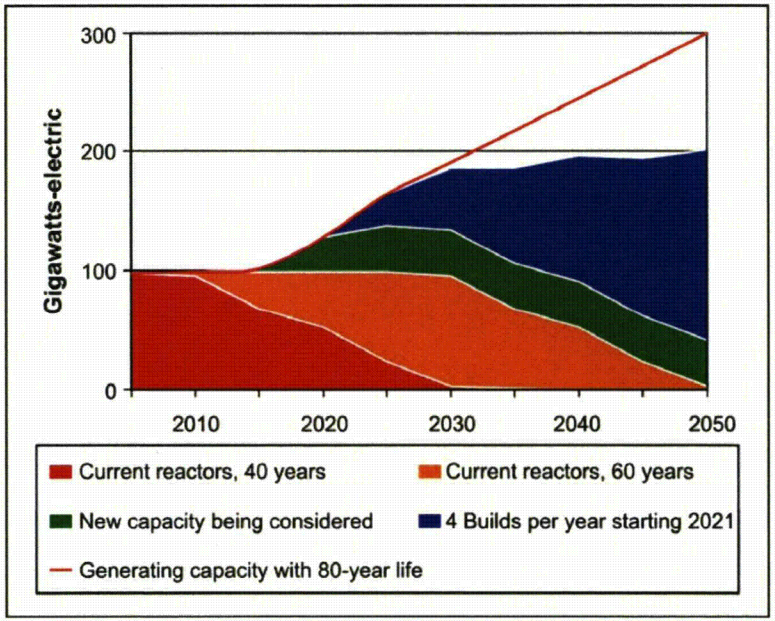
Office of Nuclear Energy



Nuclear Sector Mission Statement

EPRI Nuclear Power Council Executive Committee, Feb. 2, 2011

- Maximize the utilization of existing nuclear plants
- Enable the development of advanced nuclear plants
- Support the long-term sustainability of nuclear resources

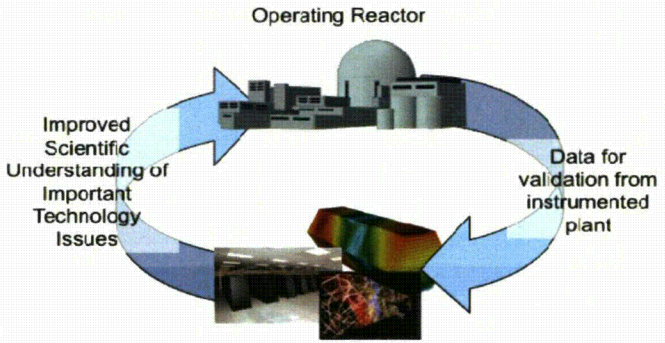


Innovation: Modeling and Simulation Hub

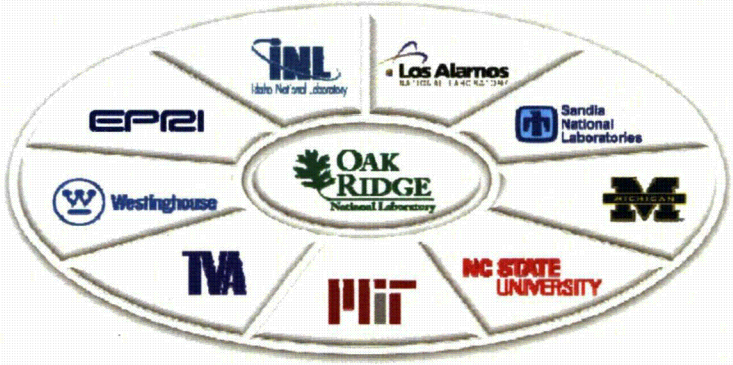
Office of Nuclear Energy

"At Oak Ridge National Laboratory, they're using supercomputers to get a lot more power out of our nuclear facilities."
-- President Obama, 2011 State of the Union Address

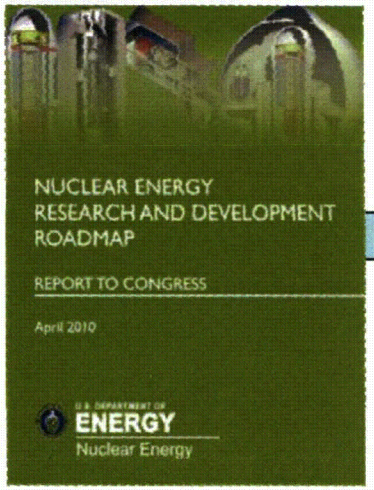
- CASL: The Consortium for Advanced Simulation of Light Water Reactors
  - A unique lab-university-industry partnership with a remarkable set of assets
- CASL vision: Create a virtual reactor for predictive simulation of LWRs
- CASL mission: Develop and apply the virtual reactor to address 3 critical performance goals
  - Reduce capital and operating costs
  - Reduce nuclear waste
  - Enhance nuclear safety
- Selection announced on May 28, 2010
- FY 2012 request: $24.3M

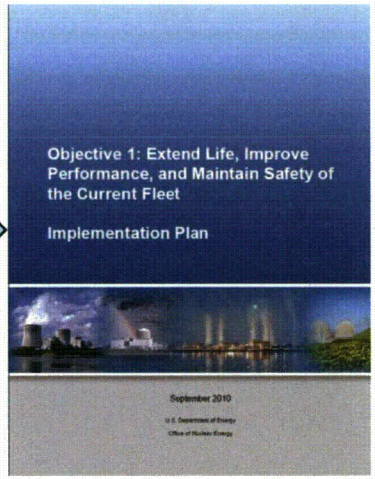


Advanced Modeling and Simulation of the Operating Reactor (aka "Virtual Reactor")

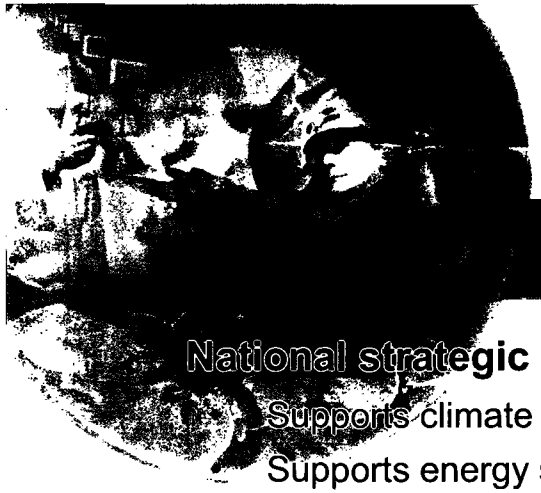


Implementation Plan for Objective #1



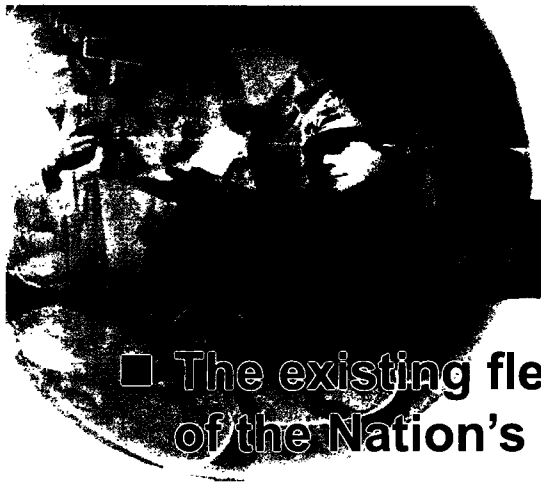


- *DOE / EPRI Joint Strategy*
- *Nuclear Materials Aging and Degradation*
- *Advanced Instrumentation, Information, and Control Systems*
- *Risk-Informed Safety Margins Characterization*
- *Advanced LWR Fuel Development*
- *Economics and Efficiency Improvements*



Federal Role

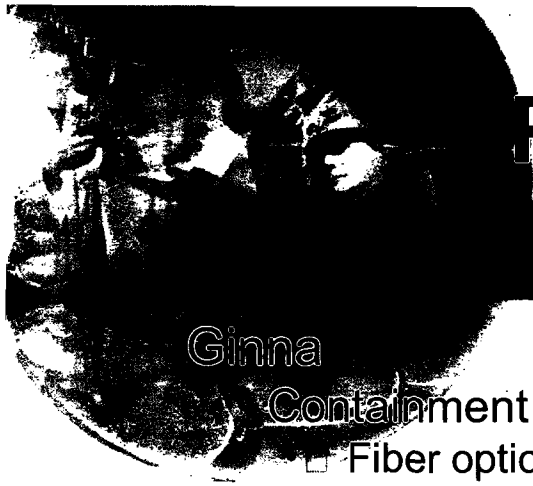
- **National strategic interest in the long-term operation of existing plants**
  - Supports climate change objectives
  - Supports energy security
  - Avoids higher cost to ratepayers for new plant replacements
- **Industry also has an incentive, so cost-share will be employed**
  - Public-private partnerships are a key mechanism
- **Addresses fundamental scientific questions where private investment or capabilities are insufficient to make progress on broadly applicable technology issues for public benefit**
- **Government holds a large theoretical, computational, and experimental capability in nuclear R&D that is not available within the industry**
- **Benefits will extend to the next generation of reactor technologies still in development**
- **The Office of Nuclear Energy has signed Memorandum of Understanding with the Nuclear Regulatory Commission and the Electric Power Research Institute to cooperate on R&D related to the long-term operation of existing plants.**
  - Strong NRC and EPRI roles are critical



Conclusion

- The existing fleet of nuclear power plants provide the majority of the Nation's low-carbon electricity generation
- The continued operation of the existing fleet is in the National interest as a key strategy for meeting climate change and energy supply goals
- Federal efforts are essential to stimulate and encourage industry efforts as well as to address the longer-term, high risk research that industry cannot address
- Sustained R&D on long-term LWR operations is needed to identify issues and develop the technical basis that supports industry efforts to relicense plants for long-term operation

Backup



Pilot Plant Projects

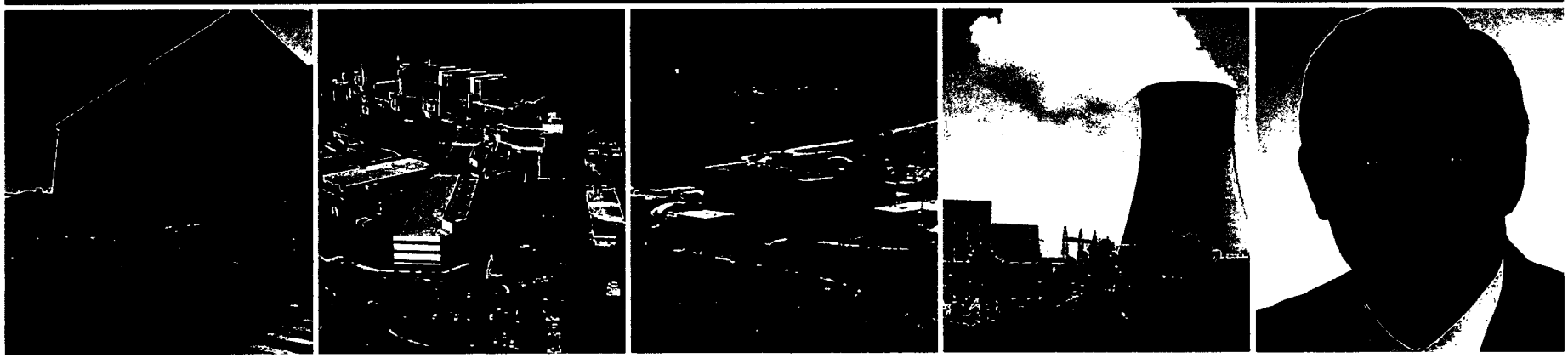
- Containment assessment
  - Fiber optic strain gage measurement of tendon relaxation
  - Coring and subsequent spectroscopy and strength testing
  - Rebar condition assessment
  - NDE (test various methods)
  - Digital Image Correlation trial
- Augmented Reactor Internals Aging Assessment (baffle bolts)
- RPV embrittlement
  - Reconstitute specimens
  - Irradiate further
  - Re-test to expand vessel embrittlement database

➢ Nine Mile Point Unit 1
- Investigate top guide cracking
- Other activities TBD

➢ Zion D&D
- Concrete Specimens
- RPV Specimens

CENG
a joint venture of
Constellation Energy
EDF

Brew Barron, CENG CEO



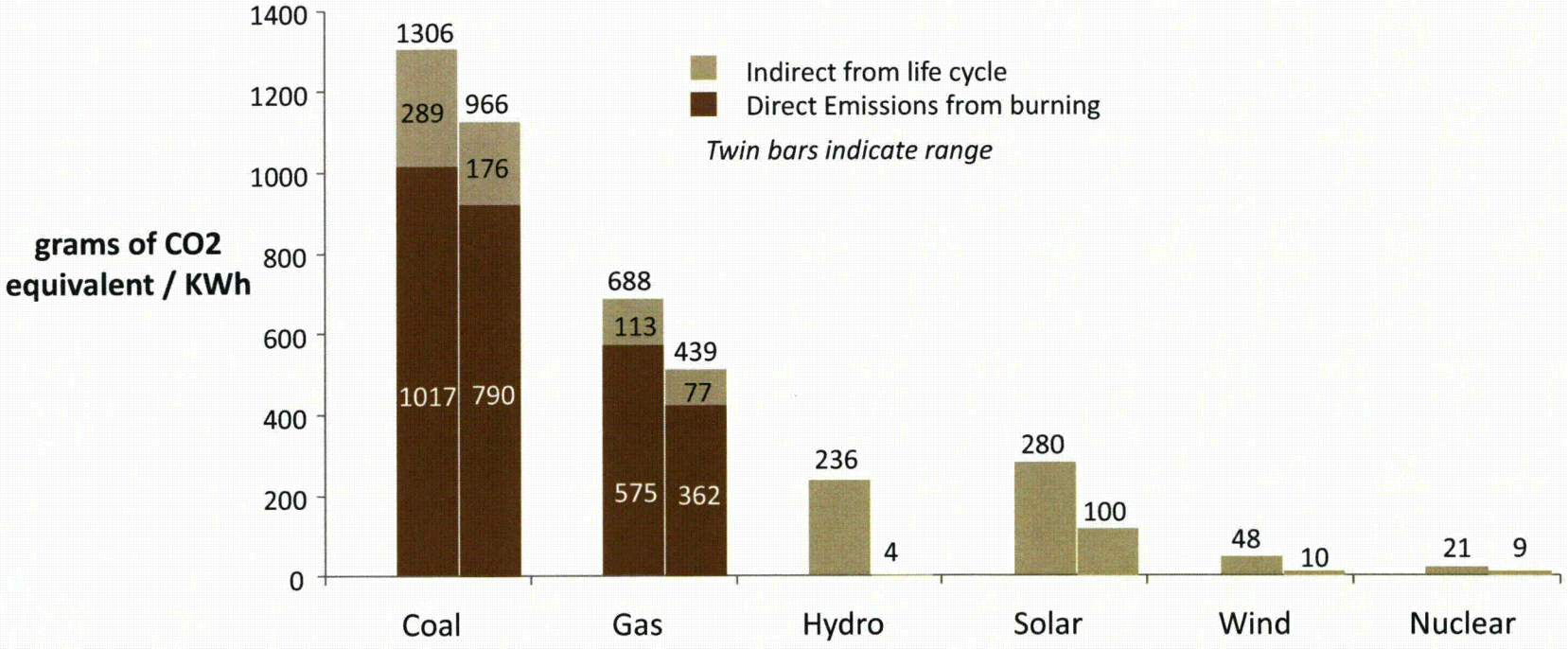
Extending life beyond 60 years is not just an academic study

February 22, 2011

Life Beyond 60 years workshop

Nuclear Power is important to a US energy strategy

- Low carbon emissions



Source: EIA 2000

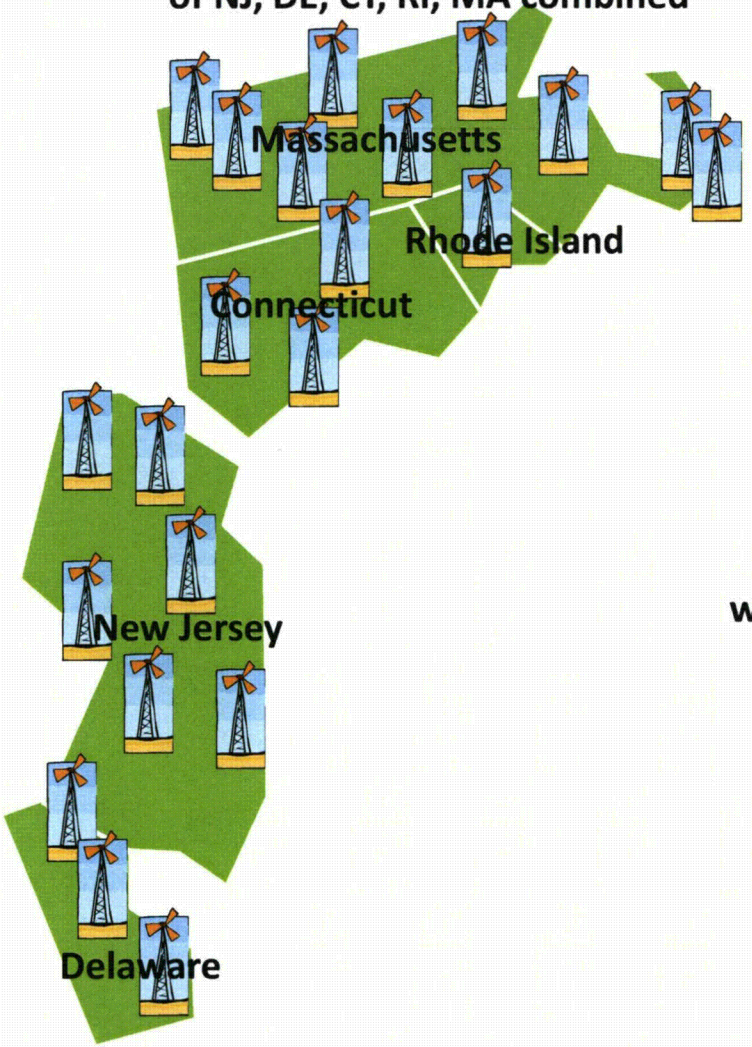
Replacing current nuclear generation with:

Solar panels

would require usage of land the size of New Jersey

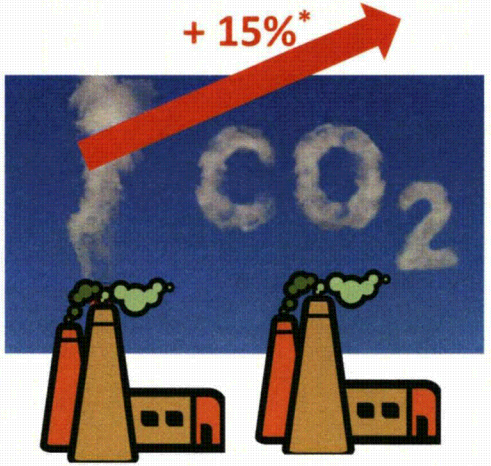
Wind turbines

would require usage of land the size of NJ, DE, CT, RI, MA combined



Gas plants

would increase greenhouse gas emissions from electric power generators by 15%

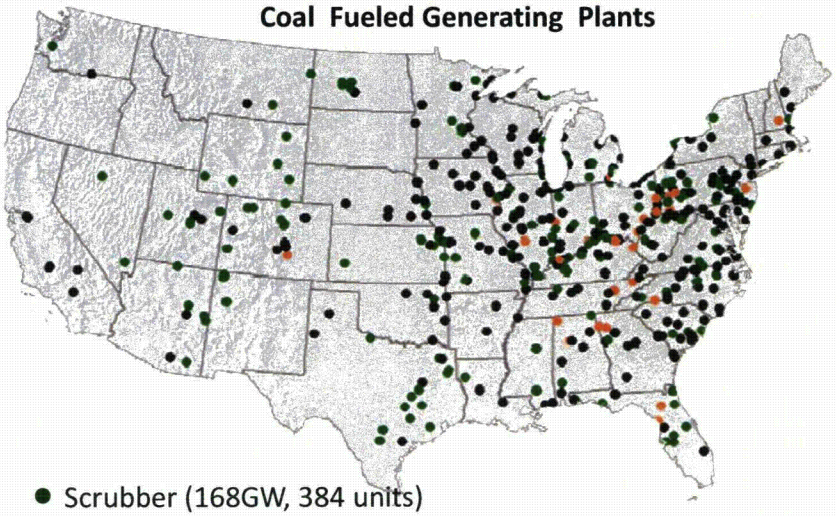


would increase gas demand and gas and electric prices with it

Coal Plant Retirement, Baseload demand increase…

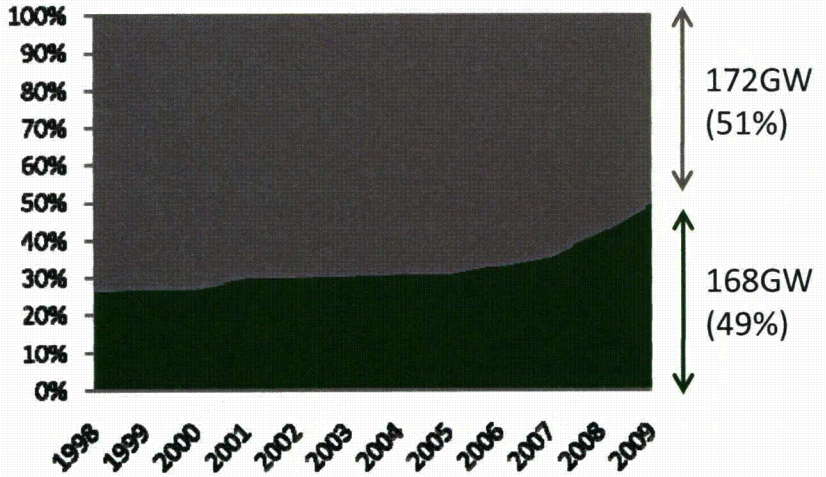
50% coal plants may be phased out

Coal Fueled Generating Plants

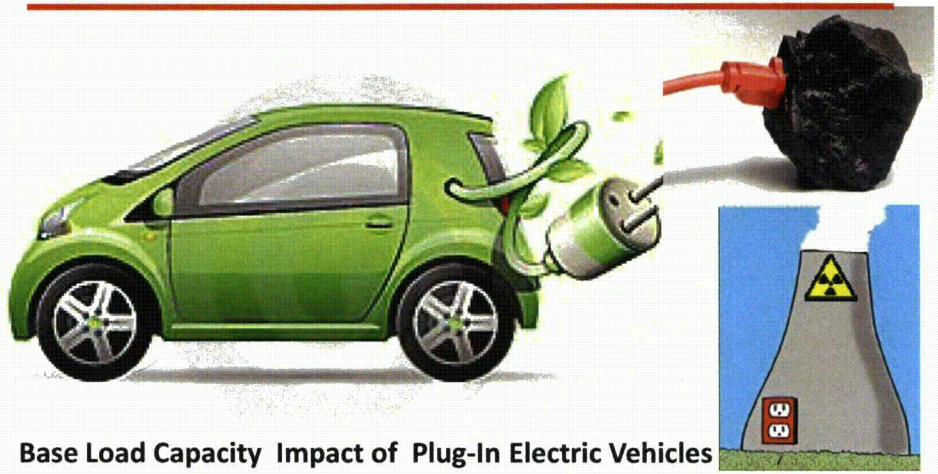


- Scrubber (168GW, 384 units)
- No Scrubber (172GW, 1082 units)
- Planned

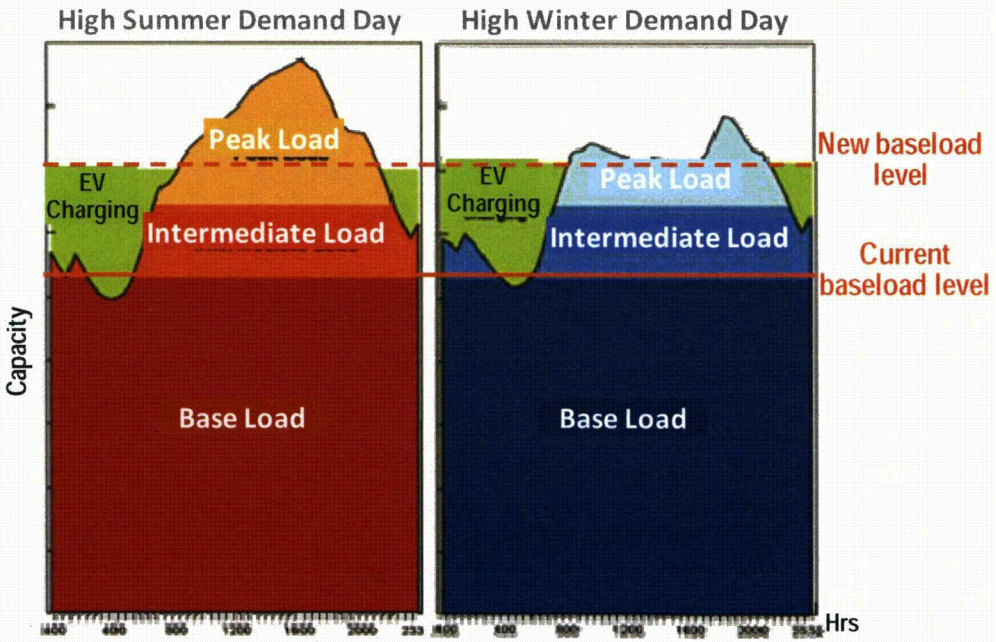
% of Coal Plant Capacity with Scrubber (2009 data)



Electric Vehicles will create baseload power need



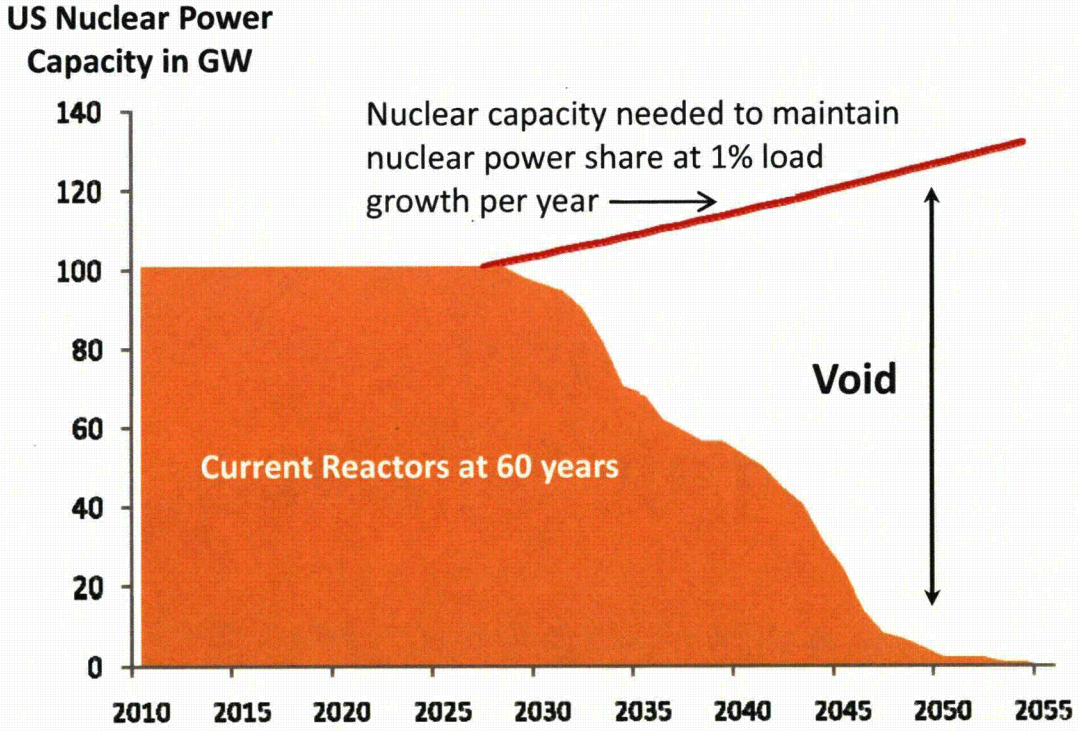
Base Load Capacity Impact of Plug-In Electric Vehicles



Load Curve for Typical Electric Grid

Source: Scrubber (EIA), Electric Vehicles (World-Nuclear)

Filling the void



We know

- 10CFR54 is a mature and robust regulatory framework for license extension

We don't know

- Any technological show stopper to safe and reliable operations beyond 60 years

Ensuring the question of life extension beyond 60 years is not an academic study, it is an environmental imperative

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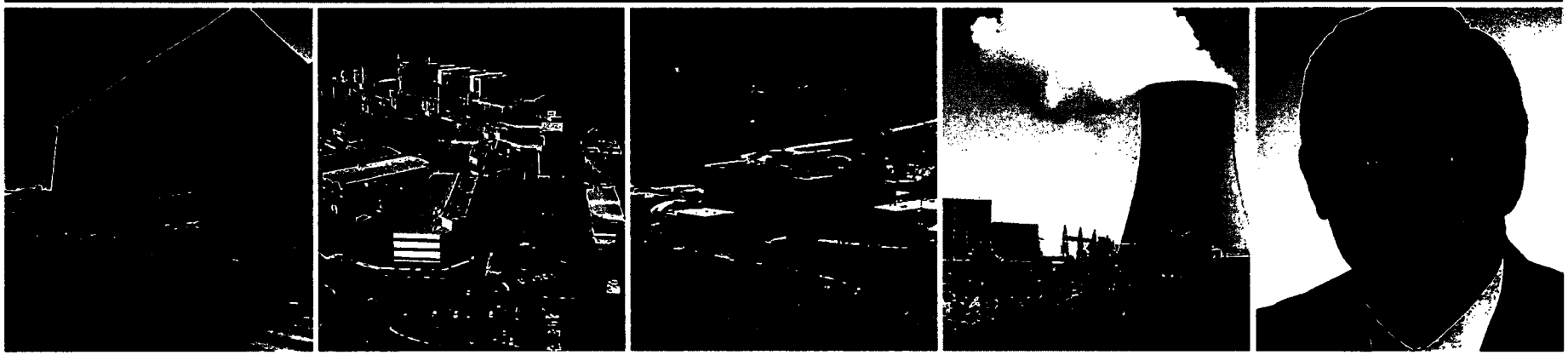
a joint venture of
Constellation Energy
EDF

Brew Barron, CENG CEO



Extending life beyond 60 years is not just an academic study

February 22, 2011

Life Beyond 60 years workshop

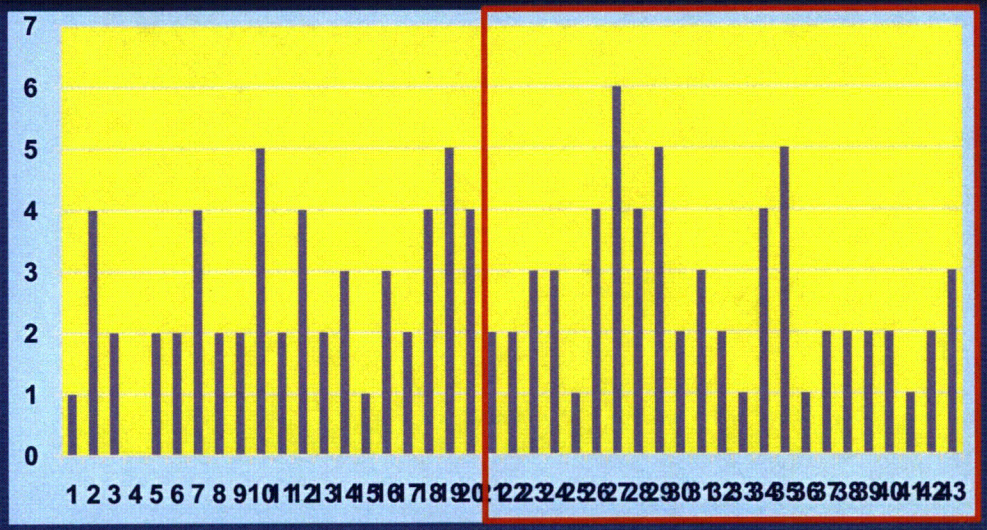
Plant Life Management Activities for Long Term Operation in Nuclear Power Plants

Feb. 22, 2011

Ki Sig Kang,
Tech. Head, PLiM/ LTO

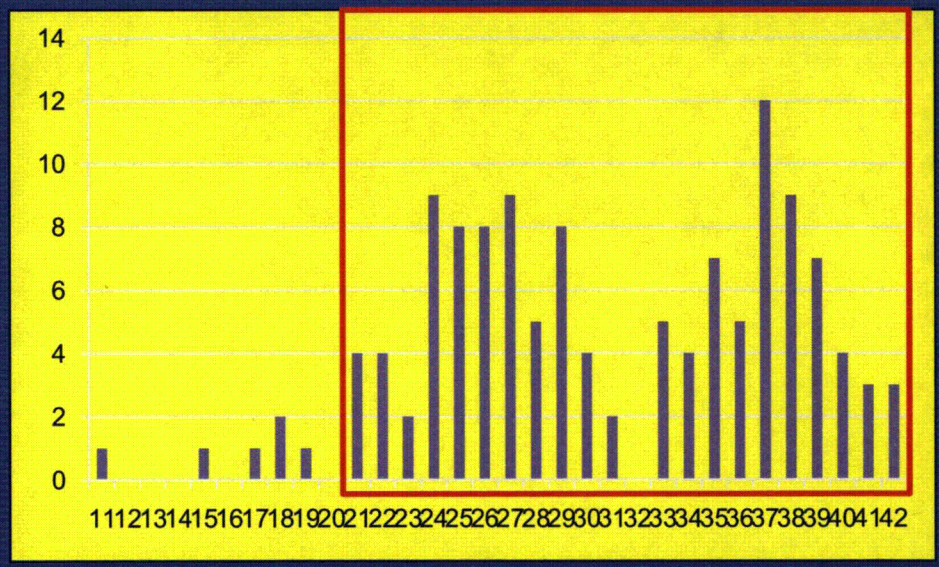
IAEA
International Atomic Energy Agency

America and Pacific Asia Npps



- America : 128 NPPs
- More than 20 years:122 NPPs (95%)

- Asia: 116 NPPs
- More than 20 years : 62 NPPs (53%)



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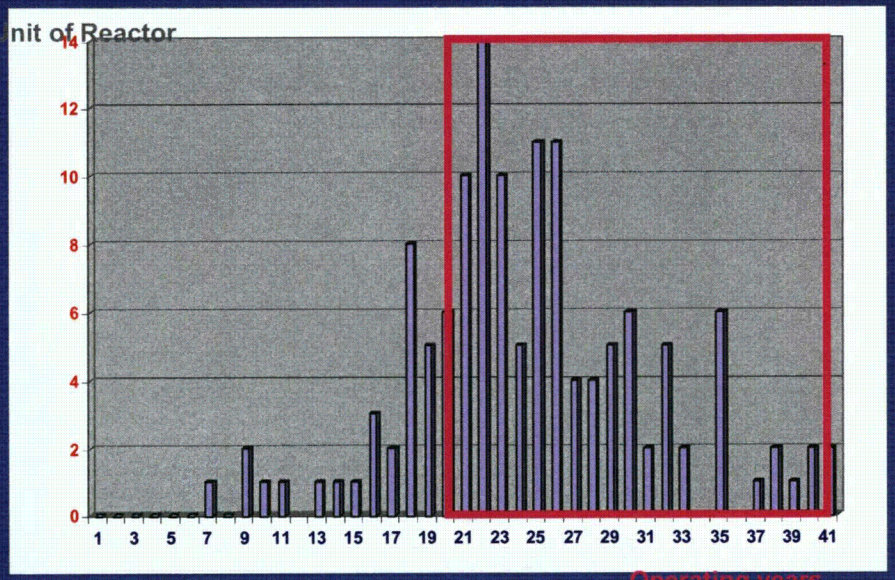
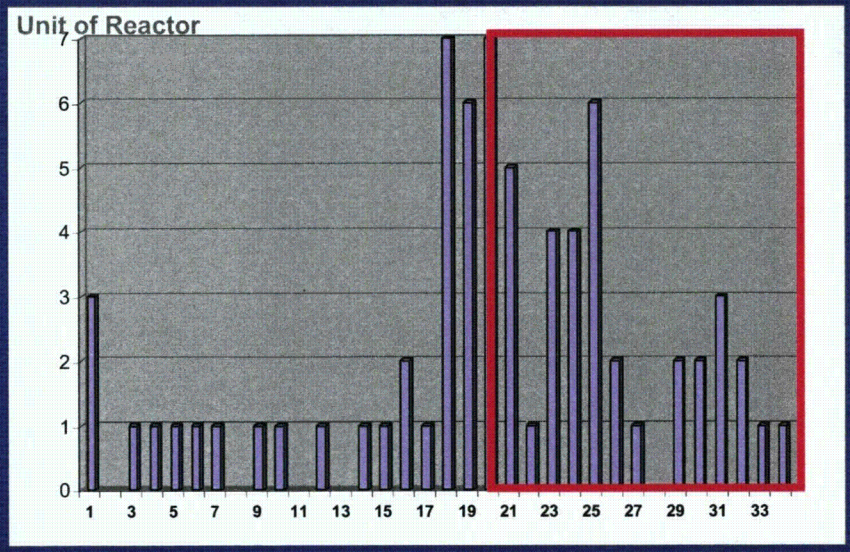
Western and Eastern Europe



- Western Europe : 135 NPPs
- More than 20 years : 109 NPPs (80%)

- Eastern Europe : 70 NPPs
- More than 20 years : 47 NPPs (67%)



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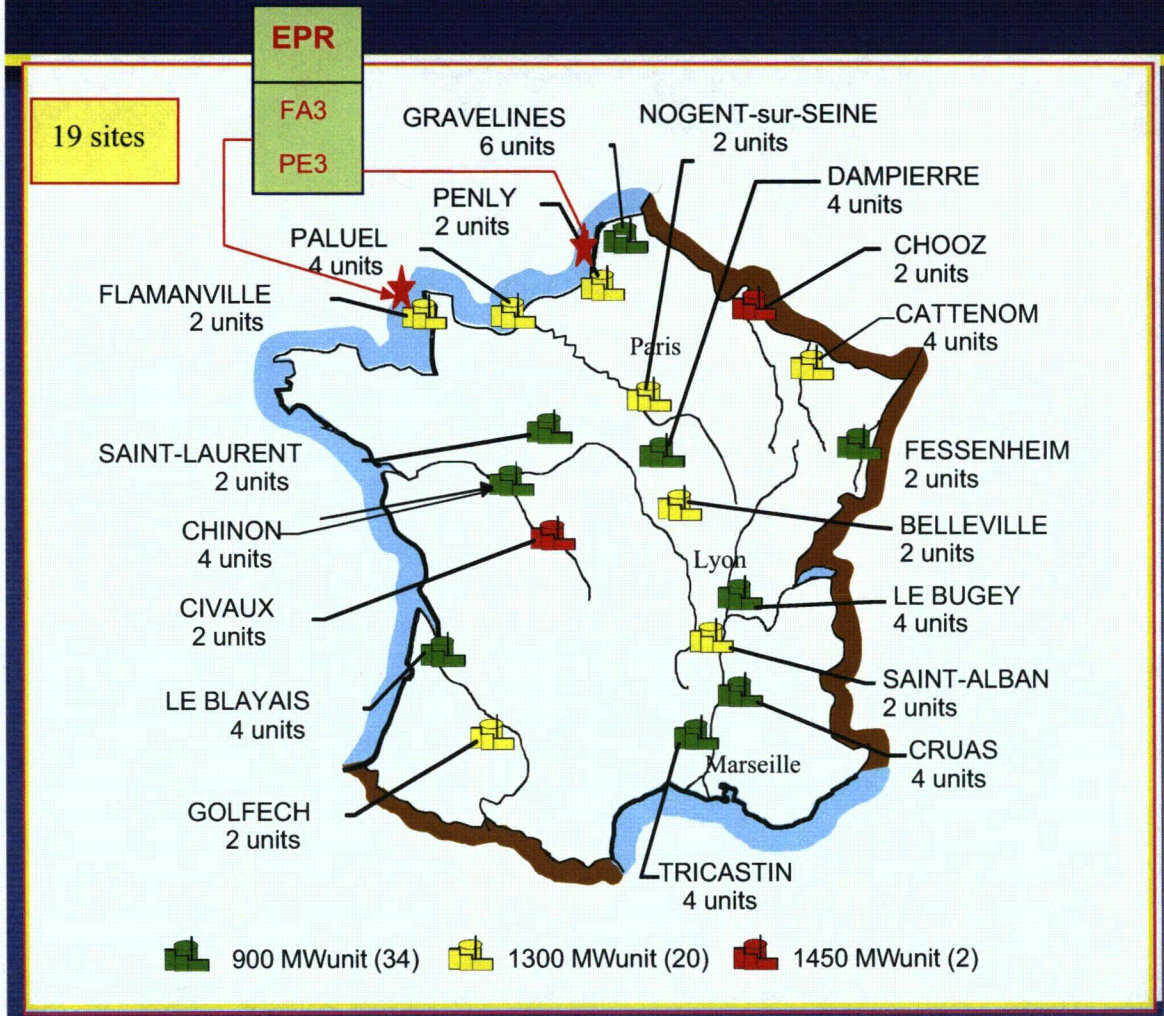
PWR in France



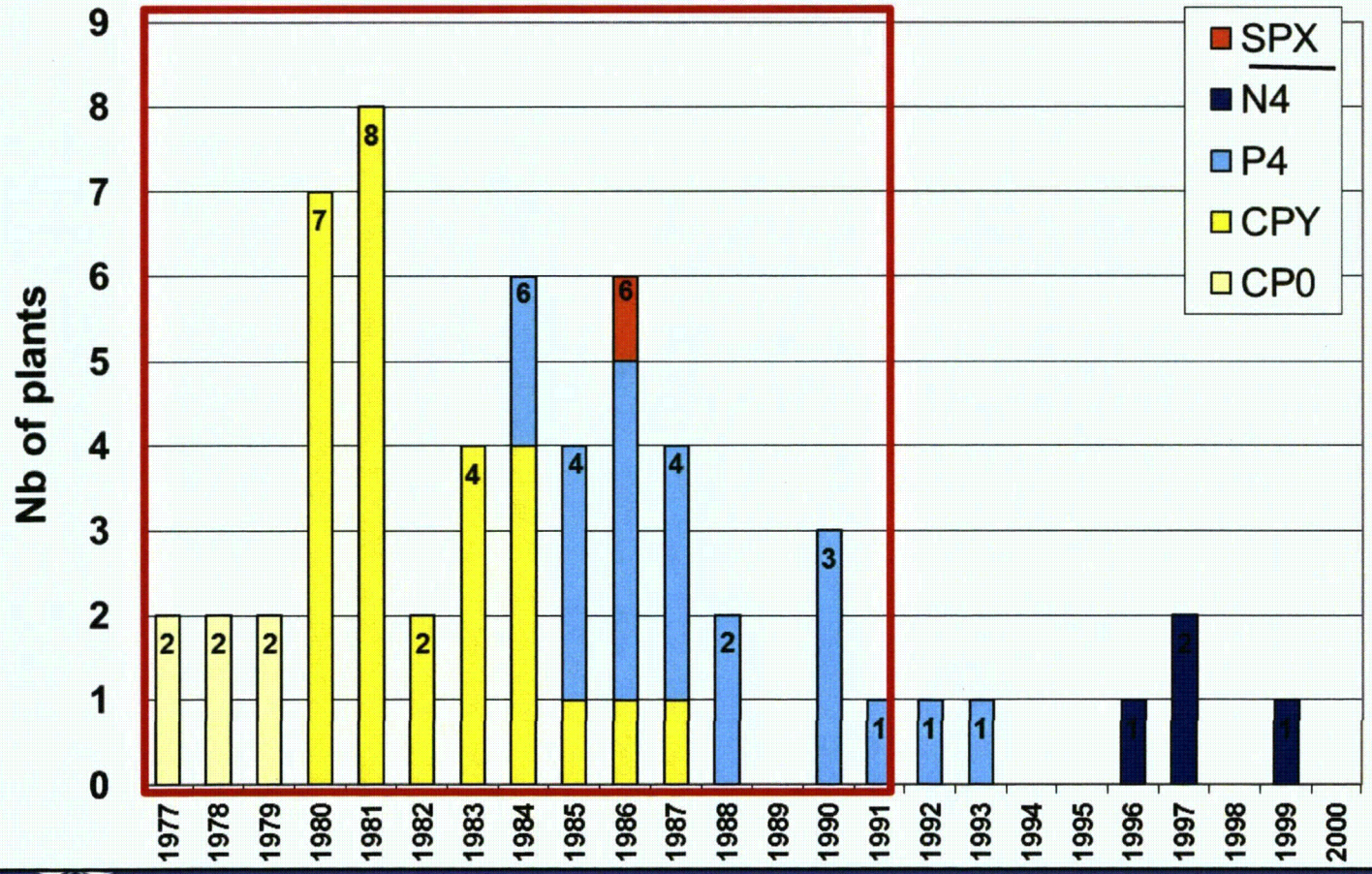
- 58 PWR reactors in operation on 19 sites, 63 GW
- 3 standardized levels :
  - 900 MW – 3 loops, 34 units, 31 GW
  - 1300 MW – 4 loops, 20 units, 26 GW
  - 1500 MW – 4 loops, 4 units, 6 GW
- 1 EPR under construction
- 1 other EPR decided

Reactor Age of French NPP's

Age : 33 to 11 years
Mean age : 20 years

EDF plant program

58 plants, 63000 MWe



Service life in France Npps

- Design life : 40 years
  - Improvement of safety continuously through operation and maintenance
  - 10 years basis through modification of installations
- Management of physical ageing of the plants (causes / consequences):
  - Improvement operating performance
  - Dynamic and proactive way

→ Considering 50 years operation.

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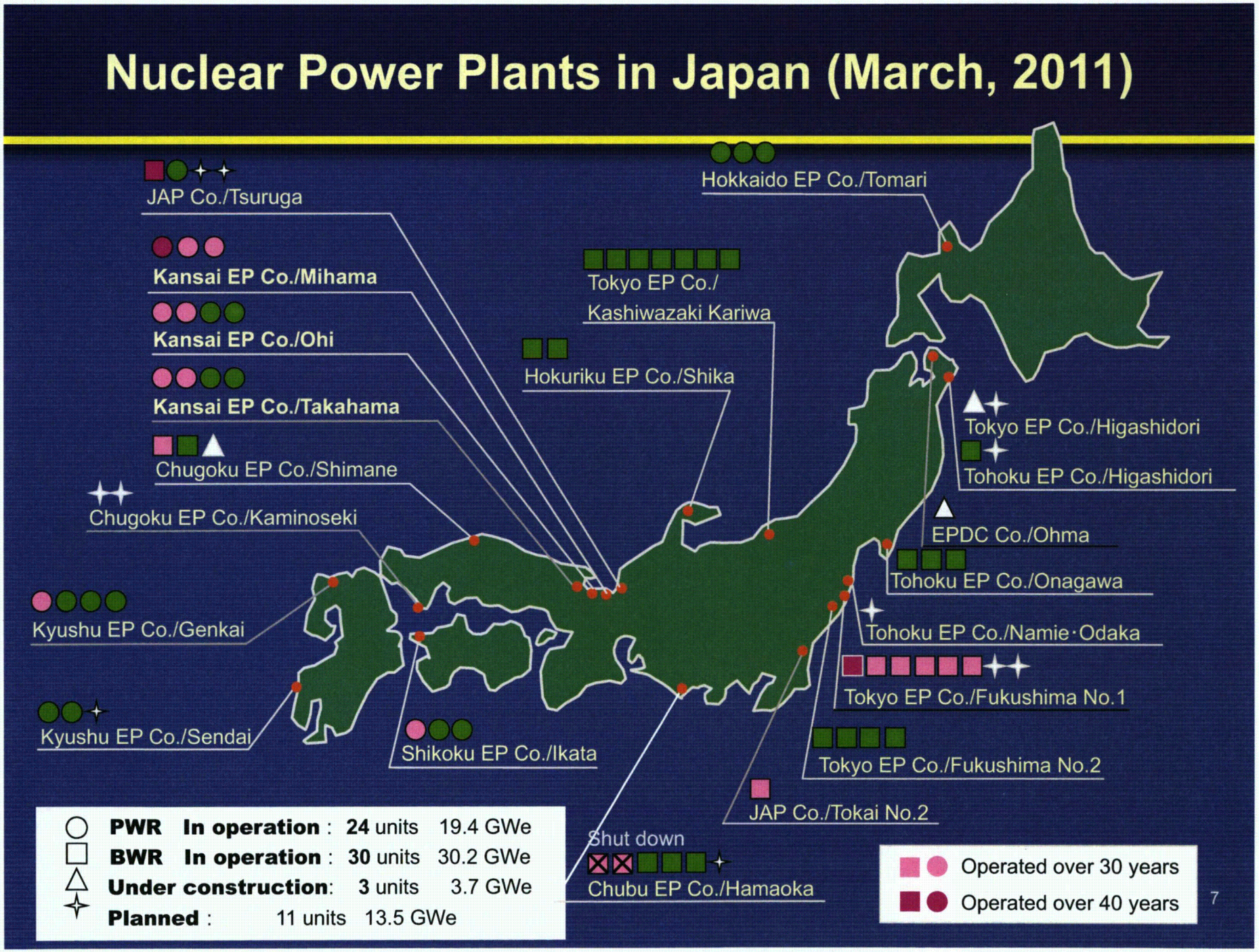
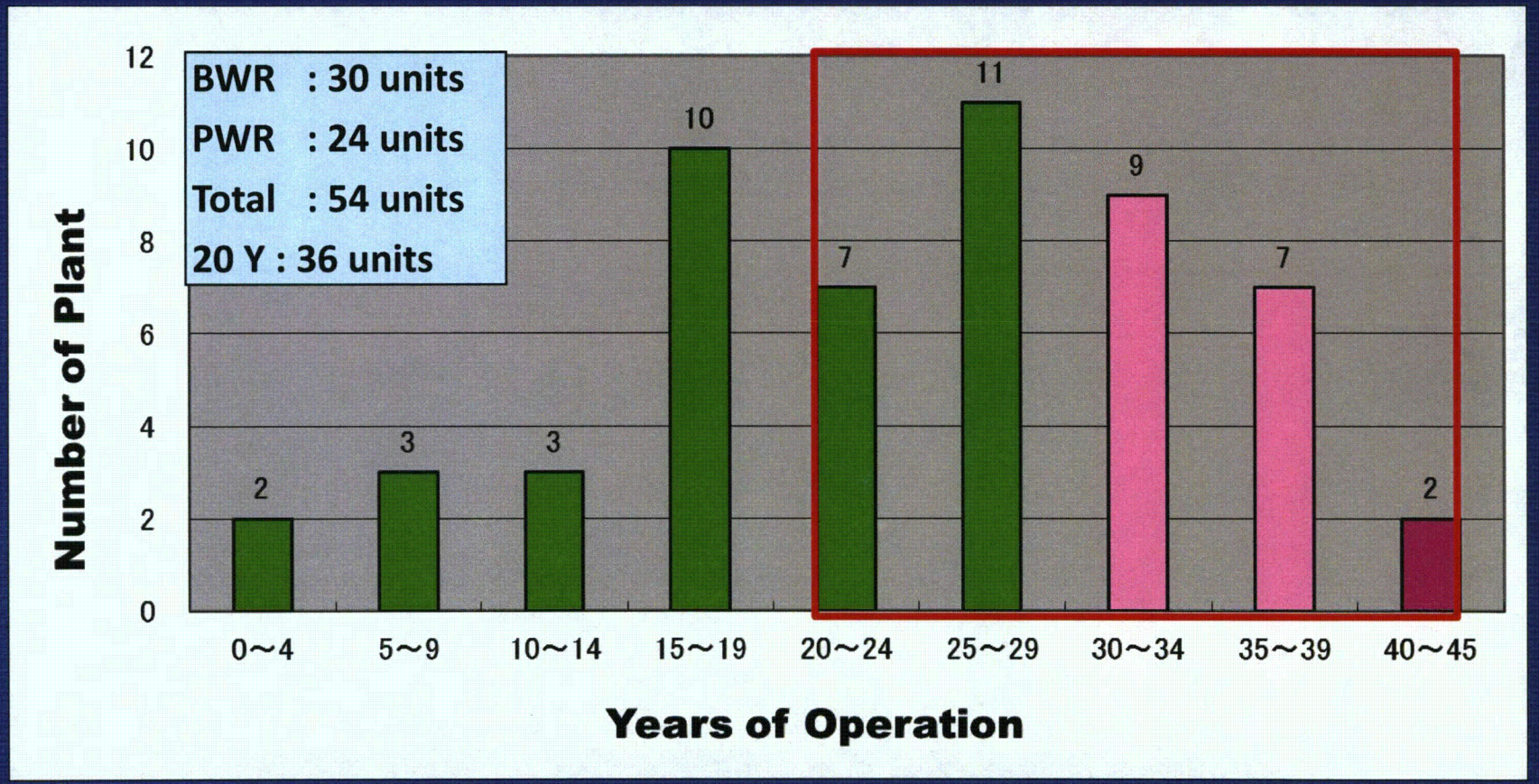
Nuclear Power Plants in Japan (March, 2011)



Reactor Age in Japan NPPs

As of Feb, 2011



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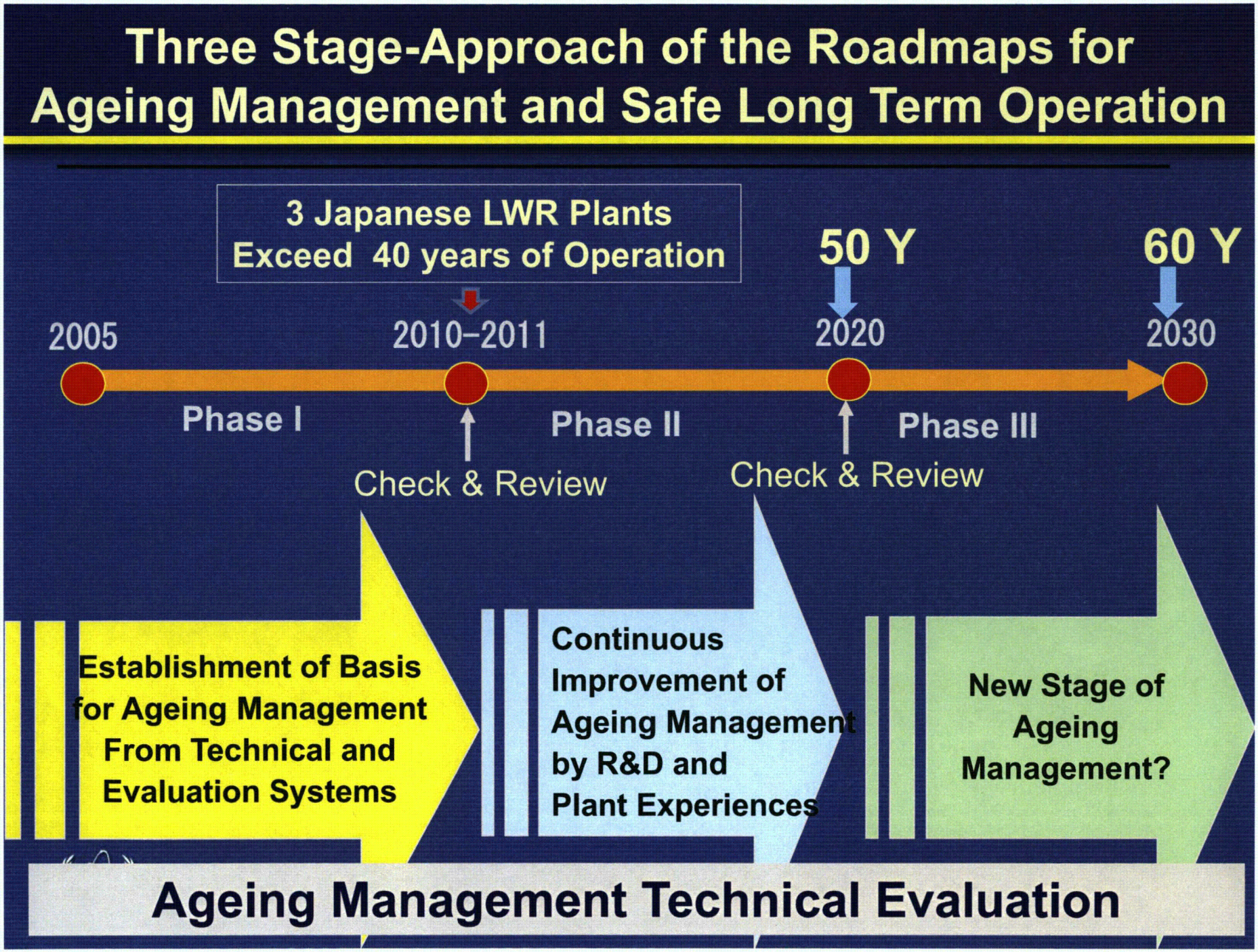
Three Stage-Approach of the Roadmaps for Ageing Management and Safe Long Term Operation



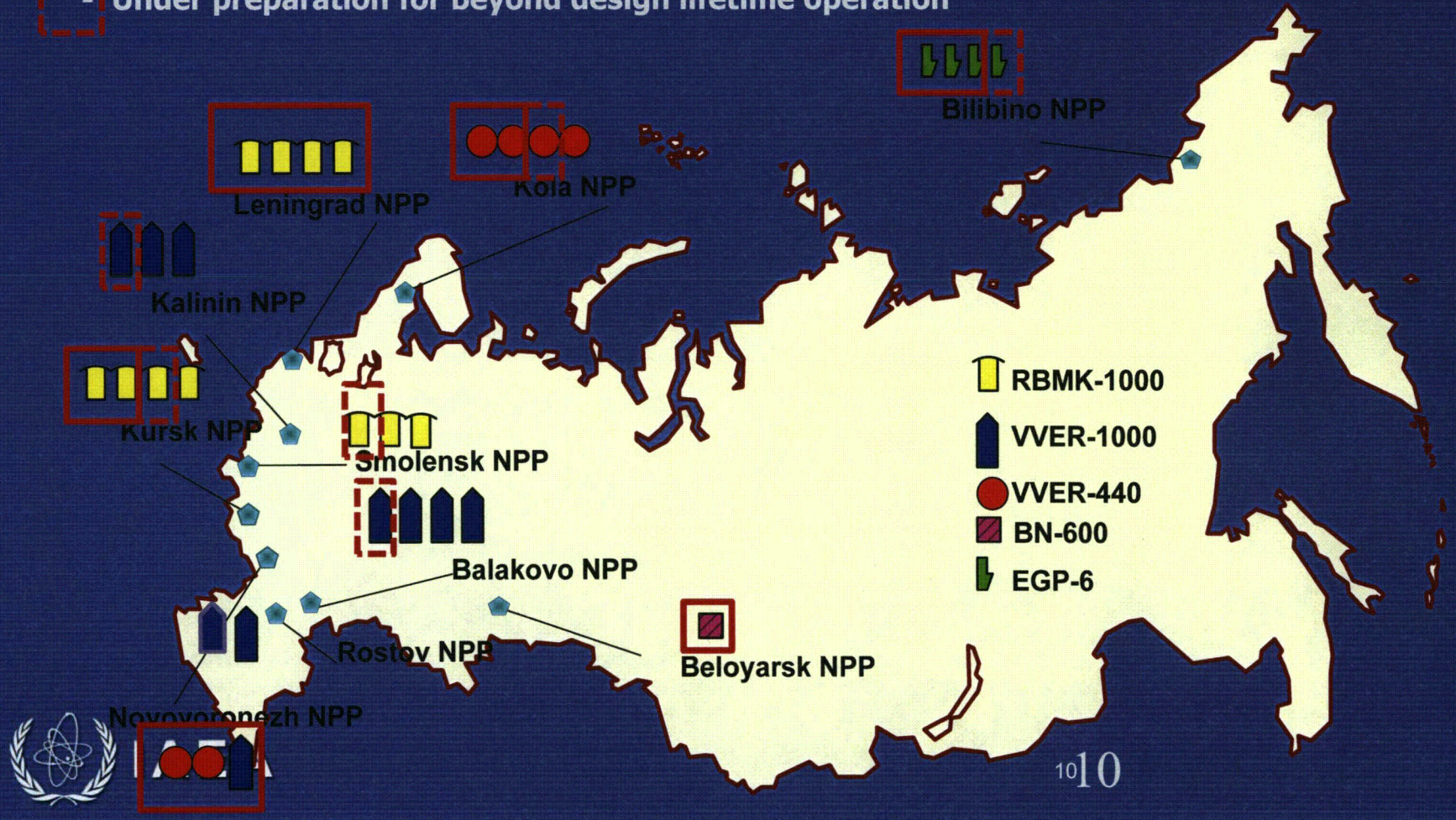
Russian NPPs

10 NPPs, *30* units – *22 242* MW including

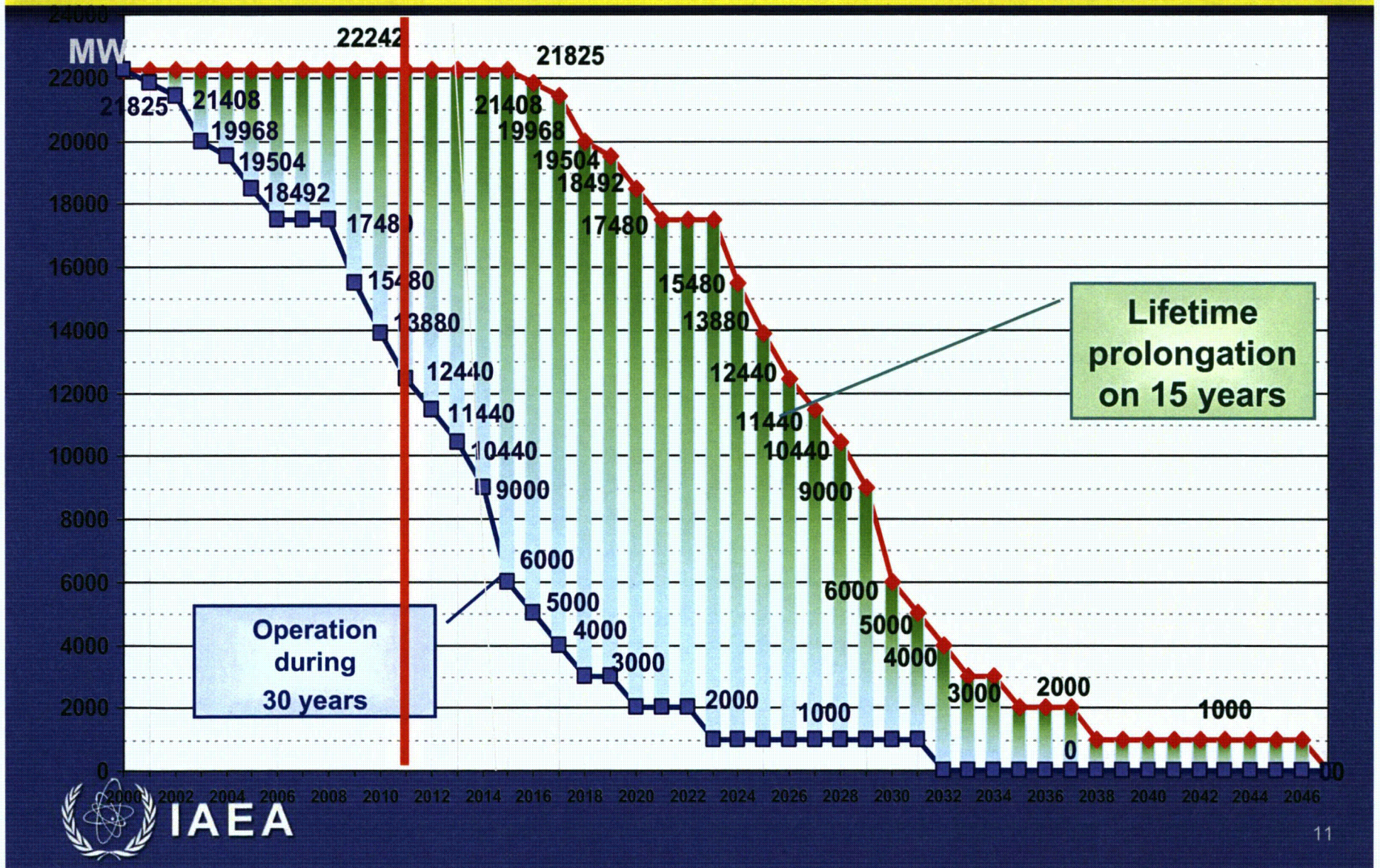
12 units of the 1-st generation - *5 752 MW*

Operated beyond design lifetime

- Under preparation for beyond design lifetime operation



Scenario Of Npps' Power Generation In Russia



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Long Term Operation (LTO) Strategy

1. **RF Nuclear power development programme for the period up to 2010”,** *approved by Government act № 815, 21.07.98*

2. **Strategy of Development of Nuclear Power Industry in the 1st Half of 21 Century**

- **WWER 440- 230: Design life : 25 Y → 15 Y (40Y)**
- **WWER 440- 213 : Design life 25 Y → 25 Y (50Y)**
- **WWER 1000 : Design life 30 Y → 30 Y (60Y)**

→ Considering 60 years operation.

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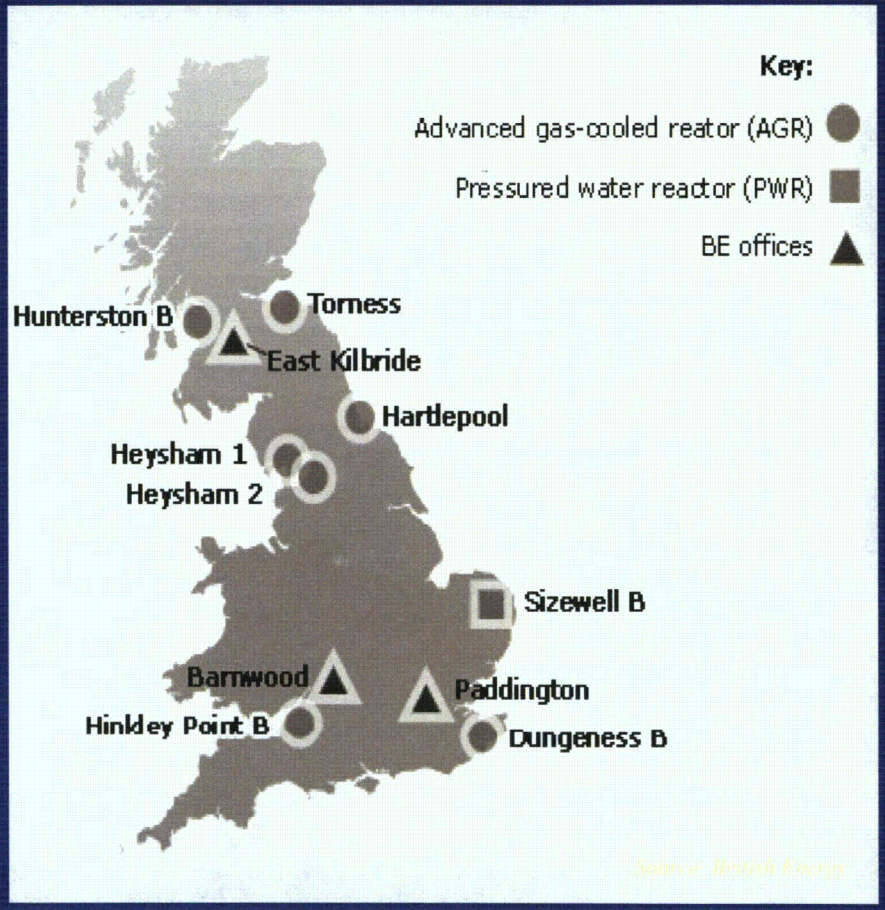
Czech Republic

- 4 units of WWER-440/V-213C type in DUKOVANY
  - Operation start-up : 1985, 1986, 1986, 1987
  - Design lifetime: NPP – 30 years, RPV – 40 years
- 2 units of WWER-1000/V-320 C type in TEMELIN
  - Operation start-up: 2002, 2003
  - Design lifetime: NPP – 40 years, RPV – 40 years

→ Considering 60 years operation.

UK Reactor

- Magnox (4)
  - Gas cooled
  - Graphite core
  - Magnox fuel
  - Design life time : 25 Y
- AGR (14)
  - Evolution from original Magnox design
  - Design life time : 25 Y
- PWR (1)



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UK Reactor

- PLiM/PLEX for LTO considered within the framework of PSRs
- British Energy became part of EDF Energy during second half of 2010
- In Dec. 2010 EDF Energy announced 5-year lifetime extensions to 2 AGR NPPs;
  - Noted PLEX programme could enable 5-year lifetime extensions for remaining AGRs
  - 20-year lifetime extension for Sizewell B PWR

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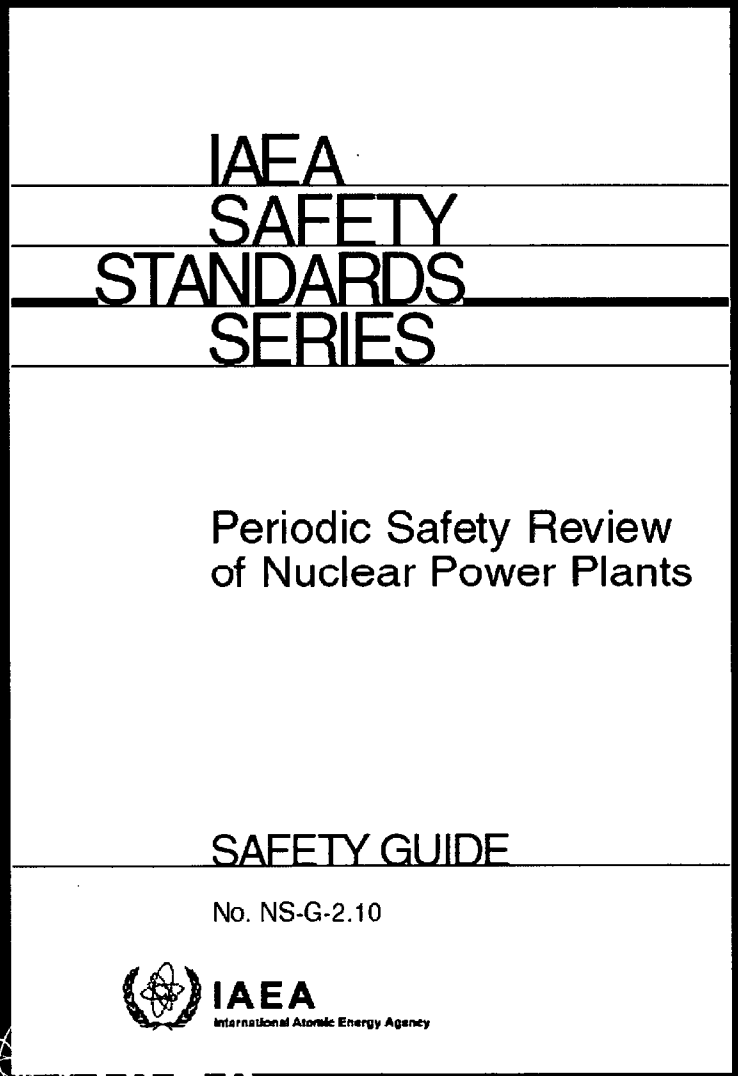
PSR Overall Process and Inputs



Plant

1. Plant design
2. Actual condition of SSCs
3. Equipment Qualification
4. Ageing

Safety Analysis

5. Deterministic Safety Analysis
6. Probabilistic Safety Analysis
7. Hazard Analysis

Performance & Feedback experience

8. Safety performance
9. Use of experience from other NPP

Management

10. Organization and administration
11. Procedures
12. Human factor
13. Emergency planning

Environment

14. Radiological impact and environment

Global Assessment

Intensive PSR (PSR + Ageing Man)

- Physical condition
- Safety assessment
- Equipment qualification
- Aging effect
- Safety Performance
- Use of operation experience & research results
- O&M procedure
- Organization & administration
- Human factors
- Emergency plan
- Environmental effects

+

- Time-limited aging analysis
- Aging management program
- Back-fitting rules
- Newly assessed regulatory requirements at international level
- Radiation environmental effects
- Field inspection

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Summary

- Operating Npps
  - Target of life extension : 50~ 60 years
  - LB 60 years operation ???
- No limitation of operational life :
  - 10 years safety review based on PSR
  - More focused on ageing management technical evaluation

IAEA

IAEA Actviites for Plant Life Management

Feb. 7 2011

Ki Sig Kang,
Tech. Head, PLiM/ LTO

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International Atomic Energy Agency

What is the Plant Life Management ?

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Plant Life Management for Long Term Operation Activities

Nuclear Power Plant
Life Management for
Long Term Operation

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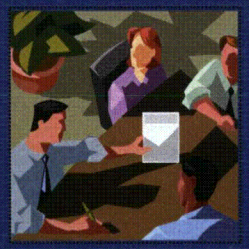
- Current Status of Nuclear Power
- PLiM Approach
- Periodic Safety Review
- Ageing Management
- SALTO Mission
- RPV Irradiation Embrittlement
- Heavy Comp. Replacement
- Effective In-Service Inspection
- Power Uprates
- Continuous Process Optimization
- Independent Engineering Review of I&C systems
- Power Reactor Information Systems
- Recently Published IAEA Nuclear Energy and TECDOC Series

International Generic Ageing Lessons Learned

EBP IGALL expected programme stages

Scoping Meeting/ Briefing for PMs of the MSs



1st – 2nd Q 2010

Launching of the Programme

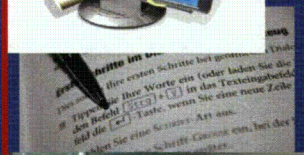
Organization set-up

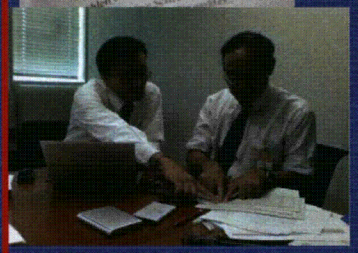
Steering Group

Working Groups

2nd -3rd Q 2010

Progress of the programme in accordance with time schedule





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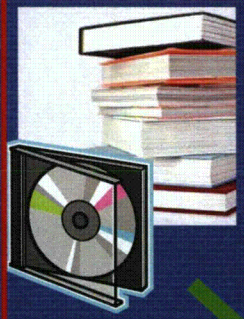
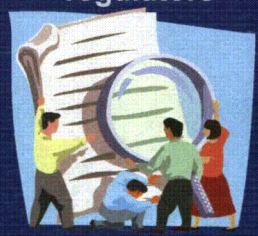
IGALL final report



2nd Q 2013

operators

regulators



vendors

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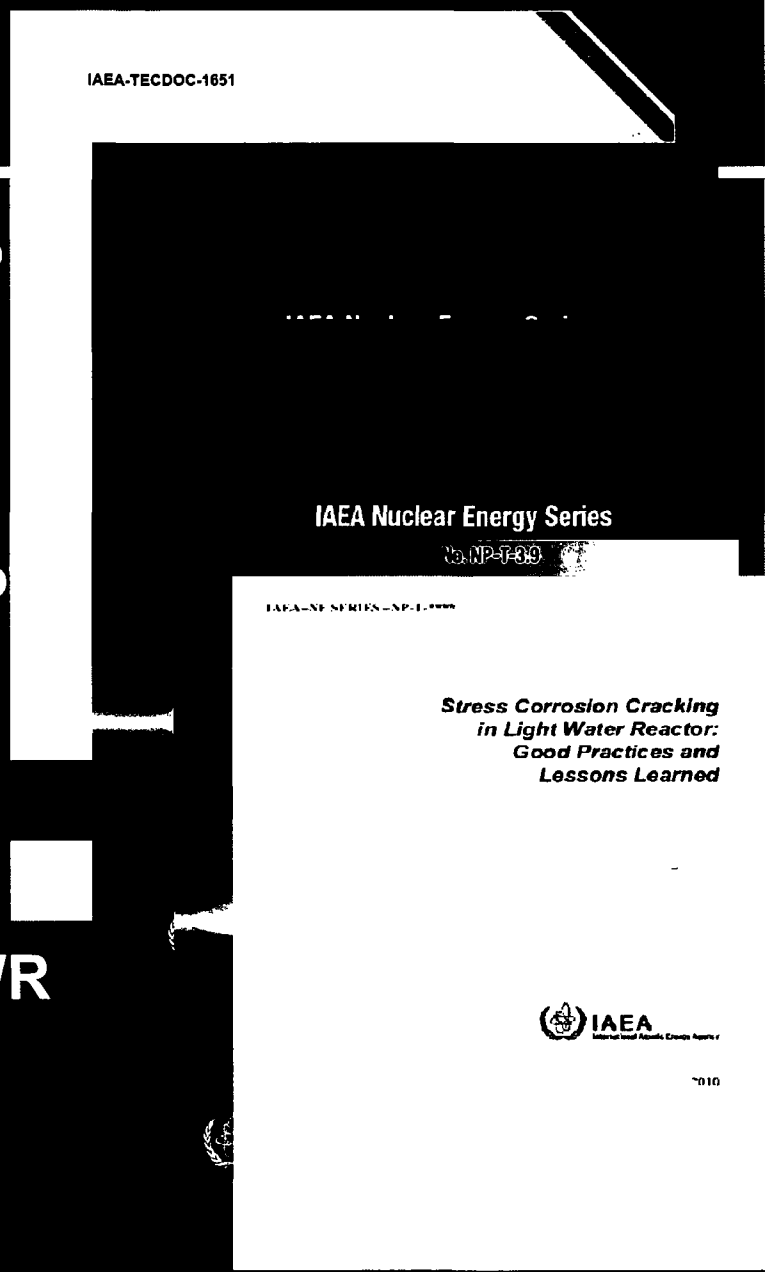
2010 New Publications

- Information Technology for NPP Configuration Management (TECDOC-1661),
- Risk -informed In-service Inspections of Piping Systems o NPPs (NP-T-3.1),
- Power Uprate in nuclear power plants : Guidelines and Experiences(NP-T-3.9)
- Stress corrosion cracking in LWR : Good practices and Lessons Learned



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Current Activities on I & C system programmes

- Impact of modern technology on I&C systems
- Increasing Instrumentation calibration interval through on-line calibration technology
- I&C Aging management
- Large Retrofit Modernization Projects in I&C Systems
- Maintenance and repair procedures of I&C systems
- Performance monitoring of instrumentation, control, and protection systems
- Testing dynamic response and calibration of instrument channels
- Database on I&C modernization projects

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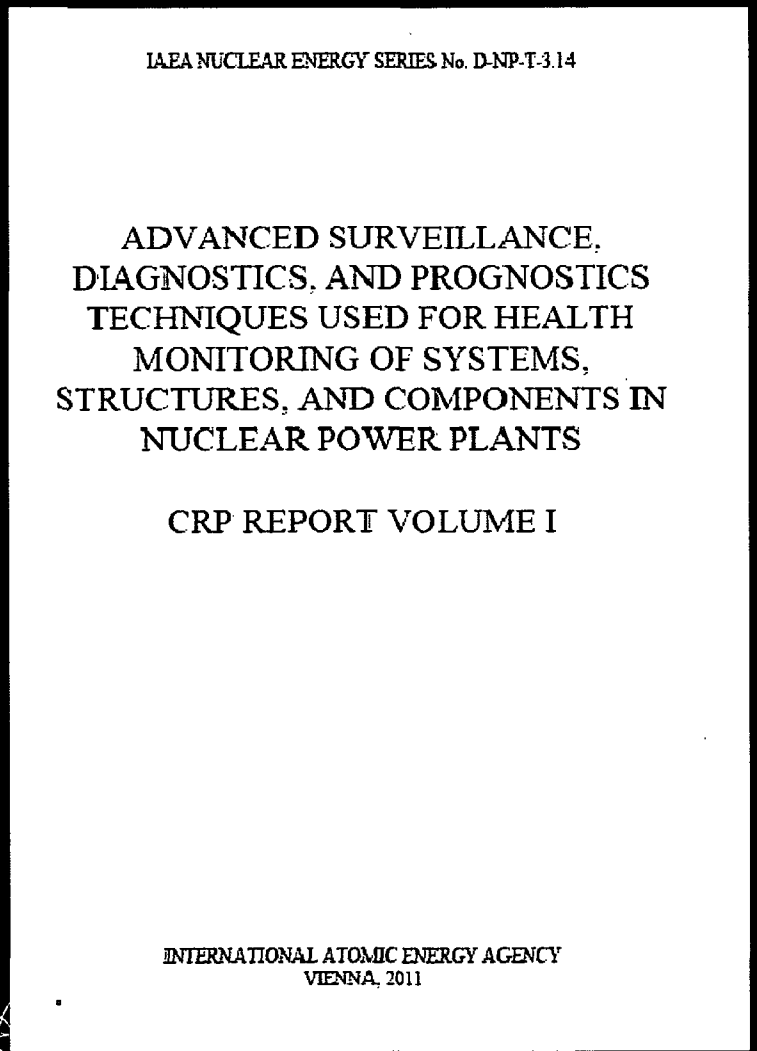
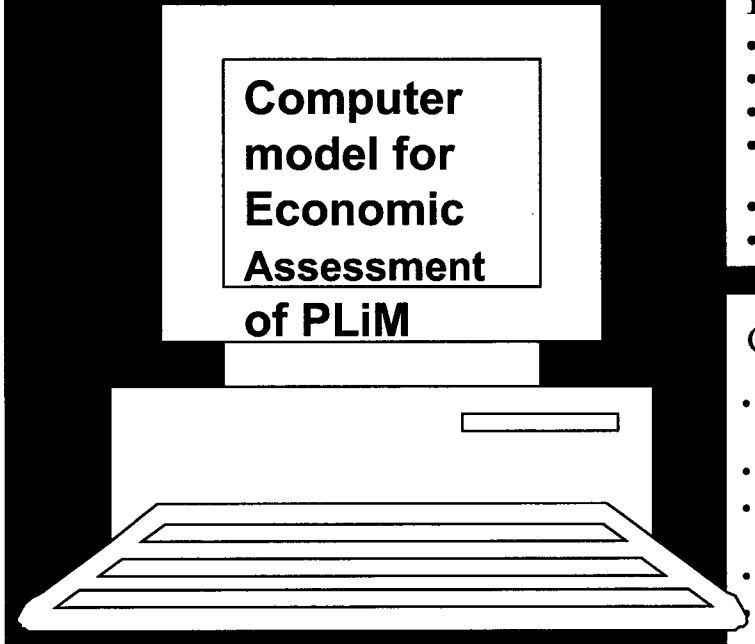
Int. Research Programme SHM



1. Reactor and Signal Noise Analysis
2. Acoustic and Vibration Monitoring
3. Prognostics and Structural Material Integrity
4. Instrument and Equipment Condition Monitoring and Enabling Technologies

Computer Model for the Economic Assessment of PLiM



Front End

Input module
- Initialization
- Nuclear Variable Selection
- Alternative Generation
- Scenario Option & Calculation
- Fuel Input
- Taxes Input

Output module
- Performance Projection Report
- Fuel Expense Report
- Economic Performance Report
- Production Cost Repot
- Production Cost Analysis
- MRRD Report

COMPUTER MANUAL SERIES No. 20

PLEXFIN
A Computer Model for the Economic Assessment of Nuclear Power Plant Life Extension

User's Manual

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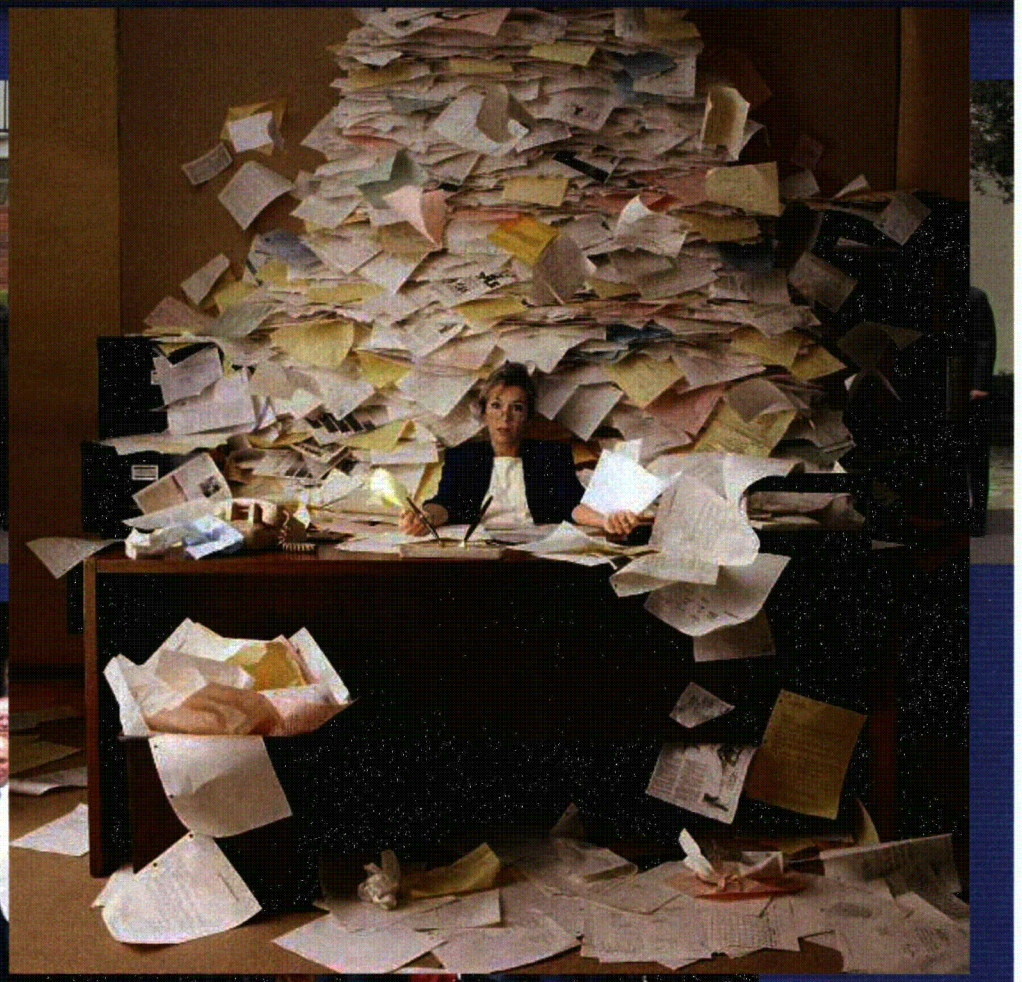
Reactor Pressure Vessel Knowledge Preservation for RPV in WWER NPPs



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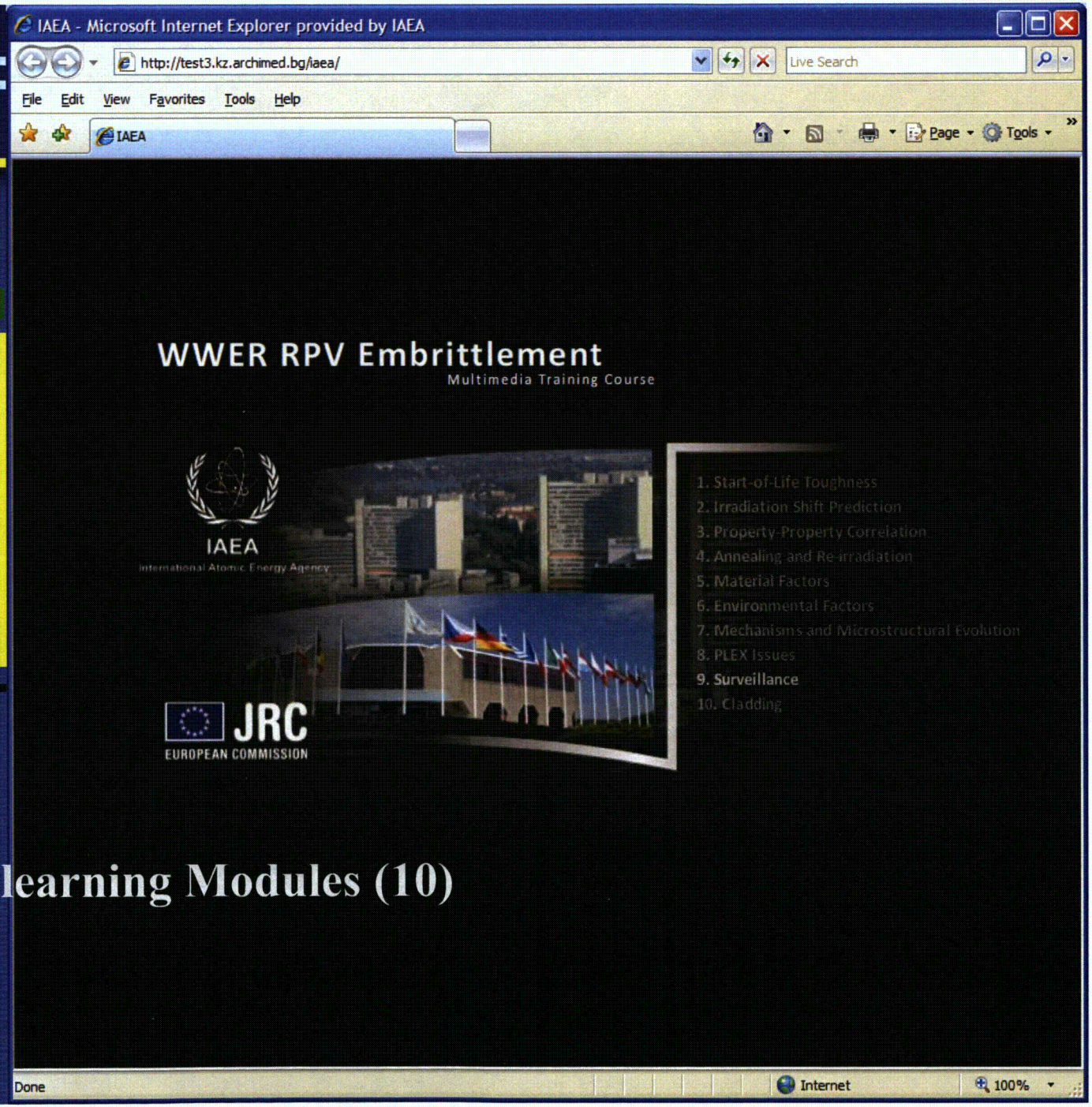
- Non-electronic publishing in the past
- Collection & Storage (scanning + OCR)
- Limited dissemination possibilities
- Retirement and Generation Gap

Reactor F



Developing E-learning Modules (10)

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PLiM- SALTO TC Programme

Support to establish PLiM Programme under TC project

- Argentina : PLiM programme for Embalse NPP
- China : Ageing management of Critical Components
- Hungary : License Renewal of Paks Nuclear Power Plant Operation
- Mexico : Life Management programme for Laguna Verde NPPs
- Ukraine : Action Plans for Nuclear Power Plant Lifetime Management
- Pakistan : Development of Capabilities in Automatic UT and Material Corrosion testing for Assessment of Structural Integrity

Review missions (SALTO peer review services) implemented:

- South Ukraine NPP (Mar. 2007, Ukraine)
- Kori 1 NPP – LTO Peer review (Republic of Korea – July 2007)
- Dukovany NPP – LTO Peer review (Czech republic 3Q 2008)
- Paks NPP SALTO Peer review (Hungary – Sept. 2008)
- Borssele NPP SALTO Peer review (Netherlands)

Third International Conference on NPP Life Management for Long Term Operation

14-18 May 2012, Salt Lake City Utah, USA

IAEA

International Atomic Energy Agency

CHALLENGES FOR SUBSEQUENT LICENSE RENEWAL

Allen Hiser
Office of Nuclear Reactor Regulation
Division of License Renewal

February 22, 2011

Background

- Atomic Energy Act
  - 40-year license to operate nuclear power plants
  - Allows for license renewal up to 20 years (e.g., 40 to 60 years)

- License Renewal Rule – 10 CFR Part 54
  - Can apply 20 years before license expiration per 54.17(c)
  - Must apply at least 5 years before expiration per 2.109(b)
  - A renewed license may be subsequently renewed per 54.31(d)
  - No restrictions on number of subsequent renewals or changes in requirements

Background (continued)

- License renewal is a mature process
  - Licenses renewed for 62 out of 104 plants
  - Current reviews for 20 more plants
- 8 plants beyond 40 years
  - 7.5 cumulative reactor-years beyond 40
- Industry discussions and interest in a subsequent renewal
  - Timing is uncertain - 2015 ?? 2019 ??

Subsequent License Renewal Focus Areas

- Technical issues
- Guidance documents for operation to 80 years
- Application characteristics

Technical Issue Areas

- Activities looking at identification of potential new aging phenomena – locations, forms, severity
  - Known mechanisms that could become more active – incubation times, activation energies, late blooming phases
  - New phenomena
- Approaches for identifying potential aging phenomena
  - Workshops with industry and international colleagues
  - Expanded materials degradation assessment (EMDA)
  - Results from 1st renewal aging management programs
    - Both "one-time" and periodic programs
  - Relevant domestic and international operating experience

It is difficult to simulate 80 years of aging when plants are just over 40 years old

Technical Issue Areas (cont.)

- Adequacy of AMPs – need new or enhanced AMPs ?
  - Considering phenomena of concern
  - Assess performance of 1st renewal aging management programs
    - Inspections methods, accessibility, frequency
- How to address primary limiting items
  - Reactor pressure vessel
  - Concrete structures
  - Cables

Guidance / Application Process

- Guidance
  - Develop GALL applicable for operation up to 80 years
  - Develop LR-SRP applicable to LRAs for 80 years of operation
  - Revision to NEI 95-10 ?
- LRA
  - Format changes needed ?
  - Self assessment of AMP effectiveness ?
- Public involvement and input
  - Workshops

Conclusions from Prior Workshop

- February 19-21, 2008, Joint NRC/DOE Workshop on U.S. Nuclear Power Plant Life Extension Research and Development
  - Long-Term Reliability Observations
  - Aging Management Observations
  - New Technologies Observations

Potential Roles and Responsibilities

- Industry has lead role to drive the process and identify issue resolutions
- NRC's primary role is to ensure plant safety
  - Coordinate and collaborate on confirmatory research efforts
- DOE will facilitate R&D and coordinate national laboratory efforts
- Industry, national laboratories, academia, and international collaborators will conduct necessary R&D

Long-Term Reliability Observations

- Systematic component replacement and Long-Term Asset Management (LTAM) for optimum Long-Term Operation (LTO)
  - Holistic approach to aging management – "Silo elimination"

- Suggested research areas:
  - Industry-wide passive-SSCs operating experience database
  - Improved inspection, prediction methods (including limited accessibility areas)
  - Expanded utilization of information from retired SSCs
  - Development of "sentinel samples" for key knowledge needs
  - Proactively developed repair methods
  - Risk-informed role in LTO approaches to address aging

Aging Management Observations

- Tools such as Materials Degradation Matrix could help target research

- Suggested research areas:
  - Combined effects testing of reactor materials
  - Complex alloy aging fundamentals
  - Sustainability of the mitigation processes
  - Concrete damage models and mitigation technology
  - Cast-austenitic stainless steels and concrete inspections
  - Alternates to existing coating technologies
  - Welding and weld repairs
  - Developing a damage tolerant approach to fatigue

New Technologies Observations

- Develop a nondestructive evaluation (NDE)/measurements matrix to compliment materials degradation matrix
- NDE/measurements matrix
  - ✓ Concrete: NDE methods and targets
  - ✓ Cables: infrared and nanocoatings
  - ✓ Cast stainless steel: ultrasonic inspection capability
  - ✓ Groundwater protection: buried pipe/tanks, spent fuel pool liner
  - ✓ Global versus local tests: guided waves, acoustic emission
- Important issues
  - ✓ Accessibility, design for inspection, validation, applicability
- NDE implementation
  - ✓ Enhanced techniques, management/analysis of large data, personnel
- Online monitoring
  - ✓ Establish failure signature database

Changes from 1st LR: GALL

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Protecting People and the Environment

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License Renewal Guidance Documents: SRP-LR and GALL Report (Revision 2)

U.S.NRC
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- Revised SRP-LR and GALL Report issued on 12/16/2010
- Updated all Aging Management Programs (AMPs) to reflect:
  - domestic and foreign operating experience,
  - precedents from License Renewal Applications and staff Safety Evaluation Reports, and
  - revisions to industry codes and standards.
- New AMPs for:
  - (XI.M41) for buried and underground piping and tanks, based on material of construction preventive (such as backfill, coating, cathodic protection) and inspection measures are described.

License Renewal Guidance Documents: SRP-LR and GALL Report (Revision 2) - continued

U.S.NRC
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- New AMPs – continued:
- (XI.M16A) on guidelines in EPRI/Materials Reliability Program reports -227 and -228 for PWR internals inspection and evaluation.
- (XI.M11B), "Cracking of Nickel-Alloy Components and Loss of Material Due to Boric Acid-Induced Corrosion in Reactor Coolant Pressure Boundary Components (PWRs only)."
- (XI.M40), "Monitoring of Neutron-Absorbing Materials Other than Boraflex," based on ISG

- Some AMR line-item changes include:
  - Further Evaluation recommendations changed from "Yes" to "No" based on augmentation of AMP and/or experience.
  - Changes from management by plant-specific AMP to GALL AMP.
  - Number of new materials added.

License Renewal Guidance Documents: SRP-LR and GALL Report (Revision 2) - continued

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- Some changes to Fatigue Monitoring Time Limited Aging Analyses

- Enhancements made to the GALL Report and SRP-LR will improve the usefulness of the documents
- Working to finish NUREG-1950 that will provide the technical bases for Rev. 2 changes along with disposition of the public comments

TLAA Considerations for Life Beyond 60 years

Eric Blocher - STARS

Agenda

- LB60 TLAA Considerations
- Definition of TLAA
- TLAA Dispositions
- Significant TLAA Dispositions

LB60 TLAA Considerations

- Existing process is adequate
- Analysis will remain valid or be projected to the end of the period
- NUREG-1801 Aging Management Programs will manage aging so that the intended function is maintained consistent with the CLB
- Some plant specific mitigation programs, inspection programs or modifications may be required

Definition of TLAA

TLAAs as defined in 10 CFR 54.3 are those calculations & analyses that:

1. *Involve systems, structures, and components within the scope of license renewal*
2. *Consider the effects of aging;*
3. *Involve time-limited assumptions defined by the current operating term, for example, 40 years;*
4. *Were determined to be relevant by the licensee in making a safety determination*
5. *Involve conclusions or provide the basis for conclusions related to the capability of the system, structure, or component to perform its intended function(s), as delineated in 10 CFR 54.4(b);*
6. *Are contained or incorporated by reference in the CLB.*

TLAA Dispositions

Pursuant to 10 CFR 54.21(c)(1)(i) - (iii), an applicant must demonstrate one of the following:

(i) The analyses remain valid for the period of extended operation;

(ii) The analyses have been projected to the end of the extended period of operation; or

(iii) The effects of aging on the intended function(s) will be adequately managed for the period of extended operation.

Significant TLAA Considerations

- Reactor Vessel Neutron Embrittlement Analysis
- Metal Fatigue
- Environmental Qualification of Electrical Equipment
- Concrete Containment Tendon Prestress Analysis
- Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis
- Plant Specific TLAAs (e.g. Cranes, LBB, etc.)

Reactor Vessel Neutron Embrittlement Analysis - USE

- Charpy upper-shelf energy (USE) of no less than 68 J (50 ft-lb) throughout the life of the reactor vessel, unless otherwise approved by the NRC
  - USE analysis or equivalent margins analysis (EMA) remains valid during the PEO because the projected ¼T neutron fluence is bounded by the fluence assumed in the existing analysis.
  - NRC RG 1.99 Rev. 2 used to project USE to the end of the PEO or ASME Code Section XI Appendix K used for the purpose of performing an equivalent margins analysis

Reactor Vessel Neutron Embrittlement Analysis - PTS

- Projected clad-to-base metal interface neutron fluence at the end of the PEO is reviewed to verify that it is bound by the fluence assumed in the existing PTS analysis, or
- Revised PTS analysis based on the projected neutron fluence at the end of the PEO
  - Delta RTNDT is determined with chemistry factor from the tables in 10 CFR 50.61, or
  - Delta RTNDT is determined with two or more sets of surveillance data

Reactor Vessel Neutron Embrittlement Analysis - PTS

- Flux reduction program implemented in accordance with §50.61(b)(3), and an identification of the viable options that exist for managing the aging effect
  - Core management plans (e.g., operation with a low leakage core design and/or integral burnable neutron absorbers) including limiting material projected fluence value, projected RTPTS value, and date PTS screening criteria exceeded
  - Aging management plans (i.e. vessel material surveillance program)
  - Options considered for "resolving" the PTS issue
    - Plant modifications (e.g., heating of ECCS injection water)
    - detailed safety analyses (e.g., using Regulatory Guide 1.154)
    - More advanced material property evaluation (e.g., use of Master Curve technology)
    - The potential for RPV thermal annealing in accordance with §50.66

Metal Fatigue

- Typical metal fatigue analysis or flaw growth/tolerance evaluations include:
  - CUF calculations for ASME Code Class 1 components designed to ASME Section III requirements or other Codes
  - Implicit fatigue-based maximum allowable stress calculations for piping components designed to USAS ANSI B31.1 or ASME Code Class 2 and 3 components designed to ASME III design requirements
  - Environmental fatigue calculations for ASME Code Class 1 reactor coolant pressure boundary components
  - Potential fatigue assessments for BWR vessel internals (applicable applicant action items identified in BWRVIP reports)
  - Potential fatigue-based flaw growth analyses or fatigue-based fracture mechanics analyses,

Metal Fatigue – Class 1 Component Dispositions

- Potential dispositions for CUF calculations of ASME Code Class 1 components include:
  - Valid for PEO: number of accumulated cycles for the design basis transients would not be exceeded
  - Analysis projected to the end of the PEO and results verified to remain less than or equal to a CUF value of one
  - Metal fatigue of the reactor coolant system components is managed consistent with aging management program requirements of NUREG-1801

Metal Fatigue – Aging Management

- Program monitors and tracks the number of critical thermal and pressure transients for selected components
- Program includes fatigue calculations that consider the effects of reactor water environment for a set of sample reactor coolant systems components
- Program monitors fatigue usage on an as-needed basis if an allowable cycle limit is approached:
  - Use of projected cycles and/or
  - Use of actual transient severity
- Program uses action limits and corrective actions to prevent the usage factor from exceeding the design code limit

Metal Fatigue – Class 2 & 3 Component Dispositions

- Valid for PEO: maximum allowable stress range values valid because number of full range thermal cycles would not be exceeded
- Maximum allowable stress range values are re-evaluated based on the projected number of assumed full thermal range transient cycles above a value of 7000
- Aging management consistent with aging management program requirements of NUREG-1801

BWRVIP Fatigue Assessments

- Address applicable BWRVIP action items for potential fatigue assessments of:
  - Core Spray Internals (BWRVIP-18-A)
  - Standby liquid control system/core plate $\triangle P$ (BWRVIP-27-A)
  - Lower Plenum (BWRVIP-47-A)
  - Reactor Pressure Vessel (BWRVIP-74-A)

Environmental Qualification of Electrical Equipment

- Components within the scope of 10 CFR 50.49 are managed consistent with aging management program requirements of NUREG-1801
  - Replacement or refurbishment of components not qualified for the current license term prior to the end of qualified life
  - Reanalysis to extend the qualification of components under 10 CFR 50.49(e) is performed on a routine basis and includes the following attributes:
    - Analytical methods,
    - Data collection and reduction methods,
    - Underlying assumptions,
    - Acceptance criteria, and
    - Corrective actions

Concrete Containment Tendon Prestress Analysis Dispositions

- Valid for PEO: existing prestressing force evaluation remains valid because losses of the prestressing force are less than the predicted losses (recent inspection trend lines)
- Aging Management consistent with aging management program requirements of NUREG-1801
  - Containment tendon prestressing forces monitored consistent with ASME Section XI Subsection IWL
  - Predicted lower limit (PLL), minimum required value (MRV) and trend lines developed for PEO
  - NRC RG 1.35-1 and NRC IN 99-10 guidance used
  - Systematic retensioning of tendons or containment reanalysis required to keep the trend line above the PLL

Containment Liner Plate, Metal Containments, and Penetrations Fatigue Analysis

- Examples of containment TLAAs
  - Fatigue of liner plates or metal containments based on assumed number of loading cycles
  - Stainless steel bellows assemblies (high energy piping penetrations and fuel transfer tubes)
  - BWR containment suppression chamber and vent system
- Dispositions are consistent with other fatigue analysis TLAAs

Plant Specific TLAAs

- Examples of plant specific TLAAs:
  - Fatigue analysis of cranes designed to CMAA specification 70 (1975)
  - Leak before break analysis
  - Metal corrosion analysis
  - In-service flaw growth analysis that demonstrate structure stability for 40 years
- Dispositions are consistent with 10 CFR 54.21(c)(1)(i) - (iii)

TLAA Options for LB60

- Analysis will remain valid for the period or be projected to the end of the period
- Aging Management Programs will manage aging consistent with the CLB:
  - Fatigue Monitoring
  - Concrete Containment Tendon Prestress
  - Environmental Qualification of Electrical Components
- Other mitigation programs, inspection programs or replacement options

Licensing and Guidance Needs for LB60

February 22, 2011

Michael G. Semmler
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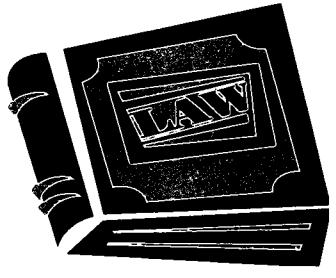
Industry Viewpoint

- Applicants will meet all applicable requirements for subsequent renewals
- Subsequent renewals will require a review similar to those performed for the first renewal
- Industry believes some changes in NRC expectations for another renewal are warranted
- Applicants need revised industry and regulatory documents to prepare and submit an application

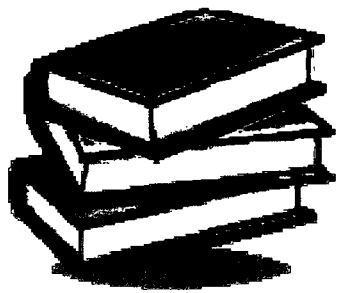
10 CFR 54
The License Renewal Rule

- No specific limitations in the Atomic Energy Act or 10 CFR 54 restricting the number of times a license may be renewed
- Industry and the NRC believe revision of 10 CFR 54 is not required for a second license renewal
- NRC has noted they have higher expectations for a second renewal but provided no specifics



10 CFR 54, The License Renewal Rule

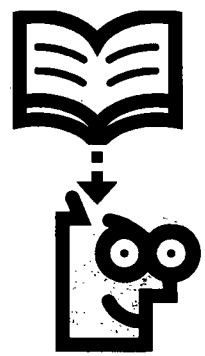
- NRC expectations are contained in the following documents
  - Regulatory Guide 1.188
  - NEI 95-10
  - NUREG-1800, Standard Review Plan
  - NUREG-1801, GALL



- Revision of these documents may be required to incorporate new NRC expectations

Regulatory Guide 1.188

- Regulatory Guide 1.188 provides the format and content of a license renewal application and endorses NEI 95-10
- Industry uses the Regulatory Guide and NEI 95-10 to develop the he License Renewal Application
- Industry believes Regulatory Guide 1.188 may require revision to reflect the new NRC expectations and endorses a revised NEI 95-10

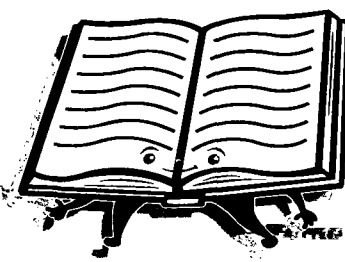


NEI 95-10

- NEI 95-10 contains a method, guidance, and NRC expectations for meeting the intent of 10 CFR 54 for first renewals as endorsed in RG 1.188
- Industry proposes adding a supplement to NEI 95-10 for second renewals
- Other changes to NEI 95-10 may be required such as in Chapter 6, LRA Format and Content

NUREG-1800, Standard Review Plan

- The Standard Review Plan (SRP) provides NRC staff reviewers guidance for their safety review of license renewal applications
- Industry reviews the SRP to ensure the LRA and basis documents provide the required information
- Industry believes revision of the SRP may be necessary to reflect the additional expectations



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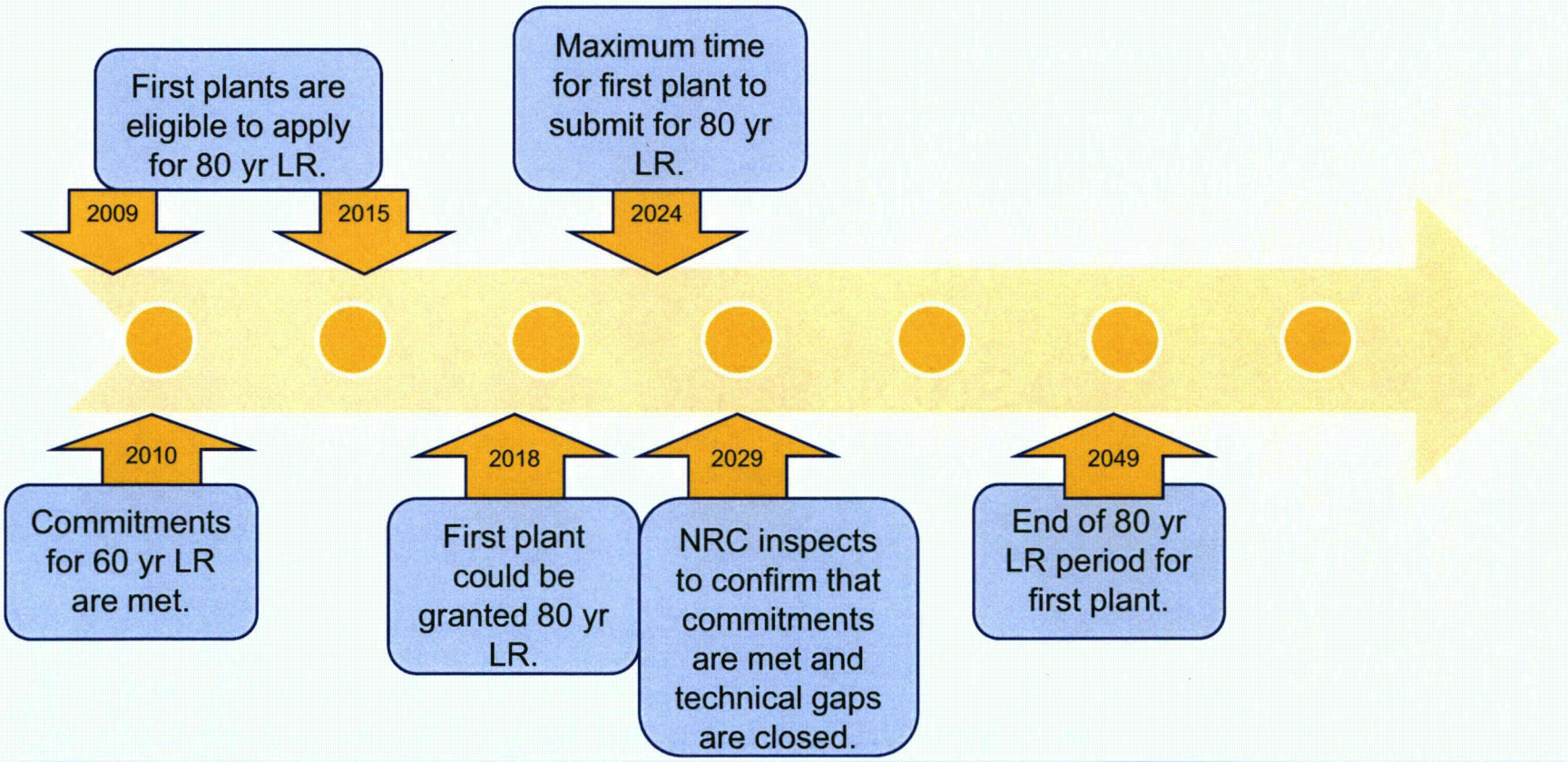
NUREG-1801, GALL Report

- Contains the NRC's evaluation of existing plant programs and documents the technical basis of their adequacy with or without modifications
- Applicants reference the GALL Report in their applications to demonstrate their programs correspond to those contained in the GALL Report
- Industry believes revision of GALL may be necessary to reflect new NRC expectations

Westinghouse Perspective on LB60

- Operation to 80 years and beyond is needed
- A coordinated and efficient use of DOE, National Labs, Owners' Groups, EPRI, vendors, and utilities is necessary to meet industry goals
- For replacement power decisions, 2029 licensees need an answer by 2019
- Westinghouse is preparing to meet customer requests that are expected in 2 to 3 years

Hypothetical License Renewal Timeline



There are only a few years before the first plant could request License Renewal (LR) to 80 years. WEC has a responsibility to help make this happen.

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QUESTIONS

NEI Perspective on Licensing Beyond 60

Julie Keys
Sr. Project Manager
jyk@nei.org

NEI
NUCLEAR ENERGY INSTITUTE

Background

- Operation beyond 60 years is needed to meet energy demands
- Currently licenses issued to 40 with 20 year extensions
- 40 was never a magic number

NEI

License Renewal Rule

- Basis of 10CFR54 is that CLB is adequate to ensure safe operation
  - Requires aging management reviews
  - Requires management of aging effects
- Goal is to maintain CLB to an acceptable level of safety during renewal period
- GALL Report used to provide NRC accepted aging management approaches

NEI

License Renewal Rule – Beyond 60

- Basis of 10CFR54 (CLB ensures safe operation) remains the same & Rule does NOT require revision to support long term, safe, continued operation
- GALL Report is used to provide NRC accepted aging management approaches
- GALL is informed by ISGs and undergoes periodic updates

NEI

Work Needed for Subsequent License Renewal

- Recognize nothing magic about year 61
- No show-stoppers identified to date
- AMPs are monitored for effectiveness and revised as needed based on OE and CAPs
  - Relationship of effectiveness reviews, OE Programs, and CAPs currently ensures no process gaps but may be implemented different at different plants
  - AMP effectiveness reviews may not be as transparent as they should
  - Industry needs to advertise improvements better

NEI

Work Needed for Subsequent License Renewal (cont)

- Some SSCs may have been engineered for a specific lifetime that is shorter than 80 years
  - Expand material degradation assessment
- Review AMPs to determine if they will continue to adequately manage aging such that there is assurance of the functionality of the SSCs within the scope of license renewal
- Implementation of programs should be reviewed to ensure they remain adequate

NEI

NRC/Industry LR Process Pilot

- A "tabletop" exercise has been outlined for Industry & NRC to review GALL & processes
  - Tabletop would critically evaluate the AMPs and their implementation for beyond 60
  - Identify where research is needed due to gap in knowledge
  - Meet NRC goals of transparency, openness & clarity in the licensing process
  - Align Industry and NRC expectations for subsequent applications

NEI

Conclusion

- No changes to existing rulemaking needed
- Programs in place for license renewal
- NRC and Industry must come to a common understanding of the adequacy of AMPs & Programs
- License renewal is a regulatory process and currently has a process to incorporate new information into current programs

NEI

Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

License Renewal Concerns

David Lochbaum
Director, Nuclear Safety Project

February 22, 2011

Union of Concerned Scientists

Citizens and Scientists for Environmental Solutions

License Renewal Concerns 1 & 2

❶ **The NRC's license renewal process does not ensure equivalent protection of public safety against the risks from aging and new nuclear plants.**

❷ **The NRC's license renewal process must conform with 10 CFR 50.100.**

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License Renewal Concern #1

① The NRC's license renewal process does not ensure equivalent protection of public safety against the risks from aging and new nuclear plants.

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License Renewal Concern #1

Scenario:

The NRC issues a new regulation supported by a regulatory analysis concluding either that its safety benefits outweigh its costs or that its safety gain is worth any cost.

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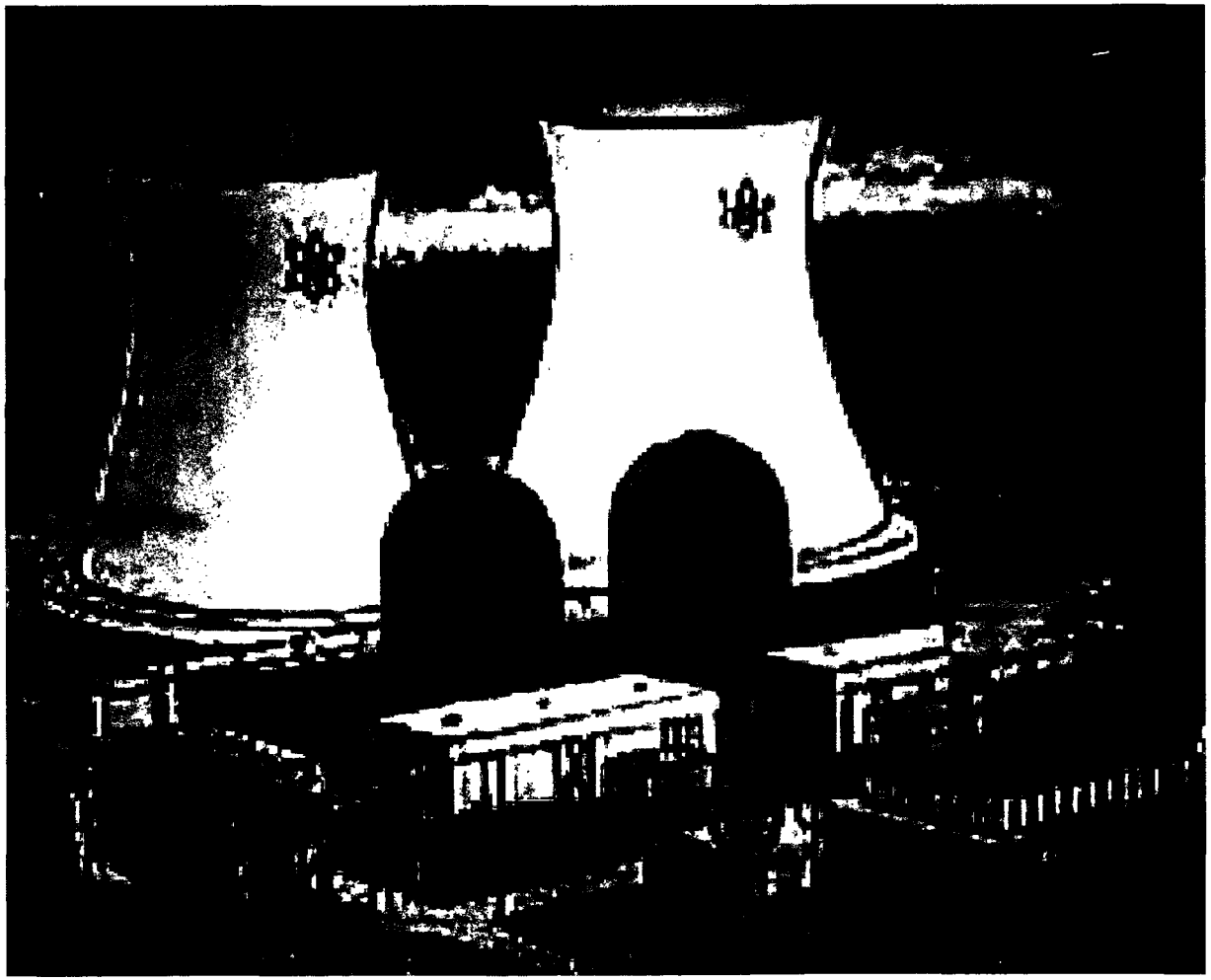
License Renewal Concern #1



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License Renewal Concern #1

Homer Simpson's aging Springfield nuclear plant is either grandfathered from the new regulation or granted an exemption from it because the safety gain over the remaining X years of the plant's lifetime do not justify the costs to comply.

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License Renewal Concern #1

The Springfield nuclear plant licensee later seeks and obtains a 20-year extension to the operating license based largely on the determination that aging management programs will prevent unacceptable erosion from current safety margins.

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License Renewal Concern #1

No one checked whether the grandfathering and exemptions from regulations for the Springfield nuclear plant remained as valid for X + 20 years as they had for X years.

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License Renewal Concern #1

The Springfield nuclear plant licensee later seeks and obtains a second 20-year extension to the operating license based on the determination that aging management programs will prevent unacceptable erosion from current safety margins.

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License Renewal Concern #1

No one checked whether the grandfathering and exemptions from regulations for the Springfield nuclear plant remained as valid for X + 40 years as they had for X years.

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License Renewal Concern #1

If the Springfield nuclear plant shut down at the end of its 40-year license and a New Springfield nuclear plant started up to replace it, that new reactor would be required to meet today's regulations and would not inherit any of the grandfathering and exemptions.

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License Renewal Concern #1

The license renewal process should identify all deltas between a reactor's licensing basis and today's regulations and formally evaluate whether each delta provides equivalent protection.

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License Renewal Concern #1

In other words, the license renewal process must formally verify that all the justifications for grandfathering and exemptions for X years remain valid when the durations are later changed to X + 20 and then X + 40 years.

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License Renewal Concern #1

Example: NRC closed USI A-43 in 1985 by revising containment sump blockage criteria that new plants would have to meet, but did not alter the criteria applied to reactors then operating.

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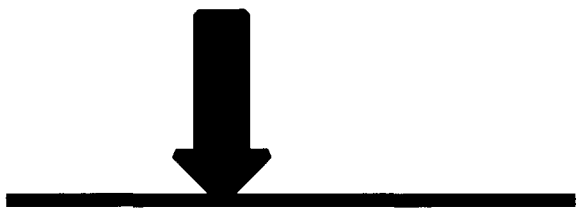
License Renewal Concern #1



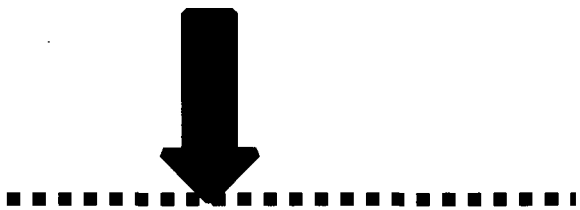
Safety Level – New Reactor

Safety Level – Old Reactor

Aging Management Programs are intended to protect against erosion of safety margins.

License Renewal Process must formally ensure that aging of the regulations has not significantly eroded safety margins.

OR



Safety Level – Old Reactor

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License Renewal Concern #2

② The NRC's license renewal process must conform with 10 CFR 50.100.

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License Renewal Concern #2

A license, permit, or standard design approval under parts 50 or 52 of this chapter may be revoked, suspended, or modified, in whole or in part, for any material false statement in the application or in the supplemental or other statement of fact required of the applicant; or **because of conditions revealed by the application or statement of fact of any report, record, inspection, or other means which would warrant the Commission to refuse to grant a license, permit, or approval on an original application** (other than those relating to §§ 50.51, 50.42(a), and 50.43(b)); … [boldfacing and underlining added at no additional cost]

Conditions, like submerged cabling and buried piping, had been revealed that the NRC requires current and future license renewal applicants to address. But the NRC did not require licensees holding renewed licenses to address them.

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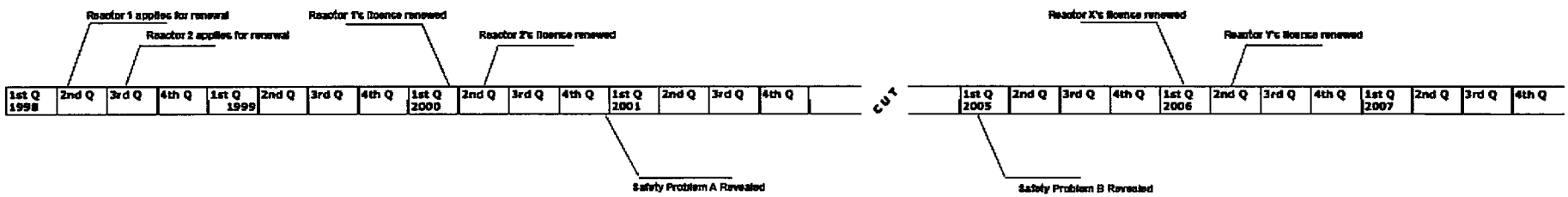
License Renewal Concern #2



Reactors X and Y had to address safety problems A and B before being relicensed, but reactors 1 and 2 never had to do so.

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License Renewal Concern #2

When a safety problem is so significant that NRC requires applicants to address it before their licenses can be renewed, 10 CFR 50.100 mandates, not suggests, that licensees holding renewed licenses address the safety problem, too.

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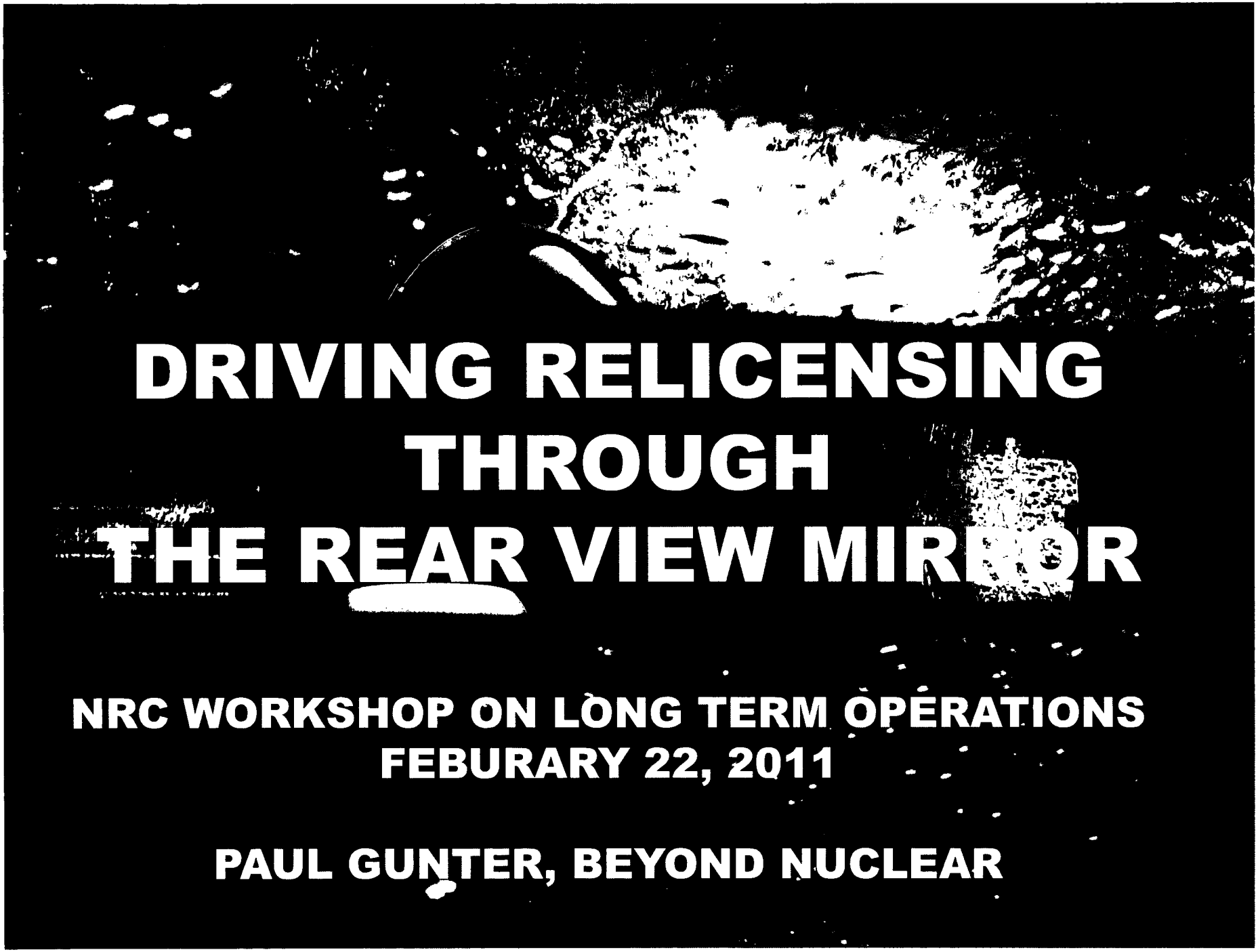
License Renewal Concern #2

The public deserves protection against known safety problems.

The public expects protection against known safety problems.

The public is not being protected against known safety problems.



DRIVING RELICENSING THROUGH THE REAR VIEW MIRROR

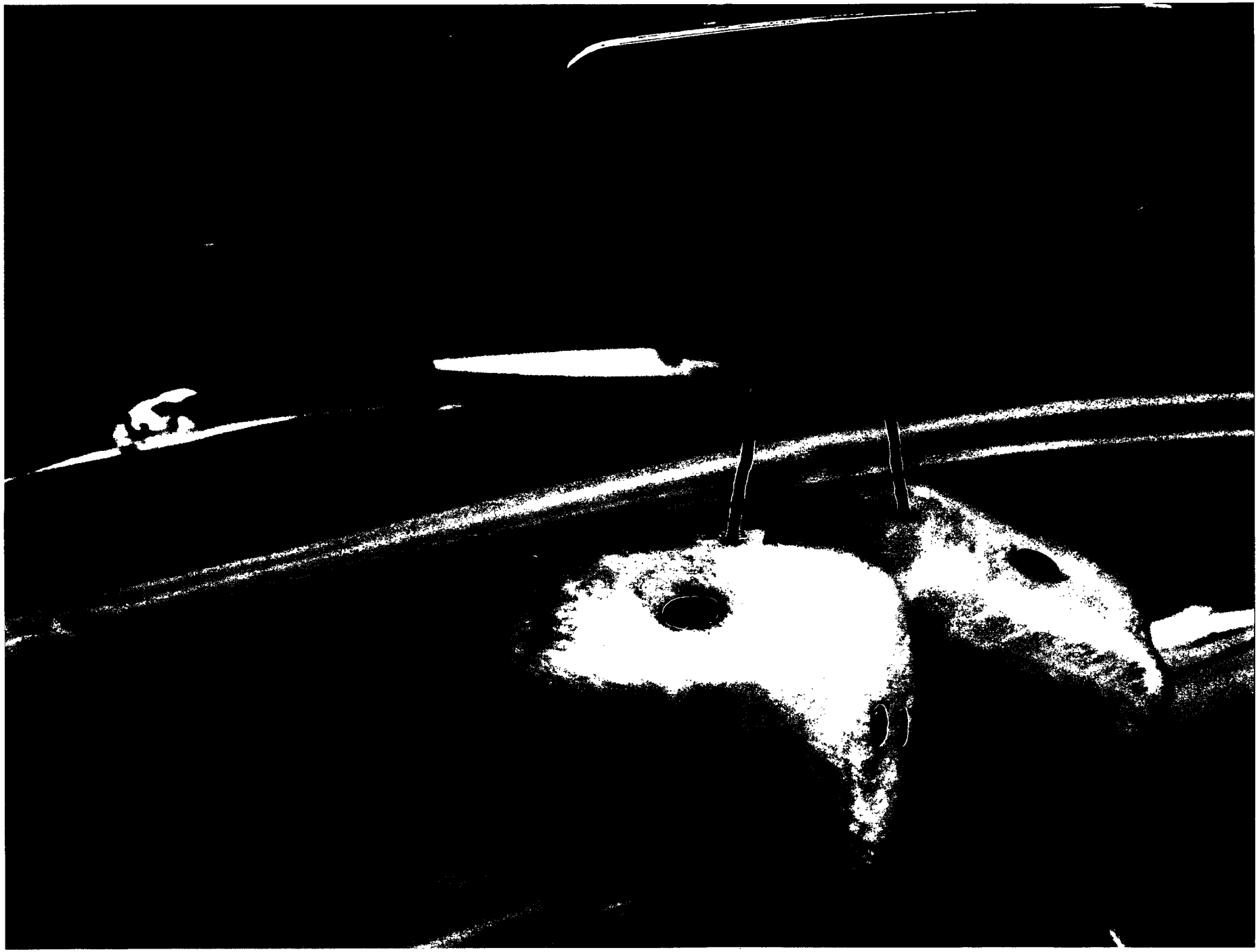
NRC WORKSHOP ON LONG TERM OPERATIONS
FEBURARY 22, 2011

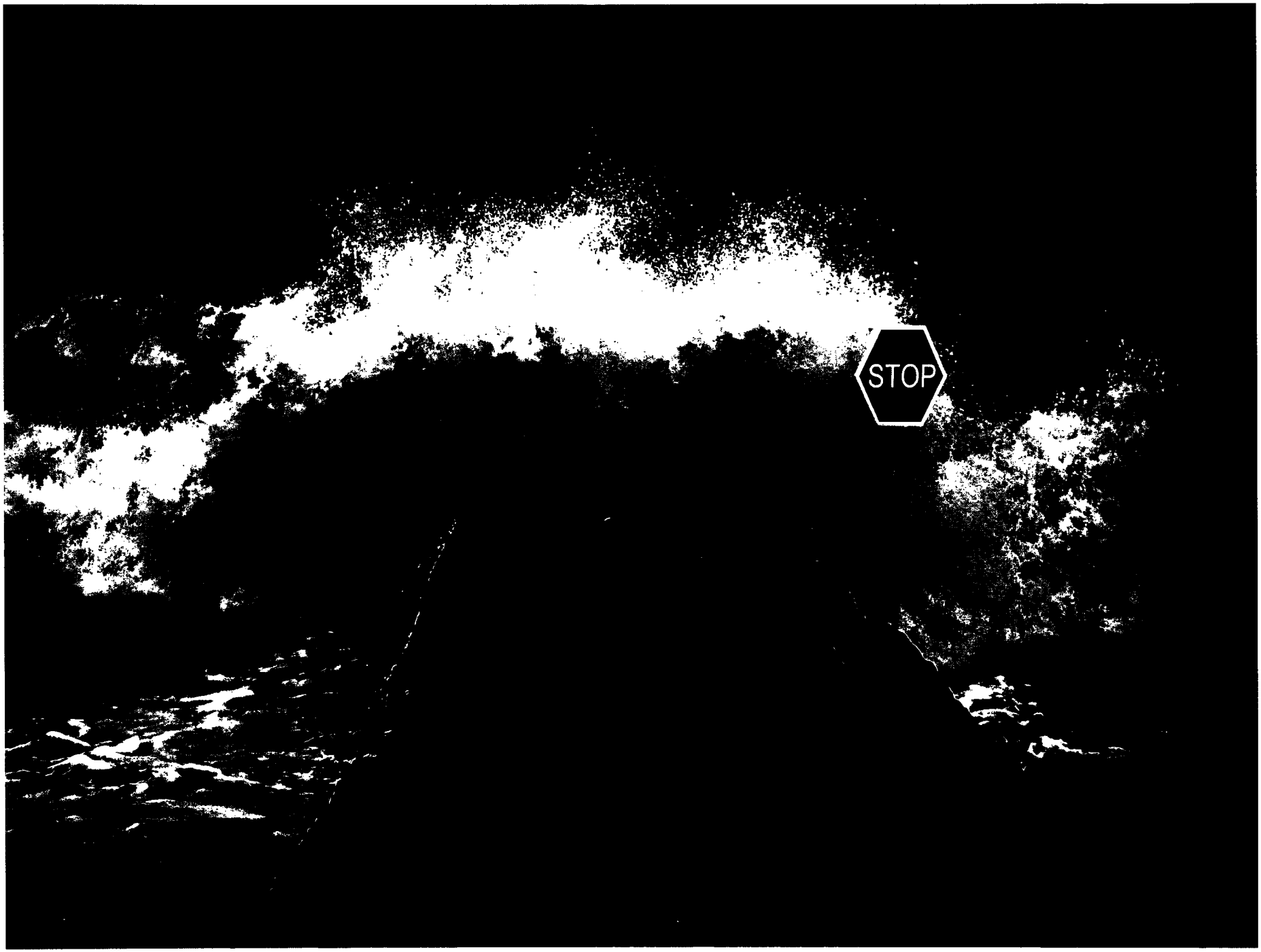
PAUL GUNTER, BEYOND NUCLEAR

EXAMPLES FOR PUBLIC CONCERN

LARGE COMPONENTS, STRUCTURES AND EXTENSIVE SYSTEMS THAT ARE

- SUSCEPTIBLE & IRREPLACEABLE
- INACCESSIBLE & UNINSPECTIBLE

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