



OECD/NEA Workshop on "Innovation in Water Reactor Technology,"

11-12 February, 2015, Paris

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Member EUR Steering Committee

OUTLINE

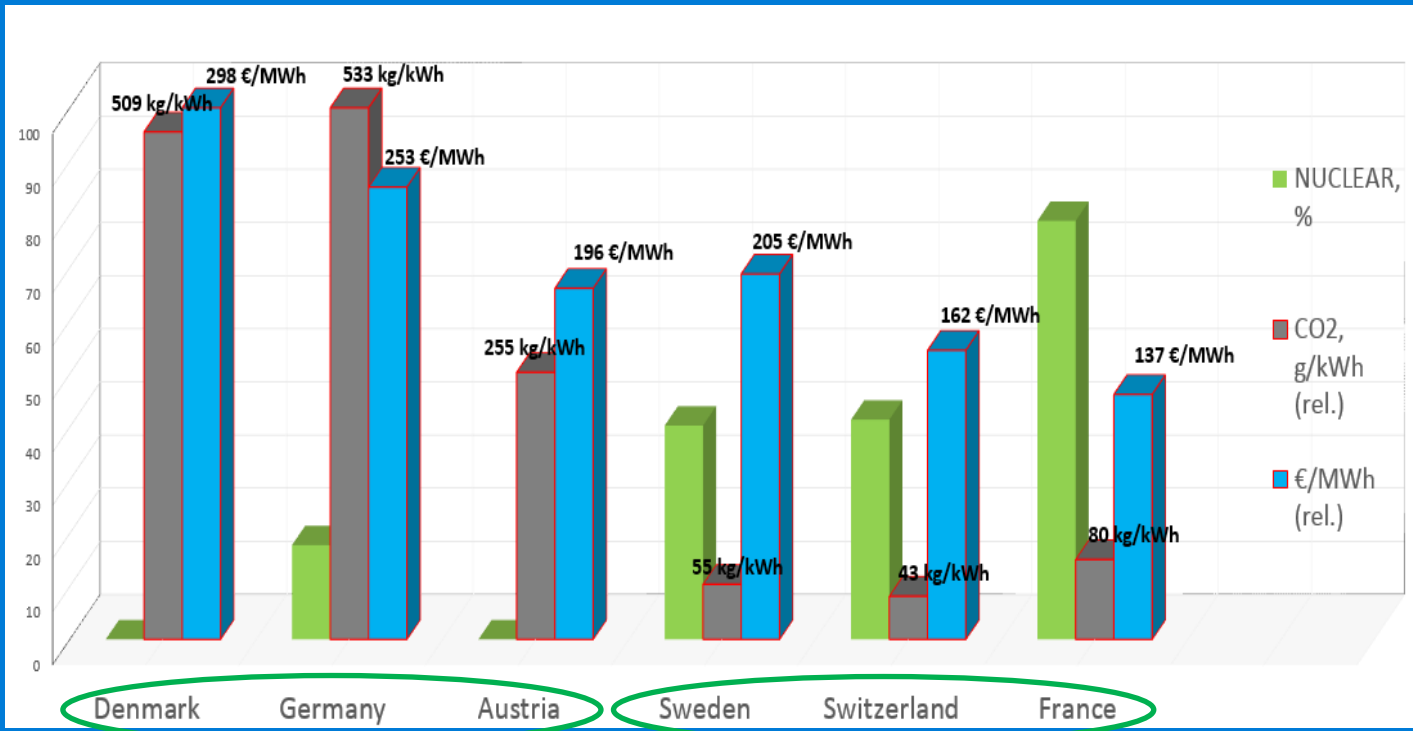
- **Energy mix policy**
- EUR framework and scope
- Evolution of requirements
- Future activities



Sustainable energy mix and cost effective decarbonization

In Europe we can observe 2 trends in energy policy

- **Nuclear** - renewable energy mix
- **Fossile** - renewable energy mix



Nuclear - renewable energy mix:

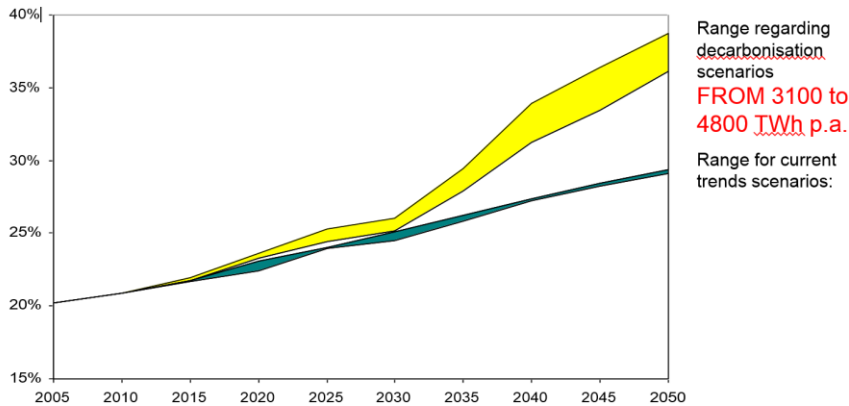
- ✓ Public health and safety
- ✓ Security of supply
- ✓ Sustainability



Results EC ENERGY ROADMAP 2050



Results EC ENERGY ROADMAP 2050 Share of electricity in final energy demand under current trends and with decarbonisation (in %)



**20% nuclear scenario 2050
~ 140 units of 1000 MW**



20% Nuclear Scenario 2050

EU Roadmap 2050	up to 20% Nuclear Electricity
4800 TWh per year	~140 Gwe (for 7000 hour per year) ➔ 100 Units of 1400 MWe avg
Today	28% Nuclear Electricity = 125 Gwe - 135 Units - Closing DE+BE+UK AGRs ➔ rest 100 Units - LTO (12 MS on 14!)
Average age of NPPs	30 years (today in EU)



Nuclear energy decisions

■ Strategic/political decisions

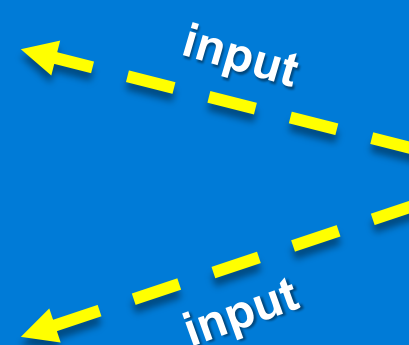
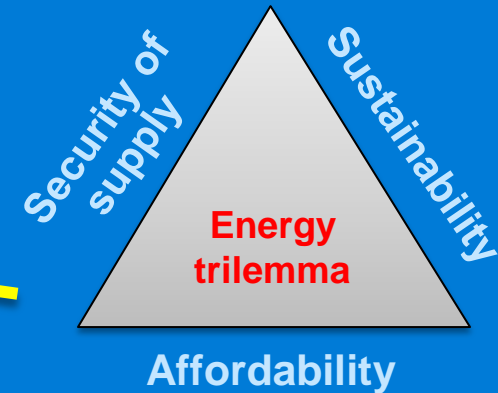
- Additional generation capacity evaluation
- Energy mix selection
- Sustainability verification

■ Regulatory decisions

- Site
- Design
- Construction
- Operation
- Decommissioning

■ Investment decisions

- Business model
- Investment model



EUR today: a mature cooperative organisation of European utilities

In 1991 the major European electricity utilities formed an organisation to develop the European Utility Requirement (EUR)



The EUR objectives

- **A utility network**
 - To **share experience** in plant specification, design evaluation, licensing ...
 - To develop **common specifications** for the European Gen 3 NPPs
- **To reduce licensing risks**
 - **High safety objectives**: common rules valid for a long enough time and in a wide enough area
 - Seek for **improved acceptance**
 - Safety **harmonisation** : within Europe and, as far as possible, with USA
- **To increase plant competitiveness**
 - allowing the development of **standard designs** usable throughout a wide area
 - promoting **cost-effective design features**
 - establishing conditions for a fair **competition** between the vendors
- **To deal with the open European electricity market**
 - **Harmonised and standardized design requirements**



The EUR document: a generic Gen 3 LWR specification

- **A specification written by investors & operators**
 - Wide experience basis (17 operators in Europe & 7 different vendors)
 - Not a regulatory document
- **Open**
 - Design objectives and functional requirements
 - Fits all the designs of interest to the European utilities
 - Modular structure, versatile, easy to adapt
- **Neutral**
 - Does not favour any specific design
 - Seldom forbids, except where there is a bad operation experience or an unacceptable industrial risk
- **Benchmarked**
 - Other industrial specifications (EPRI-URD), regulatory documents, international design guides
 - Real Gen 3 designs
- **A possible base to call for bids**



The EUR document

volume 1



main policies
& objectives

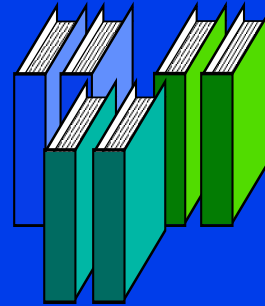
Revision A: Mar. 1994
Revision B: Nov. 1995
Revision C: Apr. 2001
Revision D: Oct. 2012

volume 2



generic
nuclear island
requirements

volume 3



Applications of EUR
to specific projects

BWR 90: 06/1999
EPR rev A: 12/1999
EP1000: 12/1999
ABWR: 12/2001
SWR 1000: 02/2002
AP1000: 06/2006
AES92: 06/2006
EPR rev B: 06/2009
APWR: 10/2014

volume 4



generic
conventional island
requirements

Revision A: Nov. 1996
Revision B: Mar. 2000
Revision C: Oct. 2007
Revision D: Oct. 2012



Main policies considered in the EUR document

- Nuclear safety
- Operational performance
- Public acceptance
- Investment protection
- Capital cost of new build
- Standardisation



Safety

- **Deterministic approach to be implemented first (design basis)**
 - Defence in depth: several barriers and redundant mitigation systems must be provided
 - Safety classification,
- **Design Extension approach and severe accidents mitigation (Beyond Design Basis)**
- **Physical protection (external hazards and attacks)**
- **Prevention of early containment failure**
 - Multiple failures considered in the design (diversity)
- **Probabilistic risk assessment**



Performance requirements

- Large output: 600 to 1800 Mwe
- Lifetime 60 years
- Expected availability > 90% over 20 years
- Outage durations: refuelling only in 14 days, refuelling + regular maintenance in 20 days, in-service inspection in 40 days, ...
- Margin policy: core reload flexibility (MOX capability)
- Spent fuel storage: 10 years of UO2 fuel, 15 years of MOX fuel
- Load follow capability
- 100% rated power load rejection capability
- Simplification of SSCs



EUR Revision D October 2012: inputs

A lot of preparatory material gathered by the EUR organisation since 2001 to improve the text:

- Feedback from project evaluations
- Comparisons with other specifications
- Analyses of the recent regulatory documents vs. EUR
- New policies and new chapters
- Initial Fukushima lessons learned



EUR Revision D October 2012: major evolutions

- Five levels of Defence in Depth
- Consideration of intentional aircraft crash
- First limited consideration of Fukushima Lessons Learned (i.e. clarification of some topics as list of hazards,
- Improvements of plant availability including shorter outage duration (refuelling and regular maintenance outage in 16 calendar days instead of 20)
- Incorporation of state-of-the art knowledge in decommissioning and consideration of environmental impact with a new dedicated chapter
- 60-year design lifetime as a requirement



Started April 2014 revision E

- Derive EUR requirements which are in line with the newest international safety standards, in particular the recent versions of IAEA and WENRA documents

Safety Classification update inputs IAEA and IEC standards and recent licensing experience

- Lessons learned from the Fukushima accident
- Criteria for Limited Impact (CLI)
- Instrumentation and Control (I&C)
- The other main technical fields:
 - Seismic Approach,
 - Probabilistic Safety Assessments,
 - Layout,
 - Grid connection,
 - Pipe Break.



Reinforced dialogue with the stakeholders

■ Reinforced interaction with other industry groups and stakeholders:

- EUR/ENISS agreement signed in 2008 in order to join their effort on new reactors with IAEA and WENRA organizations
- EUR/CORDEL (WNA) agreement to coordinate their efforts in relation with the MDEP initiative
- EUR/EPRI collaboration frame established to revisit the comparison with the EPRI-URD issued in the 90's
- Collaboration with IAEA/NP on new plants deployment



Training and access policy

- 2 important tasks of the EUR organization
- 4 one-week to 3 day courses organized
- Open access policy to utilities that are potential users
 - Whole EUR document
 - Copyrights, specific conditions of use
- Restricted access to volume 3
 - A vendor can deny access to any external party
- Volume 1, 2 readable at www.europeanutilityrequirements.org



Conclusions

■ EUR Organisation

- one of the key players for European Nuclear New Built
- in interaction with all the major stakeholders

■ EUR tribute to harmonisation and standardisation

- first priority for a harmonious nuclear renaissance development for utilities and vendors

■ EUR generic technical specifications

- fully operational
- may be used by utilities or other bodies

■ EUR development is going on - main technical priorities

- with new Gen 3 designs assessments EU-APR1400 (KHNP) and the VVER TOI (AEP design, submitted by REA)
- with the update of the requirements (towards rev. E)

