A FULLY UPDATED VERSION
OF THE EUROPEAN UTILITY REQUIREMENT (EUR) DOCUMENT IS AVAILABLE

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ABSTRACT: The major European electricity producers have worked on a common requirement document for future LWR plants since 1992 to get specifications acceptable together by the owners, the public and the authorities. Thus the designers can develop standard LWR designs that could be acceptable everywhere in Europe and the utilities can open their consultations to vendors on common bases. Public and authority's acceptance should be improved as well. Significant savings are expected in development and construction costs.

Since the release of the last versions of the EUR texts in 1996, a lot of work has been carried out: reviews by the regulators and other external organisations, comparisons, assessment of compliance of designs vs. EUR and clarification works on the controversial topics that deserved changes or clarification. At the beginning of 1999 enough material was available to start a complete revision of the EUR document.

In-depth works have been carried out during the last couple of year to develop this revision. The European utilities and the vendors have now an updated and well-tuned tool that allow them to develop, to assess and eventually to order modern LWR designs well fitted to their actual needs.

A SHORT HISTORY

Even if today's prospects may look rather dull in some countries, the major European electricity producers want to keep the nuclear option open, that is to be able to build new nuclear power plants when the economic interest or the necessity re-appear. As the conditions for construction (market organisation, licensing requirements, design objectives, etc.) will not be the ones existing up to the beginning of the 90s, the utilities and the vendors have set up various action plans to support the development of future nuclear plant designs. These new designs must together be acceptable by the regulatory bodies, attractive to the public and profitable for the electricity producer. Producing a common European Utility Requirement (EUR) document that sets out the requested targets is one of the basic tasks for this renewal.

In late '91, five of the major European electricity producers set up an organisation to develop the EUR document. Up to that time, development, design and licensing had been performed on a national basis with little interaction between countries. Their primary objective was to produce a common set of requirements that could be endorsed by the major European electricity producers and that would provide clear guidance to the designers.

The first issue of the volumes 1 and 2 dedicated to generic LWR nuclear islands' requirements was released in 1994. The EUR utilities first revised the volumes 1 and 2 considering both the comments...
received during the review of the first issue and internal requests to address new topics. In late 1995, revision B of the volumes 1 and 2 was released.

A volume 4 dedicated to the power generation plant was worked out in parallel. The first state (revision A) has been dispatched for review to the main utilities and vendors in November 1996. Many comments have been received which have been used to produce a revision B.

Since the first release of volumes 1 & 2, the EUR organisation has kept growing. In parallel, the main LWR vendors have developed advanced designs for the European market, with reference to the EUR document. The EUR organisation has come to agreements with some of these vendors to produce a volume 3 to the EUR document that specifically addresses these new designs. As of today 3 subsets dedicated to the EPR, BWR 90 and EPP projects have been published and two other ones dedicated to ABWR and SWR 1000 are still being reviewed.

Volume 2 has been kept stabilised as long as the review by the European regulators had not produced clear conclusions and that the assessments of compliance of the first parts of volume 3 had not been produced. Meanwhile, other works have been carried out by the EUR organisation to broaden the scope, to improve the requirements, to clarify the existing texts and to stabilise the background policies, paving the way to a revision C that will be published in the coming weeks.

THE PROMOTERS

The EUR promoters are a group of organisations that represent the major Western Europe electricity producers committed to keeping the nuclear option open in Europe. Started with five partners in 1992, the group now includes 10 organisations:

- British Energy/Nuclear Electric from UK,
- Tractebel from Belgium,
- Electricité de France from France,
- NRG from the Netherlands
- Agrupación eléctrica para el desarrollo tecnológico nuclear, (DTN) from Spain,
- Vereinigung Deutscher Elektrizitätswerke, (VDEW) from Germany,
- SOGIN, from Italy,
- Vattenfall/FKA from Sweden,
- Fortum and TVO from Finland.
- UAK from Switzerland

Rosenergoatom for Russia has been welcomed as associated members in 1998. They are in the process of becoming full EUR member.

MAJOR OBJECTIVES

The EUR document develops requirements addressed to the LWR plant designers and vendors. It is a tool for promoting the harmonisation of the most important plant features that were often too country-specific.

The main items considered in this convergence process are the safety approaches, targets, criteria and assessment methods, the standardised environmental design conditions and design methods, the performance targets, the design features of the main systems and equipment, and -at a lower level- the equipment specifications and standards.

Significant benefits are expected in two fields:

- better competitiveness vs. alternate electricity generation means;
- improved public and authorities' acceptance, thus allowing an easier licensability of a design developed following EUR.

The major objectives of the EUR organisation are derived from these targets. These objectives are the foundation of the requirements developed in the EUR document:

- giving the producers means for controlling construction costs through standardisation, simplification, series ordering and consideration of maintenance at design stage;
- establishing a common specification valid in an area large enough so as to allow the vendors to develop standard designs;
- establishing stable market conditions for a broader competition between suppliers;
making sure that acceptable operation and fuel cycle costs can be achieved, even in an upset economic environment;
prescribing ambitious - but achievable - availability and lifetime targets;
harmonising safety related requirements: common safety targets, common safety approaches and common technical solutions to safety problems;
setting "good neighbour" requirements like low impact into environment, reduction of emergency planning, consideration of decommissioning at the design stage...

On these bases, the main vendors are developing a number of standard designs:
that could be built in many countries with minimum adaptation;
that show acceptable economic prospects;
that actually meet the needs of the customers.

STRUCTURE OF THE EUR DOCUMENT

The EUR document is structured into four volumes:

• Volume 1 Main policies and top tier requirements: this part defines the major design objectives and presents the main policies that are implemented throughout the EUR document.

• Volume 2 Generic nuclear island requirements: it contains all the generic requirements and preferences of the EUR utilities for the nuclear island.

• Volume 3 Application of EUR to specific designs: it is divided into a number of subsets. Each subset is dedicated to a specific design that is of interest to the participating utilities. A subset includes a description of the design and an analysis of compliance vs. the generic requirements of Volume 2. It may also include design dependent requirements.

• Volume 4 Power generation plant requirements: it contains the generic requirements related to the power generation plant.

The whole document includes about forty chapters that deal with all topics a utility has to address to have a nuclear power plant developed and built.

ORGANISATION AND CONTROL OF THE PRODUCTION PROCESS

As the EUR document is customer oriented, the whole process has to be driven by the utilities that will be the final users. The electricity producers involved in EUR write the texts of the EUR document. A joint organisation has been set up for the development and the review of the document, which has been kept much decentralised thanks to e-mail and Internet.

All the other nuclear business actors that may have an influence in Europe (other electricity producers, vendors to the European market, safety authorities and administrations, international...
nuclear organisations) have been asked to review the document at the successive stages of its
development: the vendors and the utilities first, then the safety authorities and the administrations.
Beyond Europe, dialogue has been also established with the major vendors and utilities to aim at
worldwide consistency of the design approaches. For instance, in-depth analyses of the differences
between EUR and EPRI/URD have been worked out. Nevertheless, the EUR promoters keep the final
content of the document under control.

WORKS IN PROGRESS

Since the early stages of the production of the EUR document the EUR utilities have continued the
development of the EUR document. The scope of the document is being broadened- more topics and
more designs addressed- while its bases are strengthened. The essential points are as follows:

WORKS ON VOLUMES 1 & 2: GENERIC REQUIREMENTS FOR NUCLEAR ISLANDS

Discussing volumes 1 & 2 with the regulatory and licensing bodies: No generic license can yet be
foreseen at European level. Discussions have been carried out since 1997 to establish common ground
between the EUR utilities and their regulators, so that the national requirements eventually come closer
to each other. A background objective is to make a standard plant developed according to EUR
 licensable in another one, without major design change. The regulators have agreed to review the main
chapters of Rev B of volumes 1 and 2 in a coordinated way. The first results show that no fundamental
safety objective proposed in the EUR document has been called into question by the regulators.
Nevertheless a lot of comments have been produced that have needed in depth discussions by the EUR
organisation, so as to clarify the initial text or to propose changes for revision C. A new discussion round
is to start at the beginning of 2001.

Establishing the bases for a revision C of the volumes 1 & 2: During the production of the different
subsets of volume 3, the generic EUR requirements are tested at detail level vs. real designs. Thus a
number of requests for further investigation, clarification and proposals for changes have been identified
about important requirements. The review with by the regulators has brought other requests and
proposals. Other external factors have leaded the EUR parties to reconsider other important
requirements, such as the grid requirements and the I&C requirements. The EUR organisation has been
busy with the clarification and investigation works in 1998 and 1999. The proposals for evolution, related
to volumes 1 and 2, have been reconciled in 2000. Then a complex discussion and review process has
been necessary to come to a consensus on all items.

WHAT IS NEW IN REVISION C OF VOLUMES 1 & 2

From this process several thousands of changes have been actually implemented in revision C. Many of
them are rather minor but there are a few topics where substantial evolution occurred. The outstanding
points are listed hereafter.
A few safety objectives have been adjusted:

The radioactive releases targets in normal operation and incidents have been simplified, and the combination of DBE+LOCA deleted as explained on the opposite picture.

The definition of the Severe Accident Safe State has been modified. An EUR design objective is to reach "Severe Accident Safe State" (SASS) within a week after a severe accident with core melt.

The definition of SASS has been modified to allow some designs not to vent the primary containment, if the in-containment source term that can be mobilised does not exceed the EUR Limiting Release target.

The performance objectives (plant average availability, outage duration, ...) have been toughened in line with the increased competition level on the European electricity markets and the experience feedback. See the opposite picture for a selection of the updated EUR design targets.

In Europe the generation company are being separated from the high voltage transmission companies. The EUR high voltage transmission grid requirements have been generally relaxed according to the actual interest of the producers, no longer the HV grid managers. Only the performances that have sufficient value on the electricity markets to balance their extra investment cost have been kept in EUR. An example of relaxed requirement (voltage-frequency diagram) is given on the opposite picture.
The specifications for Instrumentation & Control have been made fully functional, thus eliminating all the solution-oriented requirements and giving them a wider cover and a much longer life expectation. See the opposite picture.

More detailed layout rules have been produced. The purpose is to provide the designers with more specific guidance so that the resulting standard designs can be used by all the operators with less changes.

**revision C : I & C**

- chapter 2.10 completely rewritten in revision C
- revision B derived from N4 & Sizewell experience. EUR was requesting an overall architecture and specific technical options.
- revision C = purely functional approach
  - no architecture requested, no recommended option
  - bases:
    - functional analysis, "interactors",
    - design requirements linked to the safety levels of the functions,
    - acceptable technologies
    - manmachine interface

**revision C : layout rules**

- chapter 2.11 (layout rules) rewritten and significantly augmented
- integration of the layout rule documents established for EPR, EPP and other European projects
- much more practical specifications (diagrams, pictures, data,...)
- Common layout rules are a prerequisite to the development of standard design usable by different operators in different countries
The construction methods requirements and the associated objectives have been revisited, opening the EUR to more diverse organisations and toughening the objectives.

**revision C : methods and objectives for construction**
- Chapter 2.13 (constructability) completely rewritten
- different construction organisations better addressed : turnkey, architect-engineer + constructor, driven by the owner
- toughened objectives for construction time: it shall be possible to select any duration between 36 and 60 months, according to the owner constraints.
- More than 50% of the detailed design studies shall be available when the first concrete is poured

**WORKS ON VOLUME 3 : APPLICATION OF EUR TO SPECIFIC DESIGNS**

Beside the sets of generic requirements of volumes 1 and 2, the EUR promoters are producing evaluations of selected LWR designs that may be offered on the European market. Brought together, they make up volume 3 of the EUR document. A subset includes a description of the standard design and an analysis of compliance vs. the generic requirements of Volume 2. It may also include design dependent requirements. A subset of volume 3 is produced with contribution of the corresponding vendor. The works on a first set, dedicated to EPR (1500 MW evolutionary PWR developed by NPI, Framatome and Siemens), started in 1996. The detailed analysis of compliance has followed the progress of the project. No fundamental deviation has been identified. Of course there are differences, but the EPR design actually meets the major EUR objectives. The whole set (plant description, analysis of compliance and specific requirements) has been released in early 2000. It includes the results of the EPR project Basic Design Optimisation Phase.

Two other subsets were eventually launched in 1997:

A second set dedicated to BWR 90 (1300 MW evolutionary BWR developed by ABB Atom). An in-depth analysis of compliance was possible on this project because it was offered a few years ago, thus was developed at detail level. Since the project was developed before the EUR document, one can find significant differences in the analysis of compliance. Meanwhile ABB worked out design evolution studies -known as BWR 90+- that address the most recent utility and safety authority requirements. BWR 90+ actually meets the EUR safety requirements where differences were identified for BWR 90. The whole BWR 90/90+ set (plant description, analysis of compliance and specific requirements) was finally released at the end of 1999.

A third set dedicated to EPP (1000 MW PWR with passive safety features developed by Westinghouse, Ansaldo and other European partners). The analysis of compliance has been worked out in 1998 and 1999. The depth and the scope of the analysis of compliance correspond to the stage of development of the project at the end of its phase IIA. Since the reference specification for the EPP project is the EUR document, there is obviously a good level of compliance. As for the EPR, the whole EPP set (plant description, analysis of compliance and specific requirements) has been released early 2000.

In 1999, works have been started on two other advanced LWR projects: GE’s ABWR and Siemens’ SWR1000. The analyses of compliance are being reviewed by the EUR organisation. The two corresponding subsets of volume 3 should be released by the end of 2001. Further on, a new subset of volume 3 is foreseen that would be dedicated to an advanced VVER design.

**WORKS ON VOLUME 4 : GENERIC REQUIREMENTS FOR POWER GENERATION PLANTS**

The utilities and the vendors had reviewed revision A of the volume 4 since 1997. The comments have been processed and reviewed by the EUR organisation to write a revision B that was published in March 2000.
DISCUSSION WITH THE ORGANISATIONS OUTSIDE EUR

The EUR promoters want to keep active links with all the other utilities that consider nuclear power an acceptable option worldwide. This is to make sure that the ideas being discussed for future versions of EUR are actually in the global mainstream. Actually this brings fresh ideas to the EUR organisation. In the same spirit, the EUR organisation has concluded specific agreements with other utilities to support them to produce their own set of requirements. On the vendor side, there is a living dialogue with the vendors involved in volume 3.

Beyond these discussions, the EUR document is increasingly used as a yardstick by various organisations to assess proposed designs. The EUR document is well fitted to this use since the requirements of the volumes 1, 2 and 4 are really generic. They are valid for any kind of LWR plants and are not specific of any design or of any vendor. The EUR utilities use to bring support to the users.

CONCLUSION

When the first tasks were launched at the beginning of 1992, the EUR document was a rather distant target for five European utilities looking for keeping an access to nuclear power generation open. Since that time it has become a reality. The momentum has been sufficient to update the texts and to get a complete revision in two years. The scope of the document has been extended. The base of the major policies have been clarified and strengthened. Thus the EUR document is now the best reference for the LWR plants that may be ordered beyond the turn of the century in Europe or elsewhere. Even if the growth of the EUR group makes consensus more difficult, the benefits the utilities foresee are substantial enough to keep developing the EUR document. The next phases of the programme are still being discussed.