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NUCLEAR ENERGY AGENCY
COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES

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Proceedings of the 2nd CNRA International Workshop on "New Reactor Siting, Licensing and Construction Experience"

Hosted by the U.S. Nuclear Regulatory Commission
Atlanta, Georgia, U.S.A.

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ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

The OECD is a unique forum where the governments of 34 democracies work together to address the economic, social and environmental challenges of globalisation. The OECD is also at the forefront of efforts to understand and to help governments respond to new developments and concerns, such as corporate governance, the information economy and the challenges of an ageing population. The Organisation provides a setting where governments can compare policy experiences, seek answers to common problems, identify good practice and work to co-ordinate domestic and international policies.

The OECD member countries are: Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, the Republic of Korea, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Commission takes part in the work of the OECD.

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NUCLEAR ENERGY AGENCY

The OECD Nuclear Energy Agency (NEA) was established on 1 February 1958. Current NEA membership consists of 31 countries: Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Poland, Portugal, the Republic of Korea, the Russian Federation, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States. The European Commission also takes part in the work of the Agency.

The mission of the NEA is:

– to assist its member countries in maintaining and further developing, through international co-operation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy for peaceful purposes, as well as
– to provide authoritative assessments and to forge common understandings on key issues, as input to government decisions on nuclear energy policy and to broader OECD policy analyses in areas such as energy and sustainable development.

Specific areas of competence of the NEA include the safety and regulation of nuclear activities, radioactive waste management, radiological protection, nuclear science, economic and technical analyses of the nuclear fuel cycle, nuclear law and liability, and public information.

The NEA Data Bank provides nuclear data and computer program services for participating countries. In these and related tasks, the NEA works in close collaboration with the International Atomic Energy Agency in Vienna, with which it has a Co-operation Agreement, as well as with other international organisations in the nuclear field.

THE COMMITTEE ON NUCLEAR REGULATORY ACTIVITIES

"The Committee on Nuclear Regulatory Activities (CNRA) shall be responsible for the programme of the Agency concerning the regulation, licensing and inspection of nuclear installations with regard to safety. The Committee shall constitute a forum for the effective exchange of safety-relevant information and experience among regulatory organisations. To the extent appropriate, the Committee shall review developments which could affect regulatory requirements with the objective of providing members with an understanding of the motivation for new regulatory requirements under consideration and an opportunity to offer suggestions that might improve them and assist in the development of a common understanding among member countries. In particular it shall review current management strategies and safety management practices and operating experiences at nuclear facilities with a view to disseminating lessons learnt. In accordance with the NEA Strategic Plan for 2011-2016 and the Joint CSNI/CNRA Strategic Plan and Mandates for 2011-2016, the Committee shall promote co-operation among member countries to use the feedback from experience to develop measures to ensure high standards of safety, to further enhance efficiency and effectiveness in the regulatory process and to maintain adequate infrastructure and competence in the nuclear safety field.

The Committee shall promote transparency of nuclear safety work and open public communication. The Committee shall maintain an oversight of all NEA work that may impinge on the development of effective and efficient regulation.

The Committee shall focus primarily on the regulatory aspects of existing power reactors, other nuclear installations and the construction of new power reactors; it may also consider the regulatory implications of new designs of power reactors and other types of nuclear installations. Furthermore it shall examine any other matters referred to it by the Steering Committee. The Committee shall collaborate with, and assist, as appropriate, other international organisations for co-operation among regulators and consider, upon request, issues raised by these organisations. The Committee shall organise its own activities. It may sponsor specialist meetings and working groups to further its objectives.

In implementing its programme the Committee shall establish co-operative mechanisms with the Committee on the Safety of Nuclear Installations in order to work with that Committee on matters of common interest, avoiding unnecessary duplications. The Committee shall also co-operate with the Committee on Radiation Protection and Public Health and the Radioactive Waste Management Committee on matters of common interest."

FOREWORD

The Committee on Nuclear Regulatory Activities (CNRA), based on the regulatory actions underway or being considered in different members countries concerning the design and construction of advanced nuclear power plants, established a working group responsible of the regulatory issues of siting, licensing and regulatory oversight of generation III+ and generation IV nuclear reactors. The Working Group on the Regulation of New Reactors (WGRNR) main purposes are to improve regulatory reviews by comparing practices in member countries; improve the licensing process of new reactors by learning from best practices in member countries; ensure that construction inspection issues and construction experience is shared; promote cooperation among member countries to improve safety; and enhance the effectiveness and efficiency of the regulatory process.

The WGRNR has established a programme of work which includes: the collection of construction experience and the assessing of the information collected in order to share lessons learned and good practices; the review of regulatory practices concerning the regulation of nuclear sites selection and preparation; and the review of recent regulatory experience concerning the licensing structure of regulatory staff and regulatory licensing process.

The WGRNR has reviewed and documented the regulatory practices regarding the regulation of site selection and preparation in Member Countries[1]. The WGRNR also convened a workshop[2] in 2010 in Prague, Czech Republic, which provided an excellent opportunity to communicate recent construction experience lessons learned. The workshop also discussed the lessons learned in the regulation of site selection, evaluation and site preparation as well as the review of regulatory practices for the licensing of new reactors, including the regulatory body infrastructure, staffing and expertise needed. In 2011, the WGRNR issued a comprehensive report on the different regulatory structures, licensing processes and design reviews used by member states[3]. In 2012, the working group also published the first construction experience synthesis report that summarizes the lessons learned between 2008 and 2011 from construction events[4].

The WGRNR organised a second international workshop aimed to provide a forum to exchange information on lessons learned from siting, licensing and constructing new nuclear power plants around the world. Key focus areas included siting practices and regulatory positions that have been enhanced as a

[1] Final report NEA/CNRA/R(2010)3 (Follow this link to download the report http://www.oecd-nea.org/nsd/docs/2010/cnra-r2010-3.pdf)

[2] Workshop proceedings NEA/CNRA/R(2011)7 (Follow this link to download the workshop proceedings http://www.oecd-nea.org/nsd/docs/2011/cnra-r2011-7.pdf)

[3] Final report NEA/CNRA/R(2011)13 (Follow this link to download the report http://www.oecd-nea.org/nsd/docs/2011/cnra-r2011-13.pdf)

[4] Final report NEA/CNRA/R(2012)2 (Follow this link to download the report http://www.oecd-nea.org/nsd/docs/2012/cnra-r2012-2.pdf)

result of the Fukushima accident; lessons learned from licensing and design review approaches and challenges, construction experience and recommendations for regulatory oversight; and regulatory cooperation on generic and design specific issues through the MDEP specific working groups.

The workshop, held in 24-26 October 2012, in Atlanta, Georgia, USA, hosted by the US Nuclear Regulatory Commission (U.S.NRC), provided a forum to communicate recent experience on these topics to a wider audience, to introduce and discuss the current programme of work and products under development in WGRNR, and to gain insights from workshop participants on each of the programme of work areas, and get feedback from participants on additional focus areas. This report documents the proceedings of the workshop.

SUMMARY AND CONCLUSIONS

1. Introduction

This report documents the proceedings from the 2nd "Workshop on New Reactor Siting, Licensing and Construction Experience", held in Atlanta, Georgia, USA on 24-26 October 2012. A total of 45 specialists from 16 countries and international organisations attended. The meeting was sponsored by the OECD Nuclear Energy Agency Committee on Nuclear Regulatory Activities and hosted by the US Nuclear Regulatory Commission (U.S.NRC).

The objectives of the workshop were to provide a forum to exchange information on lessons learned from siting, licensing and constructing new nuclear power plants around the world. Key focus areas included siting practices and regulatory positions that have been enhanced as a result of the Fukushima accident; lessons learned from licensing and design review approaches and challenges, construction experience and recommendations for regulatory oversight; and regulatory cooperation on generic and design specific issues through the MDEP specific working groups.

The workshop provided an excellent opportunity to learn from others which is a key to success and progress. Information obtained as a result of this workshop provided understanding keys and interpretations of regulatory issues of licensing process of new reactors, and possible methods to address them. The workshop also allowed communicating recent experience to a wider audience, including participants from OECD member countries as well as New Entrants from non-OECD member countries. The workshop allowed the WGRNR group to introduce and discuss the current programme of work and products under development in order to gain insights from workshop participants on each of the programme of work areas, and get feedback on additional focus areas.

The workshop was structured in 4 technical sessions, each followed by ample time for panel discussions. The first technical session was devoted to regulatory cooperation on generic and design specific issues, MDEP working groups (EPR, AP1000), vendor inspection co-operation, digital I&C, and codes and standards. The second technical session was intended to discuss and share regulatory positions on siting practices and enhancements as a result of lessons learned from Fukushima accident. The third technical session addressed the construction experience and regulatory oversight of new reactor construction activities. And the fourth technical session included presentations on the lessons learned from regulatory licensing reviews of new reactor designs.

2. Background of the Workshop

Based on the regulatory actions underway or being considered in different member countries concerning the design and construction of advanced nuclear power plants, the NEA's Committee on Nuclear Regulatory Activities established in 2008 a working group responsible of the regulatory issues of the siting, licensing and regulatory oversight of generation III+ and generation IV nuclear reactors. The working group on the regulation of new reactors (WGRNR) constitutes a forum of experts for the licensing of new and advance commercial nuclear power reactors and should facilitate a cooperative approach to identify key new regulatory issues and promote a common resolution.

The main purpose of the WGRNR and its products are to improve regulatory reviews by comparing practices in member countries; improve the licensing process of new reactors by learning from best practices in member countries; ensure that construction inspection issues and construction experience is shared; promote cooperation among member countries to improve safety; and enhance the effectiveness and efficiency of the regulatory process.

The WGRNR programme of work is periodically approved by the CNRA. It includes the collection of construction experience and the assessing of the information collected in order to share the lessons learned and good practices, the review of regulatory practices concerning the regulation of nuclear sites selection and preparation, and the review of recent regulatory experience concerning the licensing structure of regulatory staff and regulatory licensing process.

The WGRNR is the point of contact between the Multinational Design Evaluation Programme (MDEP) and the CNRA and is aimed to co-ordinate its work with the work performed by MDEP such that: it utilises its outputs and does not duplicate its efforts; extends the results of MDEP to other CNRA members.

3. Summary and Conclusions

The workshop was opened by a welcome address from the U.S.NRC Regional Administrator of Region 2, Victor McCree. A presentation about the on-going activities within NEA followed. Then, the vision and action plan of the Cooperation in Reactor Design Evaluation and Licensing (CORDEL) Working Group of the World Nuclear Association (WNA) have been presented. Subsequently, the U.S.NRC explained its strategies for licensing new reactors. Finally, to close the opening session, AIEA detailed its activities related to construction.

Regulatory cooperation on generic and design specific issues, MDEP working groups (EPR, AP1000), vendor inspection co-operation, digital I&C, and codes and standards

The following participants made remarks and presentations on MDEP focusing on on-going activities, major achievements and plans for the future.

- Gary Holahan, U.S.NRC, Deputy Director of the Office of New Reactors and Chairman of the MDEP, Steering Technical Committee

- Richard Rasmussen, U.S.NRC, Chief of the Electrical Vendor Inspection Branch in the office of New Reactors and member of the MDEP Vendor inspection cooperation working group

- Thomas Houdré, ASN, head of the nuclear power plant department and co-chair of the MDEP EPR working group

The MDEP representatives emphasised the support of MDEP Countries toward harmonization where safety will be enhanced. They also mentioned the benefits from MDEP cooperation in sharing documents and experience associated with design evaluation and in developing common position on certain topics, either on design specific topics or on generic issue where harmonization is needed (e.g. digital I&C, Nuclear Pressure Boundary Codes and Standards). It was also noted the benefit of identifying technical or regulatory divergences and understand their origin.

The industry representatives also provided their insights about new reactor activities, what reactor designers, operators/licensees, and representatives from standards development organizations are doing to promote standardization of designs and convergence of standards and what are their expectations toward MDEP to further enhance standardization of designs and convergence of standards:

- Andrew Wasylyk, WNA CORDEL, Codes and Standards Staff Director

- Richard Delong, Westinghouse, Director of International Licensing & Regulatory Support
- John Green, Westinghouse, Acting Manager of International Licensing Engineering
- François Bouteille, AREVA, Senior Vice-President Safety and Licensing within the Reactor and Services Business Group of AREVA
- Christian Raetzke, WNA CORDEL, Director of Licensing

The industry emphasised that they are embracing harmonisation to address new reactor issues and that they would hope that the regulators do the same. AREVA, Westinghouse and CORDEL described their efforts in maintaining standard design as much as possible to gain efficiency in licensing, constructing and operating new nuclear power plant worldwide. They considered that MDEP work was valuable, but should be pursed further to avoid differences in the design driven by differing regulatory requirements. The need that the regulators identify areas where convergence is not likely to be reached was also underlined. Cooperation between regulators involved in licensing of aircraft was mentioned as an example to be followed.

The following participants took part in the panel discussion:

- Gary Holahan, U.S.NRC, Deputy Director of the Office of New Reactors and Chairman of the MDEP, Steering Technical Committee
- Richard Rasmussen, U.S.NRC, Chief of the Electrical Vendor Inspection Branch in the office of New Reactors and member of the MDEP Vendor inspection cooperation working group
- Thomas Houdré, ASN, head of the nuclear power plant department and co-chair of the MDEP EPR working group
- Richard Delong, Westinghouse, Director of International Licensing & Regulatory Support
- Xavier Pouget-Abadie, EDF, International Safety Delegate in the Nuclear Engineering Division
- Christian Raetzke, WNA CORDEL, Director of Licensing
- John Waddington, WNA CORDEL, Director of Strategy

Some common themes emerged in the panel discussion based on the questions raised and the answers that followed. It was commonly agreed that harmonization was a long term goal and that significant progress has been made. However, this long term objective needs to be associated with short term measurable steps. To do so, MDEP approach to tackle on one side with specific technical subjects and to strive harmonisation on generic topics was considered appropriate. Regarding codes and standards, there was a general agreement that convergence on technical requirements is more realistic than harmonization of codes and standard; the participants acknowledged that concrete short term steps could be achieved. The report to be issued by the CORDEL on the comparison aviation-nuclear was discussed: the differences in the legislative and regulatory framework on the nuclear field were underlined (e.g. no high level binding common requirements), but the participants agreed that it should be studied to identify potential areas for increase multilateral cooperation and convergence.

Regulatory positions on siting practices and enhancements as a result of lessons learned from Fukushima accident

The Session featured five presentations, followed by a Panel discussion.

- Regulation of Site Selection and Preparation; Status of Siting Survey – Supplement 2.

The Survey that has already been published as NEA/CNRA/R(2010)3 was being re-visited in light of the Fukushima accident. The initial results had not shown that any countries had revised the design basis for external events, though some were considering moving to lower frequencies, particularly for seismic events. Most countries were considering deriving requirements to address combinations of events (consequential, not simultaneous). There is a movement towards analyzing for 'cliff-edge' events, where a small increase in magnitude beyond the design basis may cause a large increase in consequence. All felt that periodic re-evaluation of sites were necessary to re-characterize external hazards. For multi-unit sites, all were aware of the need to consider the impact of an external event on all units or of one unit on another, though none had imposed a limit on the number of units permitted on a site or had moved to consider the overall risk posed to the public and environment by the site as a whole. The ability to access the site following damage to the surrounding infrastructure is of common interest. Emergency preparedness is not being considered at the siting stage. The overall conclusion is that it is perhaps too soon after the accident for requirements/expectations to have been revised, since most countries are still absorbing the lessons from the accident.

- EIA Process and Siting of Temelin 3&4.

It is proposed to construct two new reactors alongside the operating reactors at the site in the south of the Czech Republic. Three designs are being considered (AP1000, EPR and MIR) with construction due to start in 2017. The EIA is continuing using a 'plant parameter envelope' approach. This has included evaluating the site characteristics and confirming acceptability against the siting criteria. Since the site is not new, available data was used, updated and expanded as available. The methods of evaluation were verified and upgraded, with a focus on seismic hazard, including performing some paleoseismic research. An IAEA mission was requested to review and verify the seismic hazard re-evaluation and validation. The site preparation quality assurance programme has also been evaluated, as has the need for physical protection. One unique element to the public consultation programme is the legal requirement to consult neighbouring countries, some of which are quite anti-nuclear, and address their concerns. As a result, public meetings were held in Germany and Austria. It was found very difficult to engage the neutral or pro-nuclear public who, according to polls, want the project to go ahead.

- Environmental Insights from Siting New Nuclear Power Plants in the United States.

This described the Part 52 combined licence review process, under which a design certification and an early site permit can come together to allow a limited work authorization to be issued for pre-construction work while the combined Construction and Operation Licence (COL) application is being considered by the regulator. The regulatory then performs ITAAC (Inspection, Test, Analysis, Acceptance Criteria) to verify that the as-build plant conforms to what was licensed. The Siting Safety Review that is performed under the COL process considers factors such as geology, surface faulting, seismology, geotechnical engineering, hydrology, flooding and groundwater. For an existing site, this involves updating the hazard evaluation from the original one. Dose consequence calculations are performed for both design basis accidents and severe accidents. Experience with siting has shown that all applicants deviate from the guidance, that it is difficult to compare existing sites with new sites, that water supply is a bigger issue now than it was for existing reactors and that site selection can come down to a choice 'among the best', rather than the 'best possible'. Consideration of alternative sites is a big part of the process; the U.S.NRC can reject a primary site if an alternative site appears to be more appropriate, though it cannot force an applicant to select a secondary site.

- Siting Practices and Site Licensing Process for New Reactors in Canada.

Site evaluation is not federally regulated in Canada but should be done by the applicant prior to submitting an application, to confirm suitability for the full lifecycle of the facility. This includes the impact of external events on the site and of the site on the environment. Site evaluation information is then expected to be kept up-to-date for the life of the facility. Regulatory guidance has not been substantially revised post-Fukushima but clarification is being added regarding the need to consider multiple and simultaneous severe external events or reactor accidents, also that earlier discussions are needed on emergency planning to prepare for extreme events. The CNSC does not specify return frequencies for external events to be considered when characterizing a site but expects the applicant to justify its approach and rationale, following best practices where they exist.

- New Reactor Siting in Finland, Hanhikivi Site in Pyhäjoki.

STUK has performed a preliminary assessment of the Decision-in-Principle on the Fennovoima application. A variety of factors must be considered in the selection of a site, including effects of the site on the plant design and the effects of the plant on the site environment. These include external hazards, both natural and human-induced. Since this is a new site, an extensive siting process is followed, that can include an EIA. A site survey is performed to identify candidate sites, after investigating a large region and rejecting unsuitable sites. The remaining sites are then screened and compared on the basis of safety and other considerations to select one or more preferred sites. Natural hazards include geology, seismology, hydrology and meteorology. Offshore ice will be a particular hazard for this plant, since the site is on average only 1.5m above sea level. The design basis earthquake corresponds to a return frequency of 100,000 years, with 50 % confidence. The existing sites in southern Finland used a design peak ground acceleration of 0.1g with the ground response spectrum maximum at 10Hz. The candidate sites in northern Finland will require a peak ground acceleration of 0.2g with the ground response spectrum maximum at 25Hz.

Panel Discussion then touched upon topics like:

- Multi-agency coordination and communication and the need for clear roles and responsibilities.
- Societal acceptability, public consultation; which organizations do it and how.
- Updating external hazard studies for existing sites; characterizations and return frequencies.
- Processes for environmental assessments and how to compare across varying local conditions.

Construction experience and regulatory oversight of new reactor construction activities

The session was devoted to discuss relevant aspects related to the construction of current nuclear construction projects with the main objective of learn from the past experience to improve future projects.

The session was co-chaired by Janne Nevalainen (STUK) and Jose Balmisa (CSN). The speakers in this session were the following individuals:

- Thomas Houdré, ASN, Head of the Nuclear Power Plant Department
- Seon Ho Song, KINS, Shin-Kori Units 3&4 Project Manager
- Richard Rasmussen, U.S.NRC, Chief of the Electrical Vendor Inspection Branch in the Office of New Reactors
- Greg Kaser, WNA, Senior Project Manager
- Laura Dudes, U.S.NRC, Director, Division of Construction Inspection and Operational Programs (DCIP)

First, a summary of the activities of the NEA WGRNR was introduced to the audience. In particular the following tasks related to the ConEx (Construction Experience Program) were presented:

- Development of the event construction database ConEx,
- ConEx procedure for program management,
- Conclusions of the ConEx synthesis first report on lessons learned during construction,
- Potential ConEx program uses for operating experience, training, etc.

Some industry members asked about the possibility of having access to the events of the database and the relationship between the ConEx events and the IRS (Incident Reporting System).

To answer the question about the relationship between IRS and ConEx, WGRNR representatives indicated that the ConEx database is specific and it is focused on events detected at any time during the life cycle of the plant but that happened before the first fuel load. This is the main feature of the ConEx database and the main difference with the IRS database. However, it was noted that the fields of the database have been made fully compatible with the IRS so they can be combined or merged at any time.

Related to the possibility of the industry of having access to the database, it was noted that currently the database is under development, being in a state of consolidation by increasing the number of events in it. Up to now the main contributors to the database are France, USA, Finland and Canada and it is the intention of the group to involve more actively other countries, currently in the group, such as Korea, India and other not in the group such as Russia and China.

Mr. Houdré made a presentation on the status of the construction of Flamanville 3. He provided detailed information regarding oversight activities by ASN, the transition from design to construction and the use of hold points during construction, supervision and regulation applicable to the design and manufacture of pressure components, ASN human resources devoted to the oversight of Flamanville 3 and the Flamanville 3 inspection program and experience feedback process.

Mr. Song presented the regulatory approach for the oversight of the APR 1400. He first introduced the licensing system in Korea and after that he described the inspection program during the construction and commissioning, operation and finally decommissioning phase. Mr. Song put special emphasis on the installation inspection (52 items), cold functional inspections (77 items), hydrostatic and hot functional test inspection (23 items) and initial fuel loading and startup test inspections (33 items).

Mr. Rasmussen made a presentation on the domestic and international construction experience sources. From the domestic (USA) point of view, the sources are event notifications, non-compliance reports, inspection reports, etc. Internationally, Mr. Rasmussen highlighted the following sources: IRS and ConEx reports, Nuclear Events Web Based System (NEWS), bilateral agreements, MDEP, etc. He also mentioned and described briefly reported on concrete, rebar, fabrication and digital issues.

The two final panelists were Mr. Kaser and Ms. Dudes. Mr. Kaser made a presentation about the project risks and how to mitigate major risks and structure a new project. Mr. Kaser also talked about the contract implications to handle the specificities of a new project: design complexities, interface between the engineering, procurement and constructing contractors, and finally he talked about the necessity of a stable regulatory environment and the role of government.

Ms. Dudes' presentation dealt with the new task force created under the umbrella of the CNRA (NEA) to cope with the emergent and safety relevant issues of non-conforming, counterfeit, fraudulent and suspect items (NCFSI). Ms. Dudes talked about what are the causal factors and challenges faced related to these problems and what are some of the main improvements and recommendations to cope with it such as: methods for inspecting NCFSI, review regulatory requirements and to work on international groups such as the WGIP and WGOE on these issues.

During the discussion of the session, some regulators and industry participants indicated the need to foster information exchange regarding construction operating experience in order to avoid recurrence of these types of events. It was also noted by the participants, that all that countries constructing new nuclear power plants, should be able to report on construction events. Besides that, some participants encouraged NEA to broaden the potential users of the database by including industry, utilities, including the supply chain members. There is a need to publish an update of ConEx synthesis first report on lessons learned during construction.

Lessons learned from regulatory licensing reviews of new reactor designs

Session IV was focused on lessons learned from regulatory licensing reviews of new reactor designs. This session started with a presentation by Mr. Steve Gibson (ONR, UK) on the NEA/CNRA report of the survey on the review of new reactor application. Mr. Gibson indicated that licensing is state specific and that timelines vary from 6 months to 4 years. In addition, review effort and documentation is significant and most states have explicit guidance for the reviews. All states include some form of public participation and regulatory oversight. Next steps include two reports, one on design reviews and another on the construction phase. Mr. Gibson also presented on licensing experience in the United Kingdom. He highlighted the importance of several practices for ensuring a successful project, including: early engagement and communication between applicant and regulatory, sharing of plans between applicant and regulator, establishing and monitoring good metrics on progress and quality for both the applicant and the regulator, identifying "work streams" and monitoring those streams closely, identifying and addressing risks, ensuring high quality interactions between applicant and regulator, and using dashboards as a way to maintain openness, transparency and trust. He also emphasized the need for engagement at different levels within the organization, including management as necessary.

Mr. Paul Wong (CNSC, Canada) followed with a presentation on lessons learned from Canadian pre-project design review. Mr. Wong provided an overview of the Canadian legislative and regulatory framework and the pre-licensing review process. He highlighted 12 lessons learned from design reviews, including incomplete project quality assurance program, lack of definition of design management process, lack of implementing procedures, weaknesses in considerations of interconnections between systems, non-conformances related to control of design, and difficulties in addressing the functions and responsibilities of the design authority.

Mr. Wong was followed by Mr. John Waddington (WNA/CORDEL, Canada) who presented on design change management in the regulation of nuclear fleets. Mr. Waddington's presentation covered activities of the WNA/CORDEL/Design Change Management Task Force, including views on the roles of vendors, owner's groups, utility and design authority, WANO and the regulators. The presentation highlighted differences of capabilities between large utilities with strong technical staff and smaller utilities that require support and expertise from others. It also noted the current expectation that licensees are solely responsible for the safety of the design and operation of their plants and for maintaining a full understanding and knowledge of the design within licensee's own organization in an internal entity called design authority. Mr. Waddington encouraged regulators to re-examine this expectation for design changes, arguing that while large utilities maybe be able to deal with design changes, the smaller utilities may be challenged due to their small size and lack of appropriate expertise. He further noted that the original designer must be involved in the management of design changes. In addition, the presentation emphasized benefits of standardization in design and regulatory expectations internationally, including the benefits of increasing safety and economy. Mr. Waddington provided that the CORDEL Working Group uses international standardization to mean that each vendor's design can be built by a vendor, and ordered by a utility, in every country and be able to meet national regulations without significant changes other than adaptations to meet site requirements. In this discussion, he highlighted the aircraft industry as an example and noted the need for internationally agreed mechanisms for design change as well as the need for formal, agreed (internationally) role for the designer to play throughout the fleet lifetime.

Mr. Thomas Houdré (ASN, France) led the next presentation on licensing experience for EPR Flamanville 3. Mr. Houdré discussed the three stages of the process: the political decision to build a new nuclear power plant, the authorization decree for nuclear power plant creation/construction license, and the commission and operation license. He noted that the operating license process requires the operator to submit the safety analysis report, the general operating rules, a study on waste management, the onsite emergency plan, and an update, as necessary of the decommissioning plan and the environmental impact assessment. Mr. Houdré followed with a discussion on the licensing of the Flamanville 3 EPR reactor. He noted that Flamanville 3 licensing was a longstanding and continuous process taking 18 years for the 3 main steps (1989 to 2007) and resulting in the authorization decree. He described the safety objectives utilized in the process, the integration of recent operating experience, innovations, and design and manufacturing. He also highlighted several examples of modifications that resulted from the technical assessment supporting the authorization decree, including diversification of emergency electrical supply, practical elimination of fuel melt in the fuel pool, and diversification of heat sink and essential service water system. He reviewed the contents of the authorization decree. Next, Mr. Houdré discussed current on-going activities and milestones related to commissioning and operating license application and noted that current ASN/IRSN review activities are focused on a number of topics, including accident studies, I&C, protection system, internal and external events, detailed design of systems playing a safety role as supporting systems, equipment qualification to accident conditions, radiological consequences, several accident management, probabilistic studies, and several other topics. Mr. Houdré explained that a "focusing" review principle is used to inform the level of review for each topic. This principle is used to choose the SSCs that will be assessed in detail. The principle considers defence in depth; follow up of assessment performed before Flamanville 3 authorization decree; new technologies use for EPR; feedback from French and German design, operating French nuclear power plants, Konvoi, etc.; and feedback from international cooperation.

Mr. Mohammed Shuaibi (NRC, USA) followed with a presentation on new reactor licensing status and lessons learned in the USA. The presentation covered a status of licensing for large lightwater reactors in the USA and insights and lessons learned from licensing reviews and on-going construction activities. In the area of lessons learned, Mr. Shuaibi highlighted the importance of pre-application interactions between applicants and the regulator. He noted that early interactions and reviews are important for major policy and technical issues and areas where research may be needed. He highlighted the importance of communication, the success of onsight audits of detailed calculations and analyses, and the importance for applicants and regulators to be aware of issues arising on similar applications domestically and internationally. He next discussed the importance of translation of design into construction documents as well as the need to ensure that construction is conducted in accordance with the licensing basis, especially under the U.S. one-step licensing process. Mr. Shuaibi also provided a discussion on new processes being implemented to address the need for changes during construction. These include a preliminary amendment request process by which the licensee could seek a no objection letter from the regulator to proceeding with installing and testing a proposed change pending U.S.NRC's review of the license amendment request. He also discussed the use of pre-submittal meetings with licensees on draft amendment requests in order to provide feedback and expedite the review of the amendments when submitted. Mr. Shuaibi noted the on-going work to address Fukushima lessons learned. He concluded by noting that the U.S.NRC has initiated a comprehensive review to identify best practices and potential enhancements to its new reactor licensing processes and that a report should be published in early 2013.

Mr. Christian Raetzke (WNA CORDEL, Germany) provided a presentation on licensing and permitting practices – views of the international nuclear industry. Mr. Raetzke provided an overview of a survey by WNA on licensing that was completed in September 2012. He explained that responses to the survey were received from utilities, vendors and architect engineer firms across 4 continents. Mr. Raetzke noted that all nuclear stakeholders agree that safety and security is paramount in any licensing process. He also noted that the survey focuses the interaction of regulatory process with the industry's commercial activities, such as procurement, contracting, and finance. The results of the survey indicate that one licensing model does not fit all and that the regulatory, political and economic environments are very diverse across countries. Mr. Raetzke highlighted differences and some pros and cons for one-step and two-or multi-step licensing. He also highlighted the importance of pre-licensing activities. He noted that vendor and site selection are also different and can be commercial or government influenced. Regarding contracting, the survey indicates that it is not practical to develop or advocate for standardization because of the diversity of factors driving commercial considerations. Regarding financing, he highlighted the importance of a clear and predictable licensing regime to the availability of financing. Mr. Raetzke concluded by noting that international harmonization of safety requirements and standardization of designs would greatly facilitate licensing, although there still remains a long way to go in that regard.

The session concluded with a dialogue of questions and answers, many of which focused on design authority capability and standardization.

Conclusions

In general workshop participants agreed on the need to regularly have this type of forum to discuss relevant regulatory issues for new builds. One important aspect of this workshop was the participation of "New Entrants". The interaction between NEA member countries with mature nuclear power plants and newcomers was quite important since it gave newcomers the possibility to benefit of mature international practices in order to focus their regulatory oversight and control. NEA members could also benefit from insights the New Entrants discover as they develop or enhance their regulatory controls. In addition technical exchanges associated with construction experience of New Entrants as they begin to license, build and operate NPP could benefit NEA members.

WGRNR chair reported to CNRA on the main workshop conclusions:

- Harmonization is a long term goal and significant progress has been made. However, this long term objective needs to be associated with short term measurable steps;
- MDEP approach to tackle on one side with specific technical subjects, and to strive harmonisation on generic topics was considered appropriate;
- Convergence on technical requirements is more realistic than harmonization of codes and standard;
- Beneficial early engagement of different stakeholders specially at the siting stage has been acknowledged;
- Need to characterise the hazards and to keep updated the safety assessment (PSR);
- Land use issues are important particularly after Fukushima;
- Commissioning aspects (e.g. training aspects for inspectors) should be addressed by WGRNR taking into account MDEP interaction;
- Importance of WGRNR ConEx Programme: construction experience sharing is a leverage for quality and so for a future safe operation of NPPs;
- Capability of licensee to follow the responsibility of design changes (could be an issue for small utilities);
- Importance of Periodic Safety Reviews to review and account for the design.

It is recommended that the WGRNR convenes a third conference in about two years time (2014-2015).

2nd CNRA International Workshop on "New Reactor Siting, Licensing and Construction Experience"
Atlanta, U.S.A. 24-26 October 2012

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CORDEL Vision and Action Plan
Christian Raetzke, World Nuclear Association

Strategies for Licensing New Reactors - Expectations and Experience
Gary Holahan, U.S.NRC

IAEA Activities Related to Construction
Stephen Koenick, IAEA

NEA OECD

Integrated NEA Response to the Fukushima Dai-ichi NPP Accident

Mr. Javier Reig
Director, Nuclear Safety Division
OECD Nuclear Energy Agency

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NEA OECD

Outline

- NEA support to Japanese Government
- NEA Integrated Response to the Fukushima Dai-ichi Accident
- Ongoing Activities in Response to Fukushima Daiichi within CSNI, CNRA and CRPPH

NEA Actions in Response to Fukushima Daiichi Accident – October 2012

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NEA Cross-committee Topical Areas

		CNRA	CRPPH	CSNI
1.	Accident Management and Progression			
	a. TRANSITION: Review of on-site accident management programmes and procedures to address the transitional conduct of operations from normal to accident conditions to severe accident conditions, and to the implementation of protective measures under the emergency preparedness plans. This includes onsite and offsite decision-making processes.	L	S	S
	b. ACCIDENT PROGRESSION: Enhanced understanding of accident progression analyses methods and techniques.	S	S	L
	c. HUMAN PERFORMANCE: Human and organisational performance issues under accident response conditions.	S	S	L
	d. OFFSITE: Improvement of offsite emergency preparedness by sharing knowledge on core melt accident progression and source term quantification to improve offsite emergency procedures and technical tools.	S	L	S
2.	Crisis or Emergency Communications (primary information exchange between CNRA and CRPPH)			
	a. PUBLIC: Communication with the public, media and other stakeholders including Japanese organisations.	L	S	
	b. REGULATORS: Communication with the regulators in other countries and with international organisations, such as the International Atomic Energy Agency (IAEA) and the Inter-Agency Committee on Radiological and Nuclear Emergencies (IACRNE).	L	L	
	c. ONSITE OFFSITE: Crisis communications between onsite and offsite emergency response organisations.	L	L	
3.	Reassessment of Defence-in-Depth	S		L
4.	Evaluating the methodologies for defining and assessing initiating internal and external events, including coupled, as well as methodologies defining the design basis criteria	S		L
5.	Reassessment of Operating Experience and prior opportunities to identify or address conditions that coul challenge nuclear safety.			
	a. OPE: Evaluation of operating experience for events that may be precursors to future events that could challenge the safety of nuclear power plants given the insights from Fukushima.	L		S
	b. RESEARCH: Review and gap analysis of safety research relevant to the analysis of the accident	S		L
6.	Balancing deterministic and probabilistic approaches to regulatory decision making	L		S
7.	Regulatory Infrastructure	L		
8.	Radiological Protection and Health Physics		L	
9.	Decontamination and recovery (onsite and offsite)		L	

NEA Actions in Response to Fukushima Daiichi Accident – October 2012 3

NEA Ongoing Activities within NEA

CSNI

- Working Group on Accident Management and Analysis (WGAMA)
  - WGAMA F-CAPS (2012)1 – Position paper on filtered containment venting
  - WGAMA F-CAPS (2012)2 - International benchmarking project on fast-running software tools used to model fission product releases during accidents at nuclear power plants
  - *WGAMA is discussing a possible additional new task on hydrogen generation and mitigation*
- Working Group on Human and Organisational Factors (WGHOF)
  - WGHOF F-CAPS (2012)1 – Human performance and intervention under extreme conditions

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NEA Actions in Response to Fukushima Daiichi Accident – October 2012

Ongoing Activities within NEA

CSNI Cont'd

- **Working Group on Integrity of Components and Structures (WGIAGE)**
  - WGIAGE F-CAPS (2012)2 – Metallic component margins under high seismic loads (MECOS)
- **Working Group on Risk Assessment (WGRISK)**
  - WGRISK F-CAPS (2012)1 – Workshop on PSA of natural external events including earthquakes
- **Other ongoing work within CSNI includes:**
  - A discussion paper on Defence-in-Depth to identifying future technical topics (joint effort with CNRA)
  - Re-constitution of DiDELSYS TG to investigate the issue of electrical system robustness in light of Fukushima

NEA Actions in Response to Fukushima Daiichi Accident – October 2012 5

Ongoing Activities within NEA

Safety Research/Joint Projects

- Importance of future safety research has been highlighted in the CSNI Concept Paper, CNRA STG Recommendations to CNRA and other supporting strategy/policy documents
- New safety research will be identified using a phased approach within NEA:
  - Comprehensive review of past safety research - done
  - Gap analysis based on research issues from Fukushima – ongoing
  - CSNI review of research direction – ongoing
- Joint international research project being established: *Benchmark Study of the Accident at the Fukushima Daiichi NPS (BSAF Project)*

NEA Actions in Response to Fukushima Daiichi Accident – October 2012 6

NEA

Ongoing Activities within NEA

OECD

CNRA

❖ CNRA Senior Task Group on Impacts of Fukushima Daiichi Accident (STG-FUKU)

- Established to coordinate CNRA and ultimately cross-committee response to Fukushima Daiichi accident
- Discuss regulatory issues (i.e., Defence-in-Depth)

❖ Working Group on Operating Experience (WGOE)

- Task on pre-cursor events - evaluation of various initiators and situations for new lessons in light of the Fukushima Daiichi accident and improvements in implementing lessons learnt. WGRISK to cooperate in a risk analysis of precursor events exercise

NEA Actions in Response to Fukushima Daiichi Accident – October 2012

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NEA

Ongoing Activities within NEA

OECD

CNRA Cont'd

❖ New Task Group on Accident Management established

- Enhancements of on-site accident management procedures
- Decision-making and guiding principles in emergency situations
- Guidance for instrumentation, equipment and supplies for addressing long-term aspects of accident management
- Guidance when taking extreme measures for AM

NEA Actions in Response to Fukushima Daiichi Accident – October 2012

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Ongoing Activities within NEA

CNRA Cont'd

❖ **Working Group on Public Communication (WGPC)**

- Completed workshop on Crisis Communication (Madrid, May 2012)

❖ **Safety of Research Reactors Task Group (SORRTG)**

- Task on peer review workshop of country comprehensive safety assessments (stress tests) of high risk RR facilities.

NEA Actions in Response to Fukushima Daiichi Accident – October 2012 9

Ongoing Activities within NEA

CRPPH

- Established Expert Group on Radiological Protection Aspects of the Fukushima NPP Accident (EG-RPF)
  - Sub-group on criteria for trade in food and commodities after a nuclear accident
  - Survey on recovery lessons learned
- Working Party on Nuclear Emergency Matters (WPNEM)
  - ✓ INEX 4 evaluation report and workshop planning
  - ✓ EGIRES report on optimization in emergency preparedness and response with special focus on reference levels
  - ✓ Update of report on Short-term Countermeasures in Case of a Nuclear or Radiological Emergency (2003)
  - ✓ Survey on emergency management lessons learned

NEA Actions in Response to Fukushima Daiichi Accident – October 2012 10

Ongoing Activities within NEA

CRPPH

- Information System on Occupational Exposure (ISOE) Expert Group on Severe Accident Management (EG-SAM)
  - ✓ Lesson learned in management of occupational exposure in high radiation areas
- Other CRPPH Activities
  - ✓ Support to Japanese government workshops on decontamination and recovery and other technical topics

NEA Actions in Response to Fukushima Daiichi Accident – October 2012 11

Thank you for your attention

The OECD Nuclear Energy Agency
http://www.oecd-nea.org/

AEN NEA NUCLEAR ENERGY AGENCY OECD

2nd CNRA International Workshop on New Reactor Siting, Licensing and Construction Experience

24-26 October 2012

Laura Dudes, Workshop Chair
Steve Gibson, WGRNR Chair
Alejandro Huerta, NEA Secretariat

AEN NEA NUCLEAR ENERGY AGENCY OECD

Working Group On Regulation of New Reactors Mandate

The Working Group on Regulation of New Reactors (WGRNR) shall be responsible for the programme of work in the CNRA dealing with regulatory activities in the primary program areas of siting, licensing and oversight for new commercial nuclear power reactors (Generation III+ and Generation IV reactors). The working group shall constitute an international forum for exchanging information and experience and with the agreement of CNRA and will plan its work to ensure improvements in nuclear safety through more effective and efficient regulation. In order to accomplish this prime objective the working group shall:

- Constitute a forum of experts for the licensing of new NPP
- Coordinate its work with the work performed by MDEP
- Closely coordinate its work with others CNRA and CSNI WGs

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AEN NEA NUCLEAR ENERGY AGENCY OECD

Program of Work

- Construction Experience
- Siting Practices
- Licensing Processes

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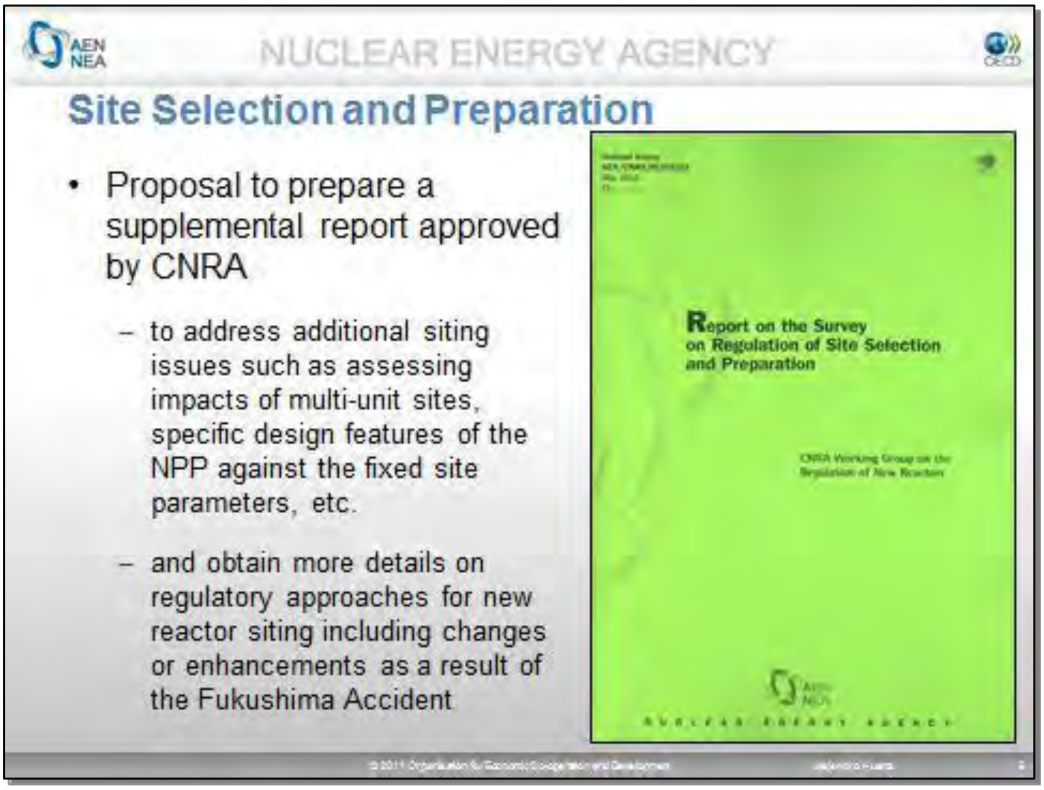
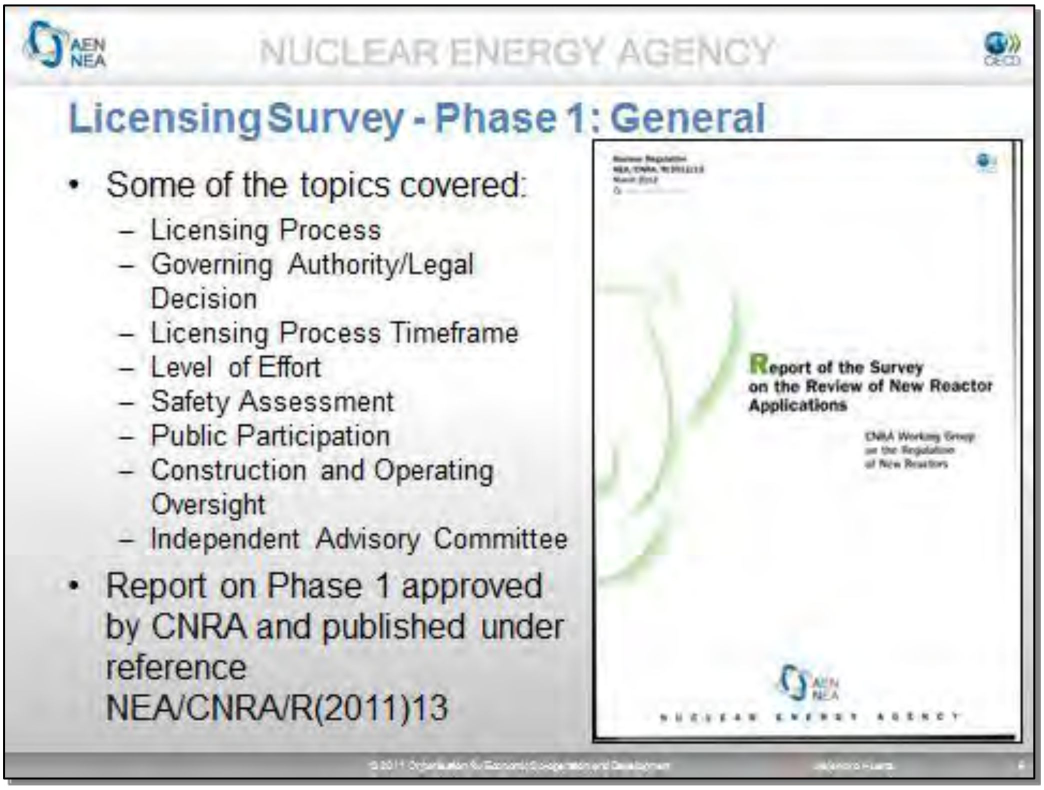
ConEx Programme

- First ConEx synthetic report (2008-2011) published
- Reinforce the Database: populate with events, QA ConEx group
- ConEx group will draft a 2nd report on event lessons learned 2011-2012
- Proposals
  - Friendly learning "Safety Cards" from new events
  - Table matching Construction Inspections and events lessons learned


First Construction Experience Synthesis Report 2008-2011

NUCLEAR ENERGY AGENCY


AEN NEA
NUCLEAR ENERGY AGENCY
OECD
Site Selection and Preparation
• Proposal to prepare a supplemental report approved by CNRA
– to address additional siting issues such as assessing impacts of multi-unit sites, specific design features of the NPP against the fixed site parameters, etc.
– and obtain more details on regulatory approaches for new reactor siting including changes or enhancements as a result of the Fukushima Accident
Report on the Survey on Regulation of Site Selection and Preparation
NUCLEAR ENERGY AGENCY


AEN NEA
NUCLEAR ENERGY AGENCY
OECD
Licensing Survey - Phase 1: General
• Some of the topics covered:
– Licensing Process
– Governing Authority/Legal Decision
– Licensing Process Timeframe
– Level of Effort
– Safety Assessment
– Public Participation
– Construction and Operating Oversight
– Independent Advisory Committee
• Report on Phase 1 approved by CNRA and published under reference NEA/CNRA/R(2011)13
Report of the Survey on the Review of New Reactor Applications
NUCLEAR ENERGY AGENCY

NUCLEAR ENERGY AGENCY

2nd International WGRNR Workshop

- Main objective would be to provide a forum to exchange information in lessons learned from licensing and construction of new NPPs.
  - Session 1: Regulatory cooperation on MDEP generic and design specific working groups
  - Session 2: Regulatory positions on siting practices
  - Session 3: Construction experience and regulatory oversight of new reactor construction activities
  - Session 4: Lessons learned from regulatory licensing reviews of new reactor designs

NUCLEAR ENERGY AGENCY

On behalf of WGRNR:

Learning from others is a key to success and progress. As a result of this workshop, participants should have an understanding of the regulatory issues surrounding new reactors and common methodologies for addressing them.

Thank you for your attention

CORDEL Vision and Action Plan

Christian Raetzke
WNA CORDEL Director of Licensing

2nd CNRA International Workshop on New Reactor Siting, Licensing and Construction Experience

Atlanta, 24 to 26 October 2012

World Nuclear Association

Content

- **WNA CORDEL History and Vision**
- **CORDEL current activities**
- **Way forward**

2

World Nuclear Association

CORDEL Working Group

- Cooperation in Reactor Design Evaluation and Licensing Working Group
- Founded in 2007
- Main aim: promoting international standardization
- Membership:
  - all major vendors
  - utilities interested in new build
  - service companies
  - observers from international organisations

International Standardization

- Each vendor's design:
  - Can be ordered by a utility in every country
  - Without obligatory adaptation to specific national regulations
  - Taking into account only site specific adaptations
- Results in a number of worldwide fleets, each of the same design
- Needs to be supported by
  - Multinational licensing (mutual acceptance or joint licensing)
  - Harmonisation of safety requirements

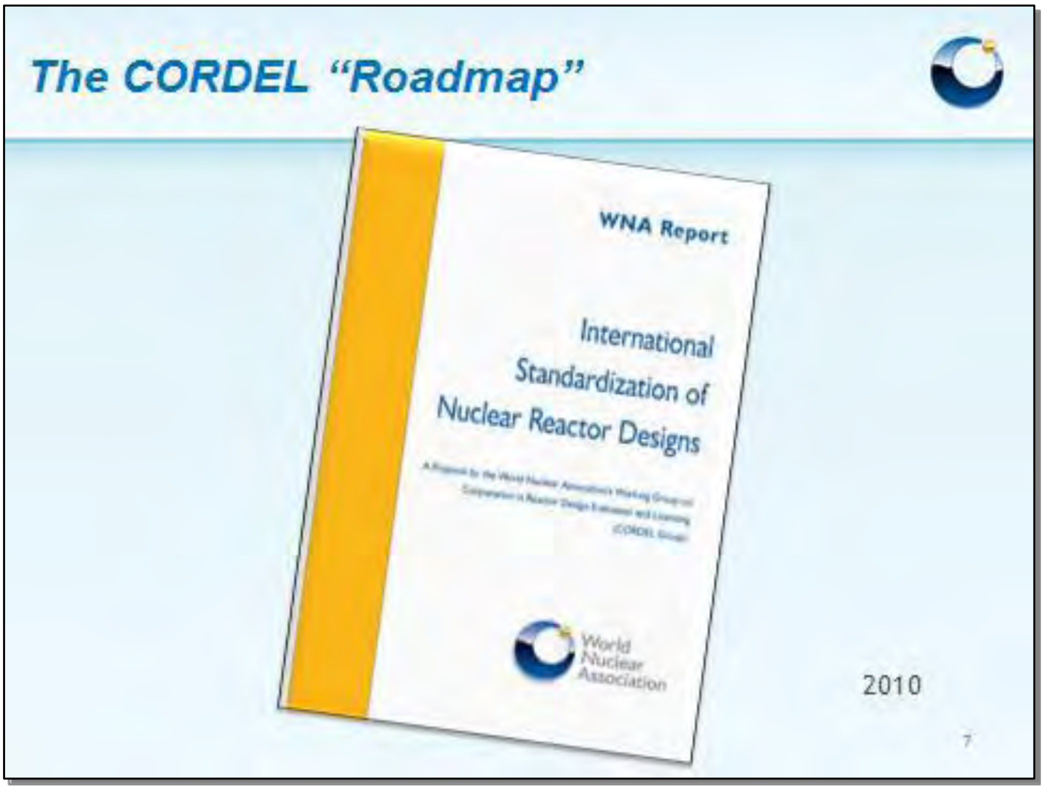
Benefits for safety and economics

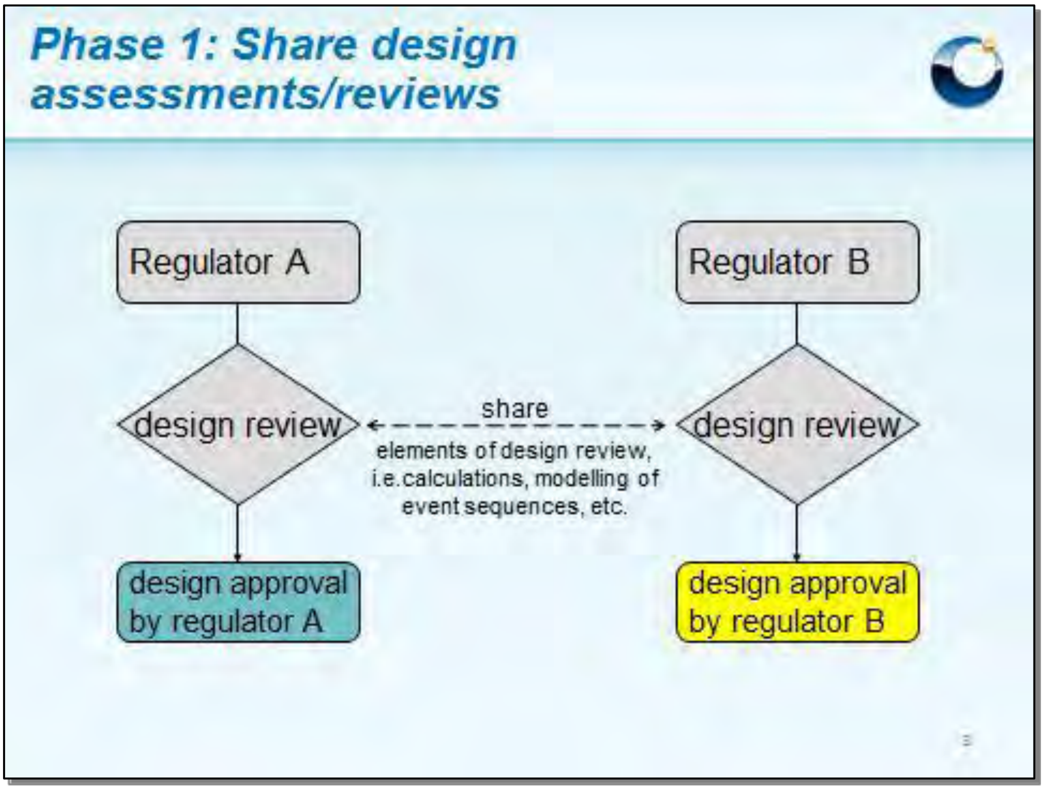
Safety benefits

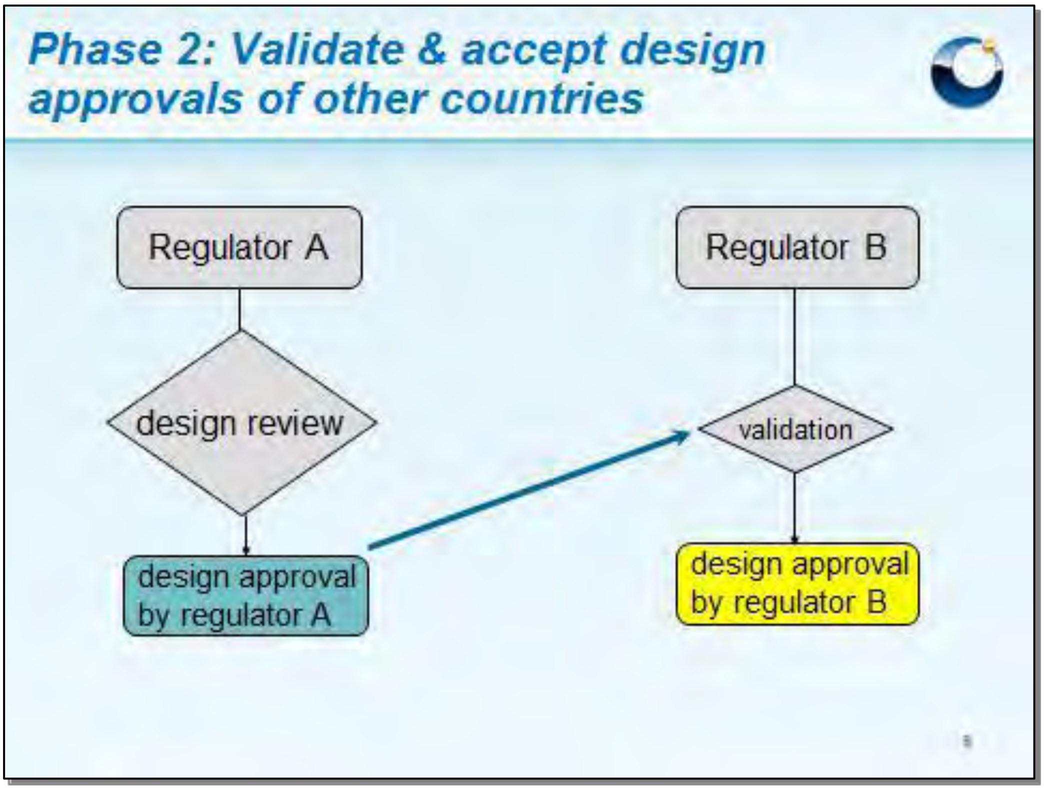
- Experience feedback:
  - Fleets of standardized designs offer a facilitated and broader basis for design, construction, and operation experience feedback,
- Design improvements:
  - Implemented across the fleet

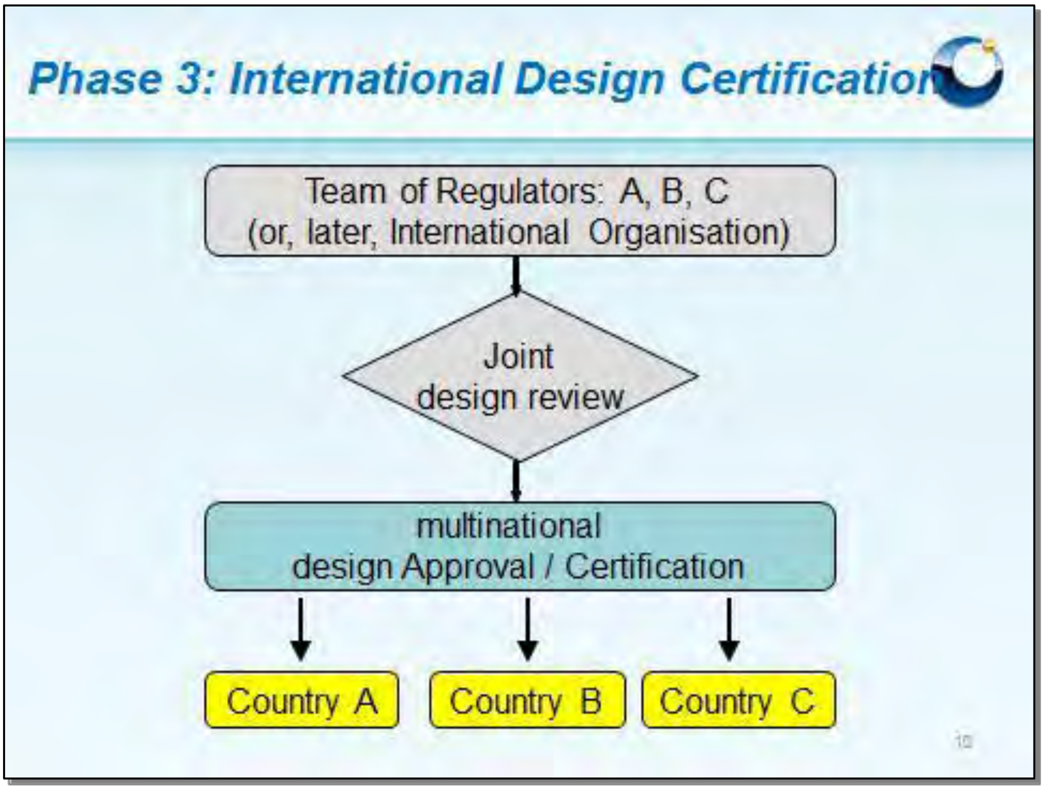
Enabling new build

- Licensing risk reduced
- Licensing processes shorter and more predictable
- Economies of scale


The CORDEL "Roadmap"
WNA Report
International Standardization of Nuclear Reactor Designs
World Nuclear Association
2010
7


Phase 1: Share design assessments/reviews
Regulator A
Regulator B
design review
share
design review
elements of design review, i.e. calculations, modelling of event sequences, etc.
design approval by regulator A
design approval by regulator B


Phase 2: Validate & accept design approvals of other countries
Regulator A
Regulator B
design review
validation
design approval by regulator A
design approval by regulator B


Phase 3: International Design Certification
Team of Regulators: A, B, C
(or, later, International Organisation)
Joint design review
multinational design Approval / Certification
Country A
Country B
Country C

Common characteristics

All steps

- Assume strong collaboration between sovereign and competent regulators
- Assist each regulator to acquire the necessary design knowledge
- Recognize the fact that each NPP project requires a national, sovereign, licensing process
- Do not change the fact that prime responsibility for safety lies with the operator

- WNA CORDEL History and Vision
- **CORDEL current activities**
- Way forward

CORDEL: From vision to practice

- January 2010: Publication of Roadmap
- CEO letter: 12 CEOs of the world's leading operating and vendor companies endorse the Roadmap in a letter to DG Amano (IAEA) and DG Echavarri (OECD-NEA)
- Fruitful discussion with stakeholders, e.g. at MDEP Conference
- After Strategy was defined: CORDEL went to work on those topics where action was most urgent

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CORDEL structure

TF Chairs : experts from WNA member companies

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IAEA safety standards revision Task Force

- Globalization implies greater use of IAEA Safety Standards and more effective IAEA Safety Standards
- Greater input from industry required than in the past
- CORDEL acknowledged by IAEA as industry interface
- Currently major focus is on review of Safety Classification of SSC (DS 367) (Applicability tests)
- Other current guides include DS456 Requirements on Leadership and Management for Safety, DS441 Construction of NPPs...
- Will also monitor safety guides revisions following lessons learned post Fukushima-Daiichi

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Probabilistic Safety Goals Task Force

- ➤ MDEP recognized importance of this issue
- ➤ Great relevance to industry
- ➤ Wide variety of PSA methods hinder internationalization
- ➤ TF will comment on and input to IAEA activities:
  - New TECDOC on Safety Goals
  - New TECDOC on Integrated Risk-Informed Decision Making

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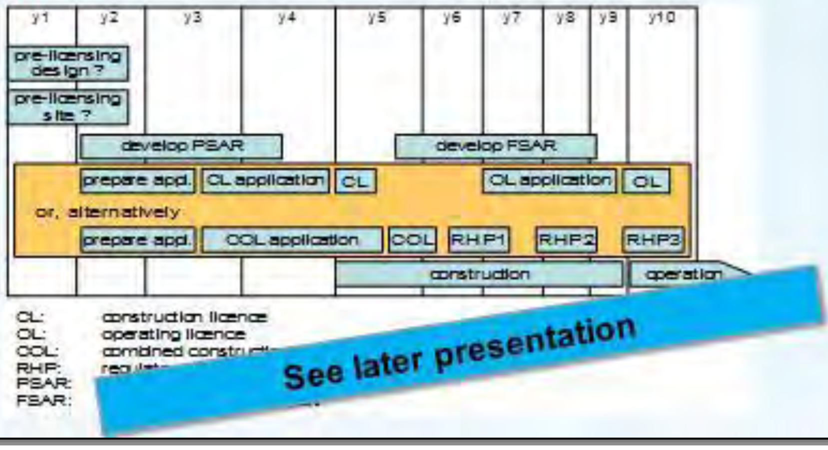
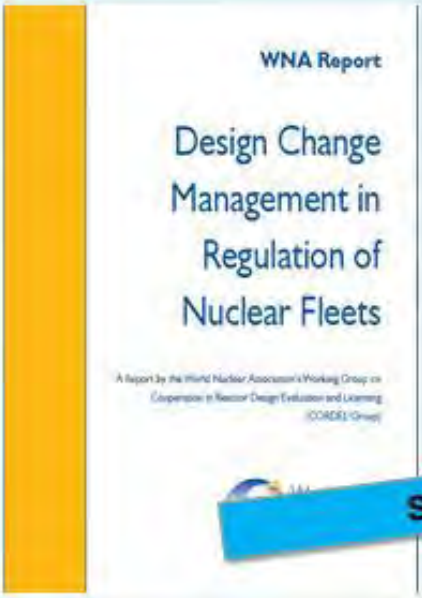
Licensing & Permitting Task Force

- Interface of licensing with commercial decisions: contracting, scheduling, procurement, financing….
- Report, based on a survey among WNA members, to be published soon



Design Change Management Task Force



- Standardization needs to be maintained throughout life
- How to maintain the Design Authority
- More responsibilities for vendors
- Enhanced role of Owners Groups: "best practices" identified

See later presentation

DCM Task Force: Aviation

- Lessons learned from aviation regulation
  - ► A dedicated task force has produced a comparison with aviation
  - ► Benchmarks identified
  - ► Report to be published soon

See later presentation

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CORDEL Codes & Standards Task Force

- Work towards international convergence of national nuclear codes
- Actively promote collaboration between SDOs, regulators and the nuclear industry (MDEP requested CORDEL to investigate code convergence)
- Limit future divergence of nuclear codes
- Further topics to be defined via Prioritization Survey

See later presentation

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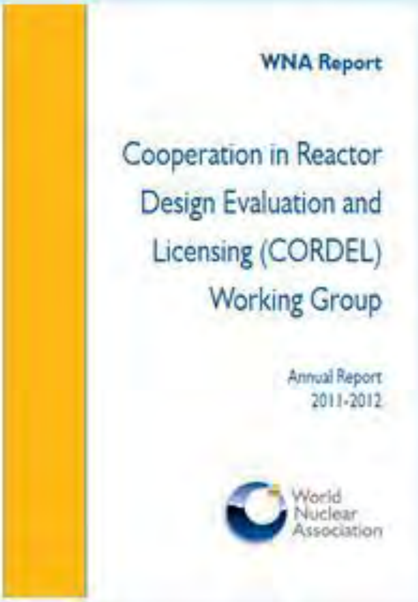
CORDEL Annual Report 2011-2012



WNA Report

Cooperation in Reactor Design Evaluation and Licensing (CORDEL) Working Group

Annual Report 2011-2012

World Nuclear Association

- WNA CORDEL History and Vision
- CORDEL current activities
- **Way forward**

Revision of CORDEL Roadmap

What happened since January 2010?

- Fukushima
- Ongoing financial crisis
- Investment environment for NPPs more and more difficult

  ► Standardization and joint licensing more necessary than ever to

  - Improve safety
  - Regain public trust
  - Reduce costs

- Discussion on SMRs became more intense

  ► New opportunities for CORDEL concept?

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Developments in licensing worldwide

- MDEP is constantly improving cooperation, but not yet making a „quantum leap" forward
- For newcomer countries, „import" of technology and regulation based on IGAs (inter-governmental agreements) is more and more common
- The EU has picked up on the issue; the ERDA (European Reactor Design Acceptance) Report was finalised in August 2012

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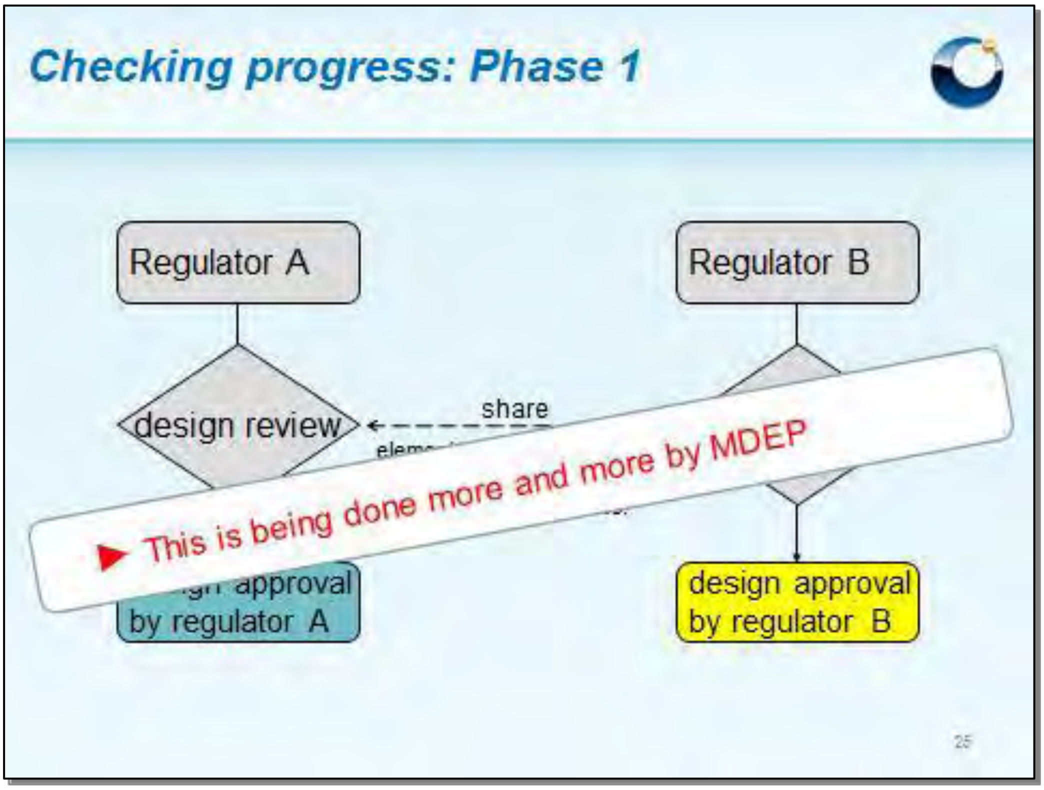
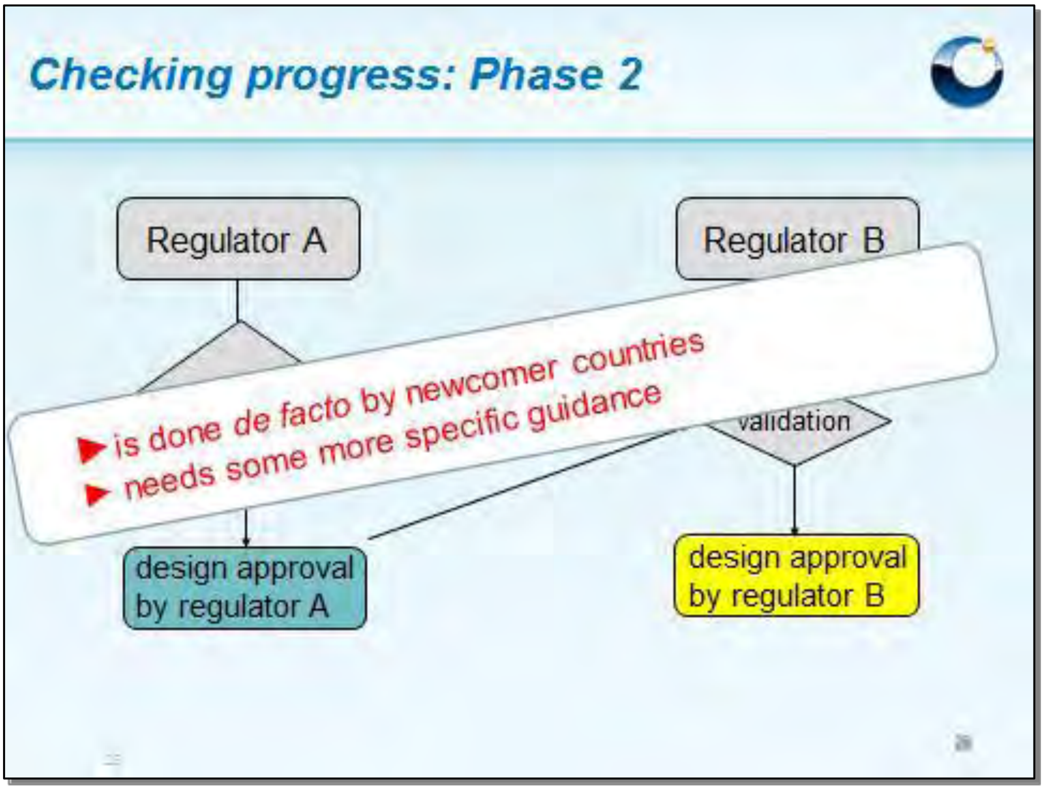
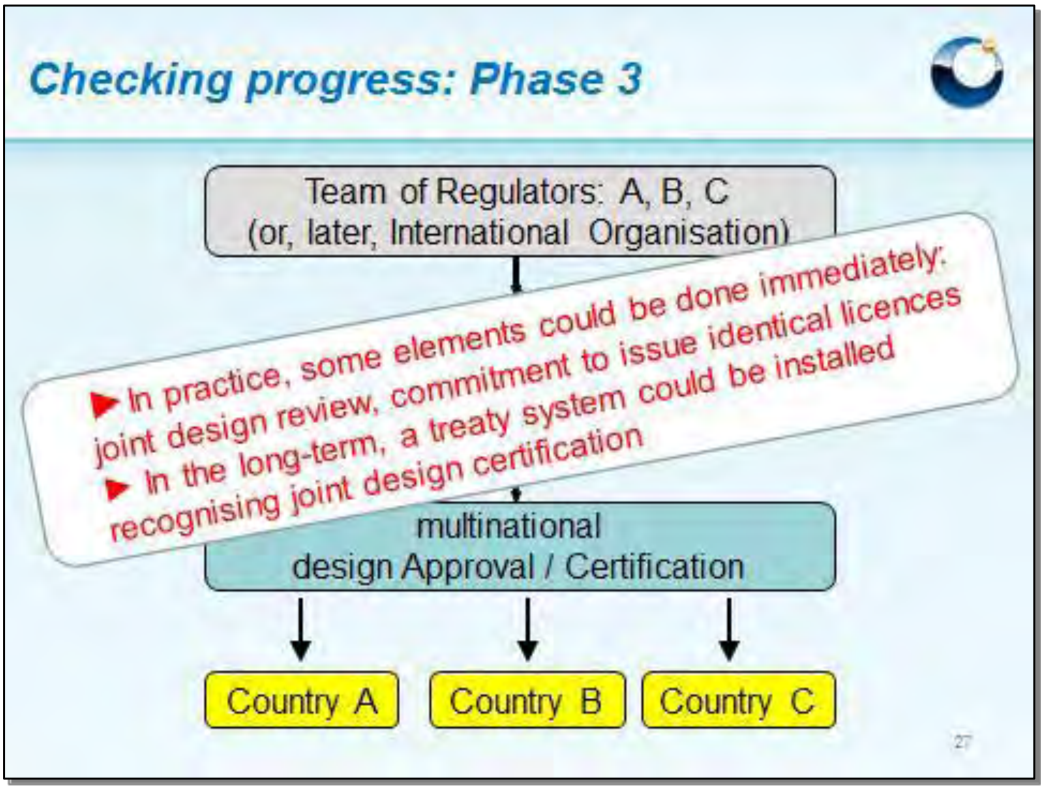

Checking progress: Phase 1
Regulator A
Regulator B
design review
share
approval
by regulator A
design approval
by regulator B
This is being done more and more by MDEP
25


Checking progress: Phase 2
Regulator A
Regulator B
validation
design approval
by regulator A
design approval
by regulator B
is done de facto by newcomer countries
needs some more specific guidance


Checking progress: Phase 3
Team of Regulators: A, B, C
(or, later, International Organisation)
► In practice, some elements could be done immediately:
joint design review, commitment to issue identical licences
► In the long-term, a treaty system could be installed
recognising joint design certification
multinational
design Approval / Certification
Country A
Country B
Country C


New Development in the EU: ERDA
• 2011: creation of a Core Group "European Reactor Design Acceptance" (ERDA)
• Initiative of European Commission, based on CORDEL ideas
• "Roadmap to ERDA", August 2012
– Nuclear licensing: A stand-alone design acceptance
– Harmonization of safety requirements
– "Validation" process
– Joint design acceptance by several regulators
– Joint design assessment by TSOs
• Next step: interaction with regulators via ENSREG

Conclusion

- Vision of Standardization remains valid
- „CORDEL Roadmap update 2012/2013“ planned to adapt the CORDEL vision to the current situation
- Growing number of topical task forces and reports
- EU picking up on CORDEL ideas
- CORDEL is encouraged by MDEP‘s work
- CORDEL encorages regulators to explore further ways to proceed on the path to harmonization and standardization...
- ... in order to reap safety benefits as well as to facilitiate nuclear new build

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Thanks for your attention

Questions?

www.world-nuclear.org

2[nd] CNRA International Workshop on New Reactor Siting, Licensing and Construction Experience

Atlanta, Georgia

Strategies for Licensing New Reactors

Expectations and Experience

October 24-26, 2012

Gary Holahan, Deputy Director
Office of New Reactors
U.S. Nuclear Regulatory Commission

The Challenge

2005:

"NRC and the industry will face an unprecedented challenge in 2008, with at least eight concurrent combined license reviews, two Design Certification applications and an early site permit application"

2012:

10 active combined license reviews; 4 licenses issued; 18 applications submitted.

3 active design certification reviews; 1 completed; 1 to 5 anticipated; 2 DC renewals

1 active early site permit review

2005 Strategies for Success:

1. **Establish Clear Roles, Responsibilities and Expectations**
2. **Minimize Technical Work Load**
3. **Start Critical Path Items Early**
4. **Provide Essential Resource and Organizational Support**

Strategy 1: Establish Clear Roles, Responsibilities and Expectations

Accelerate Part 52 rulemaking to clarify new reactor requirements
- Completed

Hold applicants accountable for quality and timeliness of submittals by formally rescheduling reviews for clearly inadequate or untimely products.
- Continuing… and a continuing challenge

Resolve issues in a timely manner though prompt elevation of unresolved items to NRC line management for decisions
- Continuing

Hold public workshops to assure that applicants, NRC staff and interested stakeholders have a clear understanding of the technical, policy, process and legal issues
- Completed

Continue early discussions with DOE on Energy Policy Act issues
- Completed

Strategy 2: Minimize Technical Work Load

Maximize standardization of designs
- Continuing strategy through DCs and utility Design-Centered Working Group

Maximize standardization and coordination of approaches and applications
- Continuing Strategy

Require complete and high quality applications
- Continuing strategy ... and a continuing challenge

Increase use of Design Certification rulemaking to codify issue closure. Use single technical evaluations to support multiple COL applications, implement "one issue, one review
- Continuing strategy ... used successfully many times

Maximize use of technical review information from MDAP participants
- Continuing strategy ... excellent cooperation and information sharing through the MDEP EPR and AP1000 working groups

Strategy 3: Start Critical Path Items Early

Maximize use of pre-application reviews to achieve early resolution of issues
- Continuing strategy

Employ pre-application reviews for environmental and other siting issues
- Continuing strategy

Identify research or other supporting information early
- Continuing strategy

Complete development of a new Construction Inspection Program
- Complete. Called Construction Reactor Oversight Program

Strategy 4: Provide Essential Resource and Organizational Support

- **Plan and schedule reviews at a new level of detail with contingency planning for inevitable changes**
  - Implemented with Enterprise Project Management
- **Accelerate updating of Regulatory Guides and Standard Review Plan, as needed for new reactor applications**
  - Completed 2007
- **Hire and train NRC staff aggressively**
  - Established new Office New Reactor, reassigned over 200 staff and hired over 200 new staff
- **Acquire expert contractors for technical & environmental reviews**
  - Complete, especially in the environmental review area
- **Establish Project Management Teams for each vendor design (AP-1000, ESBWR, EPR)**
  - Completed with new Project Management branches for each design

Conclusions

- The NRC had strategies in place to address the anticipated challenges of multiple, simultaneous new reactor reviews
- The reality exceeded the anticipated applications
- Using the strategies established in 2005, the NRC successfully addressed each challenge

IAEA Activities Related to Construction

2nd CNRA International Workshop on "New Reactor Siting, Licensing and Construction Experience"
Atlanta, Georgia, USA
24-26 October 2012

Stephen Koenick
Senior Safety Officer
Regulatory Activities Section | Division of Nuclear Installation Safety
Department of Nuclear Safety and Security

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International Atomic Energy Agency

CONTENT

- Related conclusions from 2nd Extraordinary Meeting of the Convention on Nuclear Safety
- Draft Safety Guide, DS 441, "*Construction for Nuclear Installations*"
- Draft Safety Guide, DS 446, Revision of the Safety Guide No. NS-G-2.9 "Commissioning for Nuclear Power Plants" (2003)
- Safety guides related to siting
- Draft Safety Report, DD1048, "*Development Of A Regulatory Inspection Programme For A New Nuclear Power Plant Project"*
- Nuclear Safety Action Plan
- Assistance to embarking countries

IAEA 2

Related conclusions from 2nd Extraordinary Meeting of the Convention on Nuclear Safety

2. The Contracting Parties agreed that nuclear power plants should be designed, constructed and operated with the objectives of preventing accidents and, should an accident occur, mitigating its effects and avoiding off-site contamination. The Contracting Parties also noted that regulatory authorities should ensure that these objectives are applied in order to identify and implement appropriate safety improvements at existing plants.

3. The regulator's top priority must be to protect public health and safety. The Contracting Parties will ensure that regulatory bodies have sufficient resources to undertake their duties and are effectively independent from entities having responsibilities or interests in the promotion or utilization of nuclear energy that could conflict or unduly influence the regulator's decision making.

[except from Press Release August 31, 2012]

IAEA 3

DS 441, *Construction for Nuclear Installations*

Scope -- Proposed content of new safety guide to include management system of safety-significant construction activities by licensee and supplements guidance provided by GS-G-3.1 and GS-G-3.5 on implementation of construction activities. Also provides guidance for role of regulatory body during construction.

Status – Draft was reviewed and authorized by Commission on Safety Standards (CSS) in December 2011; and distributed to Member States for comment by May 2012;

- Around 600 comments received from Member states and other organizations. Consultancy held in August 2012 to consider these comments.
- Large number of comments accepted. Preparations for safety standards review committees in early 2013.

IAEA 4

DS 446, Commissioning for Nuclear Power Plants

Scope -- Revision of the Safety Guide No. NS-G-2.9 "Commissioning for Nuclear Power Plants" (2003) to confirm technical adequacy of existing safety guide such that the revision will maintain technical content and supplement with latest proven practices.

Status -- The draft DS446 to incorporate agreed resolution of CSS comments and to be translated in Spanish, when published. 32nd Meeting CSS 9 – 11 October 2012.

IAEA 5

Safety Guides related to siting

IAEA Safety Guides recently issued

- SSG-9 Seismic Hazards in Site Evaluation for Nuclear Installations (2010)
- SSG-18 Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations (2011)

IAEA Safety Guides under development

- DS433: Safety Aspects in Siting for Nuclear Installations – incorporating MS comments
- DS405: Volcanic Hazards in Site Evaluation for Nuclear Installations – in publications process

IAEA 6

DS 1048, Draft Safety Report

Proposed Title: "*DEVELOPMENT OF A REGULATORY INSPECTION PROGRAMME FOR A NEW NUCLEAR POWER PLANT PROJECT*"

Objectives

- To support regulatory bodies in the development of their regulatory inspection programmes;
- To provide information on key technical considerations and activities related to the regulatory body's development of their regulatory inspection programme taking into account approaches, practices and experience of Member States that have been involved in recent new nuclear plant construction projects [MS examples annexed to report]; and
- To identify relevant IAEA Safety Standards within one document.

IAEA 7

DS 1048, Draft Safety Report

Status:

- Held Technical Meeting in July 30 – 3 August to revise, finalize safety report
- TM Chairman's report with working draft of safety report to be placed on IAEA webpage
- Draft Safety Report to be go through internal quality assurance in November 2012 followed by publication process.

IAEA 8

Nuclear Safety Action Plan

12 Areas

- ***Safety Assessments in the light of the accident*** – Member States perform, IAEA provide assistance
- ***IAEA Peer Reviews*** – IAEA strengthen existing peers reviews, improve transparency, Member States strongly encouraged to volunteer to host peer reviews
- ***Emergency Preparedness and Response*** -- Member States prompt reviews, IAEA peer reviews, IAEA, MS and relevant organizations strengthen international emergency preparedness, MS utilize IAEA Response and Assistance Network (RANET)
- ***National Regulatory bodies*** – MS conduct national review, voluntarily host IRRS
- ***Operating Organizations*** – MS ensure improvement, voluntarily host OSART
- ***IAEA Safety Standards*** – IAEA review and revise as necessary, MS to utilize
- ***International legal framework*** – MS encourage to join and enhance effectiveness of implementation of conventions

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Nuclear Safety Action Plan

12 Areas, continued

- ***Embarking countries*** – MS create necessary infrastructure, voluntarily host INIR and other relevant peer review missions
- ***Capacity Building*** – MS build and implement capacity building programme, IAEA provide assistance as requested
- ***Protection of People and Environment*** -- Member States, IAEA and relevant organizations facilitate use of information following accident
- ***Communication and information dissemination*** – MS and IAEA strengthen notification systems, transparency and openness, continue sharing of transparent assessment of accident
- ***Research and Development*** – Relevant stakeholders with IAEA assistance conduct research and development in nuclear safety

IAEA

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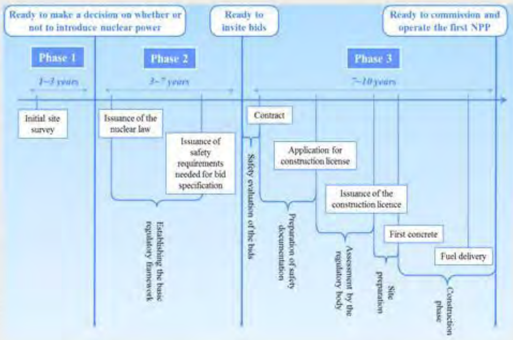
IAEA assistance to embarking countries

- Gradual application of IAEA safety standards informed by actions in SSG – 16
- Self Assessment
- Focus on principal deliverables of the Regulatory Body in each phase of the nuclear power programme
- Safety Packages of IAEA Assistance



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Self-Assessment for Regulatory Infrastructure (SARIS) and component for SSG-16

- SARIS issued September 2012
  - Revision to self-assessment tool (SAT)
  - User-friendly interface, updated to current IAEA safety standards
  - Supports preparation and conduct of Integrated Regulatory Review Service (IRRS)
- **IRIS** [Integrated Review of Infrastructure for Safety] based on SSG-16 is part of this IT system

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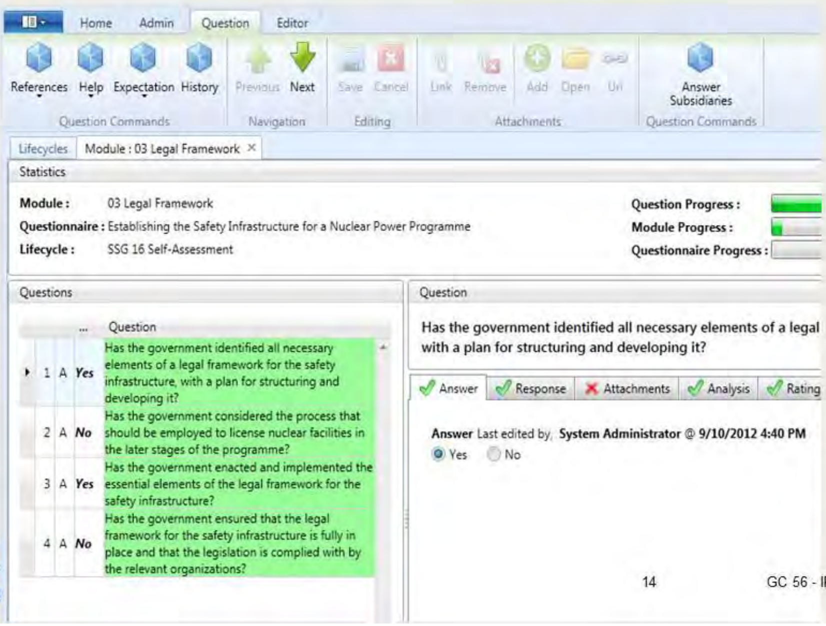
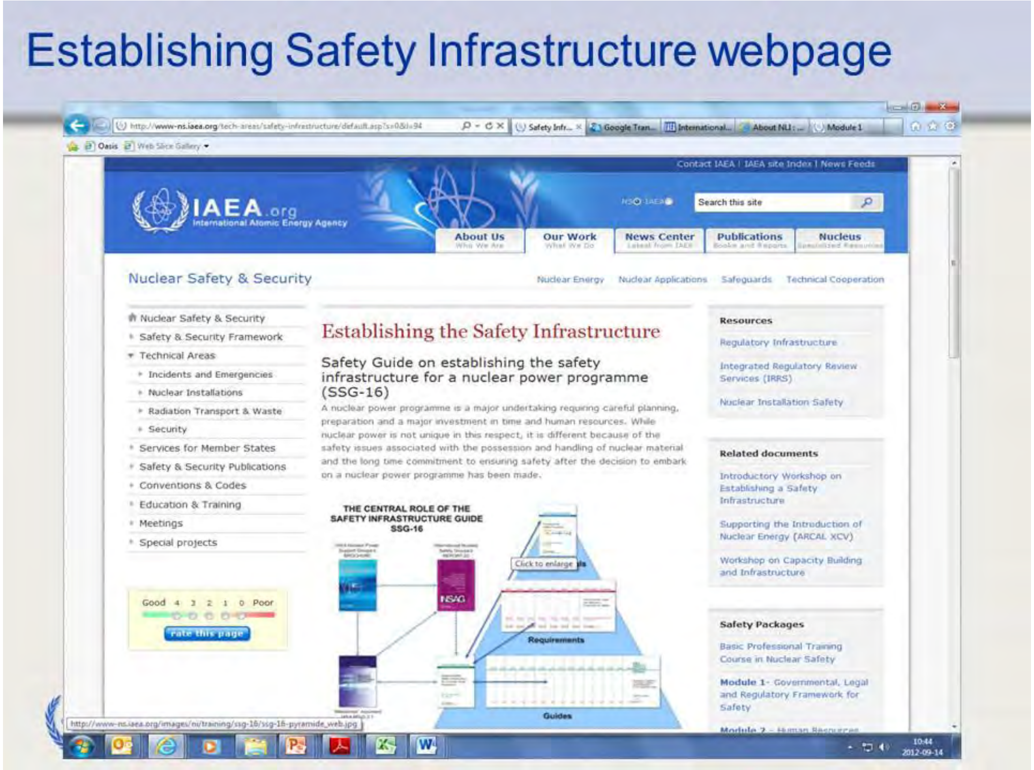
Self-Assessment for Regulatory Infrastructure (SARIS) and component for SSG-16

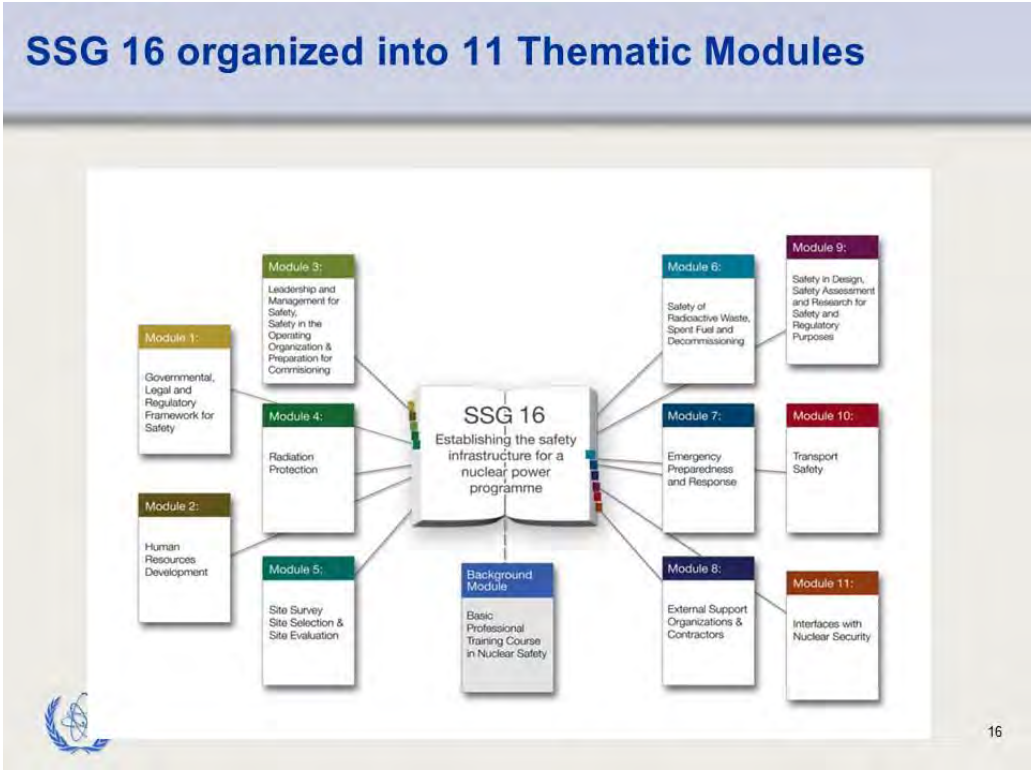
IAEA 13 GC 56 - IRIS

Self-Assessment for Regulatory Infrastructure (SARIS) and component for SSG-16

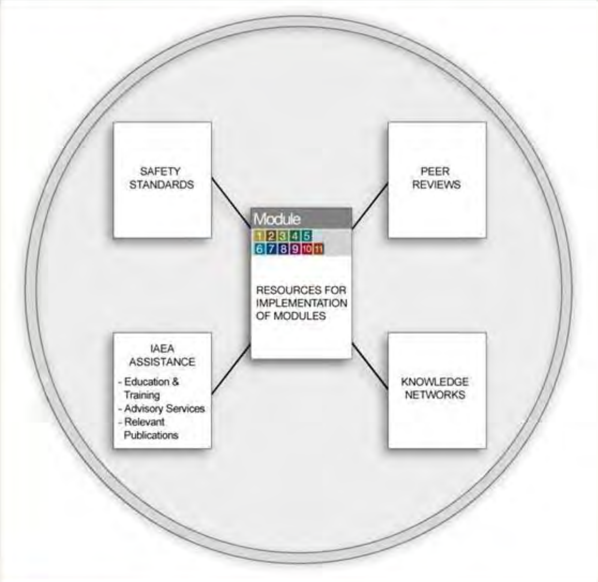


14 GC 56 - IRIS


Establishing Safety Infrastructure webpage
IAEA.org
International Atomic Energy Agency
About Us
Our Work
News Center
Publications
Nucleus
Nuclear Safety & Security
Nuclear Energy
Nuclear Applications
Safeguards
Technical Cooperation
Nuclear Safety & Security
Safety & Security Framework
Technical Areas
Incidents and Emergencies
Nuclear Installations
Radiation Transport & Waste
Security
Services for Member States
Safety & Security Publications
Conventions & Codes
Education & Training
Meetings
Special projects
Establishing the Safety Infrastructure
Safety Guide on establishing the safety infrastructure for a nuclear power programme (SSG-16)
A nuclear power programme is a major undertaking requiring careful planning, preparation and a major investment in time and human resources. While nuclear power is not unique in this respect, it is different because of the safety issues associated with the possession and handling of nuclear material and the long time commitment to ensuring safety after the decision to embark on a nuclear power programme has been made.
THE CENTRAL ROLE OF THE SAFETY INFRASTRUCTURE GUIDE SSG-16
Requirements
Guides
Resources
Regulatory Infrastructure
Integrated Regulatory Review Services (IRRS)
Nuclear Installation Safety
Related documents
Introductory Workshop on Establishing a Safety Infrastructure
Supporting the Introduction of Nuclear Energy (ARCAL XCV)
Workshop on Capacity Building and Infrastructure
Safety Packages
Basic Professional Training Course in Nuclear Safety
Module 1- Governmental, Legal and Regulatory Framework for Safety


SSG 16 organized into 11 Thematic Modules
Module 1:
Governmental, Legal and Regulatory Framework for Safety
Module 2:
Human Resources Development
Module 3:
Leadership and Management for Safety, Safety in the Operating Organization & Preparation for Commissioning
Module 4:
Radiation Protection
Module 5:
Site Survey Site Selection & Site Evaluation
SSG 16
Establishing the safety infrastructure for a nuclear power programme
Background Module
Basic Professional Training Course in Nuclear Safety
Module 6:
Safety of Radioactive Waste, Spent Fuel and Decommissioning
Module 7:
Emergency Preparedness and Response
Module 8:
External Support Organizations & Contractors
Module 9:
Safety in Design, Safety Assessment and Research for Safety and Regulatory Purposes
Module 10:
Transport Safety
Module 11:
Interfaces with Nuclear Security
16

Safety Packages for Each Module



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Safety Packages organized by Phase

✓ Who: responsible organization (e.g., Government, Operating Organization, and Regulatory Body)

✓ What: Summary of the relevant actions and underlying IAEA Safety Standards

✓ When: appropriate phase (1, 2, or 3)

How Agency can assist: Appropriate Peer review services, Advisory Services, Education and Training, and Networks and Tools

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Safety Package for Module 1

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IAEA Initiative to Strengthen Assistance Capabilities

- Development of "Exemplary Training Material" in support to Specialized Workshops to strengthen technical and managerial competences of staff of the Regulatory Bodies – emphasis on the Organizational Development
  Topics completed and currently under review:
  - Safety Regulations
  - Regulatory Review and Assessment
  - Regulatory Inspection and Enforcement
  - Human Resource Development of the RB and the use of External Support Organizations

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IAEA Initiative to Strengthen Assistance Capabilities

Workshops format and contents

- Core material - thematic and based on IAEA Safety Standards
- Application - examples of practices in Member States
- Exercises - tailored to specific needs of MS with outlook on milestones of future activities

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Duration: typically 1 week
Target: SSG 16 actions relevant to phases 1-3
Material : Exemplary set of presentations and talking points

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IAEA Assistance for Embarking Countries

IRRS for embarking countries

New module was developed for the IRRS tailored to:

- **review status of safety infrastructure based on SSG 16**
- **identify gaps**
- **support preparation of action plans for enhancing the effectiveness of regulatory bodies**
- **Considered in UAE in December 2011**
- **Requested for Poland planned April 2013**

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International Atomic Energy Agency
Thank you for your attention!!
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SESSION I – REGULATORY COOPERATION ON GENERIC AND DESIGN SPECIFIC ISSUES, MDEP WORKING GROUPS (EPR, AP1000), VENDOR INSPECTION CO-OPERATION, DIGITAL I&C, AND CODES/STANDARDS

Multinational Design Evaluation Program (MDEP)
Gary Holahan, U.S.NRC

MDEP Vendor Inspection Cooperation Working Group
Richard Rasmussen, U.S.NRC

MDEP Activities and Accomplishments on Design Specific Working Groups
Thomas Houdré, ASN

WNA CORDEL Code Convergence Effort, The example of Harmonisation of NDE Qualification requirements
Andrew Wasylyk, World Nuclear Association

AP1000® Global Plant Licensing
Richard Delong and John Green, Westinghouse

EPR Family Presentation
Xavier Pouget-Abadie, EDF, François Bouteille, Areva

WNA CORDEL report – What can nuclear learn from aviation?
Christian Raetzke, World Nuclear Association


NEA
Nuclear Energy Agency
OECD
AEN NEA Multinational Design Evaluation Programme
Multinational Design Evaluation Program (MDEP)
Gary Holahan
Deputy Director
Office of New Reactors, US NRC


NEA
Nuclear Energy Agency
MDEP Basics
OECD
AEN NEA Multinational Design Evaluation Programme
What is MDEP?
A multinational initiative undertaken by national regulatory authorities of 12 countries to:
➢Co-operate and share information on safety design reviews of specific designs in order to ensure a greater safety focus on the reviews in each country and
➢Share information about national and international regulatory requirements and practices in order to explore opportunities for possible harmonization or convergence of such requirements when safety enhancements may be realized
➢A stated objective in the MDEP Terms of Reference is to enable and encourage safer global standardized reactor designs
Important aspect is that MDEP co-operation is being undertaken under currently existing regulatory frameworks and each national regulator maintains its sovereign rights and responsibilities to regulate nuclear safety in accordance with its existing national laws.
2

MDEP Basics

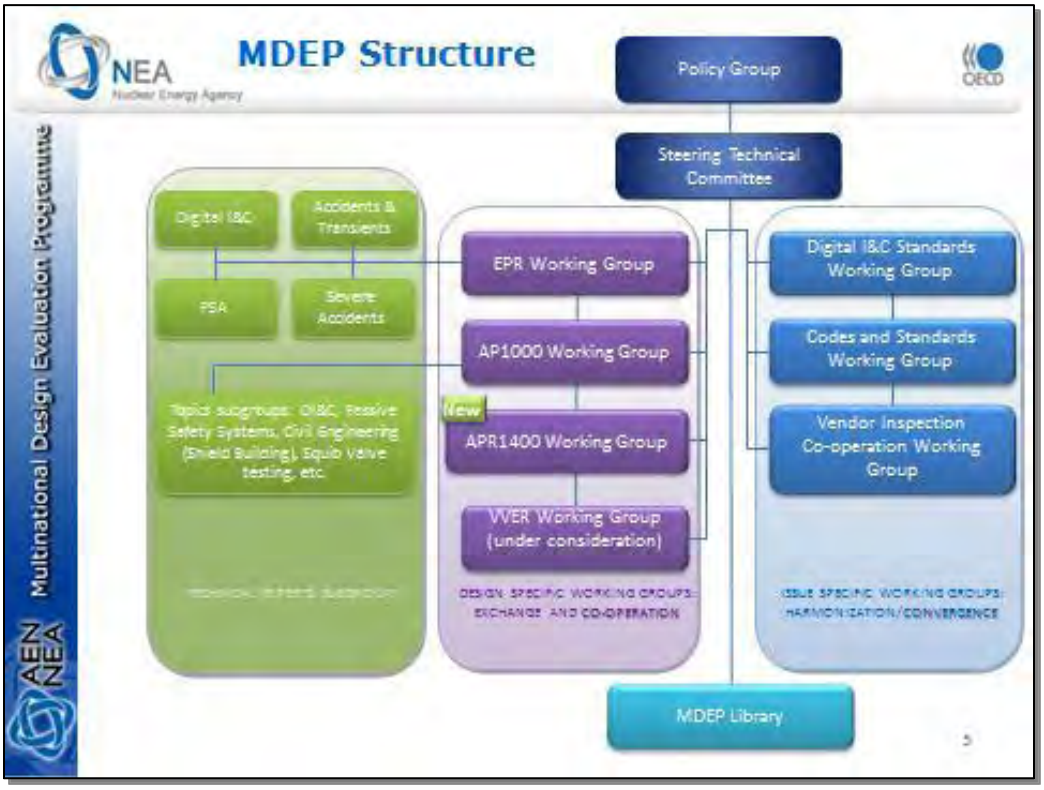
Who is involved in MDEP activities?

- Members since MDEP inception in 2006 include national regulatory authorities from Canada, China, Finland, France, Japan, the Republic of Korea, the Russian Federation, South Africa, the U.K., and the U.S.A.
- India's regulatory authority joined in 2011
- The U.A.E's regulatory authority joined in 2012 as an associate member
- IAEA participates in the generic work of the MDEP
- NEA performs the technical secretariat duties
- National technical support organizations participate in MDEP activities as requested by the national regulatory authority

MDEP Basics

What activities are part of MDEP?

- Co-operation on specific design reviews (limited to selected countries)
  - EPRWG (Canada, China, Finland, France, India, the U.K., and the U.S.A)
  - AP1000WG (Canada, China, the U.K., and the U.S.A.)
  - APR1400WG (Finland, South Korea, the U.A.E, and the U.S.A.)
  - VVERWG (AES2006/AES91 design) under consideration (Russia, India, Vietnam, and Turkey, if approved by the Policy Group)
- Co-operation on generic issues (all countries invited to participate)
  - Mechanical Codes and Standards (CSWG)
  - Digital Instrumentation and Control (DICWG)
  - Vendor Inspection Cooperation (VICWG)



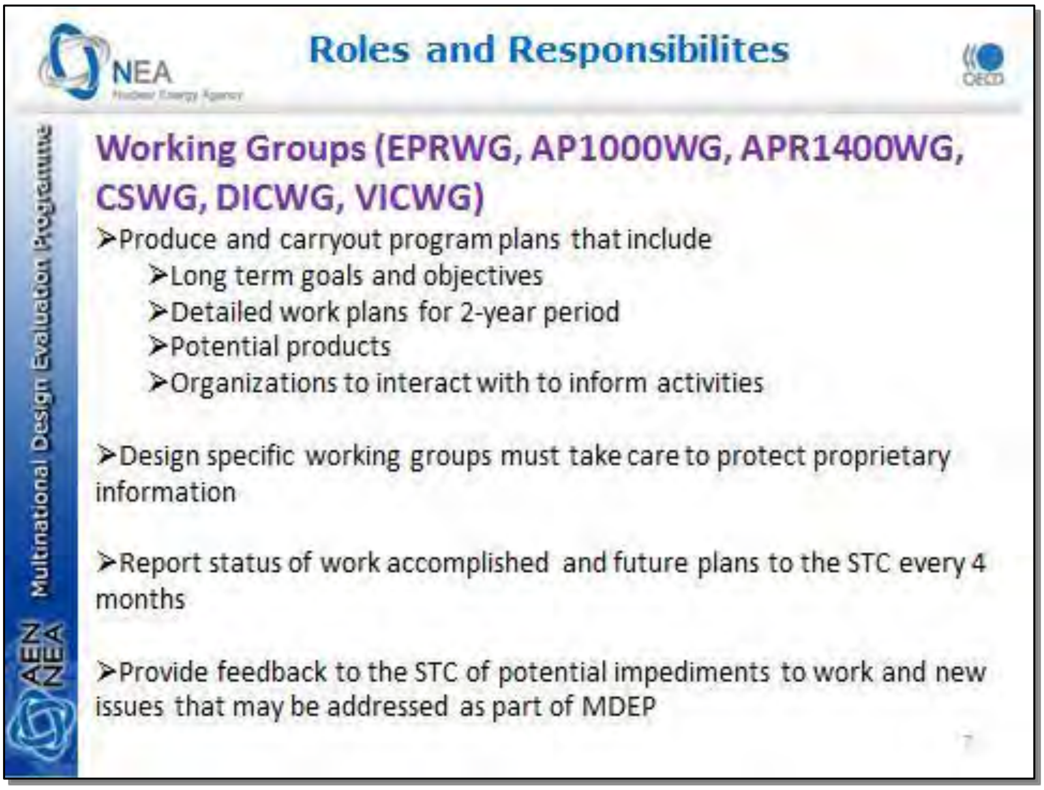
Roles and Responsibilites

Policy Group (PG)

- Heads of Agencies
  - Provide guidance on MDEP approach including interactions with industry and other stakeholders
  - Monitor progress in reaching goals
  - Determine participation and membership in MDEP
  - Approve new working groups as proposed by the STC

Steering Technical Committee (STC)

- Senior level staff involved in licensing new reactors
  - Manage and approve detailed program of work
  - Approve procedures and products
  - Coordinate communications internal and external to MDEP (important coordination with other regulatory bodies such as IAEA, CNRA/CSNI, and WENRA, and other industry stakeholders such as WNA CORDEL, WANO, GIF, vendors, operators, SDOs)
  - Report status of the MDEP to the PG


NEA
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Roles and Responsibilites
OECD
AEN NEA Multinational Design Evaluation Programme
Working Groups (EPRWG, AP1000WG, APR1400WG, CSWG, DICWG, VICWG)
➢Produce and carryout program plans that include
➢Long term goals and objectives
➢Detailed work plans for 2-year period
➢Potential products
➢Organizations to interact with to inform activities
➢Design specific working groups must take care to protect proprietary information
➢Report status of work accomplished and future plans to the STC every 4 months
➢Provide feedback to the STC of potential impediments to work and new issues that may be addressed as part of MDEP
7


NEA
Nuclear Energy Agency
Interaction with Stakeholders
OECD
AEN NEA Multinational Design Evaluation Programme
With other "regulatory" bodies
➢NEA CNRA/CSNI (Working Group for the Regulation of New Reactors)
➢IAEA
➢WENRA
➢Other regulators
Other stakeholders
➢Vendors, operators (especially of EPR, AP1000, and APR1400)
➢Standards Development Organizations
➢EC
➢WNA Co-operation in Reactor Design Evaluation and Licensing (CORDEL) working group
➢WANO
➢GIF and INPRO (advanced reactors)
These stakeholders are invited to participate in WG and STC meetings, as appropriate.
In addition, 2 MDEP Conferences have been held in Paris (2009 and 2011) at which stakeholders were invited to attend/participate.
The STC performed a comprehensive self assessment with stakeholder input in 2012.
8

NEA
Nuclear Energy Agency

Benefits of MDEP Co-operation

OECD

Multinational Design Evaluation Programme
AEN NEA

- MDEP has been very useful to the participating regulators in carrying out safety design reviews of standard designs being deployed throughout the world
- MDEP is supporting harmonization efforts where safety will be enhanced
- MDEP is communicating with stakeholders about its activities
- MDEP continues to be a unique and key regulatory activity for new build safety reviews

3

OECD

Multinational Design Evaluation Programme
AEN NEA

Codes & Standards Working Group

Goals/Objectives

- Achieve global harmonization of codes for NPPs (consistent with MDEP's goals)

Implementation Plan

- identify similarities and differences between major pressure boundary design codes
- identify most beneficial areas for convergence
- examine potential paths for reconciliation

Standards Development Organizations' Code Comparison Project

- MDEP/CSWG collaborated with standards development organizations (SDOs) to compare six countries' code requirements
- SDOs compared their nuclear codes/standards:

ASME (U.S.)	BPVC Section III (2007)
AFCEN (France)	RCC-M (2008)
JSME (Japan)	S-NC-1 (2008)
KEA (Korea)	KEPIC (2007)
CSA (Canada)	N285A (2008E-09A)
RNO (Russia)	PNAE G-7-002-86

SDOs' Code-Comparison Report

- Code comparison complete for Class 1 vessels, pumps, valves and piping for Canada, France, Japan and Korea
- Code comparison report STP-NU-051 is publicly available on ASME Website and MDEP library

(http://stllc.asme.org/News_Announcements.cfm)

- Russian Code results will be added by Dec 2012

Codes & Standards Working Group
Products

- The MDEP/CSWG has prepared four draft documents:
  - MDEP Common Position CSWG-01, "Lessons Learnt on Achieving Harmonisation of Codes and Standards for Pressure Boundary Components in Nuclear Power Plants"
  - MDEP Common Position CSWG-02, "Fundamental Attributes for the Design and Construction of Pressure Boundary Components"
  - MDEP Common Position CSWG-03, "Essential Performance Guidelines for Pressure Boundary Components"
  - MDEP Technical Report CSWG-01, "Regulatory Frameworks for the Use of Nuclear Pressure Boundary Codes and Standards in MDEP Countries"

Multinational Design Evaluation Programme

AEN NEA

Codes & Standards Working Group
Next Steps

- Continue working with standards development organizations and CORDEL to achieve convergence on selected code differences
- Continue to follow the issuance of the code comparison results by the Russian Federation
- Finalize common positions
- Explore future actions to achieve harmonization of code and standards

Multinational Design Evaluation Programme

AEN NEA


Digital Instrumentation & Control Working Group
Goals/Objectives
➢ Identify opportunities for convergence of applicable standards
Implementation Plan
➢ Identified member countries most significant technical issues
➢ Draft Common Positions
Multinational Design Evaluation Programme
AEN NEA
OECD


Digital Instrumentation & Control Working Group
NEA
OECD
Accomplishments
➢ Drafted 8 Common Positions. Three approved by the STC and made public.
➢ Obtained agreement from IEC and IEEE to increase cooperation and consider MDEP common positions for potential areas of convergence of standards. Established formal liaison between MDEP and IEC.
Multinational Design Evaluation Programme
AEN NEA

NEA Nuclear Energy Agency — OECD

DICWG Common Positions

Common Position	Status
Software Common Cause Failure	drafted
Software Tools	issued
Software Validation and Verification	issued
Data Communication Independence	issued
Complex Electronics	drafted
Simplicity in Design	issued
Qualification of Industrial Digital Devices of Limited Functionality for Use in Safety Applications	Early stages
System Architectural Considerations for Systems Classified at the Highest Safety Level	Early stages
Surveillance and Periodic Testing	drafted
Impact of Cyber Security Features on Digital I&C Safety Systems	issued
Factory and Site Acceptance Testing	drafted

NEA Nuclear Energy Agency — OECD

Digital Instrumentation & Control Working Group – Next Steps

AEN NEA Multinational Design Evaluation Programme

- Complete development of Common Positions and present to the STC and Policy Group for approval. Total of 15 positions identified and approved to work.
- Identify areas of potential convergence and make recommendations to standards organizations

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MDEP Vendor Inspection Cooperation Working Group

Richard Rasmussen
Chief, Electrical Vendor Branch
Office of New Reactors
U.S. NRC

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Working Group Overview

- Protocol Document
- Types of Engagement
- Logistical Issues
- VICWG Activities
- Joint Inspection Results
- Next Steps

MDEP Protocol VICWG-01

Purpose and Scope

- The purpose of this protocol is to provide guidance to regulators that wish to carry out vendor inspections or participate in or witness other regulators' vendor inspections. It also provides guidance for the sponsoring regulator with regard to its interactions with inspecting, witnessing or participating regulators.

Current Inspection Types

- **Witnessed inspection** – an activity in which a regulator conducts an inspection according to its own regulatory framework and one or more regulators witnesses it.
- **Parallel Inspections** – inspections that are carried out at the same time on the same vendor by two or more regulators in accordance with their own inspection framework and procedures.
- **Joint inspection** – an activity in which one regulator conducts an inspection according to its own regulatory framework with the participation of one or more other regulators' inspectors.

Key Logistical Issues

- Inspection table maintained on the MDEP website
- Sponsoring Regulator determines language
- May require training or familiarization
- Records governed by Sponsoring Regulator
- Witnessing regulators provide feedback to MDEP library

VICWG Activities

- 2011
  - 7 witnessed inspections and 1 joint inspection were conducted
  - Observing countries gained additional information and added confidence in the inspection results
  - MDEP regulators are sharing inspection practices
- 2012
  - To date, 7 witnessed inspections and 1 joint inspection completed
  - Multinational Inspections
    - Definition currently under development
    - Intent is to develop a multinational inspection team working to common requirements

Joint Inspection Experience

- KINS Lead – Doosan Heavy Industries 2011
- NRC Lead – Target Rock 2012
- Inspections leveraged resources for participating regulators

NRC Use of Foreign Inspection Findings

- NRC Led Joint Inspections
  - fully within NRC inspection process
  - cited violations, vendor branches monitor resolution and determine needs for follow-up inspection
- Foreign Led Joint Inspections
  - lead regulator issues report and tracks resolution of issues
  - NRC will monitor issue resolution process and recommend further inspections as necessary

Multinational Inspections

- Assessment of Member Country Regulations
- Discussions with Standards Development Organizations (SDO's)
- Goal is harmonization of standards

Questions?

- https://www.mdep.oecd-nea.org/mdep/workspaces/iswg/vicwg/products_of_the_vicw/vendor_inspection_pr

MDEP Activities and Accomplishments on Design Specific Working Groups

2nd CNRA International Workshop on "New Reactor Siting, Licensing and Construction Experience"

Atlanta, Georgia, USA

24-26 October 2012

Thomas HOUDRÉ

MDEP EPRWG Co-chair

AEN NEA Agence pour l'énergie nucléaire
Nuclear Energy Agency
OECD

- **EPR Working Group**

  Members- RB from:

  Canada, China, Finland, France, India, U.K., U.S.

- **AP1000 Working Group**

  Members-RB from: U.S., China, Canada, U.K.

Accomplishments

- Developed Common Positions (EPR Digital I&C design, AP1000 squib valves)
- Shared issues identified, questions to applicant, and drafts of evaluations
- Identified differences among various country designs
- Identified additional questions for applicants based on MDEP interactions

- There is no obligation for any regulatory body to follow them.
- If a regulatory body chooses to adopt a Common Position, it is through that country's normal processes.
- The responsibility for regulatory decisions continues to be with the national regulator.

2

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AP1000 WG

- Accomplishments
  - Common positions developed
    - Squib valve qualification, testing, maintenance CP developed
    - Guidelines for novel construction drafted
  - Sharing of pre-lease version of safety evaluation
  - Design review documents stored in MDEP library
  - Working relationship with counterparts facilitates communications

- Next steps
  - Increased cooperation planned to aid CNSC to complete phase 2 licensing review of the AP1000
  - Share actions on Fukushima regulation
  - Gain knowledge on construction challenges for feedback into design

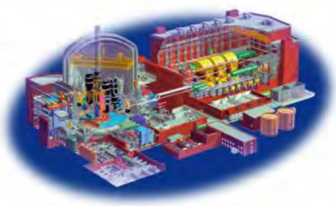
3

AEN NEA Agence pour l'énergie nucléaire Nuclear Energy Agency

OECD

EPR Working Group - Goals

- Goal of the MDEP EPRWG is to share information and experience on design reviews and construction oversight in order to
  - leverage the technical evaluations completed by each of the participating regulators
  - leverage the resources and knowledge of the national regulatory authorities
  - develop consistency between regulators and/or to understand differences
  - develop joint assessment on specific subjects
  - make safety assessments more robust and increase the safety level of EPR



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AEN NEA Agence pour l'énergie nucléaire Nuclear Energy Agency OECD

EPR Working Group - General

- Members of EPR WG are regulators from:
  - Canada,
  - China,
  - Finland (chair),
  - France (co-chair),
  - India,
  - United Kingdom,
  - United States
- Countries where EPR is being licensed or constructed
- Group has been meeting regularly since early 2008

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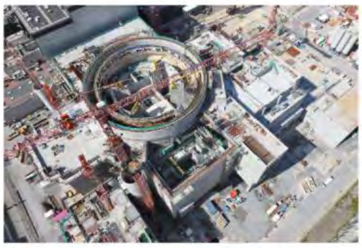
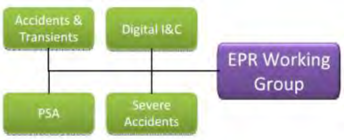
EPR Working Group - Activities

- General meetings on the status of each EPR project
  - discussions on the status of design review, construction
  - goal to identify new items for in depth discussions in the group
- Specific task groups for
  - instrumentation and control, covering also electrical issues
  - probabilistic safety assessment
  - accidents and transients
  - severe accidents
- Issue specific meetings, teleconferences/net meetings and email exchanges on specific topics
  - Internal hazards, radiation protection, human factors, grouted tendons, technical specifications, spent fuel cask loading, commissioning
- Implications on EPR design enhancements of Fukushima accident considered by EPRWG and TESG



Source: EDF



6

AEN NEA Agence pour l'énergie nucléaire
Nuclear Energy Agency
OECD

EPR Working Group - Fukushima follow up

- Continue discussions within the EPRWG about approaches being taken by regulators regarding Fukushima-related issues
  - ➢ Position on Fukushima related issues – Draft

- Items for technical experts subgroups
  - ➢ Arrangements for long lasting loss of electrical power (supplies and distribution systems)
  - ➢ Reliable and qualified instrumentation for dealing with severe accidents
  - ➢ Management of pressure in containment during severe accidents
  - ➢ Ensuring the long term cooling of spent fuel pool
  - ➢ Long term sub-criticality

- Discussions with AREVA/EDF, TVO, TNPJVC, NNB Genco, and UniStar about actions being taken to address lessons learnt from the Fukushima accident

7

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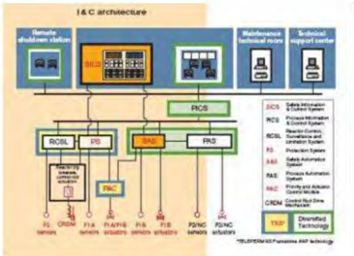
Nuclear Energy Agency
OECD

EPR Working Group - Instrumentation and Control

- Common position published in 2010 highlighting areas were harmonization can be further achieved
  - Simplicity as design principle
  - Data communication independence
  - TELEPERM XS digital platform and software
  - Embedded digital systems
  - Back up systems for defence in depth and diversity
- Some of the common positions and experiences were input to the MDEP digital I&C ISWG discussions
- Program plan
  - Loss of electrical power robustness, arrangements for long lasting loss of electrical power
  - Technical report on EPR DI&C issues
  - Update DI&C Common Position



Source: Areva EPR Brochure March 2005

8

AEN NEA Agence pour l'énergie nucléaire Nuclear Energy Agency OECD

EPR Working Group - PSA

- Comparison of EPR PSAs
  - Main result and risk profiles
  - Causes for differences and their risk significance
  - Indentification of potential issues
  - Sharing with the vendors
  - Comparison report under elaboration
- Co-operation with other subgroups
  - Modeling of I&C
  - Insights from level 2 analyses, severe accidents
- Work can be limited by the restrictions related to protection of proprietary information

Source: Clipart

Source: Areva EPR Brochure March 2005

9

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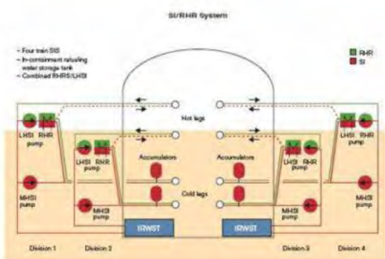
EPR Working Group - Accidents and Transients

- Activities ongoing within the following areas
  - Regulatory approaches and methodologies for accident analysis
  - Containment performance
  - Fuel and core design
  - Criticality safety
- Products in the process of being finalized
  - Technical report identifying the differences in regulatory criteria and approaches,
  - Containment circulation/mixing response evaluation
  - Mass and energy releases in containment
- Future topics related to Fukushima lessons learned: Long term sub-criticality



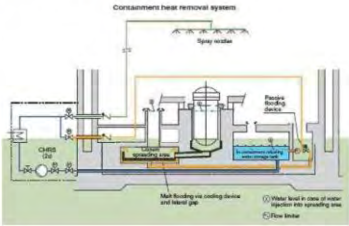
Source: Areva EPR Brochure March 2005

10

AEN NEA Agence pour l'énergie nucléaire Nuclear Energy Agency OECD

EPR Working Group - Severe Accidents

- Group has been working on
  - Hydrogen management in two room concept
  - Cooling functions and structures of the molten core
  - Scope of severe accident instrumentation
  - Operating strategies for severe accidents



- Future topics include
  - Technical report on design, arrangements and configuration of the CHRS (SAHRS) injection lines into the core catcher
  - Technical report on IRWST pH control
  - Technical report on Fukushima related issues: Management of pressure in containment during severe accidents.

Source: Areva EPR Brochure March 2005

11

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EPR Working Group - Specific topics

- Meeting in May 2011 with EDF/AREVA and involved utilities on EPR design differences
- Two meetings with EDF/AREVA and involved utilities on safety enhancements following Fukushima accident
- Other topics discussed
  - Long term cooling of spent fuel pool (Fukushima related)
  - Radiation Protection
  - Grouted tendons
  - Operational safety issues, technical specifications
  - Human factors engineering
  - Spent fuel cask loading device
- Future topics of cooperation : commissioning tests phase

12

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EPR Working Group - Accomplishments

- Sharing results of the design reviews
  - have resulted in identification of common safety concerns
  - have made national safety assessments more robust
  - have made it possible to understand differences e.g. in accident analyses methodologies
  - have helped participants to anticipate future issues
- Discussions on the design differences have resulted in
  - understanding of the differences in safety requirements
  - identification of harmonisation areas (e.g. safety classification) and design changes
- Networking the experts on different technical disciplines
  - easy to contact - ask questions, share information

13

WNA CORDEL Code Convergence Effort

The example of Harmonisation of NDE Qualification requirements

Andrew Wasylyk
WNA CORDEL Codes and Standards Staff Director

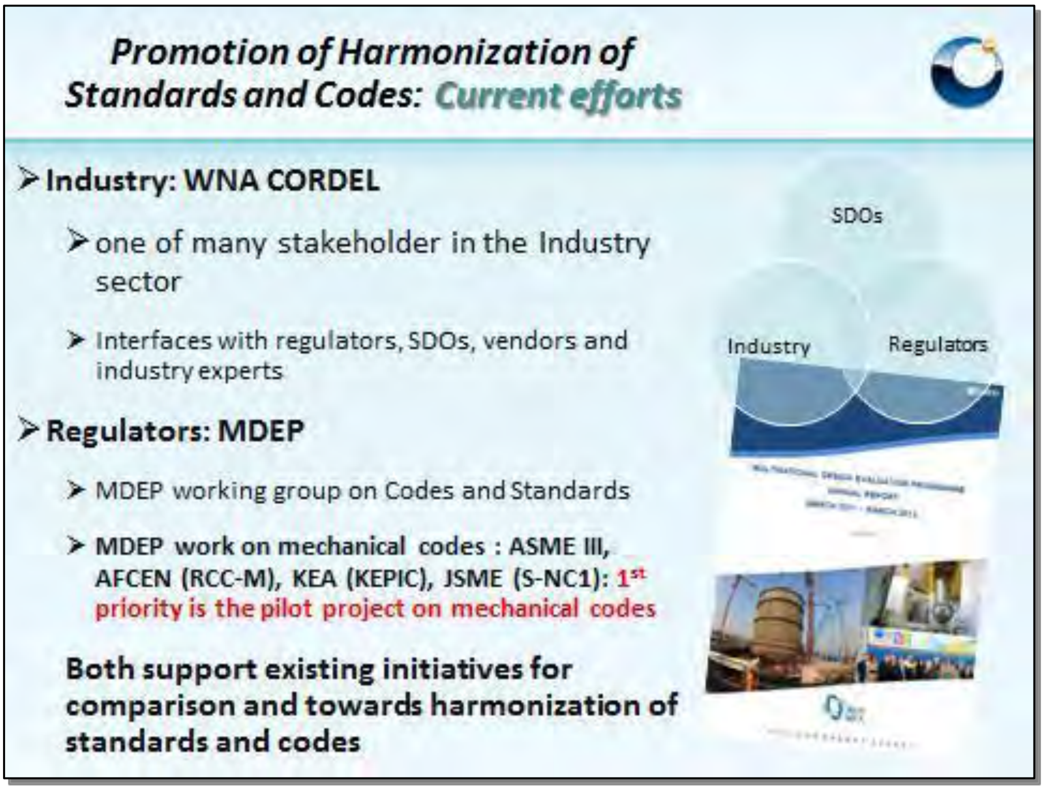
2nd CNRA International Workshop on
New Reactor Sitting, Licensing and Construction Experience
Atlanta, 24 to 26 October 2012

World Nuclear Association

Content

- **Current efforts in international convergence of code requirements**
- **Code comparison project**
- **Examples of Code Differences**
- **Convergence of non-technical issue: Certification requirements of NDE/T personnel**
- **Comparison with convergence effort for a technical issue**


WNA Board
Board Mentor for CORDEL is Aris Candris, CEO of Westinghouse
CORDEL Group
(representatives of 48 companies and organisations)
Steering Committee
Chairman, Vice Chairman
12-15 Representatives of Vendors and Utilities
Task Forces
Design Change Manage-ment
Licensing & Permitting
Codes & Standards
IAEA Safety Standards revision
Probabi-lisitic Safety Goals
TF Chairs : experts from WNA member companies


Promotion of Harmonization of Standards and Codes: Current efforts
Industry: WNA CORDEL
one of many stakeholder in the Industry sector
Interfaces with regulators, SDOs, vendors and industry experts
Regulators: MDEP
MDEP working group on Codes and Standards
MDEP work on mechanical codes : ASME III, AFCEN (RCC-M), KEA (KEPIC), JSME (S-NC1): 1st priority is the pilot project on mechanical codes
Both support existing initiatives for comparison and towards harmonization of standards and codes
SDOs
Industry
Regulators

WNA CORDEL Mandate

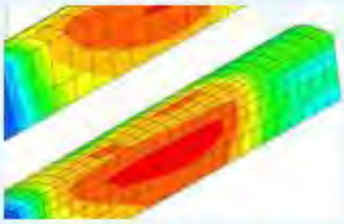
- **WNA CORDEL CSTF has the following mandate:**
  - Promote the ***international convergence of national nuclear codes***
  - Actively promote ***collaboration*** between ***SDOs***, ***national regulators*** and the ***nuclear industry*** on the issue of codes convergence
  - ***Limit future divergence*** of nuclear codes
  - Establish ***Equivalences***

Background to CORDEL CSTF code convergence effort

- **CORDEL CSTF builds on the MDEP Code comparison report written by SDOs**
  - Identification of the differences that would have an impact on the designing and manufacturing a component in one country and using it in another country
  - Line-by-line comparison of five national mechanical codes with ASME Section III : RCC-M, KEPIC, S-NC1, CSA, NIKIET
  - Requirements for class 1 components were compared,
    - *including requirements for pressure vessels, piping, valves and pumps*
  - The reasons for differences can be classified in two categories:
    - ***Technical requirements,***
    - ***Regulatory requirements***

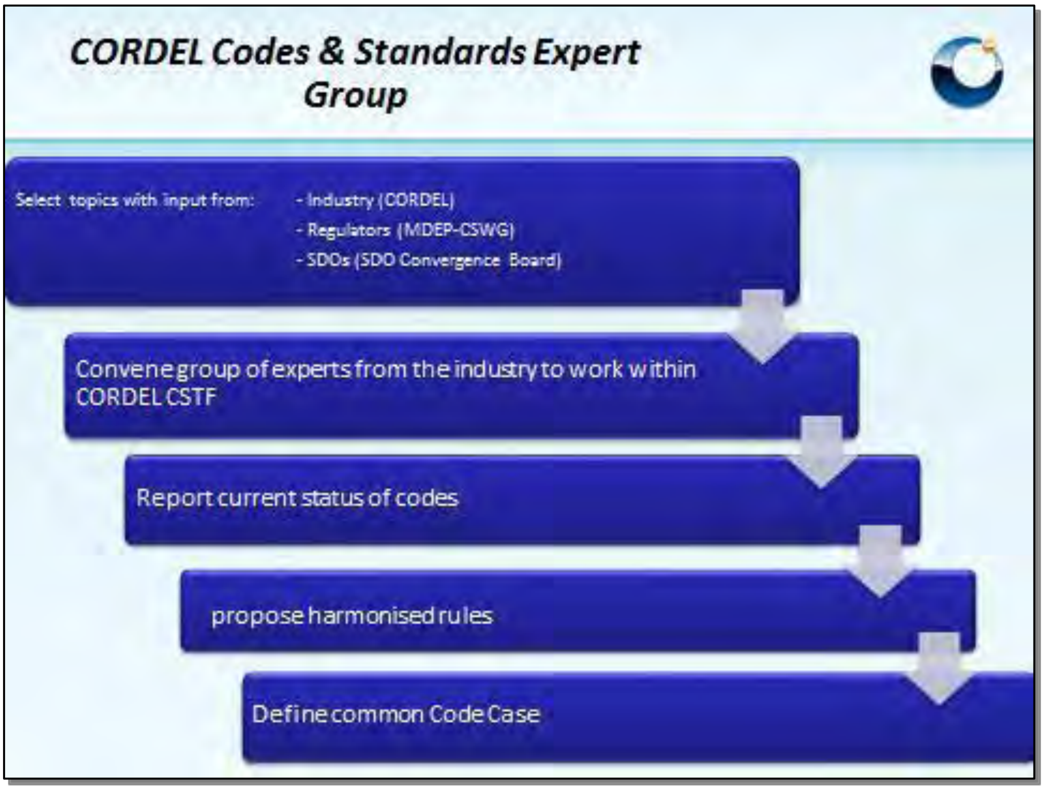
Background to CORDEL CSTF code convergence effort

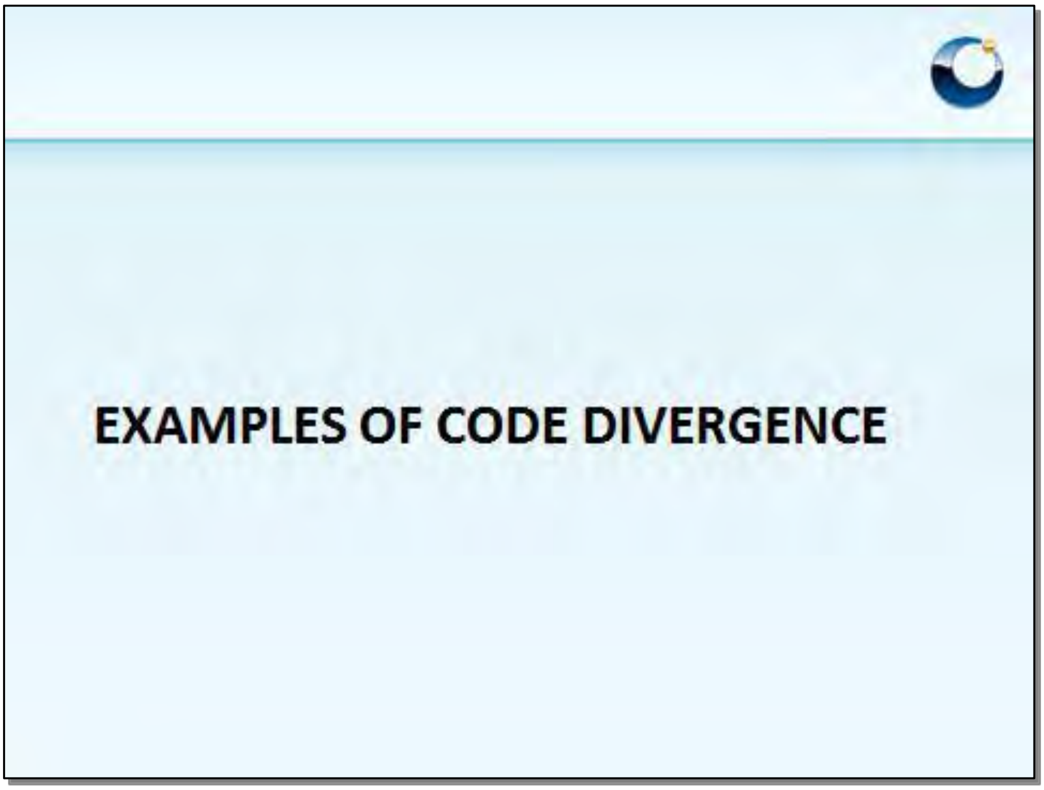
- **Selection of two subjects, one based on technical requirements and one based on Regulatory requirements:**
  - Requirements for NDT/E Personnel qualification
  - Design limits : Stress classification / Stress limits / Excessive deformation / Plastic Shakedown / non-linear analysis codified rules



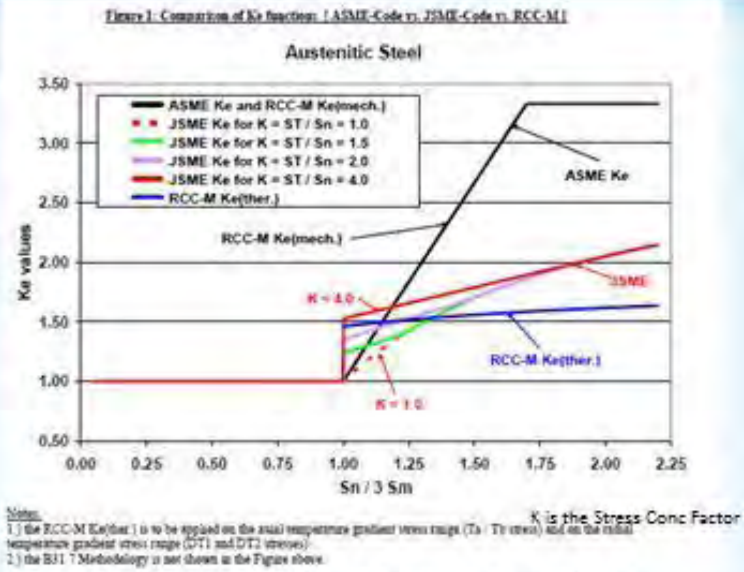
CORDEL Codes & Standards Expert Group

- **WNA CORDEL CSTF Expert group represents an industrial perspective with state of the art knowledge**
  - Active participation of 18 subject experts from 11 companies.
  - Representation from all major nuclear companies and geographies...
- **It is recognised that all differences cannot be resolved but some progress towards convergence and mutual recognition could be achieved in the short- to medium-term.**
- **The need to harmonise does not imply non-compliance but should be considered as achieving equivalent status in other countries.**
  - Diminish trade barriers
  - Allow inter-operability of products, systems and services
  - Promote a common technical understanding


CORDEL Codes & Standards Expert Group
Select topics with input from:
- Industry (CORDEL)
- Regulators (MDEP-CSWG)
- SDOs (SDO Convergence Board)
Convene group of experts from the industry to work within CORDEL CSTF
Report current status of codes
propose harmonised rules
Define common Code Case


EXAMPLES OF CODE DIVERGENCE

Example: Variation in the Ke Factor for Fatigue Assessment in Different Codes



Taken from SMiRT -19, Toronto paper F04/2 by Rami Hawileh et al (Areva)

Example: Assessing Pressure Vessel to American ASME and Russian PNAE G 7-002-86

Sizing Related:

Russian Nominal Allowable Stress = [σ] = Minimum (σUTS/2.6,σYS/1.5)

ASME Design Stress Intensity = Sm = Minimum(σUTS/3,σYS/1.5)

Pri. Membrane Russian

For NOC < [σ]

For AOO < 1.2 [σ]

For DA < 1.4 [σ]

Hydro Test < 1.35 [σ]

UTS

Pri. Membrane ASME

For Level A < Sm

For Level B < 1.1 Sm

For Level C < 1.2 Sm

For Level D < 2.4 Sm or 0.7

Hydro. Test < 0.9 σYS

Example presented by Dr Vaze of BARC

Estimating VVER1000 RPV Thickness

RPV Thickness Calculation using ASME NB and PNAE G 7-002-86

- Russian Nominal Allowable Stress

[σ] = Minimum(539/**2.6, 441/1.5)** = **207.3 Mpa**

- ASME Design Stress Intensity

Sm = Minimum(539/**3, 441/1.5)** = **179.7 Mpa**

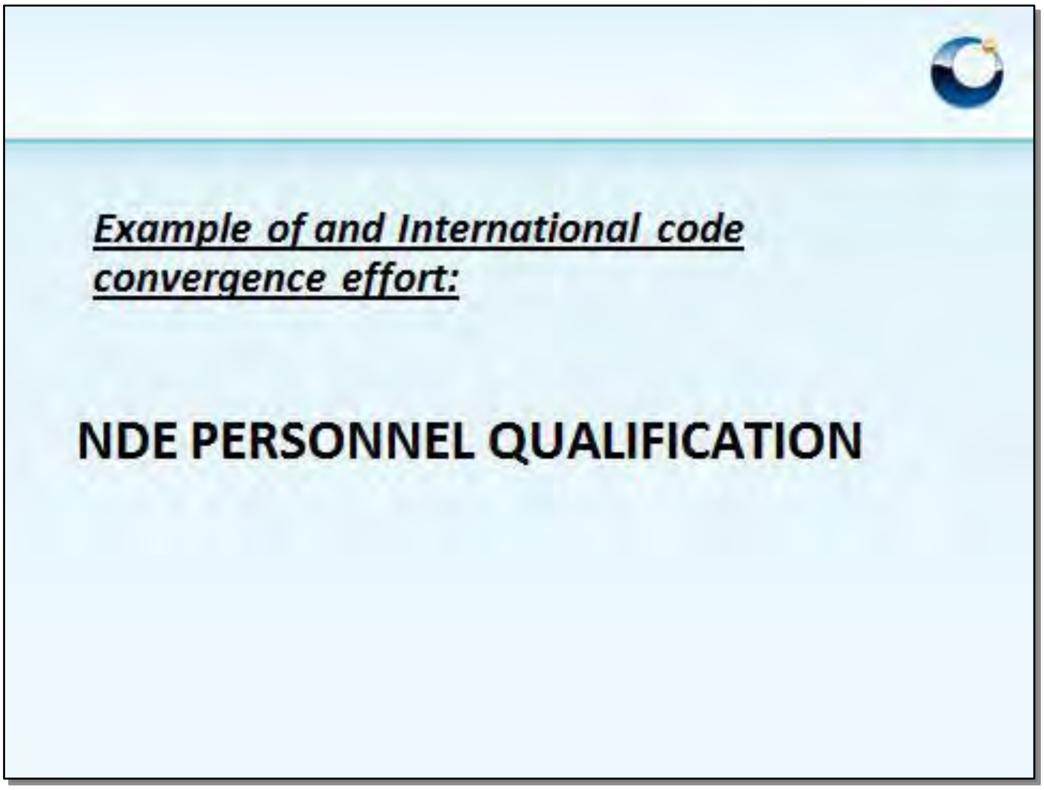
– ASME: Minimum thickness required = **214 mm**
– PNAE : Minimum thickness required = **185 mm**
– Actual thickness provided = **192.5 mm**

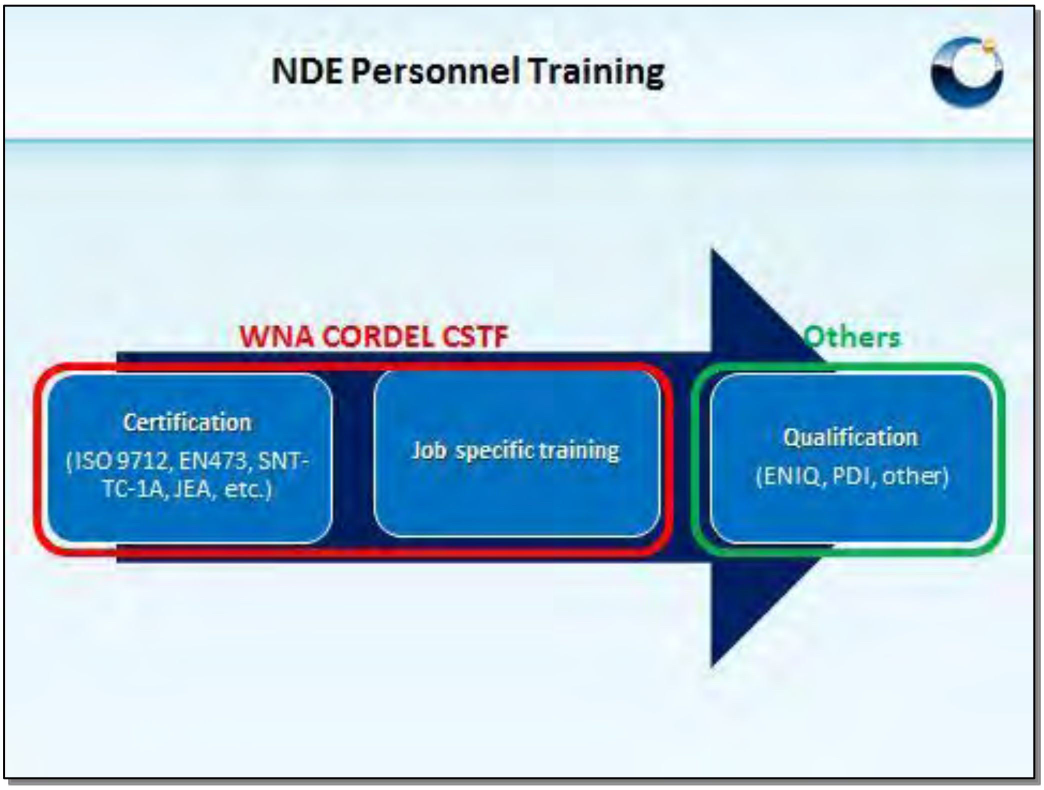
- Although actual thickness is less than the minimum required by ASME: **Is design less safe ? May or may not be**

Should we apply ASME equation to Russian design?

Harmonization of Safety Levels

- **Failure modes and the knowledge of Mechanics used are universal**
- **But code rules differ because of**
  - Regulatory Requirements and Limitations
  - Local Industry Practices
  - Qualifications of welders, NDE/T personnel and professional Engineers
  - QA and compliance requirements
  - Scope Differences


Example of and International code convergence effort:
NDE PERSONNEL QUALIFICATION


NDE Personnel Training
WNA CORDEL CSTF
Others
Certification
(ISO 9712, EN473, SNT-TC-1A, JEA, etc.)
Job specific training
Qualification
(ENIQ, PDI, other)

NDE Certification requirements divergence : Is there really an issue?

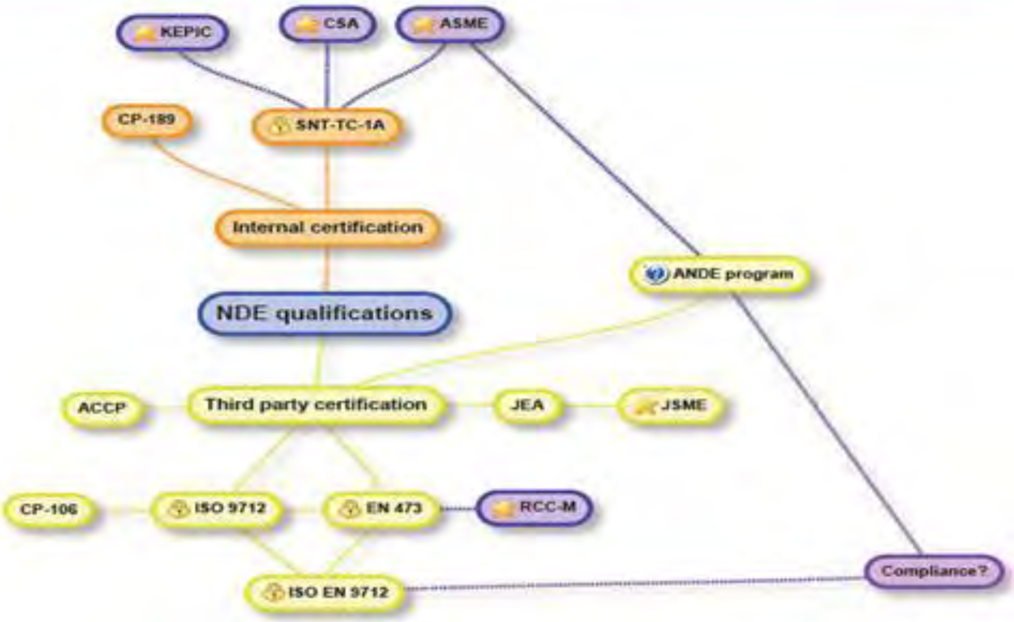
- Certification Codes are currently being used in a range of industries.
- Certification requirements for NDT Personnel defined in design codes as well regulatory bodies. This can lead to a number of issues:
  - International manufacturing of components
  - Competition between code and regulatory requirements
  - Mobility of the work force
- Convergence efforts should be taken collaboratively between the national regulators and the Standard Development Organisations
- Manufacturing supply chain is global and so it is key to have confidence that the level of NDE is of a minimum standard wherever it is performed.
  - There has been much debate in industry of the management of SNT-TC-1A certification and also how different countries have interpreted EN 473
  - NDE harmonization or base-lining will go some way to alleviate these concerns.

NDE Certification requirements divergence : Is there really an issue?

- Two main certification procedures are employed
  - Company based programs such as SNT-TC-1A
  - Third Party certification programs such as ISO 9712 and EN 473

Code	ASME	RCC-M	JSME	KEPIC	CSA	NIKIET
NDE Certification standard	SNT-TC-1A CP-189 CP-106 ACCP	NF EN 473	JIS Z 2305 (ISO 9712 MOD)	SNT-TC-1A (MOD)	SNT-TC-1A / CGSB	PNAEG-7-010-89

Scope of the NDE Issue



How is convergence achieved?

➢ **Working on convergence of topics important to Industry and Regulators**

- Convergence of ISO 9712 and EN 473 has already been achieved
- Development of third party certification program in ASSME (ANDE)

➢ **Collaboration with code developers and code users**

- Discussion with ANDE development committee regarding compatibility with harmonised ISO EN 9712
- Providing comparisons between ISO EN 9712 and ANDE Drafts
- Participation in exploratory meetings on NDE Qualification developments (ASME)
- Discussion and collaboration with a range of SDOs
- Keeping the discussion going with regulators (MDEP)

Leading the drive to code convergence

- **Promote the inclusion of third party certification in ASME code**
  - Talks with EPRI to develop a draft code proposal to include third party certification into ASME
  - Promote the same inclusion in codes based on ASME code

- **Work with international and regional NDE bodies**
  - Identify the similarities and differences between the ANDE and ISO EN 9712
  - Promote compatibility of the two codes and MOUs between certification bodies

- **Changes must come from code developers, promoted by code users and supported by regulators**

Phased approach: non-technical topic

Convergence of NDE Certification codes

- Close collaboration with the ASME NDE Qualification Code development committee
- Provide independent comparison between ANDE and ISO EN 9712
- Raising awareness of international practices and codes

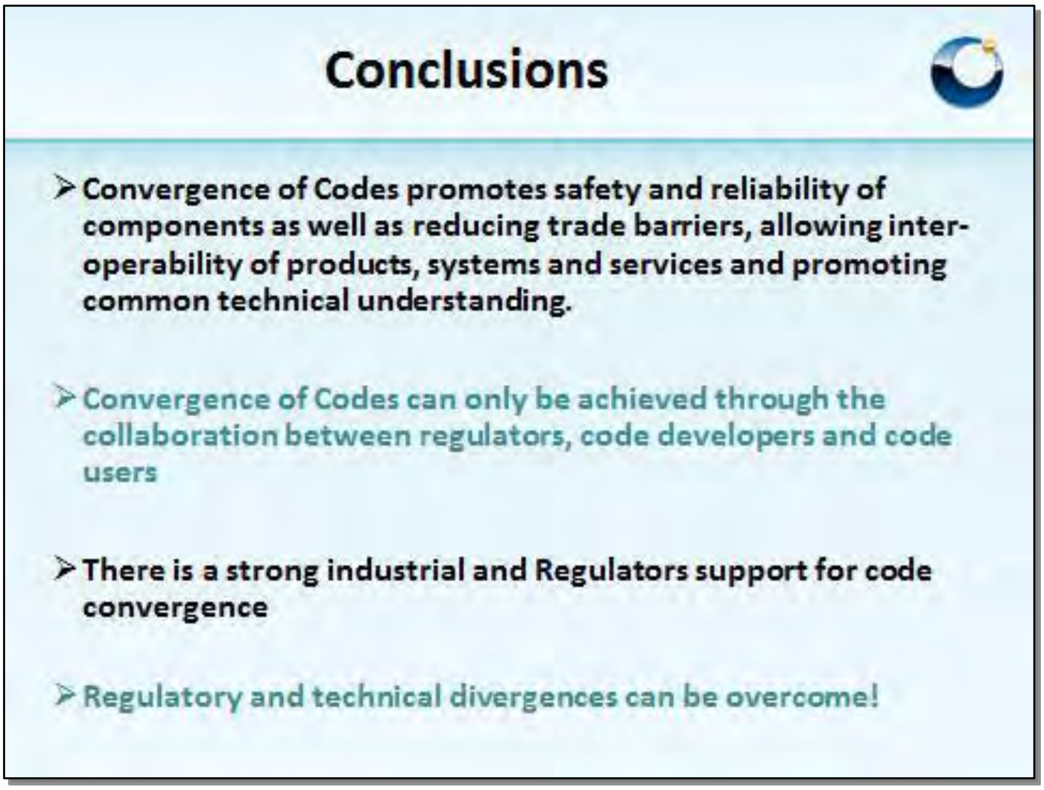
Inclusion of Third party certification within section V

- Section V will serve a repository of the requirements for third party certification
- Referenced by other code sections

Working with international bodies for the recognition of equivalence of major third party certification

- Discuss with countries that follow ISO 9712 codes
- Discuss with international bodies promoting harmonisation of requirements such as EFNDT and ICNDT


Going forward: technical topic
Status / proposal with technical background document
Presentation of Document to SDO Board of Convergence
Presentation of Document to MDEP-CSWG


Conclusions
➢ Convergence of Codes promotes safety and reliability of components as well as reducing trade barriers, allowing inter-operability of products, systems and services and promoting common technical understanding.
➢ Convergence of Codes can only be achieved through the collaboration between regulators, code developers and code users
➢ There is a strong industrial and Regulators support for code convergence
➢ Regulatory and technical divergences can be overcome!

Any Questions?

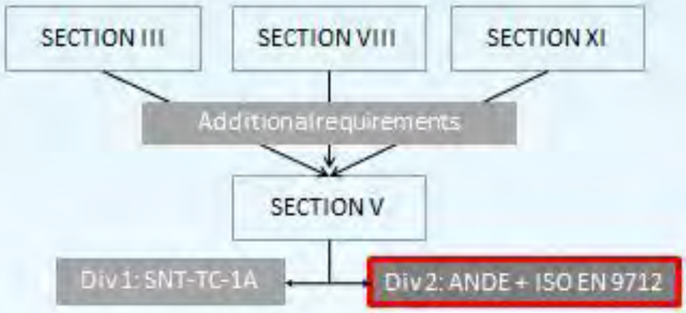
THANK YOU FOR YOU ATTENTION!

Proposed Change to ASME Sect.V

CURRENT	PROPOSED
T-120 GENERAL	
(e) For those documents that directly reference this Article for the qualification of NDE personnel, the qualification shall be in accordance with their employer's written practice which must be in accordance with one of the following documents:	*No change to T-120(e)*
(1) SNT-TC-1A,[1] Personnel Qualification and Certification in Nondestructive Testing; or	*No change to T-120(e)(1)*
(2) ANSI/ASNT CP-189,3 ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel	*No change to T-120(e)(2)*
(f) National or international central certification programs, such as the ASNT Central Certification Program (ACCP), may be alternatively used to fulfill the examination requirements of the documents listed in T-120(e) as specified in the employer's written practice.	*(f)* National or international central certification programs, such as the ASNT Central Certification Program (ACCP) or ISO 9712:2012-based programs, may be alternatively used to fulfill the training, experience, and examination requirements of the documents listed in T-120(e) as specified in the employer's written practice.

NDE Qualification Expert Group

- **Document 2:** Draft a inclusion to ASME Section V, proposing to include third party certification to be included in ASME (ANDE & ISO EN 9712)



NDE Document Scope

- **The document is expected to be around 5 - 7 pages and include two sections:**
  - The first section would identify the current requirements for NDE Certification in ASME and other major national codes.
  - The second section would be a draft code sub-section defining the requirements for third party certification using ASME NDE standard and ISO EN 9712 standard.
- **Section 1 shall include (but need not be limited to):**
  - Identification of the sections and subsections of ASME codes referring to employer based certification requirements under SNT-TC-1A and CP-189
  - Identification of any additional requirements of each section and sub-section for employer based certification
  - Identification of the sections and subsections of the ASME codes referring to third party certification schemes (i.e. ACCP, others)
  - Identification of any additional requirements of each section and sub-section for third party certification
- **Section 2 must include** a draft proposal for the inclusion of ANDE and ISO EN 9712 into the ASME code (note: ANDE will be published as an ASME Standard). The document should be of a form suitable for inclusion in ASME Section V as a division on third party certification requirements which could then be referenced by the ASME Sections.

Codes Considered

- RCC-M: B 3200 and C 3200 and appendix ZF
- ASME III: NB 3200 and NC 3200 and Appendix XIII New Code cases
- JSME
- RCC-MRx: RB3200 and RC 3200 and Appendices 3 and 10
- ASME VIII Div 2 Part 5
- EN 13445 Appendix B
- UK-R5 rules recently added

Stress Classification

Stress classifications

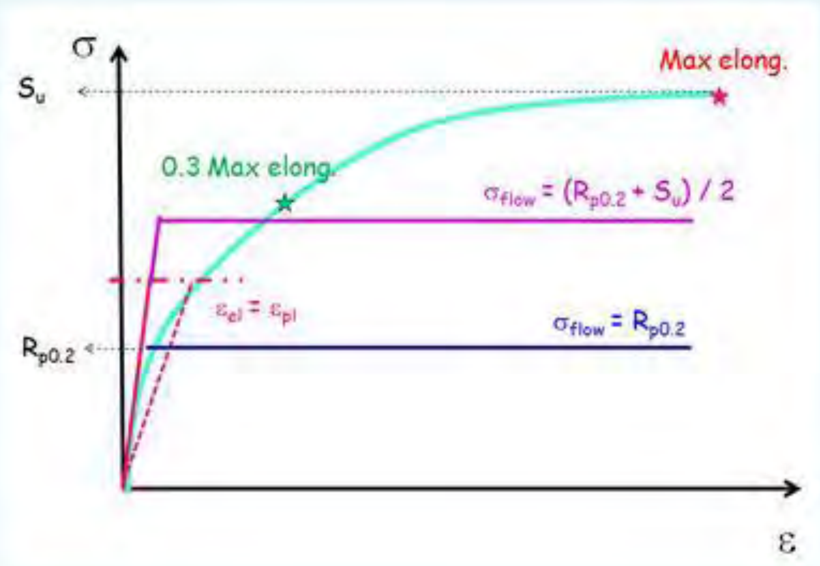
- *Loading conditions considered*
- *Failure Modes*
  - Failure due to mechanical or thermal loading
  - elastic or elasto-plastic instability (buckling),
  - progressive deformation induced by repeated loads (ratcheting/shakedown),
  - fatigue and fast fracture.
- *Definition of stresses*
- *Stress classification*
  - *Primary*
    - *General Primary*
    - *local primary membrane stress*
    - *the Primary bending stress*
  - *Secondary*
    - *expansion stresses*
    - *membrane secondary stresses*
    - *bending secondary stresses*
  - *Peak stresses*
- *Stress limits*

Non linear analysis in Component Design

- 3 different groups of applications:
  - Monotonic loads
    - excessive deformation (global elastic behavior)
    - plastic instability (gross plasticity failure)
    - Stress classification
  - Cyclic loads
    - Plastic amplification of cyclic strain amplitude: Ke and/or Kv
    - Plastic shakedown: 3Sm rule
    - High seismic loads: non-linear time history
  - Buckling associated to compressive loads
- Material properties required for different temperature
  - Monotonic stress-strain curves and elastic modulus
  - Stabilized cyclic stress-strain curves
  - Different strain hardening models / material constitutive equations

---

- Different methods for monotonic loads
  - Limit load analysis on initial geometry:
    - theoretical limitation / flow stress value
    - excessive deformation / plastic instability (???)
    - computation technique: FEA / specific computer codes (displacement/stress FE)
  - Direct elastic-plastic analysis
    - Stress-strain curve / max deformation level (engineering versus true stress-strain curve)
    - Large displacement / large strain for plastic instability
    - Allowable strain:
      - double elastic strain criteria for excessive deformation
      - a part of the maximum material elongation for plastic instability (5 to 10% ?)
- Other applications
  - Elastic stress classification: primary/secondary/local primary
  - Elastic compensation method: stiffness reduction of higher stress (E)
  - Particular case: piping system/plastic hinge/elastic follow-up



- Different methods for cyclic loads
  - Ke evaluation / direct strain amplitude evaluation
    - Ke = $\Delta\varepsilon_{plastic} / \Delta\varepsilon_{elastic}$
    - Definition of equivalent strain: Tresca, Von Mises, Rankin
    - Material stain hardening model: kinematic / isotropic / mixed
  - Ratcheting / Plastic shakedown analysis
    - Use of cyclic stress-strain curves
    - Material constitutive equations
    - FE Code limitation
    - Allowable cumulative strain

Summary

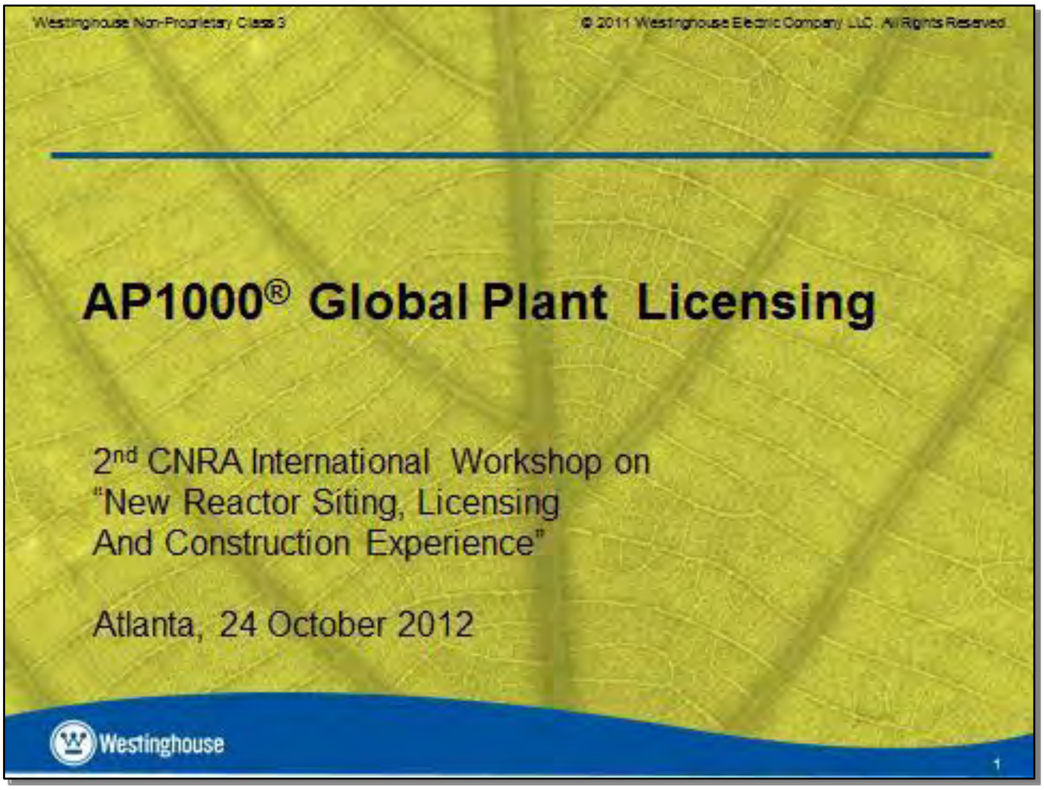
- Review of different design Code contents and scopes:
  - ASME, AFCEN (RCCM, RCCMRx), JSME, Russian
  - ASME VIII , EN 13445
- Comparisons of the contents
  - Geometry and tolerances
  - System / Component
  - Excessive deformation/ plastic instability / stress classification
  - Fatigue / Ratcheting
  - Other cyclic loads: high seismic level…
  - Buckling
  - Material properties, including temperature or radiation effects
  - Analysis tools and recommendations
- Preparation of a proposed Code Case, consistent with existing best practices and state of the art knowledge, associated to a "background document"

Going forward

Status / proposal with technical background document

Presentation of Document to SDO Board of Convergence

Presentation of Document to MDEP-CSWG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2nd CNRA International Workshop on
"New Reactor Siting, Licensing
And Construction Experience"
Atlanta, 24 October 2012
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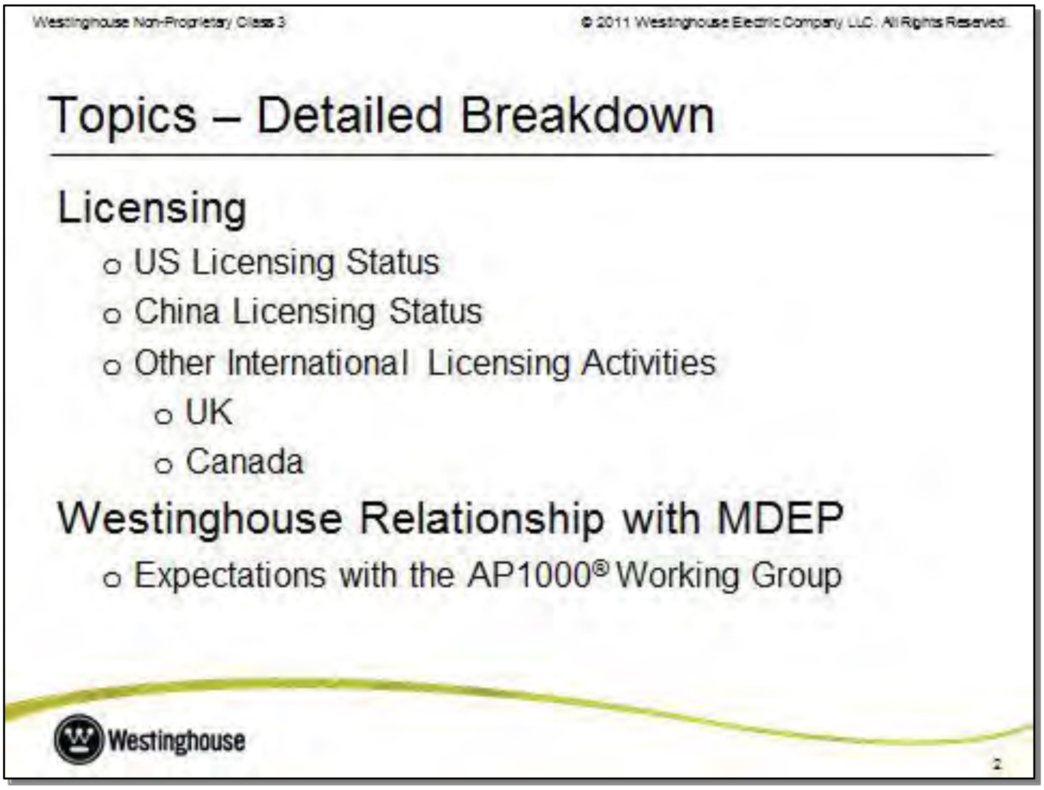
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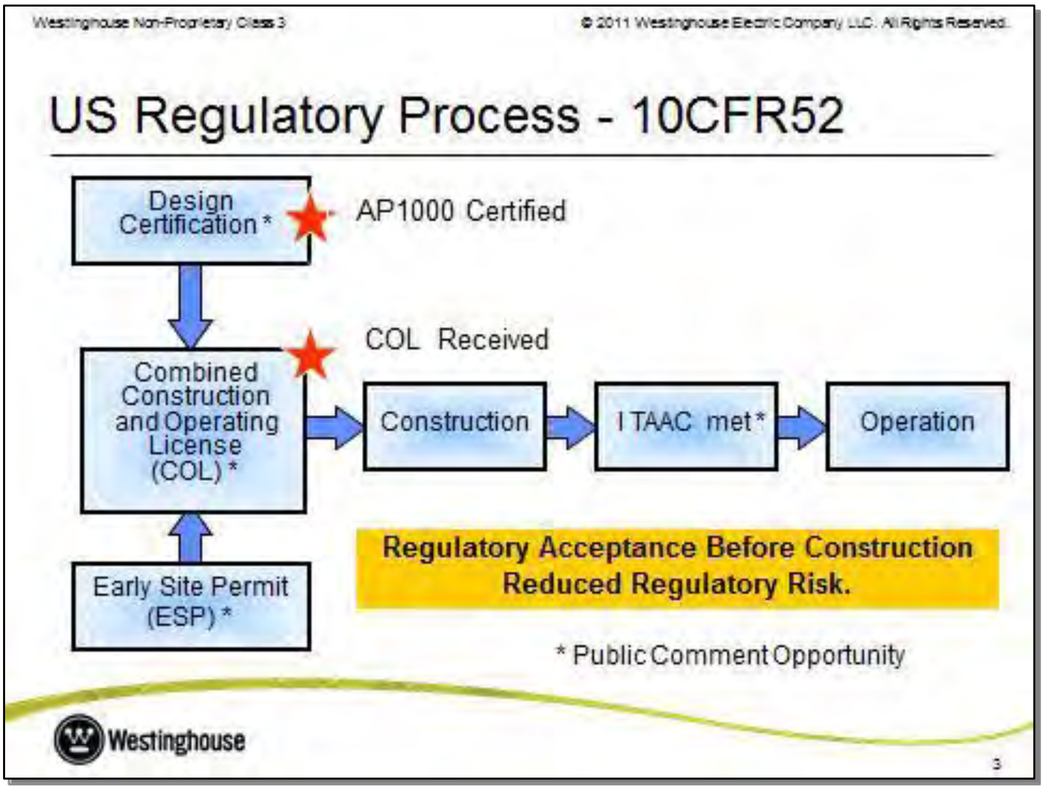
Topics – Detailed Breakdown
Licensing
o US Licensing Status
o China Licensing Status
o Other International Licensing Activities
o UK
o Canada
Westinghouse Relationship with MDEP
o Expectations with the AP1000® Working Group
Westinghouse
2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US Regulatory Process - 10CFR52
Design Certification *
AP1000 Certified
COL Received
Combined Construction and Operating License (COL) *
Construction
I TAAC met *
Operation
Early Site Permit (ESP) *
Regulatory Acceptance Before Construction
Reduced Regulatory Risk.
* Public Comment Opportunity
Westinghouse
3


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U.S. NRC Review and Approval
Amended Design Approval received from the US NRC in December 2011.
Amended AP1000 certification based on DCD Rev 19.
AP1000 Standard Design
Design Approval received from the US NRC in 2005.
Final Rulemaking in January 2006.
Original AP1000 certification based on DCD Rev 15.
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AP1000® in U.S.

NRC License Applications (12 AP1000 Units)

Southern Co. - Vogtle

COL Approved February 10,2012
Nuclear Construction February 10,2012

SCE&G- Summer

COL Approved March 30, 2012
Nuclear Construction April 2012

Progress Energy – Levy County

COL Approval 2013*

Duke Energy – W.S. Lee

COL Approval 2013*

Progress Energy – Harris

COL Approval 2014*

FPL- Turkey Point

COL Approval TBD

*Waste Confidence Rule resolution by the NRC will delay final license approval

Westinghouse

5

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International AP1000® PWR Licensing

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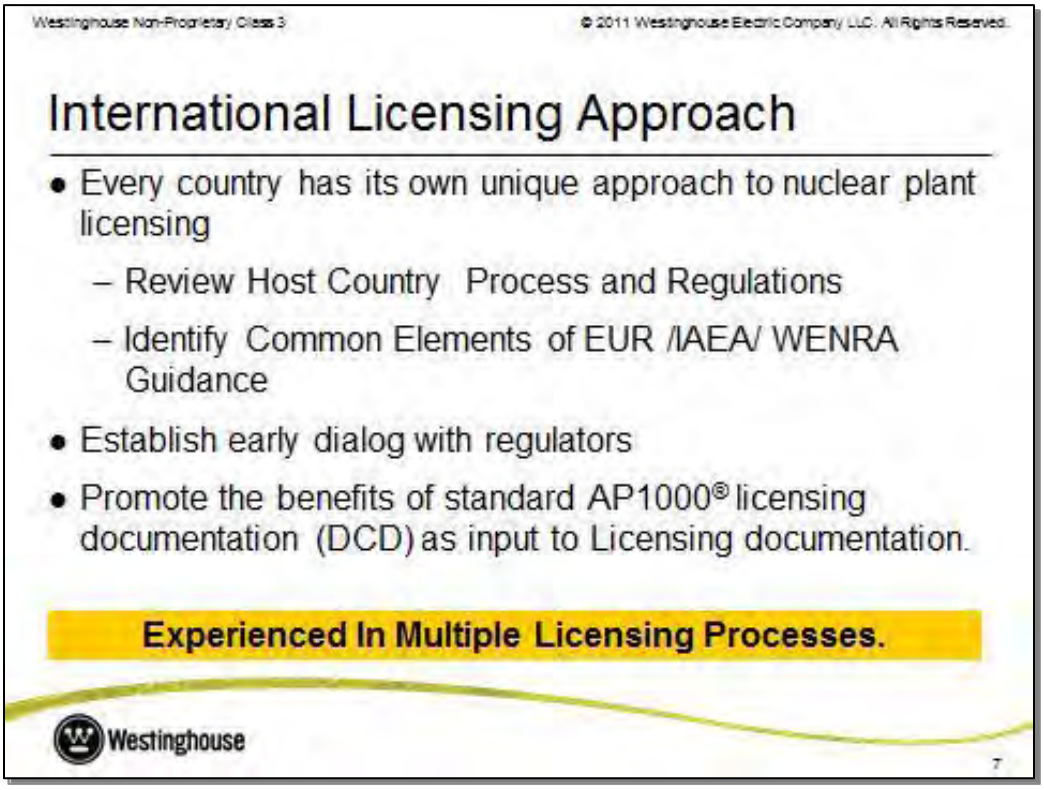
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International Licensing Approach
• Every country has its own unique approach to nuclear plant licensing
– Review Host Country Process and Regulations
– Identify Common Elements of EUR /IAEA/ WENRA Guidance
• Establish early dialog with regulators
• Promote the benefits of standard AP1000® licensing documentation (DCD) as input to Licensing documentation.
Experienced In Multiple Licensing Processes.
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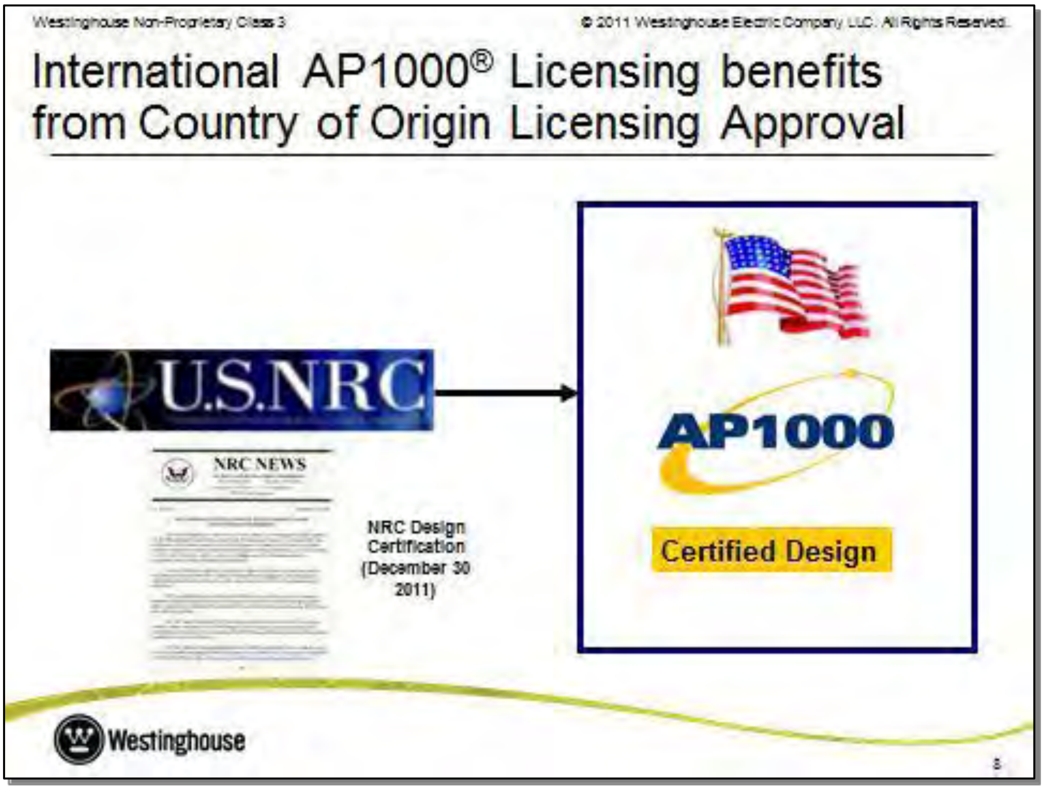
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International AP1000® Licensing benefits from Country of Origin Licensing Approval
U.S.NRC
NRC NEWS
NRC Design Certification (December 30 2011)
AP1000
Certified Design
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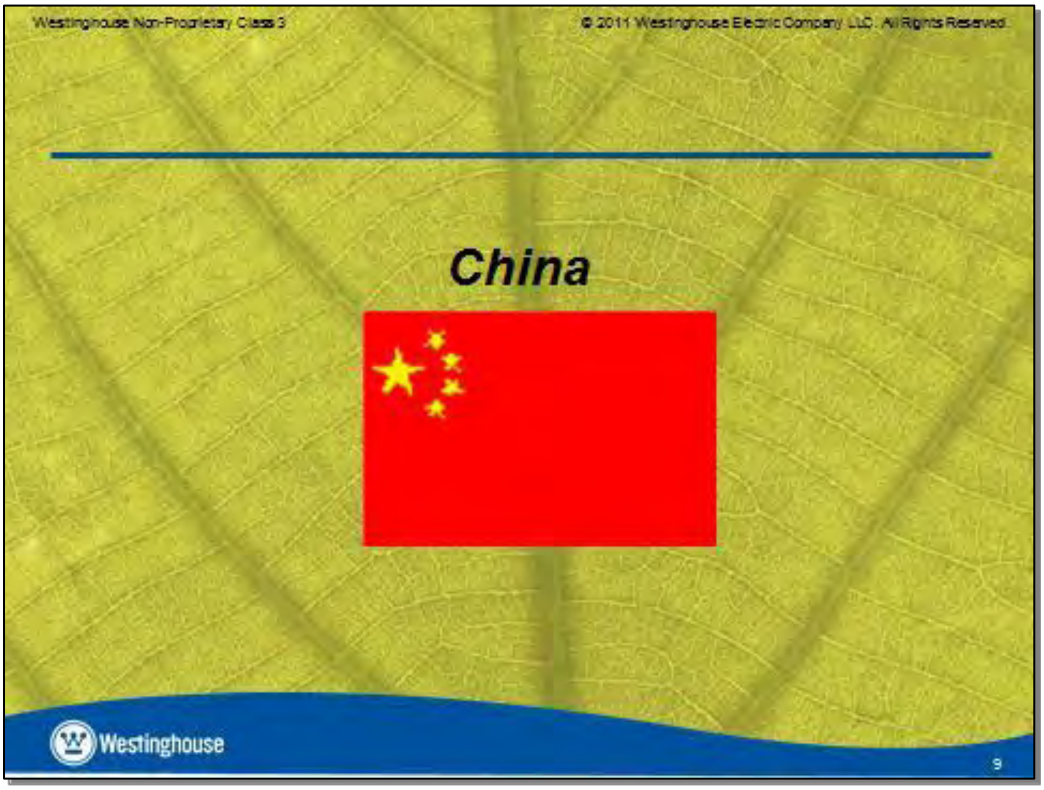
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China
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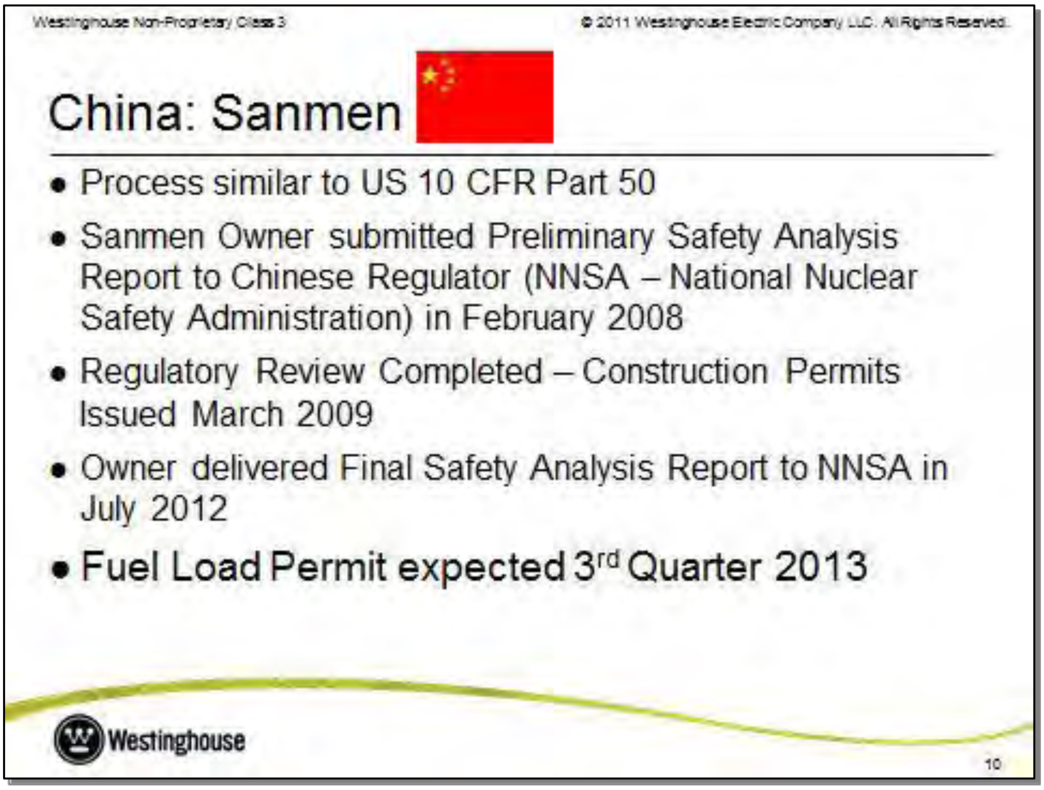
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China: Sanmen
• Process similar to US 10 CFR Part 50
• Sanmen Owner submitted Preliminary Safety Analysis Report to Chinese Regulator (NNSA – National Nuclear Safety Administration) in February 2008
• Regulatory Review Completed – Construction Permits Issued March 2009
• Owner delivered Final Safety Analysis Report to NNSA in July 2012
• Fuel Load Permit expected 3rd Quarter 2013
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China: Haiyang

- Preliminary Safety Analysis Report submitted to NNSA in May 2008
- Regulatory Review Completed – Construction Permits Issued – Sep 2009
- Owner delivery of FSAR to NNSA in 4th Quarter 2012
- Fuel Load Permit expected 4th Quarter 2013

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United Kingdom

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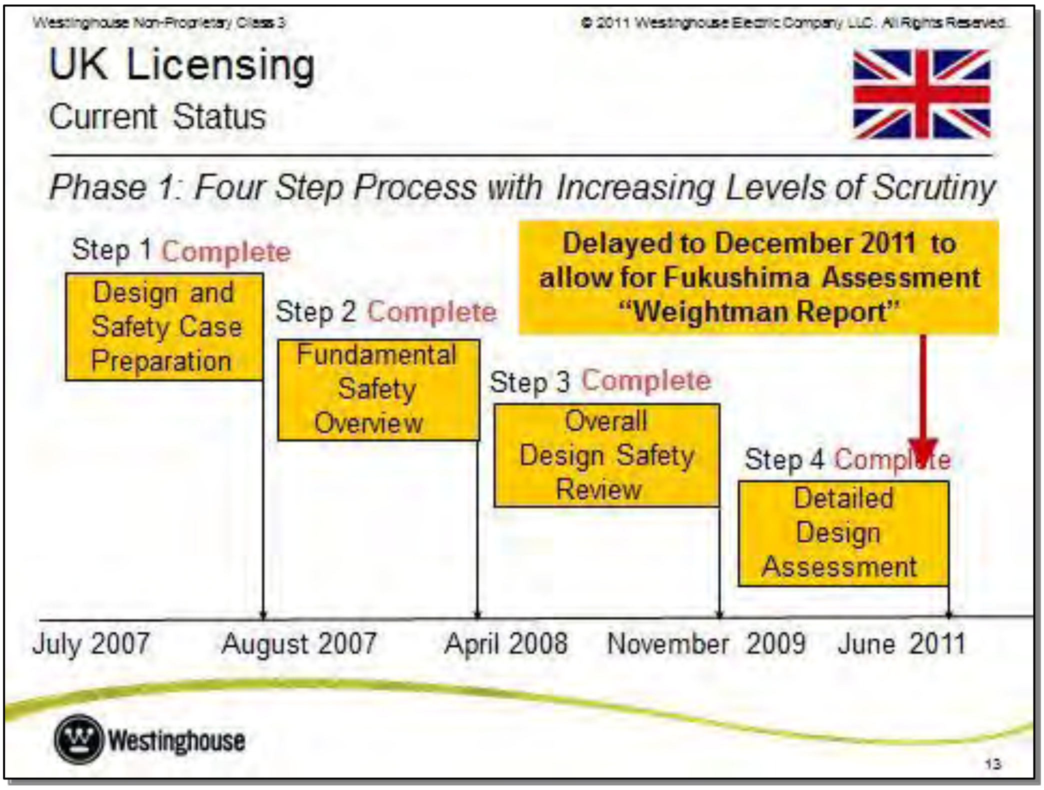
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UK Licensing
Current Status
Phase 1: Four Step Process with Increasing Levels of Scrutiny
Step 1 Complete
Design and Safety Case Preparation
Step 2 Complete
Fundamental Safety Overview
Step 3 Complete
Overall Design Safety Review
Step 4 Complete
Detailed Design Assessment
Delayed to December 2011 to allow for Fukushima Assessment "Weightman Report"
July 2007
August 2007
April 2008
November 2009
June 2011
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Summary
• Resolution plans for open issues accepted July 2011
• Interim Design Acceptance Confirmation issued December 2011
• Final Design Acceptance Confirmation expected ~2 years after being selected by a Utility
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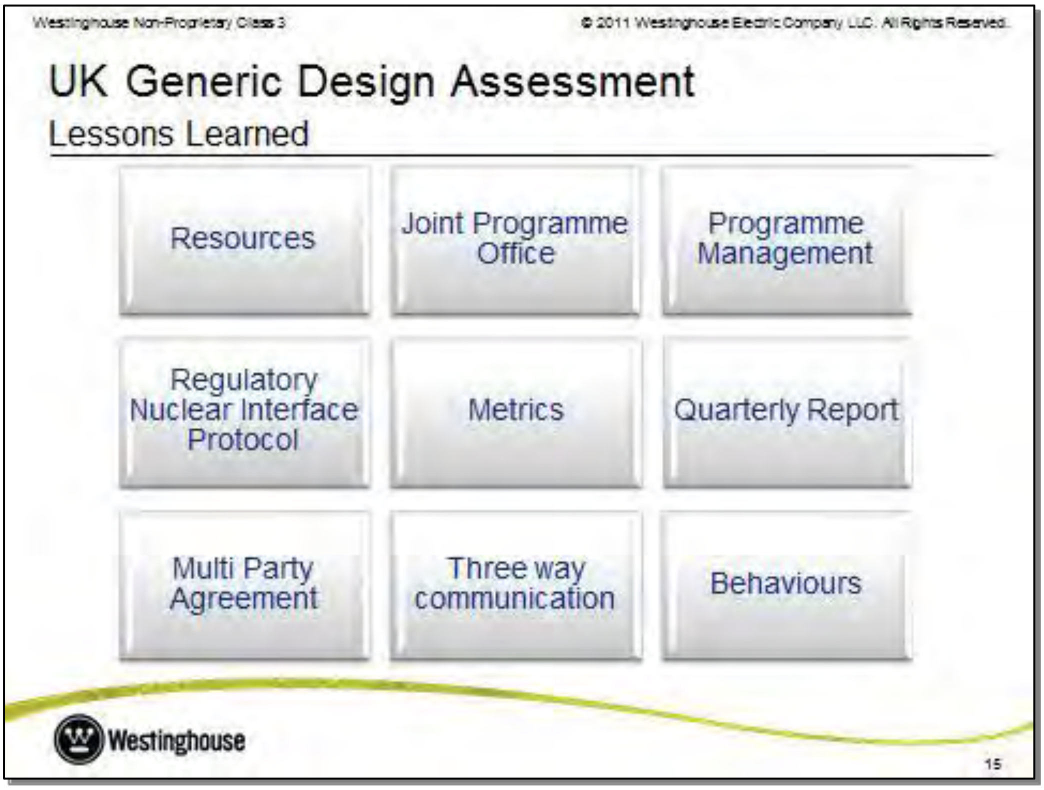
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UK Generic Design Assessment
Lessons Learned
Resources
Joint Programme Office
Programme Management
Regulatory Nuclear Interface Protocol
Metrics
Quarterly Report
Multi Party Agreement
Three way communication
Behaviours
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Canada
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Canada Licensing Activities

- Phase 1 pre-licensing review completed 2009
- Phase 2 pre-licensing review document prep commenced June 2012
  - Service Agreement with CNSC signed in September 2012
  - Submittals to 19 focus topics addressing issues identified by the CNSC in Phase 1
  - An audit of the Westinghouse design process
  - CNSC final Report expected by the end of June 2013

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Westinghouse Relationship with MDEP

- Expectations with the AP1000® Working Group
  - Regulators should be like-minded on requirements
  - Standard Plant should be licensable in each country
  - Country Specific design changes should be minimized
  - Transparency of MDEP Working Group members activities/collaboration

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Questions?
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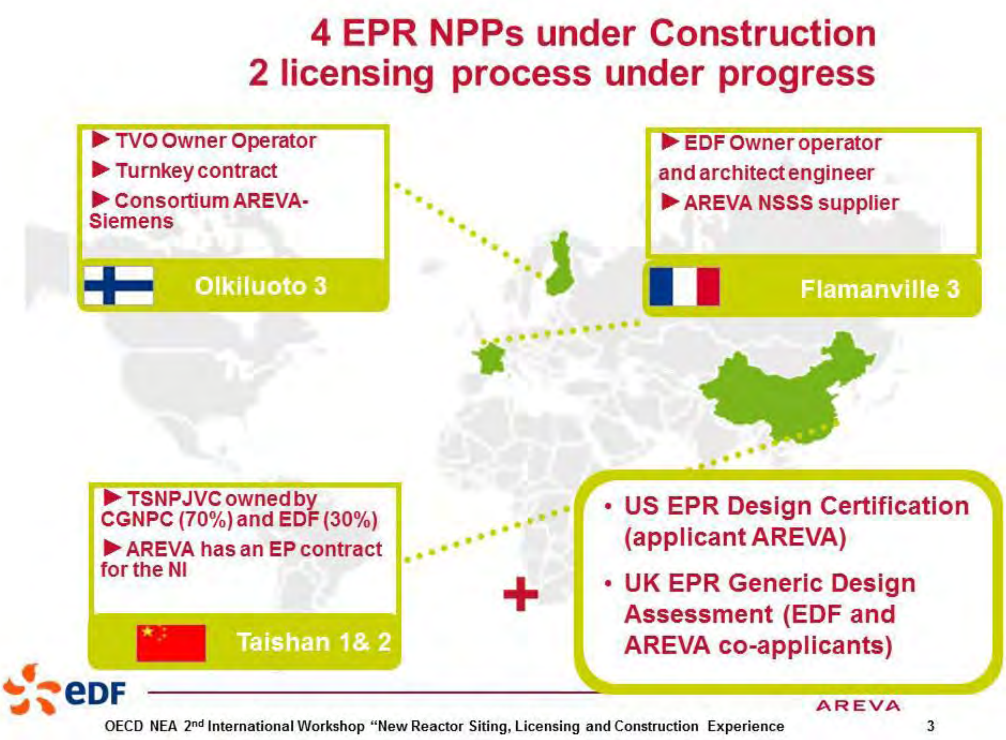
Session I: Regulatory Cooperation on Generic and Design Specific Issues MDEP Working Groups

EPR Family presentation

Xavier Pouget-Abadie
Safety International Delegate
Nuclear Engineering

François Bouteille
Senior Vice President
Safety and Licensing


4 EPR NPPs under Construction
2 licensing process under progress
▶ TVO Owner Operator
▶ Turnkey contract
▶ Consortium AREVA-Siemens
Olkiluoto 3
▶ EDF Owner operator and architect engineer
▶ AREVA NSSS supplier
Flamanville 3
▶ TSNPJVC owned by CGNPC (70%) and EDF (30%)
▶ AREVA has an EP contract for the NI
Taishan 1& 2
+
• US EPR Design Certification (applicant AREVA)
• UK EPR Generic Design Assessment (EDF and AREVA co-applicants)
EDF
AREVA
OECD NEA 2nd International Workshop "New Reactor Siting, Licensing and Construction Experience
3


EPR Family targets
▶ Sharing best practices for construction
▶ Managing critical supplies and spare parts
▶ Capitalizing on licensing experiences
▶ Preparing for commissioning and operation
▶ Ensuring consistency and reliability for the public information
Synergies and series effect between the different EPR projects
EDF
AREVA
OECD NEA 2nd International Workshop "New Reactor Siting, Licensing and Construction Experience
4

EPR Family charter

- EPR Family has been set up as a community of EPR operators and AREVA sharing experience and good practices through specific working groups
  - Safety and Fukushima follow-up
  - Preparation for Operations
  - Equipment Qualification
  - Start-up tests and Commissioning
  - Construction Feedback experience
- EDF and AREVA have more specific cooperation on design and engineering
- Cooperation programs are in place within EDF between TSN, HPC and FLA3 operators to prepare commissioning and align operating principles
  - Cross peer-reviews, secondees…
  - Systematic Approach to Training,
  - Maintenance (INPO AP 913),
  - OTS

EDF AREVA

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Harmonization of International Practices

- MDEP initiatives for harmonization of practices aiming at
  - Harmonizing regulatory frameworks
  - Harmonizing Codes and Standards
  - Sharing of resources and experience among regulators
- But efforts are still necessary to move towards mutual recognition mechanisms between nuclear regulators and international certification process
  - Reduction of uncertainties in licensing process
  - Homogeneous safety level worldwide
  - Facilitation for standardization of reactor designs
    - Licensable and constructible in every country with limited adjustments related to site specificities
- This work should be extended to manufacturing activities
  - Implementation of common international requirements for QA systems in the nuclear field, independent certification of QA systems recognized by "all"
  - Methodology for surveillance of manufacturing to be defined in common, then performed by a third party and recognized by all – with preparation of the corresponding file
- Other important harmonization initiatives are progressing in parallel
  - WENRA RHWG: Safety of new NPP designs booklet
  - IAEA standards
  - EDF and AREVA contributes as industry stakeholders

EDF AREVA

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Stabilized Industrial Process

- Experience acquired for the EPR main primary components manufacturing over the last decade allows
  - Definition of "Best Practices" for manufacturing
  - Definition of reference procedures and documents
  - For the whole set of components manufactured by AREVA
    - Large forged, molded and machined parts
    - Heavy components
    - Mobile components

Reactor Pressure Vessel – St-Marcel

» **For an optimized manufacturing process meeting high-quality requirements, in particular for forging of large ingots**

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Quality and Safety Processes

- Nuclear safety requires no compromise on quality
  - From Design to in-service inspection
- Quality requirements
  - Applied to our own processes
  - Extended to our partners and contractors
  - All over the supply chain
- Development of safety culture internally and externally
- AREVA Qualification process for contractors and suppliers
  - Quality management
  - Awareness of responsibility
- International recognition of competence of AREVA's inspection body

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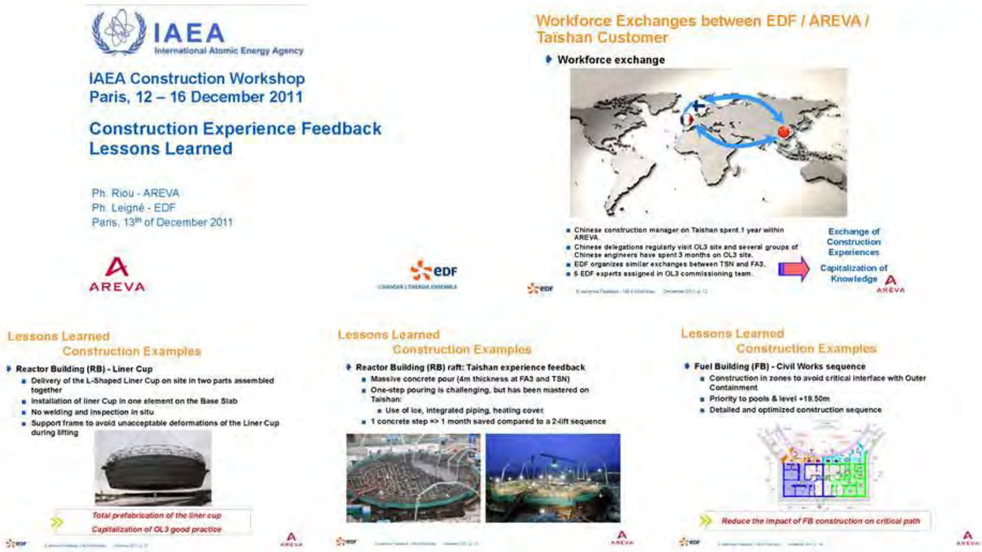
Joint EDF-AREVA actions on construction



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9

Aiming at Standardized EPR Nuclear Islands

- AREVA has developed a standard EPR™ concept combining
  - Reference design defined by technical features
  - Compliant with European Utilities Requirements
  - The unique AREVA licensing experience
  - Experience feedback from previous and current projects

- Cooperative work between EDF and AREVA for future common projects on this sound basis with focus on specific adaptation studies
- Potential for large scale effects for improved quality through stabilized industrial processes
  - AREVA manufactured primary components + subcontracted equipment
  - Reduction in lead time and construction durations
  - Possible anticipation of standard components' production
  - Strategic partnerships, qualification of local subcontractors to ensure a more dynamic response to market needs

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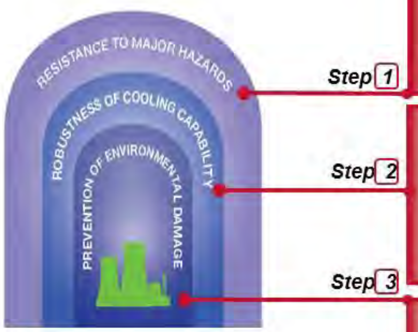
Assessment of EPR Robustness

analyzing safety issues after Fukushima, and assembling the solutions to address them



RESISTANCE TO MAJOR HAZARDS

EVENT:
External hazard: Earthquake, Flooding, Extreme Temperature
Internal hazard: broken pipe or valve, fire
Combination of hazards

OBJECTIVE:
Preserve plant safety

ROBUSTNESS OF COOLING CAPABILITY

EVENT:
External hazards beyond plant design (worse case scenario)

CONSEQUENCE:
Damage to cooling capability

OBJECTIVES:
Provide sufficient time to restore cooling capability
Avoid cliff edge effects (fuel damage) in reactor (incl. pools)
Preserve assets

PREVENTION OF ENVIRONMENTAL DAMAGE

EVENT:
Unforeseen event(s) creating extreme conditions

CONSEQUENCE:
Loss of safety functions, leading to hydrogen production, and fuel damage

OBJECTIVE:
Minimize external radioactive release

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Robustness of cooling capability

Behavior of the EPR (at power) Improvements & variants

- The initial post-Fukushima assessment of EPR shows good resistance to « beyond-design » earthquake or flooding events
- Potential improvements are identified to further enhance the EPR robustness:
  1. Means to connect mobile equipment for:
     1. Spraying cold water into containment
     2. Refilling EDG tanks and refilling SBO diesel tank from EDG tanks
     3. Refilling EFW tank
     4. Refilling the spent fuel pool (SFP)
  2. Provide electrical/manual device to down-lift the fuel assembly in the racks
  3. Provide adequate information for the SFP (additional instrumentation, qualified instrumentation, availability in control room)
  4. Means to permit external power supply (mobile generators): dedicated switchgears, cables
  5. Increase the 12-hour battery autonomy under investigation (to improve accident monitoring)
  6. Hydrogen control in the SFP hall under investigation (H2 production and distribution ?)
- Variants
  1. Containment venting as implemented on OL3 enabling to control releases. EDF assessment is ongoing

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Total loss of AC power supply discussion (1/2)

- ***WENRA : "… a loss of all AC power supply should be considered in the design. The nuclear power plant shall have arrangements to enable the decay heat removal in this situation".***
- ***AREVA/EDF proposal : "either the protection of the required electrical power supply is ensured against rare and severe hazards or a loss of all AC electrical power supply should be considered in the design for rare and severe hazards".***

Ongoing discussion with WENRA RHWG

Total loss of AC power supply discussion (2/2)

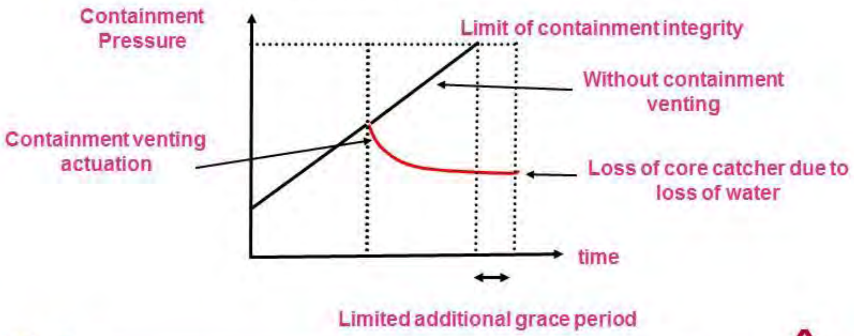
Context :

- ***Fukushima: core melt of 3 reactors with passive systems.***
- ***Essential cause : I&C loss because of DC power failure***
- ***All non protected systems could have been defeated.***
- ***Necessity to upgrade the protection against extreme external hazards***
- ***Bunkered electrical AC sources are foreseen as an additional line of defense in several countries***
- ***The industry must keep the responsibility of the technological solutions. Ex steam driven pumps vs. electrical pumps***

Discussion is taking place within the WENRA RHWG

Containment venting system(1/2)

- **Preliminary assessment performed shows:**
  - Large releases (containment failure) are prevented but EPR radiological targets are challenged after 3 days of operation possibly impairing emergency team work on site
  - The system does not increase significantly the grace period



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Containment venting system (2/2)

- The original safety objective set by the French and German Regulators in 1993 was to warrant containment integrity in case of low pressure core melt on the long term. Thus containment venting was not an "acceptable" design option
- For the EPR reactor the use of spray with the modification proposed for Flamanville 3 is preferred to containment venting as a baseline
- Provisions can be taken to implement a containment venting if it is required

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Towards harmonized safety positions

- EPR Family is committed to develop harmonized positions
  - Post Fukushima measures and modifications
  - …
- …but different regulatory practices and positions result in differences between EPR projects
- Convergence on safety standards will foster harmonization for future projects
  - WENRA Safety Objectives for New Power Reactors,
  - IAEA DS 367 on Safety Classification
  - …
- …but still more detailed work will be always needed by MDEP EPRWG to address design issues and avoid undue departures between projects

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Conclusion

- EPR Family experience benefits today to current and future EPR projects in terms of design, construction and preparation of operation,
- EPR Family welcomes MDEP EPRWG initiatives to promote harmonization of EPR safety features and mutual recognition mechanisms that would benefit to safety worldwide,
- Standardized reactor design accepted worldwide would reflect a mature technology with high quality and safety level.

EPR reactor construction site, Flamanville (France). 2012, September

EPR™ reactor construction site, Olkiluoto (Finland). 2012, September

AREVA and EDF are supporting MDEP work to strengthen its organization and other regulator initiatives to promote international harmonization

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WNA CORDEL report – What can nuclear learn from aviation?

Christian Raetzke
WNA CORDEL Director of Licensing

2nd CNRA International Workshop on New Reactor Siting, Licensing and Construction Experience
Atlanta, 24 to 26 October 2012

World Nuclear Association

Why we did the comparison

- WNA CORDEL WG promotes reactor design standardization and harmonization of safety standards
- First investigation into aviation regulation in the context of the CORDEL Roadmap (published in January 2010)
- DCM (Design Change Management) Task Force deals with consistent design development across fleets of the same design after licensing
- Results of research about safety regulation in aviation reflected in DCM paper "Design change management in the regulation of nuclear fleets", July 2012
- CORDEL WG decided to draft a dedicated paper on the comparison aviation-nuclear

2


How we did the comparison
• Scope of the report
– Written by nuclear people for nuclear people
– but based on expertise from WNA members active in both areas (e.g. Rolls Royce) and on advice from aviation experts
• Can aviation be a model for nuclear?
– "NPPs can't fly..." – it's true...
– ... but the common denominator is further development of safety in a highly regulated area within a strong international context
• Report to be published soon
3


Aviation report: contents
• Executive Summary
• I. Introduction
– Scope of the report
– Can aviation be a model for nuclear?
• II. The pillars of regulation in aviation
• III. The licensing of aircraft
• IV. Post-licensing aspects: continued airworthiness, design changes and repairs
– Continued airworthiness
– Design changes and repairs
• V. The special situation in Europe
• VI. Current initiatives and developments
• VII. Conclusion
4

The pillars of regulation (1)

AVIATION	NUCLEAR
1944 Chicago Convention. The Convention created the International Civil Aviation Organization (ICAO). ICAO is empowered to adopt and amend standards.	No single convention with the broad scope of the Chicago convention. IAEA and some topical conventions. Convention on nuclear safety is an incentive convention. IAEA broadly similar to ICAO...
ICAO standards on aircraft design safety (Annex 8 to the Convention) are binding	... but IAEA standards are not binding
ICAO USOAP as mandatory auditing tool	IAEA peer reviews are voluntary

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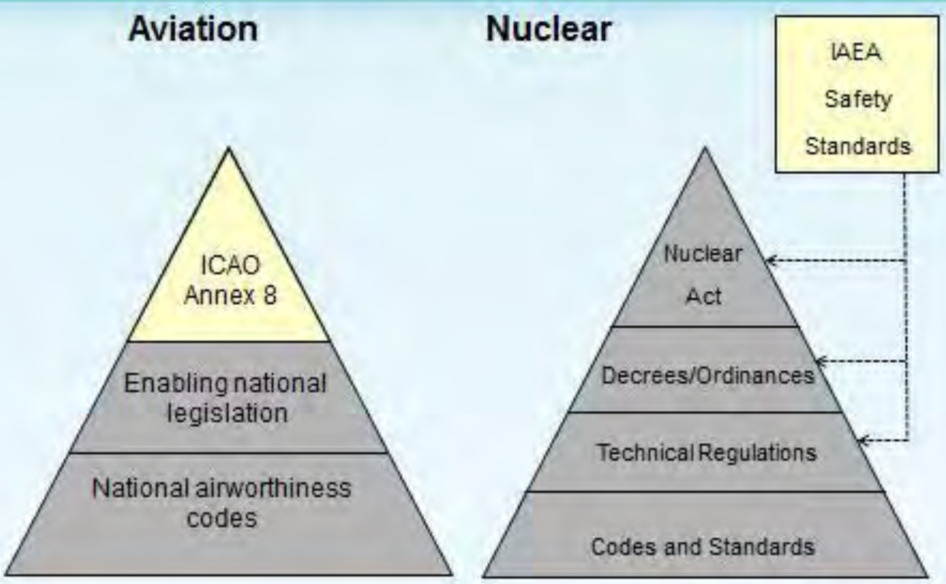
The pillars of regulation (2)



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The licensing of aircraft

AVIATION	NUCLEAR
Internationally standardised form of licensing of designs: Type Certificates (Annex 8)	No common standard, varies from country to country. Some countries have a generic design approval, others don't
Type Certificate: State of design first	Reactor design licence: State where FOAK is built
Each country needs its own TC...	Each country has its own full licensing process
... BUT: Mutual acceptance of TCs through Bilateral Airworthiness Agreements	No parallel in nuclear. No cross-border validitiy of design approvals

7

International licensing

8

Continued airworthiness

AVIATION	NUCLEAR
Reporting system assigning clear responsibilities to all parties and centering on designer and State of design	Several reporting systems (on regulator and operator side) but not as systematic
Systematic way of dealing with design improvements: Airworthiness Directive	No systematic approach, each regulator draws his own consequences
Important role of designer: continuing design responsibility	Prime responsibility for safety rests with the operator (licensee)

► **Strong link to the report of Design Change Management Task Force!**

9

Special situation in Europe

- Creation of EASA in 2002
- EASA cannot be taken as a benchmark for nuclear (too ambitious)...
- ... but the history is instructive: Joint Aviation Authorities (JAA) and Cyprus arrangements 1990
- Cyprus arrangements could be a blueprint for an agreement between nuclear regulators:
  - enhanced cooperation,
  - gradual alignment of standards and
  - acceptance of joint licencing procedures
  - while at the same time safeguarding the sovereignty of national regulators and ensuring their compliance with national legislation

10

Current initiatives and developments

AVIATION	NUCLEAR
Global Aviation Safety Roadmap and Global Aviation Safety Plan: reducing the accident risk in a context of growing air traffic	Post-Fukushima initiatives: enhancing the safety of NPPs but, as it seems, no reform of the international regulatory framework

In our view, the issue of strengthening nuclear safety requires bolder decisions which should go in the direction of stronger international cooperation of all stakeholders in a system of balanced and clearly attributed responsibilities and with some mandatory elements. **The regulatory system in aviation could be a useful benchmark.**

11

Benchmark for nuclear

- A system of licensing with a Type Certificate of the same scope issued in all countries
- Safety requirements based on common international minimum standards
- A system of mutual cooperation of regulators respecting the full sovereignty and competence of national regulators and allowing them to discharge their responsibilities
- A formal, internationally agreed system of safety upgrades to a fleet of like designs in all countries that operate that design
- An enhanced role of the designer/vendor in maintaining detailed design knowledge of the aircraft and in developing the design further, especially for safety significant aspects

12

SESSION II – REGULATORY POSITIONS ON SITING PRACTICES AND ENHANCEMENTS AS A RESULT OF LESSONS LEARNED FROM FUKUSHIMA ACCIDENT

Commission canadienne de sûreté nucléaire | Canadian Nuclear Safety Commission

Regulation of Site Selection and Preparation

Status of Siting Survey - Supplement 2

2nd CNRA International Workshop - October 25, 2012

Canada

Commission canadienne de sûreté nucléaire | Canadian Nuclear Safety Commission

Survey Background

- May 2008 – CNRA had formed WGRNR
  - Tasked to examine and document practices used by regulatory authorities in the regulation of nuclear power plant siting
  - Action "to develop…a survey on the regulation of nuclear sites, including seismicity issues, security issues, multi-unit aspects…"
- July 2008 - Survey issued
- All twelve member states responded
- October 2008 - Responses reviewed at Meeting #2

2

Canada

Survey Report

- January 2009 – First Draft issued for review
- March 2009 – Meeting #3 – Need further questions
- June 2009 – Revised report presented to CNRA
  - Supplementary questions approved
- September 2009 – Meeting #4 – Report discussed
- November 2009 - Report updated (now fifteen member states)
- December 2009 – Report presented to CNRA
- May 2010 Report published - NEA/CNRA/R(2010)3

3

Canadä

Report content

- High-level summaries per member state
  - Half-page on four topics
    - How are sites evaluated?
    - How is the preferred site selected?
    - How is the preferred site licensed or permitted?
    - How does the safety regulator oversee site preparation activities?
- Detailed responses from each member state
- Discussion / tentative conclusions

4

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Commission canadienne de sûreté nucléaire | Canadian Nuclear Safety Commission

Workshop #1 – September 2010

- Report conclusions presented
  - NS-R-3 forms basis of site selection
  - EA/EIS always required
  - Site is accepted by safety regulator
- Possible survey update proposed
  - Approaches to public consultation
  - Impact of the site on the design
  - Environmental assessment aspects
- To be considered at next meeting (March 2011)

5

Canada

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Impact of site on the design

- Impact was surveyed (Q3.5)
  - "external factors always play a major role when justifying the suitability of a selected site"
    - Natural or man-made
- Quote from Report
  - "...natural factors include seismology, geotechnics, meteorology and hydrology. Specific natural effects are considered in certain member states depending on local conditions, such as tsunamis, tornadoes, fires, drought or ice formation."

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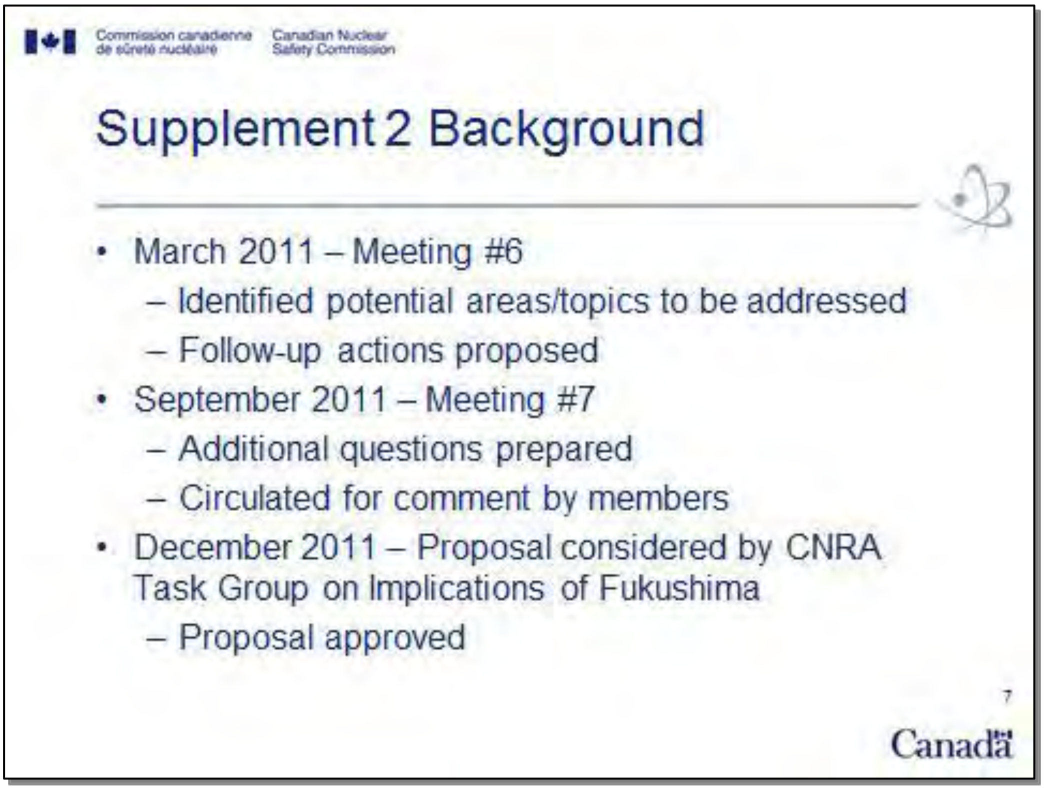
Canada


Commission canadienne de sûreté nucléaire
Canadian Nuclear Safety Commission
Supplement 2 Background
• March 2011 – Meeting #6
– Identified potential areas/topics to be addressed
– Follow-up actions proposed
• September 2011 – Meeting #7
– Additional questions prepared
– Circulated for comment by members
• December 2011 – Proposal considered by CNRA Task Group on Implications of Fukushima
– Proposal approved
7
Canadä


Commission canadienne de sûreté nucléaire
Canadian Nuclear Safety Commission
Supplement 2 and Responses
• March 2012 – Meeting #8
– Supplemental survey finalized
• May 2012 – Supplemental survey issued
– Seven questions/topics
– Some new points/ some re-visited
• Responses to date:
– Japan, U.K., India, U.S., Slovenia, Korea, Canada, France
8
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CNRA Direction

- June 2012 – CNRA Chair encouraged members to provide answers to the survey
- WGRNR charged to:
  - " conduct interactive workshop to discuss initial responses, obtain feedback on survey questions and…enhancements of the level of detail on the initial survey responses "
  - Prepare supplemental report Winter 2012
    - Regulatory approaches used…for NPP siting and enhancements or changes…as a result of the Fukushima accident

9

Canada

Commission canadienne de sûreté nucléaire | Canadian Nuclear Safety Commission

Q1 - Multi-Unit Sites

- Multi-Unit Sites
  - Limits on source term/number of units? (Contribution of all facilities to the source term including spent fuel storage, waste management and reactors.
  - Arrangement of units (distance, common equipment)
  - Arrangements to deal with impact on different facilities sited on one location (e.g., other industrial facilities)
    - During the siting review (or environmental assessment), do you consider potential impacts on the nuclear facility from co-located (or nearby) industrial facilities?

10

Canada

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A1 - Multi-Unit Sites

- No explicit limit on number of units per site
  - India apportions dose from normal operation
- Source term/safety goal/dose limit are per unit
  - All in-plant events to be considered
  - UK considers contribution of all facilities to source term but no specific limit applied
- Impacts from other units/facilities considered
  - Interaction to be evaluated/prevented
    - Distance limits may apply
  - Sharing of safety equipment is an issue

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Q2 – Site Layout

- Site Layout Considerations (utilizing natural and/or man-made features to minimize common cause initiators)
  - Describe considerations for establishing safety/support equipment/facilities locations based on site specific geographical features and potential vulnerabilities.

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A2 – Site Layout

- Generally no specific requirements to utilize natural or man-made features protect safety equipment
  - Viability of access roads after severe flooding
  - Place important equipment on highest ground
  - Question was not sufficiently clear
    - Did not ask about stations themselves
      - Stations are protected against flooding, other external events

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Q3 – External Hazards and Combinations

- Consideration of external hazards or combination of hazards at the siting stage.
  - Described extent of external hazards considered for the site and the source of the information used to establish the external hazard design basis.
    - Specifically, are there any changes being considered to update the return frequency for external events as a result of the Fukushima Accident?
  - Describe the human induced hazards considered for the site and the source of the information used to establish the design basis.
  - Describe the assessments made to consider combinations of external or human induced hazards with consequential internal events to establish a bounding case for overall site hazards.
  - Is the survivability of the local infrastructure and its ability to support site recovery assessed during the siting review?

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A3 – External Hazards – Part 1

- Natural
  - Geology, seismicity, meteorology (ice/snow, precipitation, drought, lightning, wind, storm surge, tsunami), hydrology, fires, climate change
- Man-made
  - Transport routes (explosion, release of corrosive or toxic liquid or gas), industrial activities, blasting, airplane crash, malevolent events
- Frequently many combinations of these
  - Consequential, not simultaneous
    - Internal flood/fire due to earthquake

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A3 – External Hazards – Part 2

- Analysis considers for both DBA and BDBA
  - Periodic re-evaluations performed
- Movement towards ‘Cliff-edge effects’
  - Small increase in hazard causes much larger consequence
- No overall move to re-evaluate return frequencies for DBAs
  - Japan is improving the seismic guide
  - UK is to re-consider adequacy

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Q4 – Land Use/Population Density

- Land Use/Population density
  - Describe considerations for existing population density during the siting review.
  - Describe any arrangements/agreements on future development of population centers or municipal development over the life of the facility.

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A4 – Land Use/Population Density

- Considered for emergency measures planning
  - May influence site suitability
    - US 10CFR100.20 and .21
  - Historically sites located in remote areas
- Exclusion zones apply with no residences
  - Some states place further limits on development
    - Finland must approve structures in that zone
- Typically no involvement of safety regulator in land use planning/limits on population growth

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Q5 - Emergency Preparedness

- Emergency preparedness arrangements/feasibility at siting stage
  - Describe acceptable level of established local/state/federal arrangements during sting review.

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A5 - Emergency Preparedness

- May be limited consideration at siting stage
  - Identify physical impediment to a plan and measures to eliminate/mitigate
  - Included in plans for any adjacent facilities
- Generally required prior to construction/operation
  - Applicant confirms with relevant jurisdictions that their emergency plans are adequate
- May be a topic regulator is unwilling to get into
  - Someone else's problem/jurisdiction

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Q6 - Social acceptability

- Social acceptability (Extent of public consultation)
  - Describe how the regulator and the applicants engage local population and what level of local agreement is needed to proceed.

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A6 - Social acceptability

- Proponent is expected to take the lead role
- No formal local agreement needed
  - Lack of agreement would need to be addressed
- Regulatory body sometimes also consults
  - Public Hearings often held on license

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Q7 – Design Parameters

- Practices/assessments to determine if NPP design parameters are enveloped or suitable for a given site.
  - Describe the specific design parameters that are evaluated against the site characteristics and any site specific design changes or additional design analyses needed when approving a site (e.g., seismic, meteorology, hydrology).
  - Describe the extent of regulatory review and/or requirements as to how specific site features or nearby facilities support extended station blackout.

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A7 – Design Parameters

- Grid availability and stability are important
- Station blackout generally considered in the design
- Some specify duration for on-site backup power fuel supply/battery duration

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Conclusions

- Perhaps too soon after Fukushima to expect requirements/expectations to have been revised
- IAEA Safety Standards should form the basis
  - SSR-1 to replace NS-R-3
- Safety case should include external events
  - Periodic re-evaluation advisable

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Next Steps

- Complete responses as requested by CNRA Chair
  - Review for adequacy/consistency, and update
- Update half-page summaries?
  - Changes as a result of Fukushima
- Prepare draft report
  - WG review (& approve?) – March 2013
- Feed into IAEA Fukushima report - 2014
- Longer-term harmonisation?
  - IAEA SSR-1 and its Guides

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Canadian Nuclear Safety Commission
Thank You for Your Attention!
• Questions/Comments?
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eia process and siting of temelin 3,4

Iva Kubanova
CEZ

CNRA International Workshop Atlanta
October 2012

content

- Temelin 3,4 Project Introduction
- Public Tender Status and Prospective
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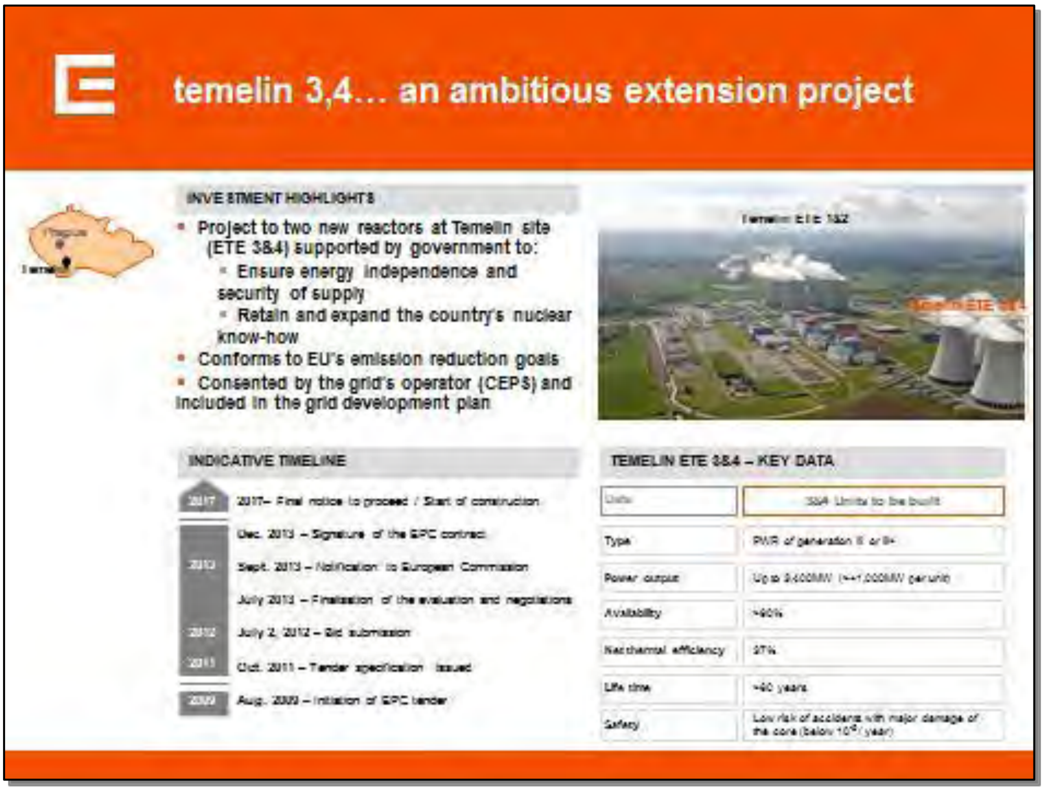
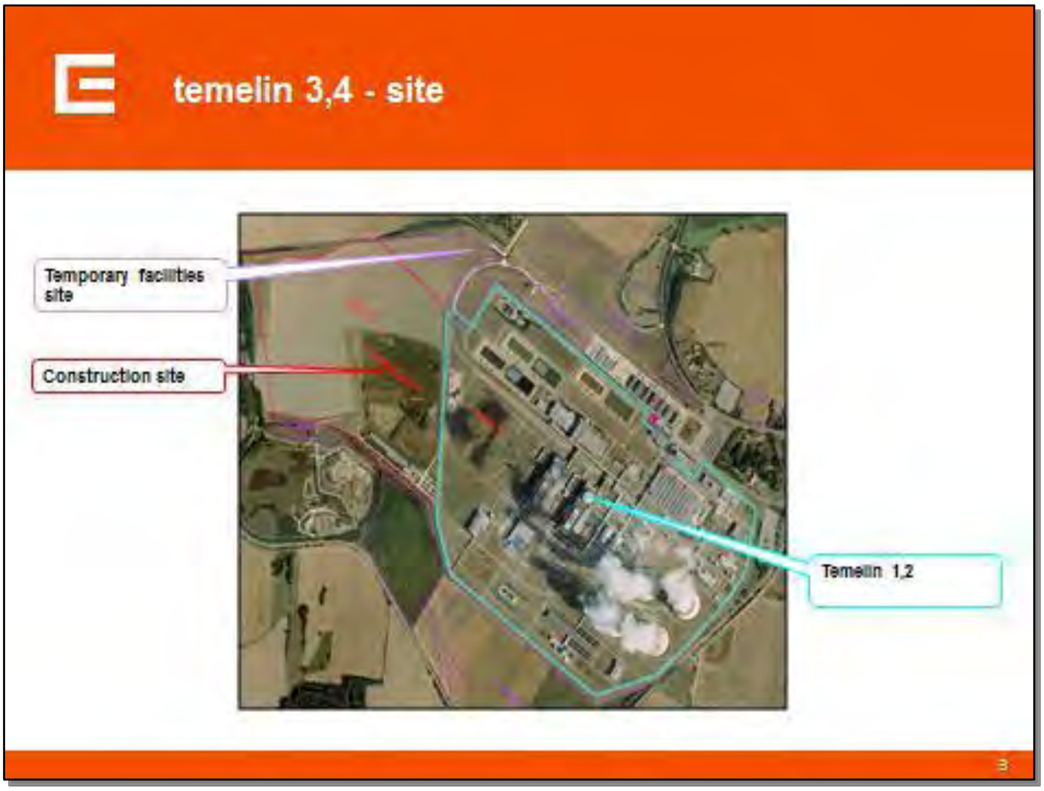
- Discussion


temelin 3,4… an ambitious extension project
INVESTMENT HIGHLIGHTS
Project to two new reactors at Temelin site (ETE 3&4) supported by government to:
Ensure energy independence and security of supply
Retain and expand the country's nuclear know-how
Conforms to EU's emission reduction goals
Consented by the grid's operator (CEPS) and included in the grid development plan
Temelin ETE 1&2
INDICATIVE TIMELINE
2017
2017– Final notice to proceed / Start of construction
Dec. 2013 – Signature of the EPC contract
2013
Sept. 2013 – Notification to European Commission
July 2013 – Finalisation of the evaluation and negotiations
2012
July 2, 2012 – Bid submission
2011
Oct. 2011 – Tender specification issued
2009
Aug. 2009 – Initiation of EPC tender
TEMELIN ETE 3&4 – KEY DATA
Units
3&4 Units to be built
Type
PWR of generation III or III+
Power output
Availability
Net thermal efficiency
Life time
Safety
Low risk of accidents with major damage of the core


temelin 3,4 - site
Temporary facilities site
Construction site
Temelin 1,2
3

temelin 3,4 – basic setting

Safety and licensing requirements

- The best European industrial safety practise
- Czech legislation, IAEA standards, WENRA recommendations for new reactors, ICRP, ...
- Concept of standard design from the country of origin (minimum modifications, if licensable / permittable in the Czech Republic)
  - relatively small country with small fleet of NPPs
- Standard design should be independently reviewed in the country of origin or in EU
- Reference plant should have license (at least for construction) in the country of origin or in EU
- Site design basis must be reflected

standard design a reference plant

Standard design and its independent review

- repeated generic solution exists
- safety standard is established
- unproven features are minimal

design is prepared

Reference plant and its license

- one of standard design applications for specific site and licensee exists
- detailed architecture of plant is more or less prepared

solution was „bought" by licensee
and licensed by nuclear regulator
not first of the kind solution

fukushima impact / reflection

Project settings

- public support of nuclear energy decreased in 2011 and increased back to the original level in 2012 (66 %)
- international atmosphere more complicated, higher differentiation of opinions (EC, neighboring countries Austria, Germany as main representatives of anti-nuclear position versus other countries, either neutral or pro-nuclear)
    - generally not ideal situation in energetic market
- investor of nuclear project needs governmental / political support; more than before Fukushima
- more flexibility and readiness for potential changes of the Project necessary
- communication, public relations extremely important; more than before Fukushima

content

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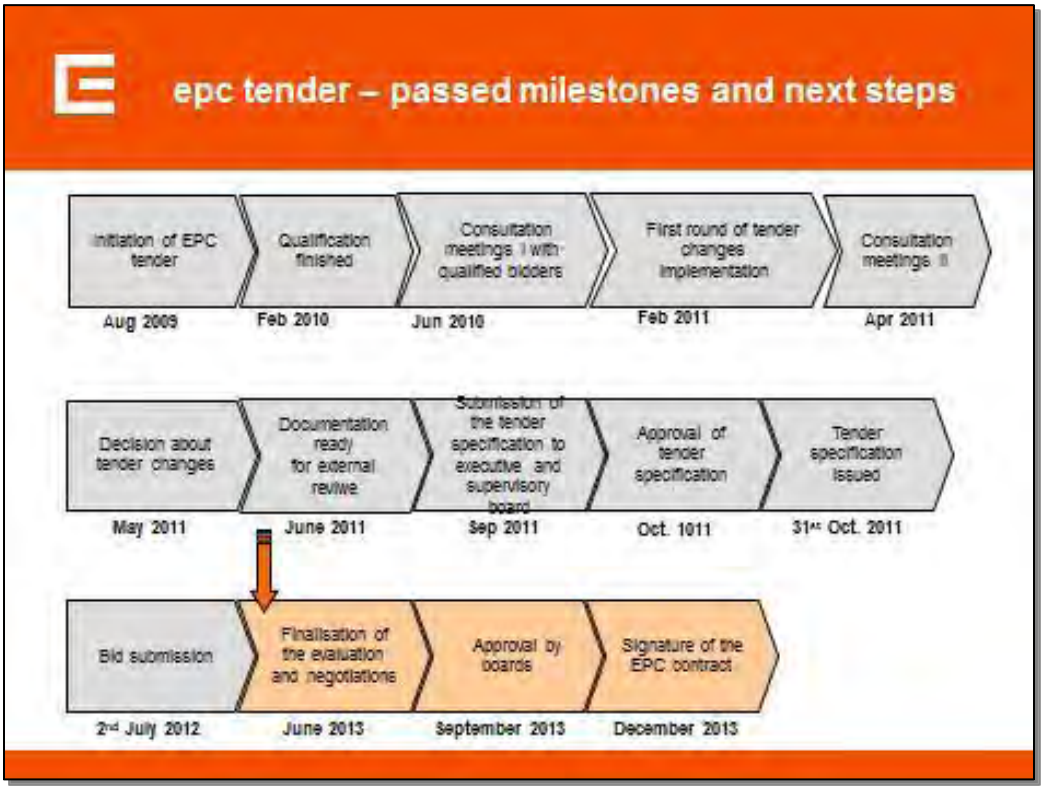
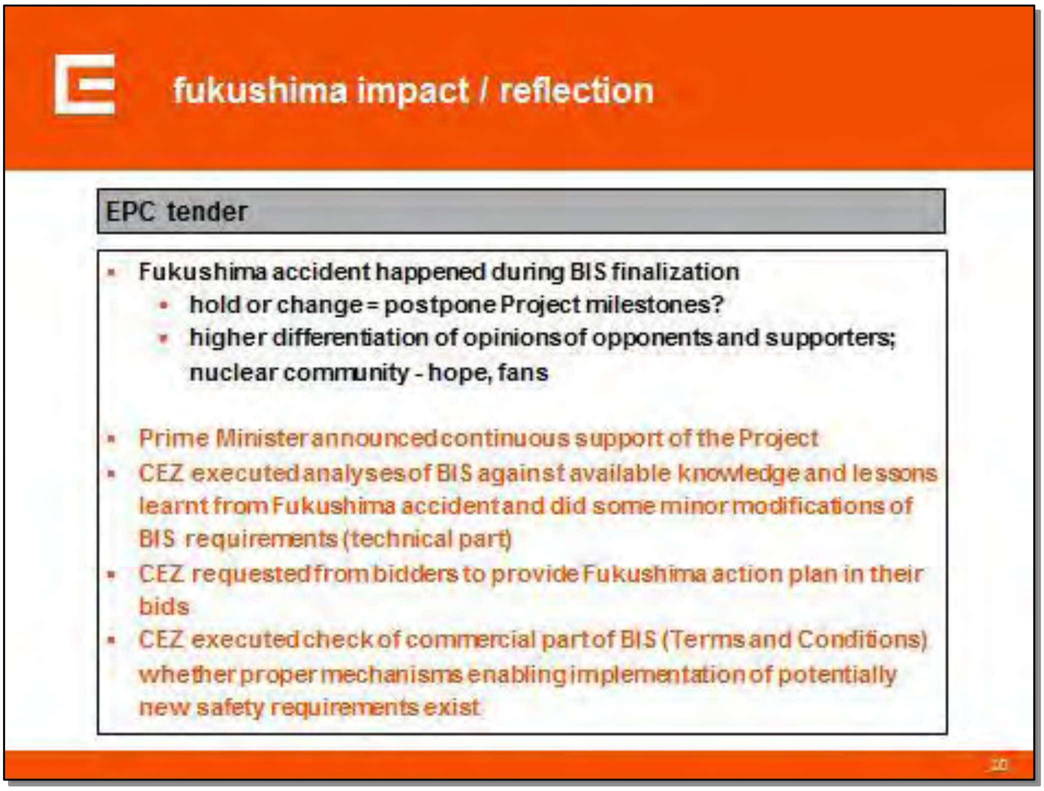
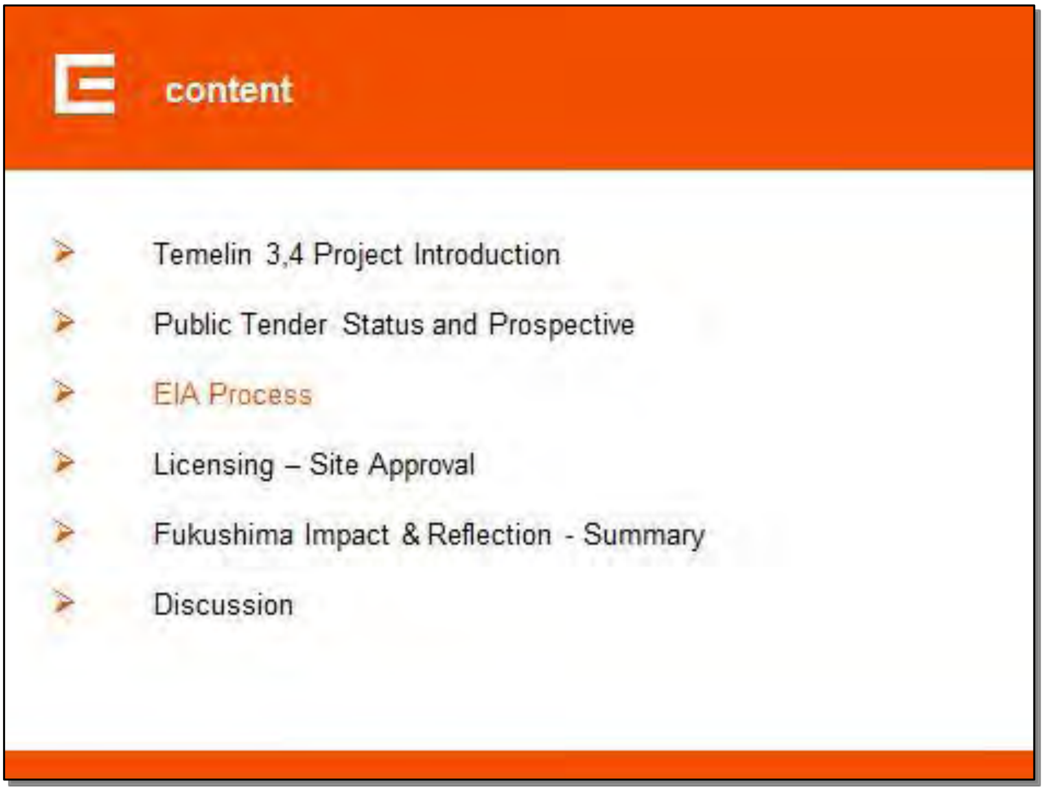

epc tender – passed milestones and next steps
Initiation of EPC tender
Aug 2009
Qualification finished
Feb 2010
Consultation meetings I with qualified bidders
Jun 2010
First round of tender changes implementation
Feb 2011
Consultation meetings II
Apr 2011
Decision about tender changes
May 2011
Documentation ready for external reviwe
June 2011
Submission of the tender specification to executive and supervisory board
Sep 2011
Approval of tender specification
Oct. 1011
Tender specification issued
31st Oct. 2011
Bid submission
2nd July 2012
Finalisation of the evaluation and negotiations
June 2013
Approval by boards
September 2013
Signature of the EPC contract
December 2013


epc tender process
Competitive open process
Tender procedure compliant with European Union and Czech public tendering
Balanced technical and commercial criteria for bids evaluation
2 nuclear technology leaders currently in competitive bidding stage
AP1000
Westinghouse Electric Company LLC
Westinghouse Electric Czech Republic s.r.o
EPR
Areva NP SAS
MIR
SKODA JS a.s
ZAO Atomstroyexport
OAO OKB Gidropress


fukushima impact / reflection
EPC tender
Fukushima accident happened during BIS finalization
hold or change = postpone Project milestones?
higher differentiation of opinions of opponents and supporters; nuclear community - hope, fans
Prime Minister announced continuous support of the Project
CEZ executed analyses of BIS against available knowledge and lessons learnt from Fukushima accident and did some minor modifications of BIS requirements (technical part)
CEZ requested from bidders to provide Fukushima action plan in their bids
CEZ executed check of commercial part of BIS (Terms and Conditions) whether proper mechanisms enabling implementation of potentially new safety requirements exist


content
Temelin 3,4 Project Introduction
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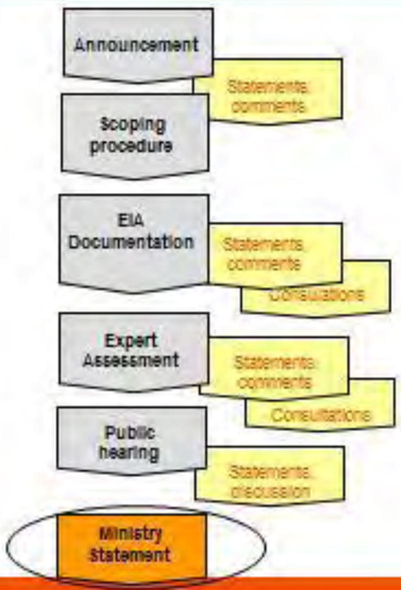
eia process for plant parameters envelope

plant parameters envelope method was applied due to time optimisation of initial Project steps; method is also being applied in USA, Canada, Finland ...

- all relevant parameters of reference plants were collected and those most unfavorable to the environment were selected and utilized as envelope of limiting parameters serving as inputs for environmental impact assessment (incuding source term for radiological impacts calculation)
- although opponents attack this method because of uncertainty, accordingly our opinion the method is acceptable; it is safe and conservative enough for such a case when technology supplier is not selected, EIA documentation does not work with imaginary plant but with specific values of parameters

technology which will be finally selected must be in compliance with plant parameters envelope specification

we are in late stage of eia process



✓ statements of relevant administration bodies and municipalities and public
✓ statements of interested parties (foreign state) accordingly Espoo / Aarhus convention

✓ statements of relevant administration bodies and municipalities and public
✓ statements of interested parties (foreign state) accordingly Espoo / Aarhus convention, questions/answers

✓ statements of relevant administration bodies and municipalities and public
✓ statements of interested parties (foreign state) accordingly Espoo / Aarhus convention, questions/answers

✓ room for statements of anybody who is interested

public discussions in austria and germany
public hearing in cz – ceske budejovice

- Prime Minister offered public discussions to Austria and Germany as goodwill expression
- delegation of the Czech Republic was nominated from ministries, nuclear regulator (State Office for Nuclear Safety), CEZ, expert groups
- public participation low (Vienna, Passau); participants mainly from antinuclear activists organizations, green parties, etc
- public participation in Ceske Budejovice: 150 people
- discussions lasted many hours (17 hours in Ceske Budejovice), they were not focused on environmental impacts too much but mainly on nuclear energy acceptability and nuclear risks acceptability


Vienna - opponent


Passau – security
measures


Passau - demonstration
abschalten
Das Atomrisiko ist grenzenlos.
Kein AKW in Bayern und Temelin!
TAXI


Ceske Budejovice - demonstration
mstopp.at
Oberösterreich
TEMELIN
NUKES
WASTE
TIME!


Ceske Budejovice - demonstration


Ceske Budejovice - hall


Ceske Budejovice - supporter
Ich bin für Temelin und ATOMKRAFT


Ceske Budejovice - outside
NÍ HALA

fukushima impact / reflection

EIA process

- Fukushima accident happened during EIA process
- in Europe stress tests were introduced for NPPs in operation and construction (not for NPPs in preparation); nevertheless some additional information derived from Fukushima accident were requested by EIA documentation evaluator (raw water issues, electrical systems requirements, seismic hazard and site monitoring details, detailed information about radiological impacts of DBA and DEC)
- opponents increased their activities throughout the EIA process

- CEZ prepared requested information in due date
- CEZ prepared carefully its team for consultations with foreign experts; important was not underestimate situation
- communication, public relations extremely important more than before Fukushima

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licensing and permitting steps it land planning phase

- 1st step: EIA process

  EIA final Ministry statement – expert input for the following proceedings

- 2nd step : Siting license accordingly Atomic Law

  issues State Office for Nuclear Safety after evaluation of Initial Safety Analyses Report; approved Quality Assurance Program as a precondition (2010)

  plan : before contract signature (2013); Initial Safety Analyses Report shall be handed over to vendor as input

- 3rd step : Site decision accordingly Building Law

  issues building authority after evaluation of Site Decision Documentation

  plan : after contract signature; estimation 2015

site approval by sons – initial safety report

✓identify, describe and evaluate characteristics and proves of site from the point of view of nuclear facility siting criteria

✓describe and evaluate (preliminarily):

Project concept

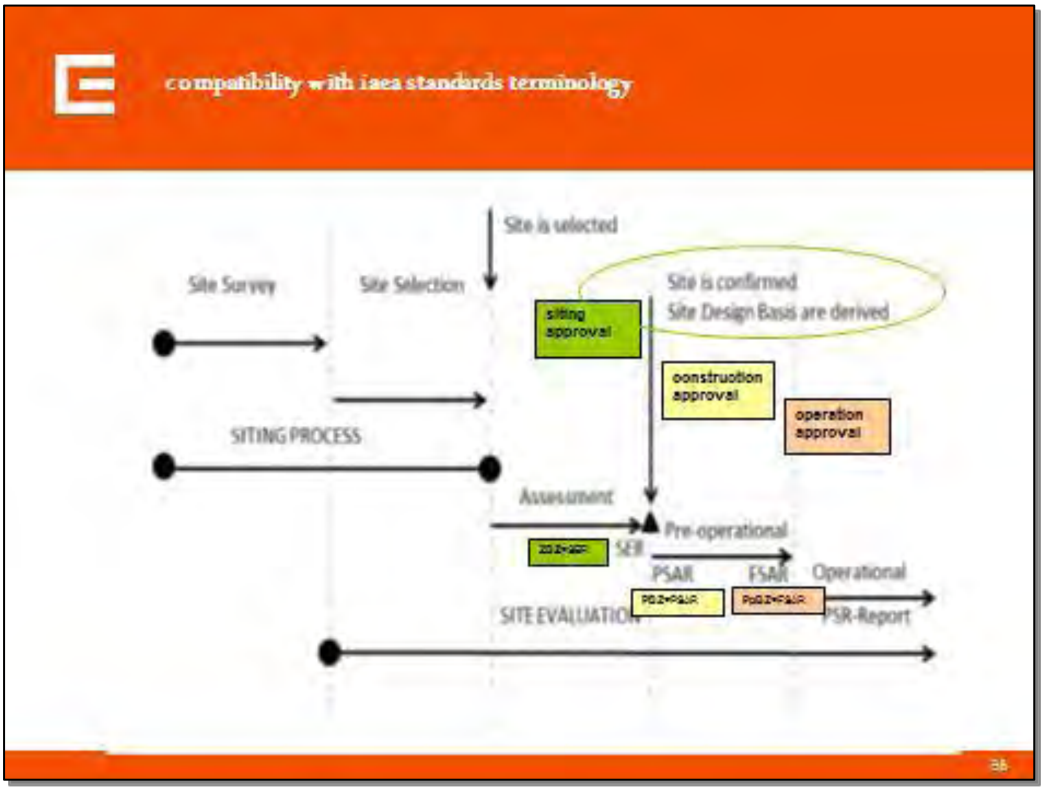
from the point of view of nuclear safety, radiation protection, emergency preparedness regulations

impact of future operation to staff, population, environment

decommissioning concept draft

✓describe and evaluate quality assurance during siting and quality assurance requirements for next stages

✓analyze needs for physical protection; confidential part



fukushima impact / reflection

Siting – first nuclear license

- nuclear safety standards under continuous revision (before and also after Fukushima accident), „floating" licensing base
- lessons learnt and newly defined requirements in limited scope (longterm matter)
- site suitability evaluation crucial

- CEZ reflected revised safety requirements in Initial Safety Report (Czech legislation, WENRA, IAEA standards - requirements level) several times during elaboration
- SONS introduced some new „post Fukushima" guidelines, CEZ follows them
- site is not new, we used available data, updated them or added new ones, also methods of evaluation were verified, upgraded
- focus on seismic hazard (good practice: paleoseismic research)
- IAEA mission requested for seismic hazard validation

content

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fukushima impact/reflection – summary remarks

Political support

- political support is crucial, nuclear Project compliance with national long-term energy concept necessary

Strenghtened nuclear safety & safety culture

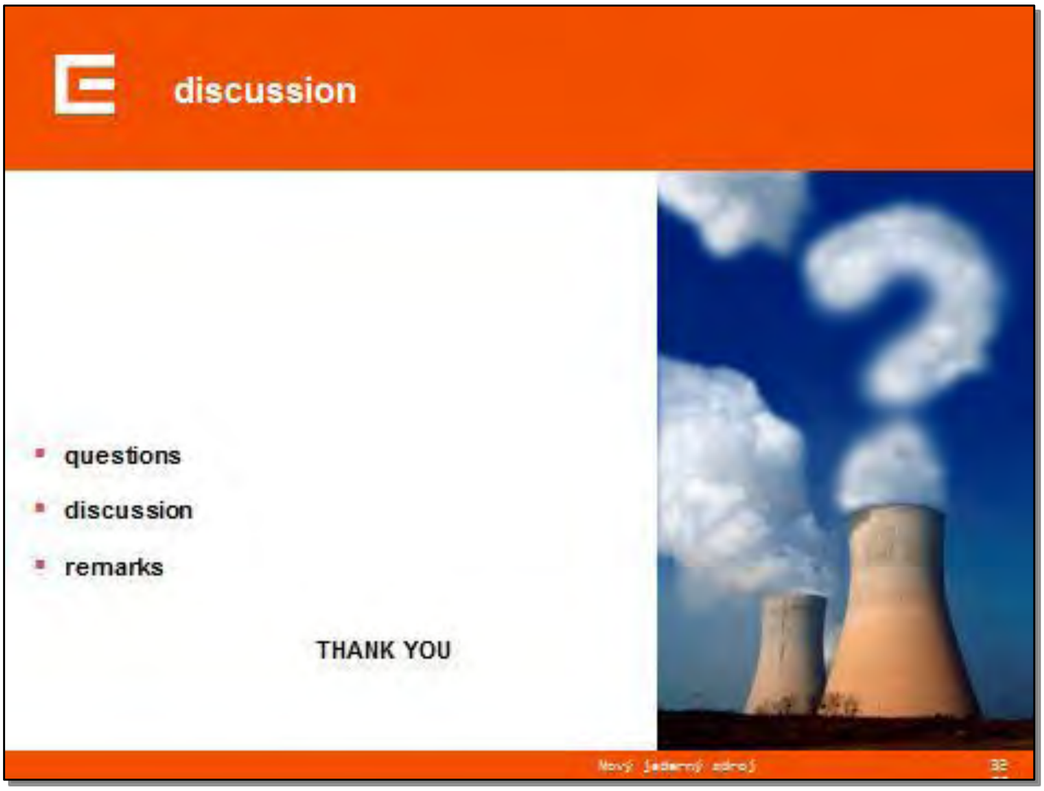
- another accident can change the energy resources map
- NPP operators have to prove willingness to improve current plants accordingly post Fukushima action plans (new reactors vs current reactors)

Flexible „Project culture"

- awareness (and acceptance) of higher Project risks
- waiting for better conditions is not the way, flexibility and high level of prepardness at each moment is the way

Communication

- public support is brittle, communication must be adapted to new situation


discussion
questions
discussion
remarks
THANK YOU

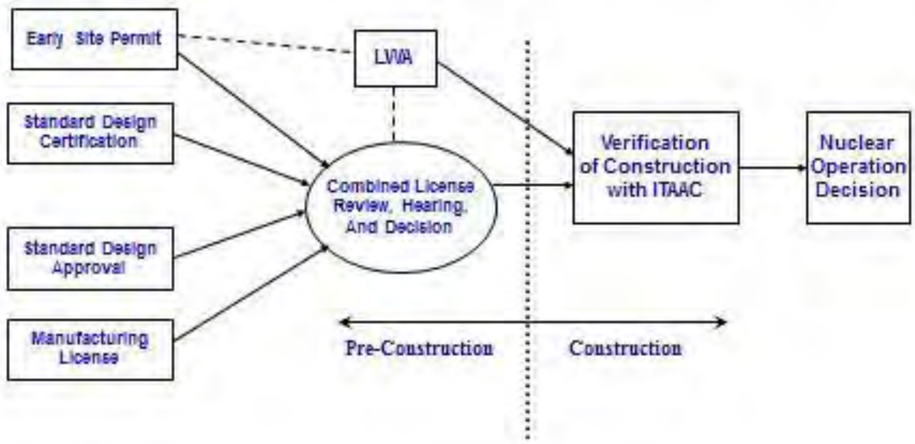
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Environmental Insights from Siting New Nuclear Power Plants in the United States

Mr. Andrew J. Kugler
24 October 2012

U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Part 52 Combined License Review Process



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Status of Design Certification Reviews

- 4 certified
  - AP600
  - AP1000
  - ABWR
  - System 80+
- 4 in review
  - ESBWR
  - EPR
  - US-APWR
  - ABWR renewal

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Current Status of New Reactor Reviews

License/Permit Issued	Under Review	Review Suspended
Clinton – ESP	Calvert Cliffs – COL (1)	Grand Gulf – COL (1)
Grand Gulf – ESP	South Texas Project – COL (2)	River Bend – COL (1)
North Anna – ESP	Levy County – COL (2)	Bellefonte – COL (2)
Vogtle – ESP(2)*	Comanche – COL (2)	Callaway – COL (1)
Vogtle – COL (2)	Lee – COL (2)	Nine Mile Point – COL (1)
V.C. Summer – COL (2)	Fermi – COL (1)	
	North Anna – COL (1)	
	Bell Bend – COL (1)	
	Turkey Point – COL (2)	
	PSEG – ESP	
	Harris – COL (2)	

* The number in parentheses indicates the number of units associated with the application, if specified.

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Combined License Process

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Siting Safety Review

- Geology and Surface Faulting
- Seismology
- Geotechnical Engineering
- **Hydrology**/Flooding/Groundwater
- **Meteorology**
- **Demographics**
- Site Hazards
- Dose Consequences
  - **Design Basis Accident Analysis**
  - **Severe Accident Analysis**

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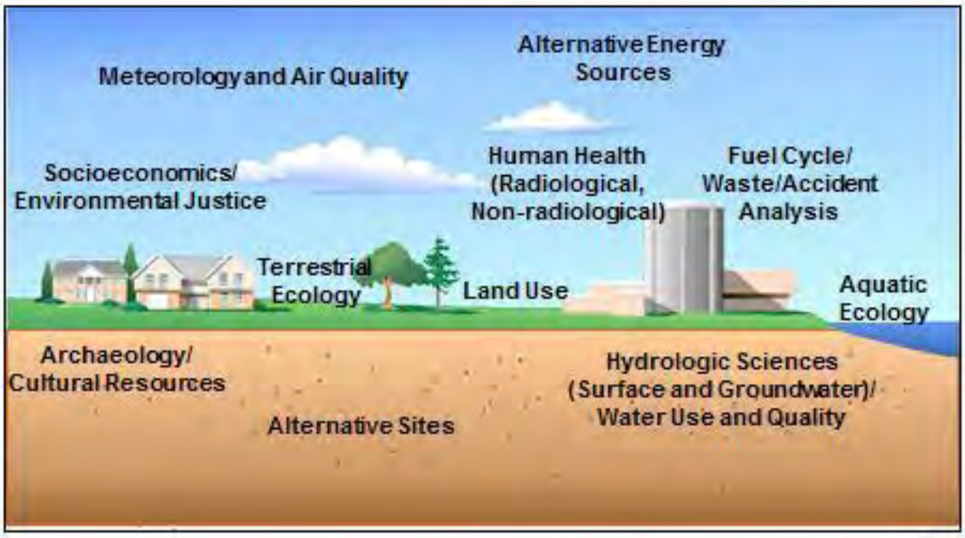
Environmental Review



7

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Insights From Environmental Reviews

- Regulatory Issues
  - Issues with information in applications, e.g.,
    - Full and complete information for key issues
    - Age and sources of data
    - Conflicting information in parallel applications
  - Interagency coordination, e.g.,
    - Clarifying roles and responsibilities
    - Coordination and conflict resolution
  - Importance of pre-application interactions
  - Updating guidance documents

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Role of Stakeholders

US Army Corps of Engineers.

MARYLAND DEPARTMENT OF NATURAL RESOURCES

- NRC must engage other agencies early and often
- Compared to the 1970's, members of the public:
  - Are better informed
  - Are better organized
  - Communicate instantly
  - Expect more from their agencies

- NRC must:
  - Find better ways to communicate
  - Plan for higher levels of public involvement

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Technical Matters

- It's all about the water
- Challenges regarding alternative energy
- Siting process guidance and experience
  - All applicants deviate from the guidance
  - Existing sites versus new sites
  - "Among the best" versus "best possible" site
  - Comparing apples to fish?
- Preparing for small modular reactors

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Summary

- New licensing process is being successfully implemented
- Issues and challenges have emerged during the reviews
- Challenges addressed through
  - Interactions between applicants, NRC staff, and other agencies
  - Improved outreach to public
  - Updating Staff Guidance
  - Rulemaking (Waste Confidence Decision)

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

CNSC CCSN

Canada's Update on Siting Practices and Site Licensing Process for New Reactors in Canada

CNRA International Workshop on "New Reactor Siting, Licensing and Construction Experience"

Atlanta, Ga. U.S.A.
October 24-26, 2010

nuclearsafety.gc.ca

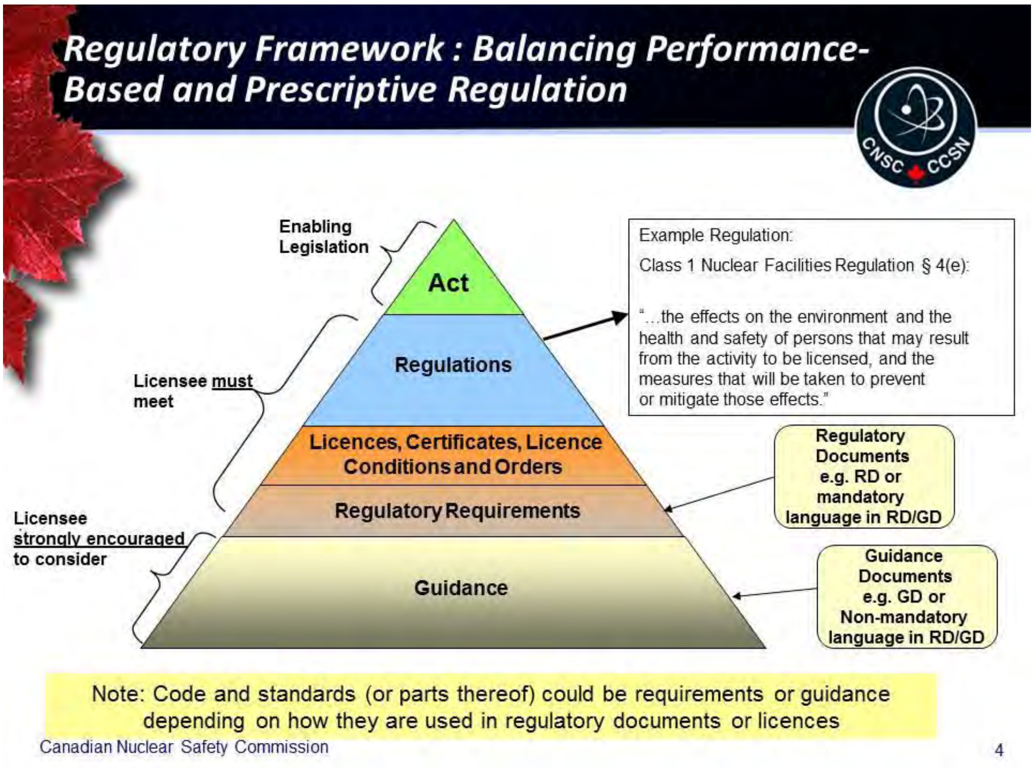
e-Docs # 4022241

Overview of the Presentation

- **Brief Overview of Canadian Regulatory Approach**
- **Overview of site selection and site evaluation in Canada**
- **Discussion of post-Fukushima proposed changes to regulatory requirements in RD-346 Site Evaluation for New Nuclear Power Plants**

Canadian Nuclear Safety Commission 2


Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire
CNSC CCSN
Overview of the Canadian Regulatory Approach
nuclearsafety.gc.ca
e-Docs # 4022241


Regulatory Framework : Balancing Performance-Based and Prescriptive Regulation
CNSC CCSN
Enabling Legislation
Act
Regulations
Licences, Certificates, Licence Conditions and Orders
Regulatory Requirements
Guidance
Licensee must meet
Licensee strongly encouraged to consider
Example Regulation:
Class 1 Nuclear Facilities Regulation § 4(e):
"...the effects on the environment and the health and safety of persons that may result from the activity to be licensed, and the measures that will be taken to prevent or mitigate those effects."
Regulatory Documents e.g. RD or mandatory language in RD/GD
Guidance Documents e.g. GD or Non-mandatory language in RD/GD
Note: Code and standards (or parts thereof) could be requirements or guidance depending on how they are used in regulatory documents or licences
Canadian Nuclear Safety Commission
4

The Licensee is the cornerstone of safety and is held accountable by their licence….

Section 24(4) of the *Nuclear Safety and Control Act* (NSCA)

No licence may be issued, renewed, amended or replaced unless, in the opinion of the Commission, the applicant:

(a) is qualified to carry on the activity that the licence will authorize the licensee to carry on; and

(b) will, in carrying on that activity, make adequate provision for the protection of the environment, the health and safety of persons and the maintenance of national security and measures required to implement international obligations to which Canada has agreed

Canadian Nuclear Safety Commission 5

Safety Case and Licensing Basis is Licensee Specific…

The applicant proposes, based on considerations contained in Regulatory Documents and applicable Canadian Codes and Standards how they will meet the requirements of the Regulations under the *Nuclear Safety and Control Act*.

This allows the applicant to be flexible based on their unique licensing case.

Additional review effort will be needed for novel approaches, and when alternative approaches to meet regulatory requirements are proposed.

Canadian Nuclear Safety Commission 6

Some key areas the applicant is expected to address…

- long-term thinking (over the expected lifecycle of their project)
- they have a Management System that will be capable of demonstrating oversight of all licensed activities
- how they are adequately communicating and consulting with stakeholders and considering their views. (e.g. potentially affected public, aboriginal groups etc)

The licensee is the first point of contact for issues of concern on their site

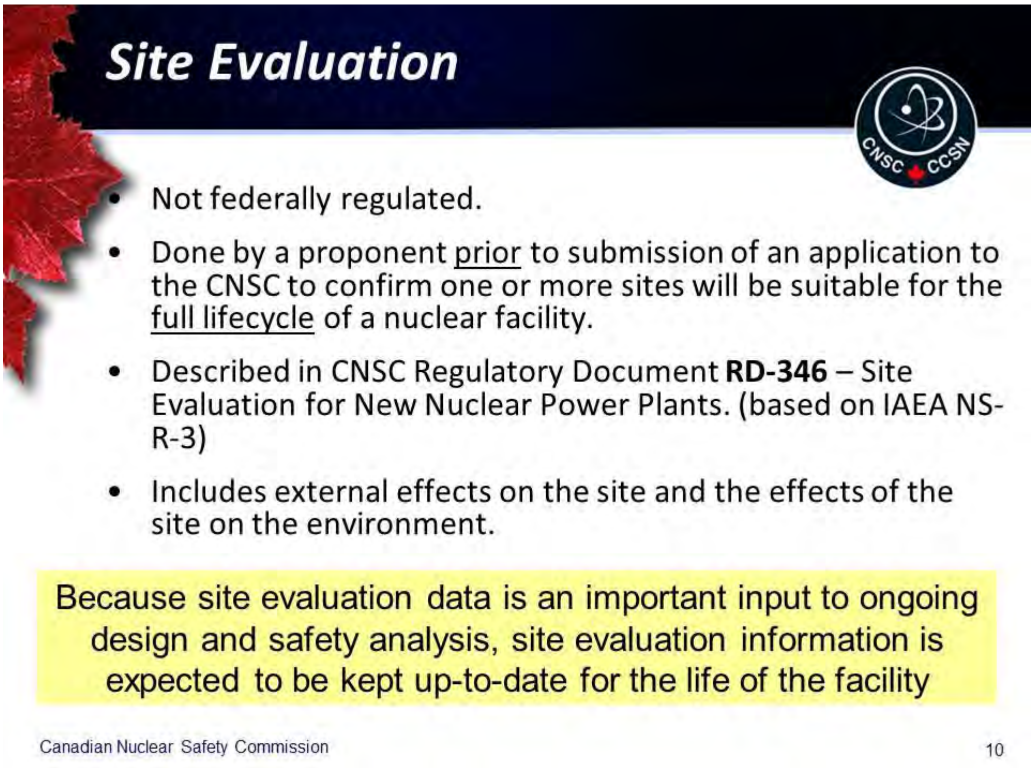
Canadian Nuclear Safety Commission 7

At a High Level…

- The applicant's proposal is then reviewed by Staff against best industry practices and documents under the CNSC Regulatory Framework.
- The proposal then goes before the Commission (public decision making forum) and if the Commission agrees, a licence is granted.

Canadian Nuclear Safety Commission 8


Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire
CNSC CCSN
Overview of site selection and site evaluation in Canada
nuclearsafety.gc.ca
e-Docs # 4022241


Site Evaluation
CNSC CCSN
• Not federally regulated.
• Done by a proponent prior to submission of an application to the CNSC to confirm one or more sites will be suitable for the full lifecycle of a nuclear facility.
• Described in CNSC Regulatory Document RD-346 – Site Evaluation for New Nuclear Power Plants. (based on IAEA NS-R-3)
• Includes external effects on the site and the effects of the site on the environment.
Because site evaluation data is an important input to ongoing design and safety analysis, site evaluation information is expected to be kept up-to-date for the life of the facility
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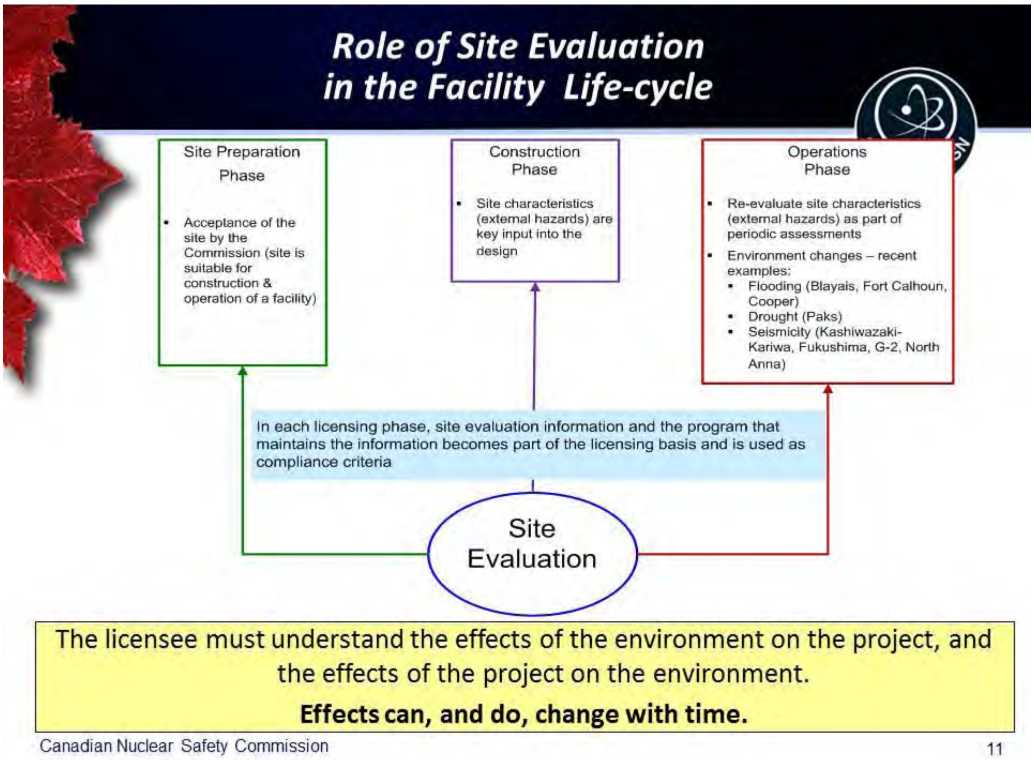
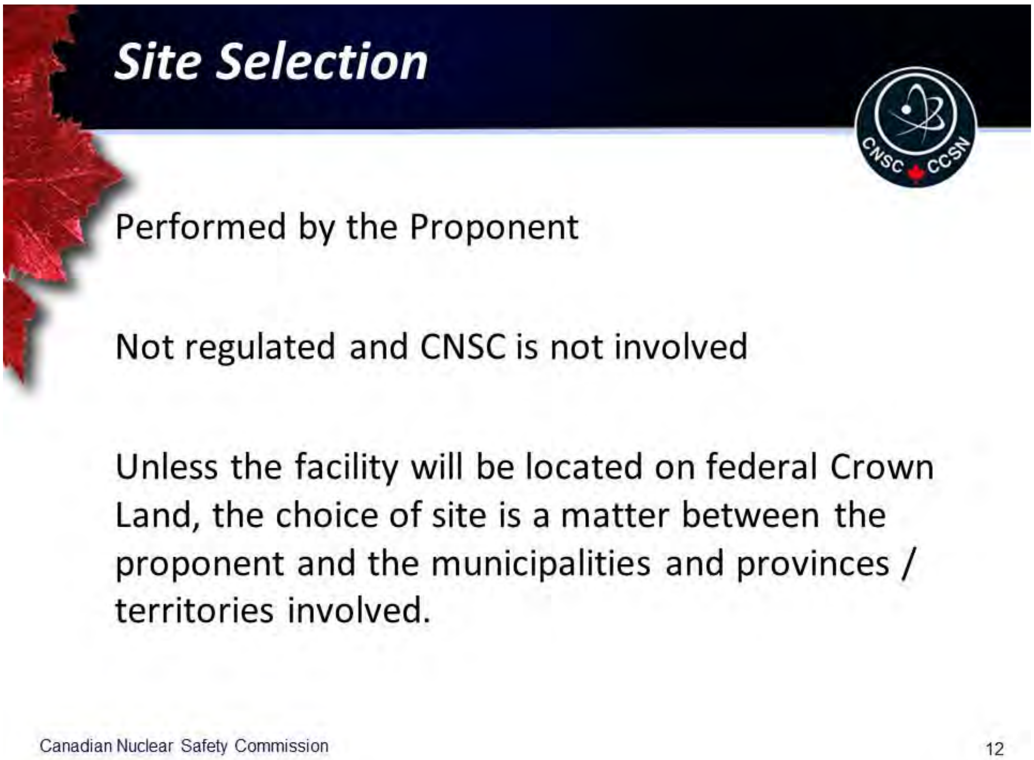
10


Role of Site Evaluation
in the Facility Life-cycle
Site Preparation Phase
Acceptance of the site by the Commission (site is suitable for construction & operation of a facility)
Construction Phase
Site characteristics (external hazards) are key input into the design
Operations Phase
Re-evaluate site characteristics (external hazards) as part of periodic assessments
Environment changes – recent examples:
Flooding (Blayais, Fort Calhoun, Cooper)
Drought (Paks)
Seismicity (Kashiwazaki-Kariwa, Fukushima, G-2, North Anna)
In each licensing phase, site evaluation information and the program that maintains the information becomes part of the licensing basis and is used as compliance criteria
Site Evaluation
The licensee must understand the effects of the environment on the project, and the effects of the project on the environment.
Effects can, and do, change with time.
Canadian Nuclear Safety Commission
11


Site Selection
CNSC CCSN
Performed by the Proponent
Not regulated and CNSC is not involved
Unless the facility will be located on federal Crown Land, the choice of site is a matter between the proponent and the municipalities and provinces / territories involved.
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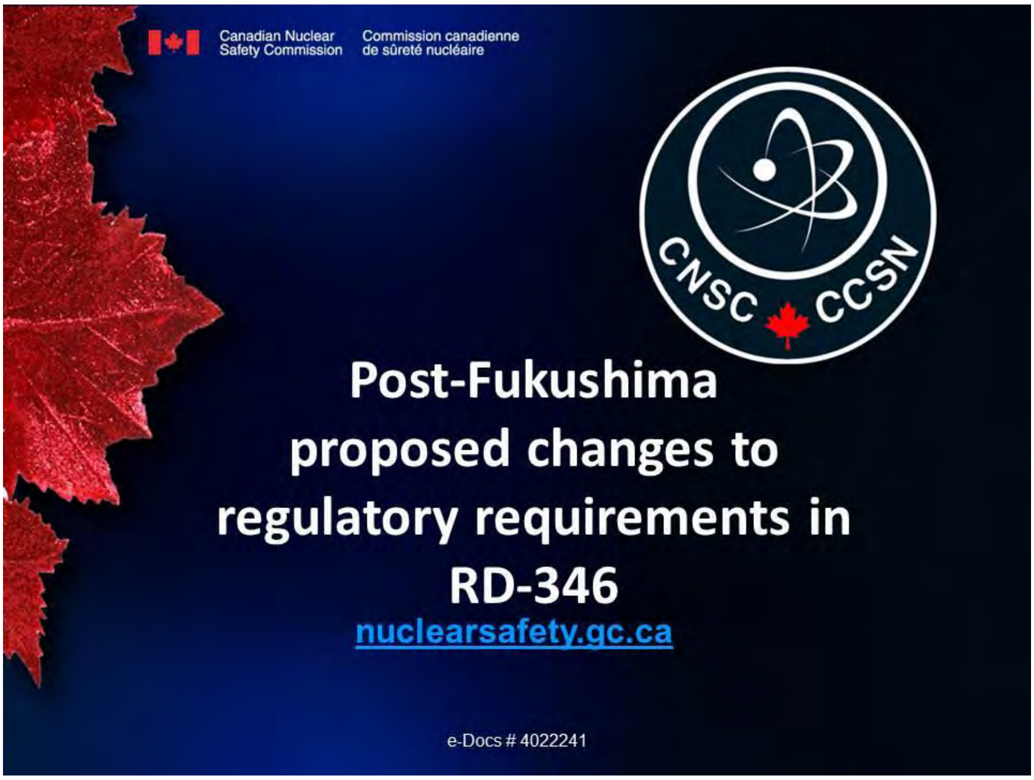
12


Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire
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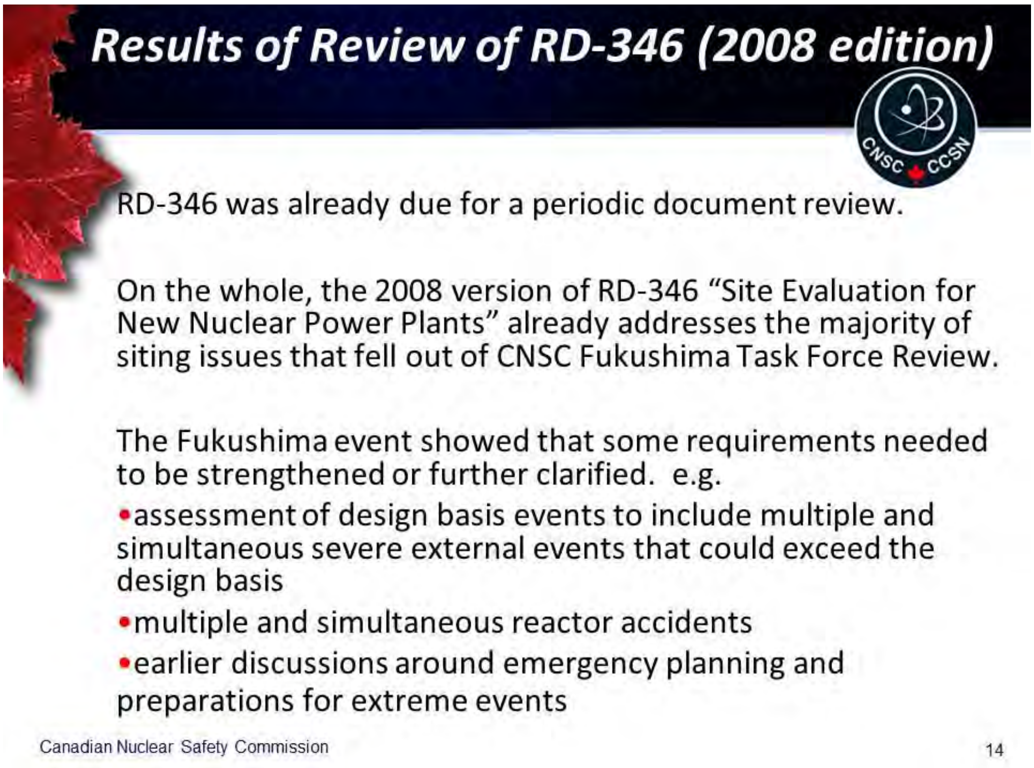
e-Docs # 4022241


Results of Review of RD-346 (2008 edition)
CNSC CCSN
RD-346 was already due for a periodic document review.
On the whole, the 2008 version of RD-346 "Site Evaluation for New Nuclear Power Plants" already addresses the majority of siting issues that fell out of CNSC Fukushima Task Force Review.
The Fukushima event showed that some requirements needed to be strengthened or further clarified. e.g.
• assessment of design basis events to include multiple and simultaneous severe external events that could exceed the design basis
• multiple and simultaneous reactor accidents
• earlier discussions around emergency planning and preparations for extreme events
Canadian Nuclear Safety Commission
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A Word on "Return Frequency" for External Hazards

RD-346 is not prescriptive on return frequencies expected to be considered when characterizing a site.

RD-346 requires an applicant / licensee to show how they have a systematic approach for identifying and assessing the hazards associated with external events, including underlying rationales

Applicant / licensee expected to use national and international best practices and revisit them as they change.

CNSC guidance generally points to best practices where they exist.

Canadian Nuclear Safety Commission 15

Evaluation against Safety Goals from a Site Perspective

Reactor facility designs should be evaluated against applicable safety goals, taking into account the characteristics of the site, the risks associated with external hazards (including any potential cliff-edge effects that may arise from small increases in the severity of external hazards), and the potential negative impact of the reactor facility on the environment. The evaluation shall include the effects of multiple unit events and – where applicable – effects from events that may affect multiple units.

Canadian Nuclear Safety Commission 16

Site Characterization: Confirming Unimpeded Implementation of Emergency Plans

- Intent is to confirm as early as possible for the site that implementation of emergency plans and related protective actions will not be compromised for the life cycle of the proposed site
- RD-346 (2008 edition): Required to be demonstrated in application for *Licence to Construct*
- Amended: Now to be demonstrated in application for *Licence to Prepare Site*

Canadian Nuclear Safety Commission 17

Continuous Improvement in Action as Part of Fukushima Amendments

New Title:

RD/GD-346:

Requirements and Guidance - Site Evaluation for Nuclear Power Plants and Small Reactor Facilities

- "New" removed to reinforce that this is a lifecycle document
- ensures requirements are clear for "SMRs" as well as reactors used for research, isotopes etc. (graded approach possible)
- more clearly identified requirements versus guidance text
- adding a second level (Appendix A) of requirements and guidance for "practitioners" (more detailed information)

Canadian Nuclear Safety Commission 18

What kind of supplementary requirements and guidance would be in the RD/GD-346 Appendix?

Examples include more detailed requirements and guidance for:

- What is expected in a licensee's site evaluation program (programmatic requirements)
- site baseline information and data, e.g. specific information for seismic hazards (references standards)
- prediction of effects of the environment on the project, e.g. natural and human induced events
- how accidents and malfunctions and their consequences should be addressed in the site evaluation program
- prediction of effects of the project on the environment, e.g. effects of lifecycle accidents and malfunctions on ground water

Intended to provide more detailed 'working level' requirements and guidance to practitioners (e.g. experts on ground water) conducting ongoing site evaluation activities for a reactor facility.

These will be used in CNSC compliance activities under any licence.

Canadian Nuclear Safety Commission 19

Example: Bounding Envelopes and Characterization of Project Accidents and Malfunctions

- As part of site evaluation, the licensee shall demonstrate that the facility is capable of safely operating within the constraints of the proposed site.
- Any design information provided by the licensee shall be credible and sufficient to adequately bound the evaluations of environmental impacts and site suitability.
- Working level requirements and guidance focus on criteria for level of design detail for a licence to prepare site application

Canadian Nuclear Safety Commission 20

Level of Information in a Bounding Envelope

- technical outline) of all major SSCs that could significantly influence the course or consequences of principal types of accidents and malfunctions
- identify limiting credible sequences that include external hazards (natural and human-induced), design basis accidents and beyond design basis accidents (severe accidents)
- limiting source terms must consider accident sequences that could occur with a frequency greater than 10-6 per reactor year of operation
- description of out-of-core criticality events
- safety goals and functional requirements are met, through a high-level safety analysis (behaviour of design is understood and consequences can be accurately predicted)

Canadian Nuclear Safety Commission 21

CNSC

Canadian Nuclear Safety Commission

Canada

nuclearsafety.gc.ca

New Reactor Siting in Finland Hanhikivi site in Pyhäjoki – STUK preliminary safety assessment

2nd CNRA International Workshop on
"New Reactor Siting, Licensing and Construction Experience"
Twelve Hotel Atlantic Station
Atlanta, Georgia, USA 24-26 October 2012

Janne Nevalainen
Section Head
Projects
RADIATION AND NUCLEAR SAFETY AUTHORITY, STUK
Nuclear Reactor Regulation

Contents of the presentation

This presentation is based on STUK preliminary safety assessment of Fennovoima Decision in Principle application.

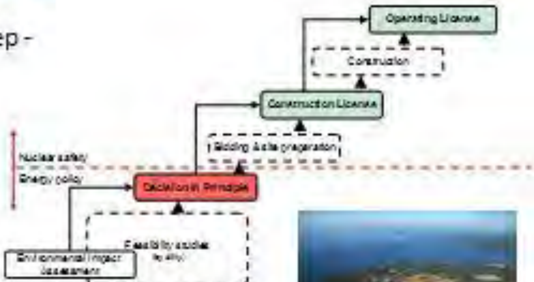
You will find the Preliminary safety assessments of new projects:

www.stuk.fi
EN > Nuclear Safety > Nuclear power plants > New nuclear power plants

http://www.stuk.fi/ydinturvallisuus/ydinvoimalaitokset/uudet_laitosyksikot/en_GB/uudet_laitosyksikot/_files/82886816940818858/default/STUK-Fennovoima_PreliminarySafetyAssessment%20_Appendix2.pdf

Status of new reactor projects

- Three applications submitted for first step - Decision in Principle
  - Teollisuuden Voima Ltd (TVO)
  - Fortum Power and Heat Ltd
  - Fennovoima Ltd (2 possible sites)
- STUK performed preliminary safety assessment in DiP phase
  - Statement on TVO, Fortum and Fennovoima applications all published
- Government's decision - 2 applications approved
  - Teollisuuden Voima Ltd
  - Fennovoima Ltd
- Parliament has ratified Government's decision 1.7.2010
  - the applicants have sent nuclear safety related bid requirements to STUK for information.
  - That was the first step for STUK to prepare regulatory project for construction license review.



General Considerations in NPP Siting

- A variety of factors must be considered in the selection of a NPP site
  - economical, technical, environmental and safety
  - examples
    - availability of cooling water
    - power transmission grid connections
    - transport routes
    - availability of services
    - land use: population, agriculture, fishing, traffic, industries
- Only safety issues are considered in this presentation
  - effects of the site on the plant design
    - identification of external hazards - natural and human induced
    - design bases for external events
    - site layout
  - effects of the plant on the site environment
    - radiation safety
    - emergency preparedness (separate presentation)
      - plant and authorities
      - interaction with land use planning
  - some factors have technical, economical, environmental and safety aspects, e.g., grid connections, cooling water supply

Legislation and conventions

- NPP siting is covered by several fields of national legislation and international conventions, e.g.
  - nuclear
  - environmental
  - land use and building
- IAEA sponsored conventions and IAEA regulations on nuclear safety
- International environmental conventions
- EU directives in the European Union
- International regulations and treaties are implemented in national legislation

International environmental conventions and regulations, examples

- Espoo convention 1991 on EIA
  - Convention on Environmental Impact Assessment in a Transboundary Context (UNECE, United Nations Economic Commission for Europe)
  - International hearing processes may be quite extensive
- Aarhus Convention 1998 (UNECE)
  - Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters
- regional marine protection conventions
  - OSPAR (Atlantic Ocean), HELCOM (Baltic Sea)
- EU directives and EURATOM Treaty in the European Union
  - EIA Directive (85/337/EEC, 97/11/EC)
  - environmental directives (biodiversity, birdlife)
    - Natura 2000 network of natural reserves
    - sometimes extensive clarifications are required

Siting and site evaluation

- **Siting** is the process of selecting a suitable site for a facility, including appropriate assessment and definition of the related design bases. (IAEA Safety Guide NS-R-3, 2003)

- Existing sites
  - site characterization is updated for new units
  - site related design requirements are determined according to current regulatory requirements
- New sites
  - an extensive siting process

- **Environmental Impact Assessment** (EIA) can be an essential part of the siting process
  - role and timing of EIA depends on national legislation

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Siting

The ***process* of selecting a suitable site** for a *facility*, including appropriate ***assessment* and definition of the related *design bases***.

- The *siting process* consists of site *survey* and *site selection*.
  - Site *survey* is the *process* of identifying candidate sites after the investigation of a large region and the rejection of unsuitable sites
  - *Site selection* is the *process* of assessing the remaining sites by *screening* and comparing them on the basis of *safety* and other considerations to select one or more preferred candidate sites

- For a waste *repository*, the *siting process* is particularly crucial to long term *safety*; it may therefore be a particularly extensive *process*, including *Site confirmation as a separate stage*

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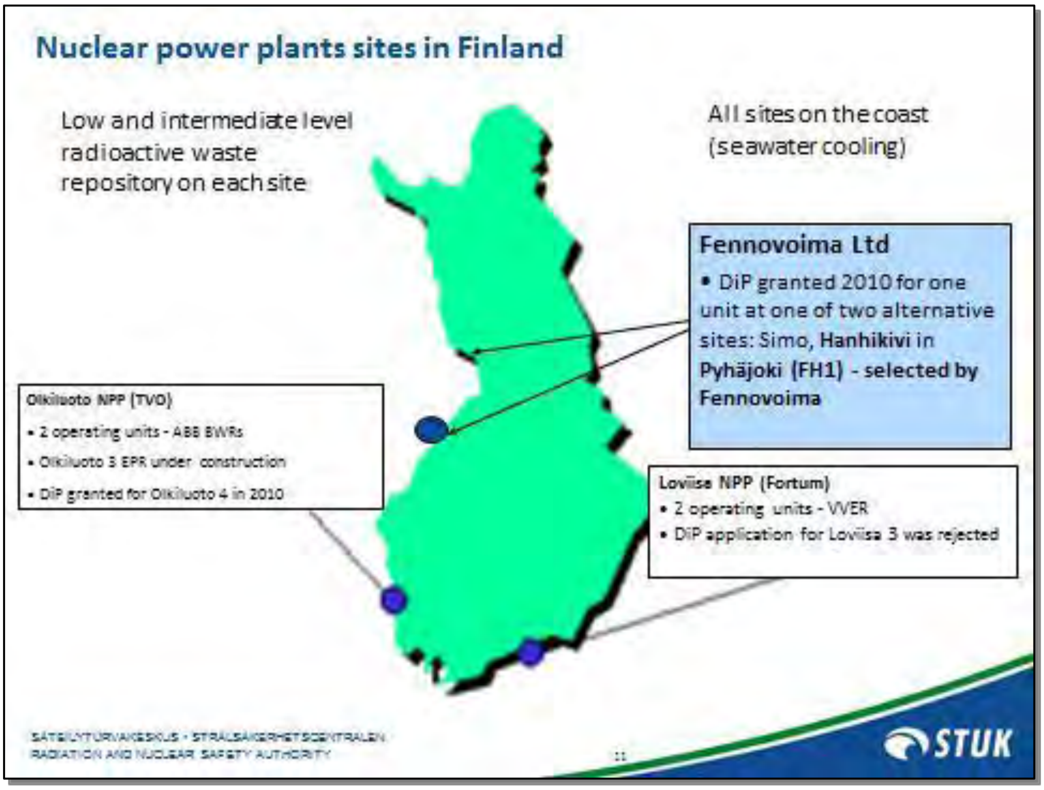
OECD/NEA comparison of siting practices

- NEA has published recently *Report on the Survey on Regulation of Site Selection and Preparation*, NEA/CNRA/R(2010)3
- Produced by CNRA Working Group on the Regulation of New Reactors
- Based on information from 15 countries (10 European countries and Canada, Japan, Korea, United Arab Emirates, USA)

Site characterization

Information on the following topics is required for site evaluation and determination of plant design values for external events

- Natural conditions
  - Geology and seismology
  - Hydrology
  - Meteorology
- Human activities
  - Transport routes (sea, land and air routes, pipelines)
    - oil and hazardous substances
    - airports
  - Industrial activities
    - production, storage
  - Agriculture
  - Population


Nuclear power plants sites in Finland
Low and intermediate level radioactive waste repository on each site
All sites on the coast (seawater cooling)
Fennovoima Ltd
• DiP granted 2010 for one unit at one of two alternative sites: Simo, Hanhikivi in Pyhäjoki (FH1) - selected by Fennovoima
Olkiluoto NPP (TVO)
• 2 operating units - ABB BWRs
• Olkiluoto 3 EPR under construction
• DiP granted for Olkiluoto 4 in 2010
Loviisa NPP (Fortum)
• 2 operating units - VVER
• DiP application for Loviisa 3 was rejected
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Hanhikivi site in Pyhäjoki (FH1)
Photos: Fennovoima
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Selected Hanhikivi site in Pyhäjoki (FH1)

- Hanhikivi headland in Pyhäjoki is in a sparsely populated area
- There are no permanent residents on the headland, and there are relatively fewer leisure homes here than elsewhere on the waterfront in Pyhäjoki
- The community nearest to the proposed site of the Nuclear Power Plant is the village of Parhalahti, some 4 km away. Parhalahti has a permanent population of about 400.

Geology - Finnish experiences

- Several important risk factors are excluded in Finland due to site geology
  - landslides, mudslides
  - avalanches
  - soil subsidence
  - soil liquefaction
- A special feature in Finland: on-site low and intermediate level radioactive waste final disposal facilities
  - both existing NPP sites have their own rock cavern repositories
  - planned also on the Hanhikivi NPP site
  - some additional geological considerations in siting

Hanhikivi site in Pyhäjoki (FH1)

- The Hanhikivi area is very low. At the proposed nuclear power plant site, the ground is on average only +1.5 m above sea level (N60 system).
- Soil surveys have been conducted at 80 points at the Hanhikivi site.
- The bedrock level is mainly between +1 and –3 m. At one of the survey points, the bedrock is some 14 m below ground level, but this point would not be under the reactor. There is some exposed bedrock at the site; generally the rock is covered by layers of loose moraine.
- The bedrock at the Hanhikivi site is conglomerate about 1,900 million years old and suitable in its properties for the construction of a nuclear power plant.

Hanhikivi site in Pyhäjoki (FH1)

- Preliminary studies suggest that the Hanhikivi headland is a uniform section of bedrock, with little or no fracturing.
- The fine-grained rock type in the area, smooth apertures and other geological properties relevant for construction will be taken into account in the design and building technology solutions of the reactor waste final repository.
- In summer 2009, Fennovoima commissioned rock surveys involving two boreholes, two drilled holes, tension measurements and seismic soundings.
  - fracture density in the bedrock in the area is variable but mainly low or moderate
  - No broad fault zones were found in the drill sampling, though minor fracture zones and individual fractures with high water conductivity were found.

The rock studies at Hanhikivi revealed no disadvantageous properties that would have a bearing on the construction of the power plant or of the reactor waste repository.

Hanhikivi site in Pyhäjoki (FH1)

- There are no industrial facilities, warehouses or other facilities near Hanhikivi that might cause a hazard at the proposed power plant.
- The nearest major industrial facilities are the Rautaruukki steel mill in Raahe and the Polargas air gas plant and LPG storage some 15 km from Hanhikivi.
- Highway 8 runs about 5 km from the proposed site, to the east of the Hanhikivi headland. The nearest airports are Oulu airport at Oulunsalo about 70 km away and the general aviation airfield of Raahe-Pattijoki about 30 km away.
- No public roads run through the site area. Two access routes are planned for the site.

Grid connection

- A new 400 kV power line will be needed to connect the new power plant unit to the national grid, and 100 kV power lines at the chosen site will have to be strengthened.
- Under the Electricity Market Act, responsibility for developing the national grid and maintaining its systems rests with national grid company Fingrid.
- Fingrid is obliged to strengthen the national grid as required. There shall be separate EIA procedures for new grid connections.

IAEA seismic requirements

- Evaluation of Seismic Hazards for Nuclear Power Plants, Safety Guide NS-G-3.3, 2003
- Seismic Design and Qualification for Nuclear Power Plants, Safety Guide, NS-G-1.6, 2003
- Safe shutdown earthquake (level 2) and possibly lower operating basis earthquake (level 1)
  - peak ground acceleration (PGA) and
  - ground response spectrum
- Seismic hazard studies required
  - deterministic or probabilistic
- Minimum recommended design PGA is 0.1·g
  - even if hazard studies indicate a lower PGA
- Updated guide "Evaluation of Seismic Hazard for Nuclear Installations" SSG-9, 2010
  - discussion on minimum PGA (0.15 ·g proposed but 0.1 g was retained)

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Seismology - Finnish experiences

- Old bedrock, hard crystalline rock (gneiss, granite)
- Intraplate region, far from plate collision areas
- Low seismic activity
  - no dangerous earthquakes have been observed
    - highest recorded magnitude ~ 4.5 Richter
    - historical evidence of magnitude ~ 5.5
    - regional differences
  - however, microseismic events are fairly common
    - possibly due to continuing bedrock uplifting after ice age
- Seismic loads are not considered separately in the general building code
- No seismic requirements when the operating plants were built
  - seismic PRAs revealed some potential problem areas in operating units
    - anchorage of equipment
      - electric cabinets, batteries
      - some large tanks
    - certain relay types
    - significant risk reduction was achieved with simple plant modifications

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Seismic requirements in Finland

- Requirements for nuclear power plants are set forth in Guide YVL 2.6
- Design earthquake corresponds to return period of 100000 years (50% confidence level)
  - peak ground acceleration (PGA)
  - ground response spectrum
- PGA 0.06·g - 0.2·g in southern Finland (100000 year return period)
  - at current sites Loviisa and Olkiluoto PGA is 0.06 - 0.085 ·g
  - design value 0.1 g according to the current IAEA recommendation (NS-G-3.3)
  - ground response spectrum maximum at 10 Hz
- Preliminary quantitative hazard estimates have been done for candidate sites in northern Finland
  - higher seismic activity
  - PGA up to 0.09·g - 0.16·g in Hanhikivi – Fennovoima consider 0.2 g
  - ground response spectrum maximum at high frequency, up to 25 Hz

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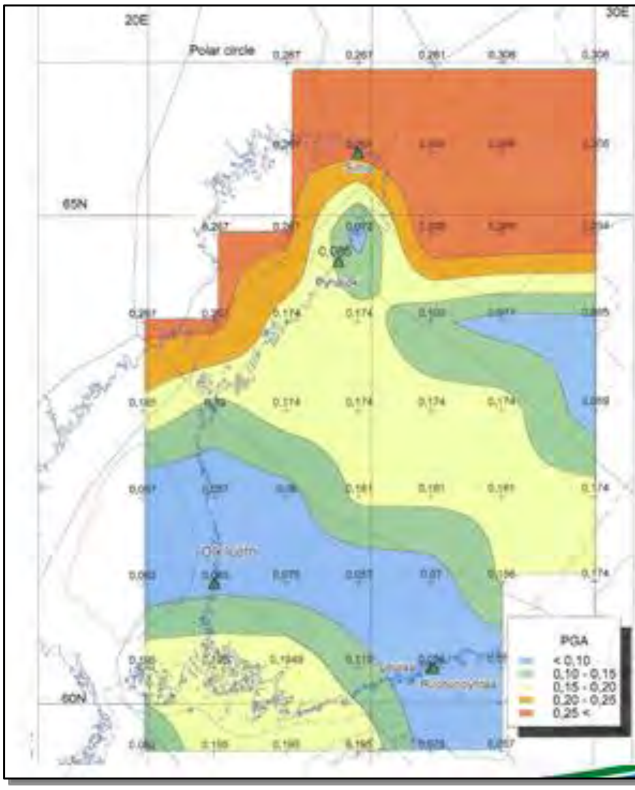

Peak ground acceleration PGA (g) for 100 000 year median return period in Finland

Range 0.05 g - 0.3 g

source J. Saari et al. ÅF-Consult, 2009

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Meteorology and hydrology

Examples of phenomena considered in NPP design

- Highest and lowest outdoor air temperature
  - instantaneous, short term, long term
- Air humidity
- Extreme wind speed
  - including tornadoes (trombs) and downbursts
- Sea/river/lake water temperature
  - high temparature
  - subcooling, frazil ice formation
- Sea/river/lake water level: extreme high and low
- Impuries in water: organic, mud, oil, chemicals
- Ice conditions, packed ice in Hanhikivi
- Precipitation
- Snow load
- Lightning (peak current, rise time etc.)

Fennovoima has sent to STUK most of the proposed design base values, which shall be approved during the construction license phase

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Meteorology and hydrology - Finnish experiences

- No detailed quantitative requirements in current YVL guides
- Quantitative risk targets provide some guidance
  - core damage frequency < 1E-5/a
  - large release frequency < 5E-7/a
  - no single factor shall dominate
- Intensity-frequency distributions have been determined based on available observations
  - reliable observations for ~ 100 years
  - return periods of interest up to 10 000 - 1 000 000 years
  - uncertainties are very large at high return periods
- Combinations of correlated events are potentially important
  - snow and wind: potential for loss of offsite power and simultaneous failure of diesel generators due to combustion air intake blockage

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Conclusions

- Siting and EIA are important phases of a NPP project and its licensing – however in Finnish NPP licensing system the site characteristics shall be approved in construction licence phase
- International conventions, requirements and guides
- National nuclear legislation and other fields of legislation
- Wide spectrum of issues
  - effects of the plant on the population and environment
    - normal operation
    - accident situations
  - effects of the site conditions on the plant
    - natural conditions
    - human induced effects

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References
Finnish guides on siting and external events

available at www.stuk.fi > In English > Publications > Regulatory Guides

YVL 1.0 Safety criteria for design of nuclear power plants
YVL 1.10 Requirements for siting a nuclear power plant
YVL 2.6 Seismic events and nuclear power plants
YVL 7.4 Nuclear power plant emergency preparedness

Preliminary safety assessments of new projects

www.stuk.fi
EN > Nuclear Safety > Nuclear power plants > New nuclear power plants

Decisions in Principle

www.tem.fi > In English > Energy > Nuclear Energy

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References, EIA in Finland
• Ministry of Employment and the Economy www-pages http://www.tem.fi > In English > Energy > Nuclear Energy > EIA Procedures for new nuclear power projects
– EIA programs, reports and Contact Authority's statements
• TVO - Olkiluoto 3 and 4
– http://www.tvo.fi/ > In English > What's on > PDF documents
• Fennovoima - three candidate sites
– http://www.fennovoima.fi/ > In English > Fennovoima > Environment - EIA
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SESSION III – CONSTRUCTION EXPERIENCE AND REGULATORY OVERSIGHT OF NEW REACTOR CONSTRUCTION ACTIVITIES

Construction Experience Program (CONEX)
J. Balmisa, CSN, J. Nevalainen, STUK

Experience of Regulatory Oversight of EPR Flamanville 3 Construction
Thomas Houdré, ASN

Regulatory Approach for Oversight of APR1400 Constructions
Seon Ho Song, KINS

NRC Construction Experience
Richard Rasmussen, U.S.NRC

Project Structuring and Risk Allocation for NPP Construction
Greg Kaser, World Nuclear Association

Task Group on Non-conforming, Counterfeit, Fraudulent, and Suspect Items (TGNCFSI) Report Review
Laura Dudes, U.S.NRC

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CONSTRUCTION EXPERIENCE PROGRAM (CONEX)

Atlanta NEA/CNRA International Workshop
24-26 October 2012

J. BALMISA
CSN

J. NEVALAINEN
STUK

NUCLEAR ENERGY AGENCY

Presentation Outline

1. Rationale and goals of CONEX program
2. CONEX database structure
3. Uses of CONEX to create KNOWLEDGE:
   - ❑ CONEX reports
   - ❑ Application to inspector training (safety cards)
   - ❑ Application to inspection procedure

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1. RATIONALE AND GOALS OF CONEX PROGRAM

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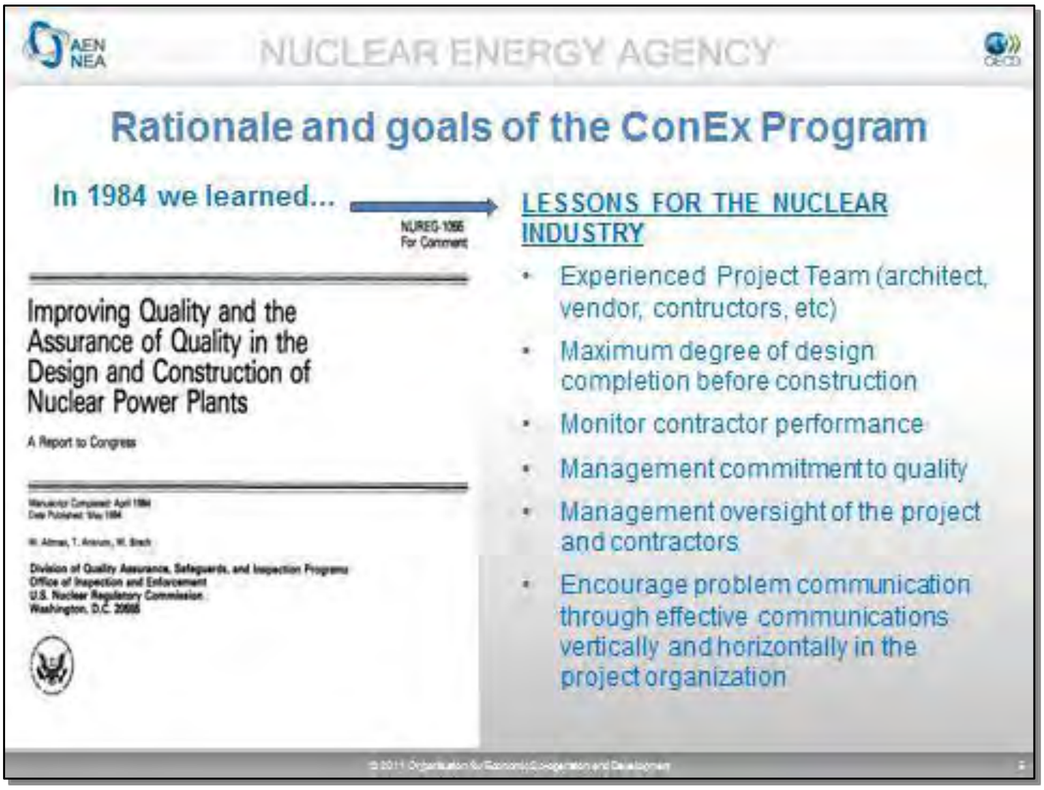
Rationale and goals of the ConEx Program

CAN WE LEARN FROM PAST CONSTRUCTION EXPERIENCES OR ARE WE CONDEMNED TO REPEATE THEM?

CONEX PROGRAM MAY BE ONE OF THE ANSWERS

Those who cannot remember the past are condemned to repeat it.
George Santayana, The Life of Reason, Volume 1, 1905
US (Spanish-born) philosopher (1863 - 1952)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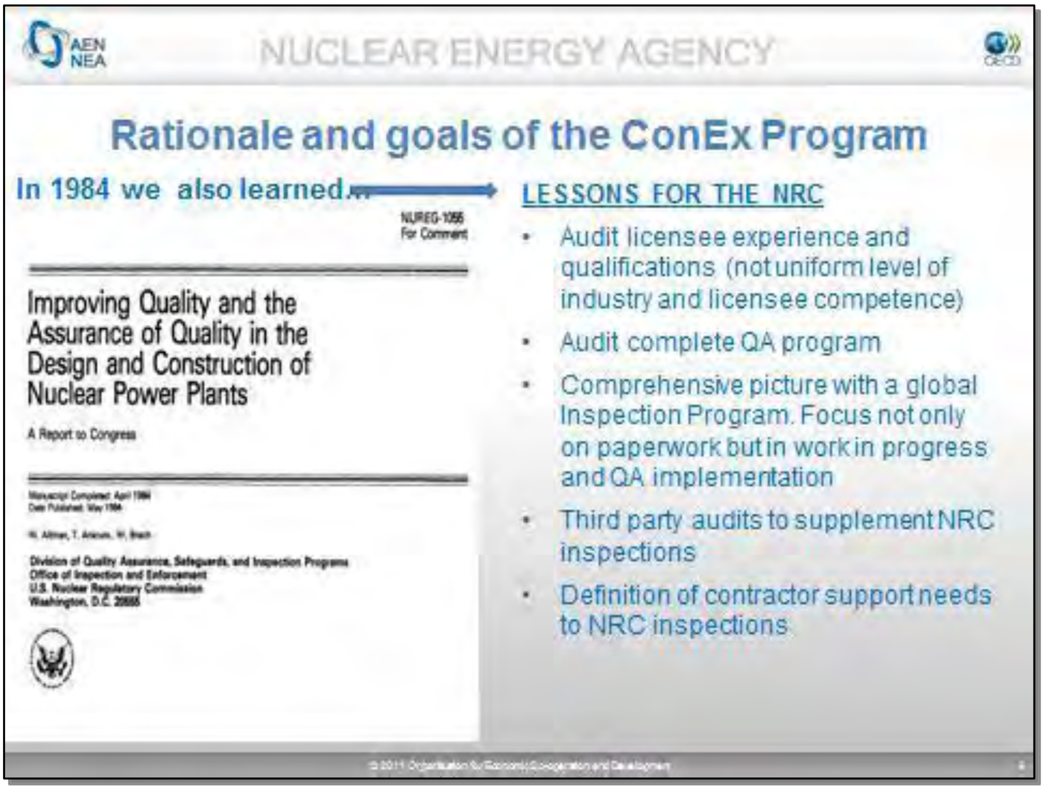
NUCLEAR ENERGY AGENCY
Rationale and goals of the ConEx Program
In 1984 we learned…
NUREG-1055
For Comment
Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants
A Report to Congress
Division of Quality Assurance, Safeguards, and Inspection Programs
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
LESSONS FOR THE NUCLEAR INDUSTRY
Experienced Project Team (architect, vendor, contructors, etc)
Maximum degree of design completion before construction
Monitor contractor performance
Management commitment to quality
Management oversight of the project and contractors
Encourage problem communication through effective communications vertically and horizontally in the project organization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Rationale and goals of the ConEx Program
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Division of Quality Assurance, Safeguards, and Inspection Programs
Office of Inspection and Enforcement
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
LESSONS FOR THE NRC
Audit licensee experience and qualifications (not uniform level of industry and licensee competence)
Audit complete QA program
Comprehensive picture with a global Inspection Program. Focus not only on paperwork but in work in progress and QA implementation
Third party audits to supplement NRC inspections
Definition of contractor support needs to NRC inspections

Rationale and goals of the ConEx Program

In 2012 from ongoing projects new lessons have come up !!

- Regulatory framework in the country of construction (clear safety criteria, early definition of hold points, etc)
- Design completion and management (change management, interfaces, clear requirements, etc)
- Experience and know how of the licensee and vendor, management of subcontractors (length of supply chain, experienced contractors, human resources, etc)
- New and advanced manufacturing technology (qualification of new methods, qualification of manufacture first pieces, etc)
- Role of Quality Management (definition non conformances, nuclear requirements vs conventional ones, etc)
- Licensee's responsibility. Safety culture
- Regulatory oversight and inspections

Rationale and goals of the ConEx Program

Conex will allow to transform past experience into knowledge for current and future projects


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OECD
2. CONEX DATABASE STRUCTURE
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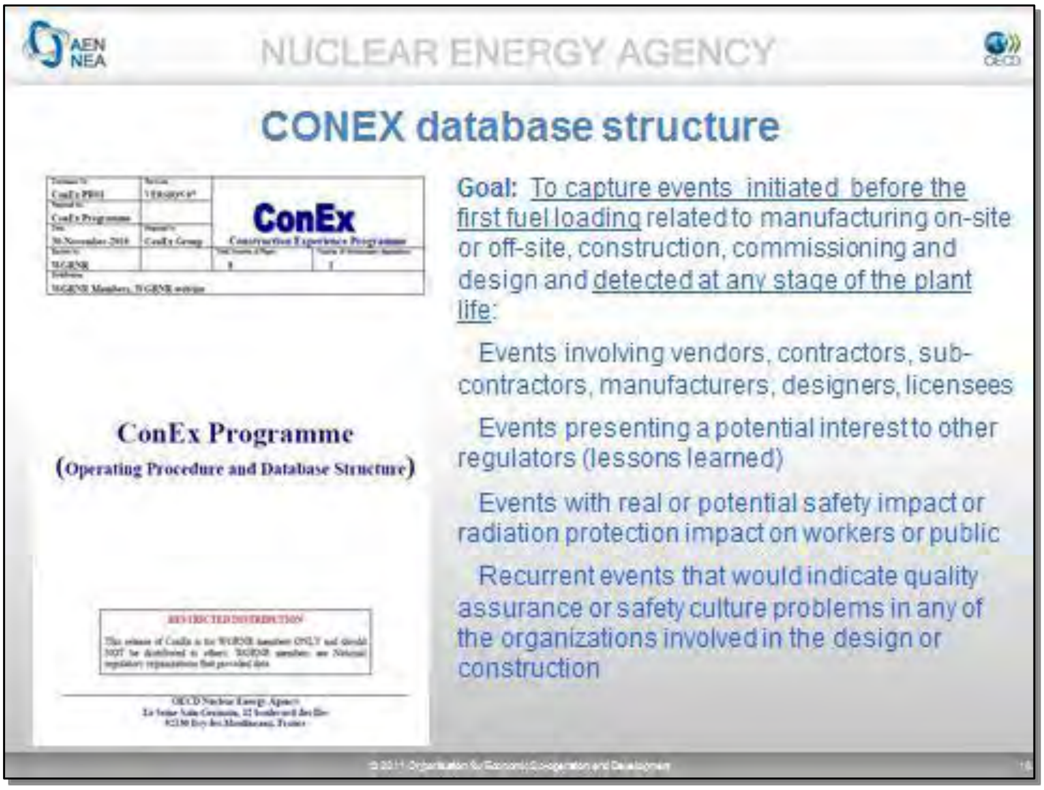
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NUCLEAR ENERGY AGENCY
OECD
CONEX database structure
ConEx
ConEx Programme
(Operating Procedure and Database Structure)
Goal: To capture events initiated before the first fuel loading related to manufacturing on-site or off-site, construction, commissioning and design and detected at any stage of the plant life:
Events involving vendors, contractors, sub-contractors, manufacturers, designers, licensees
Events presenting a potential interest to other regulators (lessons learned)
Events with real or potential safety impact or radiation protection impact on workers or public
Recurrent events that would indicate quality assurance or safety culture problems in any of the organizations involved in the design or construction
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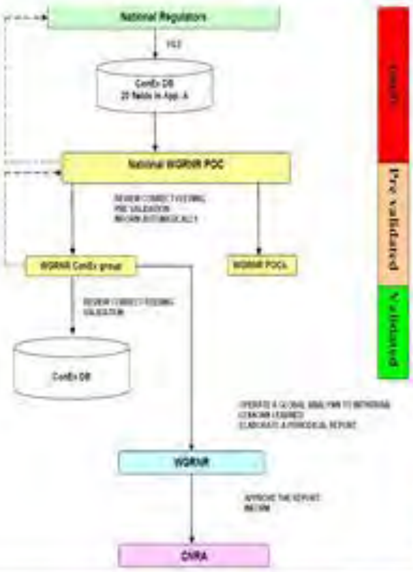
CONEX database structure



NEA
- administrator of the database
- interface and assure compatibility with IRS

National Regulators
- routinely assess construction experience information
- provide reports to the ConEx database

National PoC (Point of Contact)
- check its reports for consistency and completeness
- ask for additional information if necessary

WGRNR ConEx group
- review and validate the input
- produce a global analysis to draw lessons learned, trends, good practices and report to WGRNR
- produce topical report on a selected periods/subjects

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CONEX database structure. Field definition

Item No.	Field Name	Type	Description
001	EID	Auto number	Automatically generated record number
002	EVENT TITLE	Text	Very short characterisation of the event, with emphasis on its most significant features
003	EVENT DATE	Date	Date of event discovery
004	COUNTRY ID	Text	Roll down menu with options
005	REACTOR TYPE	Text	Roll down menu with options
006	PLANT NAME	Text	Plant name is automatically returned
007	PLANT STATUS	Text	Plant operational state (at the time of discovery)
008	SAFETY FUNCTION CHALLENGED	Text	Roll down menu with the options
009	FAILED/AFFECTED SYSTEM	Text	Roll down menu based on IRS
010	COMPONENT SAFETY RELEVANT	Text	Roll down menu based on IRS
011	ORGANISATIONS INVOLVED	Text	Roll down menu with options
012	EVENT NARRATIVE	Memo	Description of plant features, conditions and organisational data

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CONEX database structure. Field definition

Item No.	Field Name	Type	Description
013	CAUSE ANALYSIS	Memo	Direct Causes as well as the Indirect or Underlying Causes of the event
014	CAUSE OF THE EVENT	Text	Possibility to select several items Roll down menu based on IRS
015	SAFETY ASSESSMENT	Memo	Potential or real consequences of the event and should include the failure mode analysis.
016	CORRECTIVE AND PREVENTIVE ACTIONS	Memo	Corrective and preventive actions taken by licensee/vendor/contractor/manufacturer
017	REGULATORY ACTIONS	Memo	Description of the Regulatory Body's actions taken in response to the event.
018	LESSONS LEARNED	Memo	Licensee, vendor, manufacturer, contractor and regulator lessons learned.
019	STATUS OF THE REPORT	Automatic field (workflow)	- Draft - Pre-validated - Validated
020	ATTACHEMENTS	Hyperlinks (facultative)	Possibility to upload and attach documents related to the events

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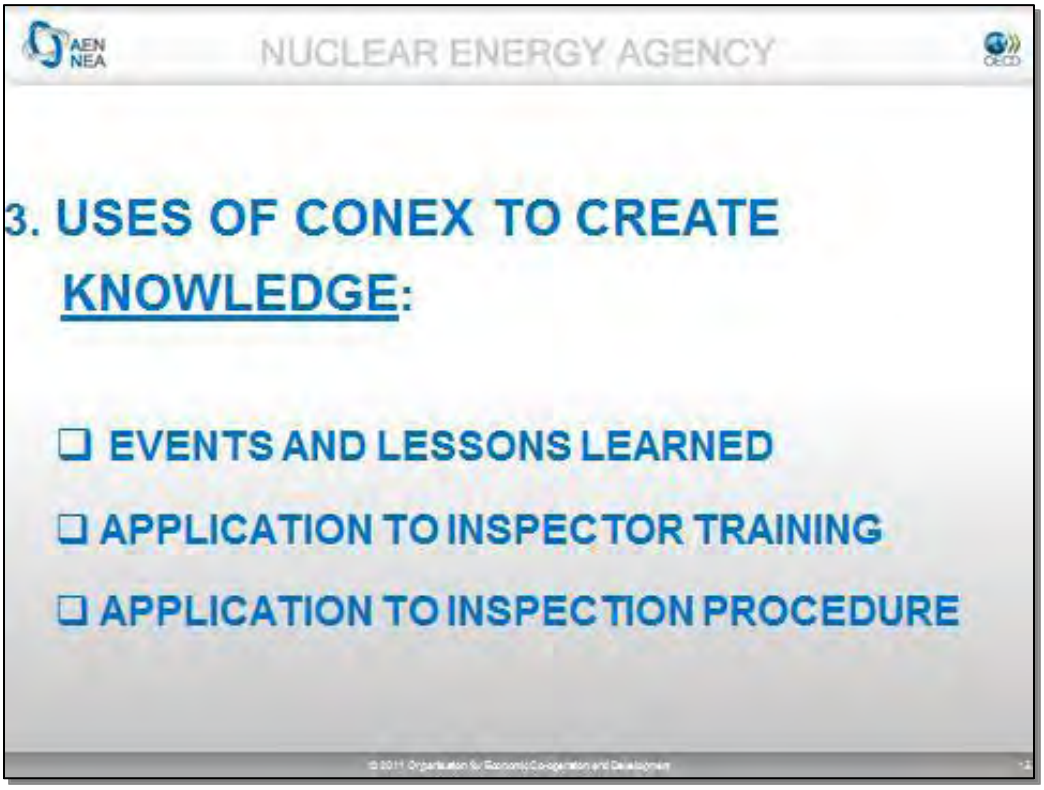
CONEX database structure

UID	Status	Plant	Date	Title	Created	By	Updated	By	Action
65	Draft	Olkiluoto 3	2010/06/23	Non-conformities on valve body surface	2012/09/19	[illegible]	2012/09/19	[illegible]	View Edit
64	Draft	All NPPs	2012/04/24	Ineffective Use of Vendor Technical Recommendations	2012/08/15	patel	2012/08/15	patel	View Edit
63	Draft	All NPPs	2012/01/26	Seismic Considerations - Principally Issues Involving Tanks	2012/08/15	patel	2012/08/15	patel	View Edit
62	Ready QA	Flamanville 3	2012/03/01	Non-conformity concerning the surface finish of pipes	2012/04/24	[illegible]	2012/04/25	[illegible]	View Edit
61	Ready QA	Flamanville 3	2010/11/01	Heavy Component Manufacturing : Reactor pressure vessel closure head	2012/04/24	[illegible]	2012/04/25	[illegible]	View Edit
60	Approved	Flamanville 3	2011/06/01	Heavy Component Manufacturing : Vessel closure head buttering thickness	2012/04/24	[illegible]	2012/09/12	[illegible]	View Edit
59	Ready QA	Flamanville 3	2009/11/01	Defects in prestressing ducts	2012/04/23	[illegible]	2012/04/24	[illegible]	View Edit
58	Ready QA	Flamanville 3	2010/12/01	Pouring activities of pools or tanks - High rebar density areas and high pouring lift issues	2012/04/23	[illegible]	2012/04/24	[illegible]	View Edit
57	Ready QA	Flamanville 3	2009/02/11	Defects in joint treatments between two concreted parts	2012/04/23	[illegible]	2012/04/24	[illegible]	View Edit
56	Ready QA	Flamanville 3	2010/06/08	Damage of the 400 kV Power cable of Flamanville 2 during Flamanville 3 construction	2012/04/23	[illegible]	2012/04/24	[illegible]	View Edit
55	Ready QA	Flamanville 3	2008/10/01	Absence of joint treatment between two concreting lifts in the gousset area	2012/04/23	[illegible]	2012/04/24	[illegible]	View Edit
54	Ready QA	Flamanville 3	2008/01/01	Appearance of cracks in the concrete basemat of the reactor building of Flamanville 3	2012/04/23	[illegible]	2012/04/24	[illegible]	View Edit
53	Ready QA	Olkiluoto 3	2009/12/15	General corrosion of OL3 pressurizer and steam generators during transportation and storage prior to installation	2012/03/21	[illegible]	2012/03/21	[illegible]	View Edit
52	Draft	Olkiluoto 3	2010/06/01	EPR Non-conformities on valve body surface	2012/03/21	[illegible]	2012/03/22	[illegible]	View Edit
51	Ready QA	Olkiluoto 3	2009/04/12	Deficient hydrostatic pressure test arrangement of valves	2012/03/21	[illegible]	2012/03/21	[illegible]	View Edit
50	Draft	Darlington 4	2010/04/21	Problem Report Analysis or Research Finding: Adjuster Rod Electronics Issue	2012/02/14	[illegible]	2012/02/14	[illegible]	View Edit
49	Draft	Darlington 3	2011/07/28	U3 Transient: 008 SOR Dropped in Core	2012/02/14	[illegible]	2012/06/13	[illegible]	View Edit
48	Ready PoC	Darlington 4	2010/04/10	D1041 (Darlington Unit 4) Spurious SDS2 Trip	2012/02/14	[illegible]	2012/03/28	[illegible]	View Edit
47	Ready PoC	All NPPs	2011/02/15	Commercial-Grade Dedication Issues Indentified during Inspections IDENTIFIED DURING NRC INSPECTIONS	2012/01/19	patel	2012/09/12	[illegible]	View Edit
46	Draft	All PWRs	2011/02/23	Contaminants and Stagnant Conditions Affecting Stress Corrosion Cracking in Stainless Stee Piping in PWRs	2012/01/01	patel	2012/03/23	[illegible]	View Edit
45	Approved	All NPPs	2011/07/18	Component Cooling Water System Gas Accumlation and Other Performance Issues	2012/01/11	patel	2012/03/23	[illegible]	View Edit
44	Draft	Seabrook	2009/06/01	Seabrook - Adverse Concrete Conditions Due to Distress from Alkali-Silica Reaction (ASR)	2011/12/15	patel	2011/12/15	patel	View Edit
43	Ready QA	Olkiluoto 3	2009/03/02	Closing gate damage of the spent fuel interim storage pumping station at Olkiluoto NPP	2011/09/20	[illegible]	2012/03/21	[illegible]	View Edit
42	Ready QA	Olkiluoto 3	2010/07/27	Main Coolant Lines (Hot and Cold Legs) manufacturing - internal indications in bended areas	2011/09/18	[illegible]	2012/03/21	[illegible]	View Edit
41	Ready QA	Olkiluoto 3	2009/10/06	Main Coolant Lines (Hot and Cold Legs) manufacturing - non-documented weld repairs	2011/09/18	[illegible]	2012/03/21	[illegible]	View Edit
40	Ready QA	Olkiluoto 3	2009/02/10	Main Coolant Lines (Hot and Cold Legs) manufacturing - heat-affected zone (HAZ) micro-cracking	2011/09/18	[illegible]	2012/03/21	[illegible]	View Edit
34	Draft	Nine Mile Point 2	2000/03/26	Instrument Air Header Failure	2011/03/14	craffey	2011/03/14	craffey	View Edit
28	Draft	Browns Ferry-1	2007/10/04	Refueling Floor Crane Cable Deformation	2011/03/14	craffey	2011/03/15	craffey	View Edit
26	Draft	McGuire-1	2007/08/06	Service Water Inoperable due to Valve Modification	2011/03/14	craffey	2011/03/15	craffey	View Edit
22	Draft	Oconee-1	2007/02/15	Switchyard Transient Leads to Dual Unit Trip	2011/03/11	craffey	2011/03/11	craffey	View Edit


AEN NEA
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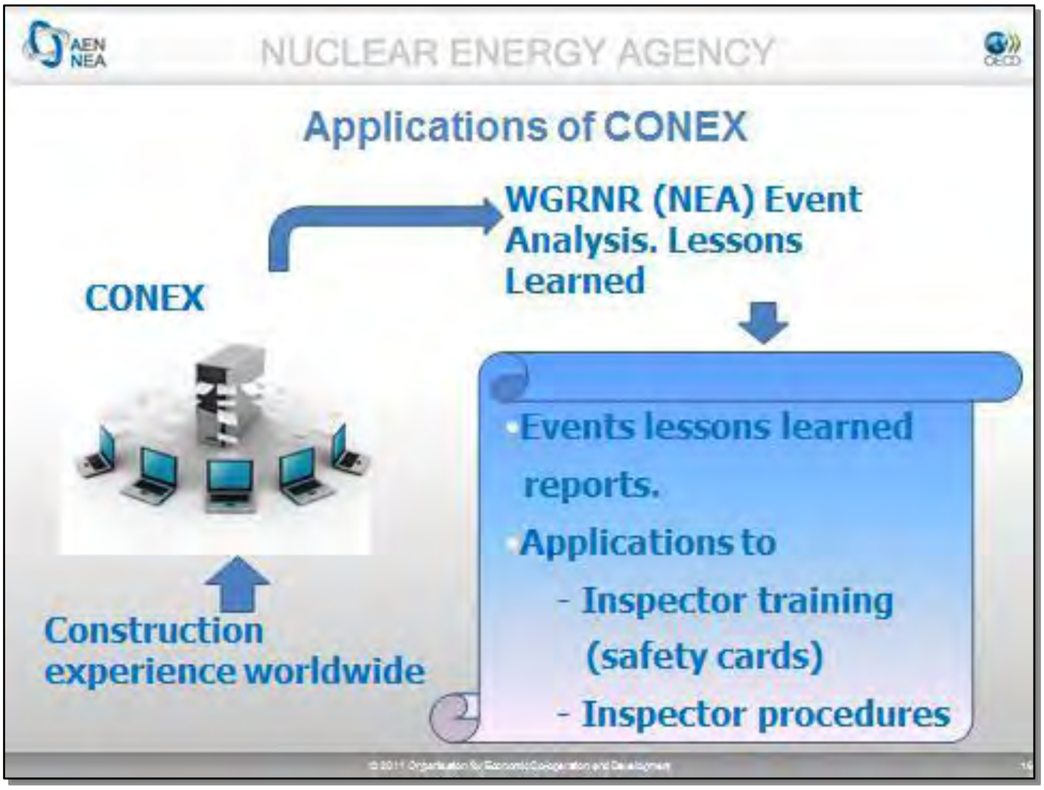
3. USES OF CONEX TO CREATE KNOWLEDGE:
EVENTS AND LESSONS LEARNED
APPLICATION TO INSPECTOR TRAINING
APPLICATION TO INSPECTION PROCEDURE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Applications of CONEX
WGRNR (NEA) Event Analysis. Lessons Learned
CONEX
Events lessons learned reports.
Applications to
- Inspector training (safety cards)
- Inspector procedures
Construction experience worldwide

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Events and lessons learned

- Currently there are 44 conex events (mainly US, France, Finland, Japan and Canada)
- First ConEx synthetic report (2008-2011)
- Working on the draft of a 2nd report on event lessons learned 2011-2012
- New "products" to learn
  - Friendly learning "Safety Cards" from new events
  - Table matching Construction Inspections and events lessons learned


First Construction Experience Synthesis Report 2008-2011

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Events and lessons learned

Construction events

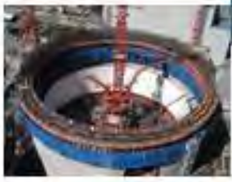
Olkiluoto 3 - Strength of the base slab concrete for the reactor building.

- **Olkiluoto 3** - Leak tightness of the containment.
- **Olkiluoto 3** - Integrity of the primary pipes.

Flamanville-3. Cracks in the poured concrete basemat of the reactor building (January 2008).

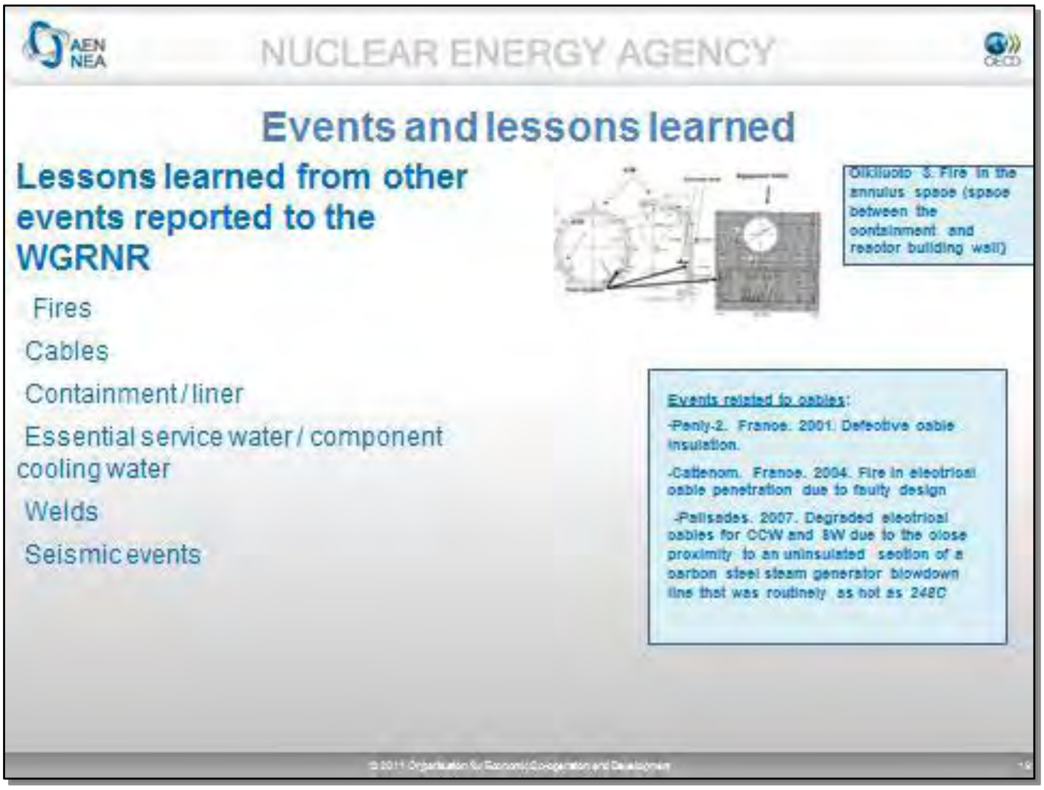
- **Flamanville-3**. Non compliances with steel reinforcement requirements at several buildings (March-July 2008).
- **Flamanville-3**. Welding process deficiencies (June 2008-February 2009).
- **Flamanville-3**. Deficiencies of the joint treatment of the steel reinforcement of the gusset area of the reactor building (December 2008)

Steel liner Olkiluoto 3 and Flamanville 3 welding deficiencies



Flamanville 3 cracks in concrete basemat

Flamanville 3. Joint treatment deficiences of the steel reinforcement of the gusset area in the reactor building



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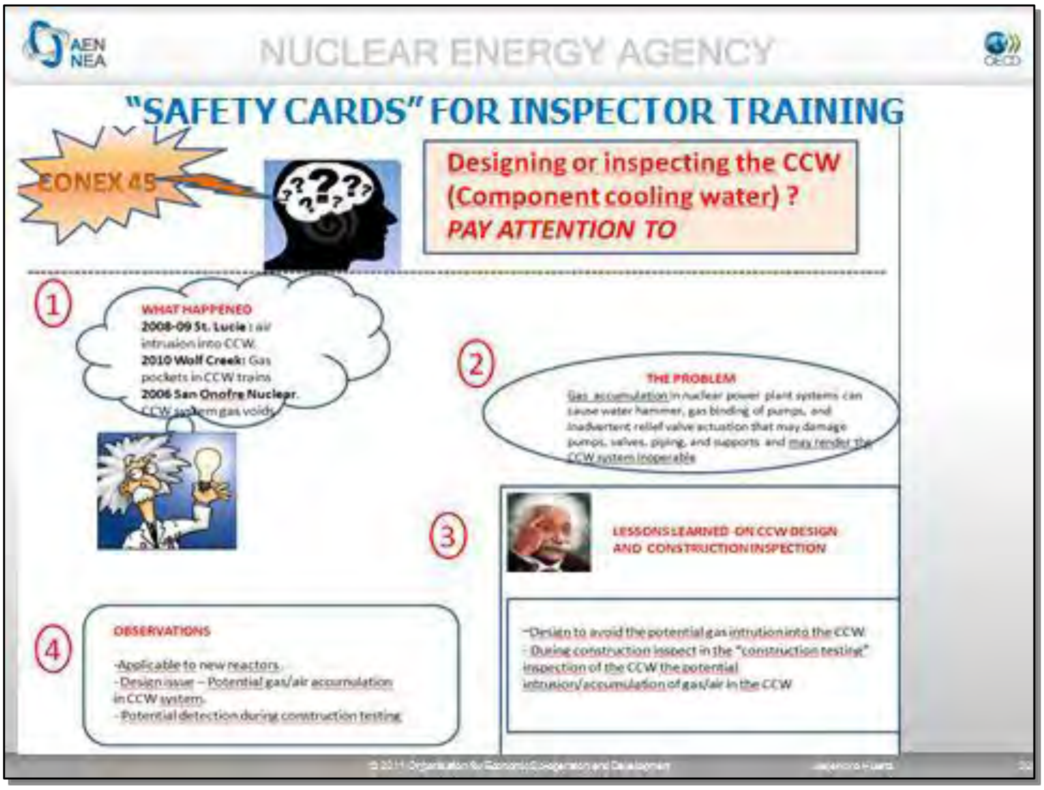
Events and lessons learned
Lessons learned from other events reported to the WGRNR
Fires
Cables
Containment / liner
Essential service water / component cooling water
Welds
Seismic events
Olkiluoto 3. Fire in the annulus space (space between the containment and reactor building wall)
Events related to cables:
-Penly-2. France. 2001. Defective cable insulation.
-Cattenom. France. 2004. Fire in electrical cable penetration due to faulty design
-Palisades. 2007. Degraded electrical cables for CCW and SW due to the close proximity to an uninsulated section of a carbon steel steam generator blowdown line that was routinely as hot as 248C



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"SAFETY CARDS" FOR INSPECTOR TRAINING
CONEX 45
Designing or inspecting the CCW (Component cooling water) ?
PAY ATTENTION TO
1
WHAT HAPPENED
2008-09 St. Lucie : air intrusion into CCW.
2010 Wolf Creek: Gas pockets in CCW trains
2006 San Onofre Nuclear. CCW system gas voids
2
THE PROBLEM
Gas accumulation in nuclear power plant systems can cause water hammer, gas binding of pumps, and inadvertent relief valve actuation that may damage pumps, valves, piping, and supports and may render the CCW system inoperable
3
LESSONS LEARNED ON CCW DESIGN AND CONSTRUCTION INSPECTION
-Design to avoid the potential gas intrution into the CCW
- During construction inspect in the "construction testing" inspection of the CCW the potential intrusion/accumulation of gas/air in the CCW
4
OBSERVATIONS
-Applicable to new reactors.
-Design issue – Potential gas/air accumulation in CCW system.
-Potential detection during construction testing

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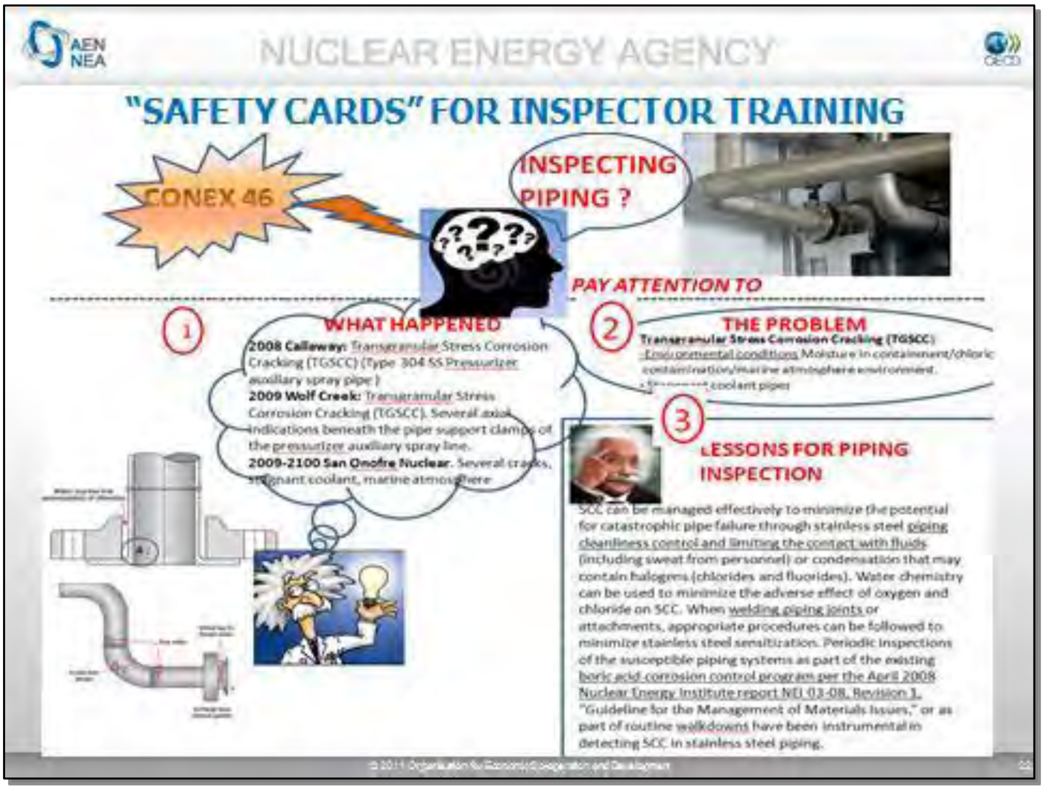
"SAFETY CARDS" FOR INSPECTOR TRAINING
CONEX 47
Inspecting Commercial-grade Dedication (CDG) programmes?
PAY ATTENTION TO
1
WHAT HAPPENED. FINDINGS FROM VENDOR/SUBSAPPLIER INSPECTIONS
-Several examples of lack of engineering justification during dedication process.
- Vendor and Licensee deficiencies to document (critical characteristics, acceptance criteria and methods) the CDG.
- Licensee failed to review and approve CGD before dedication.
-Deficiencies in vendor's surveys to verify subvendor's quality controls (material traceability and batch controls).
-Deficiencies in sampling of commericial-grade items during dedication.
2
LESSONS LEARNED CCW CONSTRUCTION TESTING INSPECTION
Acceptable dedication program:
-Technical evaluation that identifies the critical characteristics (CC) and acceptance criteria for the item to be dedicated
- Acceptance methods that verify that the CCs have been met.
- Documentation of the steps taken during the dedication process.
- Complete documentation and auditable records of the rationale, justifications, and engineering analyses must be available as part of the dedication package
-Purchaser or licensee review and approval before the dedication of the item should be part of the process.
-References: EPRI NP-5652



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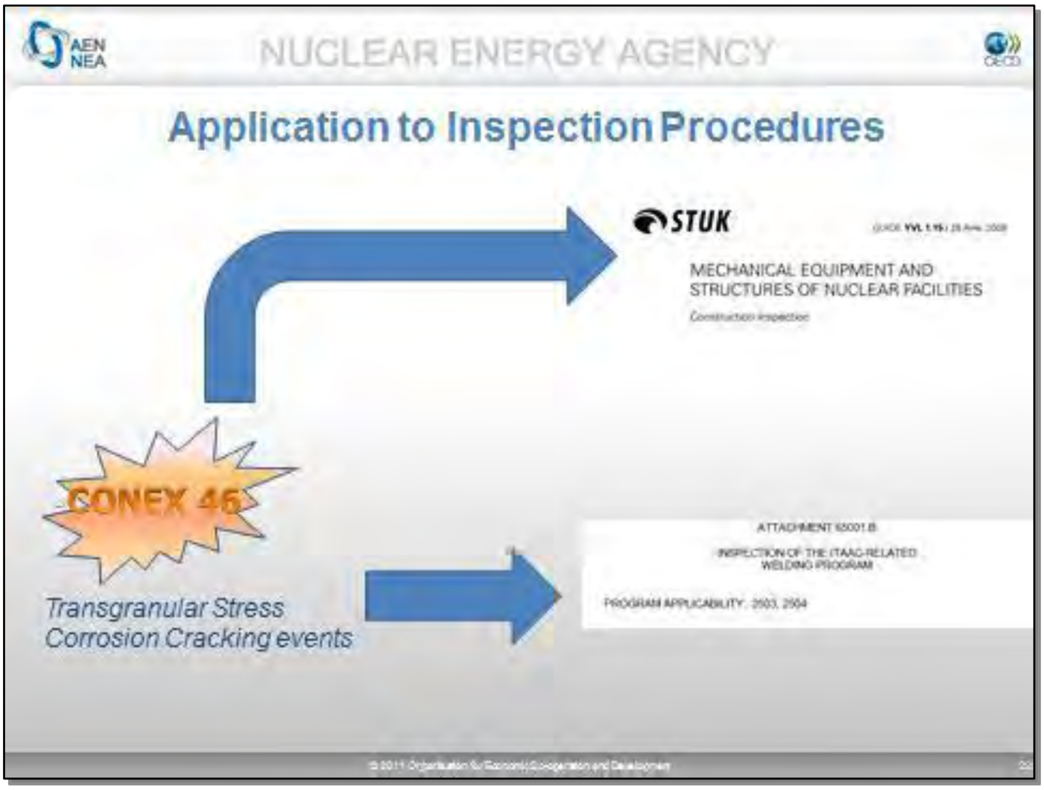
"SAFETY CARDS" FOR INSPECTOR TRAINING
CONEX 46
INSPECTING PIPING ?
PAY ATTENTION TO
1
WHAT HAPPENED
2008 Calleway: Transgranular Stress Corrosion Cracking (TGSCC) (Type 304 SS Pressurizer auxiliary spray pipe)
2009 Wolf Creek: Transgranular Stress Corrosion Cracking (TGSCC). Several axial indications beneath the pipe support clamps of the pressurizer auxiliary spray line.
2009-2100 San Onofre Nuclear. Several cracks, stagnant coolant, marine atmosphere
2
THE PROBLEM
Transgranular Stress Corrosion Cracking (TGSCC):
-Environmental conditions Moisture in containment/chloric contamination/marine atmosphere environment.
coolant piper
3
LESSONS FOR PIPING INSPECTION
SCC can be managed effectively to minimize the potential for catastrophic pipe failure through stainless steel piping cleanliness control and limiting the contact with fluids (including sweat from personnel) or condensation that may contain halogens (chlorides and fluorides). Water chemistry can be used to minimize the adverse effect of oxygen and chloride on SCC. When welding piping joints or attachments, appropriate procedures can be followed to minimize stainless steel sensitization. Periodic inspections of the susceptible piping systems as part of the existing boric acid corrosion control program per the April 2008 Nuclear Energy Institute report NEI 03-08, Revision 1, "Guideline for the Management of Materials Issues," or as part of routine walkdowns have been instrumental in detecting SCC in stainless steel piping.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OECD
Application to Inspection Procedures
STUK
MECHANICAL EQUIPMENT AND STRUCTURES OF NUCLEAR FACILITIES
CONEX 46
Transgranular Stress Corrosion Cracking events
ATTACHMENT 65001.B
INSPECTION OF THE ITAAC-RELATED WELDING PROGRAM
PROGRAM APPLICABILITY: 2503, 2504
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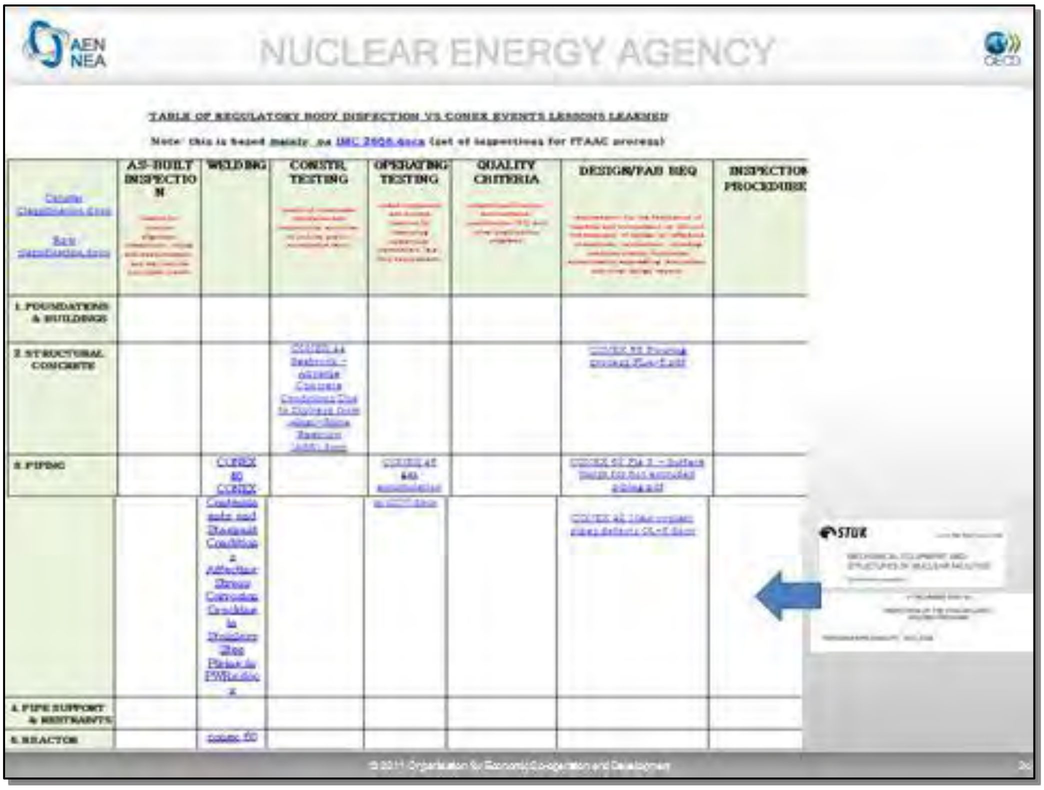
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TABLE OF REGULATORY BODY INSPECTION VS CONEX EVENTS LESSONS LEARNED
AS-BUILT INSPECTION
WELDING
CONSTR. TESTING
OPERATING TESTING
QUALITY CRITERIA
DESIGN/FAB REQ
INSPECTION PROCEDURE
1. FOUNDATIONS & BUILDINGS
2. STRUCTURAL CONCRETE
3. PIPING
4. PIPE SUPPORT & RESTRAINTS
5. REACTOR
STUK
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NUCLEAR ENERGY AGENCY

Application to Inspection Procedures

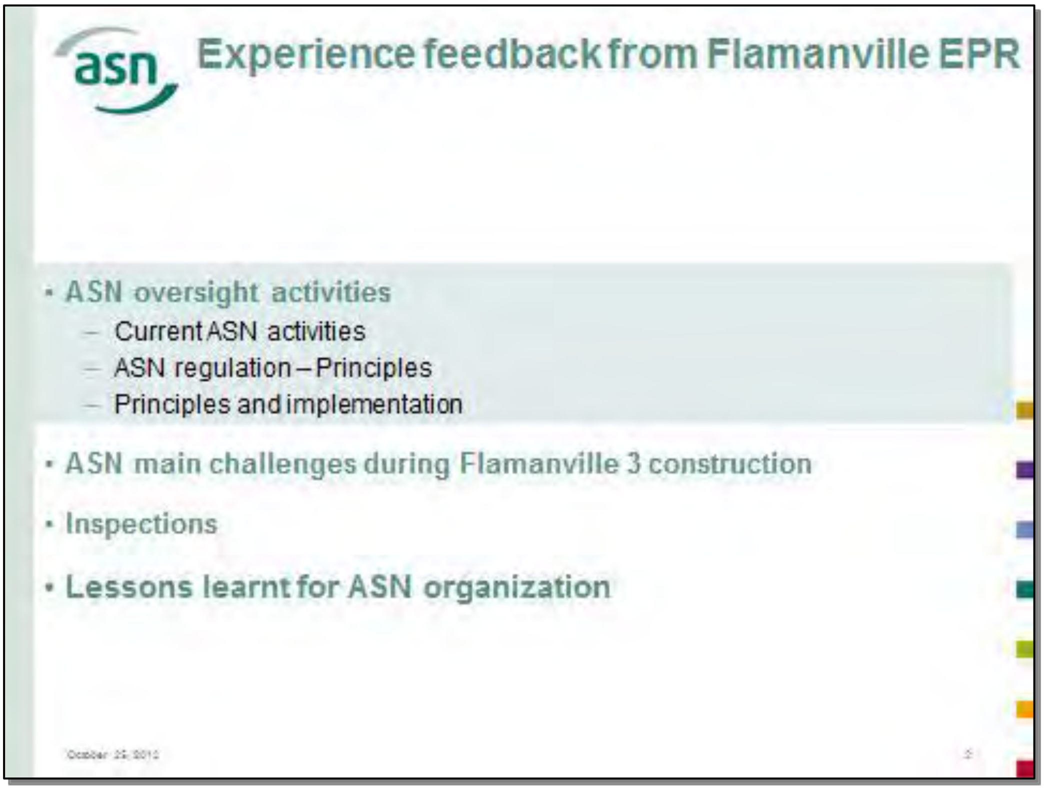
[illegible]	AS-BUILT INSPECTION [illegible]	WELDING	CONSTR. TESTING [illegible]	OPERATING TESTING [illegible]	QUALITY CRITERIA [illegible]	DESIGN/FAB REQ [illegible]	INSPECTION PROCEDURE
PRESSURE VESSEL AND INTERNALS		[illegible] .pdf CONEX 61 Vessel Head defect indications FLA-3.pdf					
6 MECHANICAL COMPONENTS				[illegible]		[illegible]	
7 VALVES			[illegible] Valves			[illegible] Valves [illegible]	

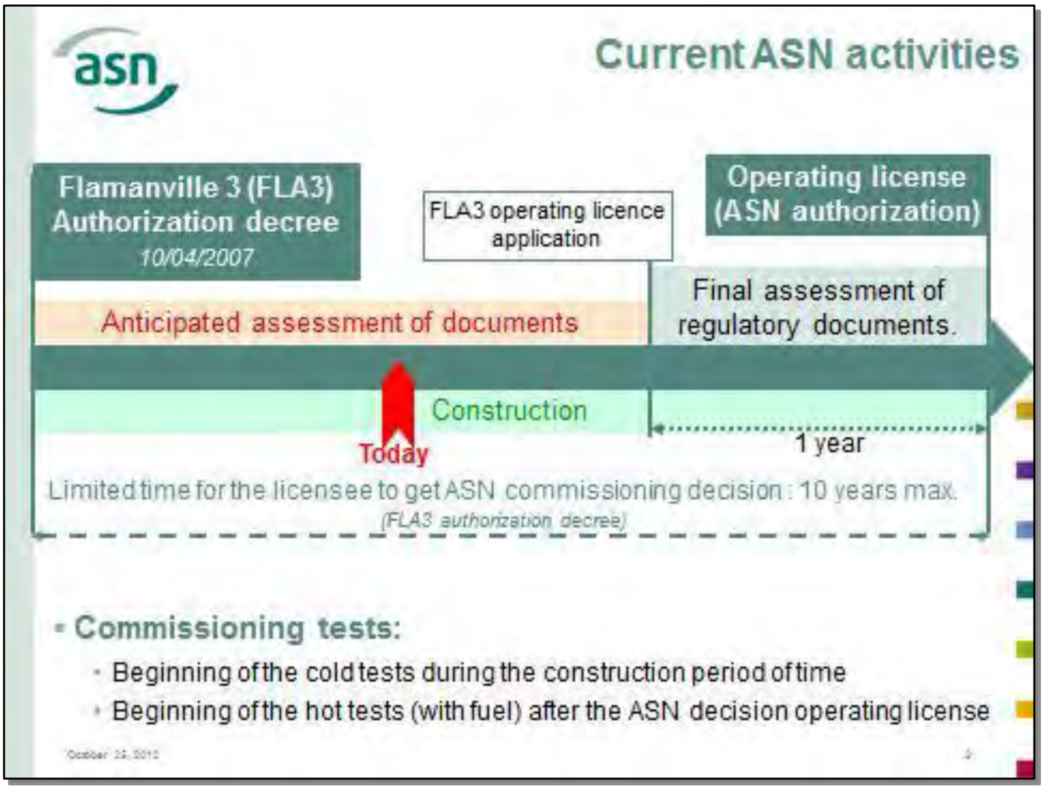
NUCLEAR ENERGY AGENCY

On behalf of WGRNR:

Thank you for your attention


asn
Experience of regulatory oversight of EPR Flamanville 3 construction
Autorité de sûreté nucléaire – ASN (France)
Nuclear Power Plants Department


asn
Experience feedback from Flamanville EPR
• ASN oversight activities
– Current ASN activities
– ASN regulation – Principles
– Principles and implementation
• ASN main challenges during Flamanville 3 construction
• Inspections
• Lessons learnt for ASN organization


Current ASN activities
Flamanville 3 (FLA3) Authorization decree
10/04/2007
FLA3 operating licence application
Operating license (ASN authorization)
Anticipated assessment of documents
Final assessment of regulatory documents.
Construction
Today
1 year
Limited time for the licensee to get ASN commissioning decision : 10 years max.
(FLA3 authorization decree)
▪ Commissioning tests:
▪ Beginning of the cold tests during the construction period of time
▪ Beginning of the hot tests (with fuel) after the ASN decision operating license


Current ASN activities
• Oversight construction of Flamanville 3
– To ensure its quality and its ability to comply with safety, radiation protection and environmental requirements
– Way to proceed
• Assessment of detailed design of SSCs
• Inspection of construction activities: on-site Flamanville 3, in manufacturers or providers workshops
• Assessment and regulation of the hazards that EPR construction may induce on the two adjacent operating nuclear plants and vice versa
• Assessment of main non-compliances
• Assessment of events relevant to safety or radiological protection
• Industrial safety inspections (safety of workers)
• Anticipated assessment of the regulatory documents to be part of the operating license application

French regulatory framework

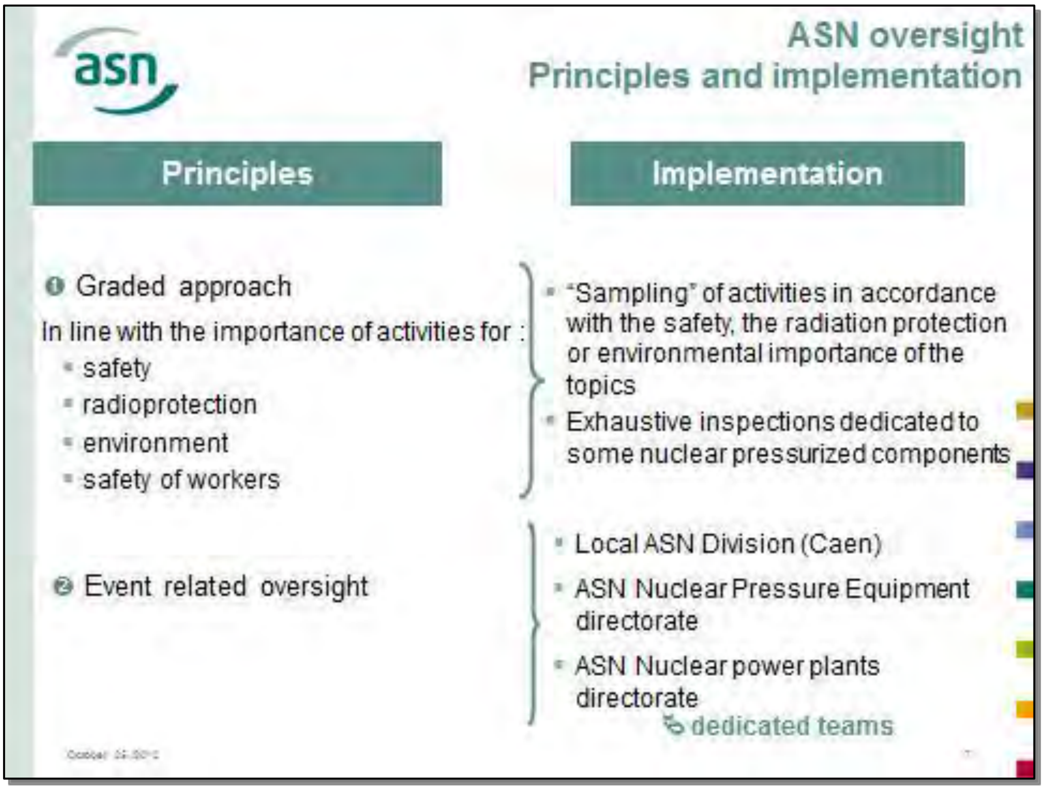
- **Fundamental principle**
  - The plant operator (EDF) has the primary responsibility for safety
  - As a consequence, this operator has to ensure the quality, the control and the supervision of the construction activities
    - except for the pressure nuclear systems which are, by law, under the responsibility of the manufacturer
- **ASN activities scope (established by the TSN Act June 13, 2006)**
  - Safety, public health, protection of nature and environment, workers safety including radiation protection
- **Regulations not specific to nuclear installation**
  - Radiation safety (labor code, public health code)
  - Occupational health an safety (labor code)
  - Environmental protection (environment code)
  - Stakeholder involvement (environment code)
- **One major TSO to support ASN work :**
  - Institute for radiation protection and nuclear safety — IRSN

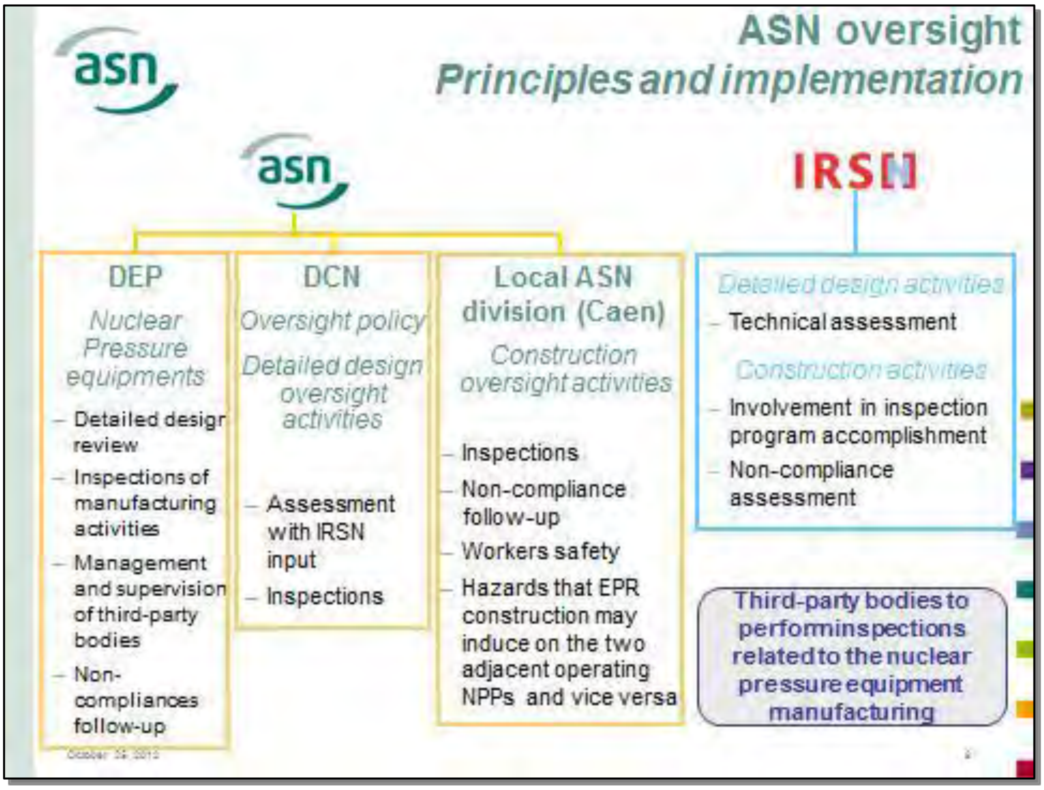
ASN oversight – Principles

- **Objectives of ASN oversight**
  - to ensure that the plant operator and the pressure nuclear systems manufacturers do implement their responsibilities
  - to review the reactor construction in order to be confident on the safety level of the construction activities
  - to verify that the installation as-built complies/will comply with national regulations and ASN requirements

to check that the plant construction activities are performed in accordance with :

- The regulatory requirements
  - Regulation concerning nuclear pressure equipments
  - Order concerning quality management of the operator
  - Authorization decree for FLA3 and associated ASN licence conditions
- The safety case provided by the licensee to get the authorization decree (preliminary safety analysis report…)
- The technical guidelines for new PWR endorsed in 2004 by ASN for EPR
- The state-of-the-art construction practices and the conventional labour regulation


asn
ASN oversight
Principles and implementation
Principles
Implementation
❶ Graded approach
In line with the importance of activities for :
safety
radioprotection
environment
safety of workers
"Sampling" of activities in accordance with the safety, the radiation protection or environmental importance of the topics
Exhaustive inspections dedicated to some nuclear pressurized components
❷ Event related oversight
Local ASN Division (Caen)
ASN Nuclear Pressure Equipment directorate
ASN Nuclear power plants directorate
dedicated teams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ASN oversight
Principles and implementation
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IRSN
DEP
Nuclear Pressure equipments
– Detailed design review
– Inspections of manufacturing activities
– Management and supervision of third-party bodies
– Non-compliances follow-up
DCN
Oversight policy
Detailed design oversight activities
– Assessment with IRSN input
– Inspections
Local ASN division (Caen)
Construction oversight activities
– Inspections
– Non-compliance follow-up
– Workers safety
– Hazards that EPR construction may induce on the two adjacent operating NPPs and vice versa
Detailed design activities
– Technical assessment
Construction activities
– Involvement in inspection program accomplishment
– Non-compliance assessment
Third-party bodies to perform inspections related to the nuclear pressure equipment manufacturing

ASN oversight
Principles and implementation

- **Transition from design to construction**
  - No predefined hold point
    - Except for some pressure nuclear equipments, where some hold point can be imposed by ASN to assess conformity
- **Based on operator or ASN findings for all phases, ASN can impose a hold point on an observed problem**
  - Regulatory basis: ASN prescriptions (licence conditions) linked to Flamanville 3 authorization decree
  - The operator must satisfy ASN that appropriate corrective measures have been implemented to allow progress
    - ① Such hold points have already been imposed

Regulations for design and manufacturing of nuclear pressure equipments

- **French regulations were historically applied to all types of pressure equipment**
- **Regulations for nuclear pressure equipments (NPE) provide additional requirements which take into account the safety of the plant and the risks due to radioactivity. The aim of these regulations is to offer additional guarantees on the quality of the equipment.**
  - Essential safety requirements (ESR): NPE requirements = PED Requirements + additional requirements
- **The manufacturer should meet the ESR which are defined as goals to achieve.**
  - The equipment is subject to a **conformity assessment** of the ESR
  - Assessment performed by ASN and third party inspection body.
  - The manufacturer must also demonstrate that the codes and standards it uses to manufacture the equipment meet ASN's requirements.

Regulations for design and manufacturing of nuclear pressure equipments

- **Conformity assessment**
  - For major components, conformity assessment is done equipment by equipment
  - For each equipment: assessment of the design and inspection of manufacturing steps, to verify conformance with essential safety requirements.
- **ASN ensures a surveillance of third-party bodies (notified and accepted by ASN).**
- **NPE cannot be commissioned if essential safety requirements (ESR) are not met**

Experience feedback from Flamanville EPR

- **ASN oversight activities**
- **ASN main challenges during Flamanville 3 construction**
- **Inspections**
- **Lessons learnt for ASN organization**

ASN main challenges
Flamanville 3 is a first of a kind in France

- **Flamanville 3 = first of a kind**
  - **Issue:**
    - The cost of detailed design would be too high for the industry to finance without the confirmation of having at least one launch order
    - Introduction of new SSCs in comparison with the operating reactors
  - **Consequences:**
    - Preliminary safety analysis report sometimes not detailed enough to perform some inspections (more information needs to be provided)
    - Detailed design is moving (adequacy and consistency issue...)
    - Teams performing the assessment have to learn about new SSC

ASN main challenges
A moving regulatory framework

- **New regulations in force**
  - **Timeframe**
    - 2005: new regulation for pressure nuclear equipments
      - AREVA and EDF decided to use it for Flamanville 3
    - 9th May 2006 : EDF submitted its formal authorization application
    - 13th June 2006 : Act on Transparency and Security in the Nuclear Field (TSN-Act)
    - **4th April 2007** : Flamanville 3 authorization decree signed by Prime Minister
    - 2nd November 2007: Decree related to nuclear facilities and the regulation of the transport of radioactive materials
      - Gives the detail of the process to get a authorization decree and a commissioning authorization
    - 26th September 2008 : ASN issued a resolution establishing requirements (i.e. licence conditions) for the detailed design and control for Flamanville 3
  - **Consequence:**
    - the review of the EDF application and the pressure nuclear equipments oversight began with the "old" regulations but took into account some of the new requirements of the TSN-Act and of pressure nuclear equipments regulation

ASN main challenges
No NPP constructions for 10 years

- **After a 10 years period without construction of new NPPs in France**
  - Latest NPP construction in France : Civaux (N4 series)
    - Civaux 1: construction started late in 1988, first criticality in November 1997
    - Civaux 2: construction started early in 1991, first criticality in November 1999
  - **Challenge**:
    - Loss of companies familiar with NPP construction requirements
    - Loss of skilled people
  - **Consequences**:
    - A relearning stage for the licensee, the manufacturers, the subcontractors...as well as for ASN and IRSN
    - To revisit past practices and establish current practices
  - **ASN aim:** to ensure that all actors involved in NPP construction have a construction experience feedback process to learn from on-going construction and to smooth any future potential construction projects

Experience feedback from Flamanville EPR

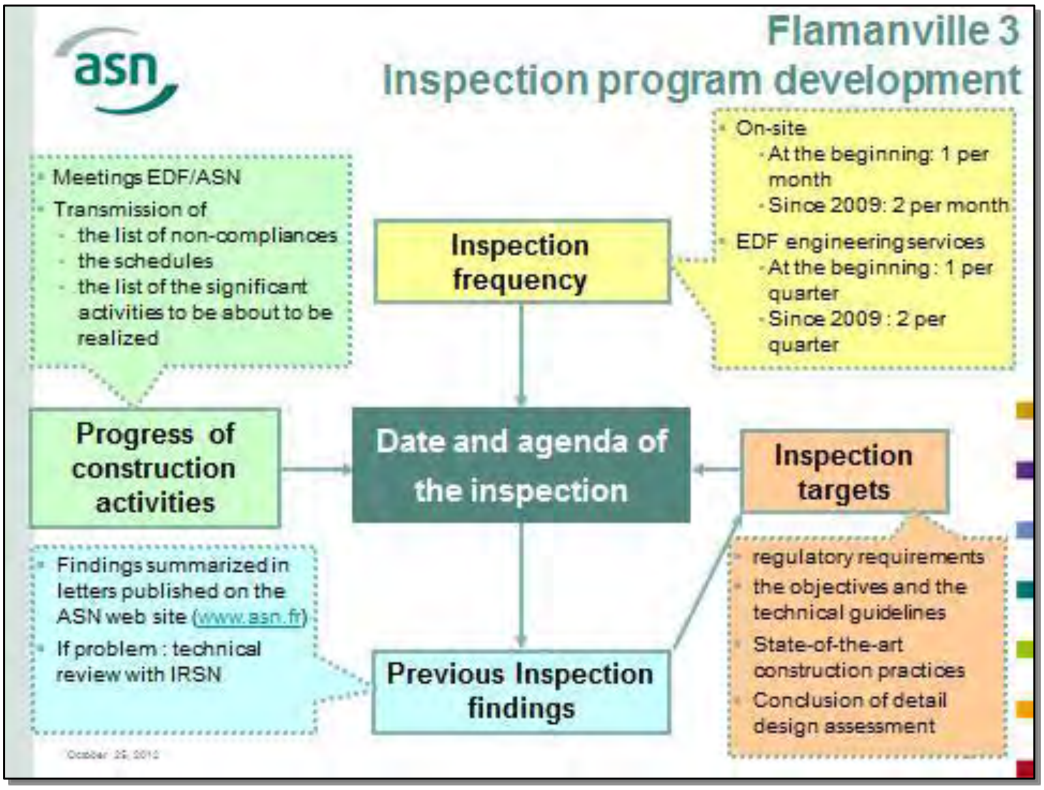
- **ASN oversight activities**
- **ASN main challenges during Flamanville 3 construction**
- **Inspections**
  - ASN inspections practices
  - Flamanville 3 - Inspection program development
  - Current status of ASN inspection program development
  - ASN tools developed for inspection activities
  - Occupational health and safety, labor issues
- **Lessons learnt for ASN organization**

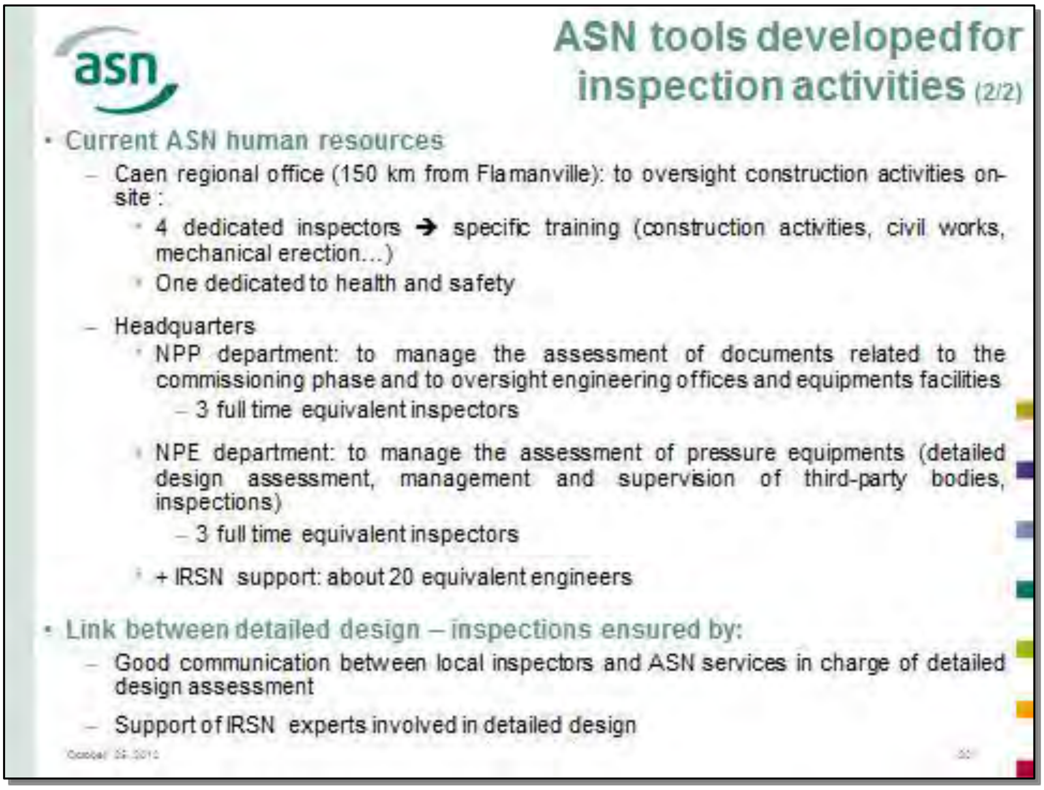
ASN inspections practices (1/2)

- Inspections:
  - Are either unannounced or notified to the licensee a few weeks before the site visit
  - Takes place:
    - mainly on the site or during the course of the relevant activities;
    - in the head office departments (or design and engineering departments) at the major nuclear licensees
    - in the workshops or engineering offices of the subcontractors, the construction sites, plants or workshops manufacturing the various safety-related components
  - Are usually carried out by two inspectors, with the support of an IRSN representative (expert for the facility or the topic)
    - ASN can mandate third-party bodies to perform inspections related to the nuclear pressure equipment manufacturing
- No resident inspector
  - In order to maintain the operator responsibility
  - ASN Caen division is less than 2 hours drive of Flamanville NPP

ASN inspections practices (2/2)

- Each inspection in a nuclear facility gives rise to:
  - At the end of the inspection, a factual record of major negative findings (signed by the inspectors and the licensee's representative)
  - A few weeks (~3 weeks) after the inspection:
    - A follow-up letter to the licensee stating, in addition to an overall synthesis of the main positive and negative findings:
      - anomalies in the facility or aspects warranting additional justifications
      - deviations between the situation observed during the inspection and the regulations or documents produced by the licensee pursuant to the regulations
      - ASN requirements to correct, within a fixed period of time, the deviations or non compliances observed by the inspectors or to improve the situation
    - An inspection report which is restricted to ASN
- Inspection follow-up letters are available on ASN web site (www.asn.fr).


Flamanville 3
Inspection program development
Meetings EDF/ASN
Transmission of
the list of non-compliances
the schedules
the list of the significant activities to be about to be realized
Inspection frequency
On-site
At the beginning: 1 per month
Since 2009: 2 per month
EDF engineering services
At the beginning: 1 per quarter
Since 2009 : 2 per quarter
Progress of construction activities
Date and agenda of the inspection
Inspection targets
regulatory requirements
the objectives and the technical guidelines
State-of-the-art construction practices
Conclusion of detail design assessment
Findings summarized in letters published on the ASN web site (www.asn.fr)
If problem : technical review with IRSN
Previous Inspection findings


ASN tools developed for inspection activities (2/2)
Current ASN human resources
Caen regional office (150 km from Flamanville): to oversight construction activities on-site :
4 dedicated inspectors → specific training (construction activities, civil works, mechanical erection…)
One dedicated to health and safety
Headquarters
NPP department: to manage the assessment of documents related to the commissioning phase and to oversight engineering offices and equipments facilities
3 full time equivalent inspectors
NPE department: to manage the assessment of pressure equipments (detailed design assessment, management and supervision of third-party bodies, inspections)
3 full time equivalent inspectors
+ IRSN support: about 20 equivalent engineers
Link between detailed design – inspections ensured by:
Good communication between local inspectors and ASN services in charge of detailed design assessment
Support of IRSN experts involved in detailed design

Inspections by ASN – Flamanville 3
Number & topics - annual synthesis

- Since 2008, about 24 inspections per year at FLA3
  - Civil structures
  - Mechanical structures
  - Electrical equipments
  - Quality management
  - EDF organization
  - Contractors oversight
  - Radiation safety (NDT)
  - Environment protection
- Since 2008, about 8 inspections per year in EDF engineering departments or equipment providers (EDF subcontractors)
- Nuclear pressure equipment manufacturing: ~1000 inspections by approved 3rd party and a few ASN inspections per year
- Occupational health & safety and labor code (a dozen per year)

Control of construction
Hazards (construction ⇨ operating units)

- Hazards generated by construction:
  - Cranes: no consideration by the operator of the risk of a falling crane on FLA2
  - Blasting, dust: in 2007, some stones were thrown on FLA2 diesel generator building
  - Protection of power cables during gallery digging: in 2010, a contractor (civil work company) damaged the power cable
- Main causes:
  - Lack of questioning attitude
  - Lack of cooperation between the two operating nuclear plants and FLA3
  - Lack of communication on site

Control of construction
Examples of non-conformances at FLA3

- Cracks in basemat (2008)
  - Cracks ran the full depth of the first layer for the reactor building basemat, caused by lack of reinforcement steelwork at the level where pouring was stopped
  - ASN set an hold point
- Construction joints (2008-2010)
  - 2008: Impossibility to access the joint, for joint preparation, due to high density of steel
  - 2009-2010: Use of unapproved chemical products (deactivator) for joint treatment in state of pressurized water and air
- Liner welding (2008-2011)
  - 2008: High level of repairs especially on reactor building basemat area
  - 2010: High level of repairs (cylindrical part of liner)

Control of construction
Manufacturing of main RCS components

- FLA3 pressurizer shell manufacturing
  - Use of a non qualified electrode to perform some Pellini tests
- FLA3 steam generator shell manufacturing
  - Wrong position for the hole of MFWS pipe
- FLA3 Vessel head
  - 2010: defects in several nozzle penetration welds
  - 2011: inadequate buttering of nozzle penetration welds

Control of construction
ASN view on causes of non conformances

- Some lack of:
  - Preparedness
    - Not enough consideration of the impact of an activity on another one
    - In the beginning, practices developed to optimize mainly schedule, underestimating quality impact
    - Old practices are given up: new ones have not always been tested
  - Communication
    - On site
    - Between engineering departments and on site departments
  - Appropriation of the requirements of the construction code and common civil works rules
  - Consistency between detailed design and on site practices
- Some shortcomings in management and surveillance of the subcontractor chain

Control of construction
ASN view on causes of non conformances

- Not enough use of experience feedback
  - Experience feedback of first events was not implemented quickly enough
  - Experience feedback of a construction activity is not used for the beginning of another construction activity
- The operator has to ensure that it is possible to comply with requirements and that they are indeed necessary
  - Operator proposals: to get out of the construction code (ETC-C) the technical requirements which were difficult to be complied
  - Refused by ASN
- Way to improve the situation
  - To consolidate construction experience feedback
    - To develop exchange between regulatory bodies
    - To ensure that the international experience feedback is shared between licensees
    - To define with the licensee an event reporting system and communication scale

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Control of construction
Non conformances and their impact

- A series of non conformances during the construction
  - Some are detected by the manufacturer and the licensee
  - Some are detected by ASN and its TSO
  - Some leads to the use of regulatory and coercive tools and additional specific assessment
- But today no real impact for the future commissioning of the reactor
  - Non-conformances are corrected or technically justified (on ASN demand or on operator behalf)
    - Extensive new assessment
    - Re-manufacturing or repair of some equipments/structures
    - Additional inspections
  - Nevertheless: the number of non-conformances is an indicator reflecting a perfectible quality management and surveillance of activities by the licensee and the manufacturer

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Experience feedback from Flamanville EPR

- ASN oversight activities
- ASN main challenges during Flamanville 3 construction
- Technical assessment
- Inspections
- Lessons learnt for ASN organization

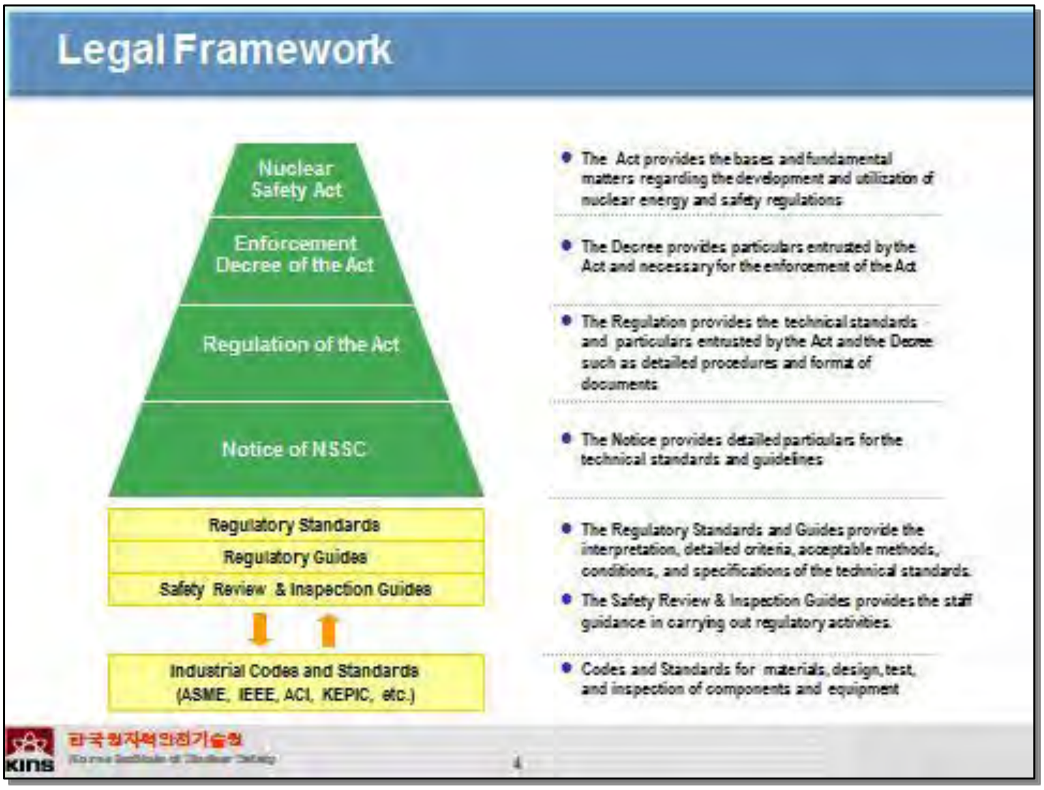
Lessons learnt for ASN organization

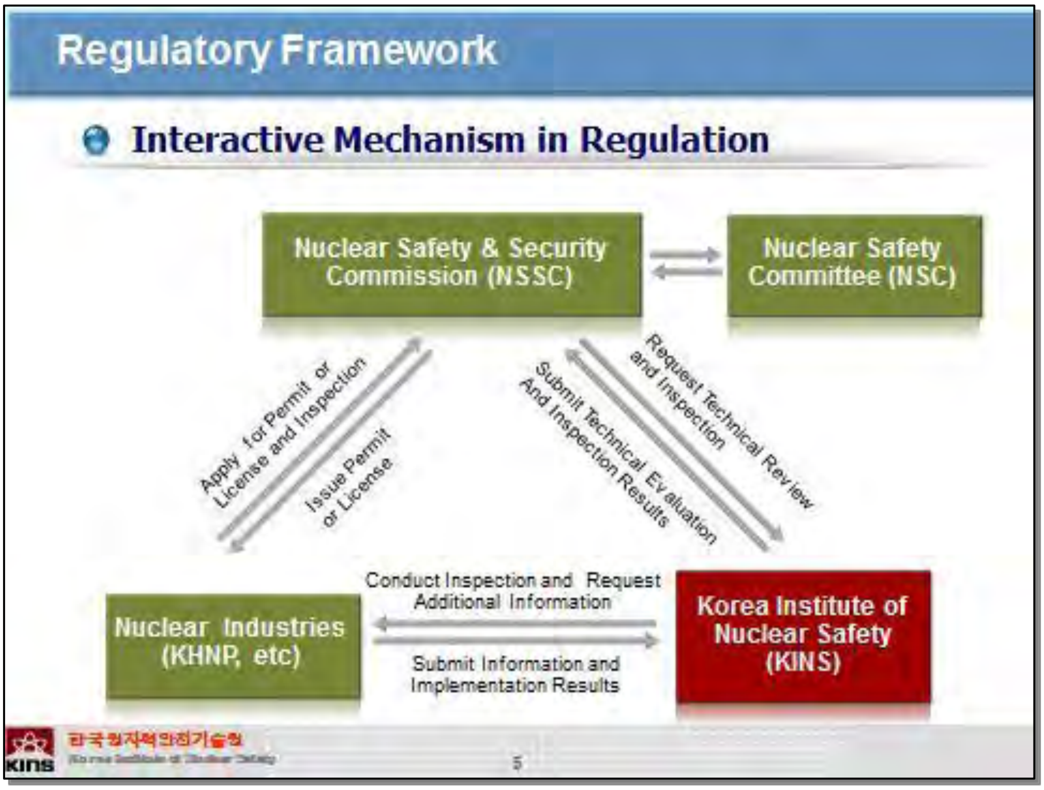
- **Regulatory tools are in place to ensure:**
  - Consistent and responsive processes
  - Large scope oversight
- **Ensure sufficient human resources dedicated to dealing with:**
  - Elaboration of methodologies to define the way to proceed
    - how to apply new regulation in force
      - 2005: new regulation for pressure nuclear equipments
      - 13th June 2006 : Act on Transparency and Security in the Nuclear Field (TSN-Act)
      - 2nd November 2007: Decree related to nuclear facilities and the regulation of the transport of radioactive materials
    - how to apply regulation to a NPP under construction, specially to FOAK
  - Public communication demands
  - International cooperation needs

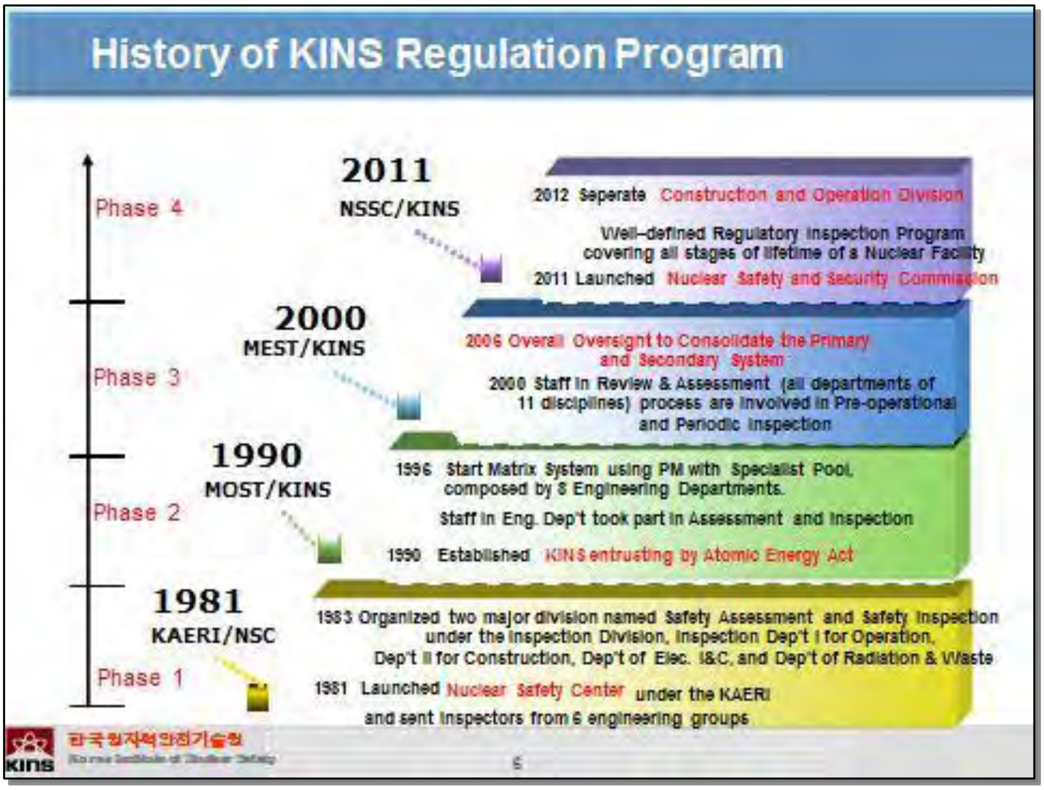

2nd CNRA International Workshop, Atlanta, Georgia, USA, 24-26 October, 2012
Regulatory Approach for
Oversight of APR1400 Constructions
KINS
Korea Institute of Nuclear Safety
Seon Ho SONG
Shin-Kori Units 3&4 Project Manager
shsong@kins.re.kr


In Operation : 21 units (18,716 MW)
Under Construction : 5 units (5,800 MW)
Ulchin
Wolsong
Gyeongju
Younggwang
Seoul
Low- and Intermediate- Level
Waste Disposal Facility
(Under construction)
Kori
In Operation
Under PSAR Review
Under Construction
The Rep. of Korea, Country Group 6, 5th RM of CNS, April 5, 2011
2


Overview of Nuclear Power Program
In Operation : 23 units
Under Construction : 4 units
Ulchin
Wolsong
Gyeongju
Low- and Intermediate- Level Waste Disposal Facility (Under construction)
Younggwang
Seoul
Kori
In Operation
Under PSAR Review
Under Construction
KINS
3


Legal Framework
Nuclear Safety Act
Enforcement Decree of the Act
Regulation of the Act
Notice of NSSC
Regulatory Standards
Regulatory Guides
Safety Review & Inspection Guides
Industrial Codes and Standards (ASME, IEEE, ACI, KEPIC, etc.)
The Act provides the bases and fundamental matters regarding the development and utilization of nuclear energy and safety regulations
The Decree provides particulars entrusted by the Act and necessary for the enforcement of the Act
The Regulation provides the technical standards and particulars entrusted by the Act and the Decree such as detailed procedures and format of documents
The Notice provides detailed particulars for the technical standards and guidelines
The Regulatory Standards and Guides provide the interpretation, detailed criteria, acceptable methods, conditions, and specifications of the technical standards.
The Safety Review & Inspection Guides provides the staff guidance in carrying out regulatory activities.
Codes and Standards for materials, design, test, and inspection of components and equipment
KINS
4


Regulatory Framework
Interactive Mechanism in Regulation
Nuclear Safety & Security Commission (NSSC)
Nuclear Safety Committee (NSC)
Apply for Permit or License and Inspection
Issue Permit or License
Submit Technical Evaluation And Inspection Results
Request Technical Review and Inspection
Conduct Inspection and Request Additional Information
Submit Information and Implementation Results
Nuclear Industries (KHNP, etc)
Korea Institute of Nuclear Safety (KINS)
한국원자력안전기술원
5


History of KINS Regulation Program
Phase 4
Phase 3
Phase 2
Phase 1
2011
NSSC/KINS
2012 Seperate Construction and Operation Division
Well-defined Regulatory Inspection Program covering all stages of lifetime of a Nuclear Facility
2011 Launched Nuclear Safety and Security Commission
2000
MEST/KINS
2006 Overall Oversignt to Consolidate the Primary and Secondary System
2000 Staff in Review & Assessment (all departments of 11 disciplines) process are involved in Pre-operational and Periodic Inspection
1990
MOST/KINS
1996 Start Matrix System using PM with Specialist Pool, composed by 8 Engineering Departments.
Staff in Eng. Dep't took part in Assessment and Inspection
1990 Established KINS entrusting by Atomic Energy Act
1981
KAERI/NSC
1983 Organized two major division named Safety Assessment and Safety Inspection under the Inspection Division, Inspection Dep't I for Operation, Dep't II for Construction, Dep't of Elec. I&C, and Dep't of Radiation & Waste
1981 Launched Nuclear Safety Center under the KAERI and sent inspectors from 6 engineering groups
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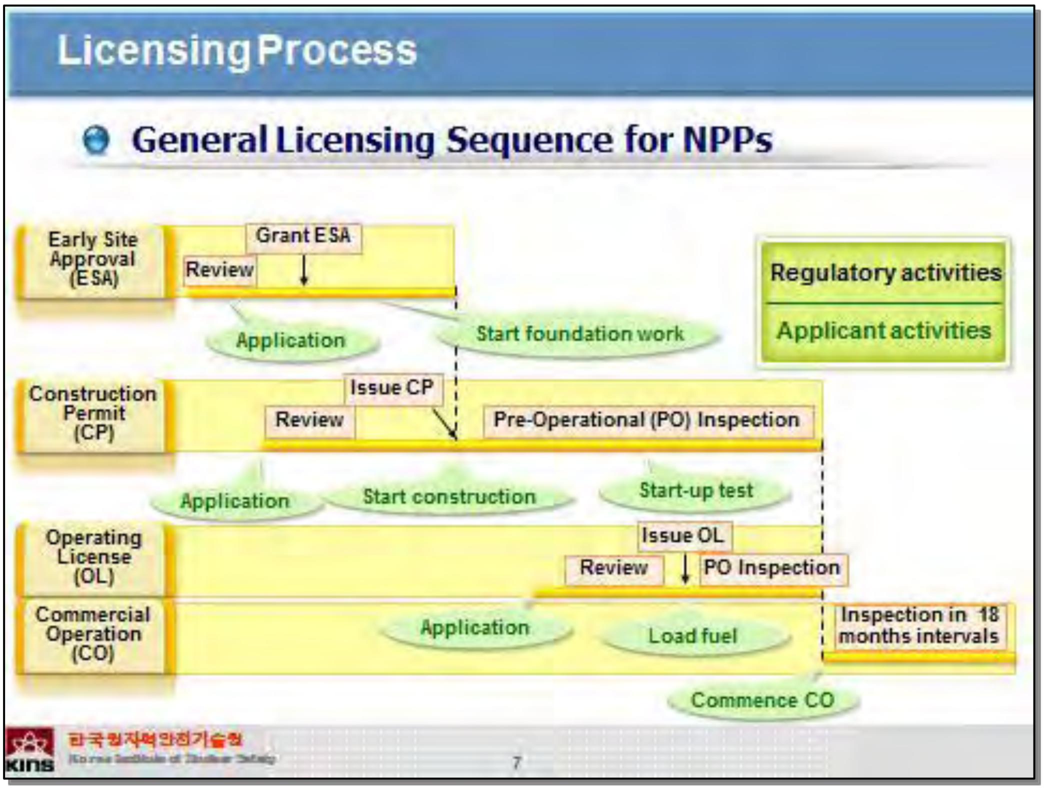
6


Licensing Process
General Licensing Sequence for NPPs
Early Site Approval (ESA)
Grant ESA
Review
Application
Start foundation work
Regulatory activities
Applicant activities
Construction Permit (CP)
Issue CP
Review
Pre-Operational (PO) Inspection
Application
Start construction
Start-up test
Operating License (OL)
Issue OL
Review
PO Inspection
Commercial Operation (CO)
Application
Load fuel
Inspection in 18 months intervals
Commence CO
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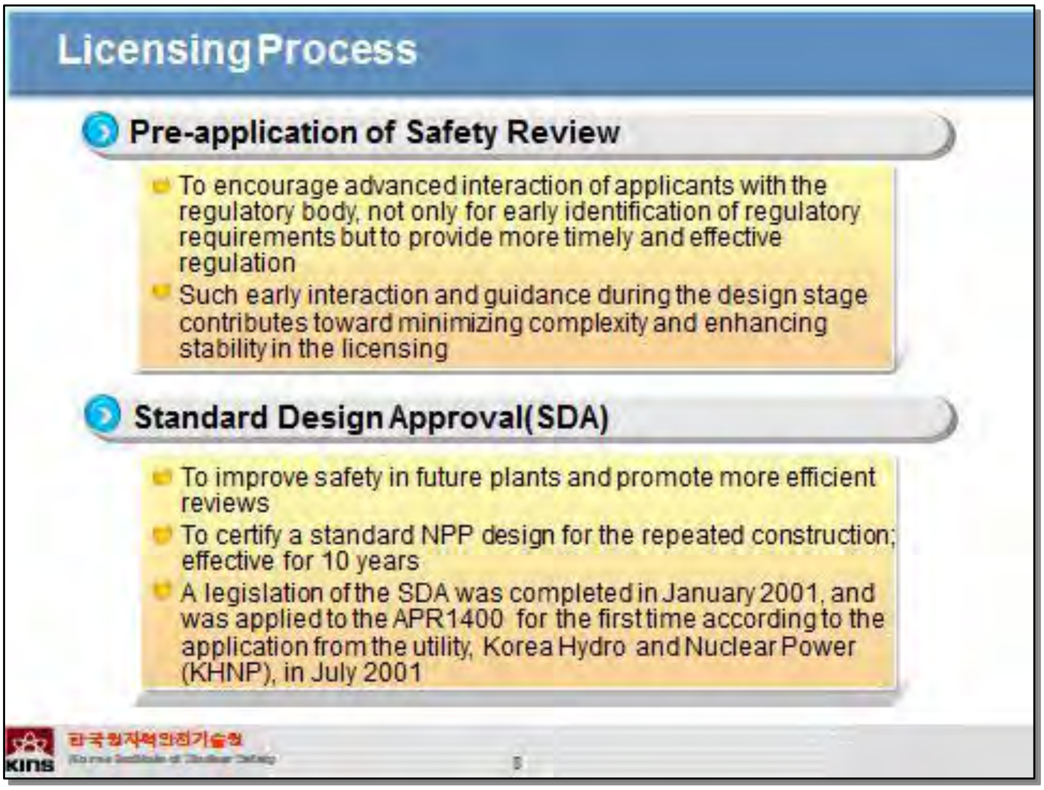
Licensing Process
Pre-application of Safety Review
To encourage advanced interaction of applicants with the regulatory body, not only for early identification of regulatory requirements but to provide more timely and effective regulation
Such early interaction and guidance during the design stage contributes toward minimizing complexity and enhancing stability in the licensing
Standard Design Approval(SDA)
To improve safety in future plants and promote more efficient reviews
To certify a standard NPP design for the repeated construction; effective for 10 years
A legislation of the SDA was completed in January 2001, and was applied to the APR1400 for the first time according to the application from the utility, Korea Hydro and Nuclear Power (KHNP), in July 2001
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Licensing Process

Early Site Approval (ESA)

- To allow the applicant to perform a limited civil engineering work for site preparation before CP
- Application documents: Site Survey Report, Detailed Geological Survey Report, etc.

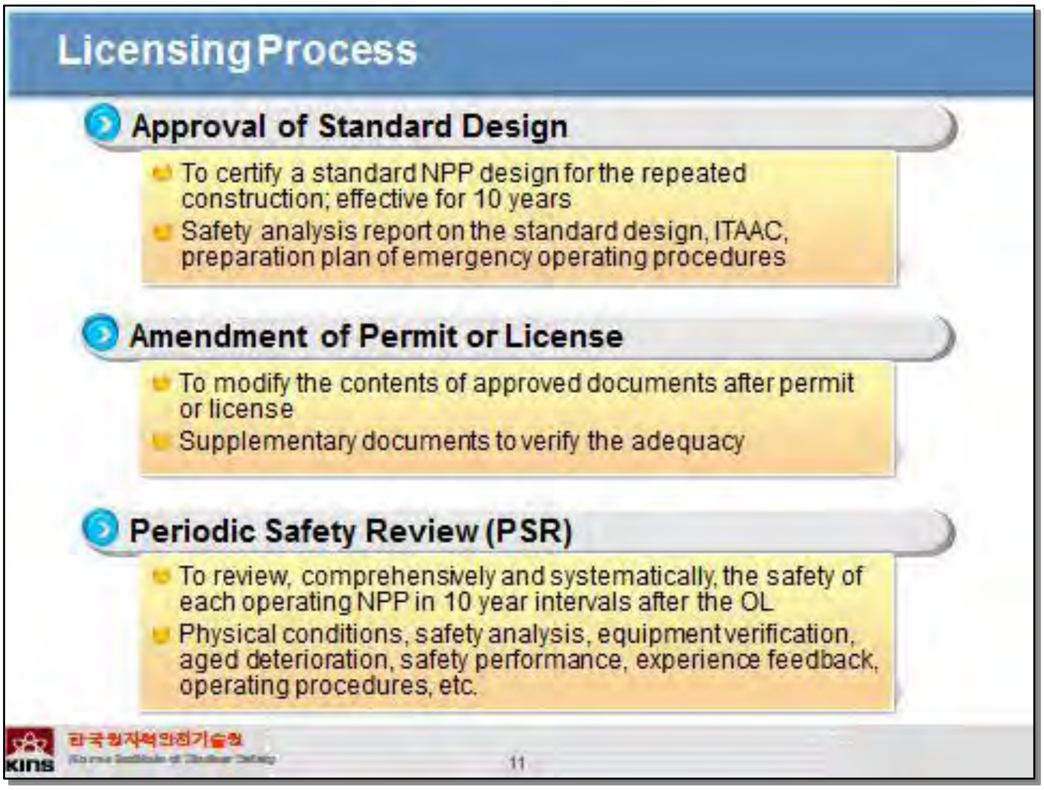
Construction Permit (CP)

- To ensure the adequacy of plant site, design, and construction in accordance with Rules and Regulations, prior to the commencement of construction
- Major application documents
  - Preliminary Safety Analysis Report (PSAR), Quality Assurance Program (QAP) for design and construction, Environmental Report (ER), etc.

Licensing Process

Operating License (OL)

- To confirm the final adequacy of plant design and operational functionality
- To review the operation and accident response capability of the applicant
- Major application documents
  - Final Safety Analysis Report (FSAR), QAP for operation, Technical Specifications for Operation, Radiological Emergency Plan, etc.
- Nuclear fuel loading and commissioning tests upon the issuance of OL



Licensing Process
Approval of Standard Design
To certify a standard NPP design for the repeated construction; effective for 10 years
Safety analysis report on the standard design, ITAAC, preparation plan of emergency operating procedures
Amendment of Permit or License
To modify the contents of approved documents after permit or license
Supplementary documents to verify the adequacy
Periodic Safety Review (PSR)
To review, comprehensively and systematically, the safety of each operating NPP in 10 year intervals after the OL
Physical conditions, safety analysis, equipment verification, aged deterioration, safety performance, experience feedback, operating procedures, etc.
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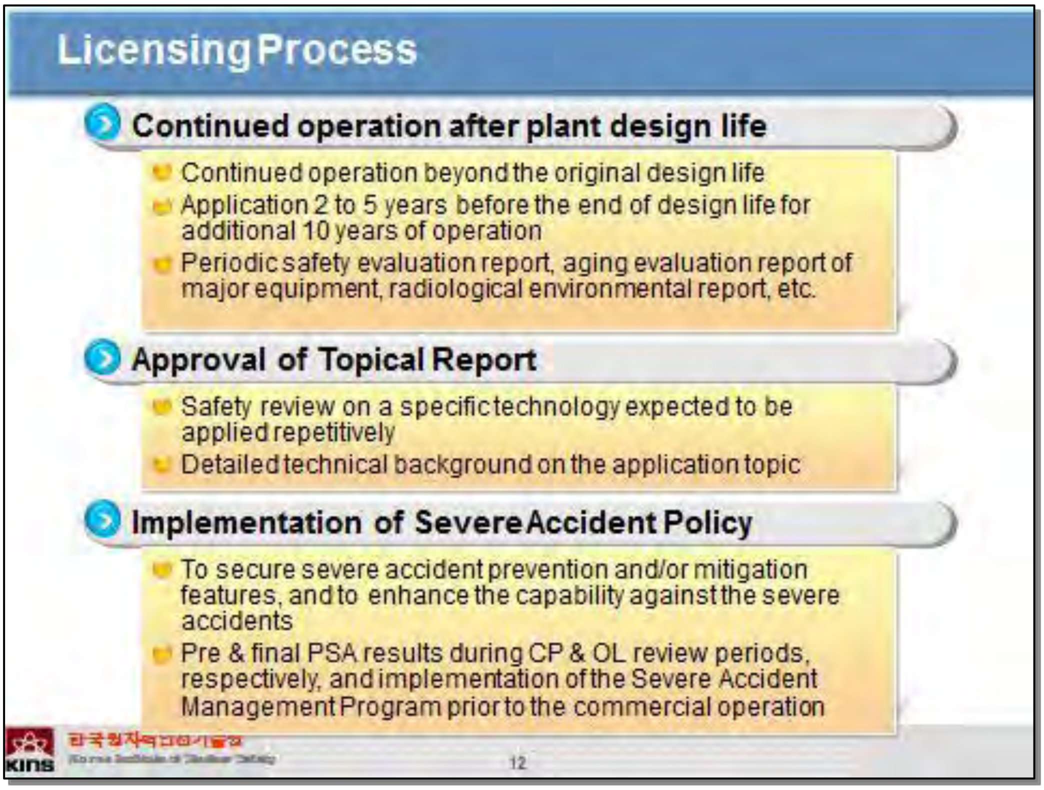

Licensing Process
Continued operation after plant design life
Continued operation beyond the original design life
Application 2 to 5 years before the end of design life for additional 10 years of operation
Periodic safety evaluation report, aging evaluation report of major equipment, radiological environmental report, etc.
Approval of Topical Report
Safety review on a specific technology expected to be applied repetitively
Detailed technical background on the application topic
Implementation of Severe Accident Policy
To secure severe accident prevention and/or mitigation features, and to enhance the capability against the severe accidents
Pre & final PSA results during CP & OL review periods, respectively, and implementation of the Severe Accident Management Program prior to the commercial operation
KINS
12

Review & Assessment Process

- **R & A is performed to confirm the compliance with Regulatory Requirements and associated Acceptance Criteria**
  - ✓ Standard Review Guideline/Procedure is used
  - ✓ Internal Guidelines
  - ➢ necessary for effective review and assessment of the application documents submitted by applicant
  - ➢ NSSC approves the KINS Rules for Entrusted Regulatory Activities developed in accordance with Article 311 (Approval of Activities) of Enforcement Decree
  - ➢ Administrative procedures for conducting the technical activities

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Scheduling and Planning of R & A

- **Processing time of license and notification of review plan**

➢ Regulatory process for CP or OL should be completed within 24 months

➢ Process within 15 months for the following cases

- Capacity, Reactor type, and Design Specifications of the Major Components are identical to those for which a CP or OL has already been issued
- Identical design to the approved standard design

➢ Following periods shall not be counted in the process timing:

- Periods required to supplement or correct the documents
- Other periods additionally required for excusable reasons
  - to conduct an experiment in order to verify safety
  - period during which the inspection cannot be performed

➢ Review plan be notified in advance to enhance the predictability of licensing

- Operating experience, Design changes, Application of the latest technical criteria, First of a kind design issue, and Issues of significant public concern, etc.

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Implementation of R & A

- **All of areas considering up-to-dated Experiences & other Factors :**
  - **Proven provisions or Qualification**
    - ✓ EQ, Software Quality of Safety-critical I&C Systems
  - **Consideration of competence and skills and others**
    - ✓ Evaluation of Technical Capability for Operation , Human Factor
  - **Incorporating on the latest experience**
    - ✓ Cyber Security for Digital I&C Systems
  - **Independent confirmatory audit calculation**
    - ✓ Uncertainty and Sensitivity Analysis, Code V & V in Safety Analysis
  - **On-site verification through regulatory inspection**
    - ✓ Electric System Design, ECCS Recirculation Sump Strainer, etc.

15

Review for OL of SKN Units 3&4

The OL of SKN Units 3&4 applied in June 2011. The operating license application and the affiliated document for SKN Units 3&4 are reviewed:

- Appropriateness of the over-pressure protective facility of the nuclear reactor coolant system
- Design of hydrogen mitigation system
- Appropriateness of the safety instrumentation and control systems designed by domestic products
- Appropriateness of the cyber security of the instrumentation and control systems
- Appropriateness of the integrated design of the soft controller and the engineered safety features-component control system
- Evaluation on the time response for the safety-related operator manual actions in the perspectives on diversity and defense-in depth (D3) design
- Evaluation of human-system interfaces in the main control room

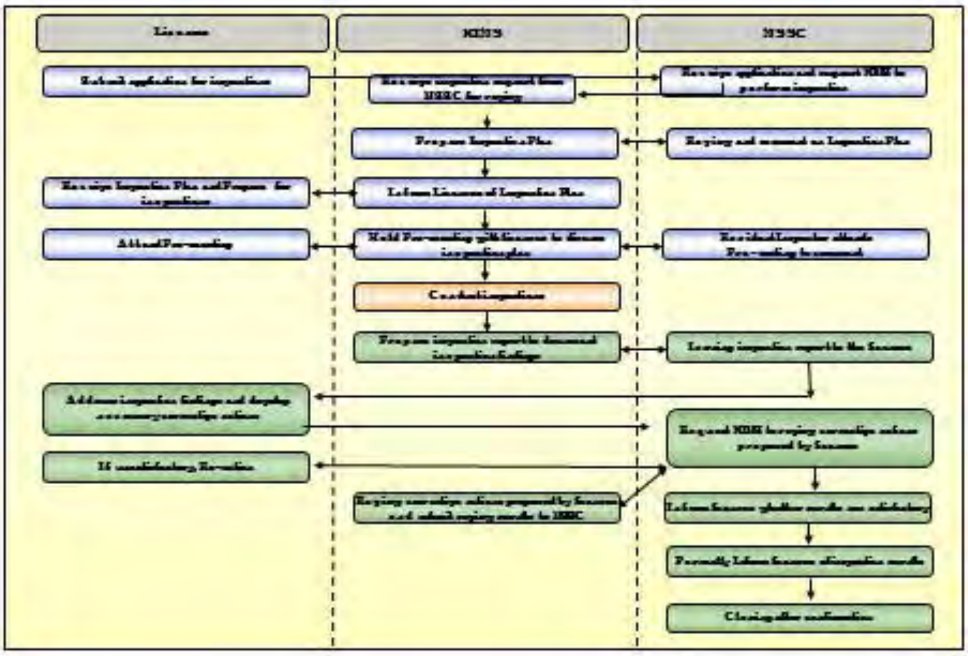
16

Regulatory Inspection – Type /All Stages

Nuclear Safety Act Articles 16 & 22 (Inspection)

Type \ Stage	Construction & Commissioning	Operation	Continued Operation	Decommissioning
Planned	Pre-operational Inspection	Periodic Inspection		Confirm and Check-up
	Quality Assurance (QA) Inspection			
	Special Inspection (Ad Hoc) (Safety Issues, Safety Culture, etc.)			
	Daily Inspection by Region Office (including Unannounced Inspection)			
Reactive	Special Inspection (Incident) (Incident Response & Investigation, etc.)			

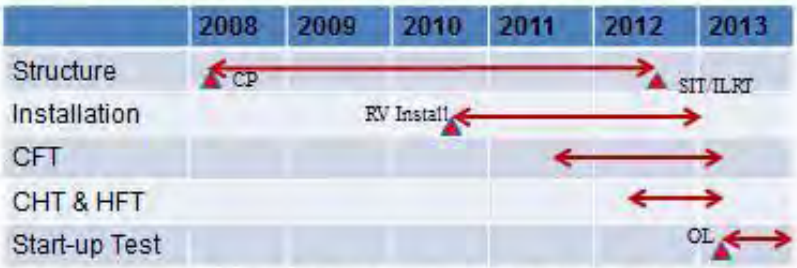
Typical Regulatory Inspection Process



Scope of Pre-operational Inspection

- Facilities of the safety related functions and important to safety. Safety functions are defined in NSSC Notice No. 2012-18:
  - Ensuring the integrity of the reactor coolant pressure boundary
  - Safe shutdown of reactor and maintaining shutdown conditions
  - Functions that prevent or mitigate situations that can exceed offsite radiation exposure dose limits

- Example : Milestone of Shin-Kori Unit 3 (APR1400)



* CFT: Cold Functional Test, CHT: Cold Hydrostatic Test, HFT: Hot Functional Test

KINS 19

Pre-operational Inspection Items

- **Structure inspection** begins at the early stage of the site construction at the time when the foundation excavation is on the way (specified in NSSC Notice No. 2012-18 for 11 facilities)
- **Installation inspection** begins when the installations, welding, non-destructive test and pressure test are ready (52 items)
- **Cold functional test inspection** is implemented whether components and systems are properly installed and ready to operate in a cold condition (77 items)
- After the **integrity of the primary and the secondary systems** are confirmed, **hot functional tests** at a temperature of normal operating condition (23 items)
- **When the OL is granted**, the operator can proceed to load fuel into the reactor and continue for **core physics and power ascension tests** (33 items)

Structure Inspection

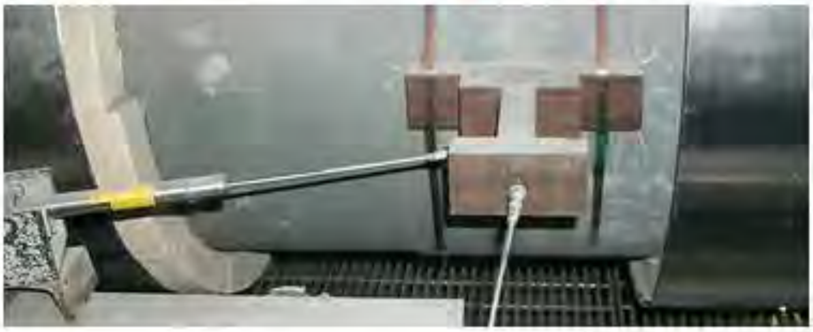
- The structure inspection begins at the early stage of the site construction at the time when the foundation excavation is on the way.
  - Foundation excavation and treatment works,
  - Structure backfill works,
  - Rebar installation works,
  - Concrete works,
  - Containment post tension system works,
  - Steel structure installation works,
  - Concrete anchor bolt installation works,
  - Seismic qualification inspection,
  - Sealing works of safety related openings and penetrations,
  - Permanent dewatering system works,
  - Facility water proof treatment works,
  - Mechanical rebar splice works,
  - Equipment foundation grout works,
  - Containment liner plate installation works,
  - Stainless liner plate installation works,
  - Concrete masonry works,
  - Radiation resistant coating works,
- Integrated construction test; Structural Integrity Test(SIT), Integrated Leak Rate Test(ILRT)

Installation Inspection

- When the installations, welding, non-destructive test and pressure test are ready (52 items).
  - Reactor pressure vessel
  - Reactor coolant system facility
  - Instrumentation and control facility
  - Fuel handling and storage facility
  - Radioactive waste disposal facility
  - Radiation control facility
  - Reactor containment facility
  - Reactor safety system facility
  - Electric power system facility
  - Power conversion system facility
  - Other facilities related to safety

Cold Functional Test Inspection

- Whether components and systems are properly installed and ready to operate in a cold condition (77 items).
  - Reactor pressure vessel
  - Reactor coolant system facility
  - Instrumentation and control facility
  - Fuel handling and storage facility
  - Radioactive waste disposal facility
  - Radiation control facility
  - Reactor containment facility
  - Reactor safety system facility
  - Electric power system facility
  - Power conversion system facility
  - Other facilities related to safety



Hydrostatic Test and Hot Functional Test Inspection

- After the integrity of the primary and the secondary system are confirmed, hot functional tests at a temperature of normal operating condition(23items).
  - Reactor pressure vessel
  - Reactor coolant system facility
  - Instrumentation and control facility
  - Fuel handling and storage facility
  - Radioactive waste disposal facility
  - Radiation control facility
  - Reactor containment facility
  - Reactor safety system facility
  - Electric power system facility
  - Power conversion system facility
  - Other facilities related to safety

Initial Fuel loading and Startup Test Inspection

- When the OL is granted, the operator can proceed to load fuel into the reactor and continue for core physics and power ascension tests(33items).
  - Initial fuel loading
  - Initial criticality test
  - Core performance assessment test
  - Axial xenon oscillation test
  - Moderator temperature reactivity coefficient
  - Rod worth
  - Boron reactivity worth measurement
  - Initial critical boron concentration
  - Power reactivity coefficient assessment and power defect measurement
  - Reactor coolant system flow measurement test
  - Unit load transient test
  - Reactor internal vibration monitoring test
  - Loose part monitoring system test
  - Acoustic leak monitoring system test
  - Reactor coolant pump vibration monitoring system test
  - Pressure test of reactor coolant system
  - Pressurizer function test
  - Natural circulation test
  - Post core loading CEDM function test
  - Power ascension test and instrument correlation test
  - Core function test in case of control rod drop and ejection
  - Core protection system test
  - Chemical and radiochemistry tests
  - Neutron and gamma radiation level measuring and shielding capability test
  - Turbine trip test
  - Reactor power cutback system test
  - Plant shutdown from outside control room
  - Loss of off-site power test
  - Load rejection test for each power level
  - Control system checkout test
  - Atmospheric dump valve and steam bypass valve capacity test
  - Main feed water control valve transfer test
  - Main turbine protective function test

Fukushima Follow-up Measures of Shin Kori Units 3 & 4

- **Special Safety Inspection by Government**
  - SSI performed to 21 operating NPPs, a research reactor and fuel cycle facilities
    - Inspection period : Mar.21 ~ Apr.15, Review of Findings : Apr.16~Apr.30
    - Hearing opinions of residents neighboring site before inspection
- **Objectives of SSI**
  - How well the NPPs are designed against natural hazards;
  - How well they can prevent and mitigate the severe accident;
  - How much effective the emergency response system are in place
    - by assuming the scenario of "earthquake → tsunami → power loss → extreme severe accident" with reference to the causes of the Fukushima accidents
- **Korean Utility(KHNP)'s voluntary inspection**
  - Mar.16~Mar.18, Focused on plant safety against great natural hazards
  - Self-improvement items on waterproofing, emergency power, hydrogen explosion etc.

Major Inspection Points of SSI

Defense-In-Depth Functions	Major Inspection Points
Extreme Natural Hazards	Adequacy of the plant design and facilities against natural hazards - Design against earthquake and seismic capacity - Design against coastal flooding and inundation protection capability
Prevention of Severe Accidents	Adequacy of power supply and cooling functions - Power system and emergency power supply - Cooling capability in case of SBO and inundation
Mitigation of Severe Accidents	Adequacy of countermeasure capabilities against severe accidents - Facilities, guidelines, and strategies against severe accidents
Emergency Response	Adequacy of emergency response - Emergency response to multi-units accidents - Facilities, systems, and infrastructure for the protection of local residents and workers

Inspection Results and Follow-up Action Plan (1)

- Follow-up actions for improvement
  - 1st Phase :
    - Execution of SSI, and follow-up of long- and short-term improvements
    - 50 items mostly cover the lessons-learned from Japanese report to IAEA and IAEA mission report, except some items related regulatory system, safety culture etc.
  - 2nd Phase :
    - Initiation of a project on feedback of lessons-learned from Fukushima ('11.7-)
      - In-depth evaluation of Fukushima accident, and establishment of a plan for review & revision of regulatory requirements
    - Request of licensee's further relevant evaluation, and review by KINS
    - International cooperation for finding and drafting of Lessons-Learned
  - 3rd Phase:
    - Adopting the improvements agreed amongst the international community
    - Applying improvements from the long-term cooperative research programs on severe accidents

Inspection Results and Follow-up Action Plan (2)

- Comprehensive Conclusions
- Korean NPPs are safe for expected maximum potential earthquake and coastal flooding based on investigation and research to date
- Implementation of 50 long- & short-term improvements for earthquake, coastal flooding, and severe accidents to secure safety even for natural hazards beyond the design basis such as the recent natural disaster at Japanese NPPs

- Improvements Review to the APR1400 (33/50)
  - Seismic(4) & Tsunami (3) Resistance
  - Reliability of Power Supply and Cooling System to cope with SBO (10)
  - Response to Severe Accidents (6)
  - Emergency preparedness and medical treatment (10)

Safety Improvements for SKN Units 3&4

Category	No.	Improvements	Remark
Prevention and Mitigation of Beyond Design Basis Accident	1-1	Installation of automatic shut-down system (automatic seismic trip system) in case of earthquake	Dec. 13
	1-2	Improvement of seismic performance for Safe Shutdown System	Completed
	1-3	Study on maximum earthquake in NPP site	Dec. '12
	1-4	Improvement of seismic resistance including earthquake	
	2-2	Installation of water proofing door & water-proof drainage pump	
	2-3	Study on design criteria on the sea level in NPP sites (Research Project)	
	2-4	Reinforcement of intake cooling water system and preventive facilities against tsunami (Research Project)	Linked with 2-3
	3-1	Addition of mobile generator and batteries	
	3-2	Improvement of design criteria on AAC diesel generator	
	3-3	Design change for anchor bolts of Electrical Transformers(MT, UAT, SAT)	Completed
	3-4	Change of management entity for switchyard	

Safety Improvements for SKN Units 3&4

Category	No.	Improvements	Remark
Prevention and Mitigation of Beyond Design Basis Accident	3-5	Preventive measure to loss of spent fuel pool cooling	
	3-6	Recovery measures to prevent submergence of final heat removal facilities	Linked with 2-1
	3-7	Responsive measure to breaking outdoor tank	
	3-9	Improvement of Fire protection plan and fortification of cooperative system	
	3-10	Improvement of fire protection facilities and self-fire service capability	
	3-11	Introduction of fire-fighting design focusing on NPP performance	
	4-1	Installation of passive hydrogen recombiners (PAR)	Completed
	4-2	Installation of automatic depressurization or vent system for containment building	Completed
	4-3	Installation of emergency cooling water injection loop from the outside	
	4-4	Strengthening training in preparation of severe accident	

Safety Improvements for SKN Units 3&4

Category	No.	Improvements	Remark
Severe Accident Management	4-5	Revision of guideline on severe accident management	
	4-6	Development of Guideline on severe accident management during shutdown or low power operation	
Emergency Preparedness	5-1	Addition of radioactive protection equipment for residents in the vicinity of NPP sites	
	5-2	Revision of radioactive emergency plan such as simultaneous emergency warning issuance for multiple NPP units	
	5-3	Addition of emergency equipment in preparation of long-term emergency warning issuance	
	5-5	Strengthening radioactive emergency exercise	
	5-6	Taking measures to obtain necessary information in the event of long-term power loss	Linked with 3-1
	5-7	Secure protection measure of repair workers	
	5-8	Improvement of emergency preparedness facilities	Completed
	5-9	Revision of information disclosure procedure in the event of radioactive emergency	
	5-10	Protection measure for residents outside of the Emergency Planning Zone	
	5-11	Reinforcement of emergency warning facilities performance (inside NPP)	Completed

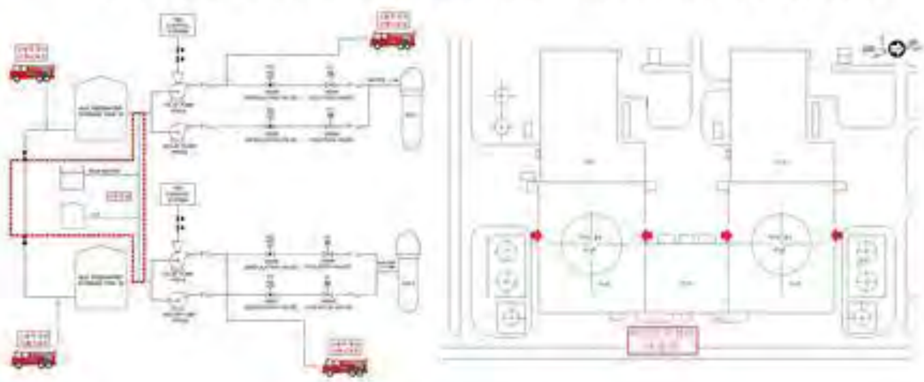
Safety Improvements for SKN Units 3&4

In addition, the applicability of the Design Extension Condition (DEC) requirements that is prescribed in the specific safety requirement SSR-2/1 developed by International Atomic Energy Agency (IAEA) are reviewed on the design of SKN Units 3&4.

The reviewed items are:
- The prevention and mitigation capability of the accident conditions
- The design bases for all the facility to prevent and mitigate the accidents
- The facilities for the prevention and mitigation of the accidents
- The reactor containment and the related safety systems to prevent and mitigate the extreme accident scenarios including reactor core melting
- The design to eliminate practically the DEC causing substantial release of radioactive materials, or the protective measures for protection of the public
- The accident conditions due to combination of a series of events considering the possibility of their occurrences

4-3. Installation of emergency cooling water injection loop from the outside

- **Improvements :**
  - **For SKN3&4, two additional injection lines to provide emergency feed water from outside the auxiliary building to the steam generators using a fire truck will be installed by 2012.**



Conclusions

- Standard design and safety approaches of APR1400 satisfied the current safety standard
- Licensing issues identified in both pre-application review and SDA reviews were resolved during the safety review of construction permit for SKN Units 3&4
- As a result of the safety review of the application for construction permit of SKN Units 3&4, the location, structure and equipment of the nuclear reactor and related facilities satisfied the current safety requirements, and the public health and the environment from the impact of the radioactive materials generated from the construction of the facilities can be protected in service.
- The safety improvements according to those recommendations to protect against earthquake and tsunami were reviewed and determined to improve safety and is supposed to be installed during the construction process.

Thank You for Your Attention !!

Korea Institute of Nuclear Safety

NRC Construction Experience

CNRA International Workshop
New Reactor Siting, Licensing and Construction

Atlanta, GA, USA
October 25, 2012

Richard Rasmussen
Chief, Electrical Vendor Inspection Branch

Outline

- New construction in the United States
- NRC Construction Experience Program Overview
- Information Sources
- Recent Construction Experience Issues

2

New Construction in the US

- **AP-1000 Construction Underway**
  - **Vogtle 3 & 4 received their combined license in January 2012**
  - **VC Summer 2 & 3 received their combined license in March 2012**
- **Additional Construction at**
  - **Watts Bar Unit 2**
  - **Fuel facilities**
- **Vendor Activities**

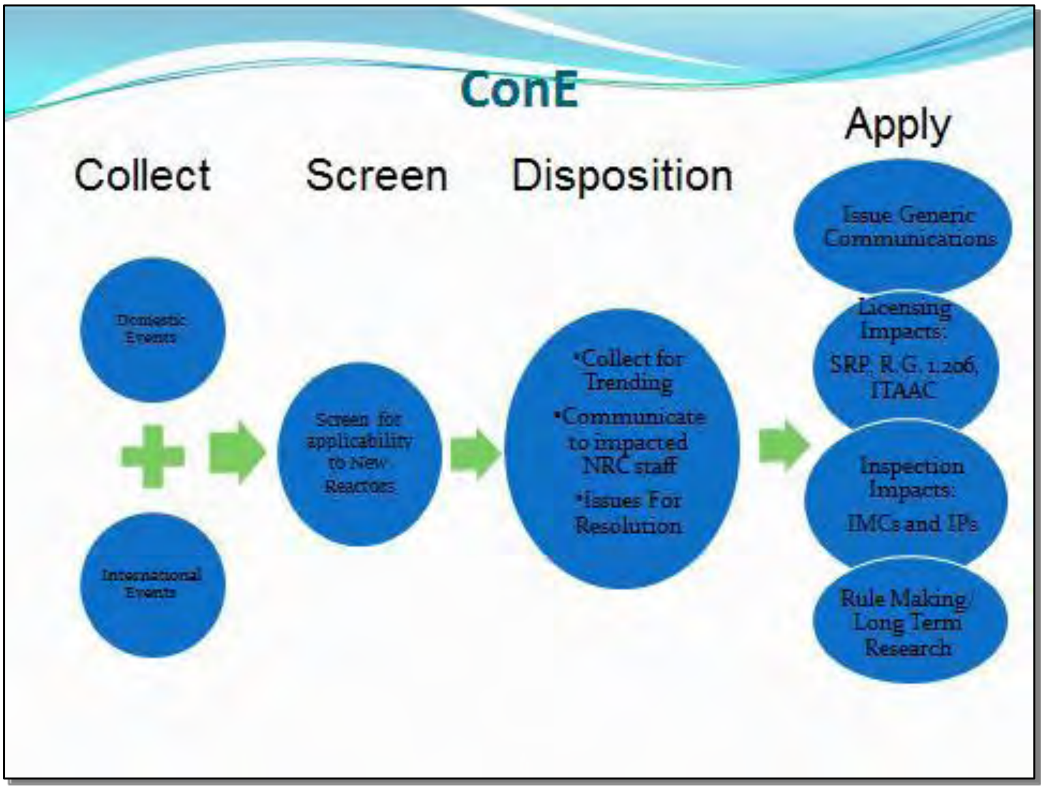
Vogtle
October 2012

Plant Vogtle units 3 and 4 construction site.


VCS 2 & 3 – March 2012
Cooling Towers
Module Assembly Building
Cooling Towers
Unit 3
Unit 2
HLD
Containment Vessel Fabrication Area
Construction Support Buildings
Unit 2 & 3 Switchyard


Construction Inspection Program
Inspections
Vendor Inspections
Baseline Program Inspections
Supplemental and Reactive Inspections


Construction Experience
To Error is Human
but Always make New Mistakes!
(Esther Dyson)
7


ConE
Collect
Screen
Disposition
Apply
Domestic Events
International Events
Screen for applicability to New Reactors
•Collect for Trending
•Communicate to impacted NRC staff
•Issues For Resolution
Issue Generic Communications
Licensing Impacts:
SRP, R.G. 1.206, ITAAC
Inspection Impacts:
IMCs and IPs
Rule Making/ Long Term Research

Domestic Construction Experience Sources

- Event notification reports (10 CFR Part 50.72/73)
- Deficiency/non-compliance reports (10 CFR Part 21/10CFR50.55(e))
- NRC inspection reports
- Other sources
  - Department Of Energy
  - Conferences (e.g., American Nuclear Society)

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International Construction Experience Sources

- Incident Reporting System (IRS)
- Construction Experience (ConEx)
- Nuclear Events Web Based System (NEWS)
- Bilateral Agreements
- Foreign Visits
- MDEP
- CNRA/WGRNR

MDEP: Multi-design Evaluation Program
CNRA: Committee on Nuclear Regulatory Activities (within the Nuclear Energy Agency, NEA)
WGRNR: Working Group on Regulation of New Reactors (within the Nuclear Energy Agency, NEA)

10

Rebar Issues

Vogtle Basemat Issues

MOX Fuel Facility rebar bending (IN 2008-17)

11

Concrete Issues

Seabrook alkali-silica reaction
(IN 2011-20)

Placement Issues
(IN 2008-17)

12

Fabrication Issues

- Vogtle 3 vessel nozzle welding
- Vogtle 3 containment cracking
- San Onofre steam generator tube failure

13

Digital Upgrades

Oconee Lessons Learned

14

Construction Experience Contacts

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Questions

Project Structuring and Risk Allocation for NPP Construction

CNRA International Workshop on New Reactor Siting, Licensing and Construction Experience

Twelve Hotel
Atlanta GA,
USA

15.30 – 16.00
Thursday
25 October
2012



Greg Kaser
Senior Project Manager

World Nuclear Association

Outline of the Presentation

1. NPP construction experience – evidence from the WNA reactor database
2. Project risks:
    - Market uncertainty
    - Contractor performance
    - Stakeholder involvement
3. Contracting & financing strategies
4. Developing and disseminating good practice

1. NPP Construction Experience

Average Construction Times of Nuclear Power Plants

Region	NPPs (number)	Net Capacity (MWe)	Construction completed within period (months) Before 1980	1980-1999	From 2000*	All
Generation I reactors						
North America	14	1 789	51	:	:	51
EEA	43	7 515	60	:	:	60
CMEA	4	346	89	:	:	89
East Asia	1	137	56	:	:	56
World	62	9 787	61	:	:	61
Generation II reactors						
North America	128	126 203	69	130	516♦	101
Latin America	6	6 056	74	150	250	178
EEA	142	130 932	65	92	295	94
CMEA/FSU	88	61 537	63	87	223	97
East Asia	117	100 850	51	54	58	55
South Asia	39	10 272	65	139	81	95
West Asia	1	915	:	:	436◊	436
Africa	2	1 830	:	101	:	101
World	525	436 595	64	95	130	90
Generation III reactors						
North America	4	4 434	:	:	60	60
EEA	2	3 300	:	:	108	108
FSU	5	5 408	:	:	71	71
East Asia	18	23 033	:	40	76	72
West Asia	4	5 380	:	:	60	60
South Asia	2	1 834	:	:	127	127
World	35	43 441	:	40	73	74

CMEA: Council for Mutual Economic Assistance
EEA: European Economic Area
FSU: Former Soviet Union

* Includes NPPs under construction
♦ Watts Barr-2 only
◊ Bushehr only

Source: WNA Reactor Database

Construction times - Lessons

- Standardization of plant design to simplify configuration, improve functionality and control systems and optimize production processes.
- Undertake detail design and work planning prior to construction.
- Modular construction techniques to allow manufacturing and construction to proceed in parallel and better quality control.
- Lean construction/ manufacturing philosophy to rationalize tiers of contracting, integrate processes and eliminate disruption and non-conformities.
- Contracting to ensure partnership:
  - risks are shared to improve communication and work planning between the client, main contractor (e.g. EPC contractor) and sub-contractors and suppliers;
  - shared objectives of on-time/ to-budget delivery.
- **Goal of an average construction time of <60 months!**

2. NPP Risks & Characteristics

- **Three types of project risk need to be managed:**
  - Technical;
  - Business; and
  - Social and political.
- **Nuclear power plants have the characteristics of 'infrastructure':**
  - Enablers of economic and social activity;
  - Strategic assets – secure energy in terms of price and reliability;
  - Part of a network;
  - Enduring – over 40 years of operating life;
  - Around-the-clock operation (base-load generation with 90% capacity factor);
  - Fixed assets;
  - Attached legacies – decommissioning at end of service.

Historically NPPs have been seen as contributing to a nation's development and to be publicly owned. It is therefore a major challenge to obtain commercial financing (rather than development financing). The developer of a nuclear power plant must have a longer term outlook and strong credit rating.

Project Risk Matrix

Type of risk	Pre-completion Phase: Development	Pre-completion Phase: Construction	Post-completion Phase: Operation	Post-completion Phase: Dismantlement	General
Technical	Siting approval Environmental impact assessment Design modifications	Construction workforce Supplier workforce Vendor & contractor performance: • Cost overruns • Delays • Quality & re-work • Supply chain fragmentation Working practices & industrial safety	O&M workforce Plant performance Fuel supply Used fuel storage/ reprocessing Nuclear event at the plant Nuclear event elsewhere	Decommissioning workforce Dismantlement & demolition workforce Used fuel disposal arrangements Radioactive waste and other materials disposal approval & arrangements	Safety assessment and licensing Maturity of the technology Project management
Business	Project finance arrangements Project procurement arrangements	Impacts of cost overruns and delay	Power purchase arrangements Sales revenues Supplier agreements	Decommissioning fund arrangement Radioactive waste disposal fund & facility	Electricity market Interest rate Exchange rate Price & cost inflation Insurance arrangements Export credit & country risks Carbon market
Societal & Political		Localised disruption	Local communities' attitude towards emergency preparedness drills	Localised disruption	Energy policy Environmental policy Regulatory change Legislative change Enforcement of contracts General public approval Local community support

Mitigating major risks

- **Technical:** Construction delay often arise from interface problems with:
  - Regulatory bodies
    - How to handle modifications to what was promised or expected?
    - How to prevent hold points from becoming road blocks?
  - Suppliers and sub-contractors
    - How to handle modifications to contract or specification?
    - How can cost escalation be contained and/or reimbursed if work is delayed?
    - How flexible is the work schedule if variations must be accommodated?
- **Business:** Market uncertainty arise from a number of sources:
  - Long-term uncertainty over revenue flow (equity stakes?);
  - Short-term volatility in commodity prices (inflation, deflation and hedging?);
  - Impact on financing from construction delays (government guarantees, flexible loan terms?);
- **Social & Political:** Stakeholder involvement can be strengthened by:
  - 'Recruiting' local champions (N.B. not paid) such as local councillors, educators, editors, chambers of commerce, etc. through briefings while respecting their independence;
  - 'Town hall' meetings and information to households and customers.

Structuring a project

- **Project delivery system should**:
  - Allocate the risks among the key stakeholders (i.e. project participants) equitably; and,
  - Provide incentives to fulfill their responsibilities:
    - Developers and their financier (and/or investors?) and their contractors;
    - Builders and sub-contractors and their financiers and their client (the developer);
    - Operators and their financiers and/or investors and their customers.
  - Distribute the risks and rewards as balanced 'packages':
    - Development phase – technology vendor-architect/engineer-developer/owner;
    - Construction phase – developer/owner-EPC contractor-suppliers/sub-contractors;
    - Operating phase – owner/operator-technology vendor?;
    - Dismantlement phase – owner/operator-technology vendor?.
  - Use entry points to engage other stakeholders (e.g. the community):
    - National policy debates (e.g. on energy security, GHG mitigation, etc.)
    - Consumer concerns (e.g. on the price of electricity and its volatility)
    - Local economic development policy discussions (e.g. on well-paying long-term jobs, on recruiting local labour for the project, on contribution to vocational education, etc.)

3. Contracting & Financing Strategies

Contracting method	Scope of responsibility	Advantages	Risks
Multi-package	Prime contractors deliver discrete packages of engineering, works and component supply.	Plant owner enjoys direct control over the project. Packages can be tendered to a wider range of suppliers.	Owner's project management is spread over a multiplicity of contractors.
Split-package	Responsibility for the works is divided between two to five EPC contractors (e.g. for nuclear island, conventional island, civil engineering, etc.).	Plant owner retains detailed oversight of the project but must coordinate contractors.	Accountability for risks may be blurred unless there is strong project management organization set up by the plant owner.
Single EPC package	EPC contractor assumes responsibility for completing all phases of the project.	Reduced need for owner's project management organization.	Clear accountability for performance is required to ensure risks are managed. A close and durable relationship must be fostered between the plant owner and the EPC contractor.

Contracting implications

- **NPP Project complexities:**
  - Developer/owner cannot stand aside from the construction. Owner is usually also the operator of the plant and carries the liability for the plant's safe operation.
  - Meeting the regulatory body's requirements is the owner's responsibility.
- **Design complexities:**
  - Technology vendors offer a proprietary design so comparing bids is not straight forward.
- **Engineering, procurement & construction (EPC) contractor:**
  - Has the experience in **managing a project** and is responsible for delivering the project on time: but,
  - **Managing the regulatory interface** remains the responsibility of the developer/owner; along with the technology vendor of the nuclear steam supply system and the design authority.
  - Milestone payment arrangements are common.
- **Sharing risks without accumulating contingencies in the price:**
  - Sub-contractors expect a voice in project management if they are to accept liability in the event of delay in completing manufacture and construction activities.
  - Incentive payments can encourage the right behaviour but the client must resource this.

Financing options

- **Utility raises finance through issue of corporate bonds and/or equity:**
  - Corporate finance has been the main means for financing the construction of NPPs to date.
  - However, it can restrict the utility's other investment possibilities (e.g. expansion through an acquisition at home or abroad).
- **Merchant plant using project finance:**
  - Project finance for merchant plants is available for non-nuclear energy technologies. The Braka project in UAE was intended to be project financed but the owner is providing funding.
  - The lengthy pay-back period of the investment is a problem but long-term investors (e.g. pension funds) want reliable income streams.
- **Development finance:**
  - World Bank and European Investment Bank used to finance NPPs but no longer do so. European Bank for Reconstruction & Development has financed decommissioning.
  - Projects must meet the Equator principles for sustainable economic, social and environmental development.
- **Export credit finance:**
  - Some NPP projects are benefitting from export credit guarantees.

Role of government

- **Stable regulatory environment:** Energy policy and safety-environmental policies need to be predictable; but,
- **Several governments have changed direction since Fukushima:** e.g. Decisions by Germany, Japan, Switzerland have had a major financial impact on utilities.
- **Deregulated vs. regulated electricity markets:**
  - Do consumers really have a choice or a voice (in practice)?
  - Unpredictable energy prices are a significant business risk for NPP construction.
  - Market distorting subsidies for renewables will displace nuclear from base-load generation.
- **Governments must take the initiative on long-term issues:**
  - Used fuel and waste disposal programmes.
  - Security of energy supplies.
  - Universal supply obligation.

4. Developing & Disseminating Good Practice

- **Fostering partnership within the supply chain:**
  - WNA initiative to define a common vendor approach to supplier certification and oversight is under discussion.
  - WNA review of contracting arrangements underway for new build.
  - WNA Construction Risk Management Working Group newly established.
- **Questions:**
  - Should governments prescribe the project delivery system for strategic energy assets?
  - Will governments that have agreed to opt out of nuclear energy allow international development banks to co-finance NPPs?
  - Will the 'level playing field' provisions of the Energy Charter Treaty deter governments from extending preferential treatment to renewable energy technologies? The World Trade Organization could rule on feed-in tariffs with cross-border implications (e.g. Ontario, Austria).

World Nuclear Association

Thank you:

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NEA OECD

Task Group on Non-conforming, Counterfeit, Fraudulent, and Suspect Items (TGNCFSI)

Report Overview

Ms. Laura Dudes
Task Group Chair
Director, Division of Construction Inspection and Operational Programs (DCIP)
Office of New Reactors
U.S. Nuclear Regulatory

9th WRGNR Meeting – 22- 23 October 2012, Atlanta, Georgia, USA: TGNCFSI 1

NEA OECD

Outline

- Background on Task Group Formation
- Objectives of the Task Group
- Overview of Task Group Report Content
- Concluding Remarks

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Current Factors

Threat: Past and Present Threat

VS.

3

NEA OECD

Background on TG Formation

- Historical incidents of NCFSI being introduced into the supply chain
- There is a continued challenge with preventing the introduction of NCFSI into the supply chain considering the increased demand that exists today globally
- Given these considerations CNRA authorised the formation of a task group in June 2011 to:
  - Identify ways to enhance the integrity of the supply chain
  - Build upon relevant learning from international experience
    - WGOE) activities (Operating Experience Report: Counterfeit, Suspect and Fraudulent Items (NEA/CNRA/R/(2011)9)
    - June 2011 joint WGOE and WGIP Proceedings from the International Operating Experience Feedback Workshop

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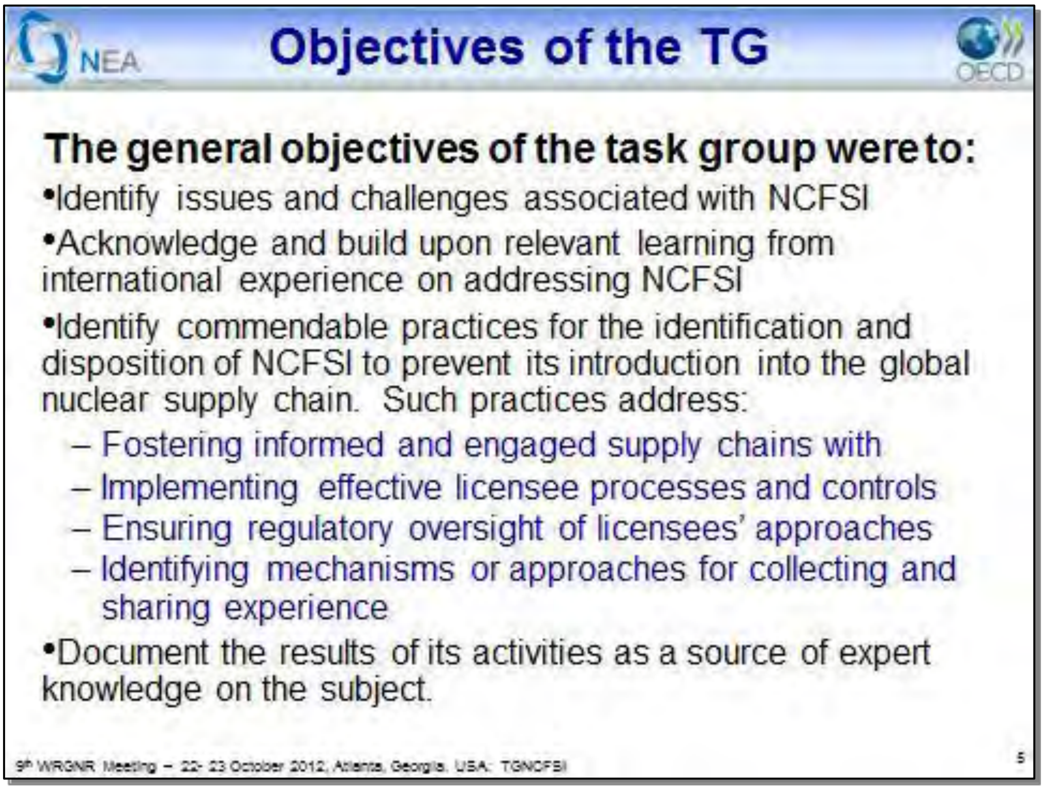
4


Objectives of the TG
The general objectives of the task group were to:
•Identify issues and challenges associated with NCFSI
•Acknowledge and build upon relevant learning from international experience on addressing NCFSI
•Identify commendable practices for the identification and disposition of NCFSI to prevent its introduction into the global nuclear supply chain. Such practices address:
– Fostering informed and engaged supply chains with
– Implementing effective licensee processes and controls
– Ensuring regulatory oversight of licensees' approaches
– Identifying mechanisms or approaches for collecting and sharing experience
•Document the results of its activities as a source of expert knowledge on the subject.
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5


Task Group Report Overview
• Background of the issue
– What does NCFSI mean
– What are the concerns
– Responsibilities of the regulator, the operator, and the suppliers
• Causal factors and challenges faced
– Root causes that may contribute to NCFSI
– Latent causal factors
– Evidence of increased incidence in the supply chain
– Ageing and obsolescence
– Adequacy of laws and the regulatory framework
– The lack of awareness of the issue and impact on safety
– Difficulties in detecting CFSI
– Safety culture in the supply chain
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6

Task Group Report Overview

- **An Informed and Engaged Supply Chain**
  - **Education and Training**
    - Acknowledge NCFSI as an issue
    - Communicating the importance of understanding and complying with nuclear related technical and quality requirements to suppliers and sub tier suppliers
    - Being an intelligent customer
    - Being an intelligent supplier
    - Training to identify and prevent the use of NCFSI
    - Translate education and training into practices and procedures
  - **Knowledge Management**
    - Understanding why things are used and how they are done
    - Partner with other industries on NCFSI
    - Capturing and sharing knowledge and experiences

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Task Group Report Overview

- Licensee Processes and Controls 1/2
  - **Quality Assurance Program or Management System provides several barriers, but additional measures are needed for CFSI that should:**
- Prevent CFSI from entering the qualified supply chain of the nuclear installations
- Detect CFSI inside of the qualified supply chain
- Prevent installation of CFSI in safety related applications
- Detect CFSI installed in safety related applications
- Detect incidents in safety systems caused by CFSI
- Provide feedback into the licensee systems and broader operating experience to industry
- Eliminate identified CFSI from the supply chain
- Support the investigation of CFSI incidents
- Respond effectively as a community to CFSI threats and incidents

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NEA Task Group Report Overview OECD

- Licensee Processes and Controls 2/2
  - **Procurement and Supply Chain Management – Detection of CFSI, placed within context of NCFSI**
    - Procedures
    - Procurement Controls
    - Selection and Qualification of Suppliers
    - Evaluation of Suppliers Tenders
    - In-Process and Receipt Inspections and Tests, Including Services
    - Control of Identified NCFSI
  - **Post procurement identification, assessment, and disposition (receipt inspection completed)**
    - Control and Supervision of Maintenance Work
    - Reliability and Testing (Surveillance) Programmes

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NEA Task Group Report Overview OECD

- **The Regulators' Role**

"The licensee shall retain primary responsibility for the safety of its licensed facility, including responsibility for those activities of contractors and subcontractors which might affect safety. The regulatory body should, through its regulatory activities, provide assurance that the licensee meets its responsibilities for the safety of its facility. This includes assuring that the licensee provides the appropriate level of oversight of all contractors and sub-contractors, commensurate with the safety significance of the activity." NEA/CNRA/R(2011)4 - The Nuclear Regulator's Role in Assessing Licensee Oversight of Vendor and Other Contracted Services

–**Enhancing Regulations and Guidance to Explicitly Address CSFI**

–**Information gathering, storing and sharing**

–**Approaches to Managing CFSI**

–**International Cooperation**

–**Established Response Protocols**

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Concluding Remarks 1/2

- NCFSI is a serious threat to nuclear safety
- We all need to be informed of the nature of CFSI
- Existing controls for procurement and nonconforming material control may need to be enhanced to address the deliberate deception involved in CFSI and the advances in counterfeiting technology
- Regulators need to be aware of the risk of NCSFI to nuclear safety and review and update their regulatory requirements accordingly
- Exchange of NCFSI information between regulators and operators should include information exchange with organisations outside of the nuclear industry

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Concluding Remarks 2/2

Recommendations:

- Regulators should consider the impact of NCFSI on current regulatory requirements, and revise them if necessary
- The regulator's inspection programs should consider methods for inspecting for NCFSI controls
- The MDEP VICWG should consider how to address the issue of CFSI within the context of its activities
- WGIP and WGOE should consider including periodic reviews on how the international nuclear safety community is addressing CFSI in the nuclear industry's supply chain

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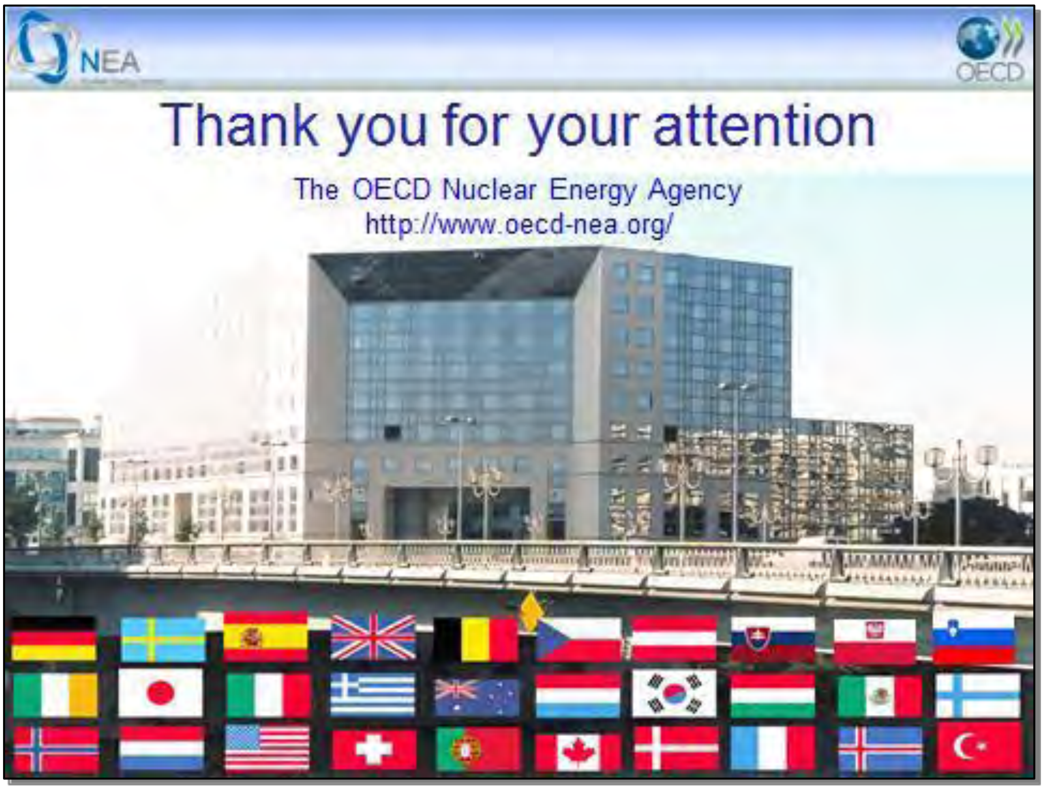
NEA
OECD
Thank you for your attention
The OECD Nuclear Energy Agency
http://www.oecd-nea.org/

SESSION IV – LESSONS LEARNED FROM REGULATORY LICENSING REVIEWS OF NEW REACTOR DESIGNS

NEA/CNRA Report of the Survey on the Review of New Reactor Applications
Steve Gibson, ONR

Lessons Learned from Canadian Pre-Project Design Review
Paul Wong, CNSC

World Nuclear Association Design Change Management
John Waddington, World Nuclear Association

Licensing Experience for EPR Flammanville 3
Thomas Houdré, ASN

New Reactor Licensing Status and Lessons Learned
Mohammed Shuaibi, U.S.NRC

WNA Licensing & Permitting Survey
Christian Raetzke, World Nuclear Association

NEA/CNRA Report of the Survey on the review of New Reactor Applications

Steve Gibson

Office for Nuclear Regulation
An agency of HSE

Terms of reference

At its second meeting in 2008, the Working Group agreed on the development of a report based on recent regulatory experiences describing;

1) the licensing structures,
2) the number of regulatory personnel and the skill sets needed to perform reviews, assessments and construction oversight, and
3) types of training needed for these activities.

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WGRNR Member States

- Canada
- Czech Republic
- Finland
- France
- Hungary
- Japan
- Korea
- Poland
- Slovakia
- Slovenia
- Spain
- Switzerland
- United Arabs Emirates
- United Kingdom
- United States

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Matters Considered in Survey

- Licensing process
- Governing authority
- Legal decision
- How each phase is implemented
- Levels of effort and skill sets
- Documents submitted
- Guidance documents
- Safety assessment
- Public participation
- Organisation/infrastructure
- Oversight
- Independent advisory committee
- Codes and standards

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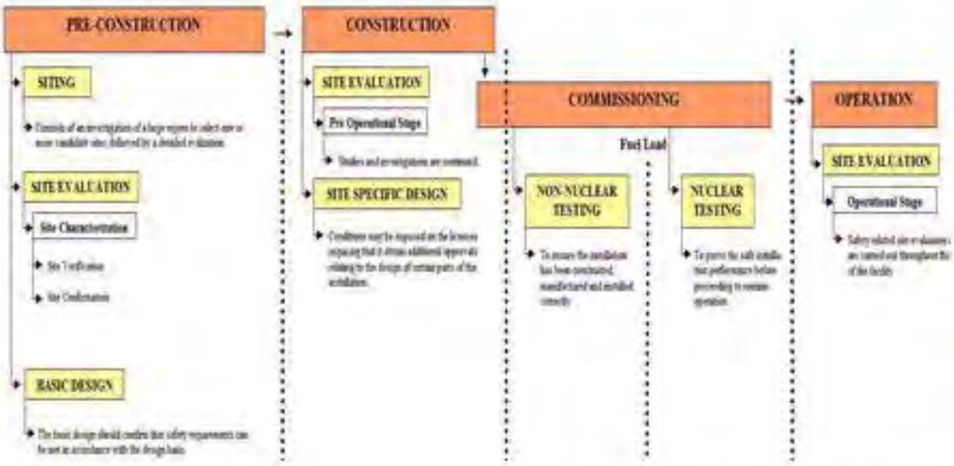
IAEA Licensing Process



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Governing authority

- Not surprisingly this varies from State to State.
- It can be quite Complex with authority held by Government, Ministers, Local Authorities and other regulatory bodies.
- But the regulator has a role as decision maker in most countries.

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Legal Decision

- Legal decisions come in many different forms but all based on the law in that state.

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Timeframes

- Three distinct stages take place in all states;
  - Pre-construction concerned with siting and basic design
  - Construction including detailed design and site evaluation leading to a licence or Consent to construct
  - Commissioning which includes a further permission of some form.

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Level of Effort

- Only three States were able to provide data.
- Effort could be anything from 25 to 50 years.
- Need to a highly skilled workforce and extensive use of TSOs.

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Documents

- An extensive set of documentation is produced at all stages of the licencing process.
- Most states have explicit guidance on the standard of documentation to be produced and some refer to the IAEA guides

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Safety Assessment

- Although all regulators have some oversight of the project, TSOs often provide detailed technical analysis.
- Pre-construction: here there is a significant level of commonality between regulators in scope.
- Construction: there are differences here in the level of assessment prior to construction.
- Commissioning: all States perform a review of the Safety Analysis Report.

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Public Participation

- All States have some form of public participation but all are unique.
- Some public participation is mandated by law, some by invitation.
- Often conducted by another Government department.
- In many cases an Environmental Impact Analysis is required.

Office for Nuclear Regulation
An agency of HSE

Oversight

- Although the nuclear regulator provides regulatory oversight, support is provided through;
  - TSOs
  - Other Governmental bodies.
- Most States make use of an independent advisory committee.

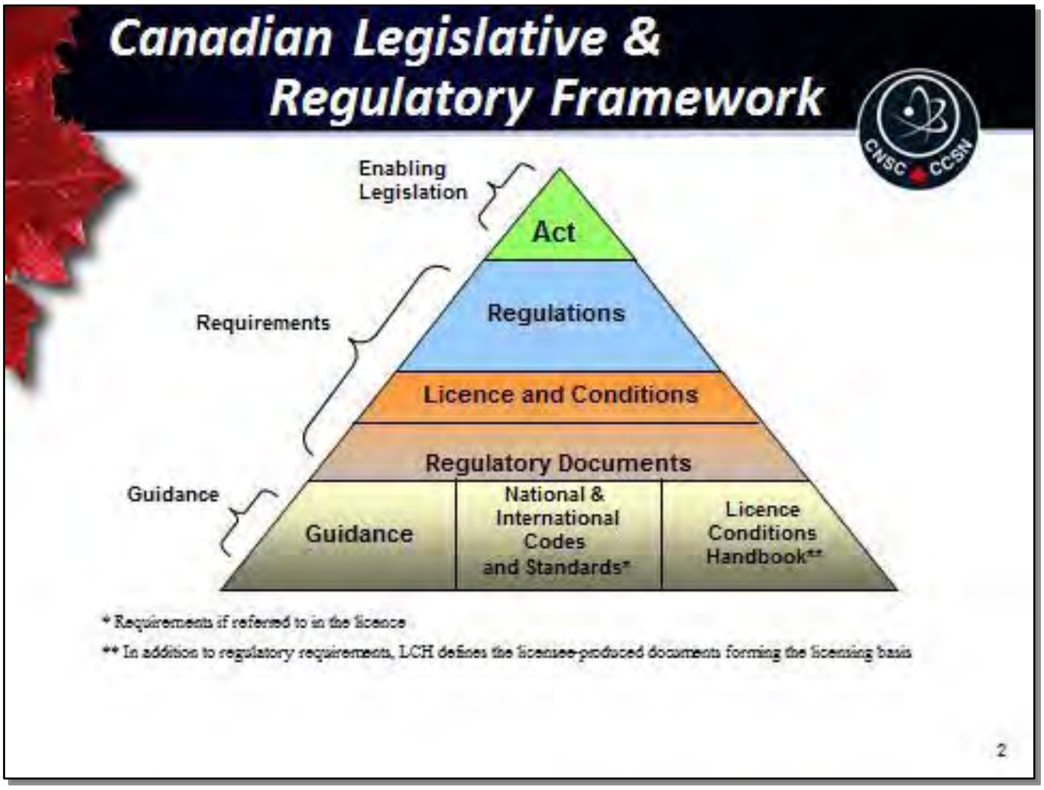
Office for Nuclear Regulation
An agency of HSE

Next Steps

- Two more reports are to be produced.
- The next report will present a survey of the reviews conducted during plant design.
- The third report will focus on questions relating to the construction stage.

Office for Nuclear Regulation
An agency of HSE


Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire
CNSC CCSN
Lessons Learned From Canadian Pre-Project Design Review
Quality Assurance of Design
nuclearsafety.gc.ca


Canadian Legislative & Regulatory Framework
CNSC CCSN
Enabling Legislation
Act
Requirements
Regulations
Licence and Conditions
Regulatory Documents
Guidance
Guidance
National & International Codes and Standards*
Licence Conditions Handbook**
* Requirements if referred to in the licence
** In addition to regulatory requirements, LCH defines the licensee-produced documents forming the licensing basis
2

Nuclear Safety and Control Act

26. Subject to the regulations, no person shall, except in accordance with a licence,

a) possess, transfer, import, export, use or abandon a nuclear substance, prescribed equipment or prescribed information;

b) mine, produce, refine, convert, enrich, process, reprocess, package, transport, manage, store or dispose of a nuclear substance;

c) produce or service prescribed equipment;

d) operate a dosimetry service for the purposes of this Act;

e) prepare a site for, construct, operate, modify, decommission or abandon a nuclear facility; or

f) construct, operate, decommission or abandon a nuclear-powered vehicle or bring a nuclear-powered vehicle into Canada.

3

Class I Nuclear Facilities Regulations

"Class IA nuclear facility" means any of the following nuclear facilities:

a) a nuclear fission or fusion reactor or subcritical nuclear assembly; and

b) a vehicle that is equipped with a nuclear reactor.

Class I Licences:

a) Licence to Prepare Site requires:
   - the proposed quality assurance program for the design of the nuclear facility;

b) Licence to Construct requires:
   - a description of the proposed design of the nuclear facility ...;

c) Licence to Operate;

d) Licence to Decommission;

e) Licence to Abandon.

4

Pre-Licensing Review

- What is a pre-licensing review?
  - Also known as a vendor design review;
  - Not required as part of the licensing process;
  - An optional service that the CNSC provides for the assessment of a vendor's design for a nuclear power plant or small reactor;
  - Provides the early identification and resolution of potential regulatory or technical issues in the design process;
  - Evaluates whether the vendor understands Canadian regulatory requirements and expectations;
  - Evaluates compliance with, as applicable, CNSC regulatory documents RD-337, *Design of New Nuclear Power Plants* or RD-367, *Design of Small Reactor Facilities* and related regulatory documents and national standards.

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Pre-Licensing Review

- **GD-385:** Pre-licensing Review of a Vendor's Reactor Design
- **Phase 1 –** Determines if, at an overall level, the design intent complies with CNSC design requirements.
- **Phase 2 –** Goes into further detail, with a focus on identifying potential fundamental barriers to the licensing of the vendor's design for nuclear power plant or small reactor in Canada.
- **Phase 3 –** Vendor can choose to follow up on certain aspects of Phase 2 findings by:
  - seeking more information or clarification from the CNSC about a Phase 2 topic, and/or
  - asking the CNSC to review activities undertaken towards design readiness, following the completion of Phase 2

6

Typical Review Topics

1. General NPP description - defence-in-depth, safety goals and objectives, and dose acceptance criteria
2. Classification of systems, structures & components
3. Reactor core nuclear design
4. Fuel design and qualification
5. Control system and facilities (main control systems, instrumentation and control, control facilities, emergency power systems
6. Means of reactor shutdown
7. Emergency core cooling and emergency heat removal systems
8. Containment and safety important civil structures
9. Beyond Design Basis Accidents (BDBA) and severe accident prevention and mitigation
10. Safety Analysis (Deterministic and Probabilistic) and internal and external hazards
11. Pressure boundary design
12. Fire protection
13. Radiation protection
14. Out-of-core criticality
15. Robustness, safeguards and security
16. Vendor research and development program
17. Management system of design process and quality assurance in design and safety analysis
18. Human factors
19. Incorporation of decommissioning into design considerations

7

Quality Assurance for Design

- Identified directly by the Regulations;
- Identified by numerous Regulatory Documents;
- QA requirements specified by CSA N286 standard and RD-337/367;
- RD-337/367 includes additional design management requirements;
- Safety Analysis a sub-set of design.

8

Lessons Learned From Design Reviews

- CSA N286 standard published in 1992;
- QA regulatory requirement introduced in 2000;
- RD-337 issued in 2008;
- Current fleet of Canadian reactors are CANDUs;
- Canadian utilities considering other reactor designs.

9

Lessons Learned From Design Reviews

1. Each reactor design runs as an autonomous project;
2. Project QAP incomplete or not aligned with governance;
3. Design management process not defined;
4. Lack of implementing procedures;
5. Interfaces not clearly defined;
6. Control of design non-conformances;
7. Design verification;
8. Use of previously finished and verified design ;

10

Lessons Learned From Design Reviews

9. Processes to ensure compliance with the RD-337 Management of Design requirements;
10. Design Authority function;
11. Proven Design;
12. Safety Analysis.

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World Nuclear Association

DESIGN CHANGE MANAGEMENT

John Waddington, Director of Strategy, WNA/CORDEL

2nd CNRA International Workshop on New Reactor Siting, Licensing and Construction Experience
Atlanta, 24 to 26 October 2012

Design change management

- It's a fundamental element of how we organise ourselves to maintain safety
- It affects plant standardisation and maintenance over a 60-80 year life
- It starts during licensing and construction
- Fukushima illustrated deficiencies

Agenda

- What is the Problem?
- WNA / CORDEL / Design Change Management Task Force
- Vendor Role
- Owners' Group Role
- Utility Role and Design Authority
- WANO Role
- Regulator Role
- Conclusions/Questions

Design Change Happens! Or fails to happen!

- In 60-80 yrs NPP lifetime, safety-related design and operating changes are driven by:
  - New analysis insights, OPEX, PSR, PRA, obsolescence….
  - Changes in regulatory and licensing requirements
  - Power upgrades
- Management objectives and values may change
- Originally standardized reactors become unique
- Potential safety drawbacks

Current Situation – Is there a Problem?

Complex, unique infrastructure

Nature of nuclear power plant design and construction involves many players:

- Architect-engineers - Operator - Owner
- Nuclear island designer - Balance of plant designers

Creating a large, complex and **quite often unique** infrastructure and **design**

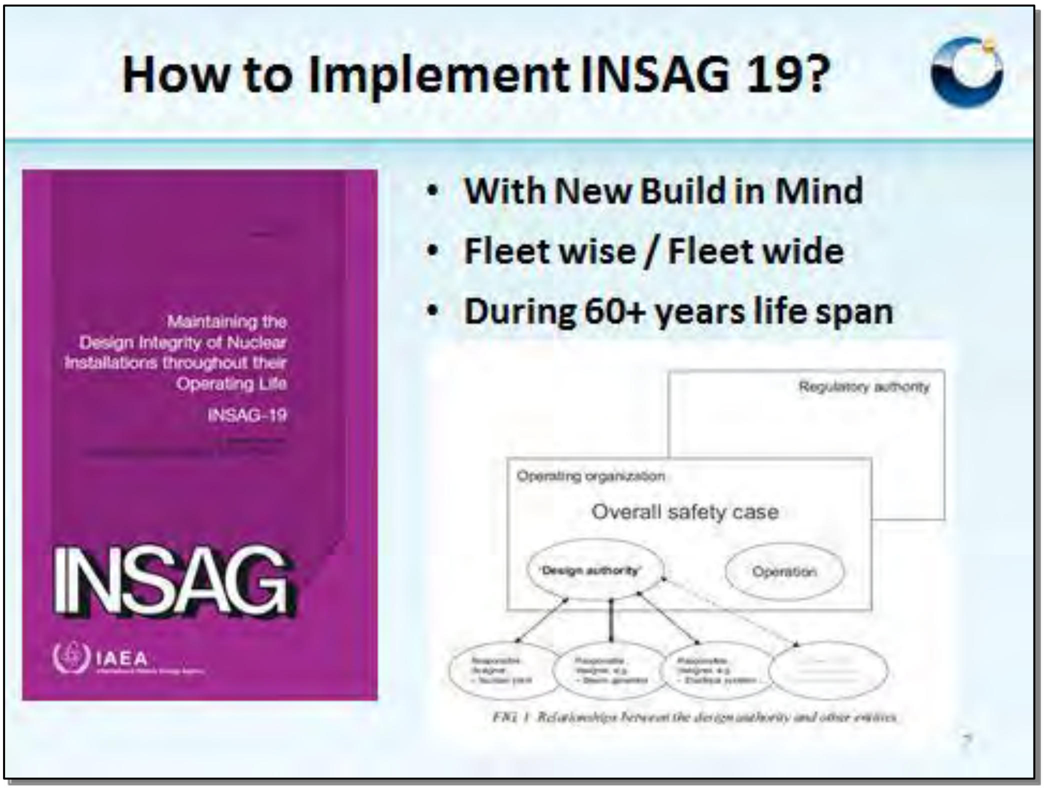
Sole responsibility with the licensee

Current nuclear industry legal and regulatory framework

- Holds every **licensee** solely responsible for safety of design and operation
- Expects every **licensee** to maintain a full understanding and knowledge of design within licensee's own organisation in an internal entity called 'Design Authority'

Current Situation – Is there a Problem?

- **Is this working well?**
  - Works for large utilities with strong technical staff
  - May be barely tenable for smaller utilities today- who require much support from others
- **May be untenable for small utilities running turnkey Gen III reactors in future**
- We encourage regulators to re-examine this expectation



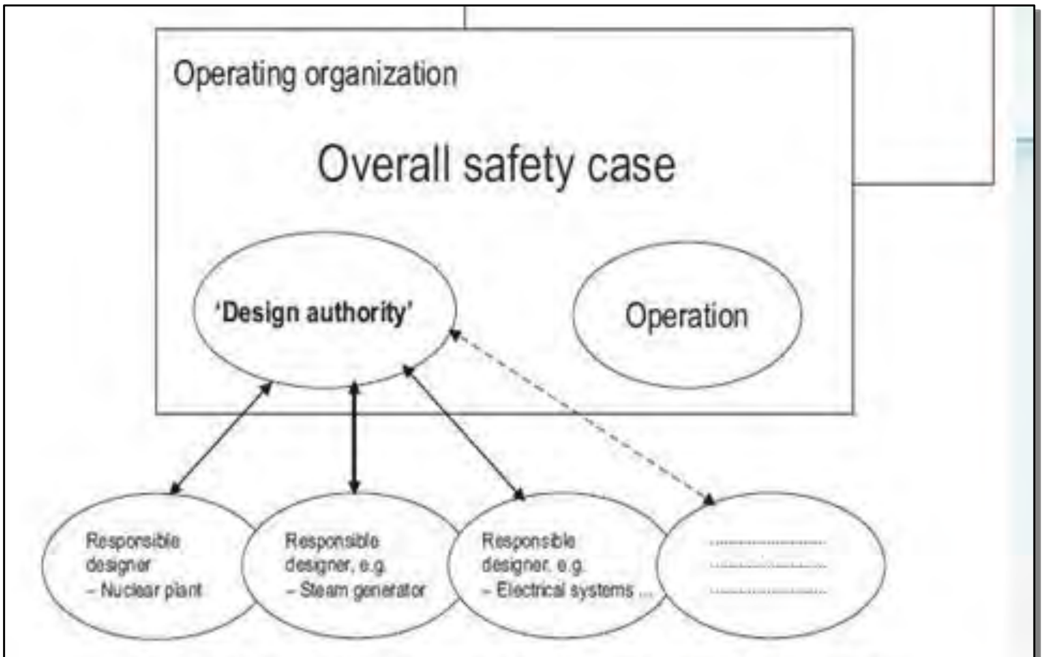


FIG. 1. Relationships between the design authority and other entities.

Design Change : Is there a problem

- **Design authority:**

To deal with design changes from all sources requires:

Why the plant looks like it does, original design calculations, research basis, mathematical models, safety analysis assumptions, safety analysis codes, inspections, OPEX information from many sources ....

A high level of understanding

- **INSAG 19: "Huge amount of data"**

- **Responsibility met by many different combinations of:**
  - In-house expertise
  - arrangements with original designers
  - Owners' Groups
  - others

Design Change : Is there a problem?

Current plant:

- Works for large utilities with strong technical staff
- Loss of capability in large utilities that don't build for a long period and reduce design staff?
- Small utilities with one or two units: have knowledge to operate safely
- May have little in-house expertise for design change
- Heavy reliance on original vendors, Owners' Groups, INPO, but no consistent, defined role
- We encourage regulators to re-examine this expectation

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Design change- is there a problem?

Fukushima evidence:

- The progression and consequences of prolonged station blackout were understood in 1989
- The Fukushima vent design was not adequate in SBO state
- Vents not designed to deal with hydrogen (not required by regulators - though hydrogen is expected in core melt)
- Design of hardened vents in BWRs were all different
- USNRC: each design "would have different operational complexities" during a prolonged SBO scenario
- Was this an optimum design change process?

Design Change : Is there a problem?

New build:

- **Small utilities running turnkey Gen III reactors in future will have great difficulty in meeting DA expectation**
- CDF and large release frequency -factor of 10 down = more events to analyse, more complex safety case, more understanding needed
- Expectation that all utilities will have large design staff to maintain full design authority knowledge ... **not realistic**
- Expectation that every utility will maintain full OPEX of all similar plants dubious
- Periodic safety review will bring more design changes – from different countries operating the same reactor

We encourage regulators to re-examine this expectation

Institutional contributions

Real accidents: major contributors to failure are human and institutional performance - in **all** highly regulated industries

- ✓ *In aircraft industry, contribution about 85%*
- ✓ *In nuclear, contribution around 70-90% of the risk of a serious accident*
- ✓ *Design / engineering issues contribute 10-30%*

If new build is to achieve factor of 10 reduction in severe accident rate, institutional failure rate also needs reducing by factor 10

Aircraft industry experience- factor 2 was difficult to achieve !

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Standardisation = better safety

- Organisation weaknesses were contributors to Fukushima – and NOT JUST IN JAPAN
- High reliability achieved through learning from each other
- Standardisation brings easier learning
- Organisational barriers to learning should be avoided
- To achieve factor 10 lower CDF needs big improvements in how we **organise** ourselves - as well as better design
- Aircraft industry looked for factor of 2 reduction in accidents- recognised need for **organisational** changes (SMS)

What organisational changes should we be thinking about?

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Organisational changes?

- Recognition by regulators of benefits of standardisation - **throughout life**
- Avoid divergence of systems important to safety at licensing
- Agreement on implementation of INSAG 19
- Design certification: Agreements between national regulators?
- Maintenance of design knowledge across a fleet?
- Prevention of design divergence over 80 year plant life?
- Recognition of the role of the designer through plant life?
- Fleet implementation of design changes - EDF experience?

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The CORDEL Working Group

Founded in January 2007

- Main aim: promoting international standardization
- Membership:
  - all major vendors
  - utilities interested in new build
  - service companies
  - observers from int'l organisations

International standardization means that each vendor's design can be built by a vendor, and ordered by a utility, in every country and be able to meet national regulations without significant changes other than adaptations to meet site requirements.

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Design Change Management Task Force

The Case for Standardisation

- **Will reduce build costs**
- **Will reduce licensing/financial uncertainty**
- **Will improve reactor safety in operation**

Mandate for DCM Task Force

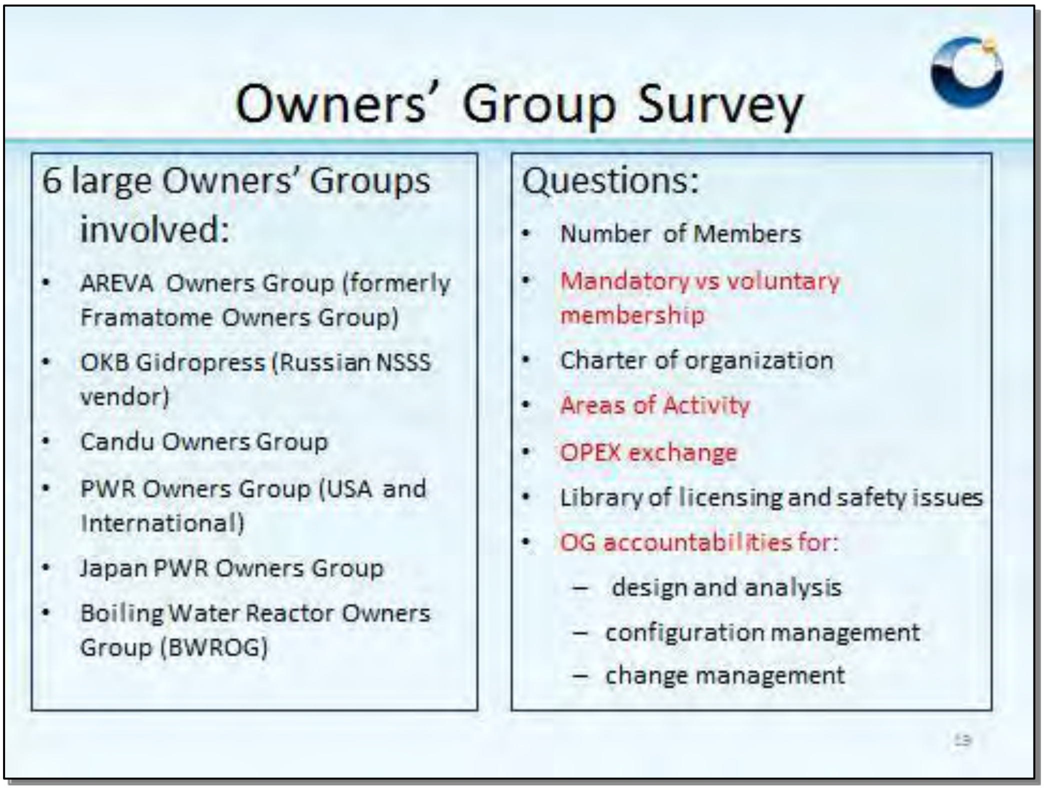
- **To develop institutional mechanisms in the industry to enable compliance with standardization throughout standard fleet's lifetime**

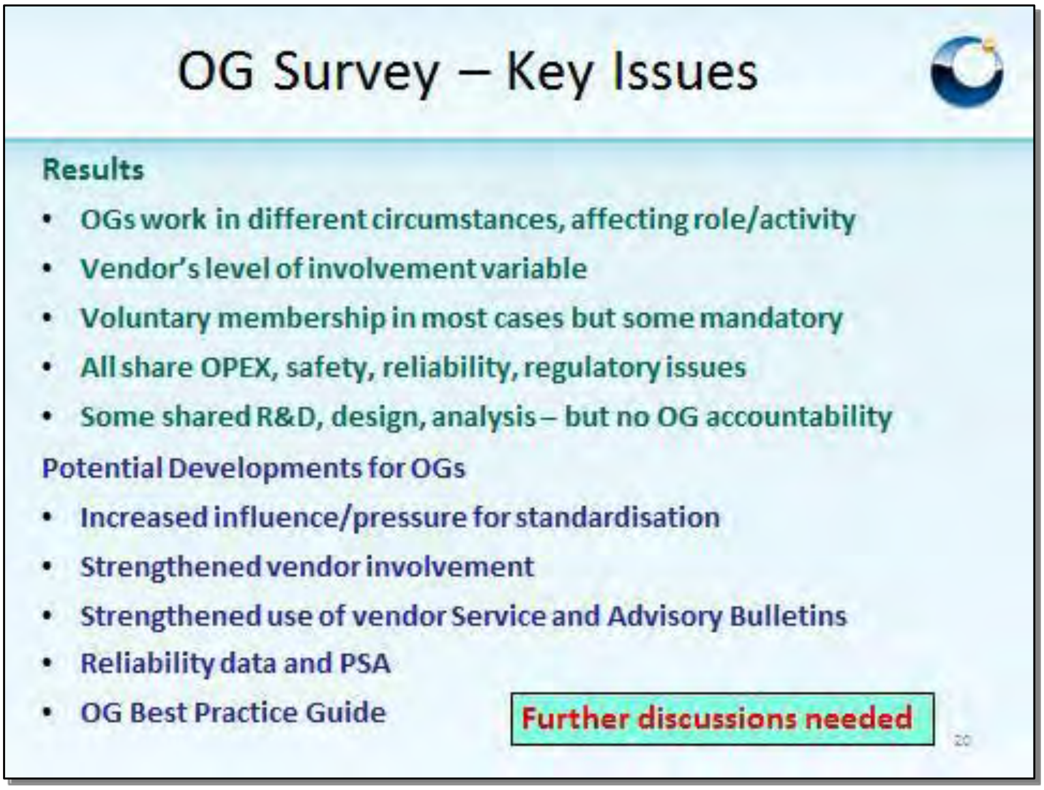
Research

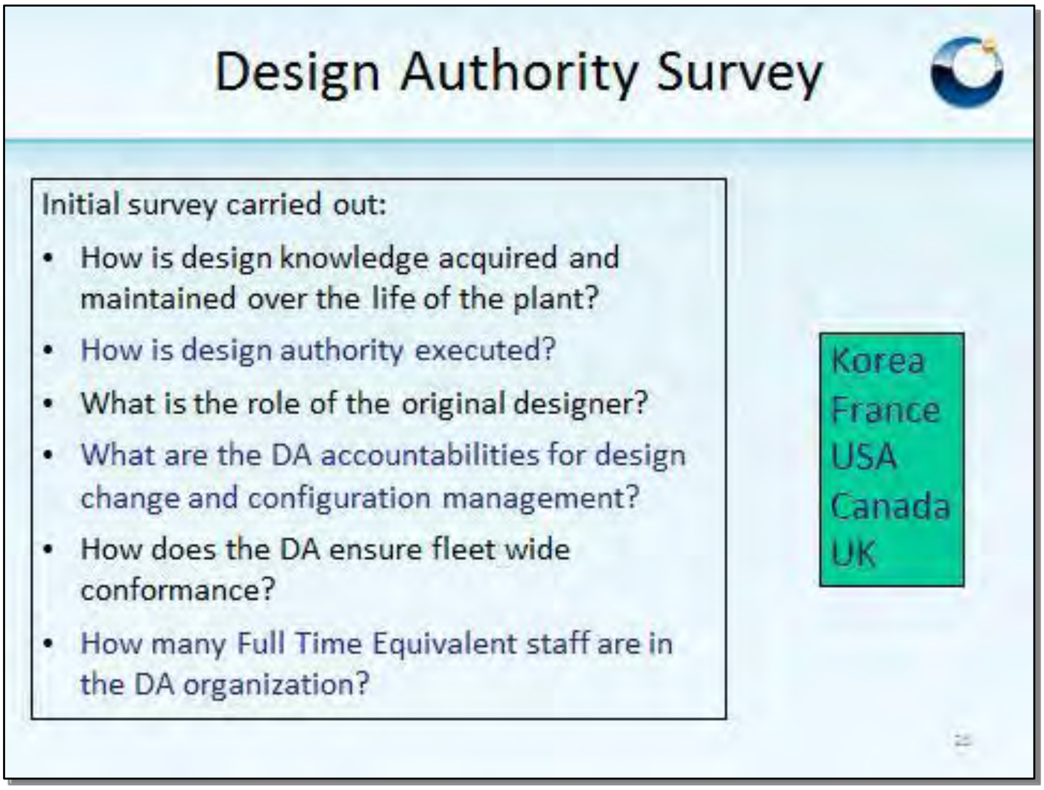
Institutional change takes time! CORDEL also looks for opportunities for short and medium term changes

- Survey of Owners Groups and Utility discussions
- Design Authority role survey
- Discussions with the Aerospace Industry
- World Association of Nuclear Operators (WANO) discussions
- Regulator (MDEP) discussions
- Standards Organisations

Owners' groups may be key institutions


Owners' Group Survey
6 large Owners' Groups involved:
• AREVA Owners Group (formerly Framatome Owners Group)
• OKB Gidropress (Russian NSSS vendor)
• Candu Owners Group
• PWR Owners Group (USA and International)
• Japan PWR Owners Group
• Boiling Water Reactor Owners Group (BWROG)
Questions:
• Number of Members
• Mandatory vs voluntary membership
• Charter of organization
• Areas of Activity
• OPEX exchange
• Library of licensing and safety issues
• OG accountabilities for:
– design and analysis
– configuration management
– change management


OG Survey – Key Issues
Results
• OGs work in different circumstances, affecting role/activity
• Vendor's level of involvement variable
• Voluntary membership in most cases but some mandatory
• All share OPEX, safety, reliability, regulatory issues
• Some shared R&D, design, analysis – but no OG accountability
Potential Developments for OGs
• Increased influence/pressure for standardisation
• Strengthened vendor involvement
• Strengthened use of vendor Service and Advisory Bulletins
• Reliability data and PSA
• OG Best Practice Guide
Further discussions needed


Design Authority Survey
Initial survey carried out:
• How is design knowledge acquired and maintained over the life of the plant?
• How is design authority executed?
• What is the role of the original designer?
• What are the DA accountabilities for design change and configuration management?
• How does the DA ensure fleet wide conformance?
• How many Full Time Equivalent staff are in the DA organization?
Korea
France
USA
Canada
UK


Design Authority Survey – Some Results
Large state-owned utilities
• DA with formal arrangements with original designer ("Responsible Designer", "Design Agency")
• Repeat projects develop Utility DA capability
• DA senior voice
• Transfer /development of knowledge -"Book of Knowledge";
• OG support, incorporation of international feedback during PSR
Medium-size privately-owned utilities
• Original designer dependence recognised
• Vendors and OGs have developed design changes but with differing implementation by operators
• Development of internal DA has some problems
What about Small Utilities?

Utility and Design Authority Summary

- **Many utility situations**
  - Large state-owned, medium privately-owned, operating across different countries, small, single country / plant
- **But ultimate responsibility for safety / design remains**
- **Clarity is required of how Design Authority (DA) is managed for all situations including:**
  - relationship with and roles of the original designer
  - Independence of DA within organisation
  - Transfer and extent of design knowledge
  - Development of design knowledge

Obligatory Utility involvement in OGs should be considered

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WANO Role

- WANO provides a unique tool for improving performance and safety of operating plants through its operating experience program
  - SOERs and SERs widely distributed among its members extensively used by most operators.
- But very few links between WANO and vendors.
  - vendor should receive the event report as a rule.
- Vendor could make use of WANO analysis and propose a common solution to customers
- WANO is developing reliability data bases - Vendors' access to relevant areas of this information would help improve their PRA quality for the overall benefit of safety.

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Regulator Role (1)

- Multinational Design Evaluation Programme (MDEP) continues past first licensing
- CORDEL roadmap postulates the achievement of joint or coordinated certification
  - Safety documentation could be distributed in two or three tiers
    - many obstacles including sovereignty issues,
    - but the industry should continue to encourage progress in this direction.
- Concept of Regulator "Owner's" Groups
  - Multiple regulators meet periodically and share operating and regulatory experiences with a common design.

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Regulator Role (2)

Some actions can be undertaken now.

- Task forces and workshops for technical problems e.g. sump clogging issue
- Life extension common approach
- Periodic Safety Reviews (PSRs) requirement to include adherence to **approved** vendor's safety-related recommendations and to include international experience feedback.
- Regulators require membership in OGs? Compliance with OGs recommendations? Compliance with "Service Bulletins" issued by vendors, **based on a graded approach** in relation to safety importance?

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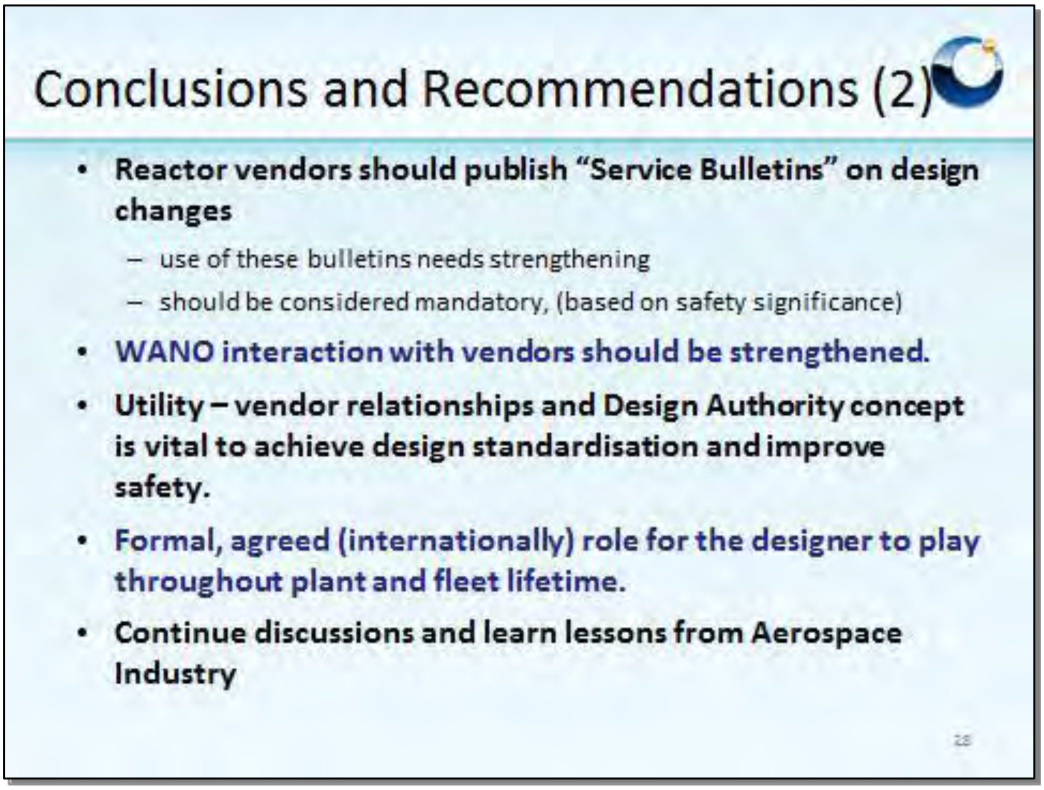
Conclusions and Recommendations (1)
• Adherence to the standard design is a vital concept that can bring significant benefits to safety and economics of nuclear power.
• Original designer must be involved in the management of design changes (particularly new build)
• Internationally agreed mechanisms for design change are needed
• Owners' Group role is vital and should be enhanced -
– joint review and peer pressure
– Best practice guide
– Potential role if vendor "disappears"
• Formation and maintenance of a Regulator's "Owners" Group is recommended.


Conclusions and Recommendations (2)
• Reactor vendors should publish "Service Bulletins" on design changes
– use of these bulletins needs strengthening
– should be considered mandatory, (based on safety significance)
• WANO interaction with vendors should be strengthened.
• Utility – vendor relationships and Design Authority concept is vital to achieve design standardisation and improve safety.
• Formal, agreed (internationally) role for the designer to play throughout plant and fleet lifetime.
• Continue discussions and learn lessons from Aerospace Industry

Quote from INSAG chair to IADG re: Fukushima Accident

- "...The operator must have engineering, financial and management capability to ensure not only that the plant is built and operated in a safe fashion, but also operates with safety as the highest priority..."Richard Meserve – 07/26/11 to IAEA DG Amano
- However, the operator as the Design Authority must be able to effectively engage larger groups of expertise such as the original vendor(s) and owner groups to take advantage of the collective R and D, OPEX and insights when making design and operating changes to their plants.

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Thank you for listening

Questions?

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World
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Visit us at
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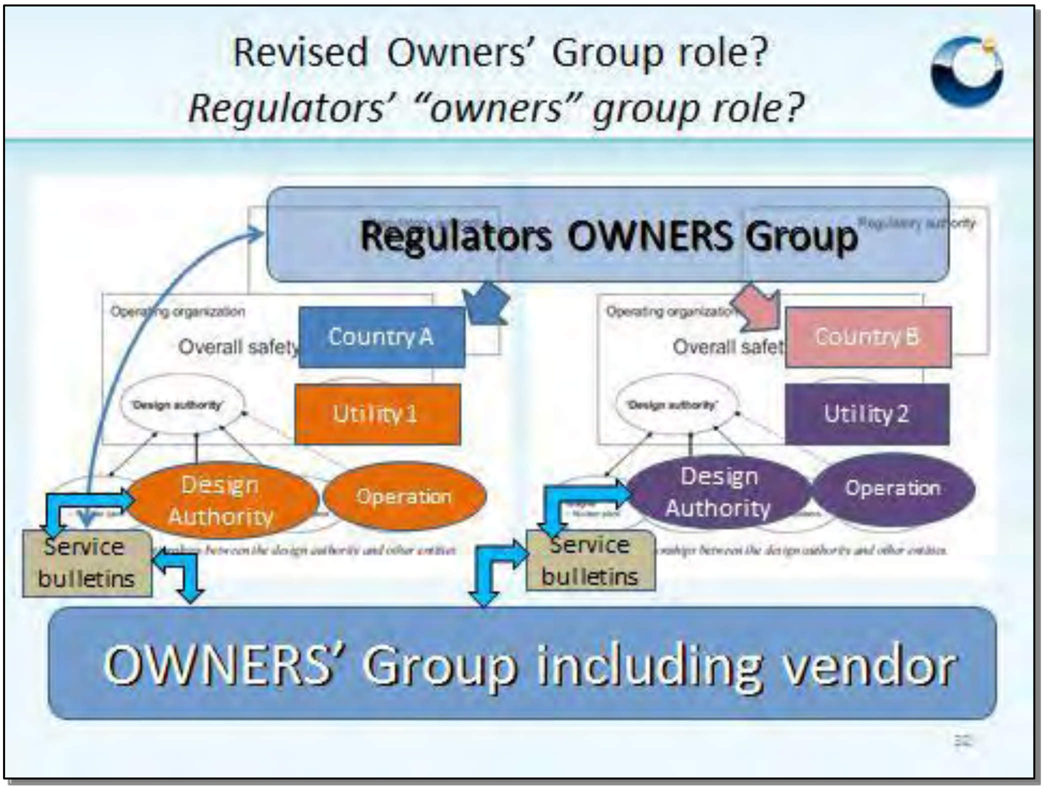
Revised Owners' Group role?
Regulators' "owners" group role?
Regulators OWNERS Group
Operating organization
Overall safety
Country A
Utility 1
"Design authority"
Design Authority
Operation
Service bulletins
Operating organization
Overall safet
Country B
Utility 2
"Design authority"
Design Authority
Operation
Service bulletins
OWNERS' Group including vendor
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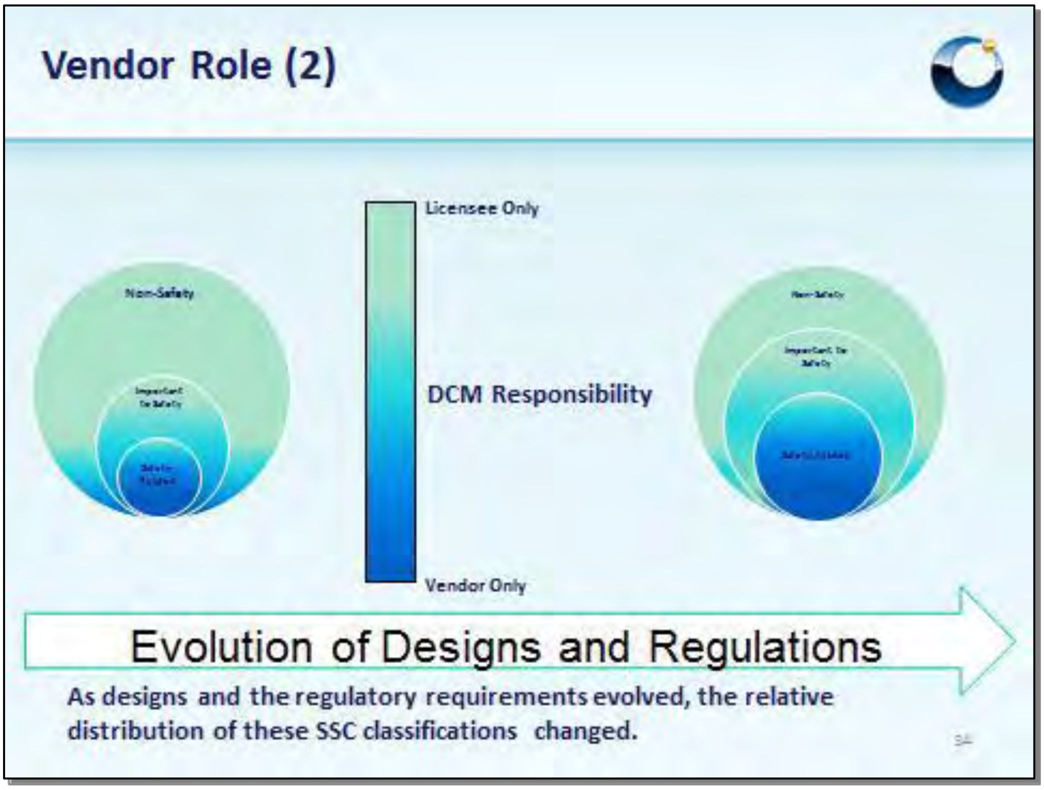
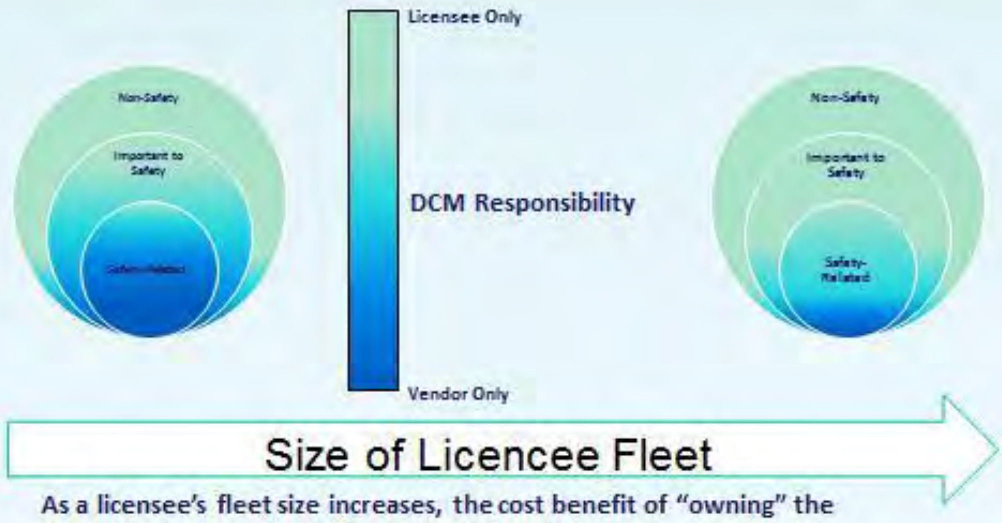
Vendor Role
Licensee Only
DCM Responsibility
Vendor Only
Non-Safety
Important
to Safety
Safety-
Related
In general, the distribution of responsibility for Design Change Management varies by the safety classification of a system, structure, or component (SSC).


Vendor Role (2)
Non-Safety
Licensee Only
DCM Responsibility
Vendor Only
Evolution of Designs and Regulations
As designs and the regulatory requirements evolved, the relative distribution of these SSC classifications changed.

Vendor Role (3)



As a licensee's fleet size increases, the cost benefit of "owning" the design basis, even for safety-related SSC's, improves.

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Key Elements of Survey

- JPOG
  - All Japanese PWRs are members of JPOG
  - ***JPOG addresses common issues and Mitsubishi takes the lead on engineering activities***
  - Coordinates new technology and R and D
  - Exchange OPEX
  - Most activities are closed and not shared with the public
  - ***Mitsubishi is the sole integrator of PWR technology in Japan and is a technical hub and source – thus has accountability in the area of configuration management and design change management***

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Key Elements of Survey - Membership

Voluntary or Mandatory? Vendor fully involved?

- COG – all domestic and foreign CANDUs plus AECL (vendor) (Voluntary)
- JPOG – all PWR operators in Japan plus Mitsubishi (vendor) (Mandatory)
- FROG – EdF, DNMC, Eskom, Electrabel, Vatenfal plus AREVA (vendor) – (Voluntary)
- Gidropress - vendor - not typical user group – technical support (dedicated team) to each NPPs with VVER reactors
- PWR user group : USA – 70, Europe and Asia– 114 vendors are party to the owner groups (Voluntary)

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Key elements of Survey

- COG
  - Pooled resources for R and D – chemistry, fuel channels, S and L, computer codes, health, safety and environment
  - Extensive Information exchange (CANDU + international)
  - Joint Projects and Regulatory Affairs
  - ***Facilitated joint RIDM review with CNSC and Canadian CANDUs of all residual safety issues (Category 1,2,3)***
  - ***Facilitated CANDU WANO SOER 11-2 responses – earned a good practices acknowledgement from WANO***
  - ***Together with AECL issue "station information advisories and bulletins" on safety issues – licensee determines reportability***
  - No accountability for "design authority" nor configuration management

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Key Elements of Survey

- FROG
  - Voluntary membership among operators and designer
  - Pooled resources to address generic actions and issues
  - ***Technical committees formed to address major items***
  - No library and no accountability for “design authority” nor configuration management.

Key Elements of Survey

- PWR Owner Groups
  - All PWRs in USA and majority of international PWRs
  - ***Support 6 main technical areas: materials, licensing, analysis, procedures, risk management, systems equipment and engineering***
  - No accountability for “design authority” nor configuration management.

Key Elements of Survey

- Gidropress
  - ***In Russia and Ukraine all VVER operators are mandated to cooperate with the vendor as a regulatory requirement.***
  - Extent of cooperation with off-shore VVERs is limited by service contracts between Gidropress and licensee
  - ***Vendor has capability to remotely monitor reactors in Russia and provide support to licensee in crisis via video link***
  - Gidropress may advise utilities occasionally on improvements common to all VVERs
  - ***Some accountability for design authority and configuration management as a result of licensing and regulatory requirements***

Deliverables and Action Plan 2012

- Deliverables: a report on DCM and the aviation analogy
- Action Plan and Schedules for 2012:
  - Agreeing on the report structure and personal commitments
    - January 2012
  - Prepare first comprehensive draft for discussion in person
    - for the TF Meeting in Helsinki, April 2012
  - Publish report
    - by September 2012, CORDEL Meetings in London, or latest end 2012
  - If no other areas to be investigated, close the Task Force
    - by the January 2012

Path Forward

- Supplement the survey and investigate/probe more fully for the "best in class" practices among the reactor licensees, vendors and owner groups to execute "design authority" that maintains or improves NPP safety over its entire lifetime.
  - TCD. - Q4/2011
- Prepare a "proposal/paper to address "effective change management and design authority" taking into account:
  - Roles of National Regulators, International agencies
  - Roles of Licensee, vendors, owner groups and the public
  - Fukushima and related review lessons learned
  - There may be lessons learned from related industries such as aviation
    - TCD – Q1/2012

Utility and Design Authority

- **Small utilities**
  - Design Authority and even "Intelligent Customer" roles may be difficult alone
  - Relationship between the utility and the original vendor becomes important
    - take advantage of the vendor's own Design Authority capability.
  - Infers long-term agreements with commercial implications.
  - Several examples in which a utility, making modifications on its own, or choosing another vendor to make a modification to improve its performance, has experienced negative consequences.
- **Several utilities are operating similar units in one country**
  - the case in Japan, Germany and the US
  - same regulator - beneficial for them to define common positions on safety issues
  - VGB in Germany and NEI and owner's groups in the US get utilities together to develop a common solution to the same safety/regulatory issue
  - New build, several US utilities have applied for a Combined Operating License around the same design.
  - NRC required them to create groups around the same design for the benefit of standardisation

Utility Role – different scenarios (2)

- **Utilities operating a number of similar units in different countries** t
  - significant incentives to keep similarities between these units
  - include sharing operating experience, sharing spare parts and the benefit of a common engineering team serving the whole fleet.
- **All situations**
  - relationship between utility and vendor must not end after plant start up
  - Some form of contractual agreements should be put in place on a long term basis to ensure the knowledge management of the design.
- **Obligation**
  - Utilities should be obliged to participate in the Owners Groups and to make maximum use of cooperation with their international peers within OGs and within international organisations such as WANO.

asn

Licensing experience for EPR Flamanville 3

Autorité de sûreté nucléaire (France)
Nuclear Power Plants Department

October 06, 2010

asn

Contents

- **French regulatory framework**
  - Licensing process of a nuclear installation
- **Flamanville 3 EPR reactor licensing**
  - Longstanding and continuous process
  - Engaging the formal licensing process
  - Timeframe
  - FLA3 authorization decree and associated ASN licence conditions
  - Commissioning authorization

October 06, 2010

Global process to create and operate a NPP
3 main stages

1) Political decision to build a new NPP

+ National public debate

- Decision taken by government
- ASN is not involved in this political decision

2) The authorization decree for NPP creation/construction licence

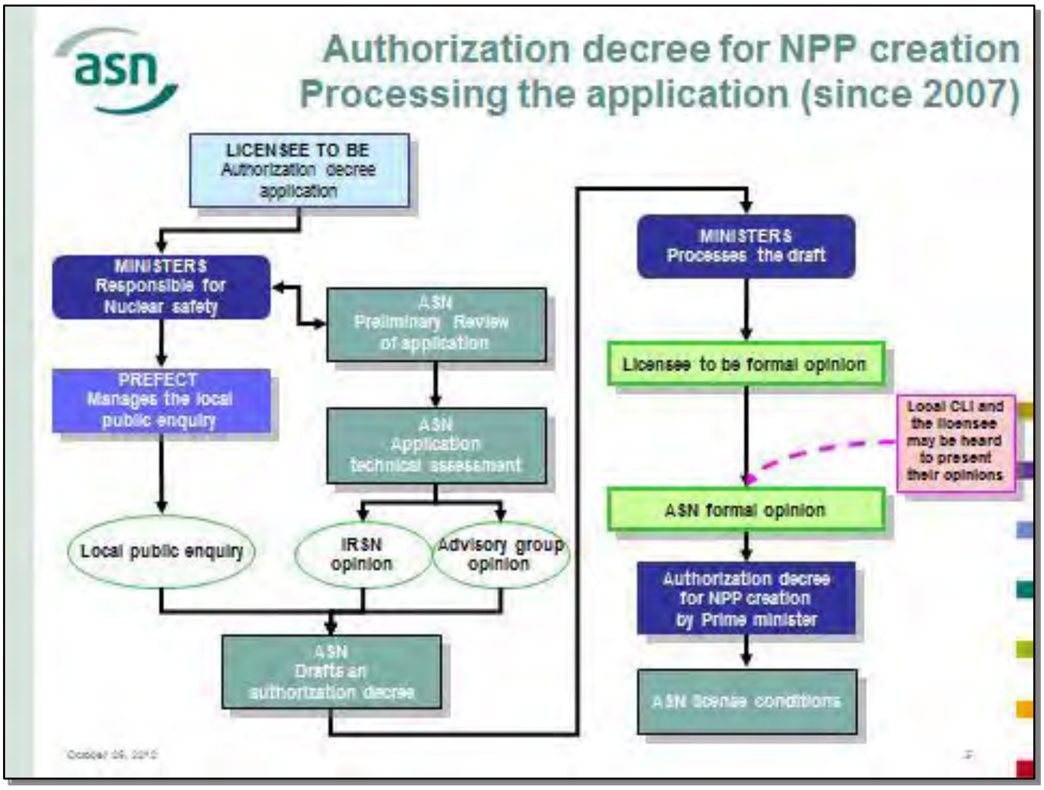
- Delivered by Government on the basis of the ASN position
- Aim of the authorization decree
  - To give the main "nuclear" characteristic to the NPP
  - To list the major requirements
  - To authorize the water intake and effluent discharges to the environment
- Process linked with other administrative authorizations (construction code…), especially an authorization to build, as well as national public debate process
- ASN can enact requirements (licence conditions) for detail design of the NPP

3) The commissioning and operation licence

- Delivered by ASN
- ASN can enact requirements (licence conditions) for the NPP commissioning and operation

French regulatory framework
Nuclear safety

- **Environment code article L593-7 gives the legal basis for the authorization process of a nuclear installation**
  - "the creation of a basic nuclear installation is subject to authorization"
- **2nd November 2007: Decree concerning Basic Nuclear Installations (BNI)**
  - Before the application ("safety options"), the licensee to be can request ASN's opinion on its project
  - Gives the detail of the process to get a this authorization decree (combined licence : site and design)
  - The first fuel load in the reactor is subjected to ASN's authorization



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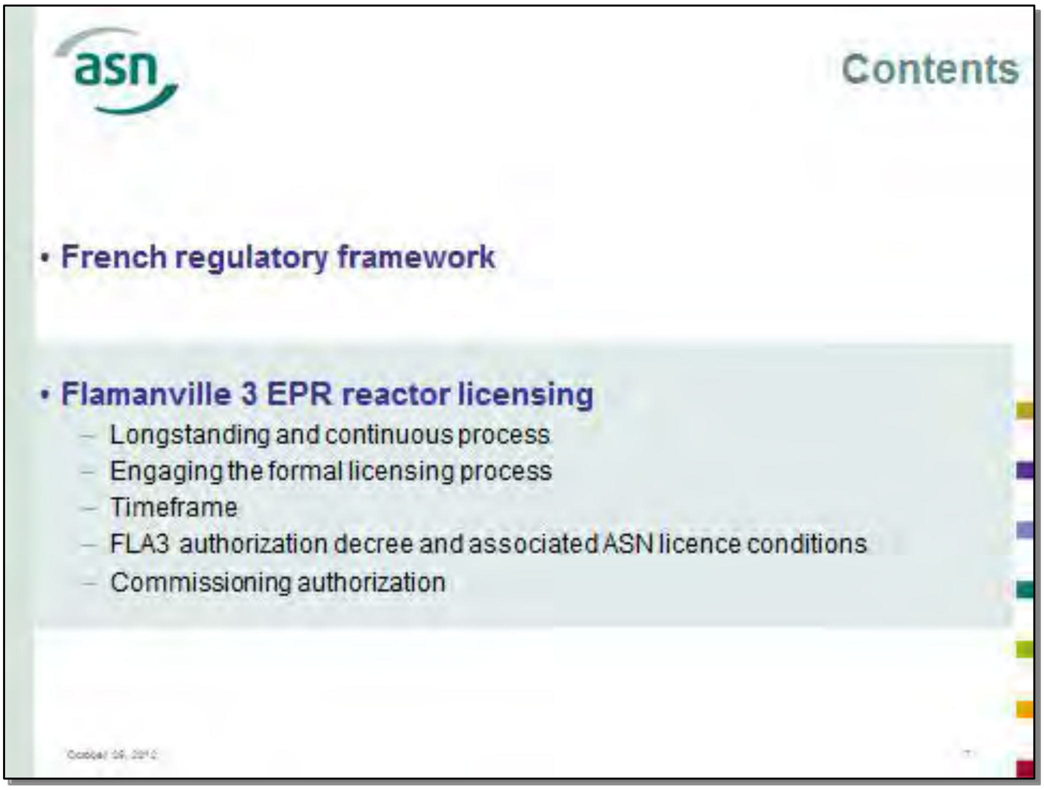
Operating licence

- **Commissioning authorization process is specified in the BNI procedure decree (art 20)**
- **To get the operating licence**
  - the operator has to submit several regulatory documents:
    - The safety analysis report comprising the updated preliminary safety analysis report and the data provided for assessment of installation conformity with the requirements of the authorization decree and the construction requirements;
    - The general operating rules ("GOR") the licensee intends to implement for protection of the interests mentioned in I of Article 28 of the Act of 13 June 2006 (people and the environment);
    - A study on waste management, specifying the licensee's objectives for limiting the volume and radiological, chemical and biological toxicity of the waste produced in its installations and, by reuse and reprocessing of the waste thus produced, for reducing the size of the repository reserved for ultimate waste. This study takes account of all installation waste management channels up until disposal. It can cover the waste produced by all the installations and equipment located within the perimeter;
    - The on-site emergency plan ("PUI");
    - An update, as necessary, of the decommissioning plan and the environmental impact assessment
  - ASN has 1 year (once the file is complete) to assess the case
  - ASN can enact licence conditions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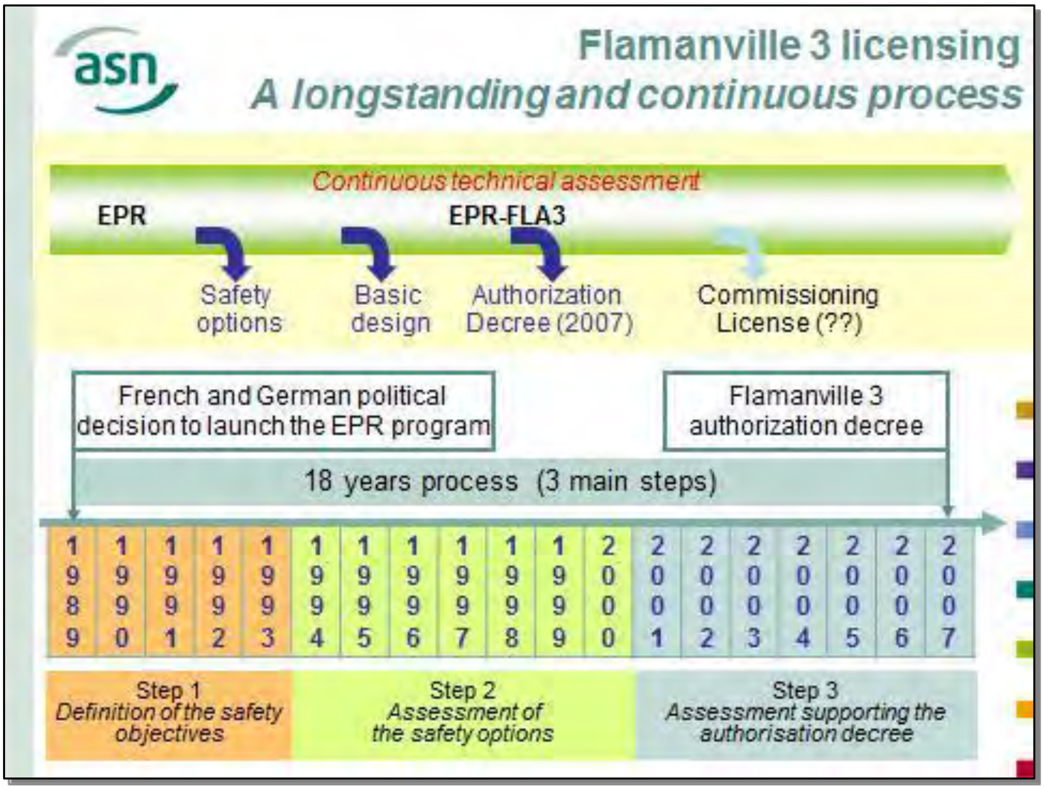
Contents
• French regulatory framework
• Flamanville 3 EPR reactor licensing
– Longstanding and continuous process
– Engaging the formal licensing process
– Timeframe
– FLA3 authorization decree and associated ASN licence conditions
– Commissioning authorization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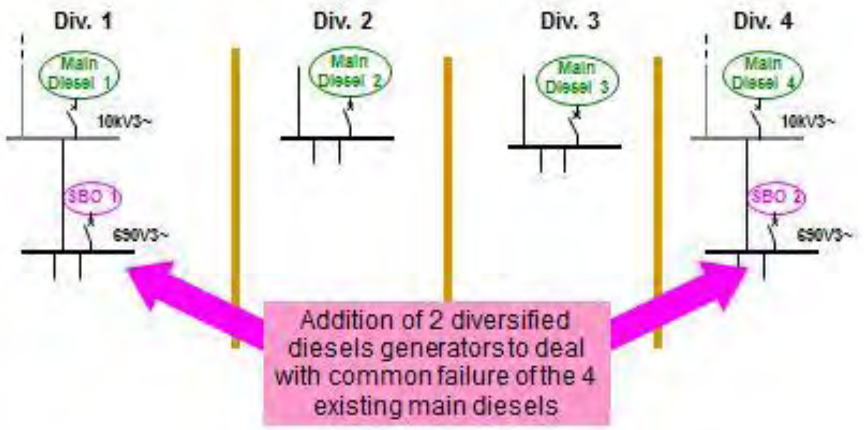
Flamanville 3 licensing
A longstanding and continuous process
Continuous technical assessment
EPR
EPR-FLA3
Safety options
Basic design
Authorization Decree (2007)
Commissioning License (??)
French and German political decision to launch the EPR program
Flamanville 3 authorization decree
18 years process (3 main steps)
1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007
Step 1
Definition of the safety objectives
Step 2
Assessment of the safety options
Step 3
Assessment supporting the authorisation decree

Technical assessment Topics reviewed

- **Technical assessment program related to the authorization decree mainly built on:**
  - The safety objectives defined in 1993
    - Control of the normal operation of the installation
    - Reduction of the number of significant incidents
    - Reduction of the core-meltdown risk
    - Practically-eliminated situations
    - Reduction of the radiological impact of accidents
  - The integration of recent experience feedback from operating reactors
    - Design basis against internal and external hazard
    - Sump-clogging risk of emergency core cooling systems
    - Crash of commercial aircraft
  - The innovations introduced in comparison to operating reactors in response to industrial concerns
    - Break-preclusion hypothesis
    - Principles and approach for equipment qualification
    - Preventive-maintenance operations in power states
    - Digital control and instrumentation
  - Design and manufacturing of nuclear pressure equipment
    - Nozzle support ring and the vessel closure head
    - Envelopes of fuel-bundle control mechanisms
    - Main components: pressurizer, stream generators…
  - Other selected topics

Technical assessment supporting the authorization decree

- **Examples of modifications resulting from the technical assessment**
  - Diversification of the emergency electrical supply

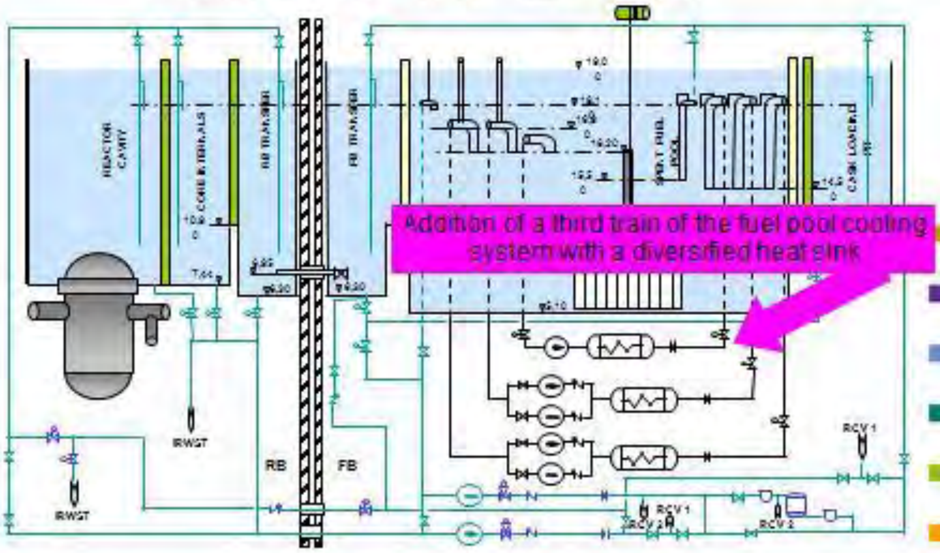


Technical assessment supporting the authorization decree

- **Examples of modifications introduced in result of the technical assessment**
  - Practical elimination of fuel melt in fuel pool
    - Assessment of reliability of the water-cooling function in the spent fuel pool performed notably on the basis of the Level-1 PSA results
    - Conclusion: excessive sensitivity of the initial design to a common-mode failure involving the two redundant systems that were originally planned for that function
    - Modification of the detailed design: the selected design evolution consisting in adding a third diversified cooling system was reviewed and approved
  - Diversification of the heat sink and essential service water system

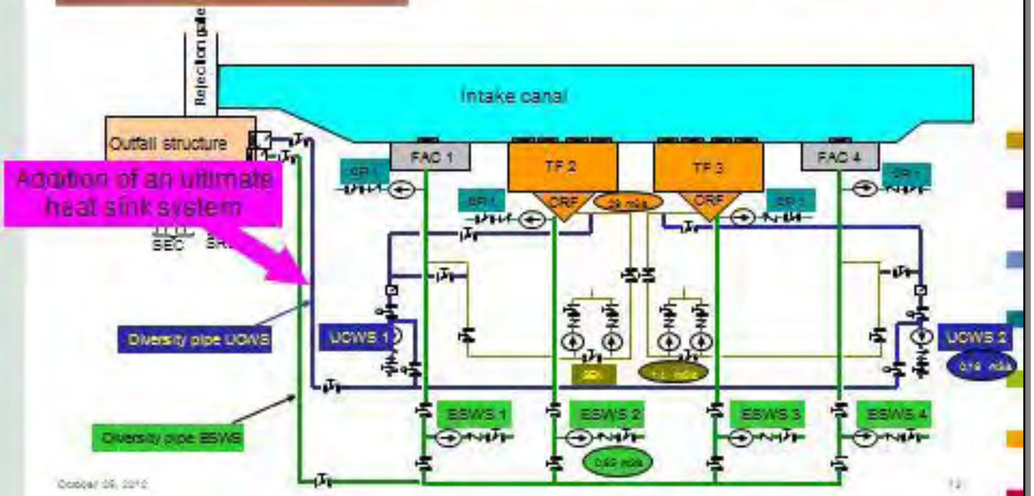
Technical assessment supporting the authorization decree

Practical elimination of fuel melt in fuel pool



Technical assessment supporting the authorization decree

Diversification of the heat sink and essential service water system



October 26, 2010

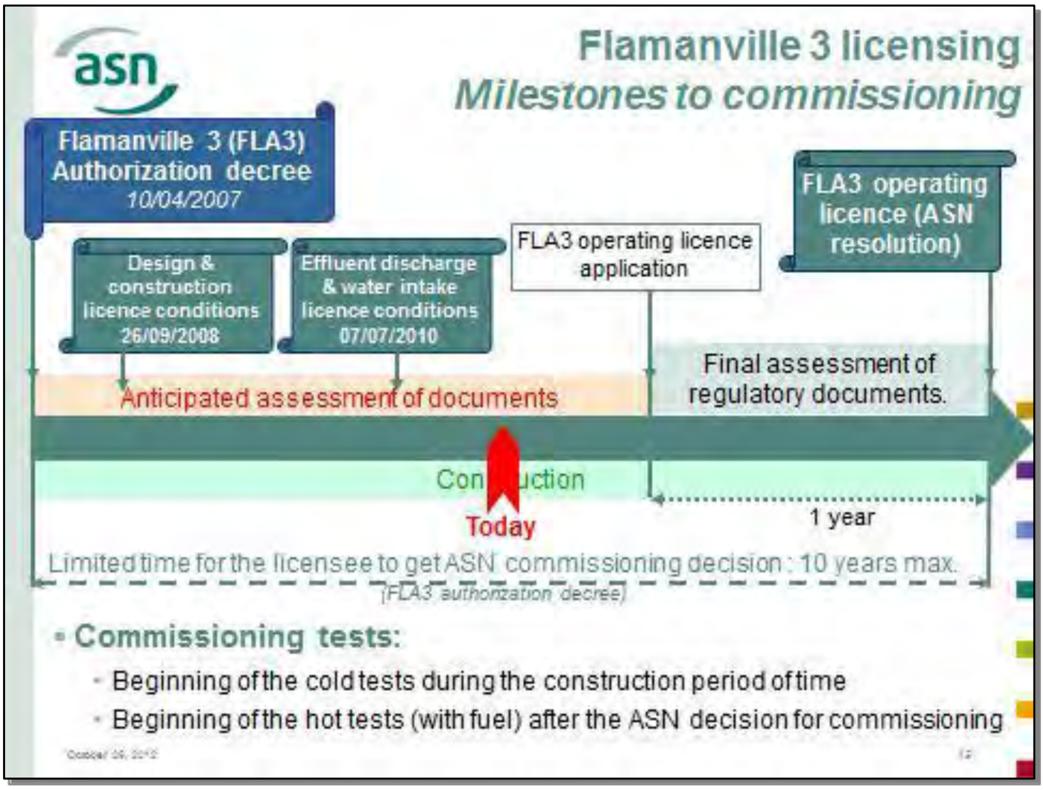
Flamanville 3 licensing

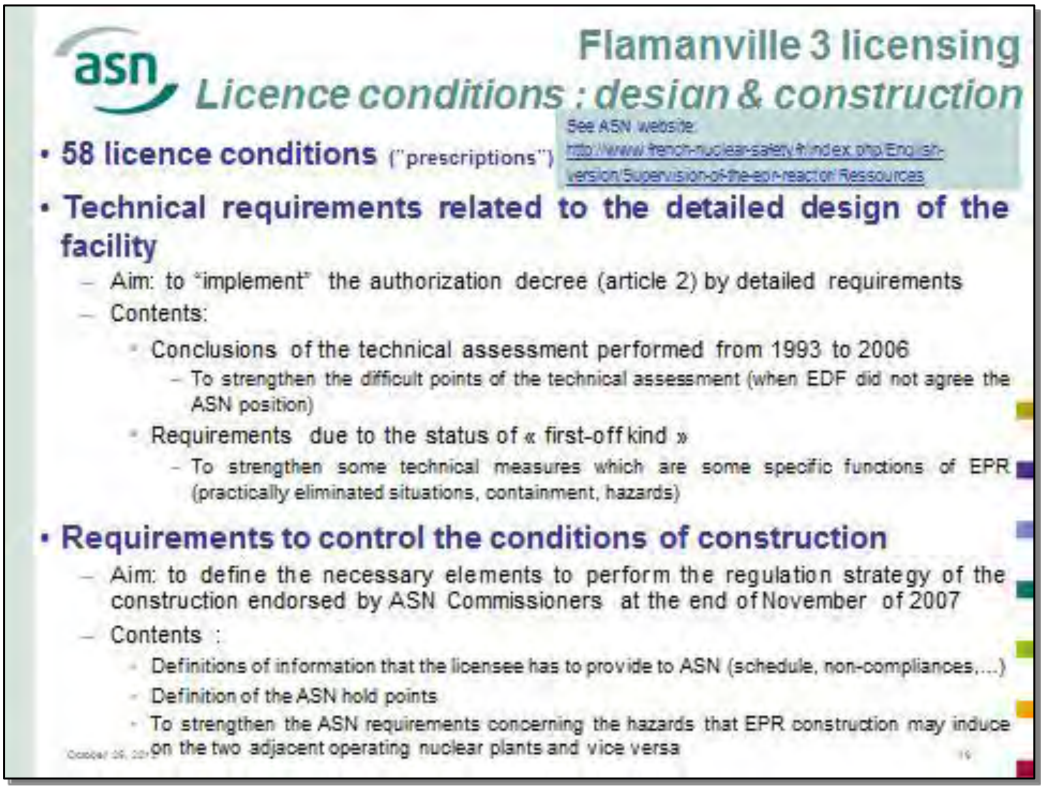
Contents of the authorization decree of Flamanville

- **Article 1: Generalities**
  - Name of the licensee
  - The nature of the installation and the maximal power of the NPP
  - Perimeter of the installation
- **Article 2: Main safety objectives**
  - I. Main characteristics of the installation
  - II. Management and control of accidents
  - III. 3 fundamental safety functions
  - IV. Management of the internal and external hazards
  - V. Qualification of the SSCs of the safety demonstration
  - VI. Management of the impact of the installation on the environment and on the public
  - VII. Information of IRSN in case of emergency
- **Article 3: Milestones to commissioning**
  - Conditions to introduce fuel inside the perimeter of the installation or for the 1st fuel loading
  - Limited time for the licensee to get ASN decision : 10 years max.
- **Article 4: Conditions to introduce some modifications**

See ASN website:
http://www.french-nuclear-safety.fr/index.php/English-version/Supervision-of-the-epr-reactor/Ressources

October 26, 2010


asn
Flamanville 3 licensing
Milestones to commissioning
Flamanville 3 (FLA3) Authorization decree
10/04/2007
Design & construction licence conditions
26/09/2008
Effluent discharge & water intake licence conditions
07/07/2010
FLA3 operating licence application
FLA3 operating licence (ASN resolution)
Final assessment of regulatory documents.
Anticipated assessment of documents
Construction
Today
1 year
Limited time for the licensee to get ASN commissioning decision : 10 years max.
(FLA3 authorization decree)
Commissioning tests:
Beginning of the cold tests during the construction period of time
Beginning of the hot tests (with fuel) after the ASN decision for commissioning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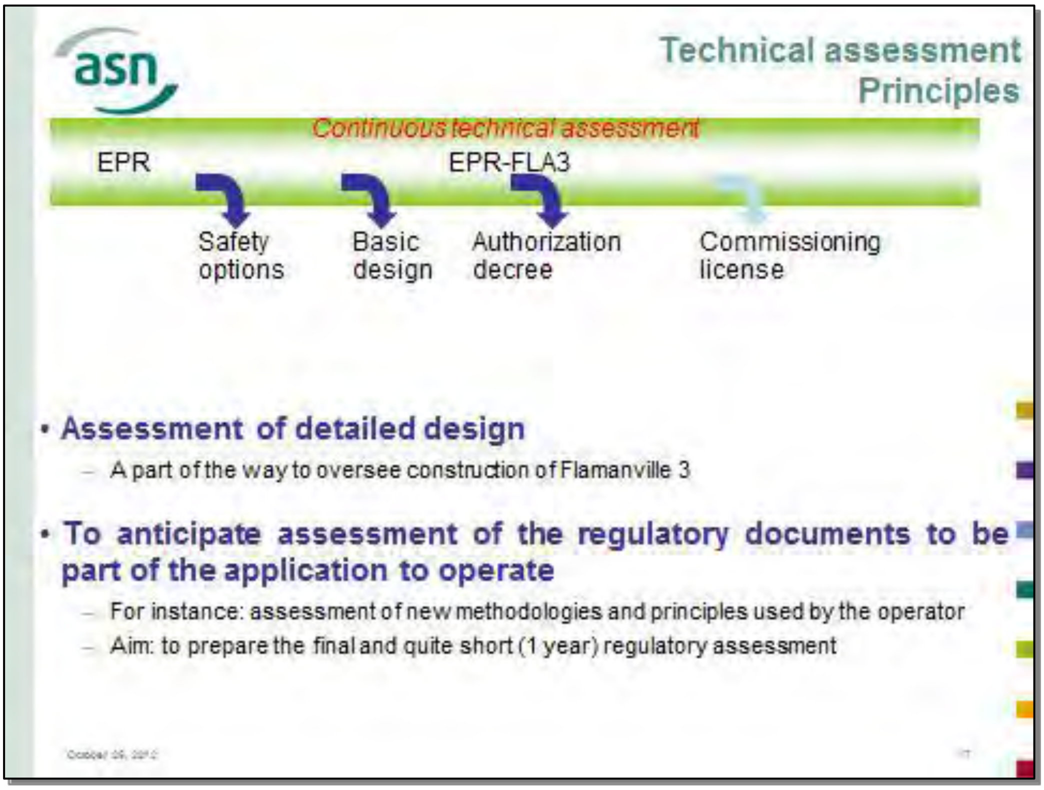
Flamanville 3 licensing
Licence conditions : design & construction
See ASN website:
http://www.french-nuclear-safety.fr/index.php/English-version/Supervision-of-the-epr-reactor/Ressources
58 licence conditions ("prescriptions")
Technical requirements related to the detailed design of the facility
Aim: to "implement" the authorization decree (article 2) by detailed requirements
Contents:
Conclusions of the technical assessment performed from 1993 to 2006
To strengthen the difficult points of the technical assessment (when EDF did not agree the ASN position)
Requirements due to the status of « first-off kind »
To strengthen some technical measures which are some specific functions of EPR (practically eliminated situations, containment, hazards)
Requirements to control the conditions of construction
Aim: to define the necessary elements to perform the regulation strategy of the construction endorsed by ASN Commissioners at the end of November of 2007
Contents :
Definitions of information that the licensee has to provide to ASN (schedule, non-compliances,...)
Definition of the ASN hold points
To strengthen the ASN requirements concerning the hazards that EPR construction may induce on the two adjacent operating nuclear plants and vice versa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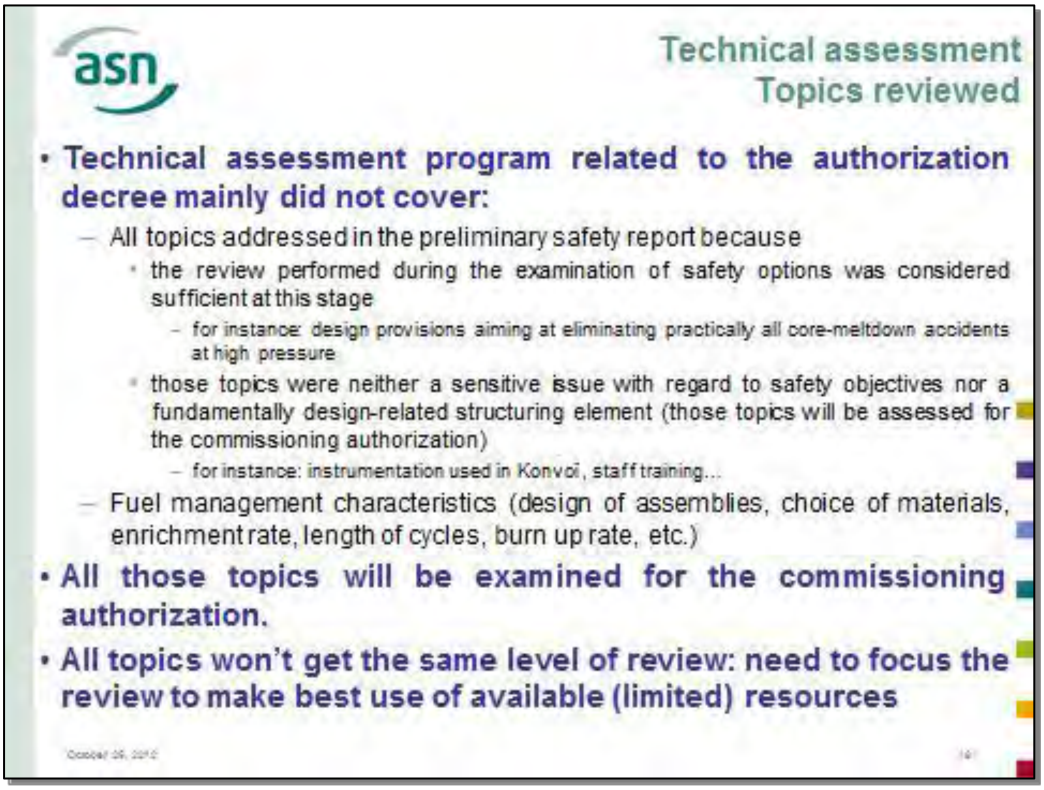
Technical assessment
Principles
Continuous technical assessment
EPR
EPR-FLA3
Safety options
Basic design
Authorization decree
Commissioning license
• Assessment of detailed design
– A part of the way to oversee construction of Flamanville 3
• To anticipate assessment of the regulatory documents to be part of the application to operate
– For instance: assessment of new methodologies and principles used by the operator
– Aim: to prepare the final and quite short (1 year) regulatory assessment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Technical assessment
Topics reviewed
• Technical assessment program related to the authorization decree mainly did not cover:
– All topics addressed in the preliminary safety report because
• the review performed during the examination of safety options was considered sufficient at this stage
– for instance: design provisions aiming at eliminating practically all core-meltdown accidents at high pressure
• those topics were neither a sensitive issue with regard to safety objectives nor a fundamentally design-related structuring element (those topics will be assessed for the commissioning authorization)
– for instance: instrumentation used in Konvoi, staff training…
– Fuel management characteristics (design of assemblies, choice of materials, enrichment rate, length of cycles, burn up rate, etc.)
• All those topics will be examined for the commissioning authorization.
• All topics won't get the same level of review: need to focus the review to make best use of available (limited) resources

Technical assessment
Current ASN-IRSN activities

- Topics currently under review
  - Accident studies
  - I&C
  - Protection system
  - Internal, external hazards
  - Detailed design of EPR system playing a safety role as supporting systems (including risk of sump clogging, electrical supply, ventilation…)
  - Equipment qualification to accidental conditions
  - Radiological consequences
  - Severe accident management
  - Probabilistic studies (levels 1, 2, for the reactor, the fuel pool, regarding internal events, internal and external hazards…)
  - Radiation protection
  - Human and Organizational Factors
  - Commissioning tests
  - General Operating rules

ASN lessons

- **Consequence of the "focusing" review principle:**
  - Build a methodology to choose SSC which will be assessed in details
  - What to consider in the methodology to choose SSC?
    - Defense in depth principle
    - Follow up of the assessment performed before Flamanville 3 authorization decree
    - New technologies used for EPR
    - Feedback of French and German design, operating French NPP, Konvoï,…
    - Feedback from international cooperation
  - January 2009: ASN commission endorsed a methodology to focus the technical review
- **Human resources:**
  - Current ASN-IRSN activities: continuous EPR assessment + operating reactor activities
  - New methodologies and principles used by the operator to elaborate the safety demonstration: heavy task
  - Human resources (ASN+TSO) need to be scheduled

Conclusion

- **A long process (18 years) concluded by Flamanville 3 authorization decree**
  - Assessment is still going on in preparation of the commissioning and operation licence

- **A very detailed technical assessment performed all along the design process of the industrial project**
  - it enables the French nuclear safety authority to <u>influence the design at an early stage</u> of the project and facilitates the authorization application procedure
- **A position of ASN based on a technical assessment involving experts from several European countries**
  - France, Germany, Finland, Belgium, UK,...
  - Making use of regulatory cooperation as part of MDEP initiative

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www.asn.fr

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

New Reactor Licensing Status and Lessons Learned

Mohammed Shuaibi, Deputy Director
Division of Engineering
Office of New Reactors
October 26, 2012

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Overview

- Status of Licensing Reviews for Large Light-Water Reactors
- Insights and Lessons Learned
- Summary

2

U.S.NRC

Completed Reviews

- 4 design certification (DC) applications
- 2 DC amendment applications
- 2 combined license (COL) applications
  - 4 licenses issued, units under construction
- 4 early site permit (ESP) applications

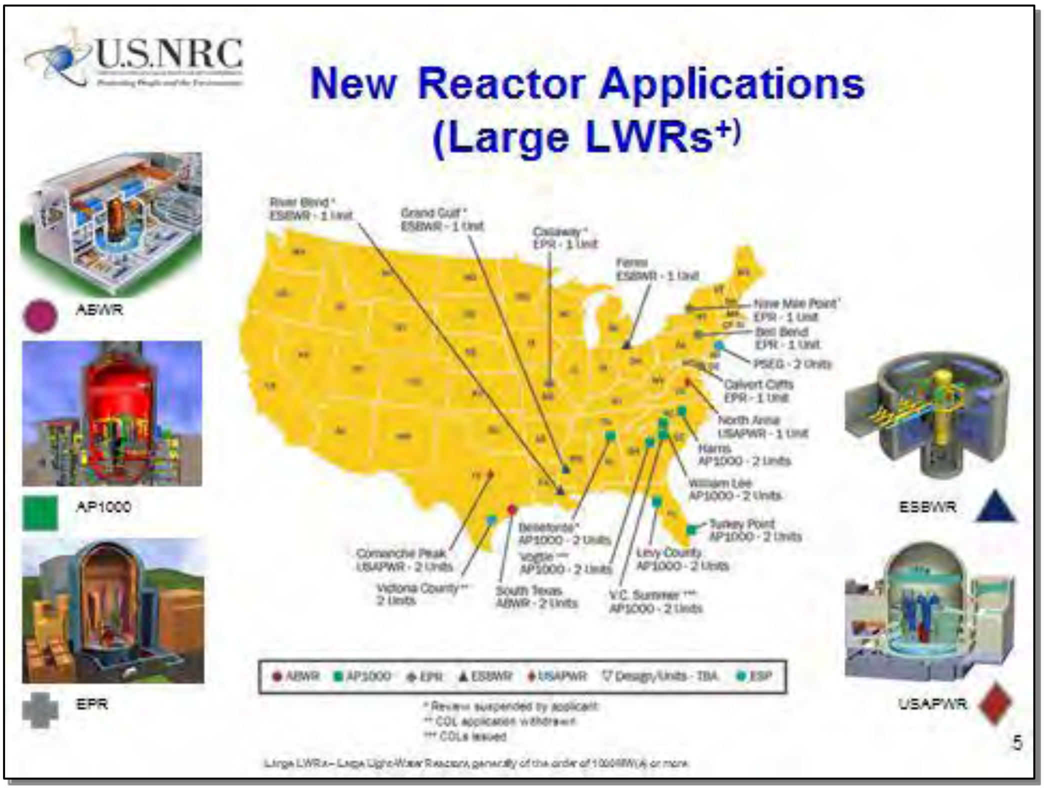
3

U.S.NRC

Ongoing Reviews

- 3 DC applications
  - GE-H Economic Simplified Boiling Water Reactor (ESBWR)
  - AREVA Evolutionary Power Reactor (EPR)
  - Mitsubishi U.S. Advanced Pressurized Water Reactor (US APWR)
- 2 DC renewal applications
  - GE-H Advanced Boiling Water Reactor (ABWR) Renewal
  - Toshiba ABWR Renewal
- 16 COL applications
  - 10 active, 5 suspended, 1 withdrawn
- 1 ESP application
  - Public Service Enterprise Group Incorporated

4



Lessons Learned - Pre-Application

- Early interaction, prior to application submittal
- Conduct pre-application reviews to address
  - Major issues that could require Commission policy guidance
  - Major technical issues that could be resolved under existing NRC regulations on policy, and
  - Research needed to resolve identified issues
- Used effectively for Design Certification reviews
  - Thermal-hydraulic codes, including the supporting test programs and scaling methods
  - Preparation for Small Modular Reactor reviews

6


U.S.NRC
Lessons Learned – Application Review
• Communication – meetings and teleconferences to address issues
• Licensing audits – onsite review of detailed calculations and discussion with analysts
• Awareness of issues on similar applications
• Awareness of issues under consideration by other countries
7


U.S.NRC
Lessons Learned - Construction Oversight
• 2 COL applications completed
– 4 units under construction (Vogtle 3 & 4, and V.C. Summer 2 & 3)
• Translation of design into construction documents
– One-step vs. two-step process
• Construct to the Licensing Basis … or Change It
– Understand the licensing basis
– Follow the Part 52 change process
– Ensure that a robust method for maintaining and changing the licensing basis is in place
Licensee is Accountable
8

U.S.NRC

Changes during Construction

- Need NRC Approval? NRC review time could impact construction schedule?
- License condition allows use of Preliminary Amendment Request (PAR) process
- NRC Letter stating no objection to the licensee installing and testing the proposed changed design feature pending NRC's review of the LAR
- Avoids unnecessary construction delays

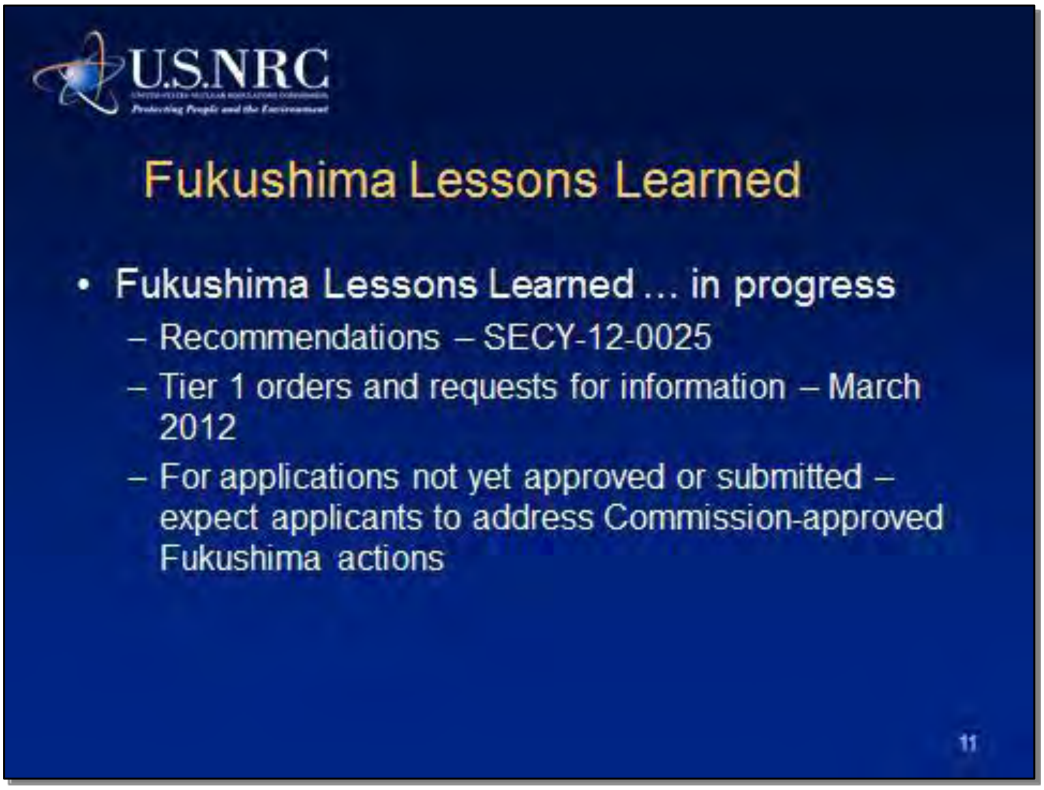
9

U.S.NRC

Construction Related LAR Challenges

- License Amendment Request (LAR) - In time to support construction schedules
- Must be high quality
  - Licensee goal is to obtain approval without a need for Requests for Additional Information (RAIs)
- Pre-submittal meetings on draft amendment requests
- Experience to date
  - First 3 amendments – No RAIs needed
  - Quick turnaround – First LAR completed in less than 3 months

10


U.S.NRC
Protecting People and the Environment
Fukushima Lessons Learned
• Fukushima Lessons Learned … in progress
– Recommendations – SECY-12-0025
– Tier 1 orders and requests for information – March 2012
– For applications not yet approved or submitted – expect applicants to address Commission-approved Fukushima actions
11


U.S.NRC
Protecting People and the Environment
Ongoing Lessons Learned Review
• Bipartisan Policy Center Report issued April 6, 2010
– Commended staff efforts on licensing reviews
– Recommended lessons learned review after first COL issued
• Staff has initiated comprehensive review to identify best-practices and potential enhancements to its new reactor licensing processes
– Report will be published in early 2013
– Report will be provided to international community
12

U.S.NRC

Summary

- Completed several reviews using the 10 CFR Part 52 ("one-step") licensing process – 4 units under construction
- Implementing several lessons learned and best practices
- One-step licensing process, by design, is rigid and requires constructing the plant to the approved licensing basis
- Understanding of licensing basis and applicable change processes is key to successful construction activities
- Formal lessons learned report on new reactor licensing to be completed in early 2013 – this addresses a recommendation of the Bipartisan Policy Center

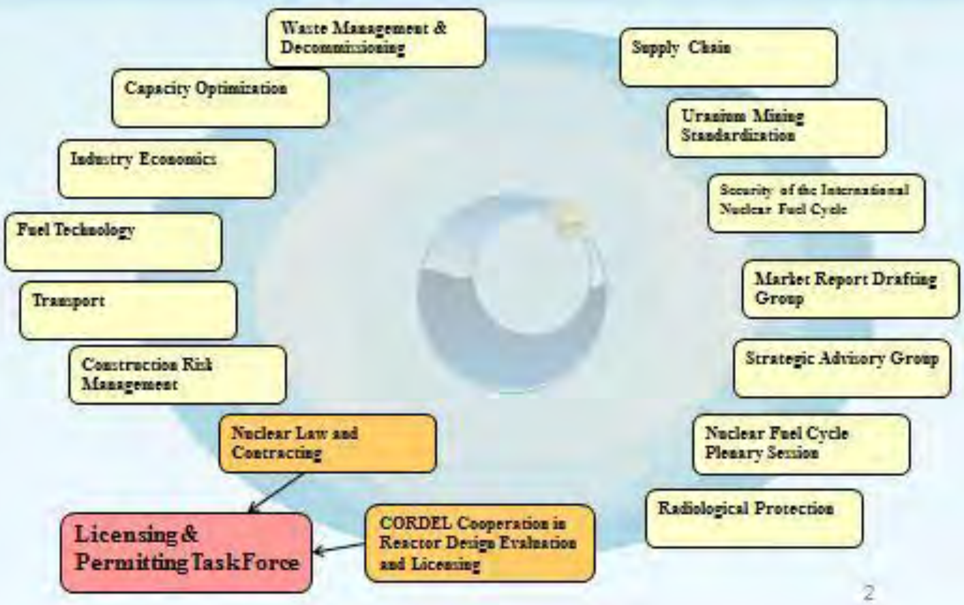
13

WNA Licensing & Permitting Survey

Christian Raetzke
WNA CORDEL Director of Licensing
2nd CNRA International Workshop on
New Reactor Siting, Licensing and Construction Experience
Atlanta, 24 to 26 October 2012

World Nuclear Association

WNA Working Groups



2

Survey on Licensing

- Survey with 50 questions prepared in the course of 2011
- Release of the Survey to WNA members in early December 2011
- 15 sets of answers received by end of January 2012
  - utilities, vendors and an architect engineer
  - from 4 continents
- Survey Report finalised in September 2012
- Publication on WNA website forthcoming (www.world-nuclear.org)

3

Scope of the Survey and the Report

- No duplication of work already being done by institutions such as IAEA, OECD/NEA and EU
  - IAEA Milestones document (NG-G-3.1) and others
  - OECD/NEA WGRNR work (ongoing)
  - ENEF Licensing Survey and ERDA group
- All nuclear stakeholders agree that safety and security is paramount in any licensing process

  ► **The Survey focuses on the interaction of regulatory processes with the industry's commercial activities, such as procurement, contracting, and finance**

- Report is an objective summary and analysis of survey responses

4

Licensing and project development

Licensing

⇕

- Manufacturing and construction, incl. preparatory phases
- Securing financing and investment
- Design work – from basic design to detailed design/specs
- Vendor selection
- Procurement, contracting, risk allocation
- Site selection, on-site activities
- Communication with stakeholders, public involvement
- Permitting, i.e. non-nuclear authorisations/licences/permits
- International standardisation

No one-fits-all licensing model...

Different types of new build countries

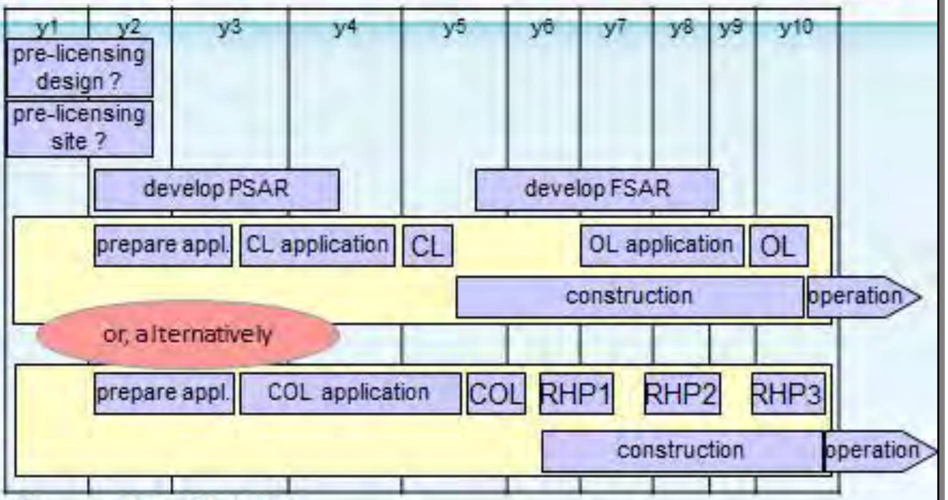
- large, mature, market driven: US, UK, Canada...
- large (mature or emerging) state-driven: China, Russia, Korea, India...
- small-mature: Czech Republic, Slovak Republic...
- emergent: UAE, Turkey, Poland, Indonesia, Vietnam....
- SMR

► very diverse regulatory, political and economic environments

FOAK, NOAK and FIAC

- FOAK: high risk and uncertainty
- NOAK (n^{th} of a kind): benefit of standardization
- FIAC (first-in-a-country): more like FOAK or more like NOAK?

Licensing: some basic notions



CL: construction licence
OL: operating licence
COL: combined construction and operating licence
RHP: regulatory hold point (consent, permit, ITAAC….)
PSAR: preliminary safety analysis report
FSAR: final safety analysis report

7

Licensing system

- One-step licensing vs. two- or multi-step licensing: commercial developers value predictability and certainty in any system rather than having a preference for a particular system
  - One-step gives more certainty because no further licence is needed...
  - ... but two-step may be quicker (CL can be obtained earlier) and better for FOAK
- Pre-licensing of a design or a site is important feature of a regulatory system, reducing the risk of licensing and making the outcome of a licensing process more predictable

8

Vendor and site selection

- Many different ways of dealing with this:
  - Can be key commercial decisions that form the basis for entering the licensing process
  - Can be based on initial governmental decision reached in advance of a commercial project (e.g. choice of the national "champion" as vendor)
- Concerning technology selection, need to make a choice as early in the process as possible, ideally before the licence application

9

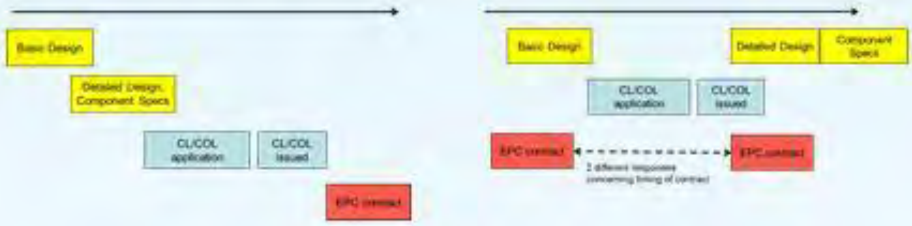
Contracting

- Development towards replacing a single contract with a system of contractual steps
- Stepwise entering into commitments, based on risk which gradually is reduced depending on progress of licensing procedure
- Main contract concluded rather late, preceded by pre-contract
- In less market-driven environments, the "classic" approach of an early upfront EPC contract is still in use
- Not practical to develop or advocate for a standardized contract, due to the diversity of factors driving commercial considerations in specific projects

10

Design Development (1)

- Main steps: basic design - detailed design - procurement specifications
- Full range applies only to a FOAK project – or, to some extent, to a FIAC project
- Timing of the design development steps: Survey shows a range of solutions. Two examples:



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Design Development (2)

- Crucial issue for FOAK projects: to what extent does the design need to be developed at the time the construction licence or COL is issued?
  - Consensus that a certain design maturity is beneficial or even necessary for licensing...
  - ...but the percentages of design completion actually suggested are very different (from 10-15% to 100%)
  - Depends both on definitions (e.g. basic design) and on regulatory and commercial environment
- Careful contractual arrangements needed, defining design completion, time schedule and licensing significance for different phases as well as the procurement time schedule
- Process should be reviewed by the regulator – some commitment by the regulator needed

12

Financing

- Timing of the Financial Investment Decision (FID): before licence application or after licence has been issued?
  - Link to contracting (full-scope commitment supposes FID)
  - Both views given by respondents, depending on their national regulations and the commercial and market environment
- A clear and predictable licensing regime increases availability of financing

13

Involvement of Stakeholders

- Government: formally binding positive decision about the NPP project at the outset relieves licensing process of political considerations and allows it to focus on safety issues
- Public: balance meaningful public involvement with the necessity to take basic decisions early in the project and not to open them up for discussion again at a later stage
- Law courts: all stakeholders in the licensing process must take care that sound and well documented decisions are taken so they will successfully withstand scrutiny by the law courts

14


Procurement, supply chain, oversight
• Procurement is a stepwise process with integrated decision-making based on pre-defined requirements and factors
• Design documentation and manufacturing documentation needs to be efficiently and effectively reviewed between all parties involved
• In manufacturing, relevant qualifications, reviews and approvals should be fully completed prior to manufacturing. In some cases, more "flexible" solutions should be feasible
• Enhanced international standardisation and greater cooperation of regulators may be a means to make component manufacturing more predictable
15


Support for international standardization
• International harmonisation of safety requirements and standardisation of reactor designs would greatly facilitate licensing.
• Particularly in the case of an FIAC, a standardised design and an acceptance of licensing results already obtained in another country would be much easier than starting from scratch and re-doing the entire assessment.
• However, there is still a long way to go
• The Survey also investigates in which areas reactor design standardisation would have a substantial impact
– Rather not for: site qualification and selection stage
– Definitely for: reactor design licensing, vendor selection and procurement
16


Way Forward
• Report to be published soon
• Discussion and interaction with stakeholders, particularly with regulators
• Depending on the outcome, the Task Force will refine its analysis and produce further reports on specific topics
17

ACKNOWLEDGMENTS

Gratitude is expressed to the US Nuclear Regulatory Commission (U.S.NRC) for hosting the workshop. To Ms. Laura Dudes, who was at that time Director of the Division of Construction Inspection and Operational Programs of the Office of New Reactors at the U.S.NRC, for her support and dedicated efforts for the organisation of the workshop, and to Ms. Toni Sakadales, who co-ordinated all the organisational efforts.

Special appreciation is given to Mr. Steve Gibson, WGRNR Chairperson, for its effort and cooperation. Thanks are also expressed to the Workshop Organising Committee, Session Chairpersons and workshop participants for their support.

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