Le rôle des organismes multilatéraux / Role of international organisations

Takeyuki INAGAKI – IAEA, Eric MATHET – OECD/NEA

Dominique ARNAUD - Nous allons entamer la seconde séance plénière de ce symposium. Elle sera consacrée au rôle des organismes multilatéraux. Monsieur Inagaki va présenter la prise en compte par l'AIEA dans ses guides techniques de la problématique du vieillissement.

Takeyuki INAGAKI, IAEA - Good afternoon ladies and gentlemen. My presentation is about major IAEA activities on safety aspects of ageing mana-gement, especially the redaction of technical features of our component specific guidelines. And also our new activity on Safety Knowledge-base on Ageing and Long-term Operations (SKALTO).

The total number of nuclear power plants currently under operation is 441 units and 81 of them have more than 30 years of operation and 221 have more than 20 years of operation. So the average age of operating nuclear power plants is constantly increasing while the number of new constructions is very small. Therefore, a role of ageing management becomes more and more important.

In this situation, IAEA initiated ageing management activities in the 1980s to facilitate information exchange on ageing management among member states and also to create guidance documents on this subject. As regards to the current major activities relating to ageing management for nuclear power plants, we are creating a series of ageing management guidance documents and also we are trying to facilitate the application of the guidance documents through workshops and seminars, which are conducted under the technical cooperation and external budgetary programme. Also we are conducting some ageing management Assessment Team Missions, involving Pakistan, Lithuania, Armenia, the Netherlands and Hungary. The next one is to create a knowledge sharing system on this subject called Knowledge-base on Ageing and Long Term Operation, SKALTO. We are also conducting an important external budgetary program on long term operation called EBP SALTO (Safety Aspects of Long-term Operations). And the last one is a new one, but a very important one, now we start creating the safety guide on ageing management for nuclear power plants and research reactors. I would like to focus on the underlined activities.

This slide shows an over all structure of IAEA Safety Standards and guidance documents related to ageing management and life management. On the top of them, there are two safety requirements, design of nuclear power plants and operation of nuclear power plants. Requirements on nuclear power plant design show basic requirements on ageing at the design stage, and the operation requirements provide basic requirements, mainly from the point of view of maintenance. On the other hand, there are series of the guidance documents, they are the safety reports and also TECDOCs. The guidance documents on ageing management are subdivided into programme guidelines and component-specific guidelines. We also have related guidance documents on specific ageing phenomena and on life management, which were prepared by the Nuclear Energy Department, another department in the IAEA. The Nuclear Safety Department is focused on safety aspects of ageing management. The Nuclear Energy Department is focused more on technical and economic-oriented activities. To fill in the gaps between the basic requirements and technical guidance documents, we started creating the new safety guide on ageing management. This will provide key elements of the recommendations on ageing management.

There are a set of component specific guidelines which provide basic tips on ageing management for specific components. They provide information on significant ageing mechanisms, including past operational experience, and also provide tips to manage ageing from the point of view of inspection, operation, monitoring, maintenance repair, replacement and mitigation. They are not mandatory or prescriptive guidelines, they just provide tips and good practices among member states. Currently, nine TECDOCs have been published and four are under preparation. Two guidelines for BWR reactor pressure vessels and core internals are now in print, so they will be published in a few months. We are also finalising two updated guidelines for PWR reactor vessels and core internals. They will be TECDOC addendums.

This slide explains component specific guidelines for PWR Primary Piping. This was published in 2003. The scope of this TECDOC covers western PWRs and VVERs. The main coolant piping, surge and spray lines, class 1 piping in attached systems, and also small-diameter piping that cannot be isolated from the primary system are within the scope. As for ageing mechanisms, six ageing mechanisms and their significance are discussed. They are thermal fatigue, vibratory fatigue, thermal ageing, primary water stress corrosion cracking, boric acid corrosion and atmospheric corrosion. Thermal fatigue, this does not mean the conventional thermal fatigue but means thermal stratification, striping and thermal shock. The susceptible sites are the surge lines and nozzles, spray lines and nozzles, other connected lines and nozzles and dissimilar welds between the main coolant piping and RPV. For vibration fatigue, susceptible sites are small diameter pipelines. Thermal ageing is significant for the cast stainless steel piping and welds, which are mainly welded by shield metal arc welding (SMAW). And the last one is primary water stress corrosion cracking. And of course, susceptible sites are components made of alloy 600.

This slide shows the key factors in managing significant ageing mechanisms, just as an example for thermal ageing, which are the replication of the surfaces of the affected area for metallographic examination to determine delta-ferrite content. For PWSCC, a development of the in-service inspection programme and external visual inspection is recognised as an important method to manage this ageing mechanism.

The next one is about new TECDOCs on BWR RPV and the core internals. They cover the RPV and the core internals of GE BWR product lines, Japanese BWRs including Advanced BWRs, called ABWRs, Siemens ABWR and ABB BWRs. As for ageing mechanisms, IGSCC is a dominant ageing mechanism and a serious common problem for RPV components and core internals made of austenitic stainless steel. These new TECDOCs also mention IGSCC of components made of nuclear grade stainless steel or alloy 182. The photo at the bottom shows IGSCC of nuclear-grade stainless steel. You can see the transformation from the TGSCC to IGSCC. This is a typical mechanism of the IGSCC on nuclear-grade stainless steel. The TECDOC for core internals also mentions the significance of IASCC for some core internals such as core shroud, top guide and core plates. Fatigue is also significant for some RPV components, for example closure studs and the feed-water nozzle.

This slide shows key factors to manage IGSCC and the fatigue of BWRs.

The next one is our new TECDOC addendums on PWR RPV and internals. The scope is to cover western PWRs and also VVER 440s and 1000s. A new and significant ageing mechanism for RPV and core internals is PWSCC of CRDMs, BMI and other products such as nozzle safe ends and radial keys. Boric acid corrosion was also recognised as a significant mechanism. Of course, the current version of TECDOCs mention these aging mechanisms to some extent. However, after the publication of the current TECDOCs, some very serious events such as Davis-Besse took place. The photo on the right side is a new event at the Japanese PWR – this is a leakage from a CRDM nozzle due to PWSCC. Another photo is very famous: the Davis Besse event. The new TECDOC addendum change the significance of these ageing mechanisms. In another addendum for core internals, IASCC of baffle-former bolts was added as a significant ageing mechanism.

This slide shows key factors in managing those significant ageing mechanisms. For PWSCC of alloy 600 (RPV), ISI programmes for the Alloy-600 penetrations and preparation of a flaw evaluation handbook are important. For the IASCC of baffle-former bolts (internals), the TECDOC addendum recommends the sub-division of nuclear power plants according to the susceptibility of their baffle former bolts to IASCC. Bolt damage prediction equations/curves that take into account fluence, temperature, stress as well as operating experience could be useful for this task. This TECDOC addendum shows one example of prediction curve created by Japanese PWR utilities.

Our large scale extra-budgetary programme it on Safety Aspects of Long-Term Operation of

water moderated reactors, we call EBP SALTO, is mainly sponsored by the US government and a lot of US and outside people are supporting this activity. This covers not only the ageing management, but also key aspects of long-term operation. Long-term operation means operating periods beyond the design lifetime. This is a 2003-06 extra-budgetary programme. Currently, 18 member states and the European Commission are participating in this programme. They are creating reports based on the PSR Safety Guide Index. The outcome of the project is 'Scope and Content of Programmes for Safe LTO'. This covers not only ageing management but also other necessary technical areas such as configuration management. It provides what has to be done within an optimal approach as well as indexed technical information such as the international GALL Report. This output will become a basis for a Safety Guide on Long-term Operation. It also provides a reference for new IAEA safety services.

This slide shows another topic: Safety Knowledge Base on Ageing and Long-term Operation (SKALTO). The objective of SKALTO is to develop a framework for sharing knowledge on ageing management and long-term operation. And its scope covers ageing management, periodic safety review, configuration management, design basis data management. This is not a database, this is a kind of road map to guide users to suitable information users want to get.

This figure shows the current image of the IAEA intranet of the SKALTO. It consists of nuclear safety standards and guides, they are relevant IAEA Safety Standards and INSAG documents as well as national requirements such as US 10CFR part 54 and the standard review plan NUREG 1800. There are also some national recommendations such as OECD/NEA and the European Commission. The second part contains basic knowledge and guidance. This starts from abbreviations and terminologies and also contains key basic reference documents, such as US NRC GALL Report and IAEA guidance documents. The third part is about the relevant safety activities. This includes IAEA AMAT mission records / reports and IAEA meeting proceedings. The fourth part is about safety research and development: this includes IAEA CRP reports and other national and international research reports. The fifth one is about education and training, and this includes standard training modules on ageing management and AQ and also past workshop and seminar materials. The last part is links to IAEA database and other sites. The Nuclear Energy Department of IAEA has created ageing databases on the reactor pressure vessel and on the containment vessel. SKALTO will have links to these databases. However, due to the confidentiality of some documents, we are considering how to create document classifications and access limitations to open the SKALTO to the public.

In terms of access to SKALTO, currently a limited scope version is already available at the IAEA web page. We are planning to open an extended scope version, which will be available to member states in 2005 on the web at www.iaea.org. This slide shows images of the limited scope version and the new extended version of SKALTO.

As mentioned before we are creating a new safety guide on ageing management. The objective of this safety guide is to provide a coherent set of high level guidelines on managing ageing in systems, structures and components important to safety in nuclear power plants and research reactors. The scope is a system structure and components important to safety in nuclear power plants and those of research reactors. The guide is mainly focused on hardware ageing, and therefore technical obsolescence is out of the scope. This slide shows the creation schedule. The document preparation profile has been approved by IAEA safety standard committees. We have just started creating the first draft, and it will be refined from the third quarter of 2005 to the second quarter of 2006. We have a technical meeting on enhancing safety and performance of nuclear reactors through effective ageing management. This will be held from 8-10 November, 2005. This technical meeting will provide an opportunity to review the first preliminary draft. In addition, after the creation of the EPB SALTO final report, we will coordinate the safety guide with EBP SALTO outputs: this will be done mainly in 2006. This slide is a little confusing because this schedule only shows the first part of the creation schedule. After this, the draft safety guide will be distributed to the regulatory authorities in Member States for their review. The final publication goal is the first-half of 2008. Although this work has top priority, we are also planning to complete one generic guidelines on proactive ageing management. In addition, we would like to update some component specific guidelines, such as for steam generators and CANDU reactor components, and create a new guideline for pressurisers.
Thank you very much for your attention.

Dominique ARNAUD - Monsieur Mathet va nous présenter la façon dont le problème du vieillissement est abordé à l'agence pour l'énergie nucléaire de l'OCDE.

Eric MATHET, OECD/NEA - Good afternoon ladies and gentlemen. It is my pleasure to present today the work of the OECD/NEA working groups and experts on this topic of ageing management. My presentation will present to you a different perspective on ageing management programmes, linking them to challenges that regulators and safety authorities are facing now. This presentation will show you how the main committee of the OECD/NEA and the working groups are addressing this issue and how it can be probably, from what I heard this morning, very helpful for most of the member countries. I will only address the metallic components in this presentation, although the scope of the Integrity on Ageing Working Group is much broader, as it includes concrete structures and seismic issues.

I would first like to introduce the CSNI and the CNRA, which are the main committees for the safety of nuclear installation at the NEA. CSNI is the Committee and the Safety of Nuclear Installation and its membership is directors of research organisations within the governments. The CNRA, the Committee on the Nuclear Regulatory Activities and its members are directors of regulatory bodies in the NEA member countries. How do these two committees work together? I would first like to say that under the CNRA a couple of years ago, regulators issued a report on ageing with regard to regulatory issues. This report is very important and from what I heard this morning, most of the issues addressed in the report have already been discussed. The CSNI is more dealing with technical issues as opposed to the CNRA, who is dealing with soft issues. I will concentrate on the work of the CSNI and technical issues now.
First, it is important to recognise the structural integrity in ageing. I think this is a key problem for structural integrity because very few of them consider it as very important and fundamental to the operation of the nuclear power plants. I think they should be more aware of that. There have been historical issues with material degradation, I will outline them, but you all know them. After briefly presenting the CSNI Integrity on Ageing Working Group, I will go through the technical topics that the working group is currently working on. Everyone knows that materials degradation has been experienced since we started the first plants. Then, all these degradations are expected to continue, so this is why we are here now. More importantly, any structural degradation could undermine public confidence. This was pointed out this morning and I think it is very important. We are on a very thin line, and if anything happened to a nuclear power plant, everything we built up during the last 10 or 15 years would be totally demolished. It is very important that we are aware of this kind of thing. And of course, regulators, licensee and manufacturers should be aware of that. Also, structural integrity and ageing is a recent burden for both regulators and operators that have to deal with it.

Some of the historical issues, you all know them. One that is important is concrete containment, but it is not the topic of today. Now we will talk about the structure of integrity in ageing and how an international organisation can bring added value to discussions on ageing management. This is the structure of the Integrity and Ageing Working Group that is under the CSNI. We have three sub-groups, and I have written the names of the chairman and the vice-chairman because I think it is important to recognise the work that they are doing. We have a very good repartition in the member countries and I think it is very important if you take for example, IA working group, the chairman is from the US NRC, which is very important for us because they have a lot of plants. The vice-chairman is from SKI, which is a smaller country, but is very active in this area. The work of the working group is under the chairmanship of Claude Faidy from EDF for the metallic components. This group has a good balance between the regulators, research organisations and utilities. And I think this is one strength of the group.

What does the working group do? It basically addresses issues where an international group can add value by sharing experiences, recommending best practices and putting resources in common. As opposed to the IAEA, the OECD does not write standards and does not write any regulations. We advise governments and we give recommendations to governments for better policy and better safety of the nuclear power plants but we do not write standards. These are the different topics which the group is currently working on. Part

of the ageing management programme you have the environmental effects, the RPV and PTS issues. The fatigue and piping failures, risk inform and service inspection, and its counterpart, the non-destructive examination qualification. You also have some containment and long-term behaviour of concrete. And also wire system ageing, which is very important. As regards external hazards, the group is doing work on seismic design and seismic input motions and this is important for the future and for site issues. The group is also going to put together new medium-term strategies that will address the challenges for structures for new and advanced reactors as things may evolve in the future. If we start building new plants, we will have new issues with these new plants. The group wants to be proactive and address this in a timely manner, so we are going to start thinking about these different issues. And now of course, we will keep an eye on ageing of components and structures, which is the basic task of the working group.

This is a typical ageing management programme. The group does not write ageing management programmes but they address some of the topics, technical topics. For example, nickel-based alloy, we will talk about what does the group do in this area. Also, RPV and PTS, piping systems, different topics will be addressed during this presentation.

What is the regulatory issue on nickel-based alloy? Of course, it is basically related to Davis-Besse, where the community decided that we should understand what happened and see how we can solve the problem or find solutions. So the group is engaged in a survey of the different member countries to collect the experience, the status of existing data and research, and review the regulatory practices in various member countries. The outcome of this report would be to address recommendations to the CSNI, to maybe harmonise regulations in the future or maybe to find what kind of measures could be put in place to try to address this.

Another topic the group is very active on is the reactor pressure vessel and the PTS regulation, so the regulatory issue is very easy to understand. The response of the group to this regulatory issue is a benchmark on the probabilistic structural integrity of the PWR reactor pressure vessel. The objective of this benchmark is to issue some recommendation on best practices in probabilistic determination of the PTS regulation criteria. This benchmark is ongoing now and has reached the second phase. We are aiming to have the results in mid-2006. These is a very important activities and about 10 countries and organisations are participating in this benchmark. When I mentioned how we can share experiences from an international point of view, it is basically from state-of-the-art reports, benchmarks or international standard problems.

There are several issues regarding pipings and we have already touched on some of them. I will address these three points and these three regulatory topics. The first one is passive component failures in risk assessment. You have different challenges such as PRA challenges and structural integrity challenges. There are different mechanisms that you find in degradation mechanisms. So in this area, the answer of the Working Group was to set up the OPDE database, the OECD/NEA Piping Failure Data Exchange Project. This project started three years ago, based on work done by SKI and briefly, this database now has 12 member countries participating. It is mainly regulators, with the support of utilities because it is important to have the utilities on board because they have the data. If you do not have the utility, you basically miss something. This database of 12 countries now is fully operational. We finished the first phase of the three-year project in June this year, and this database has something like 4,300 events that are very well-documented and that can be used for deterministic assessment like degradation mechanisms. They can also be used to validate your PRA models, to make sure you account for all the degradation. And of course, this database can be used for a risk-informed service inspection of PRA and there are several examples and uses of the database in the US, Korea and other countries. I wanted to stress a little bit what this database is to make sure everybody has the same idea about it. Then the group had a lot of activities on fatigue and in particular, thermal fatigue. That is really a key issue. Over the years, there was a three-fold project within the group. One of the activities was to write a

state-of-the-art report on thermal cycling in light water reactor components. The second activity was the benchmark on how to perform calculations, and how to calculate the crack propagation and crack initiation under a freely loading. And the third activity that the group has, in cooperation with the NRC, is to organise every other year, or maybe every two or three years, an international conference on fatigue that gathers the operators from many countries and the regulators and the research organisation. And from this three activities, it is possible for the working group to provide some recommendations to the CSNI on thermal fatigue, and some of the results and uncertainties indicates what needs to be done. So the working group is really working at a technical level at this stage. There is also a very important activity on risk-inform and service inspection and something that goes together, that is non-destructive examination qualification. The regulatory issue is very clear and many countries are now using, or thinking of using, risk-informed service inspections. There was a request from the regulators at the NEA to understand the basis for these different methodologies which the licensees are proposing for approval to the regulators.

The working group did some work on this and they first issued a questionnaire to understand what is going on in the different member countries. The results indicated that there were different approaches that existed to screen components and structures. Of course, you have the WPG methodology, the EPRI, the ENIQ. The European Community group is also doing some work and you also have the Nordic countries approach. As regards to the status, we have two countries which are using both quantitative and qualitative risk-informed in-service inspections. One is using qualitative risk-informed service inspections and others are either considering using risk-informed service inspection or are not considering using it at all or they did some pilot studies.

One thing which is very important is the NDT qualification. I would like to emphasise the fact that you need a good NDT qualification to use risk-informed in-service inspections. This became obvious during our discussions, and recommendations were issued by the different members of the working group.

So what is the outcome of these discussions and different approaches. It was first a state-of-the-art report that was published this year, or is about to be published this month, on risk-informed in-service inspections. Starting from this state-of-the-art report, there was a recommendation to benchmark the different risk-informed in-service methodology. So what are the main conclusions of the report? One of the recommendations of this report was to compare risk-informed in-service methods performance by applying several of the qualitative or quantitative methods to the same specific scope of piping. This was presented to the CSNI and the CNRA, who agreed that this would be very interesting to compare the methodologies to the same piping and observe the outcomes and how you can explain differences and what are the strengths and weaknesses and where you can do things better in one or other of the methodologies. We decided to work in cooperation with JRC Petten because, for the ENIQ Working Group, they have extensive experience in this area. The group decided to think about benchmarks that would be run by the NEA, with technical advice from JRC and the ENIQ Group. The first stage was to submit a proposal on how we can run this benchmark, what do we want to achieve, where do we start, what are the problems. One of the problems is getting the piping system description. We are working on the preparation of this benchmark and will hold a meeting in September this year to finalise the draft proposal and we will present it to CSNI in December. And then we can move on and implement this proposal. So this is a very important activity for the CSNI and for the working group.

I just want to give you a brief overview of the latest reports published by the working group over the last year and a half. So the report was published on risk-informed service inspection, on thermal cycling, containment capacity. Also on seismic input motion, wire system ageing and on experimental facilities for earthquake engineering, simulation worldwide. And also on use and performance of concretes in NPP fuel cycle facilities. I would like to point out that these reports are mainly state-of-the-art reports and they are technical reports. Our cooperation with the IAEA is very strong and in particular, several members of the group are working in the taskforce of the IAEA. These reports are used by the IAEA to prepare their ageing management programmes or different technical programmes and we have excellent cooperation with them.

So to conclude, what are the challenges for nuclear regulation and safety in the near future? Things that I have not addressed in the presentation are knowledge management. This will be one of the key issues in the future. Several people are going to retire and there is

a need to transfer this knowledge to new generations. Another issue that the CSNI and CNRA are going to fact is the new design and how to incorporate lessons learned from the current nuclear power plants into a new design and make sure we do not make the same mistakes again. By implication, there must some changes in the codes. Another issue is ageing management, that will become more and more important in countries. I think it is going to be very challenging to run ageing management programmes in addition to building new plants. That will be an interesting challenge. That completes my presentation. Thank you very much.