Témoignages et point de vue des exploitants / Point of view of utilities

Ulrich WILKE – EON Germany, Claude FAIDY – EDF France, Georges BEZDIKIAN – IAEA

Sophie MOURLON - Ladies and gentlemen, I think we are ready to start again. One of the questions that we have had is why we chose NUPEER as the name for this symposium. The original meaning is Nuclear Pressure Equipment Expertise and Regulation. The idea was to have this PEER name because I think it is very important for this symposium, the fact that we are all together here as peers to share experiences and have debates as peers.

We have talked a lot about control and regulatory practices. We now suggest that the operators, the licensees, come and give their point of view on the issues related to ageing of nuclear power plants and on regulatory practices. First, Mr Ulrich Wilke from the German utility EON, which operates 12 reactors in Germany, will speak. Then we will have Mr Claude Faidy, EDF, which operates 58 reactors in France and Mr Georges Bezdikian, who is also from EDF, but he is here as an expert at the IAEA technical working group on life management of nuclear power plants. Mr Bezdikian will speak as an IAEA member.

Ulrich WILKE, EON KERNKRAFT Germany - We have seen in several presentations yesterday and this morning, how ageing management approaches are given in several countries all over the world by the regulatory bodies. I am happy now to demonstrate how actually we, in Germany, live or apply ageing management in our power plants.

In my presentation I would like to give a top-down approach in ageing management. I would like to begin with international ageing management activities, what is the actual motivation of ageing management. I would like to give a definition of ageing management and what the German utility ageing management concept looks like. Ageing management must be plant-specific or must be implemented on a plant-specific basis. Therefore, we'll give several examples on the classification of components with an ageing management, and also on what kind of measures we actually apply for these components. And finally, due to the fact that ageing management is not an issue for one single person, it is rather something where we have to combine our different technical fields in our power plant. We want to demonstrate how preventive maintenance is actually applied, and this will be presented by my colleague and an expert in this field, Reinhard Koring.

Finally, we will present how we comply and combine results in ageing management and how we document this subject. And that will conclude my presentation.

We saw different developments with an ageing management all over the world. Here we have three examples. In the USA, one motivation was plant lifetime management, but also the extension of the life of the plant. We also saw in Switzerland that plant life management was initiated before the background of thinking about plant lifetime extension. In Germany it is somewhat different. We have several laws we have to follow, the Atomic Act and also codes and standards which already give certain regulations on how to operate our plants. This means we have to survey the relevant plant data, we have to monitor all kinds of loadings and we are also restricted to a continuous adjustment on the current state-of-the-art in our plant. And that is what we call ageing management and plant lifetime management.

Again, I will make some remarks on the international ageing management activities. We have seen some activities for the purpose of plant lifetime extension. This was done by several additional evaluation approaches like a stress fatigue analysis. And also in Switzerland the utilities were asked by all the authorities to settle evaluation on the components. And also parallel to this, a lot of documentation and concepts and recommendations were published, for example by the IAEA, as it was seen yesterday.

When we talk about ageing management, we need to define ageing management. What is ageing management? Ageing itself sometimes depends on the quality of technical issues, documentation issues, personnel issues. What we actually do in ageing management is the quantitative evaluation of the quality status of our components, and of what kinds of measure we apply to these components to ensure this kind of quality status. When we finally break down to the technical ageing management, we find the main fields of the mechanical components, we find the field of instrumentation and control components, and also of the building structures. We have to take into account the ageing management primarily for these three fields, taking into consideration that we have technological and also conceptual ageing in our components.

I would like to go into more details on the technical aspects, so firstly on what kind of ageing we find in these fields. It is the physical or material ageing like corrosion or fatigue. This is the core of ageing management, but in addition, always considering the current state-of-the-art nationally and internationally, that is what was actually proved and evaluated in the periodic safety analysis. What we will use is the results of the periodic safety analysis within our ageing management. In this way, we can ensure that we always remain true to the current state-of-the-art within our components. So what we now find in the situation in Germany is that ageing management is based on our regulation standards and atomic acts, given by the entirety of measures that we apply in our plants, which are the maintenance, the surveillance, and also the in-service inspection measures. Therefore, given the fact that there are already a lot of measures existing in our plants, the current activities primarily focus on the documentation of these measures. We try to compile these measures to demonstrate that there is an active ageing management already existing in our plants.

This is really a simple picture which gives the status where ageing management is settled in plant life management. So from an overall point of view, we find a lifetime management where we find components with safety and availability criteria. For us, from a utility's point of view, it is not only important to run a really safe power plant, it is also important to run an economic power plant. And therefore, we consider all components also for their availability criteria. Within the lifetime management we have finally found the ageing management for safety relevant components. You will still find within this ageing management a so-called 'integrity concept' which is the heart of ageing management in Germany for mechanical Class 1 components, which is the primary circuit.

Now, I want to go a little bit more into details in our ageing management. Before we deal with the single components, we need to know where to classify these components in order to find the correct measures we have to apply to maintain the current required quality status. First, we find the Group 1 components, which are of the highest safety requirements. We have to guarantee the current required component quality of these components. It is not allowed that these components fail. Therefore, we have to avoid minimised degradation effects. In terms of fatigue, it is not possible just simply to avoid degradation effects, that means we have to minimise the degradation effects that control the degradation effects during the run time of the plant. In order to reach this goal, we have several measures applied in this group, which is the monitoring of root causes of loads which result in the fatigue phenomena, and we also monitor the consequences of all kinds of degradation mechanisms.

Group 2 concerns components which are of medium safety requirements. A single failure is allowed in this group, but no common failures. We need to preserve required component quality. And we have also minimised any degradation effect. What we do here is preventive maintenance mainly.

In Group 3 we have the components with the lowest safety requirements, or even with no requirement. We have also components in our plants which have no set requirements at all. Therefore, here we have failure-oriented maintenance.

In the technical field, we find in the mechanical components, components which are settled in Groups 1, 2 and 3. If we go to the electrical part, we have components which are settled in Group 2 and 3, and building structures which are all in group 2. This is important to know because we have to know what kind of measures we have to apply to maintain the required quality.

How do we classify these kinds of components in our plants? In Group 1, we will find obviously the primary circuit, all kinds of systems for the safe shutdown, that is, leak-before-break systems, which are reactor pressure vessels and steam generator, pressuriser, a main coolant line and so on. We have to guarantee that these components will not fail. In Group 2 it is a little bit different: we have to evaluate the current quality status and monitor the status during the run time. A single failure is allowed. The kinds of components we find here are medium safety relevant vessels, like pumps, valves, recuperative heat exchange, a feed water vessel and so on. But this is just an example based on my own knowledge where these components would be classified. How can I really find these kinds of classifications within the plant? Is there any plant-specific documentation available which would help me to classify these kinds of components within these groups? There is one, we can go to the plant – it is different from one plant to another – ageing management is always plant-specific. So if we look at Group 1, we will find a classified fatigue-significant component for example, in the fatigue manual. Or for Group 2, which are safety relevant valves, we will find this in the maintenance manual as well.

As I presented here, we can go through all types of components and groups and finally find a document with which we can classify our components and finally identify the measures for these components and what we have to do for these components. Just to get a feeling of how many components we actually have in our plant, we should consider how many valves we have in our plant. We have approximately 18,000 valves in each plant. So what are we actually doing for these components? We can identify them first within a maintenance concept, which exists for all valves. From these we can classify all valves concerning safety and availability. Then we finally come up with 3,400 valves which are time-oriented maintained. And then, breaking down further, we find approximately 380 safety-relevant valves. But what we actually do, for these 3,400 values, we do the maintenance concept. We get a lot of information and experience on these valves and this experience flows directly back to our knowledge database. So we are ensuring that there is a dynamic database which will inform us if something happens to a non-safety-relevant valve. We will immediately know, we have to check this in our safety-relevant valve. So, in Germany, this is even larger than just looking at the safety-relevant valves.

This is the so called ‘integrity concept’ which is applied in Germany, based on the codes and standards we have. You will find a document available on the internet and you will find this integrity concept there and we have to apply this integrity concept. This says that we have to establish a certain required quality in our plant by design and manufacturing. And then, the commissioning and the operation of the plant start. Then we have a description of exactly what we have to do in our plant to maintain a required quality. And this is, at the same time, the beginning of our ageing management, which means that the ageing management already started in German power plants right at the beginning of the commissioning of the plant itself, which is always the current quality status of our components. So as soon as we have a new degradation mechanism identified, or as soon as there is a new state-of-the-art, which comes up in a periodic safety report, we go back to our evaluation process or integrity process and prove that our component is still safe within the safety requirements.

Now we go back to the Group 2 components with medium safety requirements, where single failures are allowed. This is a concept based on our integrity concept, but we do not need to monitor proactively our loads on these components. Therefore, we only have to react, we have redundant measures in our concept, but also, as for the M1 components, our ageing management begins here right at beginning of the commissioning of our plant. The current state-of-the-art is considered, as well as the new degradation mechanisms that are identified. As soon as we find something new in our plant, we have to evaluate it, in all plants in Germany. And one important point here in our integrity concept for the M2 components is preventive maintenance. As I have already mentioned, it is one key issue of the integrity concept in German nuclear power plants. And how the preventive maintenance actually works, how is it is established in our plant? Our maintenance expert, Reinhard Koring will now talk to you about this.

Reinhard KORING, EON KERNKRAFT Germany - There are 380 safety-relevant valves whose main task is to operate safely in every way. Therefore, we developed a concept in which these valves are composed and manufactured. That means at first there is an analysis and calculation of functional and structural values. There is also a design assessment, which is focused on special items and features which have to be considered for safety-relevant valves. And the third pillar is the maintenance, which accompanies these valves during their lifetime.

Analysis and evaluation of the construction has been done, therefore operability is given. During the lifetime, this right-turning cycle will be followed and it will enter always in maintenance. Maintenance is done on a preventative basis. Therefore this maintenance has a concept to ensure and it will define the nominal conditions again. This maintenance covers many aspects. In order to recover the nominal conditions of the functionality and operability, some special aspects are given here: dismantling, visual inspection, measuring of functional and geometrical dimensions, non-destructive testing, functional testing of internals, reassemblying and accompanying secondary technical instructions just for packings and sealings, how to treat sealings and how to fix torques on bolts and so on. For all these aspects, certain procedures are given. Based upon these procedures, measurements, are taken from the object and compared to nominal values in order to get the margins and to decide whether a repair is necessary, or replacement, or whether to just keep it as it is.

These results are documented and reported. In this way, all predictable aspects of mechanical wear influences, such as from life of sealings or differences from the media are controlled. Therefore, the intensity of the practice of preventive maintenance in German NPPs leads to the reliable identification of failure mechanisms and even new ageing effects. The maintenance results are evaluated, and if required, modifications of maintenance procedures are initiated immediately, including even the secondary technical instructions, if affected. I mentioned earlier a right-turning cycle: there is also a left-turning cycle, which is the additional approach because all valves are tested. We have periodic testing, just simple functional testing, or even we provide a diagnostic system which enables us to learn more about the constitution of the performance of the valve.
The main element is the measurement of the electric power consumption of the actuator. And from this report and recordings we can get a lot of information about the condition of the valves. And all of this is included in a complete maintenance concept and carried out for all safety-relevant valves.

I will switch back to my colleague for his conclusions.

Ulrich WILKE - My presentation demonstrates one part of our integrity concept, just one single aspect. We have an overall integrity concept, where we find all these kinds of different elements, and finally, this brings together our ageing management. So what we actually do with our ageing management results, or our results in ageing management, is that our current activities focus on the documentation of all our new experience in ageing management. We provide so-called 'basic' reports on ageing management, where we describe all these different technical fields which we cover. We describe all these different types of measures we take in our plants. And starting from this basic report, we will provide a so-called 'yearly plant report', periodic ageing management reports, which will contain all the information. If new ageing-relevant phenomena are found, we will also document them here. They were already covered in different documents, but we will also gather them together in a periodic ageing management report so that we can evaluate it in our plant and the corresponding flow of our experience is given to the plant.

To conclude, firstly, on the international level, ageing management is primarily applied this year for plant life extension purposes. In Germany we have a different background due to our Atomic Act and codes and standards. Ageing management activities are actually given by our entire measures, which are the maintenance, we have already seen. We have the surveillance, which is very important, the load monitoring and the in-service inspection for all our safety relevant components. And all these components we treat within lifetime management. The key issue is the preventive maintenance and in-service inspection and all our procedures. Our procedures in ageing management are actually based on our KTA, our nuclear code in Germany. If we compile all the results we have in our plant, it reveals that there is currently no evidence at all of any safety-relevant deficit in our plant using this approach. Therefore, the current utility activities rather focus on the description of the applied ageing management concept and its application. I must mention that all these measures which we have just presented are of course, under the supervision of the corresponding authority. Therefore, there is, at present, no need for a new fundamental evaluation in terms of ageing management for our German nuclear power plants. Thank you for your attention.

Claude FAIDY - Good morning ladies and gentlemen. I want to give a quick review of our activities in ageing management. A large part is common to many countries; I will give you some highlights of minor differences. I will give an introduction on this problem, and the methodology that we put in place recently with the three classical steps of list of components detailing anything that is bought, updates if necessary the existing surveillance programme.

I will give you some measured results and I will also try to have a short comparison with the others. I will compare the methods and the results obtained by the others. I will take a short example on the main coolant line connected to a recent event that has been discussed in different groups.

As you heard in previous presentations, in France we have a lot of plants, 58 PWR. We have two groups, mainly 34 3-loops and 24 4-loops in operation between the oldest one, which is in 77 - as you can imagine, we are close to the third ten-year outage - and the last one was in 1999. But we have some specific problems with numbers. 78% or 80% of the electricity power production comes from NPPs and we have some specific responsibilities associated with that. Regarding the plants in operation in our country, we have six plants first in the '70s, but after that we built 40 plants in eight years. Some of them arrive at 30 years of operation and we have to discuss now how we can manage the ageing of these plants and how we plan to replace these kinds of plants. Part of the ageing management is that top management gives due consideration to some options to replace some of these plants in the future. What we do in our country is not exceptional. We have daily routine maintenance that is defined when you start your plant on the basis of data collected during the design and fabrication. We have to update this routine maintenance programme periodically. If we have an event, and we don't have any event now, we have to review it systematically with the periodic safety review that is applied every ten years in our country.

Between routine maintenance and different events that can appear in the plants, we have developed a special action which is exceptional maintenance. What do we want to treat and what are the specific aspects? First, we have already defined something like 20 components that are very important for the plant life due to the cost of repairing or replacing them. And it is at this time, based on expert judgement of the subject, that we defined some actions to have a specific look at these components very, very early. And in France, the important one is all these generic situations. Any time you have an event somewhere in the plant, we have to be sure that it is not a generic problem. If it is a generic problem, we have to take specific actions to solve it efficiently due to the important consequences on the plant availability. What is the new one? We received a request by the safety authorities to include ageing management in 10-year periodic safety review, and to answer to that I will show you what we added to the existing process in EDF.

Life management is surveyed at the top management level in the company, but the plant life management has to add some economic aspects and we have discussed some economic strategies with people in charge of managing the ageing management programme.

The classical three steps to do that is the selection of components and a first level analysis. I will show you how we include some quality requirements at this level. The step two is detailed degradation mechanism analysis that is similar to TLA, that has been used, producing some presentation. And the step three is the comparison of the existing maintenance programme with the result of this analysis. We have this methodology and it is more to assure that we are systematic, exhaustive and we have good reference documents.

The classical first step is to define which are the safety-relevant components among all the components that are in the plant. And instead of these components, as I mentioned, you have components that are very important for plant availability, and some of them are safety concerned and some of them are not safety concerned. We analyse them with the same methodology, but we only report to the safety authority for this safety-relevant component with potential ageing mechanism.

The second step is a basic method: we list all these components and we put them in groups with mechanical components, composite material, concrete structures, I&C, electrical components and other types of components like oil, gaskets, rubbers, etc. As in the GALL Report, we try to have a very systematic review of the different components. If you look at the mechanical components, we have immediately the two first ones, primary and secondary systems that are covered by a special regulation due to their importance from a safety point of view. It is an interesting aspect of the work to look also at all these components of Class 2 and 3.

After that, you move to local components and local areas in each component. Belt line, nozzles, for example, for the vessel and penetration. In front of that, you put the list, a very large list, of the degradation mechanisms. We consider about 50 different degradation mechanisms. We have a question for each line and each degradation mechanism: is this type of degradation mechanism encountered in this situation or is it expected based on laboratory work? And our specific ideas include, at this level, the maintenance programme. Do we consider this degradation mechanism in the existing maintenance programme, or justification of the existing maintenance programme, or do we not consider it? It is a case for some degradation meetings.

The second aspect you will encounter in our classification, it is an important one also, is the component easy to repair or easy to replace? When you are in front of some components that are practically impossible to repair or replace, we have to take more precautions. It is a basic grid that many countries use, to have one line by location and degradation mechanism, with answers of the group and utility experts that answer the question regarding the ageing data sheet. On one sheet you put the answer to the question and the references that have been used to answer. It is not only put across. You have to justify your position for many reasons. At the end of that, we will have a different status. We consider first the degradation mechanism encountered or not encountered. We look at the existing programme: is it in accordance with this degradation mechanism or is it difficult to do this, that is the case in some specific locations? And the third question is: are repair and replacement difficult, immediately? This type of component, this type of degradation mechanism are considered very, very important. And there are two levels of classification: 2 or 0. As you can see, for the first – repair and replacement difficulty – we have a predicted degradation mechanism, nobody contradicts that, and it is considered in the present maintenance programme. In this case, there is nothing more to be done for the moment. And the second list is for repair or replacement, which is not too difficult. In this case, the only thing that is difficult or has to be analysed is the case where it is difficult to be sure that the maintenance can be well-adapted to this degradation mechanism. It appears in some cases.

In terms of the list of degradation mechanisms, we use different international documents to prepare it, for example EPRI documents, etc. Not surprisingly, a more important one is radiation embrittlement, radiation creep/relaxation, radiation swelling. The first one is for RPV, second is for RPV internals. We have fatigue, but there are two categories, low-cycle and high-cycle fatigue. We have thermal ageing, that is more important in our country than in some other countries. And we have the list of corrosion and wear.

What are the results of this process? We started with about 15,000 components, and we arrive at something like – it is probably not the exact number – around 400 couples of location and degradation mechanisms. Of these 400 couples, we have just 50 that are not completely satisfactory. We have to produce a special report to justify that the maintenance is adapted for the corresponding degradation mechanism. Due to the number of lines of components – you can have a few lines of the same components – at the end we have just 12 components that have to move to a detailed analysis report. And these 12 components are not a surprise. Generally, in other countries, we have similar lists: the pressure equipment plus RPV internals, pressuriser, main coolant pumps and loops, auxiliary primary piping, not surprising. RPV internals are not pressurised, but are also very sensitive in PWR. We also have to take care of the others: containment, electrical containment penetration, that is also a very important point for safety. In the case of large openings in the containment, again it is a very important requirement to ensure that the containment is still safe. Nuclear civil engineering structures, cables and I&C: it is not really a surprise to have this list but it confirms that, for the moment, routine maintenance plus exceptional maintenance are the answer to the major difficulties of the ageing management problem.

You have the basic situation, the description of the equipment. We also have to take care with the safety and the regulation requirements. As we discussed many times during this workshop, we have a specific requirement – mainly for Class 1 components – which has changed over time, that must be now included in our evaluation. The part 2 is a degradation mechanism and the part 3 is an important one also, the industry capacity. The part 4 is: do we need, or do we have, to develop some complementary R&D work? And all these parts have to be done under a minimum of quality assurance.

So you are doing something, you are looking at it, and do we have to make recommendations to change the maintenance rules, including ISI for example? And at the end it is the utility that is in charge to update the documents. What are the major needs in front of that? And it is for each degradation mechanism, we need the material sensitivity and more influencing parameters. We need the threshold because it is important to make sure that some of these situations are not cause for concern. And the threshold is an important tool to limit our effort on a real case. We also need the degradation rate and we have to check if we have saturation or acceleration of the damage, that is important to be sure we don't have damage that appeared due to a specific rate, like nothing for 50 years, and then a problem in a few years.

Major uncertainties are observed on the small specimens that are transferred to the plant and this is another important aspect. We have a lot of data produced on very small specimens. How do you transfer that to your plant? And we also have to define fitness for service criteria. Damage synergy must also be done along with corrosion fatigue for example, or a situation can arise when one degradation can appear inside, and another one outside. That has been encountered in some other countries. And to progress that, we are developing a living knowledge data bank on each of these degradation mechanisms. We have put all the information we have collected and developed in the company and outside of the company in this type of databank.

We also look at consistency with other similar work. We have a presentation on that from IAEA on a series of documents and we use a lot of them, or a large part of them, to define our process and to perform the detailed analysis. We also compare with the GALL Report, (not revision 1 and 2, but revision 0 and 1) and we check the draft version of revision 1. This process is under progress. What are the major differences between GALL and our work? I think the three last ones are the major ones. The first one is that they are more driven by experience feedback for the GALL and the limited aspects of potential degradation. If you look, at the end, we have three tendencies. They are more sensible to effect in fatigue in the GALL than in our estimation process. We have less thermal ageing in the GALL Report than in our practices. And the last one is that there is no high-cycle fatigue in the GALL for the moment. I am open to correction!

If you take the main coolant line and the connected lines, we do the work and we have a very useful experience feedback. It has been shown previously by some speakers. Concerning thermal fatigue, as well for low as for high cycles, we have to take care because some of these components are not Class 1 ones and we must take care when we want to transfer it from Class 2 to Class 1. It is not necessarily the same problem for Class 2 and 3. The different degradation mechanisms that you encounter on this type of system are classical low-cycle fatigue due to transient, high-cycle fatigue due to dead legs or mixing tees, vibration fatigue, thermal ageing of cast replaced stainless steel. And PWSCC, not in our country because we don't have Alloy 600, or metal wear. And boric acid and corrosion on the outer surface. This is nothing new, but we have to include high-cycle fatigue in mixing tees, that is not the case in many other applications.

For fatigue, you are familiar with the different degradations. One is the bending load due to stratifications. For a number of locations with fluctuation of the interface, this fluctuation seems to be negligible in our situation. The second one is dead legs, with or without a leak at the valve level. And the third one is a mixing of cold and hot water with different situations. And the worst one is the second one, with the two flows coming in, and a unique flow out of that. You can find a lot of fluctuations in this case.

Here is an example of high-cycle fatigue. It was discovered by a leak in Civaux in 1998. The cause was not completely satisfactory in terms of quantification but we consider that we understand the phenomenon. And in this case we have to look at a similar situation in the plant. And due to that, we arrive at a different situation: we developed a ranking process, screening material, ranking process and detailed analysis and we discovered that the CVC's nozzle has a very similar type of load level compared to the RHRS system that cracks. Another one is the inclined nozzle. We looked at the cast tables, but we also have to look at the cast inclined nozzle that can be submitted at the same time to edging and to high-cycle fatigue during fluctuations.

Regarding assessment methods, it is only the fact that we do not have rules in any code at the moment for many of these degradation meetings. In conclusion, we are in front for the main coolant line, just one of the very high quality piping systems, and we have to remain aware of the possible new event that appears in the world like the VC SUMMER event. Also, there is confirmation of the problem in some other plants, and the conclusion is we have now a detailed, systematic and documented methodology. We have systematically applied it in the past two years and we have sent it to the safety authorities in 2004 and we are in the process of reviewing all this work. And it is now two to three years before the third 10-year shutdown. Presently, under evaluation by the French Safety Authority, it is connected to design interpretation specification, adapted surveillance and maintenance procedure and we consider that there is no major problem to justify 40 years of operation for the moment. We are looking at pilot studies related to what can happen over 60 years of operation, but it is under evaluation in the company first.

Finally, we have also to look at what can change some aspects and two or three ideas are:
- leak-before-break for a specific local situation, not for a complex system,
- as it is done mainly in Europe, we can also use more probabilistic approaches to look at the uncertainties effects,
- and as you can understand, we are also interested in risk-informed ISI.

Thank you for your attention.

Georges BEZDIKIAN, IAEA – EDF, France - My presentation is on the nuclear power plant life management, an overview of key components in relation with degradation, an unusual aspect of life management. I already spoke about competencies, maintenance, cost benefit, other parts, not many technical parts.

I participate with other member states on the technical working group on plant life management. Under this organisation, the different documents are published. Yesterday, Dr Takeyuki Inagaki showed a technical guidelines document, and obviously it is for member states to give a lot of information. There are large organisations for life management studies inside companies, but other member states are not at the same level. We would like to have uniformity in our vision from the member states, giving some rules for plant life management. IAEA is collecting information from other countries and has given very useful feedback on the different methodologies and has established an inventory of methodologies of action, taken it out to different countries and proposed a guideline document.

First of all, I will speak about the classification of components. We have evaluated the different ranks of those components in terms of importance. It is for all kinds of components, not only for PWR; it is for PWR, BWR, CANDU, WWER, etc. The categories are subject to different types of components. The first point is different evolution of categories, the evolution of different rules that are not the same evolutions in different countries concerning regulation aspects and materials technology. There are many factors such as: regulatory importance, loss of revenue, radiation dose, modification required, cost to replace and to refurbish equipment, impact on plant availability, replacement, generic applicability, mode of failure, the different consequences of mode of failure.

The category of components falls into four categories. The first one is generally considered not replaceable. The two examples are the containment and reactor pressure vessel. It is not very easy to replace the reactor pressure vessel, it is impossible to replace the containment and we have to manage those components for life management. The second category is classified as replaceable, but it is very costly. It is not easy to get spare parts. You cannot call the manufacturer to have your components in a stock. You need, from time to time, two years, three years and you have to anticipate not too early and not too late. In terms of capital expenditure, it is very important to manage that with a good outage for the replacement. Category three, it is a component which is important in terms of plant safety and reliability. They are not susceptible to have a lot of failures. And the last category are components not included in one of the above categories, but not related with life consideration.

In fact, during the two previous meetings, we have studied different ageing mechanisms and relation with different points. The first one is to maintain the timing, good operation of all of the components on the material. The second point is to identify the degradation mechanisms in the good rate and to anticipate if you can get large data for anticipation. Our point is safety on performance criteria in addition to cost and benefit aspects. We also have the licence duration or periodic reassessment.

During the different meetings, we have the view that safety periodic review mixed with licensing renewal review. There is no competition between licensing renewal and periodic review. We have collected information and there are countries with licence renewal procedures, like the US, license renewal for 40 years to go to 60 years. For countries like the Russian Federation, the basic design is 30 years and to go up to 30 years they need periodic safety reviews. For older plants, it is to go to 45 years and for the new generation of plants to go to 60 years. Another example is Japan. In Japan, the first ageing management process is 30 years, and after that, PSR, each 10 years for examination. It is PSR, and the common point of view on licence renewal in France; we have a PSR, but there is no competition between different approaches for life management. Now we consider nuclear power plant, reactor, nuclear system and commercial system, certainly related. You also have selection of criteria, categorisation. And the first, very important point, is data collection. Data collection for life management is very important. We have data collection from general information and from initial database of components. And you need data for the plant-specific records. The initial condition, plant configuration, technical, etc. With a database, you need a high surveillance programme operating data trends, diagnostic data, and test results of the trends. After that, you are in the analysis phase, as described by my friend, Claude Faidy. You need, for the decision, the criteria mitigation and refurbishment on spare parts. After that, you are in the final step: safety licensing role, PSR, etc.

For the plant management process there are different points for data availability on key aspects. The first is the component specification data, material properties, etc. Ageing management needs tracking data, operational history, in-service inspections, monitoring. The other point is stress on raw data, failure of maintenance data, measures to improve design and operation. Data sets required for plant management can therefore be categorised as follows for a base line, operating history, coolant plant state, maintenance, technology, development.

I would like to focus my presentation on these slides for four points that I presented at the previous meeting at Vienna. The first point of the ageing management problem is the technical aspect – we have largely discussed this point during the two days and I would like to focus my presentation on other aspects. The regulatory aspect is the re-evaluation of the safety level and the conformity to the codification of the standard. There are two others points: the first one is that we are now in a completely deregulated market, and this is data we have to take into account for life management. The competitiveness of nuclear generation is associated with investment decisions, cost effectiveness, and the taking into account of the parameters of the deregulated market. The last one, for me, is more important: non-physical aspects like organisation, documentation – there are plants where it is very difficult to obtain original documents - competencies, obsolescence for INC, for different components which were built in different countries 30 or 40 years ago. How do you, in the industrial field, find all manufacturers of the original designs? It is not easy. For the spare parts, you have to design the new specifications. Information systems are very important. Lastly, the competencies of people, like those in this room: knowledge was acquired during the construction of the nuclear power plant. For the new generation of people who will work in the nuclear field, we have to interest the new engineers, give our knowledge through training to the new engineers. It is very important to have a good level of competencies.

I would like to show this point but Claude Faidy has largely described it and I would like to win a lot of minutes so I will focus my presentation only on other points. First point: the ageing management mechanisms is related to nuclear power plants. Manufacturing aspects needs a very good knowledge. It is very important for ageing management to know all the initial properties or parameters of the equipment. Physical ageing phenomena: they were largely discussed during the two days. The problem of degradation and phenomena through the mode of the property changing during the time in operation. There are also operational service aspects: service conditions of nuclear power plants depend mainly on the type of the reactors, the design, and, to a smaller extent, the national/utility practice, etc. In principle, the most important parameters from the point of view of components are as follows: pressure of the primary/secondary coolant characteristic leads mainly to fatigue damage, etc; temperature between primary and secondary coolant practice and ageing processes; neutron fluence which can change many mechanical properties and the beltline part of the reactor pressure vessel, as well as the internals materials of the reactor; water/steam chemistry conditions; chemistry which can, together with other parameters, result not only for other components in wall thinning, (homogenous corrosion, erosion, etc), but also in components cracking. This example is shown by everybody for the reactor head pressure vessel experience.

It is the experience in France that I have shown during the previous meeting for the Agency. It is for reactor pressure vessel evaluation: it is a characteristic of the vessel, of the transient and of the distribution of the defects, if there are defects in the sub-coating area, of the condition of the transient and of the stress-intensive factor and it is determined from a computation of the two parameters. We can have some other evolutions: fluence on initial properties of components; parameters will change during the time in operation of the components; we have the toughness of the tear and the computation at crack tips. The good safety level is to demonstrate the good margin factor for two parameters ratio.

For my conclusion I have put a picture of a steam generator in Japan at Ikate nuclear power plant. The development of methodology has followed the evolution in life management for each component. Equipments and structures require a good knowledge of the evolution of mechanical and metallurgical parameters for initial properties and the increasing of characteristics during time in operation. For this point, the key factor is to have a large database. The other point is to identify the different modes of degradation, in combination with normal and exceptional maintenance programmes. It is a strategic point of view to have a good decision.
Thank you very much for your attention.

Susanne SCHULZ - It is a comment on the presentation of Mr Wilke. Yesterday, I presented the way of the Swiss authorities. He mentioned we had a requirement for an integrity evaluation: that is only part of an ageing surveillance programme, of course. My comment is that one must be careful to use this integrity evaluation; sometimes it is mis-understood that ageing surveillance should only comprise the parts of the pressure-retaining boundary of a system. That is surely not enough, because integrity and function must be maintained for all safety relevant components. My advice is not to use integrity evaluations for ageing surveillance.

Ulrich WILKE - One word on this. In Germany, the integrity concept means all elements within the flow chart I represented. This is also the fracture mechanics and all the fracture testing, so it is the framework in which we do all our work on the component, such as fracture analysis, stress analysis. It is the sum of all the single measures we perform which is the integrity concept. It is the way to keep the integrity of our components within a certain safety philosophy.

Sophie MOURLON - I think everybody agrees that both integrity of the pressure boundary and functionality of the component must be maintained and addressed in a life management programme. It was an important comment – thank you.