Cancels & replaces the same document of 15 July 2008

Working Group on Integrity and Ageing of Components and Structures (IAGE WG)

Subgroup on the Integrity and Ageing of Metal Components

Summary Record of the 13th Meeting

OECD Headquarters, Paris, France
April 1-3 (morning), 2008
Summary Record of the 13th Meeting of the Integrity and Ageing of Components and Structures Working Group (IAGE) Sub-group on the Integrity and Ageing of Metal Components

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Main actions taken

Action 13-1 NEA will circulate the report on PROSIR - Probabilistic Structural Integrity of a PWR Reactor Pressure Vessel to all the PROSIR participants and IAGE members for comments. The goal is to have the report ready for approval at the CSNI meeting in June 2008. If it is not possible the approval will be sought at the December 2008 meeting.

Action 13-2 Metal members were urged to participate, and promote the participation within their countries, at the Workshop on Risk Informed Piping Integrity Management on June 2-4, 2008, Madrid, Spain. All the workshop information can be found at address http://nea.fr/html/nsd/workshops/ripim/index.html.

Action 13-3 Each leader will develop the proposal using the CSNI template (CAPS). The proposal will be circulated for comments. Since the time available to submit the CAPSs to the PRG for endorsement prior to submit them to the CSNI for approval is too short (the proposal should be presented to the CSNI/PRG by 15 April) it was agree to look for the CSNI approval at the December meeting. The proposals are as follows:

- LBB: Questionnaire on existing technical basis and applications. (Lead: NRC - Mr. Robert Tregoning subject to confirmation. Participants – Sweden, France, Germany, and Canada).

- Hydro-proof pressure test. (Lead: CSN - Mr. Carlos Castelao. Participants – Czech Republic, France, Hungary, USA, Slovak Republic, Germany, and Belgium).

- Fatigue test on components. (Lead: France - Mr. Claude Faidy. Participants – Japan, Finland, Germany, USA, and Czech Republic).

Action 13-4 Dr. Milan Brumovsky (NRI, Czech Republic) to coordinate the NEA contribution to the IAEA report of the CRP 9 on PTS procedures and acceptance criteria of those NEA countries not participating in the IAEA CRP.
Summary

1. The 13th meeting of the CSNI Integrity and Ageing of Components and Structures/Subgroup on the Integrity and Ageing of Metal Components took place April 1-3 (morning), 2008 at the OECD Headquarters, Paris, France.

2. The Chairman, Mr. Claude Faidy, opened the meeting and welcomed the participants. He informed that he will remain active at EdF for 3-5 more years. However, he mentioned the need to begin planning the chairmanship succession.

3. The list of participants is in Appendix 1. Apologies for absence were received from: Mr. Michael De Smet (Tractebel, Belgium) replaced in this meeting by Mr. Frédéric Somville, Mr. Stefan Cepeck (Slovak Regulatory Authority), Mr. Masakuni Koyama (JNES, Japan), Mr. Takeyuki Inagaki (IAEA), and Mr. Jussi Solin (VTT).

4. New membership includes Mr. Francois Balestri (IRSN), Dr. Klaus Germerdonk (HSK), and Mr. Mark Kearney (IAEA).

5. Members adopted the preliminary agenda NEA/SEN/SIN/IAGE/A(2008)3. It was noted that the item 10 of the agenda - Seismic event consequence of Niigataken Chuetsu-oki Earthquake in 2007 at Kashiwazaki – Kariwa NPP will take place on the morning of April 2 to allow coordination with similar presentation at the IAGE Sub-group on the Seismic Behaviour of Structures.


Report by secretariat

7. Mr. Alejandro Huerta, the NEA Secretariat, provided information regarding the activities of the Committee on Nuclear Regulatory Activities (CNRA), the Committee on the Safety of Nuclear Installation (CSNI), and the Multinational Design Evaluation Programme. He informed that the CSNI updated regularly an Activities Report, which describes in detailed all the working groups’ activities with focus on recent progress. The report also includes the status of the joint international projects sponsored by the CSNI. He then introduced the completed activities and the current activities of all the CSNI working groups.

8. The CSNI decided, as a result of the Forsmark NPP event in 2006, to undertake a task to assess the Defence in Depth of Electrical Systems and Grid Interaction with the objective to prepare a document establishing guidelines in the robustness of safety related electrical systems and interaction with grid.

9. Mr. Huerta informed the CNRA approved publication of the new “green booklet” on The Regulatory Goal of Assuring Nuclear Safety. The primary focus of this report is on how the regulatory body can systematically collect and make an integrated analysis of all the relevant safety information available to it and arrive at a sound judgement on the acceptability of the level of safety of the facilities that it regulates. Then the completed and current activities of each of the CNRA working groups were described, including the new CNRA working group on the Regulation of New Reactors. Mr. Huerta also noted that the CNRA approved the programme of the workshop on Lessons Learned from Sump Pump Clogging Issues that will take place December 4-5, 2008 at the OECD Headquarters.

10. Mr. Huerta described the results of the Multinational Design Evaluation Programme Stage 2 Pilot Project. The goals of MDEP Stage 2 were to establish reference regulatory practices and regulations to enhance the safety of new nuclear reactor designs, and increase cooperation among regulators to
improve the effectiveness and efficiency of the regulatory design reviews. The scope of the Pilot Project included the assessment of similarities and differences in the regulatory requirements and practices of the participating countries in the following areas: Licensing basis, design review, safety goals, and in component manufacturing oversight. The proposed structure for the continuation of MDEP was presented including the design specific working groups (currently EPR and AP1000) and the issue specific working groups.

11. Finally, Mr. Huerta reviewed the list of actions of the 12th meeting of the IAGE Sub-group on integrity and ageing of metal components. Indicating that all of the actions were completed.

**Reactor pressure vessel**

12. The Chairman mentioned that the report on PROSIR (Probabilistic Structural Integrity of a PWR Reactor Pressure Vessel) is practically finished and will be submitted to all the IAGE metal members for comments. The report will contain appendices with all the results and information for each PROSIR participant.

13. He noted that PROSIR Phase 3 on Probability of Failure of a Cracked RPV is too complicated. It was agreed that after issuing the PROSIR report there will be a discussion on how to proceed on the round robin on probability of failure of crack RPV. Finally, the Chairman explained some of the main results and conclusions of PROSIR.

**PTS rules/fitness for service criteria on different member countries for LTO of RPV**

14. The Chairman initiated the discussion on Pressurize Thermal Shock (PTS). He informed about the development of the methodology for assessing this issue for VVER’s within the VERLIFE project. It was noted that the IAEA coordinated research project (CRP9) is addressing the status on load and flaw evaluation in PWR and VVER (report for end of 2008). It concluded that with very similar data the acceptable RTNDT can be 80°C different through different countries. The issue is how to address this aspect when the NPP’s are extending their life to 60 years. How to define regulatory criteria and to assure the RPV integrity. It was noted that there are other internationally accepted methodologies. A discussion never took place on the criteria to accept approaches to address PTS.

15. Mr. Antonio Ballesteros (Tecnatom, Spain) made a presentation on PTS in Spain. He mentioned that they apply the American rule for the PTS, 10CFR50.61. He indicated that the PTS screening limit of +300°F (149°C) is used for circumferential welds. While for +270°F (132°C) is applied for all other materials. Since the estimated values are well below the temperature criteria there is no problem with PTS.

16. There are no special PTS methods in Sweden except the ASME rules. This is an issue for long term operation, but it is not currently in the agenda for SKI.

17. Belgium is applying the same criteria as in Spain. Currently there are no plans or criteria for life extension in Belgium. Reference temperature is based on the American rule. Estimation for 60 years is OK for almost Belgium plants. The current problem is the existence of some degradation.

18. Germany has its own rule regarding PTS. There are no plans or discussion for life extension. The issue is crack characterisation. Crack size could be two times larger than the one assume to be found by NDE. No current application for crack arrest so therefore the crack initiation is taking into account.

19. Switzerland is following the American standards. Currently, there are no major PTS concerns, nevertheless they are investigating the issue.
20. Dr. Masahide Suzuki (JAEA, Japan) made a presentation regarding structural integrity evaluation at PTS in Japan. Probabilistic approaches are based on fracture mechanics. After 30 years ageing management programmes are implemented at all NPP. There is no problem for PTS for 60 years of operation.

21. In Finland, PTS was a problem for Loviisa NPP (VVER-440) but has been largely resolved with anneal. Deterministic and probabilistic fracture mechanics analyses and surveillance programmes have been conducted to demonstrate adequate margin with respect to crack initiation. Arrest may serve as additional justification on a case-by-case basis.

22. France follows a purely deterministic approach using a conventional defect 6x60 mm². All transients have to be analysed, 2” or 3” LOCA have the smallest margin. Material properties are investigated for cracks. France is sceptical about crack arrest. No probabilistic approach has yet been approved by the French authority.

23. Mr. Robert Tregoning (NRC, USA) made a presentation on current regulations and revision status of Pressurized Thermal Shock (PTS) in USA. PTS Rule 10 CFR 50.61 requires plants to monitor reactor pressure vessel (RPV) embrittlement. PTS rule requires plants to ensure safe operation if RTPTS exceeds screening limits, and some options are provided if a plant does not meet the criteria, such as implement “reasonably practicable” flux reductions to reduce the embrittlement rate, anneal the RPV, or perform a plant-specific analyses to demonstrate that operating the plant does not pose an undue risk to the public. Before the end of life, 40 years, no US PWR plant exceeds the criteria. Several plants are close to limit and therefore will likely exceed screening limits during the 20-year license renewal period. Risk informed revision of 10CFR 50.61 to reduce conservatisms implicit to existing (RTPTS) limits which could create artificial impediment to reactor life extension. Voluntary decision by plants to implement the risk informed approach.

24. The Chairman questioned the member countries about probabilistic approaches on RPV. Sweden mentioned that some discussions are taken place. Japan noted that utilities are interested on probabilistic approaches. France has developed a probabilistic analysis which will be submitted to regulatory authority. It was informed that Russia is considering a failure probability of 10-7 (for PTS); this failure probability considers only crack initiation. Probabilistic approaches for PTS are well established in Finland and utility has submitted analysis to the regulatory authority.

25. The Chairman summarised the discussions by noting that a potential proposal to make a synthesis report on the status of PTS criteria in NEA member countries could be consider in the 2008-2009 Programme of Work of the Metal subgroup (item 12 of the agenda).

Fatigue

26. The Chairman introduced the subject of fatigue. He mentioned the current situation for stainless steel, and the new USNRC fatigue curve for Stainless Steel in air environment. He presented some EdF fatigue tests results and the proposed EdF fatigue curve for stainless steel in air environment. He informed about the work on environmental effects on small specimens. He noted that the issue is how to move to the mean curve. International consensus on fatigue curves, with/without environment effects is not reached.

27. Dr. Karl-Heinz Herter (MPA, Germany) made a presentation about the project on Fatigue strength of ferritic and austenitic materials under air environment as well as the project on Fatigue behaviour of austenitic steel for pressure vessel and piping in oxygenated high temperature water. He mentioned that the mean data curve according to NUREG/CR-6909 fits the experiment on fatigue strength in air.
environment. The project on fatigue behaviour of austenitic steel in oxygenated high temperature water simulated the BWR water chemistry at 240 °C. The fatigue behaviour in air environment at 240 °C is in quite good accordance with the ANL mean air curve and is better represented by the ANL curve than by the ASME mean air curve. He noted that the results of fatigue behaviour in oxygenated high temperature water test are conservatively covered by the ANL mean water curve.

28. Mr. Rauli Keskinen (STUK, Finland) made a presentation about the Finnish research on fatigue in hot water. VTT's results support the environmental correction factor (Fen) approach. He presented the Finnish approach described in the regulation YVL 3.5 which requires justification when ASME III design fatigue curves are applied to environmentally affected fatigue. It was noted that the pilot project for the NUREG/CR-6909 methodology application to OL 1&2 MFWS is completed.

29. The chairman questioned the member countries about the fatigue issues of their countries. A discussion ensued with the following highlights:

1. The Czech Republic’s results on fatigue were presented at the IAGE Metal meeting in 2007. Means have been developed to derive fatigue curve material by material. It was noted the Stainless Steel is really different in the VVER technology. Environmental effects are not yet taking into consideration.

2. ASME is being applied in Spain even though the environmental effects are not taken into consideration. No regulatory position on this issue.

3. Belgium is applying the ASME code.

4. This issue is considered in the Japanese code and standard (JSME). Environmental fatigue history is very long, performing various tests. It was noted that the chemical control is very important. Cladding is not considered in the environmental effects.

5. Sweden is following the ASME code for life extension consideration.

6. ASME code is being applied in Switzerland.

7. Canada expressed concerns by fatigue environmental effects, these are reflected in the new curves.

30. The Chairman concluded by mentioning the possibility to develop a SOAR on fatigue crack growth. He also mentioned about the proposal that was circulated for comments on the analytical test/experimental on fatigue, and transferability of test specimens. This proposal was discussed in the 2008-2009 Programme of Work of the Metal subgroup (item 12 of the agenda).

**Plant ageing**

31. A discussion took place about the collection and connection of the different initiatives on all major degradation mechanism of NPPS (PWR, BWR, VVER, CANDU). The Chairman questioned all member countries about the existing data banks and documents about material degradation mechanism.

1. Germany mentioned that they have a databank and is interested in having a common databank.

2. Belgium noted that they have some very small databanks in AVN, and will try to put them together based on the NRC GALL report.
3. Canada stated that they are participating actively in the OECD OPDE database, and this databank could be consolidated.

4. Spain cited that they are really interested in an international databank. It was informed that Spain is participating in four OECD NEA databases (Fire, ICDE, OPDE, and COMPSIS).

5. USA pointed out that GALL is not a databank but a compendium of degradation mechanisms. Further, USA noted that they are interested in the databank but there is a need to clearly define the scope of the databank. It was mentioned that EPRI has a lot of information, but it is difficult for the regulator to inquiry the industry databank.

6. Finland stated that STUK does not have its own databank. Utilities have a lot of databanks for ageing management programmes. A very clear recommendation was made on the applicability and practical aspects of degradation mechanism existent and expected.

7. France indicated the importance of understanding the degradation mechanism for ageing management programmes.

8. Japan indicated that they are interested in the databank, and that are participating in the OECD OPDE and SCAP projects. Summarise tables are developed (utilities efforts) for degradation mechanism on the basis of Japanese experience. Programmatic work is considered and for each mechanism a folder with relevant information is developed.

9. Slovak Republic indicated that there is no specific databank however, they have developed a lot information as part of the preparation of ageing management programmes.

10. Czech Republic pointed out that there is no database for degradation mechanism, For certain components there is a list of degradation mechanism that is updated regularly.

11. Sweden noted that there are national degradation databases. However, it was stressed the fact that it is more important to have criteria for deciding when a mechanism is active or not in a given location/ given load and environment. This is important for RI-ISI due to the significant increase in failure probability for active degradation mechanism.

12. Switzerland mentioned that they are contributing to the OECD OPDE database. There is a catalogue of degradation mechanism, and they are very interested in the database.

32. The presentation of the IAEA was made as part of this item of the agenda. Mr. Mark Kearney made a presentation on the IAEA activities to support Member States for long term operation and ageing management. He indicated that the activities are supported on: the establishment of related IAEA safety standards; provision of peer review service (SALTO peer review) to assist Member States in the application of related safety standards; and improvement of knowledge management related to long term operation. Mr. Kearney finally informed about the activity aimed to develop ageing degradation indices (International GALL). He noted that the first consultancy meeting is scheduled for May 26-30, 2008 (Vienna, Austria) and there is interest to coordinate this activity with the OECD/NEA/IAGE Metal Sub-group.

33. The Chairman concluded that it seems that there is interest in many countries on the subject, especially on the criteria for defining active degradation mechanism. Many data is available in different member countries regarding degradation mechanism. A discussion ensued on the scope of the project. Canada noted that just a database is not good enough, it is necessary to define best practices that would help the regulator to make informed decisions, criteria to consider active or not
active degradation mechanism, etc. USA indicated that simple guidance for systems and components including degradation mechanism, susceptibilities, and potentially criteria is not available and the metal sub-group could be made a contribution on this area. It was pointed out that knowledge already exists so it is good to have simple guidance, as the Japanese approach with the summarise tables. Canada mentioned that the first task would be to review the available information.

34. Further discussion of this subject took place under the 2008-2009 Programme of Work of the Metal subgroup (item 12 of the agenda).

Cooperation with other international organisations (EC, IAEA, others)

35. The IAEA activities were discussed under item 6 of the agenda (paragraph 32 of these summary records).

36. Dr. Nigel Taylor from Institute for Energy EC JRC, was not able to attend the meeting. However the group took note of his material on the NULIFE Network of Excellence for Nuclear plant life prediction.

LB LOCA redefinition / LBB break exclusion for operating and new plants

37. The Chairman introduced the subject on large break LOCA and Leak before break (LBB) for operating and new reactors. Mr. Andrei Blahioanu indicated that the LBB topic was chosen for a plenary session on the SMIRT 19 conference (Toronto, Canada, August 2007) due to its current importance. It was noted the need to validate the main assumptions on the LBB analysis. This is an issue for operating plants.

38. Mr. Robert Tregoning (NRC, USA) made a presentation on Risk-Informed Changes to 10CFR 50.46: Large-break LOCA redefinition and cladding acceptance criteria. The main objectives of the change are to develop voluntary risk-informed alternative to the current design basis loss-of-coolant accident (LOCA) break size, and to prevent plant changes that might result in unacceptable risk increases, loss of safety margin, or loss of defense-in-depth. The approach involves: the determination of passive system failure frequencies associated with normal operational service history over expected design life (60 years) using expert elicitation; ensuring that seismic-induced failure frequencies remain sufficiently lower than elicitation results; the determination of new design basis break size; and the specification of requirements for accident mitigation beyond the new design basis break size. Regarding the revision of Appendix B of the 10CFR 50.46 on fuel cladding acceptance criteria it was noted that it is a companion revision to the voluntary emergency core cooling system acceptance criteria. It was stressed that the 2200°F peak cladding temperature limit remains adequate, however, the 17% cladding oxidation does not always ensure post-quench ductility of the cladding. Therefore, new regulatory limit is required for break-away oxide layer. It is foreseeable that the proposed rule will be published in Federal Register in 2010.

39. Following a question on the PRA use of revised LOCA frequencies, Mr. Tregoning mentioned that it is planned to incorporate the revised LOCA frequencies in the PRA models to assess its impact. It is expected that medium breaks will contribute more, large LOCA will not be important, and small LOCA will remain significant contributor.

40. Following a question on risk significance evaluation, it was noted that for any plant modification the utility needs to assess the risk impact, changes are going to be assessed case by case and will invariable maintain the safety principles, defence in depth, etc.

41. Following a question on how to increase defence-in-depth, it was cited that this is a voluntary rule that should be applied, otherwise it is useless the efforts spend in its development. Therefore, some
flexibility should be allowed. It is not yet clear how specifically is going to be applied, the criteria is there, but the how is not clear.

42. The Chairman noted that EdF has sent recently a document for similar approach to the French authority. Expert elicitation is an issue. The idea is to have plant specific application.

43. A question was made indicating that current plants are designed for large LOCA and what about the new designs, are they going to be designed for transition break LOCA. Mr. Tregoning noted that an assessment should have be done to demonstrate that the frequencies, transients, etc are similar for the new plants than for the current operating plants.

44. The Chairman indicated that for EPR in France the French Regulatory Authority has accepted the justification for not considering large LOCA as design basis accident. Containment and safety systems are still designed using the double guillotine break requirements.

45. Dr. Björn Brickstad made a presentation on the regulatory aspects on the application of the LBB concept for Swedish NPPs. He informed that the unit 2 of Ringhals has applied to SKI for using LBB for the following various pipe segments such as reactor coolant loops, surge line, residual heat removal system and the safety injection system. Several problems were identified: the utility has used an in-house code for leak rate evaluations together with unrealistic crack morphology parameters which tend to overestimate the deterministic LBB-margins; SKI does not in general allow the use of LBB for not having to consider effects from the asymmetric blow down loads if rupture occurs on the RCL; and the weld connecting the safe-end to the surge line nozzle is made of Alloy 182 known to be susceptible to PWSCC. Dr. Brickstad finally mentioned that SKI approves the use of LBB for the PWR plant under certain conditions such as the installation of leak detection and updating the safety documentation and plant technical specifications. On the other hand SKI does not approve the use of LBB for the bimetallic weld in the surge line connecting to the pressuriser surge nozzle.

46. A discussion ensued with the following highlights:

1. Following a question on any work to estimate a realistic leak rate, Dr. Brickstad noted that no work is currently in Sweden. However, they are following what other countries are doing. SKI is not ready to reduce these factors/safety margins.

2. A small change in the crack pattern and morphology has a big impact on the leak rate.

3. Crack opening area is another aspect that needs to be considered.

4. Influence of residual stresses and its impact on more thin pipes.

47. Mr. Andrei Blahoianu informed the group that a proposal to prepare a synthetic document covering the different aspects of LBB, LB LOCA, and RI-ISI was circulate for comments on 2007. A discussion ensued with the following highlights:

1. Sweden considered first that these are too large topics to be covered in one common project; and second that is too early to launch this project at this time considering the different ongoing research activities in each of these three areas.

2. USA is interested in Risk-Informed LBB, due to some open points and concerns, and not in the classical LBB concept. The issue could be addressed through a benchmark exercise. It was noted that the proposal could first make a review of the work done elsewhere with the aim to identify technical weaknesses that potentially the Metal sub-group could address.
3. Finland noted that a more detailed questionnaire could be a good idea, addressing some technical issues, methodology applied, etc.

4. Spain is concerned on LBB applications, they are following the American rules and LBB is being applied and approved by the CSN. Interested on the technical basis taken into account in different countries. Probabilistic benchmark could be a second step.

48. The Chairman concluded that based on the discussion different options could be explored: SOAR on best practice (different technical aspect); round robin of some part of risk informed LBB justification; consequence of LBB on operating plant with active degradation mechanism; and a questionnaire explaining the technical basis/use of LBB. Further discussion of this subject took place under the 2008-2009 Programme of Work of the Metal subgroup (item 12 of the agenda).

Report from OECD NEA related projects

49. Mr. Alejandro Huerta made a presentation about the SCAP project, OPDE project, RISMET activity and ZIRP project.

50. The main objectives of SCAP were presented which include the development of database on stress corrosion cracking and cable insulation failure, a knowledge base and the assessment of the data to identify the basis for commendable practices which would help regulators and operators to enhance ageing management. The databases of SCC and cable insulation failure have been defined and are currently being populating.

51. It was informed that the OPDE was established in 2002 to produce an international database on the piping service experience applicable to commercial NPP. The OPDE runs its second term from June 2005-May 2008 with the participation of 12 countries. At the end of 2007 the OPDE database included approximately 4,000 records validated on pipe failures affecting ASME code class 1 through 3 and non-Code Class.

52. RISMET was established to identify how the different RI-ISI methodologies impact reactor safety and whether they lead to different results. The application groups made use of the following RI-ISI methodologies: WOG original; WOG “Sweden”; SKIFS 1994; EPRI original; ASME section XI, Code Case N716. Evaluations groups on scope of application, failure probability analysis, consequence analysis, and risk ranking, classification and selection of segments/sites were established to assess the difference in methodologies and its impact. It was informed that the fifth and last meeting was held on February, 2008. The final report will be due by June 2008. A final international workshop on RISMET in conjunction of OECD/NEA OPDE project will be organised on June 2-4, 2008, at Madrid, Spain, hosted by the Consejo de Seguridad Nuclear (CSN). All the Metal members were urged to participate and promote the participation in the workshop.

53. Finally, Mr. Huerta informed about the cooperative research project on Ex-Plant Materials from Zorita NPP (ZIRP). It was informed that a third meeting will be called to discuss the activities related with the harvesting of the core internals along with the associated costs. Also it will be discussed the specimens test programme.

Seismic event consequences of the Niigataken Chuetsu-oki earthquake in 2007 at Kashiwazaki-Kariwa nuclear power station

54. Mr. Shigenori Makino (TEPCO, London Office) made a presentation on the Situation of damages and survey caused by Niigataken Chuetsu-oki earthquake in Kashiwazaki-Kariwa NPS. The plant site map was presented with the layout of the seven BWR units. Based on visual inspections, no damage
has been identified so far in Class As/A (i.e., Safety Related) equipment. However some damage has been found in Class B/C equipment. The damages of equipment in units 1-4 were presented involving: filtered water tank, fire protection piping, duct connected to the main exhaust stack, etc. Also, the damages on units 5-7 were discussed involving: reactor well liner leakage, filtered water tank, overhead crane, etc.

55. There were some questions regarding the loads on the components, design errors or too large loads in excessive of design. It was noted that as part of the earthquake investigations loads on some of the components have been estimated.

56. It was stressed that the plants were designed with very high safety margins since the ground motion acceleration exceed by much the design. However the load stresses induced by the earthquake were well below the design limits.

57. It was commented that a dynamic response of the components should be performed, since some plastic degradations might have occurred.

58. Mr. Andrei Blahoianu mentioned that the complete assessment of the impact of the earthquake involve cross cutting issues, and therefore the potential participation of the IAGE Metal sub-group community on the IAEA Extra Budgetary Programme on seismic safety of existing facilities is desirable.

Round table on last year events in member countries regarding components failures or degradations

59. The Chairman informed that EdF has found some clogging at the tube support plate in the steam generators. A small survey was prepared and member countries were asked to provide their answers. To introduce the subject he asked IRSN to make a presentation.

60. Mr. Thierry Sollier (IRSN, France) made a presentation on the Tube support plate (TSP) blockage and SG fouling. He informed that aftermath an important primary-to-secondary leak at one SG of CRUAS Unit 4, EdF has performed a visual inspection of the uppermost TSP. This inspection revealed a heavy build up of oxide at the TSP resulting in a significant blockage of the quatrefoil holes. The leak was due to a circumferential crack 210° wide nearby the plate. The degradation mechanism is high cycle fatigue as a result of fluid elastic instability due to the TSP quatrefoil blockage which perturbs the fluid circulation inside the SG. Mr. Sollier pointed out that the French Safety Authority (ASN) and its Technical Support Organisation (IRSN) considered the TSP blockage as a generic issue for the French NPPs, at least for the plants using a low pH for secondary side water chemistry conditioning. EdF was asked to initiate a program for all its NPPs fleet with the objective to: quantify the SGs TSP blockage; and restore the thermal hydraulic conditions of the SGs to design state. Following the CRUAS 4 leakage, the High Temperature Chemical Cleaning Process (HTCC) was chosen by EdF for rapid action since this process was qualified and applied to CHINON B1 NPP to mitigate secondary side corrosion. However, there are safety issues regarding the Technical Specification due to the application of the HTCC process. It was finally informed that EdF has setup an important program to chemically clean steam generators; that the evaluation of the efficiency and harmlessness of the HTCC process for the 1300 MW-class reactors is underway; and that an alternative process (EPRI/SGOG) will be qualified.

61. The Chairman initiated a round table discussion of the subject based on the small survey that had been circulated. Written responses were provided by Finland, Czech Republic, and USA.
   1. Germany – different design and high ph water. No safety significance. Belgium – Some difference also in the design. They will look at the issue. More titanium. Chemical cleaning. Canada-Chemical
cleaning of the tube support plate. Periodic chemical cleaning. Spain – New SG German design. Suggestion to replace the condensers. USA – The SG have clogging. Potential for safety significance. Periodic programmes are not regulatory requirements. Pro-active surveillance programmes. Visual inspection and eddy current methods. Information notice issued to USA NPP plants. Not considered as generic. Finland – High pH water chemistry. For Loviisa SG are horizontal. Japan – No clogging in Japan. Scale production due to water chemistry issues. Sweden - 3 PWR, two of them have replace SG. Clogging of the TSP has not being any problem. Some cleaning has occurred, not specifically directed to TSP. Switzerland – TSP clogging is not an issue.

62. The Chairman concluded the discussion by mentioning that this issue could be a potential activity of the group. For example, to issue a report on the root cause analysis of SG tube support plates clogging. Further discussion of this subject took place under the 2008-2009 Programme of Work of the Metal subgroup (item 12 of the agenda).

63. Dr. Lubomir Junek (UAM, Czech Republic) made a presentation on the new operation experience with clogging in horizontal steam generators (SG). He informed that the SG had been reconstructed and it seems to be working well until they detected 5 clogged nozzles from 32 from the hot bottom. The mechanism of the clogging was discussed. The on-going activities involved the cleaning of all SGs traps; the verification of reconstruction of feed water distribution inside SG; and the thermo hydraulic analysis of blow down piping.

64. Dr. Masahide Suzuki (JAEA, Japan) made a presentation on Recent Events of PWSCC in Japan-Flaws in the welding of the steam generator (SG) primary coolant inlet piping nozzle. He pointed out that flaws were found at the portion of SG primary coolant inlet nozzle on several plants such as Mihama Unit 2, Tsuruga Unit 2, and Takahama Unit 2 and 3. Literature survey indicated that all domestic and foreign cases showed that the crack was axial direction; the cause was estimated to be PWSCC generated by high residual stress resulted from repair welding. Investigations of the events showed that the crack was along the columnar boundaries, high residual stress was considered to be generated by machining process, instead of repair welding. Residual stress was higher than 300 MPa, which is a threshold level for PWSCC.

65. Mr. Carlos Castelao (CSN, Spain) made a presentation on loose parts detected in the primary side of SG in Vandellos NPP. The event was initiated by a break of one “split pin”, used to align the CR guide tube into the upper core plate, due to stress corrosion cracking. Plant conducted to mid loop conditions in order to recover the loose parts, some parts of the split pin were recovered, and others remained in the RCS. These loose parts caused damage on the tube sheet of one SG. The event raised a series of concerns and safety significance such as the potential failure of control rods to insert due to misalignment, potential damage to the fuel or safety components due to unrecovered loose parts in the RCS, and potential damage to RHR pump during recovering action. All these aspects were duly justified by the licensee for continued operation.

66. Presentation by Dr. Klaus Germerdonk (HSK, Switzerland) on the inadvertent opening of multiple Safety Relief Valve’s (SRV) during full power operation at Liebhstadt NPP. On March 2007, Leibstadt NPP (BWR 6 Mark III) was operating at full power. Plant staff was preparing instrumentation functional tests at the SEHR (Special Emergency Heat Removal) system division 51, which required the bridging of SEHR actuation signals. During the test preparation, the SEHR-ADS (Automatic Depressurisation System) was activated unintentionally, which resulted in the opening of 8 out of 16 SRV during full power operation. This led to a considerable transient, involving SCRAM, MSIV isolation, turbine trip, feedwater trip, RCIC and HPCS injection, containment and RWCU isolation, SGTS and RECIRC Pump start. Subsequently, the plant was shut down to sub critical cold condition. The immediate achieved stresses and strains were assessed and found allowable according ASME
code. Selected additional NDT inspections on most stressed components during outage 2007 show no indications of major damage.

67. Presentation by Mr. Robert Tregoning (NRC, USA) on Advanced Finite Element Analysis of Pressuriser Nozzle Weld Flaws. PWSCC of Alloy 82/182 dissimilar metal butt welds is well documented and is dependent on temperature, tensile stress, time, and material. Five circumferential indications were found at Wolf Creek NPP (one in relief nozzle-to-safe end weld, three in pressuriser surge line nozzle-to-safe end weld, and one in safety nozzle-to-safe end weld). NRC concerns were raised due to this was the first case of multiple, long, and circumferential flaws, and that axial flaws lead to leaks, while circumferential flaws may lead to pipe rupture. NRC conducted a scoping study aimed to determine the time for the flaw to grow from current size to leakage, the time from leakage to rupture, and the leakage rates from emerging TW flaws. NRC staff concluded that inspections/mitigations need to be accelerated for some plants and should be completed by the end of 2007. However, if industry’s proposed advanced finite element analyses providing reasonable assurance of safety, plants with outages planned in 2008 may avoid their 2007 outages. Industry developed a research program to perform the necessary analyses and the NRC developed confirmatory program to review, benchmark, verify, and evaluate the industry’s results and the quality of their analyses.

68. Presentation by Mr. Robert Tregoning (NRC, USA) on St. Lucie Retired Pressuriser Nozzle Indications. He discussed the PWSCC operating experience in dissimilar metal butt welds, and the recent indications found (2008) at St. Lucie where circumferential cracks in safety nozzles were discovered. St. Lucie 1 PZR replaced one pressurizer to prevent disruptions due to potential Alloy 600 heater sleeve cracks & leaks. St. Lucie did not perform NDE prior to replacement and offered the pressurizer nozzles to the NRC. Indications were found by penetrant testing (PT) & manual, phased-array ultrasonic testing (UT). Five out of six nozzles had circumferential and axial indications with the deepest reported penetration of 80% on the “A” safety nozzle. The St. Lucie NDE results raised questions about the applicability of advanced finite element analysis safety assessment (AFEA) done for Wolf Creek NPP. No immediate safety concern exists, however research will continue on nozzles by conducting destructive evaluation of safety nozzle “A”, measuring residual stress distributions, considering crack growth rate testing of weld material, and considering other NDE evaluation of nozzles UT.

69. Mr. Robert Tregoning (NRC, USA), based on a request by the NEA Secretariat, made a presentation on the NRC/DOE February 2008 Workshop on US NPP plant life extension research and development (“Life Beyond 60”). The workshop objectives were: to identify technical issues that may require resolution to support safe long-term operations of light-water reactors (LWRs): to identify prioritised research areas; and to identify appropriate roles and responsibilities for industry, DOE, and NRC in potential collaborative research program to ensure continued safe LWR operation. All the workshop material could be found at the following address http://www.energetics.com/nrdoefeb08/.

70. The group took note of the following material provided by the Czech Republic: Paper to be presented at ICONE 16 (May 2008) on Analysis of SG Tubes Deposit Layers on Free Surface and Crevices of NPP Temelin; and a document describing the Electrochemical Evaluation System developed and built to enable studies of the processes on the secondary side of the steam generator, with emphasis on monitoring the chemistry of occluded volumes.
Programme planning – review and proposals for 2008

71. The Chairman made a recompilation of all the possible actions and proposals. Member countries were asked to prioritise the following list of action:

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<td>1.</td>
<td>PTS rules</td>
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<td>– LTO procedure/criteria</td>
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<td>– Complementary action to IAEA-CRP9</td>
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<td>2.</td>
<td>Fatigue test on components</td>
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<td>– to support transfer from small l specimen to structure</td>
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<td>3.</td>
<td>Plant ageing</td>
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<td>3.1 programmatic document</td>
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<td>3.2 degradation mechanism</td>
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<td>* GALL type: review of location and potential degradation, mitigation and surveillance.</td>
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<td>* Knowledge reference data base by mechanism.</td>
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<td>4.</td>
<td>LBB</td>
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<td></td>
<td>4.1 SOA or Best practice doc (too early)</td>
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<td></td>
<td>4.2 Global prob. RR</td>
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<td></td>
<td>4.3 Consider fatigue/corrosion/leak rate on operating plant</td>
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<td>4.4 Questionnaire on existing technical basis and applications</td>
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<td>5.</td>
<td>SG AM</td>
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<td>– TSP maintenance program</td>
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<td>– root cause analysis of clogging</td>
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<td>6.</td>
<td>Seismic event in Japan</td>
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<td>– cross-cutting activities in support of seismic group</td>
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<td>7.</td>
<td>Hydro-proof pressure test</td>
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<td>from 1.01 to 1.25 Pd/different frequency</td>
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<td>beneficial aspect/potential degradation for aged plant</td>
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<td>8.</td>
<td>Ni based alloys</td>
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<td>– outside of vessel head penetration and DMW : BMI</td>
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72. A discussion ensued regarding the lead organisation and the participants in the activities. Mr. Andrei Blahoianu mentioned that in order to submit a proposal to the CSNI for approval a clear indication of the lead organisations and estimation of resources is needed. Based on the countries ranking the Chairman indicated that the high priority proposal/actions were the following:

1. LBB: Questionnaire on existing technical basis and applications. (Lead: NRC subject to confirmation. Participants – Sweden, France, Germany, and Canada).

3. Hydro-proof pressure test. (Lead: CSN. Participants – Czech Republic, France, Hungary, USA, Slovak Republic, Germany, and Belgium).

4. Fatigue test on components. (Lead: France. Participants – Japan, Finland, Germany, USA, and the Czech Republic).

73. It was agreed that each leader will develop the proposal using the CSNI template (CAPS). The proposal will be circulate for comments. Since the time available to submit the CAPSs to the PRG for endorsement prior to submit them to the CSNI for approval is too short (the proposal should be presented to the CSNI/PRG by April 15) it was agreed to look for the CSNI approval at the December meeting.

74. It was also agreed to contribute to the IAEA report of the CRP 9 on PTS procedures and acceptance criteria providing information of those NEA countries not participating in the IAEA CRP.

75. Mr. Andrei Blahoiianu informed that the SMIRT 20 international conference will take place in Finland next year. In order to promote the visibility of the IAGE group, presentations should be prepared by each IAGE main group and sub-groups chairs with the support of the NEA Secretariat.

Next meeting

76. It was agreed by all the members that the IAGE meetings will take place the week of April 20-24, 2009. This date is tentative and will be subjected to the IAGE main group decision.

77. The Chairperson, Mr. Claude Faidy thanked the members for their active participation during the meeting and then closed the meeting.
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