

## The 23<sup>rd</sup> N-20 Joint Statement

The group N-20, which consists of nuclear industrial, research experts, and representatives of the government from Japan and France, held its 23<sup>rd</sup> meeting in EDF R&D center, Saclay, from November 22<sup>nd</sup> to 23<sup>rd</sup>, 2016. During the two-day meeting, the experts from both countries exchanged information and opinion on the following topics:

1. NPP fleet and light water reactor issues
2. Dismantling and decommissioning programs
3. National energy and nuclear policy
4. Fuel cycle back-end and waste management
5. Future systems development

Apart from this statement, a brief document has been prepared in order to report the main conclusion of the N20 to the sixth meeting of the Japan-France intergovernmental committee held in November 24<sup>th</sup> in Paris.

D. Minière welcomed the Japanese delegation on the site of the newly built EDF R&D center in Saclay, on behalf of EDF, organizer of this 23<sup>rd</sup> N20.

D. Verwaerde presented some recent important points for nuclear energy in France. He gave some details about the restructuring of the French nuclear industry, with the beginning in July of the new companies AREVA NP (under EDF leadership) and AREVA New Co. It is to be noted that discussions are underway with Japanese partners for a participation to these companies. The official launch of the Hinkley Point project shows that nuclear newbuilds in Europe is ready to start again. In third countries, the SINOP project was mentioned as a good cooperation example between France and Japan. In the area of R&D, CEA has achieved some substantial progress in the ASTRID project. On this project, the cooperation with Japan is very successful under the 2014 agreement. Of course, CEA is following the discussions in Japan about Fast Reactor Development. On the fusion side, major milestones were reached, with the ITER project having been put on a better track. All these events will undoubtedly have an impact on our bilateral ties. Therefore, the opportunity we have today and tomorrow to review them will certainly allow us to see how to reinforce our collaboration in order to account for such major changes.

M. Takahashi answered that he was very satisfied to be able to discuss with French friends about difficult and important subjects. In the framework of COP21, nuclear is important for France and Japan that has a commitment in this framework. In Japan, only 42 NPPs are left after Fukushima

Daiichi Accident. 5 are restarted, but 2 are stopped by judicial decision. To meet the objective of COP21, the pace of restart should be accelerated. To have 20 to 22 % in the energy mix, life time extension and new NPPs are needed, especially in the framework of the complete liberalization of the energy market. Another important point is the nuclear fuel cycle, in the framework of the new law for reprocessing, and the equilibrium necessary for the plutonium stockpile and the assessment of the fast reactor development in Japan. Nuclear waste management is also important, and Japan is following what is happening in France. Last, 1F D&D is progressing, but reconstruction and revitalization is still under way, with around 80 000 refugees still living in uncomfortable conditions. The Government, TEPCO and all stakeholders are working together for this matter. France's help on the subject is welcome. We wish also France and Japan to work together on the safe development of nuclear at the international level.

### **I/ NPP fleet and light water reactor issues**

EDF introduced its “great overhaul” program. This program has a goal of extending the operation of EDF NPP for more than 40 years. This program is online with the French energy transition program. Life operation extension is a safe and technically viable option, also from the economical point of view. It is also a common international practice. The program will unfold until 2025, and is composed of large components replacement or refurbishing, strengthening of the safety level, and qualification of components beyond 40 years of operation. The task is huge, on the same order than a newbuild program, involving more than 100 000 jobs globally.

AREVA NP introduced its comprehensive program for reactor development and in support of the operating fleet. This program involves hydraulic test facilities, corrosion test loops, component qualification facilities, hot cells, in different locations closed to the customer : France, Germany, USA... This is supported by the development of codes and their constant comparison with experiments results. The methodology developed includes expertise in root cause analysis, providing an integrated expert support for troubleshooting.

FEPC presented the status of NPP restart in Japan. The restart of NPPS is indispensable to meet the objective of 20-22% of nuclear in the energy mix, as decided. As for the moment, among the 42 NPPs that are potentially operable, 25 applied for a license, 8 licenses were granted, and 5 restarted. 2 suspended operation after a district court order. A summary of the petition of provisional disposition against NPP was presented, and the path through the different courts in Japan was explained: district court (and appeal if necessary), High Court and Supreme Court. As for now, only two courts ruled on the plaintiff side at Fukui and Otsu court. 5 cases are pending in other district courts. FEPC reiterated the importance of restarting the NPPs and allowing an extended operation after 40 years in order to meet the 20-22% of nuclear energy in the Japanese mix as scheduled by the Government.

Kansai EPCO detailed the process to restart its NPP in this framework. Takahama 3&4 are pending the result of an interrogation in high court. Takahama 1&2 have already their license of operation until 40 years, and their authorization for restart. Kansai is performing extensive work to prepare for the license of extension lifetime operation to 60 years : replacement of major components, component level evaluation of safety critical equipment, installation of shielding above containment, replacement of main control panel, construction of an emergency response center and seismically isolated administrative building...The extension of lifetime of Takahama 1&2 is critical for Kansai EPCO, and can possibly pave the ways for Takahama 3&4, and Ohi 3&4.

EDF pointed out that nuclear newbuild is an exceptional endeavor, with many challenges to overcome: regulatory, financing policy and public acceptance...A successful project should have a good product, sound financing and solid partnership. In the framework of the reorganization of French nuclear industry EDF's DIPPN (Direction for Engineering and New Nuclear Projects) is responsible for current projects (Flamanville, HPC...) but also of the design of EPR NM. Its 3000 engineers are working as architect-engineers for all projects. Its current activities range from analyzing the lessons learned from Flamanville and Taishan, to the detailed design of EPR for HPC, and the development of new nuclear projects (India-EPR, Turkey-ATMEA1, Sizewell C-EPR, Bradwell B-HPR1000). The EPR NM was introduced as a new GenIII+ model, under development, that should be ready for replacement of the French nuclear fleet, when the decision is taken. ATMEA1 is also a part of the EDF nuclear offer, taking off from AREVA.

Toshiba introduced its ABWR and AP1000 reactors, GenIII+ model, with post Fukushima features and modular construction techniques. AP1000 are under construction in China (Sanmen and Haiyang), and in the USA (Vogtle and VC summer). There are projects also in UK (NuGen) and India. A focus was made on the advancement of Chinese and American projects. For higher seismic area, some options are currently reviewed by NRC. Last, the component fabrication capacity in Japan was highlighted.

HITACHI presented its global nuclear alliance with GE, based on a long partnership and cooperation in building more than 20 BWR and ABWRs, and its global products, ABWR and ESBWR. A focus was made on the UK Horizon project, where 2 to 3 ABWR are planned to be built on both Wylfa and Oldbury sites. The ABWR GDA is scheduled to be obtained in 2017, the site license in 2018, and the FID is expected for 2019. An update on the Visaginas NP project was also provided.

MHI presented its wide presence in the nuclear fuel cycle field, such as PWR, ASTRID, Rokkasho Reprocessing Plant, fuel fabrication and ITER project, collaborating with French nuclear industries. ATMEA is introduced as a JV between MHI and AREVA, two world nuclear leaders, to develop, sell and build the ATMEA1. This reactor is a 1200 MWe class advanced GenIII+ based on both companies' proven technology and experience, with Tomari3, APWR, and EPR etc. Its main

features are well combined active and passive safety systems, severe accident management, airplane crash protection, diversity of supply sources, and full digital I&C. A focus was made on Turkey project at Sinop, where feasibility study is in progress, after the signing of the Inter Government Agreement between Turkey and Japan, and the Host Government Agreement completed with the consortium.

## **II/ Dismantling and Decommissioning programs**

EDF introduced its new DP2D (decommissioning and waste management division) in the framework of its CAP2030 strategic reflection. EDF has a long experience in decommissioning, with different technologies for plant under decommissioning in its own fleet: PWR, HWR, UNGG, FNR...A focus is proposed on Brennilis HWR, with many milestones already achieved: fuel building, conventional building and control room demolished, removing of heat exchangers...The dismantling and demolition of reactor building should begin in 2022, for an end of site rehabilitation in 2032. For graphite reactors, the strategy was changed, moving from an underwater dismantling of a large unit, to a dry dismantling of a smaller unit first to act as an industrial demonstrator. For Creys-Malville, the challenge was the destruction of 5900 m<sup>3</sup> of sodium, which was done from 2011 to 2014. In the years to come, the authorization to open the reactor vessel, then dismantling the internal parts and the electrochemical parts will be performed up to 2030. Chooz A was then introduced as the first French PWR to be decommissioned. Last, Cyclife is presented as EDF international platform in decommissioning and waste treatment, with activities in UK, Sweden and France.

AREVA introduced its different experiences of D&D operations, either internal or for external clients (France and also internationally), and the lessons drawn from it. AREVA's international presence is highlighted: UK, USA, Germany, Japan and France. In France, the decommissioning of fuel cycle facilities and nuclear reactors entails a wide variety of complex situations, spanning the whole fuel cycle and reactors: enrichment (GB I), reprocessing plant (UP1, UP2-400), conversion (Miramas), reactors (SPX, UNGG, research reactors...), allowing for a very diverse experience feedback. It is emphasized that the decommissioning of the Areva fuel facilities is performed on its own fund, building up a wide knowhow acquired in France that benefits Areva's customers, in France or for the international projects. The lessons learned touched upon different areas: the establishment of a global dismantling scenarios and related waste management strategy, the evolution of the global scenarios in the daily life operations, the risk management, the D&D site organization, the maintenance and upgrade process, the method and qualification, the tracking of efficiency gains, the constant questioning of the applicable safety framework and finally the collaboration and technical exchanges between engineers and workers teams to improve the efficiency of the work in the field.

Chubu EPCO introduced the status of 15 NPPs under decommissioning or shutdown in Japan. The regulation concerning decommissioning is presented, based on Decommissioning Plan

application and approval. The DP has several areas, like fuel shipment, decontamination, waste disposal plan, dismantling safety evaluation, quality assurance and cost. For management of wastes, 3 categories are identified: Very low (trench disposal), Low (near surface with engineered barrier) and Relatively high (subsurface storage in consideration). The establishment of a clearance threshold is under discussion...Hamaoka 1&2 are under decommissioning since 2009. The operations are scheduled to end around 2036, after different stages: preparation (1), dismantling reactor zone and peripheral facilities (2), dismantling reactor zone (3), and dismantling buildings (4). The D&D operation is currently in Stage 2. Contamination survey is being performed on RPV and PCV, and samples are being taken in order to assess the neutron damage on RPV and concrete degradation on PCV. Muon technology is used to have images of the large structures. The results are shared through national and international cooperation (IAEA, EPRI, NEA...).

CEA pointed out the numerous facilities under its responsibility to be decommissioned, due to its long history, both in the field of civilian and defense related activities. As a result, and based on the feedback of what is already successfully performed, it was decided to launch an optimization of our internal organization. CEA wanted to have a simplified organization, with a unified supervision by the top management combined with a decision making process closer to the field. In order to do that, the project management will be at CEO level, in order to have a broad overview of the priorities, and make the relevant decisions. At the field level, the manager will have a large responsibility to act on all the levels of his project: planning, cost control, safety, security, environment, operation, maintenance...this new organization will be operational at the beginning of next year.

TEPCO presented the situation and challenges faced at 1F. All the reactors are in cold shutdown, the radioactivity released at sea and in the air are very low. But still 150 tons of contaminated water per day are generated, in spite of the countermeasures. There are still some opening in the ice wall that are being filled, after discussion with NRA. For unit 3, the removing of the fuel will be started in 2017, after the installation of a roof cover on the top of the unit. Unit 2 was checked with muon technology, and TEPCO is preparing to send a robot in preparation for fuel debris removal. For the site as a whole, apart from the reactor building and their vicinity, the global dose is now below 5  $\mu\text{Sv/h}$ . The monthly exposure dose rate is thus greatly reduced, and worker's comfort and safety is greatly increased. Finally TEPCO thanked the French companies and institutes for their help.

CEA presented its work and achievements in support of 1F D&D. Due to its own R&D activities, CEA has a lot of competencies that should be useful for 1F D&D. CEA answers alone or with private companies (AREVA, ATOX, ONET...) to different RFI/RFP. CEA is active on contaminated waters and fuel debris retrieval field. For the fuel debris, a laser cutting technology is being investigated, based on the successful use of this technique combined with the MAESTRO robotic arm in the cutting of the dissolver at UPI in Marcoule. The corium concrete interaction is

studied in Cadarache and Marcoule with JAEA, and an engineer from CEA is currently working in the CLADS. Discussion is also taking place in international fora like IAEA and NEA. CEA thinks that other synergies can be developed.

### **III/ National energy and nuclear policy**

METI presented the current situation of Japanese nuclear energy policy. Nuclear power is considered as an important baseload energy source, domestic and low carbon, in order to foster energy security, economic efficiency and respect environment. In 2030, nuclear energy should represent 20 to 22% of the Japanese energy mix. This nuclear policy is in line with the roadmap for deregulation of the electricity market in Japan. METI has now a working group to assess the deregulation plans, ensuring sound competition and benefit for the customer in the frame of the new market. Japan will firmly maintain its nuclear fuel cycle policy, and the Ministerial Meeting for the Nuclear Energy Policy will finalize by the end of this year a new strategy for FR development, including the review of the role of Monju.

FEPC introduced the purpose of the electricity system reform as to secure a stable power of electricity supply, suppressing electricity rates to the maximum extent possible and expanding the choice for consumers. Deregulation began in 2000, was expanded in 2004, then 2005. A new step was passed in April 2016 with the full deregulation taking into effect, while a small transition regulated sector will be maintained until 2020. For the moment, the percentage of households having switching provider for low voltage is increasing, but stays lower than 4%. It is a bit more important for high and extra high voltage, with sales totaling close to 10% of the sales.

DGEC recalled the goals of the energy transition bill, voted in August 2015, that gives the framework for the development of nuclear energy in France. For nuclear, it is mainly the capping of the total installed capacity to the current level (63,2 GWe) and the decrease of the share of Nuclear electricity in the mix from 75 % to 50% by 2025. The Multiannual Energy Plan (MEP), published in October 2016 was presented, and its main features introduced. Particularly, the decision about NPP shutdowns will be taken after 2018, according to different parameters: electricity consumption and export levels, development of renewable energies, ASN decisions and stable and secure electricity supply. The average life of the fleet is currently 32 years, and in 2018 the ASN will give a generic opinion about the possibility of life extension beyond 40 years. The radioactive waste management is under the legal framework of the 2006 law, and the CIGEO project is underway for establishing an underground repository for HLW. The closed cycle policy (reprocessing the nuclear spent fuel, use of MOX in LWRs, and fast reactor development) was confirmed by the MEP. In order to prepare for the future, EDF has to look for the possibility to use MOX in the 1300 MW fleet (only 900 MW NPPs, the oldest ones, are using MOX fuel at the moment).

#### **IV/ Fuel cycle back-end and waste management**

METI stated that Japan will keep promoting nuclear spent fuel reprocessing and MOX use in LWR, through the completion and start of RRP and J-MOX, and promote as well the R&D on fast reactors. For RRP, NRA is currently reviewing the plant compliance with the new safety regulation, and completion of construction is now scheduled for 1S of Japanese FY 2018. For J-MOX, actually under construction, the expected completion date is the first half of Japanese FY 2019. METI introduced the provisions of the new Spent Fuel Reprocessing Implementation Act of May 2016. The Nuclear Reprocessing Organization of Japan is created to develop a master plan for reprocessing projects, collect the expenses paid by the utilities, and commission the reprocessing activities to JNFL. For the final waste storage, the basic policy has been reviewed in May 2015, and a new process of literature survey has been engaged and is ongoing as a nationwide scientific screening.

JNFL presented the status of its RRP and J-MOX plant. For both plants, the application for safety review has been done on January 2014. Since then, hundreds of meetings and reviews have been conducted with NRA. One major issue is the seismic reevaluation, moving up the design basis to 700 gals in 2016. Major geological surveys have thus been conducted, on land and at sea. Responses to design criteria and severe accident countermeasures have been also implemented: fire and flood protection measures, anti-seismic reinforcement, deployment of additional equipment and materials, training of operators and other staff. For the future, after the approvals of NRA for the pre-use inspection, there will be a safety agreement to be signed with Aomori prefecture and Rokkasho village and other local autonomous bodies. Then the operation of the plants can start.

AREVA introduced the performances of its La Hague and MELOX plant. They served as an industrial basis to move forward with international projects like MFFF and Sellafeld. Both plants performed in 2015 as expected and even beyond expectations, especially for the vitrification of waste: 1205 tons of SNF processed, and 125 tHM produced. This was done in parallel to plant improvement both on the process and management side, including a strong deployment of TPM methodology. La Hague continued to serve international customers (Switzerland, Germany, Belgium, Australia...), and MELOX trained J-MOX engineers. AREVA presented its TCP project, in order to give more flexibility of La Hague plant to treat more diverse fuels. AREVA is confident that it can manage ageing management, while improving the process efficiency, reducing the waste production, and is ready to help its Japanese partners for J-MOX and RRP successful start.

ANDRA presented the latest development of the CIGEO project. The detailed design is under way, in order to ask for a license for mid-2018, and the expectation to have the license for 2021. Several documents are already produced, like the safety option file, the master plan for CIGEO, including the technical options for reversibility, and the territory documents which details the proposal for the local community development. The definition of the retrievability is especially interesting,

since it gives the future generations the possibility to choose alternative options.

JAEC detailed the new process of siting as decided by the law of May 2015. The government has the leadership to promote the siting. The beginning is a literature survey to determine scientifically preferable areas, according to different criteria, and ranked in 3 categories: less suitable, suitable and more suitable. In these areas, a dialogue is implemented with local communities. JAEC has the task to review the activities of different government bodies or agencies or organizations (METI, MEXT, NUMO, JAEA, EPCO...) related to this site promotion. The radioactive waste working group of METI is currently reviewing the “scientifically preferable area”, following JAEC’s remarks.

## **V/ Future systems development**

CEA presented the latest development of the ASTRID program. The basic design is currently underway, with the participation of numerous industrial and R&D partners, from France and abroad. Through the 2014 agreement, Japan is a main partner with JAEA and MHI-MFBR, Japanese skills, know-how and facilities being very valuable for the program: the current design contribution moving for 3 to 9 components and R&D contribution being important as well. The main innovations of ASTRID are pointed out: low void coefficient core, gas conversion energy system, core catcher, in service inspection and repair...CEA is conducting the design under an agreement with the French government until 2019, and is now thinking about the next step, by introducing a consolidation phase from 2019 to 2023. The rationale for moving from the current LWR and associated fuel cycle to Fast reactors and FR cycle is presented, and CEA is studying different scenario in collaboration with EDF and AREVA for FR deployment strategy during this century.

JAEA introduced the work of the Council on Fast Reactor Development, and expects the government’s decision on the future of Monju by the end of this year. The collaboration with France on ASTRID program is then detailed, with important component design tasks for ASTRID: in vessel active decay heat removal system, Curie point electro-magnet for passive shutdown system and seismic isolation system. These are the initials design tasks, but new ones will be launched and there is also a joint evaluation of different components. The R&D tasks are performed by JAEA as follows: fuel R&D (7 tasks), reactor technology (10 tasks) and severe accident (9 tasks). For the future, design and joint evaluation will be performed under the current agreement, and this successful collaborative arrangement could lead to greater collaboration for future phases.

## **VI/ Conclusion**

Both parties recognize that this 2016 edition of the N20 was fruitful, and allowed as usual frank and deep discussion about the issues at hand for Japanese and French nuclear executives, and look forward to gathering again in 2017 in Japan, at a mutually agreed date.