

Conference highlights
WRFPM2008 - Water Reactor Fuel Performance Meeting,
Seoul, South Korea 19.-23.10.2008

KNS, AESJ, CNS, ENS and ANS have jointly organized the 2008 Water Reactor Fuel Performance Meeting, following to the successful International LWR Fuel Performance Meeting held during September 30 - October 3, 2007 in San Francisco, USA. Merging three premier nuclear fuel design and performance meetings: the ANS LWR Fuel Performance Meeting, the ENS TopFuel, and ASIAN Water Reactor Fuel Performance Meeting (WRFPM) created this type of topical international nuclear fuel meeting. The meeting will be held annually on a tri-annual rotational basis in USA, Europe, and Asia. This year it was organized in hotel Renaissance, Seoul South Korea, in period 19.-23.10.2008. In total 315 participants had possibility to follow about 200 papers presented in frame of oral or 2 poster sessions.

The technical scope of the meeting included all aspects of nuclear fuel from fuel rod to core design as well as performance experience in commercial and test reactors. The meeting excluded front end and back end fuel issues; however, it covered all front and/or back-end issues that impact fuel designs and performance. In connection to the conference, exhibition of several (mostly Korean) companies was organized in the foyer of the conference halls.

The scientific program was split into 5 tracks:

Track 1: “*Advantages in water reactor fuel technology*” was focused on innovative or improved achievements in fuel components and assembly designs, fuel materials, manufacturing processes, and verification/validation of test techniques for fuel performance. This track was interesting for many participants or company representatives not only due to high scientific quality but also due to a wide spectrum of commercial applications.

A higher competitiveness of nuclear energy is assumed to be provided through a higher effectiveness of a nuclear fuel use, higher safety and economic parameters of a reactor (increased burn-up, load-follow operation of NPP). In turn, the serviceability of a reactor as well as many technical and economic characteristics of NPP as a whole and the behavior of reactor under emergency conditions significantly depend on the quality and reliability of fuel rods. Gadolinium oxide as an integrated burnable absorber in uranium fuel promotes a higher safety of a light water reactor operation. However, the introduced gadolinium oxide results in a decreased thermal conductivity of fuel and correspondingly in a rise of its temperature. It is also known that with burn-up increases in the peripheral region of a pellet specific microstructure develops, attended with a formation of sub-grains (the effective size of a grain decreases) and coarser bubbles along grain boundaries (the so-called «rim» structure) which leads to higher fission gas product (FGP) releases even under conditions of lower rating. As a result, the fuel-cladding interaction is enhanced

Track 2: “*Fuel Performance and Operational Experience*” reviewed all aspects of operating experiences including analyses of failure experiences and investigations for PWR/VVER, BWR, PHWR and MOX fuel. Processes as the stress corrosion cracking, post irradiation experiments and data collection, irradiation experiences in test reactors, radiation effects limiting the fuel performance lifetime or structural integrity were referred in the

presentations. Special accent was dedicated also to water chemistry issues and corrosion counter-measures.

Investigation on the possible benefits of increasing the hydrogen concentration in the reactor coolant system with regard to ameliorating the occurrence of the primary water stress corrosion cracking (PWSCC) of nickel base alloys were discussed in detail. The hydrogen concentration shall be increased in the commercial plant from 25-50 cc/kg to a target of approximately 50cc/kg. The consequence of this envisaged increase of hydrogen concentration in the water of the primary circuit has been investigated. A consensus seems to emerge : this change in hydrogen content will have no impact on fuel reliability. This conclusion is even reinforced in the case of an M5TM alloy, considering the very good corrosion/hydrating behavior of this alloy.

The change in corrosion product deposition rates, with and without zinc injection is more difficult to investigate and it is suggested to set-up an in-reactor fuel surveillance program during the first implementation of higher hydrogen additions.

The burn-up optimization (having in mind also next utilization of burn-up fuel in MOX) was also reported and discussed.

Track 3: "*Transient Fuel Behaviour and Safety-Related Issues*" was dealing with transient fuel behaviour and their criteria such as RIA, LOCA, ATWS and ramp tests. Of course, the fuel safety-related issues such as PCI (Pellet/Cladding Interaction), transient fission gas release and cladding bursting/ballooning during transient events were discussed with high priority. Nuclear safety is undoubtedly one of the most important issues which has to be solved by analyzing all possible impact factors, using both deterministic and probabilistic safety approaches.

Track 4: "*Fuel Cycle, Spent Fuel Storage and Transportation*". This track was focused on recycling and disposal of spent fuel and fuel cycle economy. There were discussed topics as: spent fuel storage and its regulatory issues such as on-site storage, long-term interim storage and experience with interim storage installations. Spent fuel transportation and its regulatory consideration were deeply analyzed and considered as essentially important for next acceptance of nuclear fuel issues by public. The importance of proliferation issues increases gradually in recent years.

Track 5: "*Fuel Modeling and Analysis*" is in actual research strongly developing. Computer simulation is popular mostly by young generation familiar with computer techniques, but sometimes trying to go the shortest way to some published results and trying to avoid long-term experimental research in laboratories. Nevertheless, many presentations were of very high quality. Topics as: general fuel modeling methodologies, fuel performance models and computer codes, simulation of fuel behaviour under changing reactor operation conditions, and computational simulation of material properties were presented in details.

It is important to elucidate the thermal-mechanical behavior of the fuel with the objective of improving the engineering design of the fuel rods, especially after a strong pellet-cladding mechanical contact has been established. This knowledge can be incorporated into the fuel modeling codes, where the aim is to numerically simulate the interaction between a fractured ceramic cylinder (nuclear fuel pellet) and a metallic tube (Zircaloy cladding). While the evolution of the cladding mechanical properties with neutron fluence is relatively well

understood through a large number of mechanical testing, this is not true for fuel pellet material. For nuclear fuel pellet, the evolution of the mechanical properties with burn-up is challenging because of the steep radial gradient in the properties as a result of the irradiation, but also because of the pellet cracking and micro-cracking. The remaining questions in this area are about the evolution with burn-up and temperature of the: (a) elastic properties; (b) thermal creep behavior, where the possibility for the grain boundaries sliding mechanisms may become predominant; and (c) irradiation creep.

Participants had the possibility to vote for the best poster presentation which was awarded by the special price as well as the best presentation of the young generation representative. This transparent procedure seems to be a good way to attract the interest of conference participants for young generation papers. Nuclear fuel issues are typical nuclear topics connected to one of most attractive part of nuclear power engineering. Beside this, there are not only a lot of money, but also a lot of interesting topics for scientific investigation and thesis for post-gradual study. The optimal promotion of young generation work is a positive approach in their next long-term activity in this area.

Next WRFPM will be again in Europe. The TopFuel meeting will be organized in Paris at September 6-10, 2008. I can only strong recommend for all nuclear fuel experts to take part in this meeting.

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