REPORT ON THE 8th INTERNATIONAL CONFERENCE ON CANDU FUEL, HONEY HARBOUR, ONTARIO, CANADA, 21-24 SEPTEMBER 2003

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Altogether, 92 fuel specialists from 8 countries (Argentina, Canada, China, Egypt, France, India, Rep. of Korea and UK) took part in 5 sessions of the Conference. Five review papers presented CANDU/PHWR fuel status and development trends in Argentina, China, Canada, India and the Rep. of Korea and 58 contributed papers were dealing with fuel failure analyses for the current fuel, advanced CANDU fuel designs (different modifications of CANFLEX fuel bundle) and advanced fuel cycles, QA/QC in fuel fabrication, code development and fuel performance, fuel management and handling. Emphasis was given to the recent R&D in fuel design and materials to provide safe and reliable reactor operation under more demanding conditions including higher burnups (from 7 MWd/kg U with natural UO_2 to 10-12 MWd/kg U with Slightly Enriched Uranium-SEU fuel or higher, up to 18 MWd/kg HM with MOX fuel) and advanced fuel cycles (with Reprocessed Uranium, MOX or spent LWR fuel). Also, a principally new type of fuel for the new CANDU reactor, named Advanced CANDU Reactor (ACR), was presented by the AECL.

ACR will be built on the traditional CANDU fuel-channel design with on-power refuelling, light water coolant, heavy water moderator and reflector, a reduce lattice pitch, greater coolant pressure and temperature for better thermal efficiency. Fuel bundle geometry will be like CANFLEX bundle (43 rods), with 2.1 % ^{235}U in all but the central rod, which contains 7.5% dysprosium oxide mixed with natural uranium oxide. It is expected to reach burnup of 21 MWd/kg HM, nearly 3 times greater than natural uranium fuel. Maximum average channel, bundle and linear rod powers will be 7.3 MW, 850 kW and 47 kW/m, respectively. AECL's fuel qualification programme includes in-pile and out-of-pile tests as well as calculation and modelling work to prove that fuel meets design requirements and criteria.

The leading role in CANDU fuel design development belongs, of course, to Canada driven by the development of fuel for ACR. But during the last several years, serious developments in CANDU fuel design and fuel cycle were also done by the Republic of Korea or jointly by Canada and the Rep. of Korea and by co-operative effort of Canada with Argentina and Romania. Significant effort to optimize national PHWR fuel cycle infrastructure and to improve PHWR fuel performance has been done by China and India. CANDU fuel failure rate has lowered worldwide during the last five years till level of 0.04% (without Pakistan for which there are no available data). For example, from 2200 bundles of domestic fabrication discharged from the CANDU reactor of Quinshan NPP (China) only one bundle was confirmed as the failed one.

In the framework of Parallex project, three bundles with MOX fuel were assembled in the Chalk River Lab. Irradiation of the first experimental bundle loaded with MOX (3.1% WG Pu in depleted uranium oxide) fuel rods fabricated in Russian Federation and the US started in February 2001 in the fuel test loop of NRU reactor. The bundle was irradiated at linear power of 40 kW/m and was discharged in January 2003 after reaching the planned burnup of 15 MWd/kg HM. Second and third bundles with MOX rods were loaded later and they are still under irradiation. Visual examination of the first bundle in a storage pool demonstrated good fuel condition. More detailed information will be received after destructive post-irradiation examination by the end of this year.

Recommendations:

The meeting was an important event for experts in CANDU (PHWR type) fuel technology, performance and utilization. Argentina, Canada, China, India, Republic of Korea (also Romania and Pakistan) operate PHWRs, and some other countries perform R&D in CANDU fuel area (France, Egypt, Indonesia, Turkey, UK). The current stage of fuel utilization in CANDUs, like in LWRs, is

characterized by the implementation of more demanding core designs and operational strategies to improve plant performance, to extend burnup and to use advanced fuels (MOX, SEU, EU and DUPIC). New type of fuel will be required for the new type of CANDU reactor called Advanced CANDU Reactor (ACR) that is now under development. The possibility of ex-weapon Pu disposition in CANDU reactors is under testing now (Canada, Russia, USA) in the fuel test loop of NRU reactor in Canada.

Further IAEA co-operation in the CANDU Fuel Conferences (biennial) is recommended. For this Conference, the Agency initiated invited key papers from Argentina, China, Egypt, India and Republic of Korea describing fuel performance and fuel failure cases in CANDUs.