International Atomic Energy Agency

International Perspectives on the Management of Spent Fuel from Power Reactors

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An UN Organization

International Atomic Energy Agency (1957)

Department of Nuclear Energy (NE)

Division of Nuclear Fuel Cycle and Waste Technology (NEFW)

Nuclear Fuel Cycle and Materials Section (NFCMS)

Subprogramme of the Management* of Spent Fuel from Power Reactors [* but disposal → Waste Technology Section]

More than half a century ago

October 1958: Panel of Experts on Radioactive Waste Disposal in the Sea (Canada, Czechoslovakia, France, India, Japan, Netherlands, Sweden (Chair), UK, USA and FAO, WHO, UNESCO). Conclusions and recommendations published in 1960: When nuclear fission eventually becomes a major source for meeting the world's energy needs, the output will probably amount to at least 1000 tons a year. Release into the sea of high level wastes from irradiated fuel cannot be recommended as an operational practice. Fixing such wastes into solid, non-leachable forms. No word on public confidence, public acceptance, public involvement, public ...

More than half a century ago (cont.)

November 1959: Scientific Conference on the Disposal of Radioactive Waste, Monaco, IAEA-UNESCO-FAO (more than 300 experts from 32 countries and 11 international organizations). Waste from reprocessing of spent fuel, recovery of fissile material like Plutonium, disposal of high activity material at great depth in geologically suitable strata, studies were under way in natural salt formations, incorporation of high level fission products in glass. Everything (discharge/dilution, concentration/isolation, hydrology, thermal load, possible hazards of disposal in the sea, etc.) but public confidence, public acceptance, public involvement, public …

Almost four decades ago

March 1976: Symposium on the Management of Radioactive Wastes from the Nuclear Fuel Cycle, Vienna, IAEA-OECD/NEA (more than 350 experts from 32 countries and 5 international organizations). It is clear that suitable technology and processes have been conceived and have been and are being developed for managing the present day amounts of radioactive wastes and effluents from nuclear facilities. Meanwhile, a concerned public is questioning the effectiveness of this management. In spite of the capability of present technology and development work to cope satisfactorily with present needs, long-term safe disposal has not yet been fully demonstrated for the larger quantities that will arise.

Almost four decades ago (cont.)

USA: Country wide evaluation, geologic formations to be evaluated included bedded salt, dome salt, shales, other argillaceous formations, limestone, granite, other crystalline rocks and volcanic formations. High level waste disposal schedule: Select site for pilot plant #1 in 1978, initiate operation of pilot plant #1 in 1984, additional pilot plants will follow at approx. 2 years intervals

India: Choice #restricted to igneous rock formations and some selected sedimentary deposits. Evaluation of geological formations in selected areas of the country. Geological and hydro-geological, physico-chemical, climatological and seismic data collection. Work in too preliminary stage

Almost four decades ago (cont.)

Canada: Disposal of high level wastes from reprocessing are being developed as well. A mined cavity in plutonic crystalline rock is favoured, but salt is a strong candidate being carefully evaluated. A geologic disposal facility is expected to be available for commissioning and test emplacements by 1985. By the year 2000 it could be licensed to accept wastes on a routine production basis

Belgique: Disposal will have to be solved within the next few decades. Research and development programme aimed at evaluating the suitability of a clay bed. General geological and hydrogeological aspects, chemical and mineralogical analysis of samples. Planned; 200-250 m deep underground research laboratory, 590 m deep repository for high level and transuranic wastes

The Reality of the End Point of the Spent Fuel Management

Spent fuel reprocessing annual (January-December 2012) capacity (~ 4 800 MTHM) in 4 Member States (MS) – France, India, Russian Federation and UK – yearly spent fuel arising in 30 MS (~ 10 300 MTHM) and spent fuel accumulated in 3 MS currently with shut down power reactors

Spent fuel disposal (As of May 2013): Operation: 0; Operation licences: 0; Built: 0; Construction licences: 0; Construction licence applications: 2 in Forsmark, Sweden, submitted in March 2011 and Olkiluoto, Finland submitted in December 2012

An Unsustainable Future

Because lack of end point in all MS but France and possibly Sweden and Finland: Reprocessing – either insufficient or unavailable (due to economy, politics) – or disposal – failed, not determined or repeatedly postponed by subsequent deferrals (due to public confidence issues)

Most MS will face the need for spent fuel storage beyond the long term i.e. longer than about 100 years without any end point (impacts public confidence, financing, transgenerational burden) even safely and securely practicable as demonstrated along the last five decades

VIC, Vienna, Austria /Photo Credit: ZOUXUXIN