Large and ASSOCIATES

OUTLINE BRIEFING

INVESTIGATION OF THE CONDITION AND STABILITY OF

i) THE RADIOACTIVE WASTE TRENCHES

AND

ii) IRRADIATED FUEL STORAGE FACILITIES

AT AND NEARBY THE
SHUT DOWN NUCLEAR POWER PLANTS OF CHERNOBYL, UKRAINE

(BASED ON THE MEETING WITH JAN VANDE PUTTE OF 20 DECEMBER 2005)

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SITUATION OF THE RADIOACTIVE WASTE DUMPS AND IRRADIATED FUEL STORES AT CHERNOBYL

BACKGROUND

Radioactive Waste

The N° 4 RBMK nuclear power plant at Chernobyl (ChNPP) underwent a catastrophic containment failure on 26 April 1986 the result of which was that large tracts of the environment nearby and beyond were contaminated by radioactive fall-out. The emergency clean-up operations of 1986-87 resulted in a somewhat ad hoc radioactive management scheme whereby the fuel and reactor debris remaining in the shattered reactor building was to be contained within a hurriedly constructed sarcophagus and, where recovery was possible, radioactive contamination in the environment was buried in trenches, held in settling pond, river damming and dredging schemes, and so on.

In the Ukraine, the radioactive wastes trenches and dumps, excluding the radioactive materials held in the sarcophagus, depending on which source of estimate is taken, totalled about one or 2+ million cubic meters of radioactive wastes, although these dumps or *'Sites of Temporary Waste Localisation'* (STRWL) do not satisfy the present Ukraine regulatory requirements for low-level disposal facilities. The waste includes debris from the reactor and its building, contaminated soils, abandoned vehicles, and wood from pine trees heavily irradiated/contaminated in the aftermath of the Chernobyl incident.

The impact and consequences of Chernobyl were widespread. In the geographical region a total of about 440 radioactive waste dump sites were established, including 325 in the Ukraine, 92 in Belarus and 19 in Russia with corresponding amounts of radioactivity contained in these dumps being approximately 8 10^{15} Bq in Ukraine, 3 10^{12} Bq in Belarus and 2 10^{11} Bq in Russia.

The main disposal sites nearby the Chernobyl NNP are in the form of shallow or near-surface trenches, mostly without lining and with the deposited waste being unpackaged. About 100 dumps are within the exclusion zone and these tend to be periodically or permanently flooded. Migration of radionuclides (^{137}Cs and ^{90}Sr) has occurred and is continuing. At the time of the waste collection and disposal, attempts were made to distinguish between *'high'* and *'low'* with three dumps (*Podlenyi*, *3rd Stage ChNPP (*might be referred to as *Komplexnyi)*, and *Buriakovka*) being generally reserved for the higher activity waste and which are believed to be concrete lined (although no design documentation is available), holding combined about 5.5 10^{15} Bq of the total Ukraine radioactive waste. Of these sites, it is believed that only *Buriakovka* complies with the Ukraine regulatory requirements although, that said, it is doubtful that in practice these would stand any common sense test of durability and sustainability. Considerable concern has been expressed about containment role of the *Podlenyi* and *3rd Stage ChNPP* dumps.

The situation in Belarus is that about one-quarter of its territory was contaminated, mainly with ^{137}Cs and ^{90}Sr in the form of segregated fission product particles rather than the hot fuel particles found in the immediate area of the Chernobyl NPP site in the Ukraine. A total of about 400,000 cubic meters of radioactive waste is held in Belarus segregated into three activity categories the highest (PSDW I) is a concrete lined trench disposal system at *Khatki*. The other lower-activity categories of waste (PSDW II and III) are a mix of unlined trenches, quarries and pits, ravines and heaps. Many of these are periodically flooded and it is known that radionuclide migration has progressed into the groundwater table.

RBMK Irradiated Fuel

Ukraine is committed to the Joint Convention of the Safety of *Spent Fuel Management and Safety of Radioactive Waste Management 1997*.

RBMK fuel assemblies comprise two radial arrays of a total of 18 ~2% enriched uranium dioxide pellets in pins of zirconium alloy cladding of about 3.65m length with two end-on-end arrays making up a single fuel assembly of 79mm overall diameter. With the bottom seating and neutron scatter assemblies, the overall fuel assembly is about 10m length and about 560kg weight.

The spent fuel from the normal operation of all four RBMK at Chernobyl is presently wet-stored in reactor ponds on site but these original Chernobyl NPP fuel ponds and in the SFISF-1 (or KHOJAT-1) common pond, none of which are likely to be compliant with the requisite radiological, seismic and aircraft impact, site services and radiological standards. Some fuel may remain 'stored' in the closed down reactor cores of Units 1 and 3 of the Chernobyl NPP[1] and, with fuel in the cores, these reactors have to be maintained in an operational state for nuclear safety reasons. There are no fuel cycle facilities in the Ukraine with this 'open' cycle and the economic restraints of paying the Russian Federation for removal of the spent fuel, has resulted in accumulation of both RMBK, VVER and WWER (PWR) fuel, although WWER transports to Russia are now underway. Because of poor reactor pond water quality controls at the Chernobyl wet fuel ponds (and closed down reactor cores still holding fuel), the structural and containment condition of the fuel is likely to be poor which, in itself, will present fuel handling and transportation difficulties.[2]

Presently under construction in the 30 km Exclusion Zone is an interim dry storage facility (ISF-2 – Nuhoms) by Framatome. This interim storage facility will have a capacity of 22,000 RBMK fuel assemblies and 3,000 neutron absorber rods although further details of the store and the transportation and fuel handling systems are not available. The Framatome spent fuel store, now six years into its construction, however, seems to have run into considerable difficulties of delays and cost overruns.[3]

The Ukraine has plans to construct a fuel handling plant to render the interim stored although information on progress towards this aim is sparse.

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1 There are believed to be 21,352 fuel assemblies at the site, including 65 fresh assemblies. Cores of the first and the third reactor units contain 812 and 1,563 assemblies, respectively; there is no fuel in unit 2. In the cooling ponds of units 1, 2, and 3 there are 1,288, 1,057, and 961 assemblies, respectively. In the old Soviet-designed pool storage, there are 15,603 fuel assemblies. The design lifetime of that facility expires in 2016. In 1997 the estimated combined ChNPP fuel and waste stores held 13,300 fuel assemblies, along with 33,800m^3 solid and 20,000m^3 liquid wastes.

2 Up to 5% of the pond stored fuel may be in poor condition with water penetration into the pins which results in containment problems during interim storage.

3 Nucleonics Weekly, 15 September 2005