

The Mayak project

Radioactive contamination in Russia

by Richard Shaw & Paul Hooker, *Keyworth*

The BGS, jointly with a team from AEA Technology and partners from a number of Russian organisations, have recently completed a project funded by the European Commission (EC) on the assessment of the situation and disposal concepts for radioactive wastes arising from reprocessing operations in Chelyabinsk-65 (Mayak). The report on this work will be published by the EC in due course.

The Mayak works are situated on the eastern edge of the South Urals near the closed city of Ozyorsk. It was the site of early Russian plutonium production and later a major spent nuclear fuel reprocessing plant was established there which is still in operation. The safe management and eventual disposal of the radioactive wastes produced at the site are key issues.

The principal aims of the project were:

- to assess quantities and activities of existing and expected future waste arisings
- to propose a number of appropriate disposal strategies
- to evaluate the local area for suitability for safe shallow and deep waste disposal according to internationally agreed standards

Most of the area consists of Silurian to Devonian metavolcanic rocks. These are deeply weathered in some areas, resulting in a more permeable zone in the uppermost 100 metres or so. Metasedimentary rocks, including marbles, occur in the east of the area.

Deep borehole disposal of vitrified high-level waste within the metavolcanic rocks is an option that should meet Russian and International Atomic Energy Agency (IAEA) safety guidelines though no site characterisation work has yet been carried

out to confirm this. Existing and future shallow disposal facilities for intermediate (ILW) and low-level waste (LLW) are likely to need engineered barriers to enhance containment.



Metlino Mill built in the early 1900s and now in an advanced state of decay. It was abandoned in the 1950s when the village was relocated away from the Techa River.

The EC has separately funded projects evaluating specific radioactive pollution from accidental and process-related discharges that make Mayak one of the most radioactively contaminated districts on Earth. Between 1949 and late 1951 all liquid waste resulting from the production of plutonium was discharged into the Techa River adjacent to the site. This caused gross radionuclide pollution downstream, detectable all the way to the Kara Sea. A number of villages, including Metlino, were

relocated away from the river. However, doses received by some local populations, particularly those using the river or eating fish from it, were very high. To control the movement of radionuclides downstream a series of dams were built creating a number of large reservoirs of sufficient capacity to contain all local run-off balanced by natural evaporation (though there is some discharge from the reservoirs into the canals, particularly through the marbles). Two diversionary canals intercept clean drainage to discharge into the Techa River below the lowest dam.

To compound the problem of the Techa River, two accidents occurred at the plant, the explosion of a high level liquid waste tank in 1957 and the drying out of Karachy Lake in 1967. The lake is an internal drainage basin used until recently for the discharge of intermediate level liquid waste. Subsequent suspension and distribution of radioactive dust by the prevailing wind in 1967 led to the dispersal of significant quantities of radioactivity over a large area to the north-east of the site. The dispersion plumes from these two accidents are similar and overlie the same track of ground (tens of kilometres wide and more than a thousand kilometres long) with the most contaminated areas being near the plant and reservoirs.

An area of over 200 square kilometres, including the whole of the plant area, the reservoirs, and much of the worst of the contamination from the accidents, form a controlled zone with limited access, mainly for monitoring purposes. The more contaminated areas that are outside the controlled zone were treated by a number of methods including deep (one metre deep) ploughing so that they can remain in use. The controlled zone is not fenced but is policed and, while access by the general public is not permitted, hunting of game and gathering of hay and mushrooms occur within the zone, increasing the exposure of some sections of the local population.

The final solution adopted for ILW/LLW disposal at Mayak will have to accommodate not only the wastes arising from the reprocessing activities, but also the appropriate isolation of sediments accumulated on the beds of the reservoirs and, possibly, of contaminated soils resulting from the two accidents.

Richard Shaw, BGS © NERC