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## Sweden offers a lesson in handling nuclear waste

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Now that President Bush has signed the nuclear deal and India is planning to increase nuclear power generation at least 15-fold by 2030, it may be time to work out how we will handle the radioactive waste generated by the new reactors.

At present, India has nine operational nuclear reactors. At least eight more are being developed by the public sector. Private companies want a piece of the action too. Clearly, nuclear waste disposal is likely to be of critical importance to India this century.

The Swedish example may offer lessons for India. For three decades, Sweden has used nuclear power to meet 30% of its energy needs. It has done so safely. Claes Thegerstorm, president of Svensk Kärnbränslehantering AB (SKB), a Swedish nuclear fuel and waste management company, says, "We have 10 nuclear reactors and almost an accident-free history of handling them."

SKB has been involved with the disposal of radioactive waste since 1977. Its ship, MS Sigyn, is designed to transport spent fuel from nuclear facilities, hospitals and industry to the waste disposal centres at Forsmark and Oskarshamn. Highly radioactive and hazardous spent fuel is placed in special containers and transported by sea to the repository at Forsmark, 50 meters below the Baltic Sea. "The repository can accommodate 63,000 cubic meters of waste. So far, nearly 31,000 cubic meters have been utilised," says Michael Akman, information officer at Forsmark.

The repository has four, 160-metre long rock vaults and a rock cavern with a 50-metre high concrete silo. Each silo has deep shafts separated by concrete walls. Each shaft takes in six meters of waste. Once filled, the shaft is sealed with concrete. Standard freight containers and ordinary fork-lift trucks are used to take low-level nuclear waste directly into the rock vault. Medium-level nuclear waste is transported in trucks specially-built to handle higher levels of radioactivity.

Between the outer wall of the silo and the bedrock is a thick layer of betonite clay, which prevents seawater from seeping in. It is undeniable that once the repository is finally sealed, water will slowly seep in. But it will be years before the radioactive nuclides float up to reach the surface of the sea and it's thought the waste will have lost much of its toxicity by then.

Meanwhile, the high-level spent nuclear fuel from Swedish reactors is kept at a temporary storage facility in Clab, north of the Oskarshamn nuclear plant.

"The fuel is being stored in an interim water basin, 30 m below the surface. It will be kept there for 30 years - by then, 95% of its heat and radioactivity will be lost. But it'll still be highly radioactive and will need to be shielded," says Akman.

In Clab, the waste is transported in a cask on a terminal vehicle that resembles a truck. Then it's stored in specially designed steel canisters that prevent nuclear fission during storage.

The final repository for the high-level waste will be built 500 meters below the rock surface. Three levels of barriers will be used - copper canister, betonite clay and rock. "The copper canisters will be encapsulated in a special plant," says SKB president Thegerstorm.

SKB claims that a special method of sealing and welding the canisters makes them leak-proof. Once the canisters are filled with nuclear waste, they will be transported in a remote-controlled machine to the deposit hole.

Rings of betonite clay will act as a buffer between the holes and the canisters.

Once all the tunnels have been used, they will be filled with blocks of betonite clay, which swells when it comes in contact with water and becomes extremely tight. The repository is expected to contain 6,000 canisters.

SKB is preparing for the construction of the final repository with a test-run at Aspo HRL, just outside Oskarshamn. The test-run is being conducted with the help of other nuclear power-enabled countries, such as Canada, Finland, Germany, France and Japan.

The Swedish experiment has many important lessons for India in managing nuclear waste safely. Given India's long coastline and abundance of mountainous and hard rock, it will not be difficult for us to find the right place to build a final repository for nuclear waste.

It is a contentious issue. The Nuclear Energy Agency (NEA), a specialized agency within the Organisation for Economic Co-operation and Development, concedes it is a serious problem. "One of the key issues that has dominated the nuclear debate in recent years has been the safe management of radioactive wastes.... they have caused more public concern than any other type of waste," says the NEA.

There are apprehensions in India too. The lack of public data makes it difficult to estimate the quantity of nuclear waste generated here.

However, a research paper published in 2001, 'Estimating nuclear waste production in India' by scientists M V Ramana, Dennis George Thomas and Susy Varughese, estimated that India produces 5,000 cubic metres of high-level nuclear waste every year, in addition to thousands of cubic meters of intermediate and low-level nuclear waste.

This can only be expected to grow into a gigantic waste problem.

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