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How 2 Swedish towns vied for nuclear waste

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The Äspö Hard Rock laboratory, in Oskarshamn, where scientists test nuclear waste storage methods

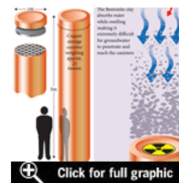
Civic competition is a deep and ancient force. Ever since towns were towns, they have found ways to assert their superiority over one another, through commerce, war and other, more sporting encounters. The thrill of outdoing a neighbour, the fear of losing to the rivals from along the shore, are apparently universal human urges and the world crackles with all kinds of local contests, from the town lantern competitions of the Philippines to America's "Best Tennis Town" and the tidy villages of Ireland.

A few of these competitions are born of a culture so specific they can be hard to understand. In the Thai town of Phuket, temples founded by Chinese immigrants compete to produce extraordinary displays of human self-harm and mutilation, known as *mah song*. In Sweden, meanwhile, two municipalities, Östhammar and Oskarshamn, have spent the past seven years competing for the right to host the world's first high-level nuclear waste storage facility.

The waste facility at Forsmark power station, Östhammar

Although it comes in many varieties, nuclear waste is short on what most people consider winning qualities. It is the downsides that catch our eye, and, of these, high-level nuclear waste has a peculiarly rich array. This kind of waste is normally "spent fuel", long rods of uranium that have been burnt in a nuclear reactor. No longer capable of supplying the steady chain reaction that a power station demands, the bundles of radioactive metal emerge at the end of their useful lives to become a terrifying hazard.

They are hot, for a start. Fuel rods come out of a reactor at around 400°C and take 30 or 40 years to become safe enough to handle, a century to cool completely. As a result, they are often placed under water, which also cloaks their radioactivity. Because although only around 5 per cent of the uranium in fuel rods decomposes in a nuclear reactor, that is enough to spawn hundreds of exotic elements and isotopes, most of which fizz with harmful ionizing radiation. Few people have ever been exposed to nuclear fuel in this state and none has lived to describe what it feels like. In 2003, a Canadian report calculated that if you stood one metre away from unshielded spent fuel, fresh from the reactor, you would receive 10 Sieverts (Sv) of radiation in 36 seconds. That is enough to kill you several times over and in any number of ways, but you would probably burn to death.



Radiation, of course, diminishes with time. The problem with high-level nuclear waste is that there is so much danger to lose. If you returned after 10 years to the same spent fuel that killed you when it came out of the reactor, it would kill you again, but you would have stand next to it for about 50 hours this time. After 100 years, high-level nuclear waste is merely poisonous in a more conventional sense and would only do you real harm if you inhaled or ingested some of its longer-lived radioactive contents, such as caesium, strontium or plutonium. Inside the body, these gravitate to the blood and bones, weakening the immune system and causing cancer. One of the earliest known radioactive ailments was "necrotic jaw", suffered by the painters of luminous watch dials in the 1920s, who licked their radium-tipped paintbrushes to make a nice sharp point and then had their mouths fall apart. Scientists agree that high-level nuclear waste should be kept out of reach of humans for a minimum of 100,000 years.

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The people of Östhammar and Oskarshamn know all this – not that I heard anyone mention the necrotic jaw. Geologists and physicists have been convinced since the 1970s that high-level nuclear waste can be stored safely, as long as it is buried hundreds of metres underground in secure repositories. The problem has been convincing the rest of us. In the US, Germany, Switzerland and Japan, all attempts to designate geologically suitable sites or find communities willing to accept nuclear waste repositories have failed. Other countries, such as the UK, have given themselves long, mid-century deadlines for dealing with the question. Only Finland and France are at a similar stage as Sweden, with all three countries expecting to open repositories some time around 2025.

The proposed site for the high-level waste facility in Oskarshamn

But as things stand, there is not a single, permanent storage facility for civilian high-level nuclear waste anywhere in the world. Instead, hundreds of thousands of tonnes of spent fuel (35,000 tonnes in the EU; 100,000 in the US) sit in cooling ponds with no final destination. And with the world's nuclear generating capacity forecast to rise by one-third in the next 20 years, these ponds will not be big enough forever. There will come a point when we all have to start digging.

Seen this way, Östhammar and Oskarshamn, which already have six nuclear reactors between them, might seem models of Scandinavian rationality and civic responsibility. But Sweden's relationship with nuclear power is more complicated than that. For nearly 30 years, the country was in the odd position of relying on nuclear for around 40 per cent of its energy needs, while at the same time trying to get rid of it. In 1980, Swedes voted to phase out the country's 12 nuclear reactors, an official goal that stood until this year, when the government said it would seek to overturn the original referendum result and build a new generation of reactors. But nuclear power, and by extension, nuclear waste, remains a divisive issue in Sweden. Although about 80 per cent of people in Östhammar and Oskarshamn want nuclear waste in their municipalities, only 40 per cent of the Swedish population wants the repository anywhere at all. In other words, the people of these towns are anomalous, even among their own kind.

The man in charge of choosing the community that will host the waste facility is Claes Thegerström. He has been searching for a home for Sweden's high-level waste for 20 years and is the president of SKB, the country's nuclear waste company. With silvery hair and a ready smile, he resembles a friendly fox. "It took a hundred years to build the big very nice cathedrals in France," Thegerström told me. "And we are doing the same but downwards instead of up to the sky."

SKB has a lot of money. It was set up in 1977 to solve Sweden's waste problem and is funded by a small levy on nuclear power. Its cash pile has grown over the years to SKr40bn (£3.25bn). Like most people, I assumed that money was a big part of the reason why Östhammar and Oskarshamn might be willing to accept high-level nuclear waste. "It will certainly be a factor in their development," said Thegerström. SKB is planning to spend SKr25bn (£2bn) building the repository, a seven-year project that will bring 750 jobs. A further 220 jobs are then assured for the century that it will take to fill the repository with 12,000 tonnes of waste. On top of that, the chosen municipality will get new roads and infrastructure for the building of the underground complex – a series of descending shafts and radiating chambers, occupying about 4 sq km of bedrock.

But, as Thegerström explained, there is a twist. After years of competition, the mayors of Östhammar and Oskarshamn got together earlier this year and agreed to split a pot of SKr2bn (£162m) in pure "added investment" that had been promised to the winner. Under the deal, the loser would get 75 per cent of the fund – roughly equivalent to each municipality's annual budget – as a reward for taking part in the selection process.

To my mind, this created a strong incentive to come second: win the cash, not the waste. But for Thegerström it was proof that the towns also have ephemeral motives: a desire to do something "interesting", pride in doing "a very necessary thing" for Sweden and an eagerness to be chosen ahead of the other. SKB selected its two final contenders for the repository scheme in 2002 and for Thegerström the resulting element of civic rivalry has helped drive the process along. "What basic forces are driving people?" He said. "One of our values is competition."

Geologists assess granite formations, hundreds of metres below the ground

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I went to Östhammar on the kind of summer's day that power companies choose to shoot their adverts. The municipality is a two-hour drive north of Stockholm and a succession of diminishing roads lead out through pine forests and brilliant green meadows to the shore. Only 5,000 people, a quarter of the municipality's population, live in the town of Östhammar itself. The nuclear power station at the village of Forsmark is the municipality's most popular tourist attraction and its second-largest employer; 1,000 people work there. SKB also has a waste facility at the site, on a wind-whipped spit of land, edging into the Baltic, and most visitors to Forsmark like to see that too.

Inger Nordholm, who has spent much of the past decade persuading residents of Östhammar that a high-level waste facility would be a welcome addition to their community

That's where I met Inger Nordholm, one of three "community acceptance officers" for SKB, who has spent the past decade persuading the people of Östhammar that a high-level waste facility would be a welcome addition to the neighbourhood. Gulls winged over our heads in the blue sky and the ropes on a row of flagpoles cracked in the breeze. Nordholm loves her work. "It's very special I think," she said. "I work in public acceptance 24 hours a day. Sometimes it takes me two hours to buy a litre of milk."

She took me to see Forsmark's existing nuclear waste facility, in an underground chamber that holds Sweden's low-level and intermediate waste 50m below the Baltic Sea. Low-level nuclear waste is made up of everyday equipment – tools, gloves, trash – that has come into contact with radiation. It is stored in steel containers. Intermediate waste is usually parts of the water-filtration system used in nuclear power plants, and is encased in concrete. Ten times a year, Sweden's nuclear waste ship, the Sigyn, arrives in Forsmark and delivers containers and concrete cubes from around the country. Nordholm drove a white van into the facility, where water ran down the dark, granite walls.

She told me that when she started working for SKB, her family were the hardest people to win over to the repository idea. Even though there were already three nuclear reactors in the municipality, they drew the line at nuclear waste. "They had made their minds up: no, no, no," she said. But Nordholm talked them round with one of the arguments that SKB uses most often: the imperative to deal with the waste problem now, and not to leave it for another generation. "What will I tell my grandson when I am 70 years old?'" Nordholm asked them. "I am really scared that he will put me through the walls for something that I could have done but didn't do."

But as we looked at Sweden's low-level radioactive waste – white containers at the end of a long, strip-lit cavern – Nordholm explained that her persuading work was largely done. Accustomed to the presence of nuclear facilities, and reassured by the rigour of SKB's geological investigations, most people in Östhammar were looking forward to the economic upsides of the repository. "People want to win," she said. A poll taken by SKB in May showed that 79 per cent of people in Östhammar were either "for" or "totally for" the scheme. "Everyone says to me, 'When can we come and get jobs?'"

Nordholm took me to the site in Östhammar identified for a repository. Next to the power station, hundreds of metres below the ground, geologists have found a huge, unusually dry slab of granite, but on the surface there were rows of pale yellow prefabricated homes for temporary workers. Pine trees stood over everything and a few plastic wine glasses lay discarded in a bush. A thrush was hopping around. It was a modest, unshowy piece of earth but it was sad, nonetheless, to imagine it containing radioactive waste that would remain dangerous for the next one hundred millennia. I asked Nordholm if, really, she wouldn't rather the stuff went somewhere else. She shook her head. "I don't think it's allowed to be so convenient that it is someone else's problem," she said. "I don't like people who think like that." What about waiting for a better technological solution than just burying it? "You know with scientists you can always find more solutions," she said. "Sometimes you need to put down your feet and say that's enough."

The candidate site for a repository in Östhammar, next to the Forsmark nuclear power station

Jacob Spangenberg, the mayor of Östhammar, said something similar as we sat in his garden that afternoon. A former agronomist who spent six years in Uganda, Spangenberg looks a little like John Malkovich, the actor. "It's now or never," he said. "We cannot continue for another five years." Spangenberg was talking about the political process – after 15 years of coffee meetings, wildlife inventories and planning consultations, the politicians of Östhammar and Oskarshamn are worn out. "Maybe I'm fed up," said Spangenberg, and as he spoke I was struck by the seemingly irreconcilable spans of time – human versus radioactive – on which the handling of high-level nuclear waste turns. Even if everything goes as quickly and as smoothly as possible, Sweden's nuclear waste repository will not be built, filled and sealed for another 115 years. In reality, a further four generations of Spangenbergs and Nordholms are going to be involved.

The epic scale of the endeavour, however, has done nothing to dampen Östhammar's enthusiasm. "It creates a mental bubble: the municipality stands or falls with this decision," said Spangenberg. He said he was staying out of it. "I try not to get very excited, to keep calm all the time."

Indeed, when I asked him about his personal attitude towards the scheme, he said: "I believe it is a good way forward for Östhammar to have the repository but that is not the same thing as saying I want it." Instead, as a sceptic of nuclear power, Spangenberg said that the only thing that mattered was finding the safest possible place for the waste. "If it is not properly done, it is going to be so damn dangerous," he said. I asked him if he would be secretly relieved if Östhammar lost out in the end. "I have not thought about that," he said. "But it's a good question. It's an interesting question."

Something of a rarity in Östhammar, Kenneth Gunnarsson (left) and Miles Goldstick and are critics of the proposed scheme

Spangenberg's agnostic attitude has irritated both those in Östhammar who want the waste the most, and its very few opponents. Later I met two critics of the project, Miles Goldstick and Kenneth Gunnarsson. Goldstick and Gunnarsson are something of an odd couple. Goldstick works for Sweden's anti-nuclear movement and has a PhD in ecology, while Gunnarsson is a graphic designer with more abstract, ethical concerns about the repository. "They call me the philosopher," he said. But both are convinced that their fellow residents have not adequately weighed the risk they are about to take. "People don't bother," said Gunnarsson. "That is the problem. People are passive."

But Goldstick and Gunnarsson are the minority in Östhammar. That evening I went to the small harbour of Oregrund, where, on the waterfront, I met a group of men drinking under a night sky that was ball gown blue. Among them was Hans-Allan Elisson, who turned out to own the small hotel where I was staying. Elisson told me that 90 per cent of his guests had some connection to the nuclear industry and that winning the waste competition too was vital for the community's future. "You know it's one of the most poisonous things in the world, but we need it," he said. He was convinced, however, that Östhammar would lose to its bigger rival, Oskarshamn. Like many people I spoke to, Elisson thought Spangenberg wasn't doing enough to close the deal. "I think the rocks are about the same," he said. "But I think their politician guy is better than our guy."

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Oskarshamn was always favourite to win the repository. A manufacturing town 200 miles south of Stockholm, it is known for its powerboat races, ice hockey team and nuclear reactors. It has been called the Springfield of Sweden, after the town in *The Simpsons.* I travelled there the day after leaving Östhammar and found a town of apartment blocks and shopping streets. Oskarshamn has a Scania

truck-cab factory, a proud municipal graveyard and two local newspapers. Huge cruise liners turn around in the port. Of the area's 27,000 residents, 17,000 live in the town itself. But it is not Oskarshamn's relative size or density that made it seem like a natural recipient of Sweden's nuclear waste. It is because it is already there. Alongside the municipality's three nuclear reactors, which stand on a forested peninsula north of the town, is Clab, Sweden's interim high-level nuclear waste store. The cooling pools there currently hold around 5,000 tonnes of used uranium fuel rods in various states of heat and extreme radioactivity.

The KBS-3 method of storing nuclear waste

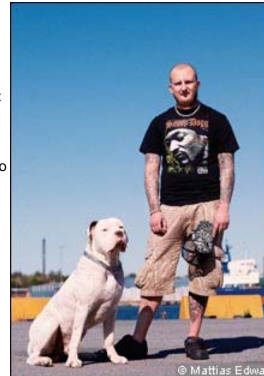
Since the 1990s, SKB has also used Oskarshamn to test its technology and its "KBS-3" method of storing high-level nuclear waste. There was a model of KBS-3 in every SKB office I went to: a cutaway of the giant, 5m copper canisters in which the spent fuel will be placed. The canisters are surrounded by rings of bentonite clay, which are designed to soak up any water in the bedrock and seal the canisters in their holes. The three layers – canister, clay and rock – are supposed to meet the statutory requirements of Sweden's radiation laws: that whatever happens over the course of 100,000 years, through ice ages and comet strikes, those living closest to the repository will have no more than a one in a million chance of developing cancer because of the radioactive waste.

Canisters containing waste will be placed in clay-lined holes 450m underground

SKB has been testing the method since 1995 in the Äspö Hard Rock Laboratory, built hundreds of metres below a small island near Oskarshamn's nuclear plant. Here I got a sense of what the eventual repository will be like. There was a dull smell of sulphur, and 400m below the surface, the bored-out passageways were perfectly round, the walls smooth to touch. At this depth, the horizontal forces in the earth's crust are more powerful than the weight coming down from above. My SKB guide showed me the 22 long-term experiments taking place in Äspö, which are testing the movement of radioactive substances through the rock, in case a canister leaks, and the canisters' ability to withstand heat and pressure. As we watched geologists tapping data into their laptops, she mentioned that a couple of engineers liked it so much they got married down here.

Peter Wretlund, the mayor of Oskarshamn, had none of the wariness of Spangenberg, his opposite number in Östhammar. "We are sitting right now in the most nuclear-power-friendly town in the world," he said when we met in his office, overlooking the town's harbour and battery factory. A Social Democrat and former union organiser, Wretlund speaks fragmented English and during our interview, which was translated by his assistant, he fiddled with a box of snuff. "It is about pride and identity," he said of the repository. "This could be a world unique thing."

In fact, the only thing that seemed to concern Wretlund was the lack of opposition to the scheme in Oskarshamn. "Why do they not activate more?" he asked. Formal opposition in Oskarshamn has been restricted to a single volunteer from MKG, Sweden's national conservation movement. And when I walked around the town, people seemed keen to embody Oskarshamn's reputation as a nuclear-friendly place. A schoolteacher told me how he liked to swim in the waste water from the nuclear plants, because it was warmer than the rest of the sea. "It is nice. It sounds strange. But it is nice." And when I met a 25-year-old man called Magnus Nilsson, whose mother worked at the high-level waste store, he could see nothing but opportunity in making that temporary store permanent. "Send England's shit here too and pay for it," he said. "We can take all the waste from all the world and put it in Oskarshamn. Think about the money."


Magnus Nilsson, an Oskarshamn resident, is keen to have the storage facility in his town, saying "we can take all the waste from the world"

In the end, the only person I encountered in Oskarshamn with doubts about nuclear waste was a 19-year-old music student called Elin who was leaving the town for good later that week. "I don't understand the people here in some ways," she said. "If you have grown up here you ask your parents about nuclear things and they are positive, so you don't question it," said Elin. "I think we should, shouldn't we?"

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Mayor Jacob Spangenberg after the announcement of the winning municipality

The winning town was chosen just two days later. The announcement was made in Stockholm, on a day streaky with wind and summer rain. At noon, the two mayors, Wretlund and Spangenberg, were summoned to the Sigyn, the waste ship, a vast red and white vessel moored in the centre of the city, and told where the repository would be. The press conference was about an hour later.

SKB employees kept the few protesters on the cobbled quayside. Inside, the two mayors stood on either side of Thegerström, the SKB president. It was impossible to know who had won. Wretlund held a sheaf of papers and looked like he had something to say, while Spangenberg, in dark jeans and a pale grey jacket, appeared slightly pained, a member of the wedding party unsure of his role.

"The bedrock has spoken," said Thegerström, and touched a button. There it was, on the screen: Östhammar. There was no applause, just a quickening of attention towards Spangenberg, who stood holding his hands tight together. Wretlund smiled, said a few words and started to slide to the edge of the stage. Spangenberg offered him a glass of water and a handshake and started to speak. The television crews surged towards him.

When Wretlund had a spare moment we walked out into the open air. He breathed in deeply. "I'm okay," he said. He looked awful. "I'm okay." He opened his box of snuff. I asked him how the people Oskarshamn would take the news. "I don't know," he said.

Peter Wretlund, mayor of Oskarshamn

By the time Spangenberg had finished talking to the cameras, the sun was out, but the wind was cold. He wore a black anorak and looked like a tourist. Photographers were still milling around. He said he felt sorry for Wretlund and Oskarshamn. "They were convinced that they were able to get it by their own efforts," he said.

He looked neither happy nor sad. I didn't know what to say to him. "I don't know what to say either," he said, and looked out at the view. Then I asked him if he was ready for his new life as the mayor of high-level nuclear waste and Spangenberg laughed loudly. "Oh no," he said. "I hope I will be recognised for something different." And then someone came up and took his picture.

Sam Knight is a regular contributor to FT Weekend Magazine

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