eco@work

January 2018

Sustainable reading
from the Oeko-Institut

Final storage

First steps

The National Support Body
Interview with Professor Klaus Töpfer

Starter's orders for final storage

Michael Sailer
CEO, Oeko-Institut
m.sailer@oeko.de

In July 2016, the German Commission on the Storage of High-Level Radioactive Waste presented its final report. I myself was a member of the Commission, which spent a total of two years working to define a procedure for the selection of a final storage site for Germany's nuclear waste. In summer 2016, the new Federal Office for the Safety of Nuclear Waste Management (BfE) began work and soon afterwards, the Federal Company for Radioactive Waste Disposal (BGE) was established as the operator of the final storage facility. In March 2017, the German Bundestag approved the amended Repository Site Selection Act (Standortauswahlgesetz). This means that a sound scientific, political and organisational framework is in place for the forthcoming search. Despite the challenges that this has involved, the process thus has democratic legitimacy, and that is immensely important. We can view this as an initial success, and it is something which I myself worked long and hard to achieve.

Now the real work starts on putting these theoretical bases into practice. Our approach to the search and the identification of a site must be diligent and unbiased at all times. The public in the potential site regions must be involved, and every stage of the process must be as clear and transparent as possible. This issue of eco@work describes the challenges that lie ahead. It also provides answers to the question of what awaits us, as a society, during the decommissioning and dismantling of our nuclear power plants now and in future.

I am particularly pleased that this issue includes an interview with Professor Klaus Töpfer, who is contributing to the search for a final storage site as a member of the new National Support Body (Nationales Begleitgremium). He reports on the initial stages of its work and explains how he believes it will be possible from the outset to engage with local citizens and involve them at every stage of the process.

At the Oeko-Institut, we will continue to provide constructive and critical support for the search for a final storage site: I myself will contribute, as will my colleagues who feature in this issue of eco@work and other staff who are working on this topic.

I hope you enjoy this issue of eco@work and wish you a good New Year.
Yours,

Michael Sailer

CONTENTS

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

eco@work – January 2018 (date of publication of German edition: December 2017) – ISSN 1863-2025
Published by: Öko-Institut e.V.
Edited by: Mandy Schossig (mas), Christiane Weihe (cw)
Responsible editor: Michael Sailer
Translated by: Christopher Hay
Design/Layout: Tobias Binnig, www.gestalter.de – Technical implementation: Markus Werz
Address of editorial office: Schicklerstr. 5-7, 10179 Berlin, Germany
Phone: +49 (0) 30/4050 85-0, Fax: +49 (0) 30/4050 85-388, redaktion@oeko.de, www.oeko.de

Account Details for Donations:
GLS Bank, Bank Code No.: 430 609 67, Account No.: 792 200 990 0,
IBAN: DE50 4306 0967 7922 0099 00, BIC: GENODEM1GLS
Donations are tax-deductible for German income tax purposes.

Picture Credits: Title: © racamani - Fotolia.com; P.3 left © VRD - Fotolia.com, right © Schulzendorff; P.8/9 © Glaser - Fotolia.com; other © private or © Öko-Institut, Ilja C. Hendel

"We must build trust and involve the public"

No discussions behind closed doors, no decisions over people's heads – the search for a final storage site will be transparent, fair and involve the public. A key role in this context is played by the National Support Body (NSB), set up at the recommendation of the German Commission on the Storage of High-Level Radioactive Waste. The NSB, whose members are respected public figures and citizens' representatives, is tasked with providing mediating and independent support for the site selection procedure and ensuring adequate public participation. In this interview with eco@work, one of its Chairs, Professor Klaus Töpfer, who previously served as Germany's Environment Minister and as Executive Director of the United Nations Environment Programme (UNEP), reports on its remit, objectives and progress so far.

Professor Töpfer, what has the NSB been doing since its constituent meeting in December 2016?
First of all, and under considerable time pressure, we scrutinised the draft of the Repository Site Selection Act (Standortauswahlgesetz) to ascertain whether it complied with the Commission's stipulations. Our analysis was then synthesised into a set of recommendations to the German Bundestag's Environment Committee and resulted in significant changes to the legislation – as regards the role of the NSB itself and the banning of exports of high-level radioactive waste, among other things. However, much of our work is still about establishing robust structures for the NSB and putting ourselves in a good position to respond when the discussion of specific sites begins. That means building trust and credibility, and that can only be achieved through transparency and strict independence.

Has there been any direct contact with the public yet?
Yes, of course. All the members of the NSB see consultation with citizens as the most important and central task. For example, in September 2017, we organised a fact-finding visit to the Asse II nuclear waste storage facility. We wanted to form our own impression of the facility, but one of our main priorities was to talk to people. We had some very long and informative discussions with members of the Asse Support Commission about the kind of experience they had gained in dealing with other agencies in the past. We can learn lessons from this for our own work, including the type of mistakes to avoid. And our meetings are open to anyone interested.

What do you see as the NSB's main role?
It is about involving people in decision-making early on. The time when decisions were taken over people's heads, with "acceptance" then sought retrospectively, is past. We have to build trust across society as a whole – especially within affected communities. That means involving the public in the site selection procedure from the start. So we have to show that we are able to create conditions for genuine participation. It's a constant learning process for us as well.

What expectations does the NSB have to fulfil in this context?
Honesty and transparency are key, as is the willingness to listen. We must discover what people need to empower and encourage them to participate. And we must refuse to bow to time pressure, as otherwise there would be suspicion that some concerns and objections are not being addressed. Of course it is important to have a timetable – not least with regard to the interim storage facilities where the high-level radioactive waste is being kept until the repository is open. But finding the best solution will take time. We also have to give people space to see themselves as participants in the decision-making process.

What made you take on this role?
It was not an easy decision for me, partly because I was at the centre of the conflict over the planned repository at Gorleben when I was Germany's Environment Minister. But I firmly believe that we have to deal responsibly with the legacy of nuclear power. The procedure that is now in place is sensible and workable. This is a massive challenge for the whole of society and I would like to make a contribution.

To what extent do conflicts like the one at Gorleben feature in the work of the NSB?
They are a big part of it. The way in which we deal with the past, its legacy and negative human impacts is a very good indicator of our credibility in tackling the challenges of the future.

Thank you for talking to eco@work.
The interviewer was Christiane Weihe.

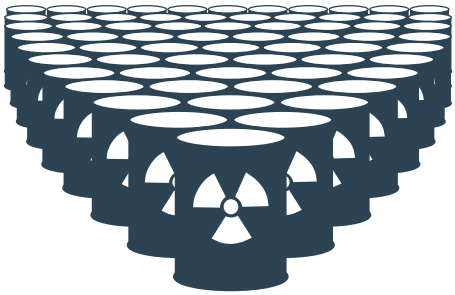
Talking to eco@work: Professor Klaus Töpfer, Chair of the National Support Body
klaus.toepfer@gmail.com

First steps

The search for a final storage site

It is a process of superlatives. It affects the whole country. It focuses on all the regions. It will preoccupy our society for many generations to come. It is about building a facility that guarantees the highest possible level of safety for a million years to contain surely the most hazardous type of waste of all: high-level radioactive waste (HLW). The search for a final storage site officially began in September 2017 – and the Oeko-Institut's experts are working to ensure that it proceeds as smoothly as possible. They provided support for the preparations at various levels and will continue to share their expertise as the process unfolds.

The German Commission on the Storage of High-Level Radioactive Waste was the key player in preparing the search for a final storage site, publishing its final report in July 2016. "The fact that, based on the consensus on the need for a new search, the Commission managed to define the procedure in such detail and take equal account of both the technical and the social dimensions is a major success," says Stefan Alt from the Oeko-Institut. "This was certainly not a given. After all, there were so many different social groups involved, from federal and state politics, the churches and trade unions, environmental organisations, the energy sector and various scientific disciplines." Now that the procedure has been described in detail, an open-ended search can begin. As a member of the Commission, the Oeko-Institut's CEO Michael Sailer was also involved in shaping the process. "The Commission proposed a model showing how the search for a final storage site should be organised, based on a transparent selection procedure and clear criteria that the future repository must meet," Stefan Alt explains. "The search will focus on deep geological formations – the only ones stable enough to store high-level radioactive waste over extremely long time periods. They are also the only formations for which we can make credible predictions for a period of around one million years." Suitable types of host rock that can be considered are tonstein, rock salt and crystalline rocks such as granite. The future repository will store almost 35,000 spent fuel elements and 8,000 waste canisters, known as casks, containing high-level radioactive waste from reprocessing. Currently, this waste is kept in interim storage facilities.



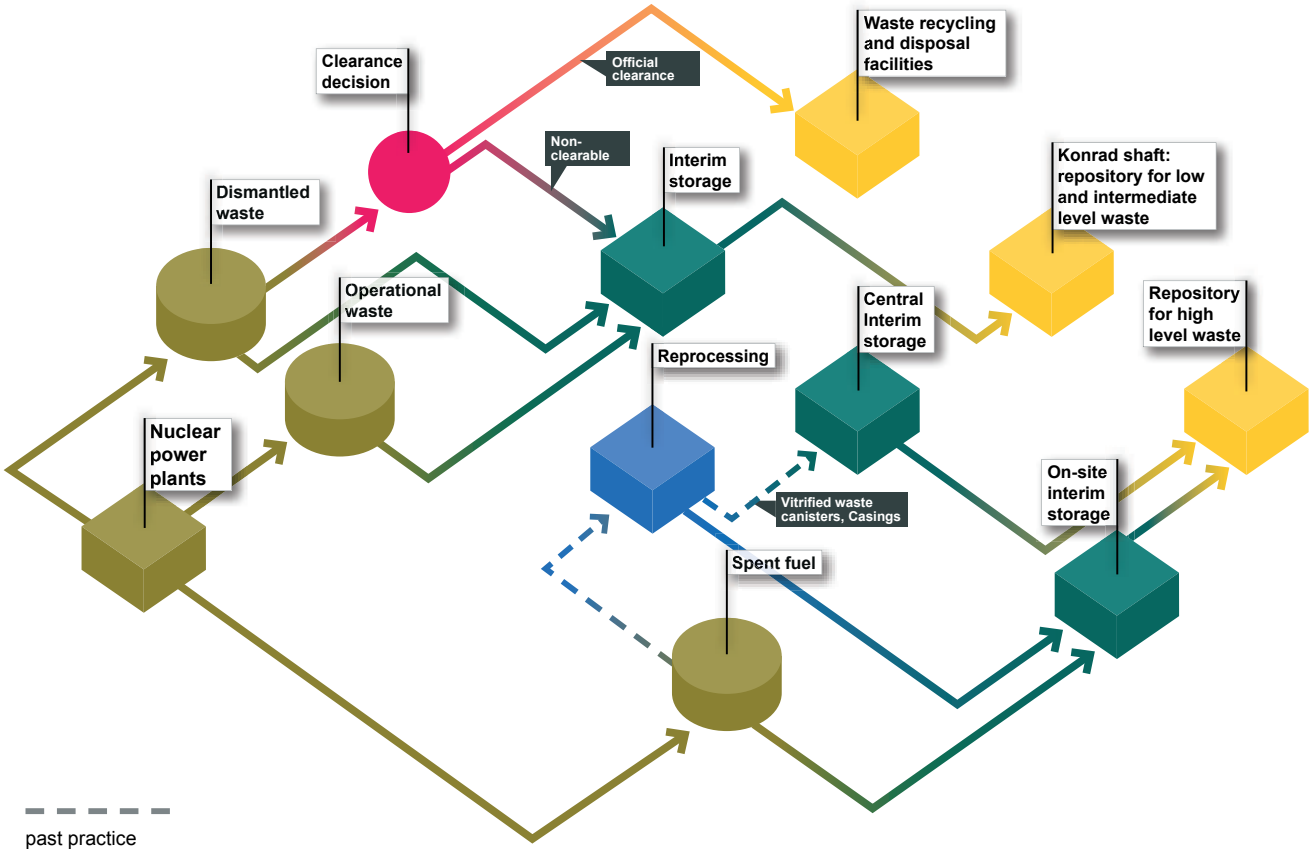
Almost **35,000** spent fuel elements will be sent for long-term storage in Germany's repository

STARTER'S ORDERS

In March 2017, the German Bundestag passed the amended Repository Site Selection Act (Standortauswahlgesetz – StandAG). "The reorganisation of the requisite structures and agencies was already well under way by this point," Stefan Alt explains. "They are also based on the Commission's recommendations. With the establishment of the new Federal Office for the Safety of Nuclear Waste Management (BfE) and the Federal Company for Radioactive Waste Disposal (BGE), a clear separation has been made between the supervisory authority and the operator." These organisations are now responsible for successfully completing the search for a final storage site by the ambitious target date – 2031.

The search for a final storage site was given the official go-ahead in early September 2017. "The first step is to exclude unsuitable areas, so regions without the right type of host rock or with recent volcanic activity or a higher seismic risk will undoubtedly be ruled out early on," says Stefan Alt. "The next step is to carry out surface exploration of selected sites that meet the minimum criteria. And the final stage involves an underground inspection of the potential sites, a comparative analysis and the selection of a site for the repository."

Conflicts are inevitable in the search for potential sites, Stefan Alt is sure of that. "In Bavaria and Saxony, for example, the state governments are already on the offensive: they categorically refuse to allow a search on their territory on the grounds that no suitable host rock formations exist there. Those responsible for conducting the search may well arrive at the same conclusion, but if a region is excluded, that decision must be based on the application of the criteria, not on pure supposition." To ensure that decisions are well-founded, minimum geoscientific assessment criteria and weightings, defined in the procedure, will be applied to determine the rock formations' suitability as a host for a final storage site. If several options appear to be equally suitable, spatial planning criteria are applied. "For example, an assessment is carried out to determine whether there are residential areas, groundwater reserves or natural and cultural heritage sites nearby that must be protected. These factors are then weighted to identify the site that will have the least impact on these assets." In order to direct the search for potentially suitable sites around the country, deep drilling now requires permission from the Federal Office for the Safety of Nuclear Waste Manage-



From nuclear power plant to repository: The paths of radioactive waste

ment (BfE). "Saxony recently attempted to make the case that this would kill off the geothermal rollout – but in fact, no one is being prevented from exploiting geothermal," Stefan Alt explains. "This kind of claim needlessly discredits the selection process."

Germany's repository will not be located in an area of potential seismic or volcanic activity

A LOOK ACROSS THE BORDERS

The Oeko-Institut's researchers are not only working on final storage in Germany – they keep an eye on what is happening elsewhere as well. "What is interesting is the varying extent to which countries struggle with the process of identifying a final storage site," says Stefan Alt. "Take the Finns and the Swedes, who mainly have crystalline host rock formations available. They have already made good progress. On the assumption that the geological conditions are fairly similar everywhere, they build the repositories at the most practical and least controversial sites – at the nuclear power plants." It is much more of a struggle in Switzerland, where three potential sites are currently being explored. "In Switzerland, as in Germany, every effort is made to ensure that the decision is seen as fair in what is a very complex process. This makes it all much more difficult," he says.

The Oeko-Institut has also looked at the costs of the Swiss nuclear phase-out. A study, commissioned by the Swiss Energy Foundation (SES) and entitled Assessment and Plausibility Check of the 2016 Cost Study by swissnuclear, investigates whether the estimated costs of decommissioning Switzerland's five nuclear power plants and disposing of the resulting waste are plausible and transparent. "The owners of the Swiss nuclear power plants are required by law to pay into a fund. The annual contributions are determined on the basis of these cost estimates, which are updated every five years," Stefan Alt explains. "According to the latest estimates from the industry association, swissnuclear, these costs amount to around 22.8 billion Swiss francs. However, there are major cost risks associated with this figure." The study identified serious flaws in the cost estimates, particularly for final storage. "No consideration was given to the legal and political risks associated with site selection, and the geological problems affecting construction and a scenario in which radioactive waste has to be removed from a storage facility have been underestimated. Any hidden cost risks will be covered by top-up payments as required, but these payments will not be met by the nuclear power plants themselves." The Oeko-Institut is also critical of the study's presentation. "The basis for the estimates is not transparent, which makes it difficult for the lay reader to follow in many places." As a comparison, the costs of Germany's nuclear phase-out are currently estimated at around 77 billion euros, but again, this excludes certain costs, such as the removal of nuclear waste from the Asse storage facility, which is not fit for purpose, and safeguards to facilitate the recovery of waste from the future repository, should this be necessary.

THE FUTURE AND THE PUBLIC

The Oeko-Institut focuses particularly on future generations and their involvement in the process – which includes raising awareness of the challenges that lie ahead. "Even if a site is identified, we are certainly looking at a period of 100 years or more until the repository is finally sealed." So in 2014, together with the Independent Institute for Environmental Issues (UfU) and with support from the Legacy for the Future Foundation, the Oeko-Institut produced teaching materials for schools about final storage issues. "We have now updated these materials in light of developments and a new edition has already been published," says Stefan Alt.

The experts are also available to give presentations to schools and other interested groups. "Extensive public participation is a key element of the search for a final storage site; this was one of the reasons why the National Support Body was set up as an independent entity to ensure that the social dimension of this process is not overlooked," says Stefan Alt. "But it is also important to empower people to participate in a meaningful way." That means providing information in good time and communicating in a clear and transparent manner. In parallel to the work in various expert bodies, such as the German Commission on the Storage of High-Level Radioactive Waste and the German Commission on Radiological Protection, he sees an important role for himself and his colleagues at the Oeko-Institut in such communication. "There needs to be dialogue among professionals, affected communities and the public at large. Based on the increased awareness of the process and the opportunities to participate, one of the aims must be to create an understanding of the final decision when it is ultimately taken, whatever that decision may be," he says. "The agencies involved should not hide behind press releases and websites; they must come out and talk to people and provide as much support as possible for affected communities."

Christiane Weihe

Stefan Alt works on the issue of radioactive waste in many of his projects. He was a consultant for the German Commission on the Storage of High-Level Radioactive Waste and has advised the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety on the Asse pit and the interim storage of radioactive waste. He has also conducted assessments of decommissioning and final storage programmes in other countries. Remediation of soil contamination and groundwater resources are among his other areas of expertise. A graduate geologist, Stefan Alt has worked for the Oeko-Institut since 2007.
s.alt@oeko.de

Final storage, landfill or reuse?

Clearance of dismantling waste

For many of Germany's nuclear power plants, the post-nuclear age has already begun. There are now only eight operational nuclear power plants left in Germany; decommissioning is already under way at 21 nuclear facilities, and applications for decommissioning have been lodged for a further four. With so many nuclear plants now being dismantled, what happens to all the waste – the fuel elements and pipes, the reactor pressure vessel and the masonry from the reactor building? Who decides – and on what basis? Some of the waste produced during the decommissioning of a nuclear facility is significantly radioactive; some is not radioactive at all. Making the distinction and determining how the waste should be processed has been part of the Oeko-Institut's work for years.

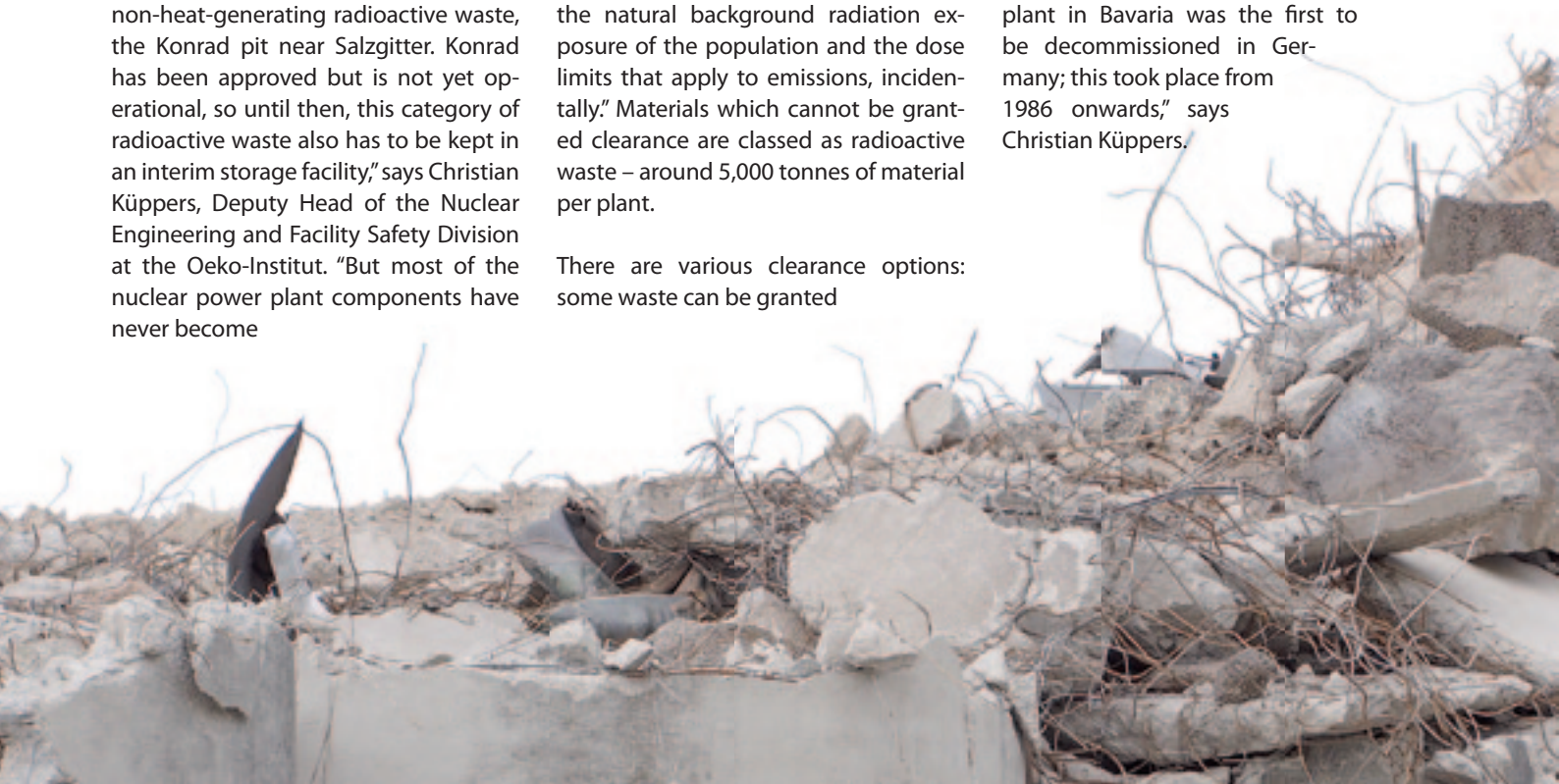
There are currently more than a dozen decommissioning programmes under way across Germany: at Obrigheim and Philippsburg in Baden-Württemberg, Würgassen in North Rhine-Westphalia, Mülheim-Kärlich in Rhineland-Palatinate, and elsewhere.

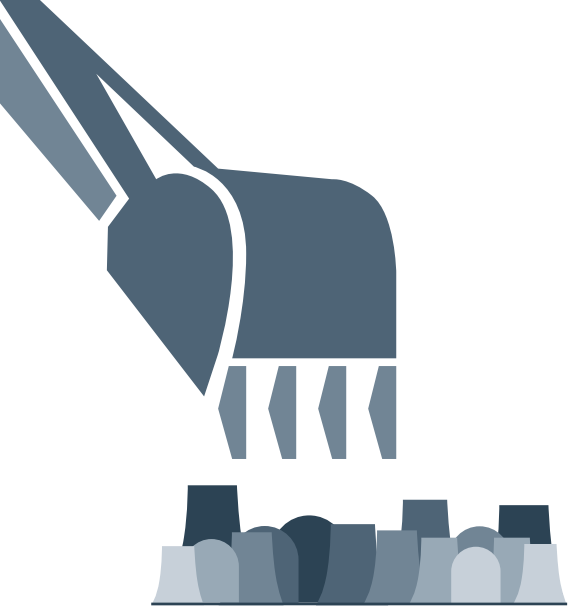
Decommissioning a reactor after shutdown produces various types of waste. Fuel elements, for example, have high levels of radioactivity and must therefore be kept in an interim storage facility until a repository for heat-generating waste is available in Germany. But what happens to the rest of the waste from dismantling? "Some of it will have to be placed in the storage facility for non-heat-generating radioactive waste, the Konrad pit near Salzgitter. Konrad has been approved but is not yet operational, so until then, this category of radioactive waste also has to be kept in an interim storage facility," says Christian Küppers, Deputy Head of the Nuclear Engineering and Facility Safety Division at the Oeko-Institut. "But most of the nuclear power plant components have never become contaminated during operation or can be decontaminated and then disposed of as conventional waste." Before potentially contaminated waste from dismantling can be sent to landfill or reused, it must undergo clearance. "This procedure ensures that no materials are removed from a nuclear site without first being checked for radioactivity. This is known as release measuring," says Christian Küppers. "Clearance is granted on the basis of the clearance limits specified in the Radiation Protection Ordinance. These limits are set at a level which ensures that no one is exposed to an annual dose of more than 10 microsievert (µSv), e.g. from inhalation or ingestion. This is very much lower than the natural background radiation exposure of the population and the dose limits that apply to emissions, incidentally." Materials which cannot be granted clearance are classed as radioactive waste – around 5,000 tonnes of material per plant.

There are various clearance options: some waste can be granted unrestricted safety clearance and used as rubble in road construction, for example. In other cases, restrictions apply. For example, specific criteria must be met for disposal in landfill. "Landfill sites must be properly sealed so that no leachate seeps into groundwater for at least 100 years from the start of construction and there is no rainwater percolation for at least 100 years after closure," Christian Küppers explains.

The Oeko-Institut has been working on the issue of clearance, including procedures and associated challenges and conflicts, for a number of years.

"The Niederaichbach nuclear power plant in Bavaria was the first to be decommissioned in Germany; this took place from 1986 onwards," says Christian Küppers.





21 German nuclear power plants are already undergoing decommissioning.

"Back then, there were no reliable scientific data about possible exposure, nor any relevant limit values for the clearance of waste. Despite this information gap, large quantities of rubble were used in road building." For a long time, it was difficult to gain an overview of the waste clearance procedures being applied: indeed, some Land-level authorities made their own independent decisions on what should happen to the waste.

It was only in 1995 that the German Commission on Radiological Protection (SSK) recommended scientifically sound limit values for various clearance options for the first time. The Radiation Protection Ordinance has included a detailed list of the values currently applicable since 2001. Responsibility for their implementation lies with the state (Land) level. "Our view here at the Oeko-Institut is that the procedure now in place is fit for purpose and the clearance values are set at the right level – they are calculated with a very high level of safety in mind," says Christian Küppers. "Even so, our position often comes in for criticism from citizens' initiatives and environmental organisations." There are frequent calls for waste that is currently cleared for landfill to be sent to the future repository or kept in safe enclosure at the nuclear facility until it is no longer radioactive. "If a new final storage facility had to be set up to accommodate this very large volume of waste, it would be impossible to restore these sites to a greenfield state, which is the ambition, or to carry out dismantling in an appropriate manner," Christian Küppers explains. "In reality, the risks resulting from the current clearance procedure are negligible and certainly do not justify the expense and effort of placing this type of waste in final storage."

LANDFILL – WHAT HAPPENS NEXT?

The Oeko-Institut investigated the risks associated with decommissioning in another study, entitled Potential radiological consequences of clearance for disposal according to § 29 StrlSchV in the subsequent use of a landfill during post closure care and in the period afterwards. This analysis for Baden-Württemberg's Ministry of the Environment models the subsequent use of landfill sites containing waste from the dismantling of nuclear facilities. Various scenarios are considered, including use of the site for farming, forestry, recreational purposes, housing and roads. "We assessed whether, in this type of follow-on use, the dose remains below 10 microsievert (µSv), both in the post-closure care period – which lasts for decades with these particular landfill sites – and during and after subsequent monitoring by the authorities," says Christian Küppers. Two separate case studies were considered: a restored landfill site, now in subsequent use, whose surface was properly sealed, and a landfill with water leaching into farmland from its base 100 years after closure. "Various options for subsequent use were modelled, based on clearly defined parameters – such as use as farmland, where the surface is protected from erosion and the sealing is undamaged by roots and so forth," Christian Küppers explains. "In both these case studies, and, indeed, in all the subsequent use scenarios that we modelled, the annual dose is less than 10 microsievert (µSv)." The study was not only helpful in addressing the specific challenge of the proposed agricultural use of a former landfill in Ludwigsburg rural district. "It also closed a major gap in the science underpinning regulatory activity: previously, no one had thought about clearance values in relation to the follow-on use of restored landfill sites."

Christiane Weihe

Graduate physicist Christian Küppers works on radiation protection, radioecology, radioactive waste management and safety issues associated with handling radioactive substances. In parallel to his work at the Oeko-Institut, where he has been employed since 1986, he sits on various key advisory bodies, including the German Commission on Radiological Protection (SSK) and the Committee on Decommissioning set up by the German Environment Ministry's Nuclear Waste Management Commission (ESK).
c.kueppers@oeko.de