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eco@work

Sustainable reading from the Öko-Institut

Nuclear power under fire

Risks persist

Dear reader,

A warm welcome to a new issue of our e-paper, eco@work. This time, "nuclear power under fire" is our focal theme. We explain why nuclear power plants can never be 100% safe – despite many improvments. And we make it clear why extending the service lives of such plants is no solution to climate change. Read about it in the "big issue" section of the paper. In addition, the paper reports, as ever, on many further cutting-edge projects and findings of the Öko-Institut.

Wishing enlightening reading

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"We need clear rules"

One of the most pressing environmental problems of our age still awaits a solution: the long-term storage of high-level radioactive waste. Yet the debate over where to site a final repository has been running for a very long time – and the outcome is still uncertain. At present, Germany's two main political parties are unable to reach agreement: whereas the CDU would like to see a speedy continuation of exploratory drillings at the Gorleben site, SPD environment minister Sigmar Gabriel proposes that, along with Gorleben, several other final repository sites should be investigated on the basis of international criteria.

Here is an interview with Michael Sailer, nuclear expert and member of the Board of the Öko-Institut.

When do you expect a final repository to go into service in Germany?

First, we need to differentiate between two categories of radioactive waste. The first category includes medium- and low-level radioactive waste, which gives off virtually no heat. From 2014 onwards, such waste is scheduled for final disposal in the Konrad mine in Lower Saxony. The second category includes high-level radioactive waste, which exhibits high levels of radiation, generates a lot of heat and therefore needs to be safely disposed of in a final repository. However, there is still no political agreement on the way forward. This means that it may be 2035 before a final repository for high-level radioactive waste goes into service.

At the moment, there's a political stalemate. This isn't a favourable starting position, is it?

In my opinion, the next German government needs to decide on the way ahead.

What requirements must be met by a final repository site?

#What is needed is a suitable salt dome or stratum of claystone. This is the basic requirement for ensuring that high-level radioactive waste can be encased for one million years.

What are the scientifically objective criteria for a safe final repository?

What is required is a zone, the isolating rock zone, that is between 500 and 1300 metres below ground and which can be predicted not to undergo any damaging changes over the next one million years, i.e. it must be a geologically quiet area where, for example, there is no volcanic activity or strong earthquakes and in which the deep groundwater conditions will not change such as to pose a risk to the encased waste. Afterwards, the "holes" in the isolating rock zone – such as the two shafts – must be very tightly sealed.

Some experts advocate the idea, on cost grounds, of establishing an international final repository. Do you agree with them?

Germany has such a broad nuclear programme that we alone could fill a final repository with our own high-level radioactive waste. Therefore, the cost factor does not apply in our case. Another fact is that, geologically speaking, Germany has excellent conditions. Furthermore, for political reasons alone, it will be impossible to establish an international final repository, because people will refuse to accept nuclear waste from foreign countries.

We can see today that mistakes were made in the past in the search for a final repository site. What lessons can we learn?

For me, the most important lesson is that, unless we have clear rules, there will always be political resistance – from the public and in the political parties. As part of these clear rules, a set of test criteria must first be laid down, and only then must potential sites be evaluated – not the other way around, as was the case in the past. The search for a site that began in the 70s still lacks transparency in the way it is presented. Nor has there been a continuous dialogue with the candidate regions.

Do you sometimes get the strange feeling that the secure management of radioactive waste might also contribute to

Nuclear waste must be kept away from the Earth's surface.

the safe operation of nuclear power plants?

I don't see it like that. It's simply a fact that nuclear waste is produced, and it is highly dangerous. Therefore, there's no alternative: it must be kept away from the political happenings at the Earth's surface, so as to avoid harming future generations. What do you think would have happened if there had been an overground nuclear waste repository when war broke out in Yugoslavia?

Thank you for this interview.

Interviewer: Christiane Rathmann.

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Michael Sailer, *55, has worked for 29 years at the Darmstadt office of the Öko-Institut. His main fields of work include reactor safety and waste management. A chemical engineer, he is a member of several commissions and committees, including (since 1999) the German Environment Ministry's Reactor Safety Commission, (since 2005) the Euratom Scientific and Technical Committee and (since June 2008) the newly established Nuclear Waste Management Commission.*

Vulnerability

Complexity is the problem: Why nuclear power plants remain a safety hazard

There's one new fault after another.

Nuclear power plants not only produce electric power, but they also need it for their safe operation. This was precisely the problem on 25 July 2006 at the Swedish nuclear power plant in Forsmark. A short circuit cut the plant off from the external power grid and, soon afterwards, the reactor was only a whisker away from disaster. In actual fact, in the event of a power outage there is an emergency power system to maintain the supply to key safety systems. However, two of the four emergency power units were knocked out by the short circuit and failed to operate. As a subsequent analysis revealed, it was merely by chance that only two of the four systems were affected.

If a plant's power supply collapses entirely, this can quickly lead to a core melt, because the reactor is no longer being cooled. The impact on the local surroundings can then be comparable to the accident in Chernobyl. Coming 20 years after the disaster in Ukraine, the incident in Sweden once again highlighted the vulnerability of nuclear power plants.

"What makes a nuclear power plant vulnerable is its complexity," explains Michael Sailer, a nuclear expert at the Öko-Institut and member of its Board. His experience suggests that, despite a host of improvements, there is still one new fault after another. And such faults cannot be prevented either by sophisticated technology or by more stringent safety systems. Moreover, at the international level, too little is learned from such faults, as is demonstrated

A deliberately caused plane crash could destroy the reactor building of Biblis A (photo left).

by the accident in Forsmark, because there have already been similar, albeit not so serious incidents.

"Although German plants have been made safer since Chernobyl, we still have no such thing as a 100% safe nuclear power plant," says Sailer with the benefit of his many years as a member of national and international reactor safety committees. "Therefore, there will continue to be serious accidents in future; it's simply a question of where and when," predicts the expert.

His words are backed up by the high number of incidents, which also bring to light an unending succession of new risk factors, such as at the interface of man-technology organization. If, because of the complexity of the system, an incident is wrongly interpreted or misunderstood by the operating team, the consequences can be disastrous.

This is what happened in Brunsbüttel in 2001, when, despite some unusual signals being registered in the control room, the precise cause was not established until two months later. What happened? In December 2001, a release of steam was detected from the containment. This was traced by the operating team to a leaking pipe, and the problem was subsequently remedied by blocking off the pipe. It was not until two months later that the plant was shut down in order to allow a close-up inspection of the situation inside the containment. In the course of that inspection, the team discovered that a pipe had been destroyed over a length of 2.7 metres by a hydrogen explosion. On account of the purely operational function of the pipe in question, the risk of such an explosion had not been sufficiently taken into consideration in the design of the plant.

Often, there are also failings with regard to the culture of safety. An incident in 2001 at Philippsburg nuclear power plant in Germany showed, for example, that the operating regulations had not been complied with by the local operating team – a situation that had been tolerated for a number of years by the plant's operator.

The terror attacks of 11 September 2001 in the USA shifted the focus onto yet other aspects of nuclear energy. Dr. Christoph Pistner, nuclear expert at the Öko-Institut, has long been concerned with the issues of terrorism and nuclear non-proliferation. At the end of 2007, he concluded in a study that Germany's oldest still operational nuclear power plant, Biblis A, was not terror-proof. "A deliberately caused plane crash could destroy the reactor building and subsequently result in a core melt," he warned. The consequences would be disastrous: depending on the circumstances, an area of up to 10,000 square kilometres would be radioactively contaminated.

Biblis A is not terror-proof.

There is no clear dividing line between the civil and military uses of nuclear energy.

No renaissance of nuclear power!

Is nuclear energy having a renaissance? No, say the experts from the Öko-Institut and they produce cogent arguments. Here are some examples:

- **There are 439 reactors worldwide, only 38 of which are less than 10 years old; the majority of reactors are between 20 and 30 years old.**
- **The decisions to build many of the reactors were taken in the 60s and 70s. Also as regards many of the plants currently being built, their construction was started in the 80s.**
- **At present, it is scarcely possible to put a figure on the cost of building a reactor. Furthermore, the costs have to be financed a long time in advance, because depreciation periods of around 20 years are necessary.**
- **Reserves of the required raw material uranium are finite and, at today's rate of consumption, will be sufficient for another 50 to 100 years. A global expansion of nuclear energy would correspondingly reduce the remaining timespan.**
- **There is still no operational final repository for high-level radioactive waste anywhere in the world. Every country ought really to address this issue before going down the nuclear energy route.**
- **New "evolutionary" reactors pose basically the same technological and security-related risks as conventional reactors.**
- **"Revolutionary" reactors of the so-called 4th generation are not available.**

However, there are also security policy aspects of nuclear energy, it not being possible to draw a clear dividing line between the civil and military uses of nuclear energy. Either plutonium or highly enriched uranium is required in order to produce nuclear weapons. If, for example, a country is in possession of both uranium and also the know-how and technology required for enriching it into nuclear fuel, then it also has the capability to produce the fissile material needed for a nuclear weapon.

Many countries have renounced nuclear weapons.

Today, with the exceptions of Israel, Pakistan and India, all countries are signatories to the Nuclear Non-Proliferation Treaty. North Korea withdrew its membership in 2003 and subsequently carried out tests on nuclear weapons. The USA, Great Britain, Russia, China and France are the only official nuclear weapon states under the terms of the Treaty. All other countries have renounced the possession of nuclear weapons and have also agreed to submit to relevant inspections. At least that's the theory. In practice, however, there is the persistent suspicion that some countries are seeking to circumvent the official non-proliferation regime, with the latest controversy focusing on Iran. If things get serious, international inspections will be unable safely to prevent an escalation.

The political consequences arising from the military application of nuclear energy are dramatic. The nuclear programmes of Iran and North Korea are causing substantial international tensions. In recent years, the conflict between the two nuclear powers of India and Pakistan over Kashmir has repeatedly been a cause for great concern. If there is a further proliferation of nuclear weapons, this will result in further tensions with considerable potential for escalation.

What is the verdict of the Öko-Institut experts? "I'm highly sceptical about many aspects of nuclear energy," concludes nuclear expert Michael Sailer. "Nor do I consider that we actually need nuclear energy. However, since we've got it, we'll just have to come to terms with it."

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"Longer operating times are of no benefit to the climate"

The renewed debate over nuclear energy is dishonest

Over the last few weeks, there has been a chorus of voices calling for a reversal of Germany's decision to phase out nuclear energy. Doubtless a contributory factor in all of this has been Sweden's recent decision to lift its freeze on nuclear power, which, despite being adopted in 1980, was never implemented. Hence, the renewed debate over nuclear energy is currently gaining tremendous momentum. But what's really behind it? Helmfried Meinel, spokesman of the Board at the Öko-Institut, and member of the Board Franz Untersteller have put together some facts and arguments. Here, they take a stand.

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To date, none of those who make the case for a renaissance of nuclear energy has been able credibly to demonstrate what such a renaissance is supposedly good for. Who benefits from this new debate? Not the climate. The emission of greenhouse gases from power generation is regulated in Europe through the emissions trading system. Each country is allowed a certain amount of carbon dioxide that it can discharge into the atmosphere when generating electric power, and which is distributed between the power generators in the form of permits. Those who emit less are free to sell their spare permits to third parties who were not so successful in cutting back their emissions of carbon dioxide.

If, therefore, Germany's nuclear power plants are kept running for longer, thereby ousting the already budgeted emissions of carbon dioxide from fossil-fired power plants in Germany, the resulting surplus permits can be sold on to third parties, reducing the pressure elsewhere to cut back on the use of fossil fuels. To make matters worse, the 439 reactors that are currently in operation around the world meet little more than two percent of global final energy demand. In spite of ambitious construction plans in some countries, this share will fall even further in future.

So does the renewed debate at least benefit our security of supply? Even that is not the case. On the contrary: whereas, in the 90s, the balance sheet was more or less even, since 2003 Germany has regularly exported more power than it imports. Last year, there was even a record export surplus of 22.5 billion kilowatt-hours – enough to supply over six million households!

The reason is simple to explain: on the one hand, German power generators own many old power plants that have long since been amortized and which allow them to generate power extremely cheaply. On the other hand, Germany runs a highly suc-

The amount of electric power generated from renewable energy sources is increasing steadily from year to year.

cessful market launch programme for renewable energy sources, the Renewable Energy Sources Act (abbreviated in German to EEG). The amount of power being generated from renewable energy sources is increasing steadily from year to year, and is growing even more strongly than originally forecast. Last year, as much as 14.4 percent of the power consumed in Germany was generated from wind, water, biomass or solar radiation thanks to the EEG.

Since 2003 Germany has exported more power than it imports.

The German Energy and Water Association estimates that, in up to five years' time, that proportion will rise to around 30 percent. In addition, a few percent of electric power comes from old hydropower plants, which are still able to hold their own in the market while receiving no EEG assistance.

If the operating lives of nuclear power plants are now extended, this will result in a further increase in capacity compared with the existing plans. At first glance, this might seem in the interests of the consumer, because longer operating lives for nuclear plants ought to mean a temporary stabilization of the market price of electric power. On the other hand, extending the operating lives of nuclear power plants will foil the investments in new coal-fired power plants that are currently being constructed. It's all the same as far as the climate is concerned – because of emissions trading.

Yet won't the costs of any failed capital investment in new power plants simply be added on to the price paid by the consumer? By all the rules, that ought not to be possible if the price were determined exclusively by supply and demand and not by costs – all of which, of course, presupposes the existence of an effectively functioning market, something which, given an energy market structure presently dominated essentially by four players, is simply not the case.

The real reason behind calls to extend the operating lives of nuclear power plants is to be found elsewhere: money. In a liberalized energy market, electricity prices depend on the fuel costs of the most expensive power plant that is just still needed to meet the market's demand for power. In Germany, this will normally be a hard-coal-fired power plant. The price of coal is determined mainly by prices on the global energy markets, with old nuclear power plants making big profits in the process, because their fuel and other running costs are low and their capital costs negligible.

If the running lives of all currently operational nuclear power plants were extended by eight years, this would mean increased total earnings of 65.5 billion euros for the four major power suppliers according to the results of a 2008 study by the Öko-Institut based on a wholesale price of 70 euros per megawatt-hour, which is roughly in line with the current market situation.

The conclusion to be drawn is that, as Germany has an excellent means at its disposal for expanding the renewable energy sector and has already made very considerable progress along that path, it is very well placed, even without nuclear energy, to meet its internationally agreed and highly necessary climate protection targets.

What we need is not a new debate over nuclear energy, but a consensus on future energy policy. We will need to invest much more heavily in expanding and improving the grid. We need smart grid management and storage capacity to enable us to achieve security of supply with a high proportion of our power generated from intermittent sources such as wind power and solar radiation. We will presumably also need to build the odd new coal-fired power plant. As long as this goes hand in hand with a vigorous expansion of combined heat and power generation, the net result ought to be acceptable. And, above all, we need substantially better energy efficiency.

This is what we should be concentrating our energies on, and not on talking into being a renaissance of a 50s technology called nuclear power!

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