Interview with an expert in management systems and documentation at the *BGZ Gesellschaft für Zwischenlagerung* (September 9, 2024)
Length: 1:30h

PM:

Could you start by describing your activities and responsibilities at the BGZ?

Expert:

I have a history here at the site, a history in Nuclear technology. For 20 years, I worked at the [nuclear power plant location] nuclear power plant in the management systems department as an auditor, but I was also responsible for processes and process management. When BGZ was founded, I took the plunge, so to speak, and started there as a documentation specialist. Today, I am back as a quality manager at BGZ here in [nuclear power plant location]. My main tasks: writing lots of regulatory framework and manuals. So processes, work instructions and the like. But I also oversee the supervision process when there are changes to the regulatory framework or to the plant. That's kind of my business. And I'm responsible for introducing the document management system here at the site, which we have newly introduced. In this respect, my colleagues in Essen [note: BGZ headquarters] picked me out as an expert.

PM:

What training do you have and how did you get started at the power plant?

Expert:

Quite traditionally, as an industrial clerk. My training ended around 2000. As an industrial clerk, I worked in the management system department for a while and then decided that I needed to add something else to my skills. I then did further training to become a technical specialist at the Chamber of Industry and Commerce. And yes, various courses and further training. In terms of qualifications, I am a technical specialist, trained by the Chamber of Industry and Commerce.

PM:

In preparation, I looked at the location flyer for [location of the interim storage facility] and it said that BGZ has been responsible for it since 2019. The interim storage facility has been around for a long time. Who was responsible for it before?

Expert:

Previously, it was actually [the operator of the neighboring nuclear power plant]. At the beginning of the 2000s, [the operator] was essentially obliged to set up interim storage at the site because there was no longer any transport to reprocessing. And so [the operator] obtained permission to build an on-site interim storage facility at that time and, in 2006, received approval to start operations and handed it over to BGZ in 2019. Previously, the interim storage facility had also been operated entirely under the direction of the power plant.

PM:

Have work and organizational processes changed significantly since 2019?

Expert:

Strictly speaking, no. The activities and tasks have remained the same. The storage facility has a license in accordance with Section 6 of the German Atomic Energy Act (Atomgesetz, AtG). This stipulates to a certain extent what can and cannot be done there, and how it should and should not be done. In this respect, nothing has actually changed in terms of processes. There are still maintenance processes and there is an inspection process. The storage and retrieval processes are defined. They were valid for [the operator] in the same way as they are now valid for BGZ. This means that nothing has actually changed in terms of the actual range of activities. What has changed, of course, is the organization. The BGZ is organized a little differently than RWE was organized as an energy supplier at the time. There is a much smaller group here at the site. The power plant was operated with 700 people for the entire site, including storage. We are now at 34 at the BGZ. That's quite a difference. But basically, the processes and tasks are the same as before.

PM:

It is not only an interim storage facility for high-level radioactive waste, but also for low- and medium-level radioactive waste. This combination is not often found in Germany. Is there any overlap in personnel, or are the 34 people you mentioned basically responsible for everything?

Expert:

This combination exists at several BGZ sites in Germany. The staff is responsible for the entire site. We have not set up a separate organization for low- and medium-level waste. We have two such storage facilities. We have one that [the operator] has been operating for a very long time, since the 1980s. That is [name of the old storage facility]. And we also have [name of the new storage facility]. It has been in operation since 2018. [The operator] handed it over to BGZ in 2020. But we operate it with the same organization. Simply put – let's take the example of Radiation protection – the tasks are the same in a site-based interim storage facility for spent fuel elements as in an interim storage facility for waste. So there is no distinction. In this respect, it can also be serviced and operated by the same organization. We are working with one organization. However, this is also the case at BGZ at the other sites that operate more than one storage facility. One exception would be Unterweser. They have two organizations, at least on paper. We don't have that.

PM:

What technical facilities and systems are there at an interim storage facility that are subject to maintenance and repair?

Expert:

Basically everything, of course. It ranges from light bulbs to water pipes. But there are a few essentials, of course. In our case, it's a crane and handling equipment. So everything I use to lift a container, handle a container, move it from A to B, store it, remove it from storage – these are the essential systems that are subject to relatively frequent maintenance and servicing. We do this using test manuals, which we have to have approved by the authorities. But also OS facilities, structural security systems – i.e. fences, doors, gates, cameras, and the like. These also require a relatively high level of maintenance. A hazard detection system, i.e. fire alarm system, burglar alarm system, and the like. These are also control systems that require a high level of maintenance and servicing. Of course, power supply, water supply,

emergency power supply. We have our own emergency diesel generator in the interim storage facility for spent fuel elements, which also has to be serviced regularly and undergo regular test runs. The waste containers are relatively easy to maintain. There is very little maintenance required for containers. There is a container monitoring system, again as a control system. There is maintenance involved there. We actually have very little maintenance on the Castor containers themselves or on the mosaic containers in the [old storage facility] or [new storage facility]. It's more the plant technology around them. But that adds up to quite a lot.

PM:

I read the following sentence in the site brochure: "We are currently planning for self-sufficient interim storage operation. This means that by mid-2026, the BGZ site will likely be able to operate independently of the neighboring nuclear power plant in terms of technology, organization, and personnel." I asked myself, where are the cross-connections?

Expert:

As mentioned at the beginning, it was of course previously operated by [the operator of the neighboring nuclear power plant]. For example, it is still located on [the operator's premises]. There is no separate fence around it. But now the ATG license says that an interim storage facility needs its own fence. Until now, it had one, namely the large fence around the power plant. If we now operate it as BGZ, we have to at least erect the OS facilities ourselves, i.e., object security, fences, etc., and thus effectively remove it from the power plant complex. Another example: power supply. The interim storage facility, just like the other two halls, is simply connected to the power plant's normal grid. As an independent operator, we need our own power supply, so we have to set up a self-sufficient power supply. The same applies to water. We would also have to operate the water supply independently. And basically many, many services. When the storage facilities were effectively transferred in 2019, the basis for this was the Waste Management Transition Act. This means that the operators – all four major ones in Germany – are legally obliged to provide services to the new third party, in this case the BGZ, for the next five years and to support it on its path to self-sufficiency. This starts with maintenance. It continues with shared site security and a shared plant fire department. The BGZ pays for the services; there is a large contract with almost 400 pages of agreements. It contains a number of service certificates, as they are called. These are basically service agreements for which services we can request from the power plant and pick up. The goal of self-sufficiency is to ultimately be completely self-sufficient. This means having two separate plant sites and separate access points. At the moment, we are still located in the power plant's administration building because we don't have our own building yet. So it starts with these "little things." The goal is to have our own self-sufficient site in the immediate vicinity of the nuclear power plant. There is still a lot to do on this path. Self-sufficiency is divided into three phases. The first phase is to equip the interim storage facility for fuel elements with its own plant security system; in other words, its own fence, its own security center where property protection is located and the map situation is monitored. This is well underway, and we estimate it will be completed in mid-2025. Meanwhile, the shell of the administration building is already being erected. Mid-2026, as stated in the brochure, is very ambitious. But that is basically the whole package: to completely separate ourselves from the power plant.

PM:

Why is this being demanded in the first place? The dismantling [of the neighboring nuclear power plant] will take decades. So why this demand for self-sufficiency right now?

Expert:

On the one hand, the permit stipulates that we should operate the plant ourselves. It is important for us that we are not dependent on the power plant. This can be clearly seen in the property protection and plant security measures. Once the power plant has delivered its fuel – and this applies to all power plants – it can lower its property protection level. This is called prudent operation. In other words, they can basically put a gatekeeper at the front and switch off the fence monitoring. However, they can only do this once the fence monitoring at our facility is active, so the power plant has a very strong interest in separating itself from us. This is also due to the IT systems, for example. We have relatively high requirements for our IT systems at an operating interim storage facility. Take an operational management system, for example: we classify it as having a higher security requirement and security level than, say, a nuclear power plant undergoing decommissioning. That's why the power plant has already said, "Sure, we could make our operational management system available to you for the next ten years. You can tinker with it. But then we would have to upgrade it especially for you." But of course, the power plant is not really interested in doing that because A) it is expensive, B) it is time-consuming, and C) we don't need it. "And just for you? Get your own."

So it's a mutual interest. On the one hand, we want to get rid of dependencies. Because the power plant also clearly states that they need their people for decommissioning. It's complex and labor-intensive. There have also been staff cuts, so bottlenecks will automatically occur at some point. And we said that we actually have to be able to do it ourselves and be our own masters. What's more, the legislator requires this in the Waste Management Transition Act. It says that after five years, the plant must stand alone.

PM:

What is the current mood like? [An operator] invited us to [the site of a nuclear power plant] last year, just a few days after it was shut down. Everyone there was pretty downcast. They had done a good job for decades, and then they were told that it had to be shut down. How do you perceive that? What is the mood like at the BGZ and the interim storage facility?

Expert:

At BGZ, the mood is rather the opposite. There is more of a spirit of optimism. Some joke that BGZ is a start-up. Of course, you can't really say that. The BGZ has quite long roots if you look at where it comes from – basically from Alt-GNS [note: GNS Gesellschaft für Nuklear-Service] and then newly to BGZ. But nevertheless, there is a bit of a spirit of optimism because everyone is currently marching in the same direction. Every site has the goal of finally achieving self-sufficiency. This also has the goal of eventually relocating at least the interim storage facilities for LLW [low-level waste] and MLW [medium-level waste] to Konrad. The goal must be to empty the facilities. In this respect, the mood at BGZ is good. Of course, from the perspective of an energy supplier operator, I can confirm what you have observed in Lingen. On the one hand, it is clear that the problem or task is greater th ly thought at the beginning. It is not so easy to dismantle a nuclear power plant and return it to greenfield status. To begin with, construction waste is not accepted by any construction landfill site.

PM:

I heard the discussion myself.

Expert:

These are the problems of unresolved waste disposal in Nuclear technology. That has to be said quite clearly. I have been an absolute fan of nuclear power plants. I grew up with them. My father worked here. But I have to acknowledge, and this became clear to me again at the BGZ, that we in Germany have simply not solved the issue of waste disposal. We didn't solve it while the nuclear power plants were in operation. And now that we are decommissioning the nuclear power plants and generating much more waste, it must be said quite clearly that this is really adding up.

And that's what I think you notice among our colleagues at the power plants. It's all very tough going. It's very, very costly and it wears you down over time. And of course, there's the cost pressure that arises. That's also something that dampens the mood on the EVU side a little. Yes, of course, the shutdown phase – that was like the rug being pulled out from under our feet. Personally, I will never forget the images from Fukushima. And I also know what the first thought that went through my mind that morning was. I said, that's it for the lifetime extension. I think everyone saw that coming at the time. The gloom had already started a little before that.

PM:

What are your responsibilities in the area of monitoring and documentation?

Expert:

Quite a few. There are actually two areas: documentation and monitoring. When I think of monitoring, radiological monitoring immediately comes to mind. That's a very big monitoring issue, where we basically have permanent weekly routines to implement radiological monitoring of workplaces in the surrounding area. This means that the radiation protection officers go out with the measuring device, take contamination measurements, measure dose rates, and so on. This involves a lot of monitoring, which is also documented. All of this is then incorporated into the documentation. Of course, we also monitor our inventories. We are required to keep records of every container that enters our facility. The same applies when it leaves our facility.

The topic of documentation is such a broad field. But for us, an essential factor in documentation is the very general stuff that we are required to do for business reasons. We are also required to archive documents in accordance with the HGB [German Commercial Code], keep invoices, etc. In addition, the Radiation Protection Ordinance requires us to keep a whole host of documentation – for example, personal dosimetry, where we have to document and archive the exposure of the personnel who work for us. And one major point that we have inherited from Nuclear technology, so to speak, is KTA 1404. This is a regulation from the Nuclear Technology Committee. This was essentially a standards committee for nuclear technology – similar to the DIN standards, which we are also obliged to comply with to a certain extent. KTA 1404 describes the documentation required in nuclear power plants ( ) and can, of course, also be adapted to the documentation required at an interim storage site.

It also gives us relatively strict guidelines on what to document and where. What are the tasks? Classic archiving. It must be said that the industry is still very paper-based. We have large, extensive paper archives. And, most recently, we have also set up our own electronic document management system. However, both run in parallel. This means that everything we archive electronically is also archived in paper form. These are the main tasks in the area of documentation and monitoring. Collecting data from operations. However, unlike nuclear power plants, where a great deal of data is generated, we generate relatively little data. In an interim storage facility for fuel elements, where there are 108 CASTOR containers, we already know that they will remain there for another 100 years, that no more will be added and that probably none will be removed... Then we hope that none of them will be removed prematurely, because then something would have happened... There is little data that I really need to

measure. Data collection is a little less, so our focus is currently on radiological monitoring, i.e., monitoring data.

PM:

You mentioned KTA 1404 and said that many of the requirements for the power plant also apply to an interim storage facility. Does this also apply to Radiation protection? Do you have the same procedures and requirements as in an operating nuclear power plant?

Expert:

Yes, you have to say that clearly. This is because the basis for radiation protection is the same. In nuclear power plants, it is governed by the German Atomic Energy Act (Atomgesetz, AtG), the Radiation Protection Act, and the Radiation Protection Ordinance in the same way as it is for us. We are no different in this respect because we simply deal with the same radioactivity. We also have Radiation protection, and we also have a work permit procedure before I enter the Controlled area. We also have to identify and secure our Controlled areas accordingly. The clearance regulations for removing materials or items from the Controlled area are identical to those in the power plant. We also have to measure for clearance before we can dispose of waste. Of course, on a smaller scale than in a nuclear power plant undergoing decommissioning. But we too must prove for every garbage bag that it is clean below these 10 µSv criteria, which correspond to our release regulations. These are the same paragraphs and, in this respect, the same requirements for us. KTA 1404, on the other hand, if we take that as a guideline, we use it as a reference. Of course, it was written for nuclear power plants at the time. It also takes into account the large scope of documentation for a nuclear power plant. However, things such as retention periods for certain documents still apply to us. For example, from Radiation protection, a log of routine measurements. There are specifications in the KTA on how long such things must be kept. This also applies to us, of course, because we also generate corresponding protocols. The topic of secondary documentation, i.e., that a set of documentation needed to return the plant to a safe condition must always be stored somewhere outside the plant. The power plant had this in the backup location, once here on the power plant premises and once in a nearby facility. We have moved our secondary documentation to [location of an interim storage facility], i.e., another interim storage facility. We also use the topic of safety specifications. The KTA stipulates which documents must be marked separately so that the workforce can immediately recognize that these documents describe the safety-related framework conditions. These are things from the KTA that we also comply with. Of course, there is also the issue of archiving, i.e., how an archive must be structured. I always say it should be similar to a potato cellar in : dark, dry, and cool. Preferably without pest infestation. Then you have already met most of the KTA requirements.

PM:

You said that relatively little data is generated for the CASTOR containers in terms of documentation. But what kind of data is it? Are they test reports?

Expert:

Quite a lot. Per Castor container, we have about ten thick Leitz folders full of documentation. That makes around 1,080, plus a few fog determination documents that the authorities required us to provide when granting the permit. We have around 1,200 folders of documentation for the 108 CASTOR containers. It starts with the manufacturing documentation: every report, every acceptance test certificate from the suppliers is documented there. That's a relatively static process. Once accepted, the

container is actually clean at that point, unless there are new screws, for example – but we haven't had that yet. Then there is the Licensing documentation for the container – approval certificates, etc., which in future will be handed over by the BAM, the Federal Institute for Materials Research and Testing. This is the transport documentation for this container, so that it can be put back on the road later. This is stored in the files.

Sometimes things do change. For example, test specifications may have changed somewhere, which are then cited in these approval certificates. Then the approval certificate changes again. So you run down to the basement with 1,000 sheets of paper and start replacing individual pages in the folders. The loading documentation is also relatively static. It also makes for a good Leitz folder—in other words, everything that was generated in terms of protocols relating to the one-time loading at the nuclear power plant at the time when elements were brought in. There was also a container-specific schedule for this. That was an approved document. And according to this, the container was loaded from step 1 to step X and the inspection was carried out during loading. This includes the reports generated from this, which are torque reports. There are also radiological wipe test reports and the like. It's all in the folders.

And then, depending on how often the container was handled, there are 1 to 3 folders of inspection logs, in which each handling step with the container is documented again. An example: There is a requirement that a Castor container may only be lifted by its trunnions 200 times. Then one assumes that the material – although this is hard to imagine once you have seen one of these trunnions – has reached the end of its load-bearing life. So, of course, you have to keep a record of this. Every handling operation, every lifting by the trunnions, must be documented in the test logbook. Even if it's just because the container has been moved from storage location A to storage location B because space was needed there – this must be added to the logbook. And so you end up with a good 10 folders per Castor container. It's important to note that you don't have to do this too often. We are currently operating in a very static manner. The last changes to the documentation were approval certificates, where the BAM said: "Test specification 140 has changed; it is now revision 5 instead of revision 4." This is added to the approval certificate somewhere on page 24 in the appendices, and then you just run down with the paper.

PM:

So you have little reason to look up anything specific in the folder?

Expert:

No, that really rarely happens. Of course, it did happen when there was something unusual somewhere. We now had a case where we really had to look at the documentation. That was the issue of block measurement protocols. It had been determined, for example, that the sample protocol for this block measurement—which, I believe, is how deep the reinforcement cover seal sits in the container so that the measurement fits... That was measured there, and there were tolerance ranges that were permissible. To my knowledge, this protocol was changed so that the tolerance measurements had to be entered in a different field. However, not everyone in the country was aware of this. And in one plant, the wrong tolerance measurements had been entered in the wrong place. This was noticed – something like this is also communicated to all other sites; there is a procedure for this. And we were obliged to actually check our Castor containers to see how this had happened there. This meant spending a bit of time in the archive. Until you pulled out all the records, only to find that we had made the same mistake twice, but the tolerance dimensions were correct. The probability of exceeding the tolerance was only in the wrong field of the form, which was tolerable. But these are the kinds of things you have to revisit.

PM:

Let's stick with the many Leitz folders: How many documents do you maintain there from the BGZ? I understand that by the time a CASTOR arrives, most of the documentation you keep is already finalized.

Expert:

Yes, I would say maybe a fifth of it needs to be reviewed. Of the ten folders, there are two that are looked at more regularly. For example, because they have been handled or because something has changed in the container's approval or testing specifications. It's not really any more than that. The rest needs to be kept. The requirement for a Castor container is that the documentation must represent the latest status at the time of its transport, when it has to be transported by road or rail again. Of course, you could wait ten years and then update everything, but that doesn't make sense. The hope, or rather the future prospect, is that we will have everything electronically, i.e., we will actually have a database in which we can compile the latest valid documents for each Castor and each Castor type. This is a project currently underway at the BGZ. It will take a few more years. But in the end, it will be necessary, because it is very tedious to maintain this documentation manually on paper. And in 2024, we should be able to do this electronically.

PM:

At the beginning, you said that archiving is mainly analog, but also partly digital. What things are you already doing digitally? Is this redundant or complementary, i.e., how do I imagine the coexistence of analog and digital?

Expert:

In this case, it is redundant. When I open the cabinet behind me, I see the analog operating manuals in paper form with TÜV stamps. These are indeed the sacred originals, but we naturally make them available to employees in digital form. This means that we are currently doing both in parallel. We also use a document management system, as it would no longer be possible to do otherwise. When BGZ started here, everything was done via a file server. So classic Windows Explorer, network drive, directory structures. That worked well for a while. But after two years, that was the end of order and findability. And we don't even need to talk about audit compliance. If someone clicks "Delete All" tomorrow, the IT department in Essen will be happy to restore everything. In this respect, a Document Management System (DMS) was needed.

We now have one. However, it has not yet been introduced across the board at BGZ; it is still an ongoing project. However, there is a pilot project. It is working very well. And so we have the opportunity to do this in parallel. Some documents still need to be digitized before they can be maintained digitally. For example, we are running this ILS project for Castor containers, "Integrated Storage Information System (Integriertes Lagerinformationssystem, ILS)." But there is certainly still a lot from the past that needs to be digitized. Finally, there is what is digitally recorded and ultimately only archived—i.e., incoming correspondence. This includes all correspondence relating to approvals, supervision, or even correspondence with experts, service providers, etc. All of this is already handled digitally. The correspondence is digitized directly when it is opened in the operations office, in the assistant's office, recorded in the DMS, and also distributed there. The hope is that in the future, paper will really only be filed for archiving purposes. At the moment, some of it is still filed with stamps, as was common practice in the past at government agencies: incoming mail stamps and five people have to check it off. That still happens. It's just tradition. I could do without it. The DMS can do it digitally, and we should be able to do

it digitally in the future. But we still need to go over it a few times to make sure everyone really gets it. We are still a long way from a paperless office.

PM:

Is there any data that you couldn't store analog, such as construction drawings or 3D data? Because you can't print out that data.

Expert:

Yes, there are also plans such as CAD plans. Of course, you can print out everything in principle. You just need the right printer, which has to be big enough, as long as we stick to the plan. But of course, the [plans] are mainly recorded digitally. That was one of the requirements for the document management system: that we have the option of storing native file formats—not just the PDF of a drawing, the view file—but also a native format such as a DWG or DGN file, so that we can give it to a supplier if necessary when they need to change the circuit diagram. These are things that are only processed digitally.

PM:

Is your document management system only for storage, or are viewers also integrated for native file formats, for example, so that you can view these files internally in your system without additional software?

Expert:

Half and half. We need a PDF file for a drawing. So I need a converted view file. And the DMS has no interface to drawing programs. It doesn't automatically convert a DWG file to a PDF, so the supplier or the drawing office really has to provide me with that. Otherwise, I can draw a DWG, but I can't open it. In this respect, there are no interfaces.

PM:

So the way to do it would be to find a document—e.g., a DWG—download it, copy it, and open it locally?

Expert:

Exactly. I would download it, copy it, and give it to the service provider, for example. We now had the case of new fire alarm line plans or route maps for the fire department when they need to enter our buildings. But these looked different in all three warehouses, having developed over time. One person drew it that way 20 years ago, and the new person drew it a little differently. And we said, well, we have to harmonize this somehow, and approached a service provider. That's what we did. We took the DWG files out of our DMS, sent them off and said, "Here are the drawing files, please tidy them up." And they sent us a PDF of the newly created drawing and the DWG file back, and we can archive them again.

PM:

So when you pass on data from the DMS, you make a kind of extract and then send it, but you don't allow direct encapsulated access to your DMS?

Expert:

No.

PM:

Is something like that planned for the future, or do you think that there are security concerns...

Expert:

...It will hardly be possible externally. Internally, there is the possibility that location A can access location B. And we set that up back then because we said we wanted to be able to work together somehow. It is entirely possible for colleagues in the approval department at headquarters to look at our operating manuals to see what the latest approved status is. So internally at BGZ, yes, but externally, no. However, that is simply a security requirement. You have to take the detour of downloading it and then bringing it back in again.

PM:

Is the same archiving system used at all interim storage sites, both analog and digital?

Expert:

At least digitally, that is the goal. Yes, by introducing the DMS at all sites with the same software. Of course, there are differences here and there, but you have to look at it from a historical perspective. Not every site has used the same labeling systems. It starts with the fact that older plants such as [the neighboring nuclear power plant] have an AKZ system as their plant labeling system – an invention by Siemens KWU [Kraftwerk Union AG]. In [another nuclear power plant], they have KKS. For the newer Konvoi plants, the newer power plants have the same thing in green. But with a different nomenclature. This means that the metadata fields in the DMS itself also differ slightly. [One power plant] has to file its documents a little differently than [the other power plant] so that they can be found again later. And they have to fit in with the whole large package of migrated data that has been taken over from the previous operating period under the power plant's management. So you can't make a clean break and say, "We've been archiving it this way for 20 years, and now we're going to do it completely differently." Then the data won't match anymore; it just won't work. That's why each location is somewhat chained to the old document order for better or worse. There's no getting around it. In that respect, the system is always the same. We all use the same document management system with the same functions, the same roles, and the same workflows that exist for working together. What distinguishes the DMS at the individual locations, however, is the issue of metadata and labeling.

PM:

You are a documentation specialist. What character traits do you bring to the table? Or what traits would one need to have in order to perform all the tasks you have just described well?

Expert:

Soft skills. For me, the most important character trait is the ability to work in a team. Because we always work with technology as well as with supervisors, experts, expert reports, and authorities, you have to be a team player. The other is conscientiousness. You have to have a penchant for accuracy. I can't enter a license plate number one way today, another way tomorrow, and yet another way the day after tomorrow. That won't work. And I really have to be able to stick to this pattern. That's what I mean by conscientiousness. These are two characteristics that I would say are beneficial for a documentation specialist.

Sure, and a certain understanding of the entire system. But that's something you can learn. Someone has to teach you that. When you come in as a career changer, it can be a bit overwhelming. Just looking at the legal pyramid and seeing everything that applies to us and what tasks arise from it. That may be a bit overwhelming at first, but it just takes a while to get there and understand why an Safety specification has to be on the document. Why does the TÜV complain if it's not there? These are the kinds of things you learn over time.

PM:

In which areas do the 34 employees at the site work? How important is documentation and how important are other activities?

Expert:

We are divided into two areas. We have a "monitoring" area and an area that will probably be divided again, "security and maintenance." How important is documentation? Basically, documentation could also be attached to the head of the interim storage facility as a staff unit. This is because documentation from both areas processes everything that is documented there in any way. Every form, every profile, every protocol, every maintenance order, every safety measure—everything ends up on the documentation desk afterwards. Every test report, every test certificate. Whether these are inspection reports with experts or, if defects have arisen as a result, the defect rectification certificate. The processing of the defects is also logged, and in the end, you end up back at the documentation. Basically, this is a support process. If we imagine the whole thing as a process model, then we have clear core processes: in , outsourcing, and interim storage. We also have, because it is important, the core process of "maintenance," i.e., keeping the system operational. Documentation is a support process that cuts across all of these. Each of these processes generates documentation, documents, logs, etc. And they all end up with us.

How important is that? We are asked where it should be archived and how it should be archived. But we are also asked where the plan is. These are very simple things. My colleague asked me last time if there must be a circuit diagram for our old interim storage facility. How do I find it? Well, we'll have to look together, i.e., proceed according to the plant identifier; there are a few clues. After two or three clicks, you'll find it. That's why I think documentation is relatively important. Simply because you can't do without it. Otherwise, each department would have to do it themselves. It's also conceivable that I could say, I'll do the whole thing decentralized, everyone does it themselves. But one thing is clear: the more cooks stirring the same pot... Let's get back to the point that it should always run according to a set formula. Of course, if 15 times 15 different people cook according to the set formula, the same dish won't always come out.

PM:

I would like to talk to you in more detail about the containers. You said that you currently have 108 CASTOR containers. Is there still a lot of movement there, or is it more static? And what about the rest of the waste containers?

Expert:

Castor containers are static. It is standard practice that a permit for an interim storage facility always specifies what may be stored there. So, of course, the permit [for our site] states that the fuel elements from blocks A and B of the [neighboring nuclear power plant] are to be loaded into Castor containers and placed in the Spent fuel interim storage facility (Brennelemente-Zwischenlager, BZB). For example,

we could not accept CASTORS from [another nuclear power plant site] without changing the permit. You need a new § 6. [Units A and B in the neighboring power plant] are free of nuclear fuel; they have loaded everything. With the last CASTOR (Cask for Storage and Transport Of Radioactive Material), they also loaded the pieces of fuel rods that were still lying around in the pool as scrap into quivers and placed them in the CASTOR. Then came the last return shipment from the reprocessing plants in Sellafield and La Hague. Those were the glass molds, the HAW containers. They're in there. That makes 108 in total, which means the storage facility is virtually full. I believe we still have two or three spaces available, but we can't expect any more. We haven't received any more, so operations are really static.

The situation is completely different for the LAW/MAW [Low/Mid Active Waste] containers. We have – and this is of course subject to fluctuations – let's say just under 2400 containers at the site. Across all three sites. All possible types of containers, from cast containers to mosaic containers, concrete containers, steel sheet drums, and steel sheet containers – pretty much everything is there. There is movement there. These are the actual waste containers for dismantling. The power plant has to produce dismantling waste in such a way that it is ultimately suitable for Konrad, as it is called. This means that both the material and the container properties must be suitable for later storage in the Konrad final repository. There are specifications for this. These are specified by the BGE [Federal Company for Final Storage]. And then it has to be conditioned, i.e. packed, compressed, concreted and, in the end, stored with us until Konrad is ready to accept it at some point.

There is a relatively high level of activity at this point. It could be more. But it always depends on how well the dismantling of a nuclear facility is progressing. RWE is finding this difficult because, as I said at the beginning, it is not that easy to dismantle a nuclear power plant. So a lot of activity is to be expected because the goal is, of course, to get rid of all this waste in the end. In the [older storage facility], we are talking about approximately 2,000 containers, 700 of which are steel drums. These are the classic yellow drums that we know from the news. They all have to be processed again and ultimately packed into containers suitable for Konrad and transported back there. So there is movement there.

PM:

What does interim and final storage look like for the EVU? Who is responsible for compiling the documentation for the campaign registration with regard to final repository? Does the EVU have access to your premises, or how does that work in practice? You have to give the EVU Leitz folders for interim storage and the same again in green for final repository in the Konrad repository, right?

Expert:

This is a relatively interesting area because a lot of documentation is involved. If I add up the documentation for these 2,400 containers here, we have three archive rooms full of documentation alone. The special feature here is that, as an interim storage facility, we are the users of the containers. However, we are not the owner. Until the final confirmation of suitability for final storage, i.e., until this G2 status [product-controlled waste containers] is granted in accordance with a specific paragraph of the Atomrechtliche Entsorgungsverordnung (Atomrechtliche Entsorgungsverordnung, AtEV), the owner remains the owner of this container and [the operator of the neighboring nuclear power plant] also retains the documentation.

It is still possible that something may change. Ultimately, [the operator] will register the containers with the BGE and state: "In our opinion, these containers are packaged in a manner suitable for final storage, i.e., they can be produced in accordance with the approved Conditioning process using an approved container of the appropriate material quality." This is a very rough outline; there is, of course, much, much more to it than that. The BGE will check this and, if it is suitable – which has not happened very

often in Germany so far – will grant G2 status, stating that this Konrad container is packaged in a manner suitable for final storage, both in terms of material and container technology. And then the entire container is transferred to the BGZ and becomes the property of the BGZ, and from then on we are not only the users but also the owners of the waste. This remains the case until we deliver it to the final repository.

PM:

Where does the repackaging into Konrad containers take place?

Expert:

Under [the operator's supervision]. [The operator] has a small... It used to be called a tool storage hall, but today it is actually a conditioning plant. There is a concrete mixing plant inside where containers can be placed, for example, five 200-liter drums in a Konrad container. Then it is concreted, the lid is put on and screwed down with TÜV certification and a protocol. However, this does not mean that the container is ready for G2, so this must also be reported to the BGE. This is another conditioning measure within the framework of a conditioning campaign. Then it is finished, it has been approved and then it would be transferred to us. A second variant, which is currently running at in Block B, for example, is the dismantling / segmentation of the core components. This involves cutting up the upper core structure of the reactor vessel and placing it in Konrad containers. This takes place directly inside the block, which means that these conditioning campaigns are actually still being carried out under [the operator's supervision] and we have nothing to do with them.

This is also due to the fact that we do not have a license to handle open radioactive materials. We are only allowed to handle tightly sealed waste containers. We are also not allowed to open any [containers]. This always brings us to the same point: if the containers have been standing for a very long time and are eventually sent to Konrad, they must meet certain requirements. This means that the last WKP, i.e., the periodic inspection, must have been carried out. In the worst case, depending on the type of container—this is referred to as 1-2-3 measures—they must be drained and vented again. These are all things that cannot be done under our supervision because we do not have the equipment to open such containers. This must all be done on site, and a facility there is being converted into a conditioning center for this purpose.

PM:

So there is a clear spatial separation and in this case the BGZ has nothing to do with it, but it is the operator's responsibility?

Expert:

Ultimately, it will be the operator's responsibility. We'll have to see if there is a joint venture where they say, "You participate in the facility in some way and use it as BGZ for this purpose." We'll have to see. Let's take a Mosaik 2 type BU as an example: The packaging, which would basically be suitable for Konrad, has been transferred to us and will be called up by Konrad in 10 years. Konrad then says, I need these containers and batches so that I can store them cleanly in Konrad. Then the BGZ is notified that these containers should be in their possession, because the G2 statuses are known. This then goes to [the location of the interim storage facility] and they say, "We need the container at the back left." Then we realize that the thing has been sitting there for 15 years. But it's our property. Then, of course, as BGZ, we have to do the final checks and, in the worst case, also these 1-2-3 measures. This is a project that is currently getting underway in Essen. How it will work remains to be seen; the final word has not

yet been spoken. Will there be a facility at the site? Will there be a mobile plant that can be driven from site to site to assemble such batches? That's still a bit of a strategic question, simply because the LOK in Würgassen, the Konrad logistics center, has now been canceled for Christmas. For us, of course, this means relatively quick replanning. Of course, things are no longer working as originally planned. Then there is also the question of what to do with the documentation. Will it be handed over to Konrad? These are all issues that still need to be clarified. We are working with headquarters on this, so we'll see.

PM:

When waste is transported from the power plant to the interim storage facility, does the documentation always have to be transported immediately with the waste? How is this handled when the waste is transported by vehicle? Does the corresponding documentation also have to be in the same vehicle?

Expert:

If you ask my boss, the head of monitoring, he'll say "Yes, with the cord tied around the outside." In principle, the [documentation] should be handed over with the container, but that's not realistic. Our containers are at the back and the documentation is here in the Archive. In the end, they are actually handed over separately. If you take a mosaic container, for example, it also has one or two folders of production documentation, i.e., manufacturing documentation very similar to that for a CASTOR container. The documentation also has at least one folder of test records, so that every handling of the lid attachment points, every repainting, or every inspection of this container is documented. And each of the containers also has loading documentation showing what went in and how it got there, so you can assume there are a good three Leitz folders for that as well. Of course, these will be transferred to us in container bundles. It will be interesting to see how far they have been digitized. It's not always possible to say anything about that. I know that in the past, the EVU has run quite a few digitization campaigns where they took out folders, gave them to a service provider, and said, "Please digitize them, add barcodes, and then send them back to us." From what is currently coming into the Archive over there, I would say that about 50% of the containers really do have parallel digital documentation. The rest is paper-heavy. So now the question is: Do we bother to digitize it again? I think ultimately yes, depending on how quickly Konrad comes. We'll just have to see.

PM:

You'll have a little time until then.

Expert:

Yes, we're afraid so.

PM:

What if, in a few decades, Konrad is really finished, the future of the interim storage site? In a few decades, the dismantling [of the neighboring nuclear power plant] will also be completed. Ideally, there will be a green field there and your storage facility will be full. After the waste has been transported to Konrad, will your facility also be decommissioned, or how should we imagine this?

Expert:

Basically, yes. In principle, the BGZ has of course planned for the end of its life. Once we have transferred everything to the final storage facility, the BGZ will no longer be necessary. The goal is to empty at least the interim storage facilities in the long term – although the medium term would be

optimistic. That is a clear goal. Until then, we really only have one goal: safe interim storage. That means storing the waste in such a way that nothing is lost, nothing leaks, it poses no danger to the environment or the population, and it is ready for transfer to the final repository at time X. Those are the main premises we have as BGZ. Once we have delivered all the waste, then theoretically we can demolish AZB 1 and produce more waste. That also has to be taken into account.

Where we will remain here at the site for generations, in my personal opinion, is in the Interim storage of high-level waste. In my view, there is not even the slightest prospect of a final repository for fuel elements and high-level waste containers. And even in the long term, if you look at the time horizons of the BGE and see that we are already at 2078 or whenever, this is an unresolved problem . In our society, it must be said. I don't know if it can ever be solved. But as long as things remain here at this site, the BGZ will continue to exist. That is my assessment.

PM:

After 40 years, the interim permits for the sites will expire. That will soon become an issue. How do I imagine the process? Does the extension also have anything to do with the waste, or is it really only about the building fabric and infrastructure of the interim storage facility?

Expert:

Both. On the one hand, it is quite clear that I have to obtain a new permit for the interim storage facility because the old one is only valid for 40 years. The situation is similar with the Castor container. It, too, is only approved for a certain period of time. Here, too, I will have to prove that it will remain in service for longer than 40 years. Of course, no one has tried this yet, it must be said. When you look at the operating life of nuclear power plants and see how long fuel elements have been packed in CASTOR (Cask for Storage and Transport Of Radioactive Material), I can't get to 40 years, so I don't have any empirical data on that. BGZ is currently running research programs, together with many other companies, to see how the inventory in a CASTOR can be examined. What do the fuel elements look like after 40 years in a CASTOR container in dry interim storage? Hardly anyone has done this yet. Finding a CASTOR container that is 40 years old is difficult. What does it look like inside after 40 years? Research is currently underway to X-ray the CASTOR container, so to speak. This allows me to see whether everything inside is still as it was originally arranged, or whether individual components such as polyethylene absorber rods or the like have lost their function. These are research projects that are currently underway. But the BGZ will also have to make a statement on this. If only because it wants to obtain a new license.

The permit will certainly be issued on a holistic basis. So I can't just say, "Yes, the concrete is still fine. The gates still open and close, and the crane is basically still in good working order." That won't be enough. It will have to be considered holistically. Preparations are already underway and time is pressing. We'll have to see how it goes. Whether it goes smoothly, or... I could imagine that it will be tough for the industry and also for the communities where the intermediate storage facilities are currently located to determine what it means in plain language if I add another 40 years or more to the permit.

PM:

What would be the consequences if a permit were not granted? In the worst case, it would mean that the interim storage site would have to be closed. But that is hardly conceivable for logistical reasons alone.

Expert:

We have an example in the industry where you can see this. Brunsbüttel is currently de facto without any valid operating licenses. It is still under Vattenfall's control; BGZ has not yet taken it over – precisely because the licensing situation has not yet been fully clarified. This is an example that clearly shows that, in the end, nothing will change except that everyone is working flat out to obtain a license. There is no going back, there is no left, there is no right. I cannot move the CASTOR containers to another storage facility. It is not feasible to relocate the CASTOR containers and transport them elsewhere. I do not have the space for them elsewhere, and the other storage facility does not have the necessary permits. As mentioned at the beginning, a permit is only valid for the specific location.

In this respect, politicians and society will have to come to some kind of agreement. That's the only thing I can imagine. Of course, a permit is always subject to certain conditions. In the end, there will be a whole bouquet of requirements that the operator will have to meet. Whether these are safety requirements—in which case we will just have to build another wall around the outside—or we discover that the walls do not hold up as they should in the event of a plane crash, or that planes have become larger. Then some technical measures will have to be implemented to compensate for the safety risks. All of this is feasible with sufficient effort; with enough money, it can all be done. But that will be the crux of the matter. I also don't believe that the new permit will come without additional requirements. The state of science and technology has evolved since 2006. This will have to be taken into account.

PM:

No decision has yet been made on a final storage site for the highly radioactive waste. So now we have these 40 years, then another 40 years, and probably more after that. There will be a few more iterations.

Expert:

Yes, let's see if I'll still be around to see it. That's what I mentioned at the beginning: the problem of nuclear technology waste disposal, which society and politicians have not solved during the operating life of nuclear power plants. The BGZ won't solve that either. We are only the interim buffer and we store the waste until someone else takes our place at some point.

PM:

Let's come back to container labeling. What is the link between the physical object and its documentation? How are the containers labeled—do you use numbers or perhaps QR codes that can be scanned?

Expert:

It's actually relatively straightforward. As I mentioned briefly earlier, the specifications for container labeling are mainly derived from the Nuclear Waste Management Ordinance (Atomrechtliche Entsorgungsverordnung, AtEV). Section 2 stipulates how I have to keep records and refers to a whole range of annexes to the AtEV, which describe the labeling system in relative detail. It is an alphanumeric label. First, there is a labeling system for waste. The AtEV provides a good overview of what this consists of—who produced it, what kind of conditioning process was used, what are the material properties of the waste, and in what year was it conditioned? This is how an alphanumeric label for the waste itself is composed, and then the waste container—when we talk about containers, we always mean containers plus pre-packaged waste—is given a specific number. This is also an appendix in the AtEV, which consists of a producer code, here [at the site] it is [three-letter code], and then a seven-digit number. And so the

containers are actually marked with a large banderole, e.g., "[code] 0002534." That is the seven-digit number. This number is used to keep track of the container in the accounting system. There is a database system in the accounting system. Here, the operators and BGZ have agreed to use the same one. Since the data records have to be moved back and forth, this makes perfect sense . It is called AVK – Waste Flow Tracking and Product Control System (Abfallfluss-Verfolgungs- und Produkt-Kontrollsystem, AVK) – and was developed by GNS, a major service provider for nuclear services in Germany. They came up with the system. It is currently in its fifth version and is a web-based application. And that's where these numbers are used. This means that I can search for waste in the AVK directly using either the container number or the waste number. These are the two essential numbers for LRW/MRW waste.

The CASTOR containers simply have a simple numbering system, e.g., "CASTOR 119" or "CASTOR 127," which links them to the location. There is also a table in the AtEV, in Annex Part D, which describes the data collection. Everything that is recorded there takes up five pages. It's too much to list here now, we'd still be sitting here tomorrow... Essentially, it describes what kind of container it is – there are different Castor containers, different HAW containers for high-level waste. What type of container? What radiological data does the container have, what fuel elements are in it and how many? Fuel element data, i.e., burnup, age, etc., must also be maintained in this database. The same applies to the heavy metal masses contained, i.e., from plutonium to uranium to thorium, and the activities involved in the inventories. It's a relatively long table. That's the essence of container identification.

What can be traced back from the AVK is the repackaging that is practiced in many cases. For example, you take 200-liter drums, five of which fit into the Konrad Container III, and encase them in concrete. Then I have produced a new waste container, but in fact I only have waste that has already been produced and recorded in the waste container. And so I can see in the AVK, for example: A Konrad container with the number 0053742 contains five 200-liter drums. They all had their own numbers. So I can use this number to look inside the 200-liter drum and see what's in it and which waste code the waste is recorded under. That's the idea behind this accounting system and the requirement in AtEV § 2, which stipulates that we have to do it this way.

It is clear that in this case we are actually only recipients of the data. That means we have to have it, of course. We also enter it into our database and are currently moving data records back and forth. This means that when we receive 200-liter barrels from the operator from its waste processing, it simultaneously sends us a data record for them. The data record contains information about what kind of waste it is, the type of waste, how heavy the waste is, and when it was generated and conditioned. What is it packed in, i.e., what type of waste container/container type is it? And also various other [information], including radiological data and decay series that are applied. We take this information and enter it into our AVK database. If the operator later says, "I need this 200-liter drum back now so that I can pack it in the Konrad container for final storage," we physically transfer the 200-liter drum to them and at the same time they receive the AVK data record. You can also track the history in the AVK, i.e., how the waste has moved from A to B and back to A or even to C when it is transferred to external conditioning. The idea is to track the waste so that it doesn't end up somewhere in limbo.

PM:

Exactly, preventing proliferation. It should always be possible to track where the waste is located.

Expert:

That's kind of the background. The past has shown... If you look at the Mol scandal with the waste from Belgium, where they ended up producing waste containers where you couldn't tell what was inside and

couldn't ask exactly what was inside. All you know is that what's inside shouldn't be there. So there are a number of things that need to be prevented. The issue of proliferation mainly concerns nuclear fuels. It is clear that LAW and MAW waste are free of nuclear fuel. They are de facto free of nuclear fuel and do not generate heat. Let's be honest: even for a dirty bomb, such waste would be sufficient if you wanted to achieve the desired effect. So here, too, nothing must be lost.

PM:

Earlier, you mentioned labeling systems such as AKZ and KKS. In principle, one could say that something similar exists for the containers. Do you have a common guidance system for the labeling systems of your technical facilities and waste containers?

Expert:

These are separate systems, as they come from different sources. As I said, for containers we have the AtEV or the container manufacturer number, which is determined by the manufacturer. We have little influence on this. Another example is Eisenwerke Bassum and its Konrad containers with the EB number. These are also unique – like the chassis number on a car – but as BGZ, I have no influence over them, whereas the plant identification system (AKZ) was simply specified by the EVU at the time. So these are not interconnected identification systems that follow any kind of common logic. Except for one: as with any identification mark, it is uniqueness. An identification mark may only appear once on a container. In other words, there cannot be two containers with the same identification mark, just as there cannot be two pumps with the same AKZ. The requirement here is to prevent confusion.

PM:

How much digitization do you already have in terms of labeling systems? For example, there are service providers who develop applications that allow you to scan a QR code next to the number during maintenance, open a form above it, and enter information directly. You click OK and then you no longer have to maintain it on the PC. Does that play a role for you?

Expert:

In short: it's a pipe dream. To be honest, it shouldn't be a pipe dream, but state of the art. The approaches are underway, the projects are underway. For example, there is a group of documentation specialists who exchange experiences. Six months ago, there was a big discussion where everyone agreed that we need to find a way to make our labeling systems barcode-readable. Simply to network them. If I want to put them in the archive later, I can scan them at the archive and see that the folder is in the following position on the shelf. There are many other reasons why such a barcode system should be implemented. The ideas are there. At the moment, it's a matter of persuading IT to really take on the task. Something like this has to be programmed or purchased on the market. It's definitely available to buy on the market. But that's why it's still a long way off for us. The idea is there, but no one has really come up with a) an implementation and b) an idea of how it should be implemented. The documentation specialists are meeting again the day after tomorrow. It will be a topic of discussion. Let's see what comes out of it; I don't want to bury the idea completely. It's actually important to me because I don't think we have to work like we're in the Stone Age. There are more modern ways of doing things than what we're currently doing, I'll admit that openly and honestly.

PM:

Let's stick with QR codes. What advantages do you see in knowing what data is stored directly on the physical object?

Expert:

In the area of archiving, I see a very specific advantage, similar to that of container handling. I could label storage locations and containers with a barcode, just as I can label folders or documentation and archive locations with a barcode. This would allow me to record where each container is located, for example. This manual recording would be one application. It would of course be interesting if I could scan the barcode on the back of the folder, for example, and open the corresponding data record on the computer. That is now a convenience feature. Of course, I can also simply enter the document number to open the data record. But this would make it a little easier for me. These are the areas of application I have in mind. There are certainly many others, but we would have to take a look at those. However, since this is still a long way off for BGZ, we are not quite there yet.

PM:

Yes, but I think a lot is happening in other areas too. In logistics alone, for example, if we look at how an Amazon warehouse works. People no longer play a role there; it's all image recognition.

Expert:

It's becoming much more digital, that's for sure. I always say that I'm glad we don't have to fill out stone tablets. So it's still manageable. But nuclear technology is not the most innovative industry.

PM:

Which data in the area of monitoring and documentation is collected automatically and which manually? Are there, for example, sensors that measure values and automatically transfer them to systems? Or how much of a role do humans still play?

Expert:

I would say 99% manually. It is actually the case that the [data] is mainly recorded manually. What we had earlier, the whole radiology department, is all manual recording and manual evaluation. Container monitoring, for example, is the pressure switch at the top still tight? Yes, that's done electronically, but otherwise it's mainly manual. But it's also because we have few processes that run continuously, in which I would have great process data processing. Unlike, for example, in a nuclear power plant, where I had a process computer system that continuously received and processed data from the plant and then made it available to the shift personnel, so to speak. We don't have processes like that at all. If no inspections or maintenance are taking place, nothing happens in the warehouse that I would have to record automatically with data. In radiology, there are recorders at the measuring points, in the measuring houses for environmental monitoring, for example . Yes, data is also recorded automatically there and does not have to be recorded manually again. So I would say that 90% of the data is recorded manually and on an ad hoc basis.

PM:

A Castor container has cooling fins. In terms of container labeling, do I have any space to attach anything there, and am I allowed to physically touch it?

Expert:

Yes, the CASTOR (Cask for Storage and Transport of Radioactive Material) is clean. You would notice that it is warm—depending on what kind of facility it comes from, it might even be really warm. The CASTOR has a single spot on the cooling fins where the sticker is attached. It has a very sturdy fixture with an engraved sticker on it. And that plaque contains the Castor data: container number, registration number, parts list number, drawing number. The situation is similar with a mosaic container, which also has a fixed area where it is marked and where a plaque is also attached. With the Konrad container, the container identification is simply painted on. Similarly, 200-liter drums are labeled with stickers, for example. But with the Konrad container or the Castor container, there is actually an area designated for the plaque.

PM:

Does the safety regime allow me to actually attach something there by hand, i.e., to approach the container and touch it?

Expert:

Yes. It provides very good shielding. The spheroidal graphite used there has a very good shielding effect. You can also walk between the Castors. Of course, we are in a Controlled area, which in this case is monitored radiologically with normal personal dosimeters and neutron dosimeters. And yes, you would also detect a dose rate afterwards, but that is within acceptable limits. In this respect, you can also touch it. It is clean on the outside; it has been proven to be contamination-free, otherwise it would not be allowed to leave the power plant and enter our facility.

PM:

You just have to rule out surface contamination.

Expert:

But otherwise, you can touch it.

PM:

I would like to talk to you about the topic of "knowledge and experience." We discussed this in advance by telephone, talking about the exchange of experience and the next generations that will come. As long as there is no final repository for high-level radioactive waste, the interim storage site will remain in operation for decades to come. In your opinion, what is the biggest challenge when it comes to passing on knowledge?

Expert:

I'm giving you my personal assessment here; I'm by no means the human resources department. But I do have a bit of experience in this area. The problem is simply that the pool of young talent in nuclear technology is no longer as deep as it was when nuclear power plants were operating and the industry was attractive. Whether it's degree programs that have been discontinued due to a lack of new applicants. One of the challenges will be to get people excited about nuclear technology, as well as about the relevant degree programs, and to attract young talent to these fields. I think that's the biggest challenge we have to tackle. The second challenge – whether it is a challenge remains to be seen – but one task is to get career changers who are entering the industry up and running. This means equipping them with the knowledge they need to deal with the subject matter in their daily work. On the one hand, there are regulatory, i.e., legal requirements. There are a number of courses that can be offered,

that must be taken, to find out: What does the AtEV say, what does the Radiation Protection Ordinance say, what does the German Atomic Energy Act (Atomgesetz, AtG) say? What does the license mean? What does that mean for me as the operator of a facility that requires a license? These are all things that can be taught to people in courses. In the field of Radiation protection and the like, academic training is also needed to get ahead. I think it will be a challenge for the BGZ to recruit young staff and keep training going. Power plants will need less and less. But the BGE and BGZ will certainly be active in keeping the market going.

PM:

What kind of practical knowledge is important for you? Of course, I could look at all kinds of laws and regulations. But what kind of knowledge can I only learn from others on site?

Expert:

We have a relatively highly regulated environment in many areas. Take maintenance, for example—the processes that take place there are regulated. There is an officially approved maintenance regulation that specifies how the maintenance procedure must be carried out. When do I have to fill out which form, who has to sign it, do we have to adhere to the dual control principle, do I have to do a pre-job briefing and job debriefing? All things that have been communicated to the authorities in the maintenance regulations. These are things I have to teach people first.

We have a policy of "no work without an order." What does that mean? What are all the formalities? The same applies to the whole topic of maintenance and inspections. Here, too, the entire inspection process in our warehouses is regulated in inspection manuals, for example. This has also been coordinated with the authorities in terms of organization. We have inspection manuals that require the involvement of experts. So I can't just go ahead and inspect the emergency power system. To do this, I have to make an appointment with the expert in advance. I have to invite them and they have to be present. These are all things that set us apart from a normal industrial company. This means that the regulatory requirements at the site are knowledge that I have to impart to people on the job. Otherwise, the whole thing doesn't work. The situation is similar with documentation. What I said earlier, the contents of KTA 1404... When do I have to write Safety specification [safety specifications] on it? When do I have to write a change request to amend a document? There are documents that I can amend freely. Our classic work instructions and service instructions – that's a set of rules that we as a site can change freely and don't need to inform the authorities about. But as soon as I start working on an operating manual, such as a maintenance regulation, I can't change it freely . For every change to the maintenance regulation, I have to ask the supervisory authority for approval because of § 19 (supervisory process). Only once the supervisory authority has given its approval can I change the processes and introduce new ones. Then the expert reviews it – is everything state of the art, scientifically and technically sound? And only then can I make the change. People need to be taught these things a little. Those who are not from the industry will not be used to the fact that the instructions they work according to require the approval of the Hessian Ministry of the Environment.

PM:

All the examples you have listed relate to processes and thus represent process knowledge. My impression when I interviewed someone from a power plant was that this experiential knowledge there relates very much to the physical objects in the room. So less the processes behind it, but rather, for example, an understanding of what was done to a particular control cabinet at a certain point in time. Or a particular pipe, or, if there were minor incidents, deviations from normal operation. You should be

able to assign all of that afterwards. I take from you that you regard the interpretation and practical application of regulations as experiential knowledge.

Expert:

Yes, I can understand the statement in the nuclear power plant very well. In the nuclear power plant, the focus was different, but that is simply due to the characteristics of the plant. If we are completely honest and look at our plants: A fire alarm system at our plant is no different from the fire alarm systems used elsewhere in industry. In terms of plant technology, we don't really have that many special features.

Take the change history, for example: we don't have four redundancies that have been dismantled and reassembled during every inspection. We have very few retrofitting measures that have been implemented in nuclear power plants, for example, in order to maintain safety requirements at all times. None of this actually applies to us. We have no pressure and no temperature, so we have a completely different level of risk. What I have to say at this point is that we naturally also have the empirical knowledge about the history of a system, for example, or about the systems, components, and equipment. Of course, I also have to explain to someone how the emergency power system works, for example. But it's not such a highly complex emergency power system that a trained specialist with knowledge of electrical engineering can't understand it. You can almost assume that this is already covered in vocational training. It's different in nuclear power plants because they are special facilities. Take reactor protection, for example. If you've ever looked at a nuclear power plant, some of the connections are not digital, but actually analog wiring... When you stand in front of the reactor protection with all those wires, you definitely need technical know-how and knowledge of the systems. In our case, there are a lot of processes and procedures.

PM:

Yes, I think so too, if you look at the entire life cycle of a power plant. In our research project, we have found – and this applies equally to the operators, of course – that a lot of design knowledge is required for decommissioning. That means knowing how the plant was planned and built at the time. They would like to draw on knowledge from the 1960s and 1970s, but this was not documented according to today's standards. First, this knowledge has to be tracked down, and then you realize that people back then placed value on completely different things or, conversely, placed no value at all on things that are of great interest to us today and simply did not document them. I can imagine that knowledge retention is much more critical to the business model in a power plant than in an interim storage facility.

Expert:

But we do have one example where I would say it might be interesting. That's the fuel elements in the CASTOR containers. As we said earlier, if we really want to find out how they behave after 40 years, I should know how they were actually manufactured 40 years ago. That's the kind of knowledge where I say, yes, of course, we have to pass it on. It's certainly documented; nuclear fuel is highly documented. That's knowledge we shouldn't forget and that we'll need again at some point. At the latest when I have to prove that a fuel element is still a fuel element after 40 years and not basically lying around as a small pile at the bottom of the CASTOR container, as is sometimes assumed... This is the kind of knowledge where I have to say that it would be interesting to know what happens to the fuel element during production and what happens to the fuel element during its operation in the nuclear power plant. Has it ever been repaired, has it ever been damaged, fretting [note: foreign body friction] or anything else?

These are things where I say, yes, the fuel element history is something that is interesting for us as BGZ and later also for the Final repository to know in order to be able to assess its condition.

PM:

When you look at when the final repository for high-level radioactive waste is supposed to be ready, you realize that it will still take some time. Of course, interim storage is a temporary solution, but it will remain an issue for perhaps another 100 years.

Expert:

That's my assessment too. We won't be able to do it as quickly as the Finns or the Swiss did. That's not in the German nature. *Laughs*