Research Reactor FRJ-1 (MERLIN) Disappears Almost Without Trace - Review of the Ups and Downs of Reactor Dismantling - 10453

B. Stahn, R. Printz, K. Matela, C. Zehbe
Forschungszentrum Jülich GmbH
52425 Jülich, Germany

ABSTRACT

At Forschungszentrum Jülich, the research reactor FRJ-1 (MERLIN) went into operation in 1962 and was subsequently used for various irradiation experiments, especially in the field of materials science. After 23 years of operation, this research reactor was finally decommissioned at the end of 1985. Having been shut down for ten years, dismantling work began in 1995 and was completed at the end of 2009 when the site was recultivated.

Dismantling work was divided into a total of eight main steps: dismantling of the air cooling system, disassembly of the loop systems and the remaining experimental facilities, removal of the reactor internals, dismantling of the reactor block, gutting and decontamination of the reactor building, clearance measurements and clearance of the reactor building, conventional demolition of the reactor building, clearance measurements and clearance of the ancillary buildings (operating, sanitary, supply and water treatment buildings).

Forschungszentrum Jülich was breaking new ground with the dismantling of the research reactor (FRJ-1) since at the start there was no experience with decommissioning and dismantling to fall back upon. Problems also arose in special cases, which made it necessary to find individual solutions. This concerned, in particular, remote control and remote handling, as well as the broad subject of clearance measurements of buildings and materials. However, the necessity of undertaking this ground-breaking work also led to great successes that were reported in the press.

The dismantling of the highly active components and structures, such as the reactor internals and the reactor block, presented particular challenges. These challenges were ultimately overcome by means of precise planning and expert implementation. It should be noted that during the entire 14-year dismantling period there were no accidents worth mentioning nor any inadmissible exposure of the staff to radiation.

Dismantling the reactor building gave rise to a total of roughly 10,000 Mg of dismantled material, of which about 9,000 Mg was released after clearance measurements. After clearance measurements, the ancillary buildings were demolished conventionally. This led to a total of approx. 8,500 Mg of dismantled material.

During the entire dismantling period (14 years) the collective dose was only about 54 mSv, although between three and 14 members of staff were at work at any one time. The total cost of the dismantling project amounted to roughly € 30 million.

Work started with the dismantling of the air cooling system, during which about 350 Mg of “reactor scrap” was removed at a stroke, although the term “reactor scrap” sounds slightly exaggerated for a conventional structure such as an air cooling system. However, this demolition was a visible sign since almost overnight the skyline of the Forschungszentrum Jülich had changed and it became clear to everybody that a new era had been ushered in at Jülich – namely, the “era of nuclear dismantling”. What had begun as a starting signal continued behind closed doors for the next 13 years. The actual dismantling of the reactor plant took place hidden from public view. The dismantling work was characterized by numerous ups and downs until, finally, in April 2008 it was

possible to open "Pandora's box" when the reactor dome was lifted off and the reactor hall was exposed to the light of day for the first time in almost 50 years.

A unique project was successfully completed. The staff on the project team are now using the experience they gained to tackle new challenges in dismantling nuclear facilities.

INTRODUCTION

At Forschungszentrum Jülich, the research reactor FRJ-1 (MERLIN) went into operation in 1962 and was subsequently used for various irradiation experiments, especially in the field of materials science. After 23 years of operation, this research reactor was finally decommissioned at the end of 1985.

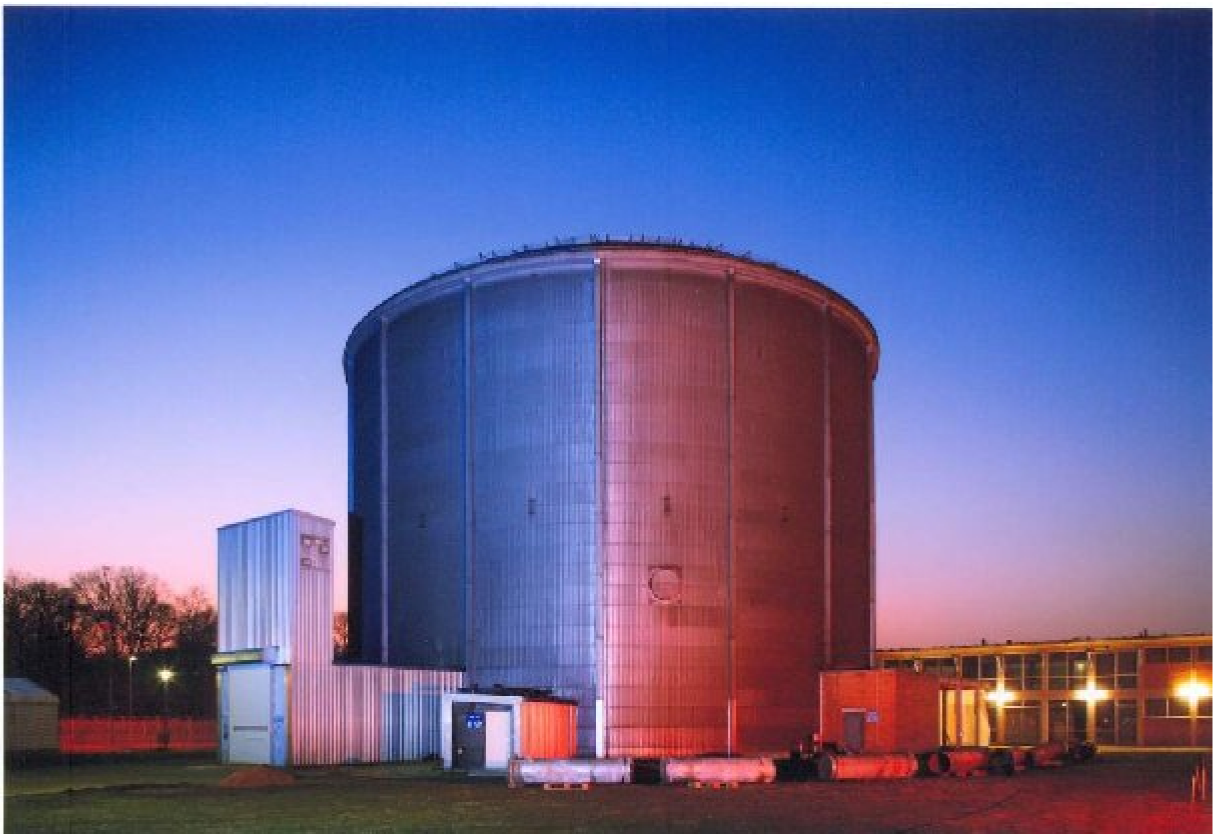

Fig. 1. Research reactor FRJ-1 dazzling in blue and red

The research reactor MERLIN (**M**edium **E**nergy **R**esearch **L**ight-Water-Moderated **I**ndustrial **N**uclear Reactor) was a light-water-moderated and -cooled swimming pool reactor of British design with the following characteristics:

✓ Thermal power:	10	MW
✓ Thermal neutron flux:	max. 1.1 x 10^{14}	n/(cm² s)
✓ Coolant and moderator:	water (H_2O)	
✓ Main dimensions of reactor building (diameter x height):	30 m x 28 m	
✓ Construction phase:	1958-1962	
✓ Commissioning (first criticality):	23.02.1962	
✓ Operating phase:	1962-1985	
✓ Final decommissioning:	22.03.1985	

The foundation stone for the reactor was laid on 11 June 1958 and the reactor was put into operation on 23 February 1962. Operated in the final phases at a thermal power of 10 MW, it was finally shut down in 1985 after 23 years of operation. After shutdown, the fuel elements were removed from the plant and most of the experimental installations disassembled. After becoming something of a "Sleeping Beauty" for about 10 years, the first dismantling activities began in 1995. Dismantling work was finally completed in late 2009 with the restoration of a green-field site. In the following, we describe the ups and downs of dismantling work and the results and experience obtained.

CHRONICLE OF REACTOR DISMANTLING

It is fourteen years since the start of work on dismantling the research reactor FRJ-1 (MERLIN) marked the beginning of the era of "nuclear dismantling" at Forschungszentrum Jülich, this being the first nuclear demolition project on campus.

Within the framework of four partial licences pursuant to the German Atomic Energy Act, the reactor plant was dismantled to re-establish a green-field site according to the following major dismantling phases:

- 1995: Dismantling of the air cooling system
- 1997 - 1998: Dismantling of the loop systems and remaining experimental facilities
- 2000 – 2001: Removal of the reactor internals
- 2001 – 2003: Dismantling of the reactor block
- 2004 – 2007: Gutting and decontamination of the reactor building
- 2007: Clearance measurements and clearance of the reactor building
- 2008: Conventional demolition of the reactor building
- 2009: Clearance measurements and clearance of the ancillary buildings (operating, sanitary and supply buildings) with subsequent conventional demolition

UPS AND DOWNS

The path from the first dismantling step to the final ceremony sowing the lawn and planting the tree consisted of a long series of small steps. It was in part a very rocky road where a large number of obstacles had to be overcome. Sometimes we found elegant solutions, but we also took some hard knocks. However, our efforts were rewarded by some spectacular highlights. On the other hand, we also encountered many surprises and problems during dismantling work.

We have to distinguish between different sorts of highlights. On the one hand, there were highlights which, in principle, only represent personal successes and were not nominated as "real" highlights simply because most people didn't know anything about them. On the other hand, there were highlights that attracted public attention.

A real public sensation, attracting extensive coverage in the local press, was, for example, the removal of the reactor dome, which had a diameter of 30 m and weighed more than 100 Mg. Two 500-Mg cranes lifted the dome off and like a UFO it was set down in one piece next to the reactor building.

Just as attractive to journalists, and thus a real highlight, was the recovery of the foundation stone of FRJ-1, which was also the foundation stone of Forschungszentrum Jülich itself. Almost to the day 50 years after it was first laid, the foundation stone was presented to the public again.

Technical problems accompanying the dismantling of a nuclear facility are not generally made public. An exception is if they affect public interests. Thank goodness, this was never the case during dismantling of FRJ-1.

Not every dismantling phase involved highlights or serious problems. Due in particular to different degrees of difficulty or their publicity value, these problems and highlights were mainly concentrated in certain dismantling phases. With respect to the chronology outlined above, this affected in particular the stages after the removal of the reactor tank internals up until the conventional demolition of the reactor building.

Removal of the reactor internals

The reactor internals can be divided into two categories. On the one hand, there were the internals installed underwater in the reactor tank and which primarily served to accommodate the reactor core (reactor tank internals). On the other hand, there were internals in the former beam tubes of the reactor block (beam tube internals). The latter also first had to be removed and disposed of in preparation for the dismantling of the reactor block.

Reactor tank internals

The reactor tank internals, which essentially comprised the core support plate, core box, flow channel and neutron flux bridges, were aluminium components fastened and assembled with about 150 stainless-steel screws. The core support plate served to accommodate the fuel elements enclosed in the core box. The flow channel connected the core support plate by form-fitting to the cooling water return opening in the tank bottom and thus ensured optimum flow through the support plate. The neutron flux bridges acted as a link between the core box and the thermal columns with the aim of improving the neutron flux. A precondition for removing the tank internals was minimization of the high-level waste. For this reason, the separation of aluminium and steel, whose levels of activation differed by several orders of magnitude, was the primary goal. Because of the difficulties presented by the mounting position – 6 m deep, underwater, screws perpendicular to the line of vision – and the structural difficulties, for example, the fact that these were slotted screws, the pessimists finally came into their own. They wrung their hands and conjured up visions of corroded aluminium-steel joints since the components had been underwater for decades.

In view of this horror scenario, it was therefore a personal highlight for us when the first screw was loosened underwater at the first attempt (see Fig. 2 and 3).

Fig. 2: Loosening a screw in the reactor tank

Fig. 3: Looking through the video endoscope

More than 90 % of the screws could be loosened in this way without difficulty, and even with the others corrosion was not the reason for any problems arising.

However, the road to the highlight of "loosening the first screw" was full of obstacles. Not only the purely physically constraints, such as installation underwater, difficult position, confined conditions and radiological considerations, represented major factors, but also to a considerable extent the psychological pressure since suddenly there were pessimists all over the place who took great pleasure in ridiculing our efforts.

Due to the physical and radiological conditions, dismantling work had to be performed by remote control and underwater. The problems involved were solved by designing and constructing various special tools in order to perform the necessary screwing, milling and sawing procedures. Special mention should be made of the following:

- Screwing device to loosen the screw connections (see Fig. 2 and 3)
- Milling device to remove the screw connections that could not be loosened (see Fig. 4)
- Sawing device modified for use underwater (see Fig. 5)

The dismantling area was visualized underwater with the aid of an 8-mm video endoscope.

Fig. 4: Testing the milling device

Fig. 5: Testing the sawing device

Beam tube internals

After the FRJ-1 reactor plant had been shut down and the experimental insets removed from the beam tubes, the latter had been equipped with shielding plugs as protection against direct radiation from the reactor core. And here time had taken its relentless toll. Due to the severe oxidation the shielding plugs (aluminium) and the beam tube (stainless steel) were as if fused together and dismantling was initially out of the question. A solution to this problem was ultimately found by the trial-and-error method.

The first attempt to exploit the different expansion coefficients of steel (beam tube) and aluminium (plug) by using a stainless steel plug cryocooled by nitrogen was a complete failure (see Fig. 6). Either the achievable difference in expansion was too small to overcome the forces transmitted by corrosion, or the capacity of the temperature sink provided by the nitrogen-cooled plug was insufficient, or the spatial positioning of the plug in the beam tube was not suitable for a sufficiently rapid thermal flux. If cold wouldn't work we decided to try heat. According to this plan, we used an oxygen lance. Lo and behold, all the factors seemed to work together to overcome the forces arising from the corrosion by exploiting the different expansion coefficients. Fig. 7 shows the shielding plug after being withdrawn from the reactor block.

Fig. 6: Cold shock

Fig. 7: Shielding plug – some like it hot!

Dismantling of the reactor block

The reactor block was the central component of the reactor plant. With an overall height of approx. 11 m, the block represented an octagon with a spacing of 5.65 m between the parallel surfaces (see Fig. 8).

The reactor block was of a sandwich design, the main component being the biological shield. In the core region, the biological shield consisted of super-heavy concrete with a thickness of approx. 1.80 m and a density of approx. 4,200 kg/m^3. In the upper region, iron-reinforced normal concrete with a density of approx. 2,350 kg/m^3 was used with a thickness of approx. 1 m. The biological shield was surrounded externally and internally by a steel liner of different thickness (12 to 25 mm). In the bottom region of the reactor block, a thermal shield was additionally provided. This shield consisted of aluminium-clad lead segments with a thickness of approx. 100 mm.

Fig. 8: Reactor block before disassembly

The central element of the reactor block was the reactor tank made of aluminium with a maximum wall thickness of 13 mm that previously housed the reactor tank internals.

Work on dismantling the reactor block began in October 2001. This represented one of the major challenges in dismantling the FRJ-1 reactor plant. The sandwich construction and also the choice of what sounded like rather exotic materials (e.g. super-heavy concrete based on magnetite with the addition of nail scrap) was the reason for a large number of problems, many of which proved to be real obstacles. Preliminary examinations and investigations led at an early stage to various types of tools having to be ruled out, such as diamond tools and the use of water abrasive suspension (WAS) jet cutting.

However, the disassembly itself was only one problem to be solved in dismantling the reactor block. The danger of spreading contamination, the handling of waste packages and tools, and the protection of the dismantling crew were other problems that had to be solved during dismantling of the reactor block. Against this background, it was sometimes necessary to select and implement very individual approaches.

Dismantling tools

Since the use of diamond tools and also such approaches as WAS, which was very innovative at that time, had been ruled out, the range of tools available for dismantling the biological shield was considerably restricted from the very beginning. The proposal of employing explosives was only briefly considered and then immediately rejected, mainly due to the expected licensing problems. It was finally decided to use an electrohydraulically driven, remotely operated dismantling excavator, which was remotely operated with the aid of a control console in the former reactor control room (see Fig. 9 and 10).

Fig. 9: Dismantling excavator in operation

Fig. 10: Remote operation console in the control room

A remote-controlled sawing device was first envisaged for disassembling the metallic components comprising the reactor tank (13 mm aluminium), inner and outer liner (12 – 25 mm steel) and the thermal shield (100 mm lead) (see Fig. 11).

After the sawing device had been fabricated, it became apparent that it was very difficult to use in practice. The precise positioning of the saw within the reactor block led to long positioning times and thus to long intervention times for the crew in the radiation field. As a result, it was found that this sawing device was only of limited use. However, the remote-controlled dismantling excavator turned out to be a real alternative. Its flexibility and remote control meant that the crew only required short intervention times in the radiation field (see Fig. 12).

Fig. 11: Remote-controlled sawing device

Fig. 12: Disassembling the thermal shield with dismantling excavator and rock chisel

It should be noted here that this application of the excavator, for which it was not designed, led to high levels of wear and tear and to increasing downtimes as dismantling proceeded. Nevertheless, the advantages clearly outweighed the disadvantages and the remote-controlled dismantling excavator proved to a universal dismantling tool for concrete, steel, aluminium and lead.

A particular problem was presented by the 10 horizontal beam tubes, which were integrated into the reactor block at the level of the former reactor core in order to perform irradiation experiments. The horizontal beam tubes were composed of aluminium, steel and lead, and were additionally surrounded by cooling pipes. Without preparatory work, it would have been very time-consuming in the course of uncovering the beam tubes as part of reactor dismantling to disassemble them in packages in the region of the former reactor core, i.e. at the

location of the highest dose rate. A special device for disintegrating the beam tubes was therefore designed and constructed, by means of which the beam tubes were pre-segmented while still installed and shielded (see Fig. 13) so that after uncovering the structures little subsequent dismantling work was required and only for a limited time (see Fig. 14). This was another measure which considerably reduced the time the crew had to work in the radiation field.

Fig. 13: Device for disintegrating the beam tubes

Fig. 14: Subsequent disassembly with the dismantling excavator

Avoiding the spread of contamination

Everyone knows that working on dry concrete raises dust. And this is no different with a reactor that mainly consists of concrete. If you drill a hole in your living room wall at home and forget to turn on the vacuum cleaner then this is really annoying because you'll have clean the whole place. Dust gets everywhere. But if you work like that when dismantling a nuclear facility then it can turn out to be expensive and also dangerous. Expensive because the airborne contamination can pollute large parts of the nuclear facility, which then have to be decontaminated with considerable expenditure of time and money. Dangerous because the uncontrolled propagation of contamination can also lead to people becoming contaminated or indeed incorporating radiation. The application of protective measures for the avoidance of the spread of contamination is therefore absolutely indispensable when dismantling nuclear plants.

Fig. 15: Moistening apparatus

In order to avoid the spread of contamination, in our case the entire reactor block was encased and the encased area vented via two ventilation systems with a volumetric flow totalling 12,000 m^3/h. This ensured a directed flow from the reactor hall into the casing. Furthermore, a moistening apparatus was used, which immediately prevented any contaminated dust from spreading during dismantling of the concrete structures (see Fig. 15).

Communications

Have you ever tried to make yourself understood next to a pneumatic drill? If you have then you will know that you haven’t got much chance and that your voice will soon give out. In dismantling the reactor block, the sound pressure level sometimes reached more than 120 dB (A). This corresponds to the noise of an aircraft at close range and is more or less at the pain threshold. In order to ensure coordinated dismantling at such a noise level, and also for reasons of safety, the crew must be able to communicate with each other. We carried out a market study for a suitable system capable of satisfying our requirements, but unfortunately with no success. We were therefore forced to design our own system from existing components. This was ultimately composed of the three components of ear defenders, ear plugs and walkie-talkies. This system was then qualified by the German Institute for Occupational Safety and Health.

Work began on dismantling the reactor block in October 2001, and was completed in December 2003. After many obstacles and problems, of which only the major occurrences are described above, we were finally able to report “mission accomplished” at the end of 2003. This meant that most of the activity had been removed from the reactor building. This moment (see Fig. 16) was one of the main highlights in the history of dismantling the FRJ-1.

Fig. 16: Mission accomplished! - The reactor block dismantling crew after their work has been done

Gutting and decontamination of the reactor building

The conclusion of work on dismantling the reactor block was at the same time the signal to start hunting down the final undesirable nuclides that had taken refuge in the walls, floors and ceilings. “Refuge" is the right word because in the course of decontamination work it became apparent that the contamination had in some cases penetrated deep into to the structure. This involved, in particular, the penetration of Cs-137 along the reinforcement due to the structure coming into contact with the primary water. In the preliminary investigation, it was not possible to determine this contamination since these regions were inaccessible at that time. Due to this development, decontamination work had to be extended considerably and in total a further approx. 500 m^3 of concrete had to be dismantled. At the end of the work, the site of the former reactor building looked to the casual observer like an archaeological dig from Jülich’s Roman period. It was also suggested that the building could be use as a discotheque, and our photographer’s impressions show that this idea was not so far-fetched (see Fig. 17 and 18).

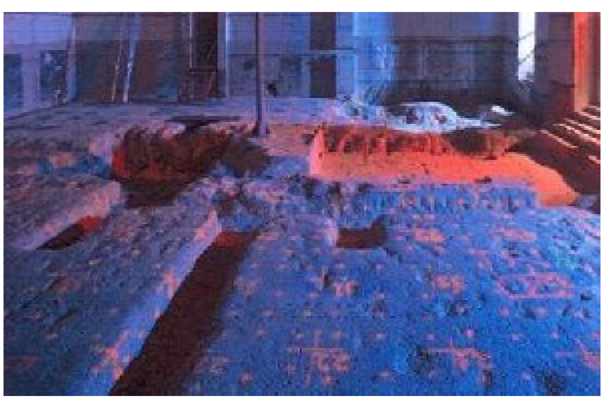

Fig. 17: “Jülich dig?”

Fig. 18: Starship “Merlin”

Clearance measurements and clearance of the reactor building

More than 100,000 measurements were necessary for the reactor building to be granted clearance, and about 30,000 of these measurements had to be documented. Clearance measurements of the 30-m-high reactor dome proved to be particularly difficult. Since none of the available hoisting platforms had sufficient lifting height, a suspended scaffold with a dead weight of approx. 23 Mg had to be installed on the bridge of the 10-Mg overhead crane. The only thing that helped us here, apart from blind faith, was reliable statics. Those of us who believed in statics therefore took the risk (see Fig. 19), while others bent their backs to undertake more down-to-earth tasks (see Fig. 20).

Fig. 19: Clearance measurements of the reactor dome

Fig. 20: Clearance measurements of floor and walls

After work had been completed, the reactor building of FRJ-I was finally released from the scope of the atomic energy and radiation protection legislation by the nuclear supervisory authority of the Federal State of North Rhine-Westphalia in November 2007. This was indeed a truly magnificent highlight when a former restricted area only accessible to a limited number of people suddenly became a conventional building, which was at least theoretically open to the public.

In order to celebrate this transformation and underline the unique status of the former reactor building we held a so-called "reactor breakfast" in the reactor building on 17 January 2008 (see Fig. 21).

Fig. 21: "Reactor breakfast": a real breakfast of champions

During the breakfast celebrations the guests, including various dignitaries from Forschungszentrum Jülich and several ministries, did not actually have to eat off the floor, but after more than 100,000 clearance measurements and official release from the scope of the German Atomic Energy Act they certainly could have. At the same time, the breakfast was the final highlight that took place inside the reactor building of the research reactor FRJ-1 (MERLIN).

Conventional demolition of the reactor building

After the reactor building had been given unconditional clearance pursuant to Section 29 of the German Radiation Protection Ordinance and released from the scope of the German Atomic Energy Act, work immediately been on the conventional demolition of the reactor building, which led straight to the next highlight,

Off with his head!

On 23 April 2008, the public were able to enjoy the next highlight – the dismantling of the reactor dome (see Fig. 22 and 23).

Two 500-Mg cranes were needed to raise the dome, which had a diameter of 30 m and a weight of more than 100 Mg, lift it off so that it was suspended like a UFO, and then gently place it down in one piece next to the reactor hall. This spectacle attracted great attention from the public and the media. Removing the dome was precision work that had to be accurate to the millimetre. However, precise planning and expert implementation proved their worth once again and in spite of some anxious moments the story ended happily.

Fig. 22: Off with his head!

Fig. 23: The UFO has landed.

Shadows of the past

The foundation stone for the two research reactors FRJ-1 (MERLIN) and FRJ-2 (DIDO) was laid on 11 June 1958. It was at the same time the foundation stone for today's Forschungszentrum Jülich, the former Nuclear Research Centre Jülich (KFA). On 24 June 2008, exactly 50 years and 13 days after the foundation stone was laid, it was safely recovered from a sea of about 5,500 t of rubble. This was, so to speak, the next highlight (see Fig. 24).

The only problem was the copper cylinder which had been placed in the foundation stone and contained the foundation deeds, copies of the two Jülich daily papers, plans, brochures and coins. In the course of the years moisture had penetrated the cylinder and damaged the historical documents and also the coins. Experts were then given the task of preserving the documents and the coins.

Fig. 24: Foundation stone of KFA: the "philosopher's stone" — Can anything be saved?

The proverbial "green field"

There was one special day that inspired work in the second half of the year – 8 September 2008. On this date, a large reception was held for politicians and other local dignitaries. At this reception, apart from the dedication of the "green field" a tree was also symbolically planted.

Fig. 25: The tree-planting ceremony

In good time for 8 September 2008, the local and the regional papers – the Jülicher Zeitung and the Aachener Zeitung, respectively – ran the headline "The sun's going to shine here again" on Saturday, 6 September, drawing attention to the big day. Numerous spectators were present at the ceremony and saw how, as the highlight, a tree was planted on a lush green field (see Fig. 25). The tree chosen was an oak symbolizing the oak forest that once had to make way for the reactor.

Clearance measurements and clearance of the ancillary buildings

Where there was once a reactor block an oak tree now stands. Was that the end of the story?

Not at all since … as soon the main figure had taken his bow it became clear that the protagonist alone does not guarantee the success of the story. We suddenly became aware of the bit players. They were still there, unnoticed in the background. What would a research reactor be without its ancillary systems? The operating, supply, sanitary and water treatment buildings that once housed these systems no longer existed. After the necessary decontamination work and clearance measurements they were also released from the scope of the German Atomic Energy Act and conventionally demolished. The work involved in demolishing the ancillary buildings was never a highlight but it should still be mentioned since only after the completion of this work can the last chapter be written on the dismantling of the FRJ-1 research reactor and the book finally closed.

KEY DATA

It is now time to take stock and briefly summarize the key data. This means the data on mass, activity and dose rate as well as on time and cost.

Mass of the demolished structures

Altogether, from the start of dismantling the reactor building, **about 10,000 Mg of dismantled material** arose in total, mainly in the form of concrete, rubble, steel, lead and aluminium, of which approx. 9,000 Mg was measured and given clearance. This amounts to a **clearance quota of approx. 90 %.**

After clearance measurements, the ancillary buildings were demolished conventionally. This gave rise to a total of approx. **8,500 of dismantled material**, mainly in the form of concrete, masonry and road rubble.

Activity and collective dose

Only the dismantling of the reactor building is relevant with respect to the activity of the dismantled components and the collective dose accumulated by the dismantling crew. Here three main phases can be distinguished, which basically reflect the partial licences granted for the dismantling of the radioactively contaminated plant parts and components.

1st main phase:	Dismantling the loop systems and the remaining experimental facilities
Licence:	2nd partial licence
Max. spec. activity:	Approx. 2 E +01 Bq/g
Collective dose:	Approx. 5 mSv
2nd main phase:	Removal of the reactor internals
Licence:	Supplement to 2nd partial licence
Max. spec. activity:	Approx. 3 E +10 Bq/g
Collective dose:	Approx. 9 mSv
3rd main phase:	Dismantling of the reactor block
Licence:	3rd partial licence
Max. spec. activity:	Approx. 1 E +07 Bq/g
Collective dose:	Approx. 40 mSv

The structures arising during demolition had a total activity of approx. 1.06 E +16 Bq.

The collective dose during the entire period of dismantling the reactor building (13 years) thus only amounted to about **54 mSv**. The work covered by the 1st partial licence, comprising dismantling of the air cooling system, was purely conventional. All the material removed was measured for clearance and disposed of conventionally.

The situation was similar for the decontamination and clearance measurements of the reactor building as part of the 4th partial licence for FRJ-1. Although contamination was present here, which meant that clearance could not initially be given, this was only residual contamination which did not make any appreciable contribution to the activity and collective dose of the dismantling crew.

Time and cost

About 13 years passed between the start of dismantling work and the planting of the oak tree at the site of the former reactor. Added to this was a further year for the decontamination, clearance measurements and conventional demolition of the ancillary buildings. The time intervals for the individual dismantling activities can be taken from the section "Chronicle of Reactor Dismantling" The progress of dismantling work largely depended on staff capacity and the funds made available. The project team initially only consisted of two members, but by the end there were a few more. Funds were not always made available in step with the project plan, so that project handling had to be extended. This meant that on many occasions we had to improvise with the planning and especially with the implementation of work, which we nevertheless managed successfully. Annual funding requirements ranged between half a million euros (start of project) and about € 3.5 million (phase of dismantling the reactor block). At the conclusion of all dismantling activities in the FRJ-1 (MERLIN) project, we can say that the project involved a total expenditure of about € 30 million.

Outlook

The project "Dismantling Research Reactor FRJ-1" has now come to a close. The project team entrusted with dismantling work now have other challenges to deal with – mainly in the dismantling of nuclear facilities. However, the Dream Team took care to make their mark on the reactor building (see Fig. 26). This silent witness was not sacrificed to the scrap press, but was saved in the nick of time. Where? That's the Dream Team's secret.

Fig. 26: The Dream Team make their mark