Customer Story

BERTHOLD PROTECTS WORLD'S LARGEST STELLARATOR

Nuclear fusion involves the emission of high-energy neutrons and the activation of shielding materials, that can become radioactive and emit gamma radiation. The Max Planck Institute for Plasma Physics (IPP) has trusted Berthold since 2014 to ensure the radiation protection of workers and the environment in one of the most important fusion research facilities in the world: Wendelstein 7-X in Greifswald, Germany.

Nuclear fusion is considered by many as the energy of the future: it produces immense amounts of energy in a much safer way than nuclear fission, and the availability of its fuels (deuterium and tritium) is virtually unlimited. However, nuclear fusion remains experimental, and significant scientific and engineering advances are still required to achieve commercial power generation. There are two main magnetic-confinement fusion concepts: tokamaks and stellarators. Both confine plasma in a toroidal magnetic field, but tokamaks require a large plasma current, whereas stellarators generate the confining field entirely with external coils. Most fusion devices worldwide are tokamaks (for example ITER in France), but stellarators offer advantages for steady-state operation and are therefore the subject of intensive research.

One of the most important fusion research facilities in the world is located in Greifswald, Germany: it's called Wendelstein 7-X, it is run by the Max Planck Institute for Plasma Physics (IPP), and it is the world's largest fusion device of the stellarator type.

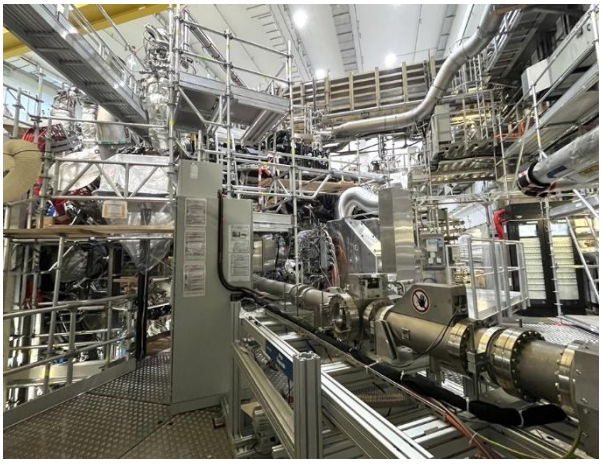


Figure 1: torus hall of Wendelstein 7-X.

We spoke with Rico Schwibbe, Radiation Protection Officer at Wendelstein 7-X, about how Berthold Technologies' radiation protection solutions have been supporting the facility since 2014.



Figure 2: an example of arrangement of detectors, with the LB 6360-H10 gamma dose rate probe (right) and the LB 6411 neutron dose rate probe (left) connected to an LB 112 data logger*.

What were the main requirements of the project?

We monitor both neutron and gamma radiation across the facility. There are two key areas that require monitoring: the torus hall, where radiation is generated during operation, and the surrounding areas of the facility.

Inside the torus hall, it is essential that the radiation probes can recover quickly and reliably from saturation after experiments, as access to the radiation protection areas following an experiment depends on the readings from the gamma probes in the torus hall. In the rest of the facility, although the hall is surrounded by 1.8-meter-thick concrete shielding on all sides, radiation monitoring is also required. The objective is to ensure that the annual dose rate limit of 1 mSv is not exceeded, which requires the use of highly sensitive probes capable of measuring very low dose rates.

In total, we required 20 radiation probes, including both neutron and gamma detectors. Two gamma probes and one neutron probe were installed inside the torus hall, while the remaining units were distributed around the exterior of the hall on different floor levels. They were strategically positioned in locations where we wanted to verify the effectiveness of the concrete shielding and ensure that the dose rate limit of 1 mSv per year is not exceeded.

Another important requirement was the ability to process and visualize measurement data within our existing control system software.

What did Berthold's offer consist of?

Berthold offered LB 6360-H10 gamma dose rate probes and LB 6411 neutron dose rate probes, connected to LB 112* data loggers.

Why did you choose Berthold's solution? Were you already familiar with Berthold?

No, we were not familiar with Berthold beforehand. The procurement was conducted through a standard competitive tender process. We selected Berthold's proposal because it offered the best overall value while fully meeting all of our technical and operational requirements.

* The LB 112 is the predecessor of the current LB 115 and was the current data logger when the project started in 2014.

Featured instruments

LB 6360-H10 Proportional Counter Gamma Probe

- Dose-rate probe for photon radiation
- Broad energy range (35 keV – 1.3 MeV)
- Suitable to measure low does rate levels (30 nSv/h to 20 mSv/h)
- Suitable both for indoor and outdoor use
- Low intrinsic background (0.12 cps)



LB 6411 Neutron Dose Rate Probe

- Extremely high sensitivity of approx. 3 pulses per nSv.
- Wide neutron energy range, covering thermal up to 20 MeV
- Versatile deployment: usable as a portable probe with the LB 134 Universal Monitor or as a stationary instrument with the LB 115 data logger
- Robust design featuring a polyethylene moderator sphere with a central He-3 recoil proton counter tube
- Special version for high energy applications available



LB 1100 NewTriNo Tritium Monitor

- Highly sensitive detection of ^{3}H with a detection limit <1 kBq/m³
- Continuous measurement of the ^{3}H activity concentration in room air and exhaust air
- Dynamic compensation for fluctuating gamma backgrounds or other gaseous nuclides
- Proportional counter detector; dual-chamber operation also possible
- Activation of external relays in conjunction with alarm thresholds
- Compliant with ISO 11929



LB 115 Data Logger

- Large 7-inch color touchscreen display for optimal readability
- Intuitive and user-friendly software
- Flexible alarm configurations with up to 4 individually-configurable alarm thresholds per channel
- 5 dual relays for flexible alarm routing and triggering immediate responses
- Connectivity for up to two measurement probes



A long time has passed since 2014. To what extent are you satisfied with Berthold's solution today?

The key question, in my view, is: what do you expect from a radiation protection system? My primary expectation is that it performs its function reliably and consistently. From that perspective, I am very satisfied with the system.

It is worth noting that we have not yet produced any measurable radiation above the natural background level, that will happen during deuterium operation, which is currently planned to begin in 2029. The entire monitoring infrastructure was installed in preparation for that phase. Nevertheless, we carry out regular testing of all systems, and throughout these years, Berthold's equipment has proven to be highly reliable. We have experienced very few failures, no false alarms, and both the probes and data loggers have performed dependably.

Of course, no technical system is entirely immune to occasional issues. For me, however, the true measure of a supplier is the quality of its after-sales support. We are located in the north-east of Germany, which can make service visits more challenging, but Berthold's support team has consistently responded quickly whenever assistance was required.

Overall, we have been very pleased with the solution and the support we have received over the years.

In addition, you are currently testing one of our newest instruments, the tritium monitor LB 1100 NewTriNo, correct?

Yes. Tritium is produced during deuterium operations and is partially released via the exhaust air, within the permitted discharge limits. We use the tritium monitors to monitor both the air inside the hall and the exhaust air and ensure compliance with safety requirements and radiation protection standards.

We previously operated a tritium monitor from another manufacturer, but it caused a number of challenges. The instrument required frequent attention and proved difficult to repair when issues arose. As a result, we began evaluating Berthold's LB 1100 NewTriNo as a potential alternative.

The test programme is planned to run for a full year, so it is still too early to provide a final assessment. However, based on our experience so far, the NewTriNo already represents a significant improvement over the system we used previously. Its operation has been noticeably smoother, and our initial impressions have been very positive.

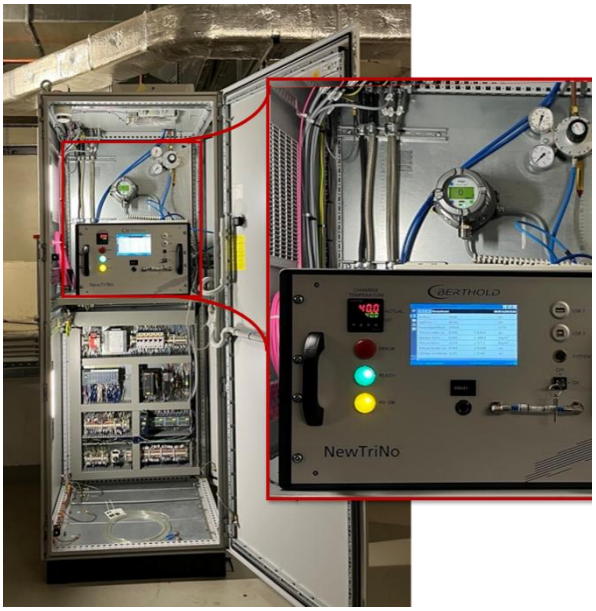


Figure 3: The LB 1100 NewTriNo Tritium Monitor installed at Wendelstein's facilities. Left: general view; right: detailed view.

Is there anything else you would like to add?

I would particularly like to highlight the excellent collaboration and open dialogue we

have had with Berthold's specialists over the years. The discussions are always constructive, professional, and focused on finding practical solutions. For us, that kind of relationship is extremely valuable.

When it comes to service, responsiveness and reliability are what matter most. Nobody expects a supplier to be on-site the day after a service request, but it is important to know that your concerns are taken seriously and addressed in a timely manner. With Berthold, we have never had the feeling that we needed to repeatedly follow up or ask the same question multiple times before receiving support.

In my experience, that level of reliability is a key indicator of good customer service. Knowing that you can count on a knowledgeable and responsive partner gives you confidence in the long-term operation of the system, and that is something we have consistently experienced with Berthold.

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