WERKLICHT

Augmented Reality for Industry 4.0

Success Story

World's largest fusion power research project, ITER, relies on AR projection from EXTEND3D

When assembling the massive vacuum vessel of the ITER fusion research project, the requirements for precision are some of the toughest in the industry. The welded studs on the reactor chamber, which measures approximately 1,400 cubic meters, may deviate by no more than 2 millimeters. To ensure this, ITER project relies on EXTEND3D's WERKLICHT laser templating system.

The ITER fusion research reactor in southern France is one of the world's largest research projects. Thirty-five nations have been working there since 2007 to make fusion energy commercially viable. The plant is still under construction. The core of the project is the so-called tokamak: Fusion is to take place in this donut-shaped chamber with a diameter of 19 meters and the height of a three-story house.

The initial situation

The ITER project continues to break new ground, both scientifically and technically. This also applies to the manufacturing precision of the reactor chamber. Countless sensors and connecting cables have to be mounted on the outside and inside of the vacuum vesel. To do this, the workers have to set an enormous 150,000 welded studs on the shell of the vacuum vesel. The accuracy required in the process allows for deviations of no more than 2 millimeters. "Plus, minus 2 millimeters for a plant that is as tall as a three-story house and 19 meters in diameter. That's far less relative

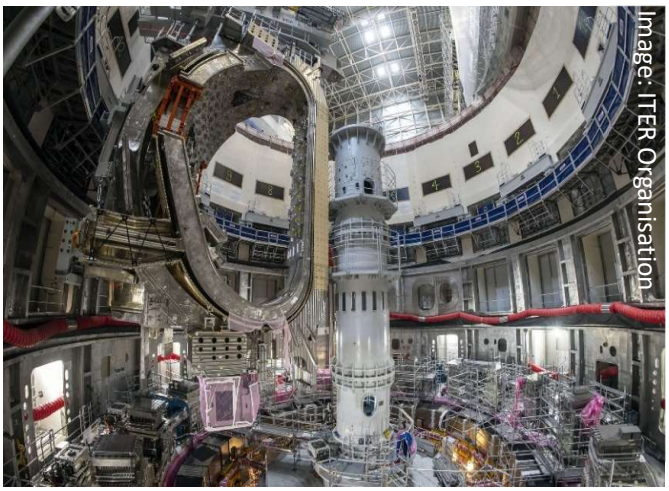

Image: ITER Organisation

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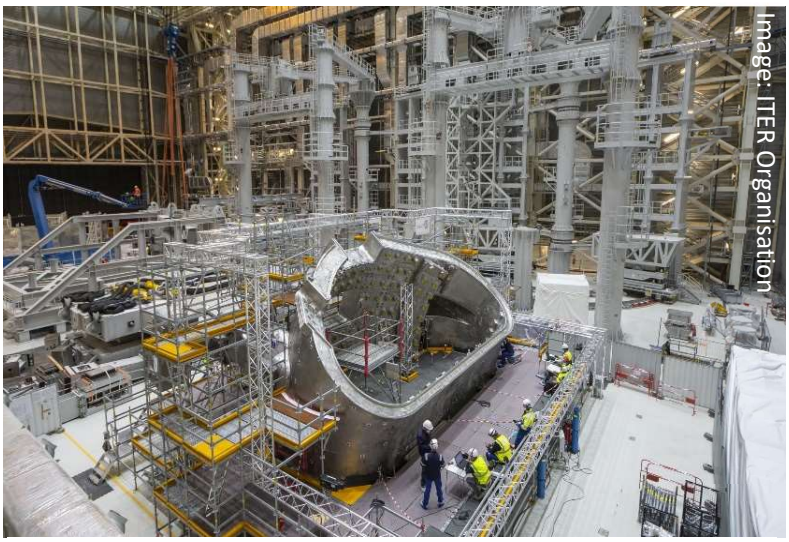
tolerance for error than a Swiss watch movement, so it's a huge challenge," says Jean-Marc Martinez, Group Leader of ITER's Vacuum Vessel Section . Without an assistance system, it was impossible for the welders to consistently meet that level of accuracy. The ITER team therefore decided to look for a laser-based projection system that would project the weld spots onto the reactor chamber with high precision. Since there was no comparable project to ITER that the responsible parties could refer to as a reference, a comprehensive selection process was required, which was performed together with F4E – the European Fusion agency – and vacuum vessel manufacturer Walter Tosto. Three selected manufacturers presented their solutions, and EXTEND3D emerged as the winner.

The project

The WERKLICHT dynamic laser projection system best met the requirements of the ITER project. WERKLICHT's stereophotogrammetry cameras allow technicians to position the system as they wish without having to call in a metrology team for every change of position. This allows the entire welding process to be completed more efficiently and quickly with the particularly high number of weld studs.



On the outside of the reactor chamber, which measures around 1,400 cubic meters, workers set 150,000 spot welds.

The ITER project managers were satisfied with the hardware and software right from the start: "We received the projectors and they

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worked right away. The precision was immediately at the high level we wanted to achieve. The cooperation with EXTEND3D went smoothly," reports Martinez.

The biggest challenge in the implementation was that the ITER team first had to provide the correct data on the current state of the vacuum vessel. These were determined in a reverse engineering process and made available for the WERKLICHT system. The ITER team was entering uncharted territory with almost every step, as there had never been a similar project before. But once this internal hurdle was overcome, the way was clear for the use of the WERKLICHT projectors. We initially thought that it might be difficult to position the stud gun with millimeter precision since half of the laser marking is covered by the stud gun when welding. In practice, however, these concerns quickly dissipated," says Martinez.

The laser projects weld seams and laser contours precisely and directly onto the component

The laser projection system is used in several ways. Mainly, it projected the attachment points for the welder onto the vacuum vessel. In addition, however, workers also used the system to indicate the location of components so they could then attach them with tack welds. A third method of use was to project instructions such as part number and weld number simultaneously. This way, each worker knew he was attaching the correct part to the correct position without having to refer to written records and

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thus losing time. These markings also allowed work progress to be updated in the physical records. In addition, sensors had to be connected to the vacuum vessel - WERKLICHT was also used to route the cables. The individual routes of the cables could be projected onto the surface of the chamber by laser. In this way, the technicians ensured that the lines were laid as planned.

The result

Currently, the ITER project has two WERKLICHT laser projectors in use for over a year. At the beginning of the project, only three days of on-site training by EXTEND3D staff were required. With the WERKLICHT devices, the production precision could be increased to a level that is far above the demands of conventional industrial facilities.

Currently, ITER is in assembly phase one. WERKLICHT systems will definitely be used until the end of this construction phase in about five years. Currently, ITER, a subcontractor and EXTEND3D are in discussions about the delivery of additional projectors. In 2023, further installation works on the inside of the vacuum vesel is scheduled to begin. The workload will increase again during this phase of the project. Two projectors will then no longer be sufficient to support all the necessary work steps.

"In a highly complex project like ITER, there is always something to revise or adjust. The demands on precision remain undoubtedly high. EXTEND3D's work light systems can therefore continue to serve well in the research facility - even after the first experiments have begun in the reactor," Martinez sums up.

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