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Reliable testing under all conditions

In a global market with different national regulations, on-site testing of power plant components can be complex.

Thanks to smart glasses, remote testing should become easier.

VR glasses from manufacturer RealWear.

By Christoph Gatzen and Simon Lemin

An on-site inspector performs a visual inspection of an oil pressure adjustment on an emergency power generator. (Photo: TÜV SÜD)

The challenges of climate change are bringing nuclear energy back into focus. Even in Germany, which decided on a general nuclear phaseout in 2011 as a response to the Fukushima disaster that year, nuclear energy is again being discussed as a bridging technology. Compared with fossil fuels, nuclear saves considerable greenhouse gases. However, for a holistic view of CO_2 emissions from power plants, the procurement, maintenance, and repair of plant components must also be considered. At the very least, the CO_2 emissions caused by the high costs of testing and maintaining a nuclear power plant can be reduced.

The nuclear industry is highly regulated, both in terms of occupational safety and environmental protection. Therefore, only specially qualified nuclear equipment may be used for safety-relevant components. The safety assessment of a newly built power plant or newly installed plant components usually involves travel to the factories involved in the production process. These locations are spread all over the world—both a cost and a time factor—while the number of nuclear safety experts is limited.

Saving resources and time

Inspections can be conducted remotely with smart glasses and assisted reality (aR). In this way, experts from a wide range of disciplines can be involved, even on short notice. For complex inspections that require an entire team of specialists, only one expert with data glasses needs to be on site, saving time and travel expenses. The expert with boots on the ground can constantly be connected to colleagues via WLAN and carry out their instructions. In the same way, information can be provided to the on-site expert audiovisually in the field of vision of the glasses.

Use of this technology can largely eliminate lengthy air travel and associated stays on-site, making it easier

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VR, AR, and aR—virtual reality, augmented reality, and assisted reality—are now permanent fixtures in the optimization of operational processes. The possibilities of high-performance data transmission and the miniaturization of end devices have contributed to this in particular. Digital realities are particularly useful in the field of nuclear technology. In addition to repair, testing, and maintenance work, they are used here for structural and technical changes in construction, architecture, or building equipment.

The terms are often used synonymously but have different meanings. VR depicts a real (or simulated) environment with which the user can interact without actual risk. AR, on the other hand, adds digital data to reality, for example, by superimposing information on the user's field of vision. Digital glasses are required for this work. With aR, this data appears next to the field of vision on the edge of the glasses.

to schedule appointments and reducing the time required by the inspectors. Inspections can thus be carried out more quickly and at significantly reduced costs. Even pandemic-related restrictions around travel, contact, and walk-in bans no longer would be an obstacle.

U.S.–Germany connection

TÜV SÜD, an independent German testing service provider, uses data glasses for production monitoring, acceptance testing, site acceptance testing, and training and education. The company uses the HMT-1 model from the U.S. manufacturer RealWear, combined with the SHARE app from German software provider oculavis GmbH. Currently, TÜV SÜD estimates that about 100 pairs of smart glasses are in use. The glasses are robust and durable, and because the device is resistant to the ingress of dust or other particles, it can also be used in machine rooms and factory halls. In addition, the glasses withstand moisture and even direct contact with high-pressure water streams. They are also compatible with personal protective equipment (PPE), such as safety glasses, helmets, and hearing protection.

A camera on the glasses transmits the on-site image in real time, and a moving, high-resolution screen provides the inspector with additional information in the form of images, videos, or texts. In addition to the visual connection, remote experts can exchange data—such as tutorials, manuals, or circuit diagrams—with the on-site inspector, enhancing communication and information sharing during the inspection process. The system is operated by voice control so that the inspector has both hands free and can concentrate on the task at hand. The operator of the glasses can also mute the microphone or use the noise suppression feature. All these functions, in addition to making it easier to complete the work, increase worker safety.

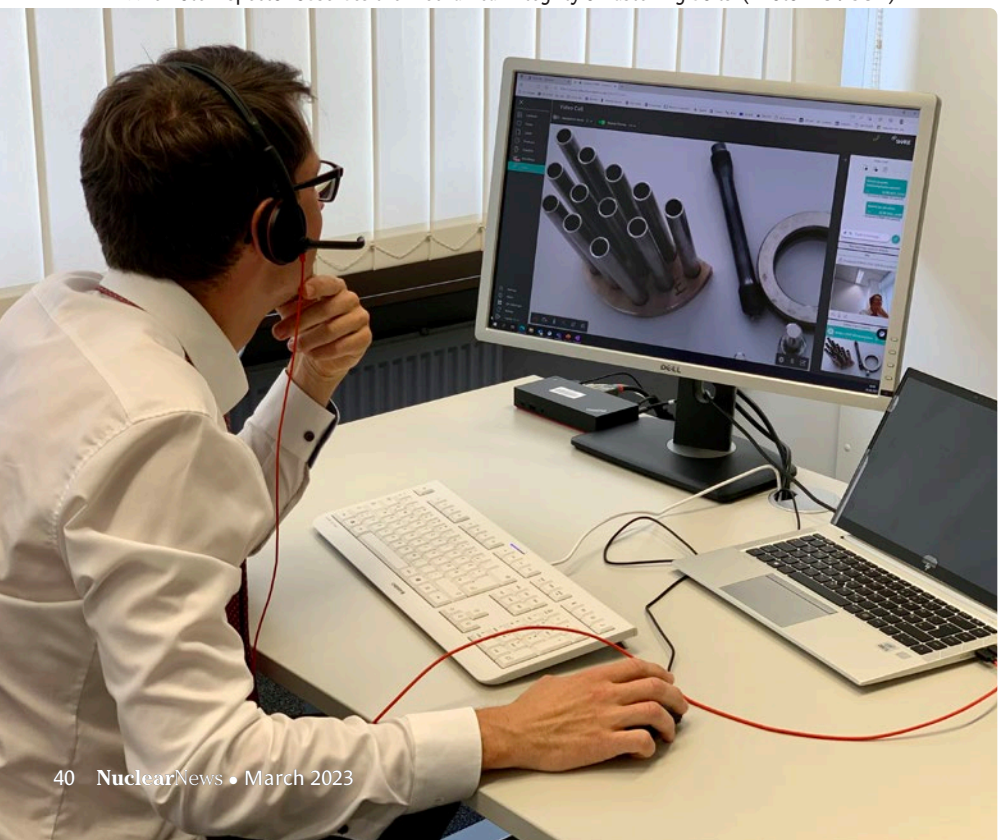
Oculavis, who provided the software for the smart glasses, is a market leader for video support software using augmented reality. RealWear, headquartered in Vancouver, Wash., is a pioneer of aR wearable solutions across several industries. Together, they develop integrated solutions. The SHARE app can be used independent of a device and can enable remote guidance as well as independent augmented reality workflows. The wearer is thus provided with step-by-step instructions for operation.

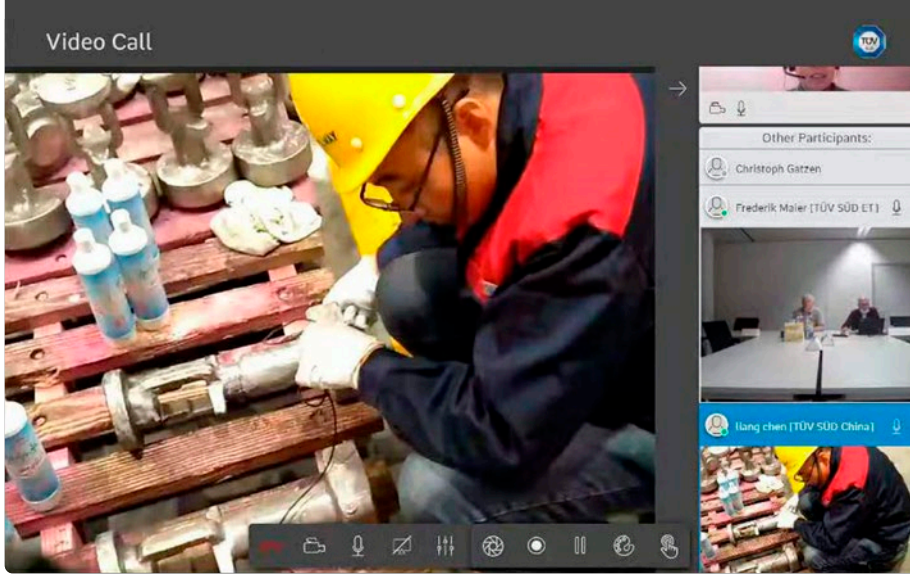
Can my plant be inspected remotely?

If a plant is suitable for remote inspection, the technical and organizational framework conditions must be clarified. The prerequisite for remote inspections is a fast and stable Internet connection via WLAN or LTE with at least 4 megabits-per-second bandwidth for uploads and downloads. This roughly corresponds to the requirements for the average video conference. Data must be stored in accordance with the security requirements of the General Data Protection Regulation, a regulation in European Union law. The service provider should use its own servers for this purpose, the results of which should be available to the customer at any time via the remote service platform.

The customer must agree in principle to both remote inspection and video and audio transmission. A data protection officer should be involved in the approval process and, if necessary, will define limits or specify measures. For example, this can include making faces unrecognizable to protect the privacy of employees. Ideally, an employee of the inspection company who is available in the vicinity of the plant can assume the role of remote inspector.

A remote inspector observes the mechanical integrity of fastening bolts. (Photo: TÜV SÜD)





An on-site technician works while remote inspectors watch the proceedings. (Photo: TÜV SÜD)

International experts for local work

As technology continues to improve, the testing business is adapting to a global market. In one recent instance of cross-national industry, valves manufactured in China were to be installed in a nuclear power plant in the United Kingdom. To complete a comprehensive safety assessment of the components, the production process also had to be evaluated, but at the time the quality assessment of the production process was due, travel restrictions prohibited the service provider TÜV SÜD from sending inspectors to China in person. Fortunately, the provider had a local representative already in the country who was able to complete the testing.

As the resident employee conducted the testing, he was assisted remotely by electrical engineers, mechanical engineers, and specialists for non-destructive testing and leak tightness and welding technology, all of whom were in Germany. Thanks to the smart glasses, this team of seven specialists from different disciplines was able to perform the assessment of the valve production process at short notice—and a distance. aR and a good Internet connection eliminated the need for seven intercontinental flights, a combined total of more than 70 hours of travel time, and the corresponding on-site transfers. In addition to the savings of time were the savings of associated costs—not to mention approximately 20 tons of CO_2.

In another instance of international collaboration, smart glasses with aR technology were used at a manufacturer of fuel element furnaces in France. Due to pandemic-related travel restrictions during the initial lockdown, experts could not visit the sintering furnaces, which are used to produce mixed oxide fuel elements for the nuclear industry, in person. Instead, they were able to perform a remote inspection of the production process. Later, after furnaces were installed in Hanau, Germany, the factory acceptance test was also performed remotely. The experts were ultimately able to pursue their inspection despite protective measures and restrictions, and the client was able stay on schedule.

Training and education

Installations, repairs, and maintenance, among other things, take place under radiation exposure. Smart glasses are particularly suitable for the training and education of nuclear power plant personnel. They provide a safe working and learning environment for potentially critical situations, enabling realistic training without risk while eliminating the need for safety measures such as PPE or work permits. At the Kepco International Nuclear Graduate School in South Korea, TÜV SÜD virtually guided decommissioning students through a radiation protection laboratory in Mannheim, Germany. Aided by smart glasses, the students were able to conduct experiments independently and gain insight into this distant German facility, despite pandemic times.

Conclusion

Remote inspections with smart glasses connect experts with plants and customers around the world, allowing for the benefit of expert knowledge independent of location. Construction errors and damage can be identified directly and remedied immediately—regardless of external circumstances. The possibility of integrating expertise from a wide range of specialist areas, if required, also increases inspection quality. Appointments can be made more easily, and the overall time required for on-site inspections and evaluation of the results is reduced. At the same time, the carbon footprint created by the inspector and the customer shrinks. The application possibilities of the glasses are extensive—and are continuously expanding.

Christoph Gatzen is head of Inspection Body and of the Instrumentation and Control (I&C) and Electrical Division at TÜV SÜD Energietechnik GmbH.

Simon Lemin is director of the Industry Service Division at TÜV SÜD Greater China.