

Nuclear Energy
Green Energy & Mobility

#Disaster Prevention and Resilience #Co-creation and Open Innovation #Sustainability #Generative AI #IoT/Data Utilization #Digital Solutions
#Energy

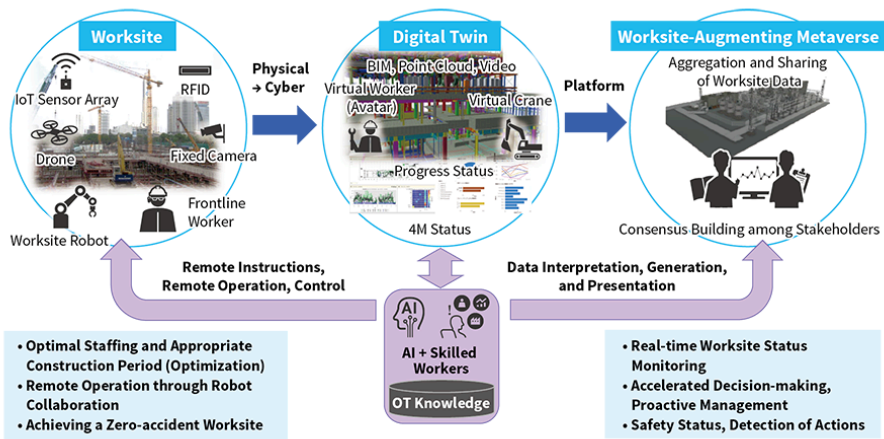
1. Supporting Plant Construction Workers Using Worksite-Augmenting Metaverse

Issues such as an aging and shrinking workforce, a decline in skilled workers, and occupational hazards pose significant challenges at plant construction sites. To address these issues, Hitachi has developed a “Worksite-Augmenting Metaverse” that enables the digital twinning of a site to monitor conditions remotely and support on-site workers.

The Worksite-Augmenting Metaverse embodies the concept of the “Three Realities Principle,” which emphasizes seeing the actual site, the actual object, and recognizing the actual reality. By extending this principle, it brings innovation to site-centric projects such as those in the construction industry. Many temporary structures such as scaffolding are present at worksites, leading to work interference and the risk of occupational accidents. The Worksite-Augmenting Metaverse has established a model generation technology that creates spatial models incorporating not only the three-dimensional (3D) model of the plant itself, but also temporary structures that change daily, using low resolution for superior operability. Also, the system incorporates artificial intelligence (AI) to comprehensively interpret the accumulated site data within the generated spatial model. This enables the intuitive presentation of design information, construction progress, and safety management details, allowing worksite personnel to easily understand key operational insights. As a result, this innovation revolutionizes information sharing and consensus-building across various operational processes, including planning, design, construction, operation, and maintenance.

(Hitachi Plant Construction, Ltd.)

[01] Digital Transformation in Plant Construction and Management through the Worksite-Augmenting Metaverse



IoT: Internet of Things
RFID: radio frequency identification
BIM: building information modeling
4M: human, machine, material, and method
OT: operational technology

2. Robust Imaging and AI-based Remote Visual Inspection System for Reactor Internals

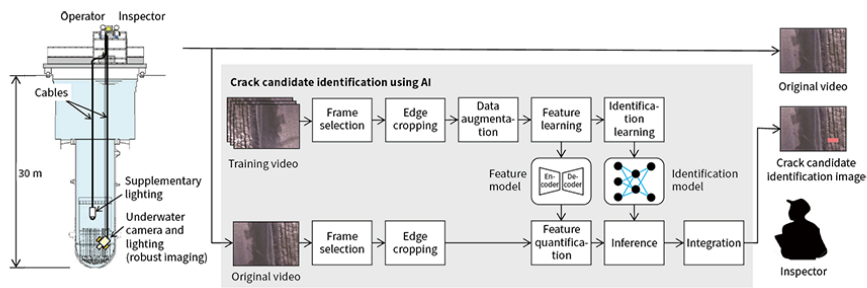
Hitachi-GE Nuclear Energy, Ltd. is developing a remote visual inspection system using robust imaging technology and artificial intelligence (AI) with the aim of reducing inspection time and supporting inspection tasks for the internal inspection of nuclear reactor pressure vessels. Robust imaging technology is a method

that introduces blur using a phase plate, which is insensitive to focus shifts, and restores the image through image processing. This technology expands the camera's depth of field when compared to traditional methods. The use of this technology reduces constraints on the camera's position and orientation, making it easier to inspect narrow areas and areas with complex shapes.

Furthermore, by using lighting that balances reflected and diffused light on the test surface, it is possible to capture images that highlight cracks. In terms of AI utilization, the system is trained on known visual inspection video to learn how to identify cracks. The trained model is used to infer and identify potential cracks from the evaluation video during inspection, thereby assisting inspectors. The goal for the future is to develop a practical system incorporating these technologies and apply it to actual plant inspections.

(Hitachi-GE Nuclear Energy, Ltd.)

[02] Remote Visual Inspection System for Reactors Using Robust Imaging and AI



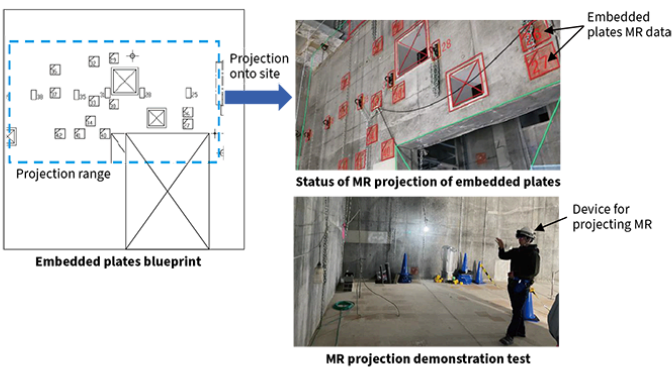
3. MR-based Field Inspection Streamlining for Promoting DX in Plant Construction

In recent years, plant construction sites have been facing challenges such as labor shortages and regulations on total working hours, leading to an increasing demand for productivity improvements through the use of digital technologies. This initiative focuses on the inspection of embedded plates during construction while considering measures for rationalization. In conventional inspections, workers would visually check the construction status of embedded plates against drawings one by one after a wall was built. This process took time and led to delays in subsequent work due to missed discrepancies between drawings and the actual installation. To address this challenge, Hitachi-GE Nuclear Energy, Ltd. constructed a mixed reality (MR)-based inspection system for embedded plates.

This system uses commercially available MR software and devices to project the drawings of embedded plates onto the site with simple steps, and then records the projection results. By instantly determining the consistency between the drawings and the construction status, the system is expected to shorten the inspection period. Additionally, double-checking the projection records is expected to reduce the chances of overlooking discrepancies with the drawings. The system also enables timely reflection of any deviations in the installation of embedded plates onto structures such as pipe supports. It can also provide value to customers by reducing the risks associated with extended construction timelines and the occurrence of costs caused by work errors. Our aim is to widely implement this system when setting up new facilities in the future.

(Hitachi-GE Nuclear Energy, Ltd.)

[03] Streamlining On-site Inspections Using Embedded Plates Projection with MR



4. “HUMALT” Work Robot with Flexible Structure

Hitachi-GE Nuclear Energy, Ltd. has developed a work robot with a flexible structure called “HUMALT”. HUMALT can perform delicate tasks that are typically carried out by humans, in high-radiation environments such as the decommissioning of Tokyo Electric Power Company’s Fukushima Daiichi Nuclear Power Station. HUMALT is a robot system that does not use electronic components in its main body, allowing for long-term use in high-radiation environments. It features a “soft” structure, where the joints can flex and rotate flexibly while it handles objects.

Hitachi is also developing a remote operation support system to reduce the operator’s workload when remotely controlling HUMALT. This system combines a digital reconstruction of the work status in a digital space based on autonomous movement control and arm-end position control functions, along with a grasped object recognition function, thereby contributing to improved operability of HUMALT in remote operations.

Hitachi-GE Nuclear Energy, Ltd. is advancing the practical application of HUMALT and its remote work support system in order to contribute to the safe and reliable decommissioning of the Fukushima Daiichi Nuclear Power Station.

(Hitachi-GE Nuclear Energy, Ltd.)

[04] HUMALT Joint Module Configuration

Joint module	Image	HUMALT combined with joint modules
Soft joint		
Flexion joint		
Swivel joint		

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