



Lasers. The Nuclear Option.

How laser scanning can reduce planning time for plant modifications by half while doubling your personnel's safety.

In the past decade, laser scanning has quickly and broadly gained acceptance in the power and industrial fields, particularly where nuclear power is concerned, because of its ability to rapidly collect field data, minimize plant risk, and maximize worker safety. Even more, parts of a nuclear plant are only accessible during outages (to refuel), which typically occurs every 18 months. Thus, any project involving a nuclear facility is usually planned a year or more in advance and having accurate information is imperative. Laser Scanning has been used to achieve and support power uprate programs, facility maintenances, and plant upgrade in compliance with [U.S. Nuclear Regulatory Commission \(NRC\)](#) directives.

Fukushima Daiichi Nuclear Power Plant Disaster

On March 11, 2011, Japan's Fukushima Daiichi Nuclear Power Plant suffered a catastrophic failure as a result of a 45-foot tsunami triggered by a 9.0-magnitude earthquake. With three of the plant's six boiling water reactors reaching meltdown, the damage was extensive. The consequences were immediate, and by the next day, the plant released considerable amounts of radioactive materials, making it the largest nuclear incident since the 1986 Chernobyl disaster. As with Chernobyl, the Fukushima Daiichi facility was designated Level 7 on the International Nuclear Event Scale, primarily due to its uncontrollable emission of radiation.

U.S. NRC Issues Orders & Requests for Information (RFIs)

A year [following the Fukushima nuclear catastrophe, the NRC issued an order](#) on March 12, 2012, requiring all U.S. power plants with the Fukushima-style containment design to install a reliable, hardened vent that can dissipate heat and pressure before potential damage can reach the reactor core. Beyond helping to preserve the integrity of the containment building, this safety measure can also delay reactor core damage or melting. The use of laser scanning in plant engineering projects has become a reliable solution to fulfil NRC initiatives. With their high level of precision and quick data collection, laser scans can map sections of the plant and potential locations for new piping penetrations.

Maintenance & Upgrades Using Laser Scanning to Continue the Safe Generation of Power

The responsibility of ensuring the safe and proper mechanisms of a Nuclear Power Facility lies with the nuclear plant operations and maintenance groups. Typically, owners look beyond maintenance and seek facility upgrades that reduce operating and maintenance costs while improving both the safety and performance of their nuclear power plants. Projects to analyse and model facility systems so upgrades can be designed, fabricated and installed have steadily increased their confidence and reliance upon laser scanning support.

Laser scanning is used to achieve such upgrade activities by providing numerous services, including modelling piping, enhancing inspections and removal of equipment. Due to the congestion and tight



configurations of nuclear facilities, *load path planning*, or the process of modelling to determine access paths for new installations or the removal of old equipment, becomes critical. The use of laser scanning conquers the obstacles of traditional and manual load path planning and substantially reduces the time to complete the process. Additionally, laser scanning provides higher safety standards and considerably higher accuracy given its precise data collection methods.

Benefits of Laser Scanning

A rising technology and work process successfully used in the industrial, commercial and manufacturing fields, laser scanning has gained popularity over the years as a reliable tool for cutting costs and shortening project schedules. Errors, omissions and entire re-works have been greatly eliminated due to the accurate and comprehensive data collected via laser scanning. Completed in early project phases, this advanced technique can provide project teams with ample information to use from the design stage to construction. With more precise field data, Project Managers can minimize their overall budget by being more efficient from the start with smarter operational planning and task scheduling.

Design Process Improvements

The primary benefit of design engineering is having access to accurate information on existing conditions. The design of piping, utility services and equipment can be optimized by using the ***laser scan point cloud model***—a technique that accurately identifies tie-in locations, plans demolitions and performs comprehensive pipe routing. A laser scan model can also be incorporated into the coordination process model to improve both the design and construction phases by providing the most up-to-date information of facility conditions.

Cutting-edge software and tools such as [Leica Cloudworx](#) or [LFM Server™](#) permit the *point cloud data* to be integrated seamlessly with a computer-aided design (CAD) model. This overall scan-based work process is a big step up from traditional 3D modelling and hand measurements and major improvement from designing with conventional 2D workflows, plans, elevations and sections. Not only does laser scanning take a fraction of the time, but its output is more precise, providing an all-inclusive, reliable data set for designers and planners.

Improved Worker Safety

Data collection is a crucial facet of field work, and the safety of field technicians can be substantially improved by using laser scanning on certain projects. For one, laser scanners gather information at a significantly faster speed than conventional or manual methods using a laser range finder, camera and sketch pads. This reduces the field team's exposure to a range of safety risks.

Additionally, a laser scanner can capture information from a distance, so measurements of elevated features no longer hold the same potential for danger or accidents. The laser scan model can even serve as a virtual field walk-through to minimize the need for repeated site visits by field or design personnel. Measurements, evaluations and closer reviews of the laser scan model and its results happen in the office, not on-site or as part of the collection process.



Nuclear Project Work

Within the nuclear field, ALARA is an acronym for *as-low-as-reasonably-achievable* and serves as a radiation safety principle. Its goal is to minimize doses and releases of radioactive materials by using all reasonable means. Not simply a safety standard, ALARA is also a regulatory requirement for all radiation safety programs prior to any form of nuclear project.

Laser scanning helps in meeting such requirements by reducing the length of stay and exposure of its operator in a radiological environment. Also, fewer field members are needed to run the equipment and gather sufficient information for a comprehensive, accurate view. With increased reach, it even puts more distance between the technician and high exposure areas.

Experienced Laser Scanning Partner

The best work process begins before the field team even steps foot on-site. A knowledgeable service partner can be a great advantage and help the project team pre-plan to ensure that design requirements are met and the information gathered is suitable. By beginning with well-defined requirements for the project design, a field work plan can be assembled to optimally map the scope area. Laser scanning collects visual information while surveys capture target data to relate the scenes back to an existing database. Quality procedures are ingrained as part of the capture process to secure the accuracy and completeness of its data.

Summary

The benefits to using laser scanning technology, particularly on revamp and maintenance projects, are very compelling due to the myriad of positive impacts it has on total costs, scheduling, safety, data quality and team coordination.

Cost

Compared to conventional methods of surveying or measurement, laser scanning reduces both time and error margins in data collection. Comprehensive and cost-effective, this progressive technology cuts down the potential for traditional setbacks, including incomplete information, delays and additional field work.

Design and commission errors are ranked by industrial managers to be the leading cause for reworks, which raises the overall project cost and duration. In 2005, the Construction Industry Institute (CII) revealed that direct costs due to rework averages 5% of total construction costs. To further depict the significant cost burden of reworks, the Bureau of Economic Analysis reported that the U.S. construction industry expended \$1,502 billion in 2004 for total installed costs, meaning that almost \$75 billion was wasted on correcting initial project mistakes that year in the construction field alone.

Schedule

Inaccurate documentation of existing conditions can directly result in unexpected field problems and delay, which escalates costs when reworks and extended outages become necessary. The streamlined collection process and reliability of data accuracy from scan results are crucial to minimizing unknown challenges. Using laser technology allows managers to significantly shorten project timelines.



Safety

With “zero injuries” being the ultimate safety goal, limiting exposure to risky conditions or known hazards is important for all projects. By reducing both the overall time and manpower required for field work, laser scanning is a critical tool in raising safety standards and minimizing the need for repeated site visits. In helping to decrease safety incidents, the frequent use of laser scanning benefits project owners by lowering liability and workers’ compensation insurance rates.

Quality

The advanced capabilities of laser scanners combined with an experienced field specialist can all but eliminate errors, omissions and reworks. The inclusive, reliable information provided by laser scanning will be a major advantage to the project team from early on. Its applications are extensive and pivotal in providing superior solutions.

Coordination

Once the scanning is complete and an interactive 3D model is created from the data, the site itself can be recreated on a desktop. Access to this dynamic model across geographic locations greatly improves collaboration among project team members and simplifies every phase. The accessibility of laser scan bubble view applications reduces the skill level required to open and handle the data, increasing its practicality and user reach.

The Author



Andrew Titcomb is an Advanced Technologies Manager at Fenstermaker with 13 years of experience in professional 3D laser scanning for high definition survey (HDS) projects. Part of the Houston, TX, team, he oversees all HDS operations and is responsible for managing the scope of services, field crew, and client expectations associated with laser scanning projects. His industrial expertise in HDS includes plant design efforts and upgrade support, spanning from pre-planning stages to data collection to final project deliverables. Mr. Titcomb’s laser scanning experience extends to nuclear and fossil power generation facilities, refineries, chemical plants, and large-scale manufacturing plants. Particularly, his specialty in working with nuclear power facilities was developed through diverse

fabrication and installation projects that involved detailed planning, scheduling and construction administration. He is also adept at completing work packages for the error-free replacement and installation of facility equipment.

*Established in 1950, **Fenstermaker** is an experienced multi-disciplinary firm specializing in Survey & Mapping, Engineering, Environmental Consulting, and Advanced Technologies. Headquartered in Lafayette, LA, the company has over 300 team members providing professional services through multiple office and field locations across the U.S. Across all disciplines and locations, the firm’s principal mission is to be a vital partner in the success of their clients, and each individual is committed to providing exceptional customer service.*