

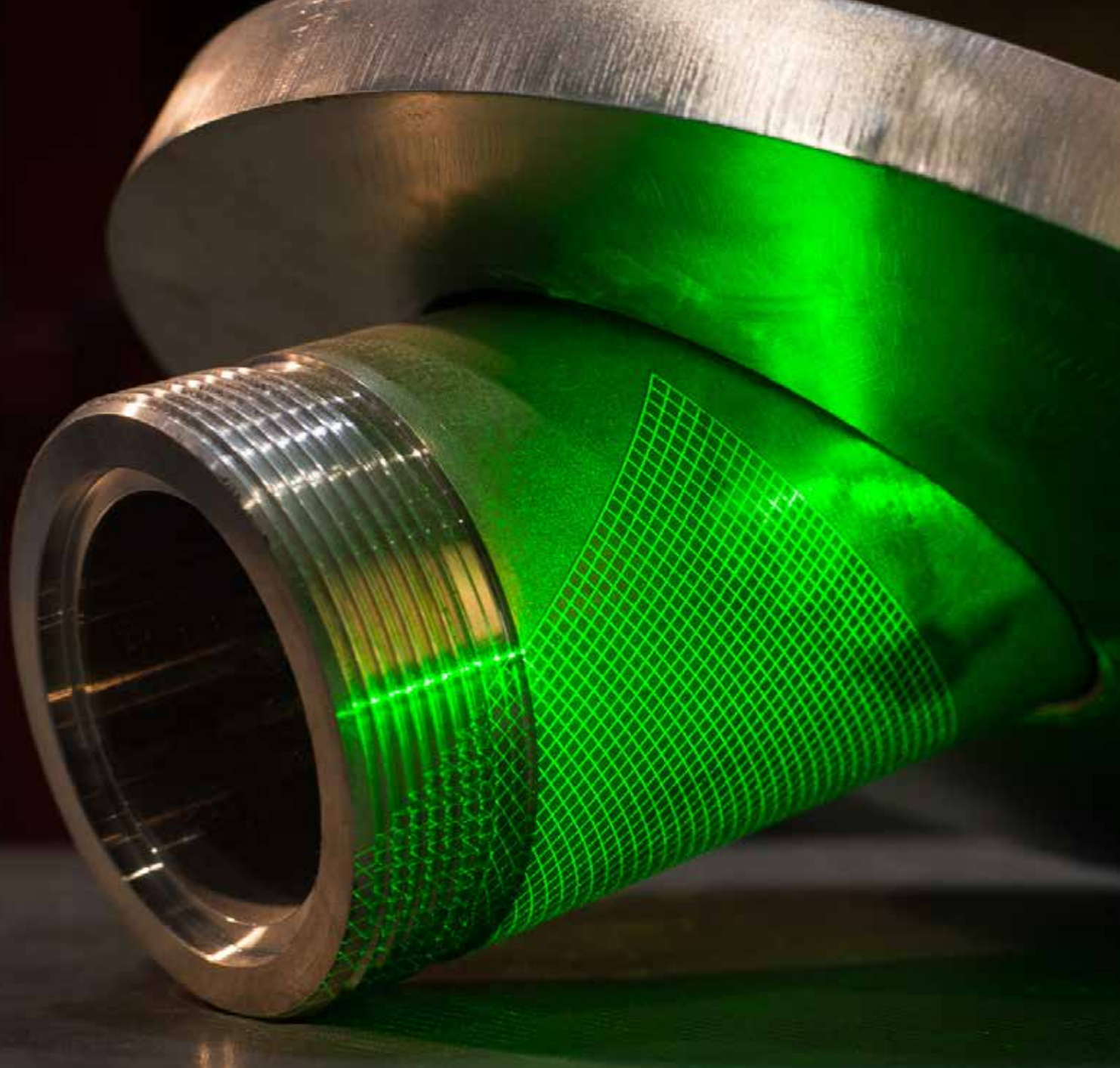
# framatome

Integrated Measurement Solutions

# Playbook

The Perfect Fit.





## » The Metrology Game Plan

- Reduces project dose
- Reduces project risk
- Reduced project time
- Improves project safety
- Improves project predictability
- Improves financial success

Framatome's Metrology Services team is the most experienced group of metrology professionals, bar none. Our portfolio spans a wide range of industries — from aerospace and shipbuilding to nuclear — providing the basis for our sound judgement while supporting the nuclear industry. Our team possesses a deep bench-strength of knowledge and can provide your personnel with the most comprehensive solutions to the unique challenges of our industry — all backed by Framatome's commitment to operational excellence.





# Play 1 Component Replacements

## Challenge:

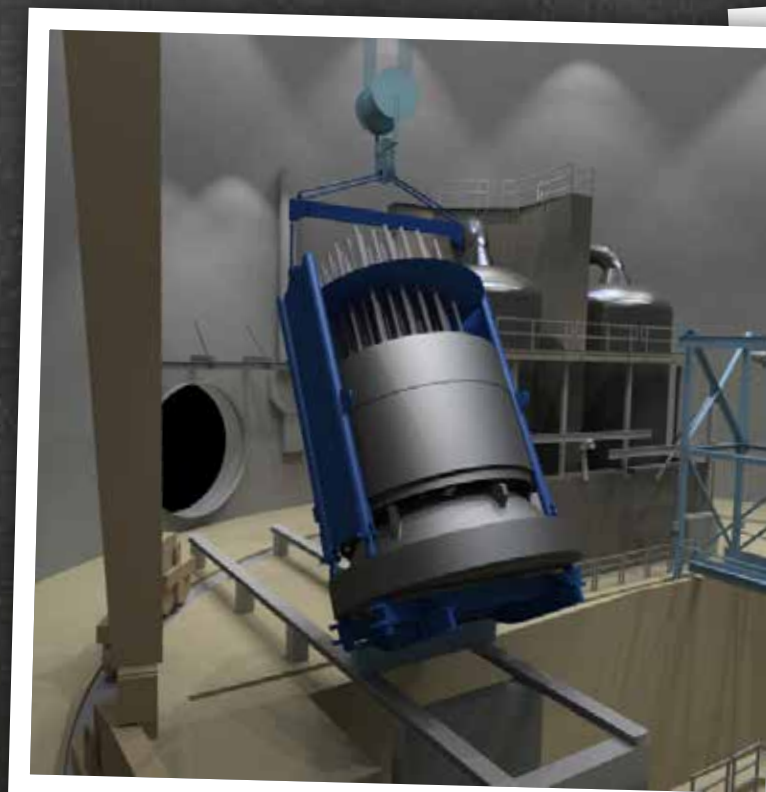
- Identify plant interferences for ingress/egress during removal and replacement
- Formulate a successful rigging plan
- Understand original design configuration vs. new
- Identify system pipe sever and final machining locations
- Acquire shim calculations
- Achieve first-time fit-up with as-built plant configuration

## Project Examples:

- Steam generators
- Reactor vessel closure heads
- Feedwater heaters
- Heat exchangers
- Circ water pumps
- Strainers
- Coolant pumps

## Solution:

- Capture as-built plant configuration to include in-service component
- Virtual simulation of component and rigging along load-path to validate rigging plan, identify issues, and identify plant interferences
- In-service and replacement component comparison to as-built plant condition
- Predetermine piping sever, preps, and shim package
- Predetermine new bolting locations for predrilling





# Play 2 Plants Modifications

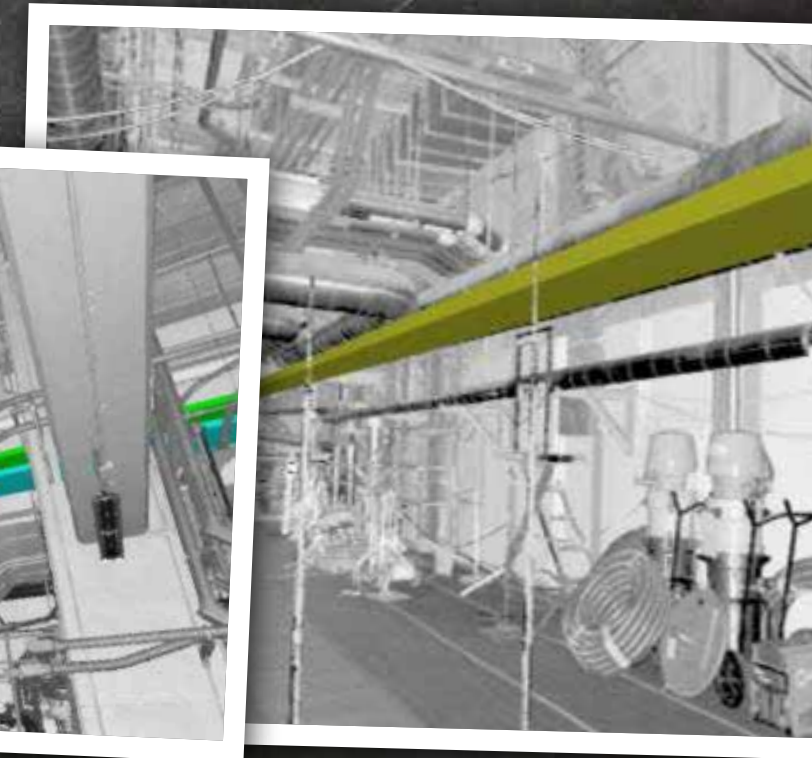
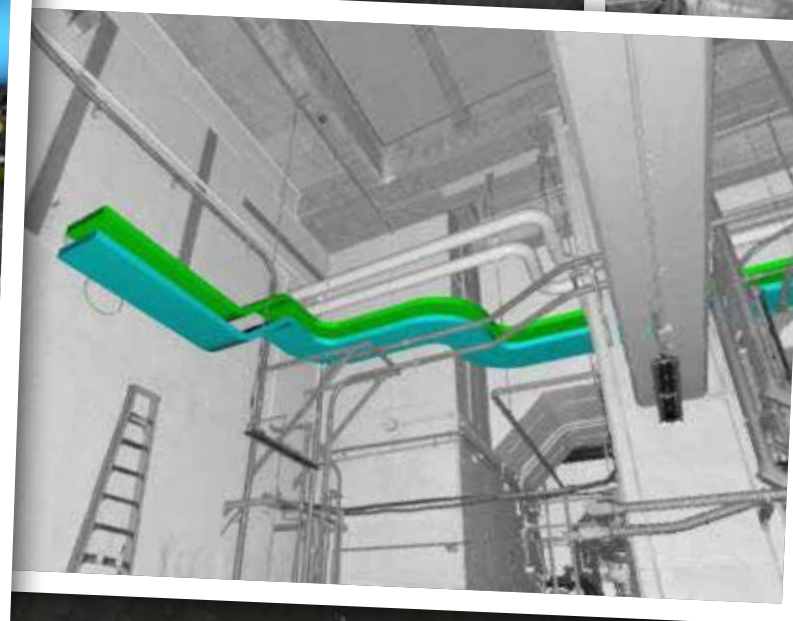
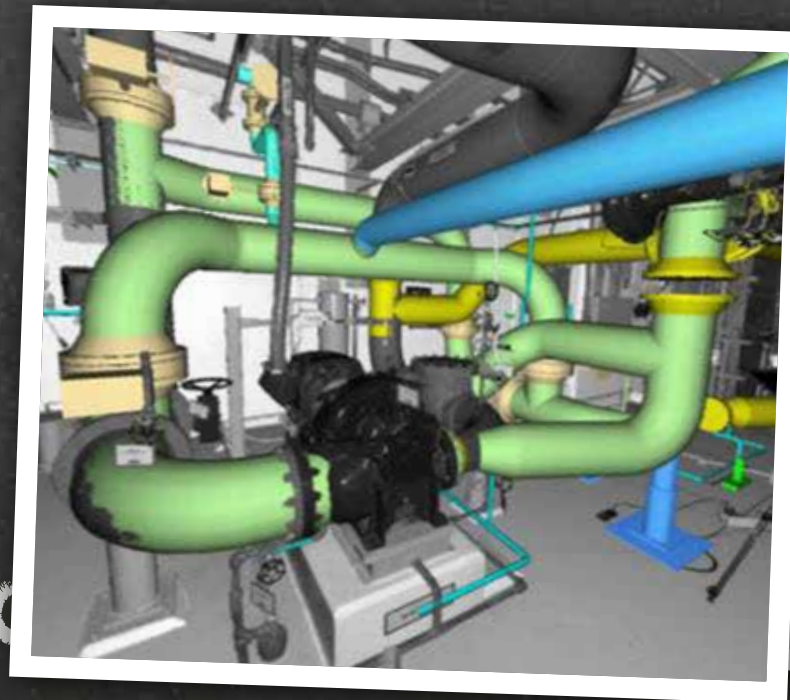
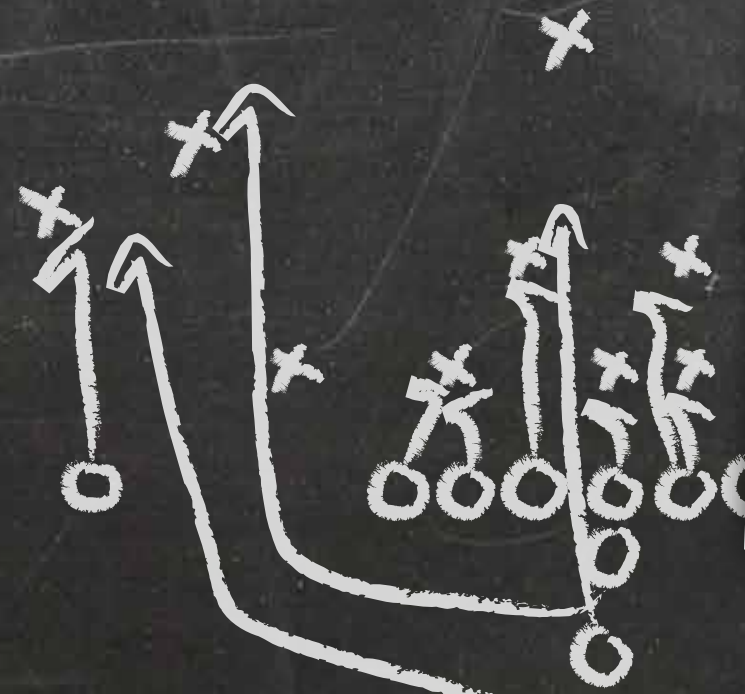
## Challenge:

Design and implement a new system into the plant's as-built configuration

- Lack of credible or updated design drawings
- As-built plant configuration and plant design drawings differ
- Design flaws identified during implementation impede progress, causing cost and schedule overruns
- Project lacks on-site 3D capability

## Solution:

- Capture as-built 3D plant configuration
- Overlay Rev 0 design with collected data to identify areas in need of correction
- Design inside collected data vs. plant drawings
- Identify design to as-built plant interferences and correct
- Render Rev 0 design interference-free prior to release





# Flow 3 Flow Accelerated Corrosion

## Challenge:

- Proper identification of system configuration (design vs. as-built)
- Efficiently replace in-service piping
- Shorten the duration of replacement projects
- Maximize the amount of pipe that can be replaced in a given outage



## Solution:

- Capture as-built system configuration
- Move as much preparation as possible to a pre-outage environment
- Pre-fabricate “like for like” replacement piping
- Electronically overlay in-service and replacement piping to predict sever and final prep location
- Prep “new” pipe in shop environment
- First time fit-up every time
- Reduce field welds, delays, and rework
- Maximize schedule





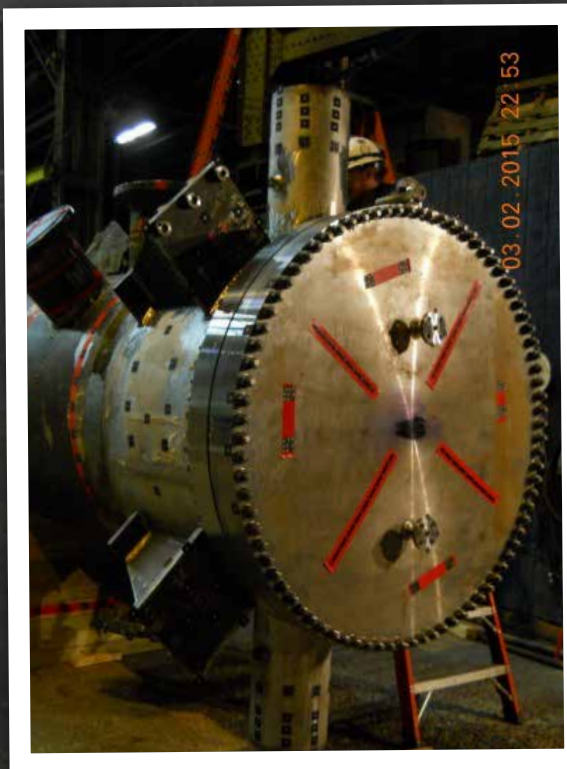
Play 4  
Component and Piping  
Fab Support

Challenge:

- Ability to accurately pre-fabricate piping to existing plant conditions
- Accurately fabricate and machine new components to existing plant conditions

Solution:

- Capture plant as-built data and incorporate into new component or piping drawings
- Control fabrication using advanced measurement techniques
- Layout and pre-drill anchor bolt locations, if needed
- Predict and control final machining of supports and pipe nozzle connections
- Predict component-to-plant support shim sizes prior to install





# Play 5 Virtual Database of Plant

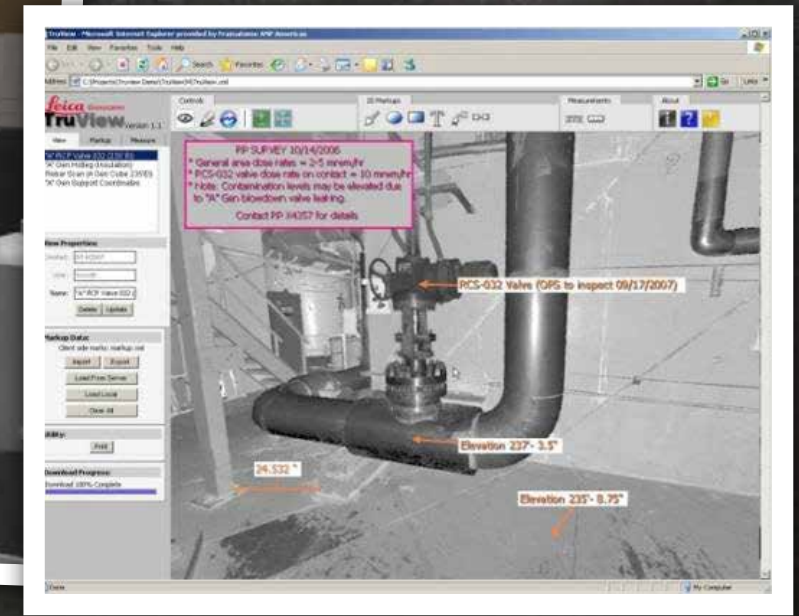
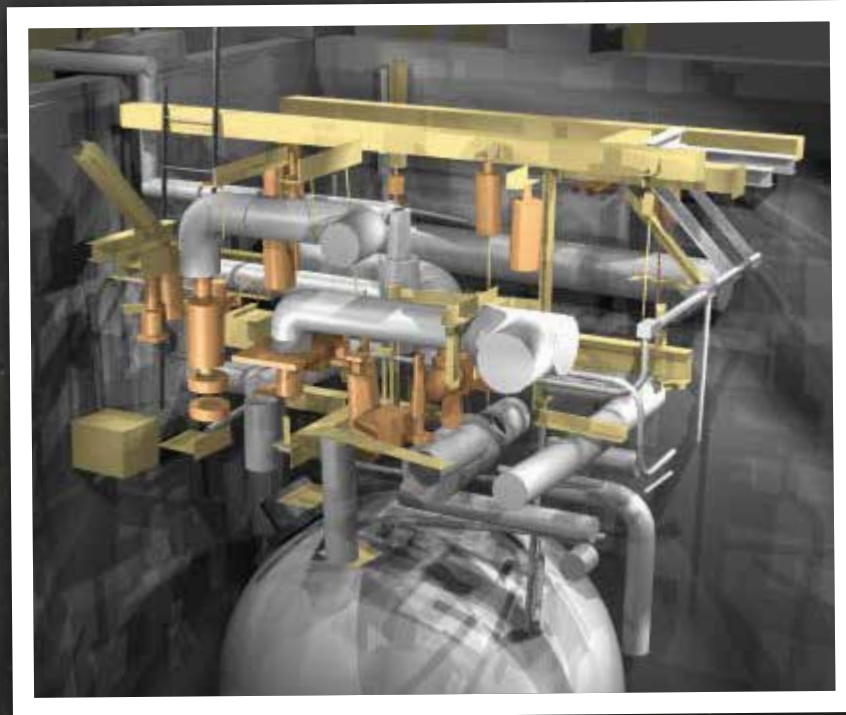
## Challenge:

Project area is difficult to access or inaccessible during operations, slowing your progress toward full project implementation

- Operating equipment, high temperatures, and excessive dose prohibit entry into area
- Access denied while plant is operating
- Protected train issue will not allow access
- Upcoming project with zero as-built data

## Solution:

- Capture as-built plant configuration in project area when accessible
- Enables virtual access to area when needed for project support
- Easy-to-use “free” viewing software
- Create 3D model of project area
- Design, engineer, and plan in collected data, removing the need for area walk-downs
- Generate animations of project work flow

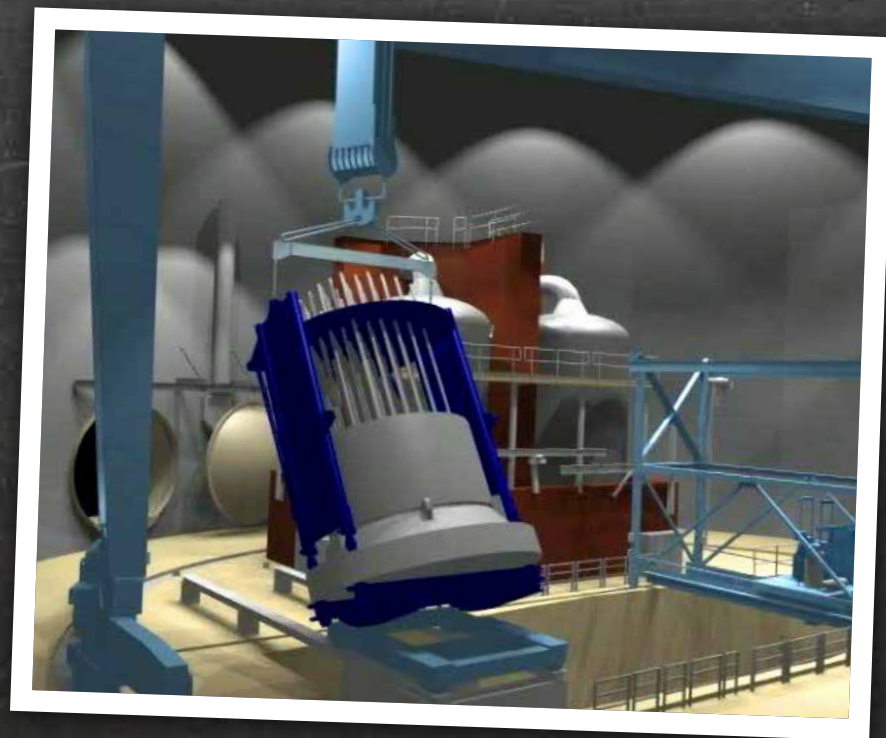




# Play 6 3D Modeling and Animations

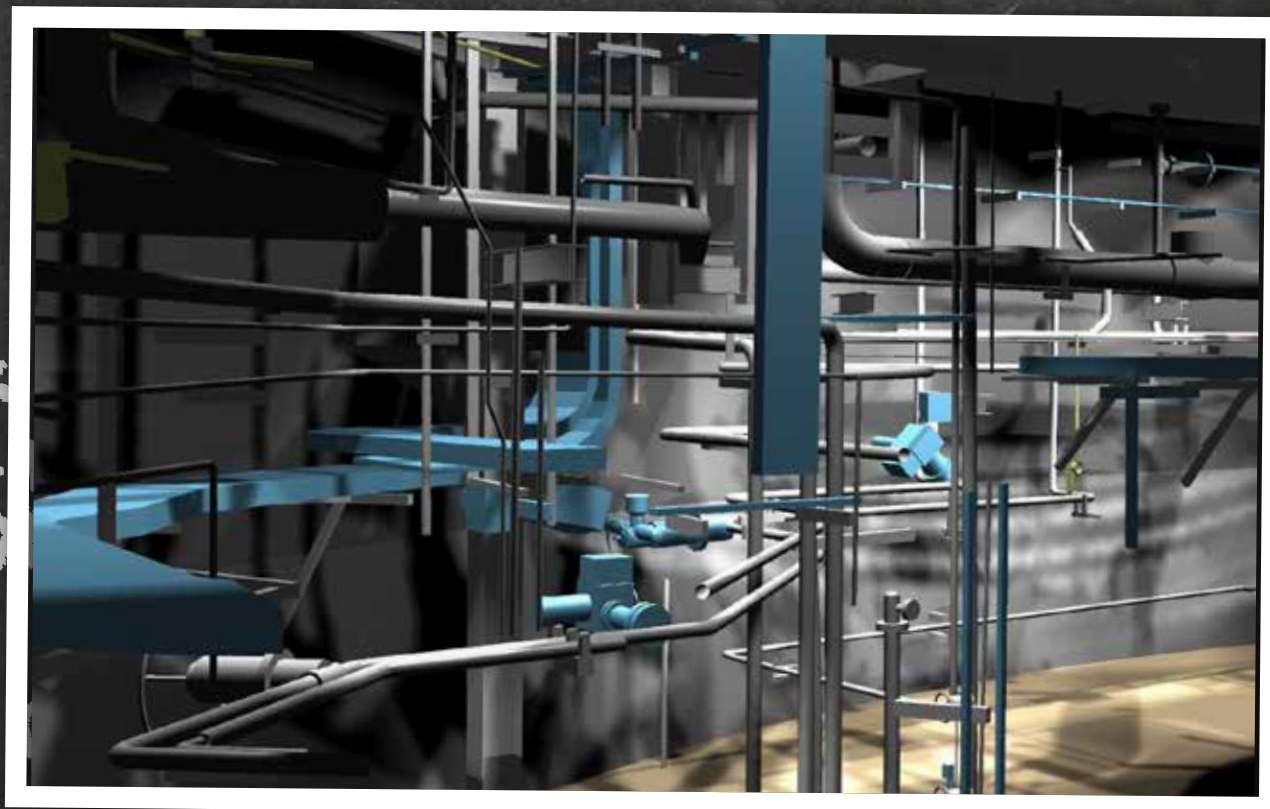
## Challenge:

- Ability to visualize the total project complexity and flow
- Project lacks design drawings
- Project lacks clear image of challenges
- Project needs better understanding of overall project flow



## Solution:

- Capture plant as-built data
- Create 3D model of project area
- Use model to further develop project plan and design bases
- Develop animation of planned rigging effort and component moves
- Create animation of egress/ingress to better understand challenges and remove uncertainties

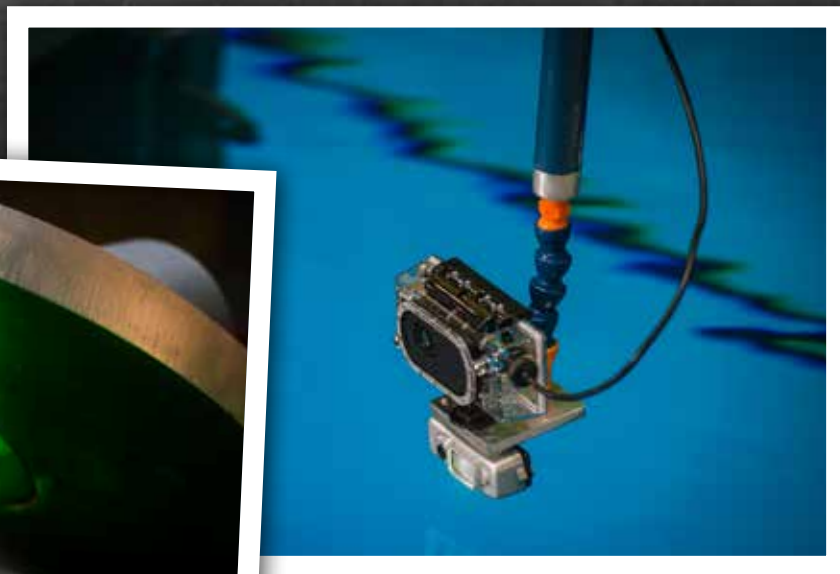
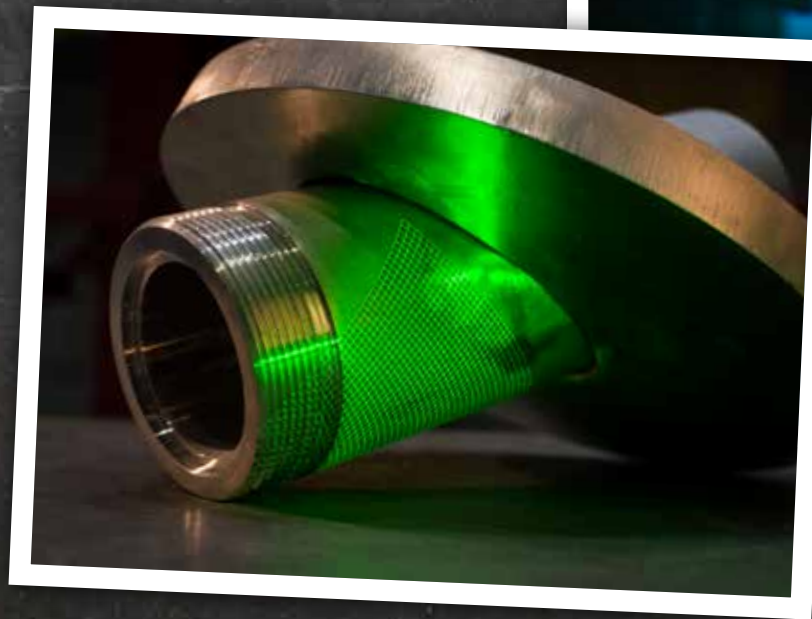




# Play 7 Underwater Measurements

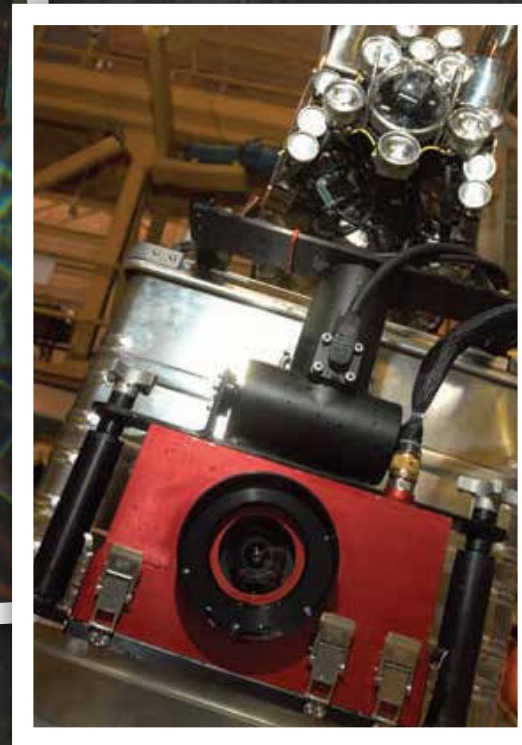
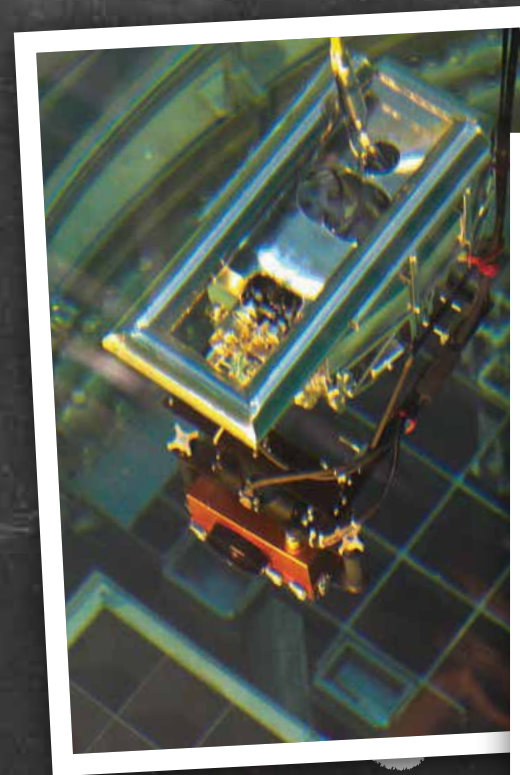
## Challenge:

- Lack of design drawings
- Project area not accessible
- Project needs better understanding of area configuration
- Project needs to reverse engineer replacement parts



## Solution:

- Capture as-built data with our underwater photogrammetry system, accurate to +/- .015"
- Reverse engineer parts lacking quality design drawing
- Verify design vs. actual configuration

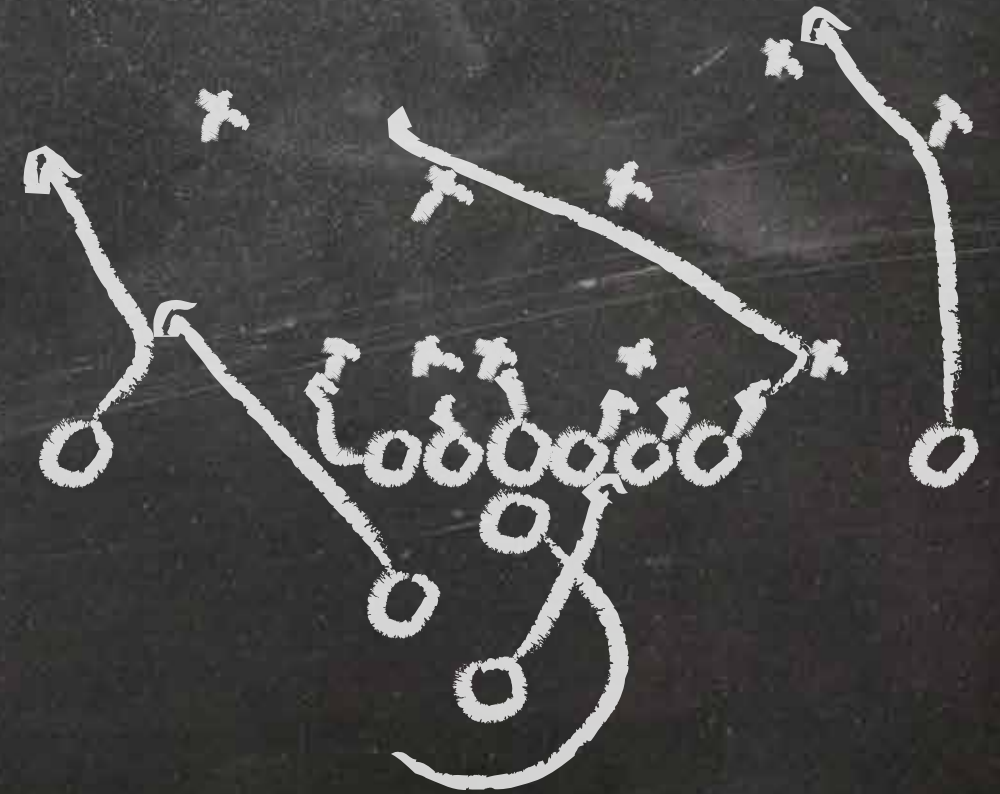






## »» Special Teams Plays

*Innovative Solutions to Emergent  
Industry Challenges*





# Special Teams Pump & Motor Alignment

## Challenge:

- Traditional methods of dial indicators produce acceptable alignments but are susceptible to human error
- Inaccurate pump-to-motor alignment
- Excessive bearing wear
- Gasket failure



## Solution:

- Advanced measurement techniques that save time while providing a superior product

## Benefit:

- Using advanced techniques produces a better overall product:
  - Removes human factors
  - Reduces time to perform
  - Reduces risk of bearing and gasket failures
  - Further ensures full-cycle runs

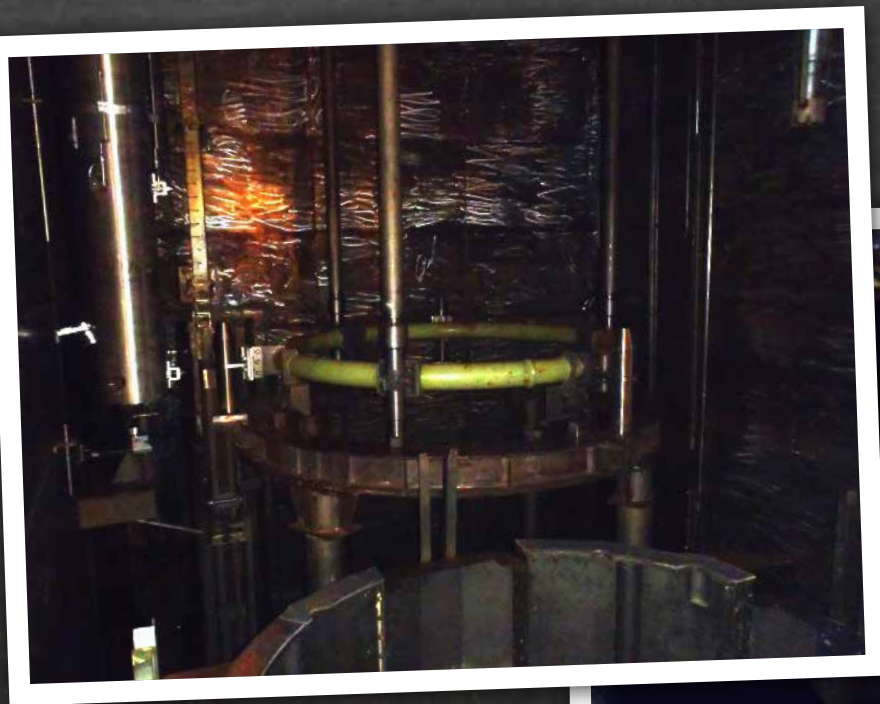




# Special Teams Internals Lift Rig Alignment

## Challenge:

- Internals lift rig does not align properly with the reactor vessel and upper/lower internals during critical path refueling operations

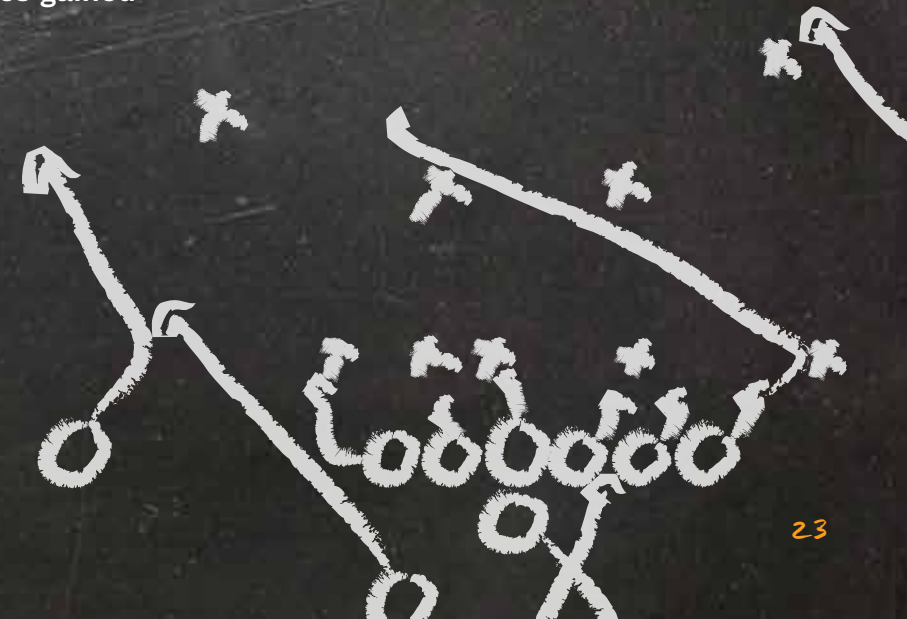


## Solution:

- Perform a local realignment of the critical engaging features of the internals lift rig using our advanced techniques
- Engaging screw guide sleeves, guide stud guiding sleeves, and keyways can be realigned to ensure proper engagement to the reactor vessel and internals

## Benefit:

- Inspection and adjustment process can be accomplished prior to refueling window
- Removes schedule delays associated with the many attempts to engage while in an out-of-tolerance condition
- Schedule savings recognized over the course of many outages due to efficiencies gained

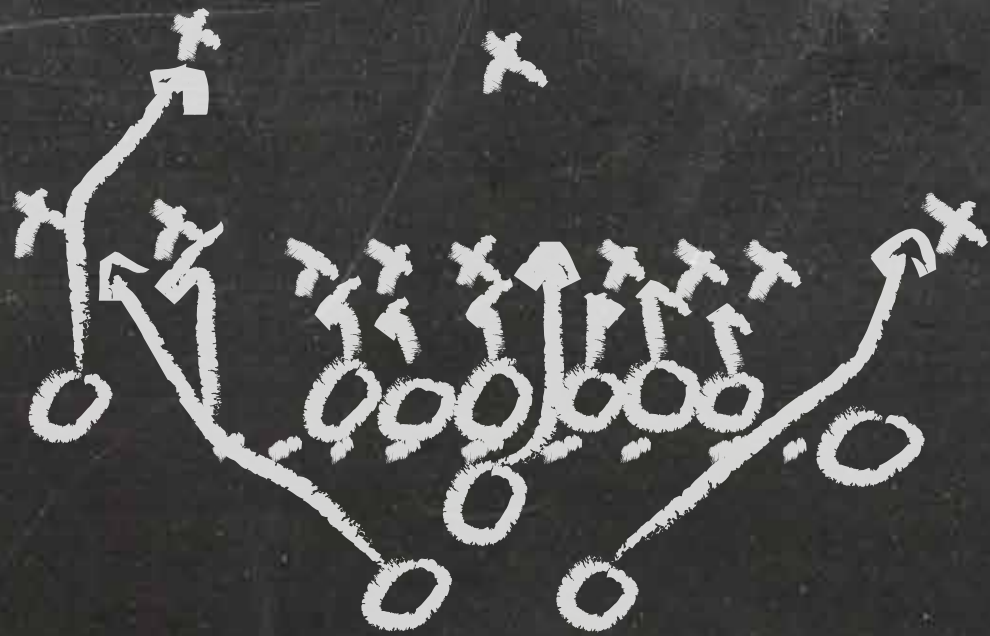




# Special Teams Fiber Insulation Replacement Projects (FIRP)

## Challenge:

- NRC GSI-191 requires the replacement of all fiber insulation in certain plant areas
- Accurately design reflective metal insulation package that will fit plant as-built configuration



## Solution:

- Capture plant as-built data in project area
- Overlay as-built data with the design insulation package to identify and correct errors
- Simulate the expansion caused by plant heat-up to further identify potential interference issues

## Benefit:

- Renders the design package virtually interference-free
- Drastically reduces rework and dose overruns during implementation





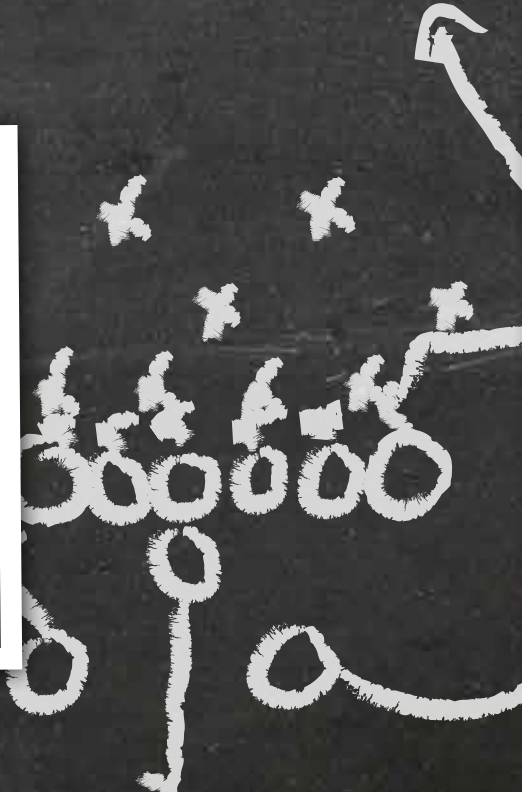
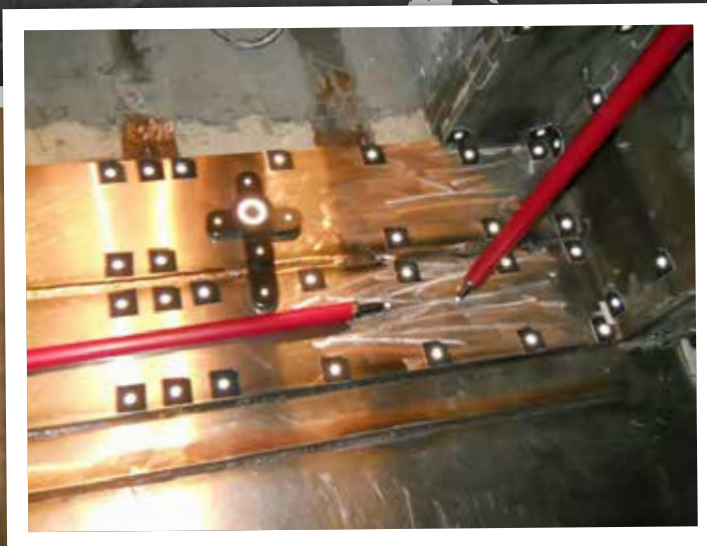


Special Teams

# Spent Fuel Weir Gate Install

## Challenge:

- Spent fuel pool rough opening constructed poorly
- Concrete and structural steel bulge and twist
- New weir gate has twist
- Virtually impossible to cut/trim gate frame in place



## Solution:

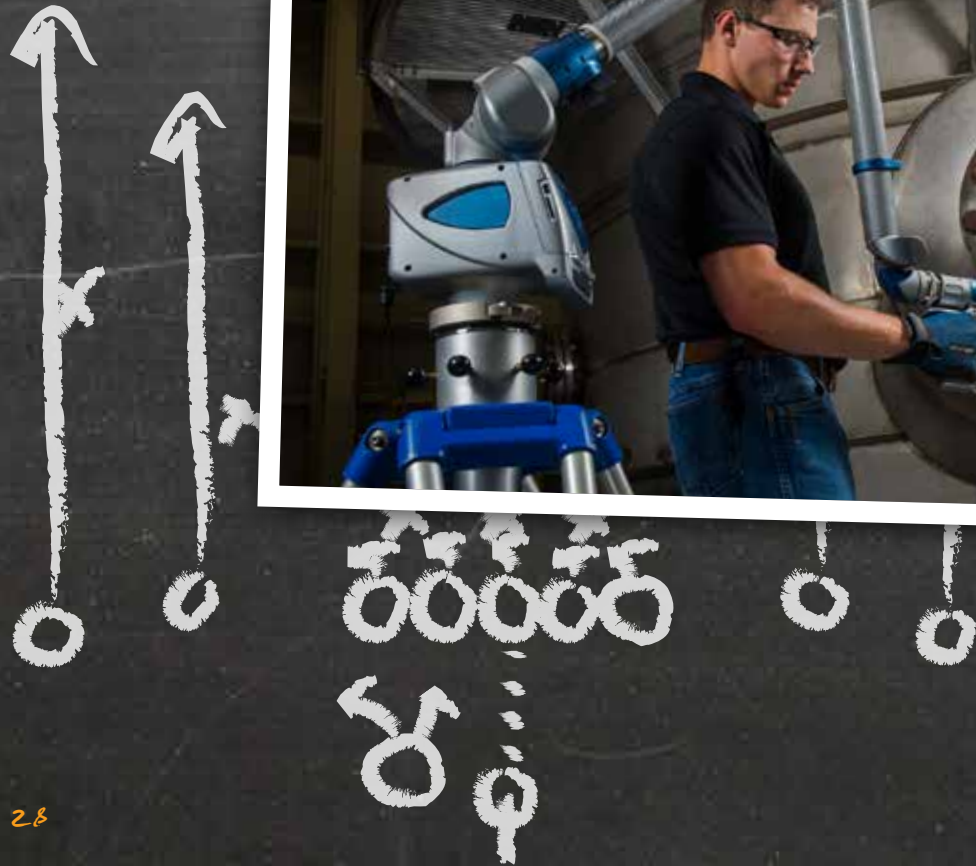
- Capture plant as-found opening configuration
- Develop shim package that provides a flat vertical surface to set gate against
- Capture new gate as-built configuration
- Overlay data sets to predict cut package
- Cut/trim gate in shop prior to install





# »» The Right Equipment

We've Got You Covered



# »» Photogrammetry

Photogrammetry is an extremely versatile measurement tool that provides the user with the freedom to move about the survey area without concern for stable platforms or area access while producing survey accuracies of +/- .005"

## Features & Benefits:

- Photogrammetry is a triangulation measurement process that utilizes a series of overlapping high-resolution digital images and a robust software package to derive accurate, three-dimensional coordinate measurements
- Field accuracies utilizing the methodology of photogrammetry are typically within +/- 0.005"
- Field-proven track record of providing the latest high-tech metrology support
- Portable — We can take our battery-operated, highly portable system to the most remote locations





## » Laser Tracker

### Features & Benefits:

- The laser tracker is a real-time measurement tool that uses an interferometer, two precision encoders, and sophisticated proprietary software to calculate the three-dimensional position of a mirrored target (probe)
- The system follows the mirrored target over features, updating the position at a rate of 1,000 times per second
- The abundance of data collected yields good statistical redundancy, permitting excellent accuracy and repeatability
- Capture real-time measurements of survey area with accuracies of  $\pm .001''$



## » Industrial Total Stations

### Features & Benefits:

- The total station is a real-time measurement process — by measuring vertical and horizontal angles, and incorporating electronic distance meter (EDM) determined straight-line slope distances, a three-dimensional coordinate value of each survey point is electronically calculated
- The total station measurement system is accurate to within  $\pm 0.024''$
- The total station utilizes retro-reflective targeting to collect the required data, but can also be used targetless

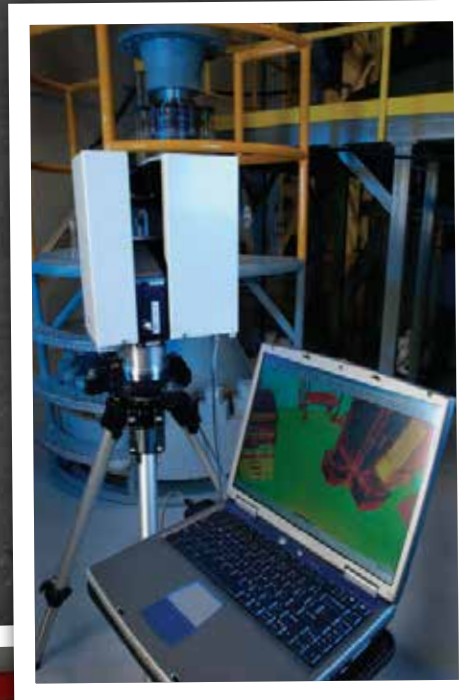




## » Laser Scanning

### Features & Benefits:

- Our laser scanning capabilities allow us to capture large volume survey areas such as containment with accuracies of +/- .125" down to small volume part laser scanning with accuracies of +/- .001"
- These tools allow the user to capture a large volume of data in a short period of time, which can then be used to:
  - Generate 3D models
  - Perform load path interference studies
  - Validate rigging plans
  - Animate project workflows
  - Overlay design models for interrogation and identification of design to real-world differences
  - Reverse engineer parts
  - Develop 2D drawings



## » Portable CMM ARM

### Features & Benefits:

- Portable measurement system that consistently produces measurement accuracies of +/- .0015"
- Superior tool for measuring machined parts
- Perfect tool to enhance the manufacturing of small components and piping with tight tolerances
- Accuracy allows reverse engineering with confidence





## »» 3D CADD Packages / Modeling

### Features & Benefits:

- 3D models or 2D design drawings can be created from collected laser scan data to support project needs
- Enables the design of new plant modification in the real-world environment
- Provides a project with the ability to animate the project workflow
- Enhances team's ability to understand the work-scope while vetting out workflow issues



## »» Underwater Photogrammetry System (UPS)

### Features & Benefits:

Framatome has partnered with the DimEye Corp. to bring you an advanced underwater measurement process

- Provides the ability to capture as-built measurements in areas once thought to be inaccessible
- Enables reverse engineering of parts with little to no design information
- Survey accuracies are typically +/- .015"





## »» The PWR Bench

### PWR Project Support Examples

- Steam generator replacement
- Reactor vessel head replacement
- Feedwater heater replacement
- Small component replacements — such as strainers, pumps & valves
- Reverse engineering of existing components & systems
- Piping as-builts, drawings creation, pipe fab and install
- RCP alignment
- Transformer replacement
- Fuel transfer system measurements
- Underwater measurements (+/- .015")
- Load path interference analysis
- 3D modeling and animation services

## »» The BWR Bench

### BWR Project Support Examples

- Feedwater heater replacement
- Circ water system intake pump replacement
- Service water piping replacement
- Emergency diesel generator upgrades
- Turbine controls upgrade
- FLEX
- Feedwater heater valve replacement
- Main and aux transformer replacement
- Condensate margin piping replacement
- Underwater measurements (+/- .015")
- Load path interference analysis
- 3D modeling and animation services

»» Your Full-Service  
Metrology Provider



## »» A Word From Our Fans

“I was very impressed with the technology that Framatome brought to the site to perform the 1A NS AHU coil header metrology and the sophistication of the output product. Additionally, Framatome’s ability to operate VERY independently at the site (negotiating badging, RP, knowledge of various internal processes, etc.) was extremely beneficial. Framatome personnel were also extremely responsive to our needs — another great plus.”

“I saved over a million dollars on this project as compared to the same project on the other unit by employing the Framatome metrology team to help. Their innovative thinking and ways to support my project workflow reduced rework to nothing, improved my schedule, and saved the project a lot of money. It was well worth the investment.”

“Framatome technicians were willing to educate [site] engineers on photogrammetry and willingly answered any questions we had. Framatome technicians took time to evaluate future potential work and advise best method to perform measurements/scanning. Framatome technicians adapted to site issues that held up work or put extra pressure on them to get the work done.”

“We continued to pursue industry practices for dose reduction and found the use of Framatome Metrology would allow fabrication of the flex connection spool piece to be accomplished outside of the RCA. The Metrology crew went to the job site and took laser pictures of the connection points. These measurements were entered into a computer program that converted the pictures into a 3D picture with dimensions. The weld crew set up in the fab shop, and the Framatome Metrology crew with their special cameras guided the fit-up at the shop. The piece was QC inspected and carried to the field location in the U/1 RB 20' on top of the DW roof. When the spool piece was lifted into place, it fit like it had been made in place. This method of fabrication allowed all of the fabrication of the spool piece to be accomplished outside of the RCA. This technology and a strong sense of ownership by the crew members realized a savings of approximately 700mrem from the project ALARA goal.”



Framatome is an international leader in nuclear energy recognized for its innovative solutions and value added technologies for the global nuclear fleet. With worldwide expertise and a proven track record for reliability and performance, the company designs, services and installs components, fuel, and instrumentation and control systems for nuclear power plants.

Its more than 15,000 employees work every day to help Framatome's customers supply ever cleaner, safer and more economical low-carbon energy.

Visit us at [www.framatome.com](http://www.framatome.com), and follow us on Twitter: @Framatome\_ and LinkedIn: Framatome.

Framatome is owned by the EDF Group (75.5%), Mitsubishi Heavy Industries (MHI – 19.5%) and Assystem (5%)

For more information, contact:

[component-repair-replacement@framatome.com](mailto:component-repair-replacement@framatome.com)

**Framatome Inc.**

155 Mill Ridge Road  
Lynchburg, VA 24503

[www.framatome.com/us](http://www.framatome.com/us)

The data contained herein are solely for your information and are not to be construed as a warranty or other contractual obligation.

©2022 Framatome Inc. All rights reserved. B\_US\_628\_ENG\_06/22