

## Inspecting Concrete Structures Remotely

### Summary

Unmanned aerial vehicles, or drones, can reduce costs associated with inspection of concrete structures (containment, cooling towers, etc.). A business case analysis indicates that nuclear plant owners who currently rely on manlifts or cranes to conduct inspections could save up to 90% of inspection costs using drones. Nuclear plant owners in several countries have used EPRI guidance to support the development and deployment of drone inspection programs.

### Example – Member Application

Nuclear plant owners in the United States, France, and Spain have used EPRI guidance to support development and deployment of drone inspection programs.

### Background

Drones have become an increasingly used technology in the nuclear industry for performing inspections of structures and components in hazardous areas. The ability to remotely conduct inspections using high-quality cameras and other equipment can save costs and enhance personnel safety compared to conventional techniques. Establishing an effective program requires a comprehensive awareness of the many factors involved, from technology selection and payload to airspace compliance and security.

#### APPLICABILITY

All nuclear plants with concrete structures

#### VALUE

**Up to 90% reduction** in inspection costs compared to traditional methods.

#### EPRI PROGRAM

Nondestructive Evaluation

### EPRI's Role

EPRI research on this topic was one of the industry's first instances of showcasing the use of drones to perform visual inspections of concrete containment structures from the exterior. EPRI's research showed that this technology can perform the inspections to the same level, if not better, than traditional methods while providing a better inspection record.

A collection of EPRI reports provides users with the technical basis for performing visual inspections of concrete structures with drones, guidance on developing a drone program, a cost benefit analysis of utilizing this technology, and a tool for assisting with the data analysis.





## Value

EPRI's Business Case Analysis Methodology (BCAM) tool has shown that utilities that use manlifts or cranes to gain access to the containment structure and dome for inspections could save up to 90% of inspection costs with the deployment of drones. The one area of increased burden identified during the cost benefit analysis was the additional time required for review of the images and videos collected during the inspection. EPRI has developed a machine learning algorithm to automatically detect concrete defects from images and videos of containment structures, which can assist with data analysis from drone inspections.

Specific benefits include:

- Increase in personnel safety – reduce the need to work at heights and on manlifts
- Increased data quality and improved inspections record – full capture of the containment structure, not just identified defects
- Cost savings – up to 90% of inspection cost savings compared to traditional methods used
- Efficiency gains from data analysis with the use of AI tools



## IMPLEMENTATION GUIDANCE

All nuclear power plants that have concrete containments and shield buildings are viable candidates for drone deployment. This technology and guidance can also be used for other concrete structures, including cooling towers and/or hydro dams, and for other non-concrete applications, such as indoor radiation surveys.

EPRI has published several resources to support implementation of remote concrete structure inspection technologies. These resources are included in this Value Guide along with guidance to assist in implementing and sustaining a remote inspection program at plant sites.

Note that while this Value Guide is specific to aerial inspection tools, EPRI has also developed guidance to support the deployment of ground-based robotics systems.

Recognizing the growing use of robotic and remote inspection vehicles in industrial environments, EPRI has launched a supplemental project to capture lessons learned and drive more effective use of this technology. The supplemental project, *Unmanned Mobile Technologies Collaboration Group* (3002030221), provides a forum for sharing operating experience and promoting the adoption of unmanned robotic technologies.

## Resources

- [3002013193](#), *Remote Visual Inspections with Unmanned Aerial Systems*
- [3002020913](#), *Nuclear Unmanned Aircraft System (UAS) Users Guide*. Provides information and guidance on implementing drone inspections at nuclear power plants. The users guide addresses a range of implementation topics, such as regulatory compliance, safety, security, electromagnetic compatibility, roles and responsibilities, maintenance, transportation and storage, and using a third-party as a service provider. The report describes multiple use cases, including inspection of concrete structures, metallic vessels, piping systems, and rotating equipment; radiation monitoring (both continuous and plume monitoring); and thickness measurements to aid in the discovery of corrosion or erosion.
- [3002021027](#), *Plant Modernization Business Case: Drone Inspections of Containment Structures*. Provides guidance on how utilities can collect inspection-related cost information associated with labor, equipment rentals, and contractors to conduct a cost benefit analysis for the use of drones. Such an analysis can assist users in assessing, for example, whether a drone inspection program is cost-justified for a utility with only one or two nuclear units.
- [3002018419](#), *Automated Analysis of Concrete Images*
- [3002025464](#), *Unmanned Ground System (UGS) User's Guide for Nuclear Power Plants: Implementation Guidance, Technologies and Applications, and Cost Savings Opportunities*. Outlines existing technologies and how they can be employed at nuclear plants to increase worker safety and process efficiency and quality. The report provides implementation guidance and includes several use cases.
- [3002030221](#), *Unmanned Mobile Technologies Collaboration Group*
- The [Nuclear Plant Modernization Toolbox](#) ([nuclear-plantmod.epri.com](http://nuclear-plantmod.epri.com)) includes several Modernization Technology Assessments that address robotics.

To support more effective technology transfer, EPRI is tracking implementation of key R&D activities.

Please access this link to provide input on your company's use of this particular research:

<https://www.surveymonkey.com/r/TK3LMJ7>



Access additional Value Guides and examples of EPRI R&D application at:

<https://interactive.epri.com/nuclear-value/p/1>

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