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Multi-purpose robots provide O&M safety and efficiency

As asset managers look to cut costs and manage risk, the advent of a new generation of multi-purpose robots is making a compelling case for wide-spread adoption in the power business.

Power generation plant owners and operators face numerous challenges maintaining margins in often extremely competitive markets.

- Regulatory requirements require regularly scheduled asset inspections. Standard, manual maintenance practices are labor intensive and inefficient, consuming resources and stopping plant production.
- Emergent situations such as leaks, fires or breakdowns can occur, requiring the plant to be shut down for immediate, unplanned investigation.
- Areas needing inspection are often hazardous, posing a risk for human entry. Incidents involving injury are tragic, and directly impact operations and the bottom line.

To address these challenges, the power industry is keenly focused on ways to optimize operations and maintenance (O&M). The objective is to cut costs through maximized asset availability, improved productivity, increased safety and minimized downtime.

Industrial robotic solutions are a growing phenomenon

Today, rapidly maturing technologies like robotics, artificial intelligence, and machine learning are providing new options for the power business to achieve these critical O&M objectives.

The adoption of industrial robotic solutions across the sector is increasing at a rapid annual pace.

According to the latest figures from the International Federation of Robotics (IFR) 2018 World Robotics Report, there has been a 30% increase in the number of industrial robots shipped over the last year. IFR also states that from 2018 to 2021, global robot installations are estimated to increase by at least 14% per year (CAGR).

Specifically, the power industry is increasingly turning to remotely operated vehicles (ROV) to meet its O&M targets for reliability, productivity, safety and cost control. A new class of industrial ROVs with advanced mobility, sensor capabilities, and high-quality data collection provide credible solutions for the power industry. Used for first-look inspections, these robots augment traditional inspection practices to provide more effective inspection results, with high-quality, actionable data. As such, these ROV platforms will serve a critical role in the digital transformation of the industry.

John Santagate, Research Director at industry research and analysis firm IDC, highlights some key trends driving robotic technology adoption among industries like oil & gas and power generation:

“It’s about advanced capabilities and new task-driven robotics…companies are looking to improve productivity, improve efficiency, increase capacity and drive safety of their workforce. Until rather recently, robotics hasn’t necessarily been a high-profile alternative technology in those industries. What’s changed is the reduction in the cost of the robots themselves, and improvements in the capabilities of robotics through things like artificial intelligence, advanced sensors, and connectivity.”

– John Santagate, Research Director, IDC

Motivators for robotics in power

Downtime is the single largest source of lost production time in the power industry.

According to recent US EIA figures, in the area served by the California Independent System Operator (CAISO), peak-period electricity prices in July 2018 averaged US$101/MWh. In this kind of market, revenue losses during downtime for a 500 MW power plant can easily exceed $1 million per day, making even planned outages extremely costly.

Owners and operators aiming to decrease downtimes costs are looking to leverage the capabilities of the latest generation of industrial robotics to maintain their margins in this extremely competitive market. In that regard, ROVs represent an opportunity to make a significant impact in reducing associated outage costs across several areas:

Efficient inspection and investigation

Many of the complex systems within power plants require internal and external inspection to continue safe operations and meet regulatory requirements. For example, regulatory compliance requires scheduled inspections of equipment such as valves, pipelines, pressure vessels, tanks, reactors, boilers and their respective supporting structures. Costly inspection and intervention are also required in the event of an unplanned outage.

Improved employee safety

There are often hazardous environments associated with inspection practices in the power business, such as the need to work at heights, underground, or in confined spaces. High temperatures, high pressures, chemical or radiological hazards in such areas mean that manual inspections often pose additional health and safety risks for workers. Ultimately, this translates into incremental inspection costs associated with health and safety preparations, like operational planning, extra personnel, scaffolding, training, and specialized equipment.

Need for quality asset data

Manual inspections using conventional tools often result in incomplete data collection. For example, inspectors using a handheld camera or borescope may gain access to an area by dismantling it or cutting openings at regular intervals in order to reach into the area and use the camera to take pictures. It is nearly impossible to gather a complete, accurate set of data. The problem compounds over time as some areas don’t get inspected at all. This process is time intensive, very costly and adds safety risks.

For example, Ameren Corporation, a U.S. power utility company serving the mid-west, has been actively seeking and testing various robotic inspection tools to augment its current O&M processes. David Strubberg, Ameren’s Innovation, Programs & IT Projects director, has spent the past few years identifying and testing the right platform that meets all of the company’s operational criteria. In outlining what he looks for in new technology adoption, he says:

“We’re looking for things that make our workers safer, give us more information, and in the end will probably gain some productivity and quality.”

– David Strubberg, Director of Innovation, Programs & IT Projects, Ameren Corp.

The growing use of robotics in power

Early adopters in all areas of the power industry have discovered the benefits of robotics.

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– David Strubberg, Director of Innovation, Programs & IT Projects, Ameren Corp.
Nuclear

Nuclear power plants have extensive piping systems, and inspections are required to ensure their structural integrity. In 2014, GE Hitachi Nuclear Energy (GEH) announced that its ultrasonic robot, Surveyor, successfully completed an inspection on a section of underground pipe at the South Texas Project Electric Generating Station, the site of two Westinghouse pressurized water reactors.

Hydro

Hydropower is also challenged by the need to inspect hazardous piping areas and carry out repairs. In 2010, the operators of the 12 MW Glenlee hydroelectric project in Scotland, needed to refurbish the 1870 ft-long (570 m) penstock in their 70-year-old facility. Deemed too dangerous for human operators, a robot was deployed to automatically advance through the penstock, cleaning the one-acre (4,200 m²) surface of the interior using a high-pressure water jet. The robot completed the task in six weeks, without exposing personnel to hazardous work conditions.

Thermal

Heat recovery steam generator (HRSG) tubes in thermal power are prone to contamination build-up and require regular inspection to avoid an adverse effect on thermal efficiency. Tube failures represent a dangerous event, requiring many days of downtime, and a significant cost to the plant owner.

The US Electric Power Research Institute (EPRI) sponsored a project in which power utility company Dynegy used an ROV to inspect tube bundles in HRSGs. The project demonstrated that industrial robotics may offer a less time-consuming and less-destructive method than conventional inspection techniques, and that ROVs could help to identify areas of corrosion and thermal fatigue before they lead to forced outages.

Natural Gas

In 2016, GE announced that its robotic inspection systems would be used in 19 generators manufactured by GE, Alstom, Mitsubishi and Brush at seven of Alinta Energy’s gas-fired power plants in Australia. The systems will alert the utility to potential generator issues and give it time to evaluate its options. Inspections began in 2016 and are scheduled to continue through 2020.

According to IDC, the growing trend in industrial robotics adoption are underscored by companies’ confidence in extracting operational value from their investments.

“You’ve got people that are more open to investing in technology, that are more willing to try things, to have capabilities in place to mitigate potential risk down the road. They’re doing that by investing in new modern technology, and they will prove the value.”

– John Santagate, IDC.

Multi-purpose robots for the power business

To date, industrial robotic technologies have typically served to complement more traditional approaches to maintenance. This trend is beginning to change with the commercial development of a new generation of ROVs that are more sophisticated, multi-purpose and re-taskable. These robots are augmenting inspection practices with first-look inspections that provide insight into both asset and environmental conditions, creating the following benefits:

Reduced costs

Robotic, remote visual inspection solutions can be easily and quickly deployed, conducting both regular and unplanned inspections more rapidly and reliably. Saving both time and resources, ROV-based inspection is far less costly than manual, human-based inspection. Health and safety costs with manual
inspection, including requirements for scaffolding, additional staff, paramedics and specialized training can be significant. ROV solutions provide a first-look inspection that can help to characterize the assets and environment without having to send inspectors into hazardous areas.

Operation in hazardous areas

ROVs can operate in hazardous environments, confined spaces and difficult to reach areas that are impossible or unsafe for human entry. Inspecting assets in hazardous areas such as tanks, pipes, penstocks, confined spaces, and irradiated zones requires detailed safety planning and precautions. Using ROVs for a first look, remote visual inspection keeps employees out of harm’s way while providing high quality data that helps operators to effectively plan the necessary inspections and repairs prior to inspectors entering hazardous areas, if they even have to enter at all.

High quality asset data

With advances in sensors, computer processing power and IT services such as the cloud, operators are ‘digitizing’ assets and collecting the data needed to help make better maintenance decisions. Recently available ROV platforms can manage multiple sensor packages to collect this sensor-based data for specialized analysis. For example, visual sensors can collect high quality images and video, and GPS functionality can enable 3D asset modelling and 3D inspection mapping capabilities. These and a number of other sensors such as Infrared, multiRAE and eddy current support more complete data recovery and a thorough basis for making decisions on maintenance regimens or establishing preventative solutions for outages.

Predictive and preventative maintenance

Perhaps more significantly, advanced ROVs are also paving the way for the widespread digital transformation that is sweeping through every industry and business sector. Industrial firms are able to significantly improve workforce performance, productivity and safety through smarter maintenance strategies that include technologies such as robotic sensor platforms, data analytics, and cloud computing.

According to worldwide consulting firm McKinsey and Company, predictive maintenance is expected to reduce equipment maintenance costs by up to 40% and equipment downtime by up to 50%, ultimately generating economic value of $630B annually by 2025.

High quality visual and sensor-based inspection data from robotic platforms is now feeding into more advanced asset management systems that analyze multitudes of data collected over time. Access asset-specific, contextual data is enabling companies to more accurately forecast potential failures and apply appropriate predictive and preventative maintenance programs to mitigate future risk, ultimately reducing downtime and its associated costs.

A first class, first look inspection

Among the latest generation of ROVs is the Guardian™ S mobile IoT inspection platform. As a first-look, remote visual inspection tool that can carry multiple sensor payloads, the robot is a uniquely capable, quick-deploy solution.

Developed by Sarcos Robotics, the Guardian S platform can reliably traverse challenging terrain including stairs, culverts, pipes, boilers, plenums, penstocks and tanks. The robot was designed to access small, confined spaces such as pipelines or HVAC systems, and thanks to its magnetic tracks, it can also climb vertical ferrous surfaces.

When asked about his company’s selection for the right alternative inspection solution, Ameren Corp’s Strubberg shares the following:

“Our first big test case will be at our pump-storage facility. The penstock is a “permit required confined space” which is inspected on a periodic basis. Part of the penstock is very steep that makes it unsafe for a person to visually inspect. There’s really no good way to do it without installing scaffolding, which presents a safety risk in itself. We are thinking this Guardian S ROV - the way it can run on a little bit of water, its magnetic traction - has the possibility to let us inspect the part that we haven’t inspected in a while.”

- David Strubberg, Ameren Corp.

The untethered, remotely operated Guardian S robot has long operational runtimes and superior maneuverability due to its various movement modes that allow it to move forward, backward or sideways, and in other configurations, to prevent itself from tipping over, and to turn itself back upright.

With its six built-in 4k cameras to gather real-time, high-resolution, color images and video, the robot provides the operator with a 360-degree viewpoint throughout the inspection.

Crucially, the Guardian S remote visual inspection tool is also able to transport a 10-pound (5 kg) sensor payload. This design provides the flexibility to add task-specific sensors, making it ideal for a multitude of inspection scenarios in the power industry.

For instance, a dangerous high-pressure steam leak is invisible and cannot be heard when the boiler is shut down, making it extremely difficult to precisely determine its location. The infra-red camera and wireless connectivity of the Guardian S robot are critical features in the detection of steam leaks.

As Ameren’s Strubberg explains:

“Now you can bring this ROV in and with the infra-red camera, you’d be able to pinpoint where that steam leak is coming from.” He adds, “Then you’d obviously know where to rope off to keep people away until you can shut down and it would also give you a jump on where the leak is to make sure you have the proper materials for repairs - that’s another advantage.” He says, “I think it’s one of those technologies that, when you have it in your hands and play with it, the use cases will just keep coming.”

- David Strubberg, Ameren Corp.

The Key to Success in Modern Power

Optimizing O&M is the key to success in the modern power business. To significantly reduce downtime, efficient inspection and maintenance processes and high-quality data collection are required. The latest generation of multitasking ROV solutions are delivering on that requirement by helping power companies improve operational processes, detect problems sooner, enhance plant reliability and reduce safety risk.

The bottom line for operations is that the detailed insight into environmental and asset conditions provided by ROV inspection platforms is empowering plant managers to make better-informed business decisions in the field or on the plant floor.

For today’s power business it makes a convincing case for the use of multi-tasking robots. As IDC’s Santagate concludes:

“There is no question robots are delivering value for the companies that are investing in the technology. If you’re not investing in modern technology today, you will be left behind.”

- John Santagate, IDC

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