Tacoma Power Reduces Costs and Risk with HMI/SCADA Virtualization

Have you thought about deploying your HMI/SCADA system in a virtual environment? With virtualization, you can optimize resources and consolidate hardware. Virtualization also maximizes uptime with greater agility, protects investments, and reduces risk.

While a minority of automation and control systems take advantage of virtualization, migrating is easy. As a case in point, Tacoma Power in Tacoma, Washington, successfully deployed a multi-phase virtualization project with GE's HMI/SCADA iFIX using Microsoft Hyper-V across its hydroelectric and fish hatchery facilities—without having prior implementation experience.

"With this project, Tacoma Power became an industry leader. We faced the learning curve in order to take advantage of the potential gains," said Ozan Ferrin, Generation Automation Engineering Supervisor at Tacoma Power. "We carefully compared the benefits of a virtual environment with traditional practices and built the business case for migrating to virtualization. Planning and developing best practices have allowed us to maximize the benefits, such as maintenance cost savings and reduced risk."

Following this success, other organizations can learn from Tacoma Power's experiences—including how to evaluate, plan for, and deploy a virtual environment for automation and control.

Why Virtualization?

Virtual Machines (VMs) use an operating system or application environment that is installed on software, which imitates dedicated hardware. VMs are common in the IT world with about 75% of x86 architecture workloads virtualized on servers, according to Gartner Group, with software providers VMware and Microsoft leading. However, in automation and controls, less than 30% of systems are virtualized, based on research conducted by GE.

In an IT or automation application, virtualization offers significant benefits. Server productivity can increase by a 10X factor. To safely achieve higher utilization, virtualization enables consolidation of workloads from underutilized servers onto a single server.

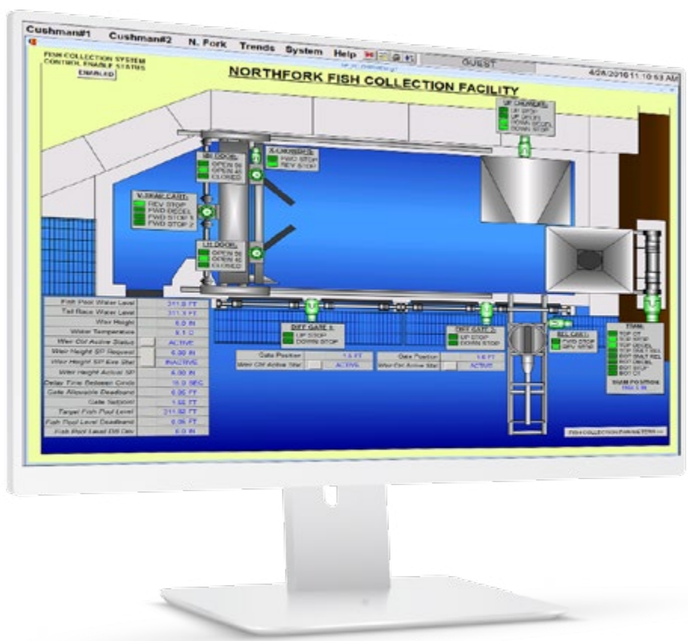
Key capabilities of virtual machines include:

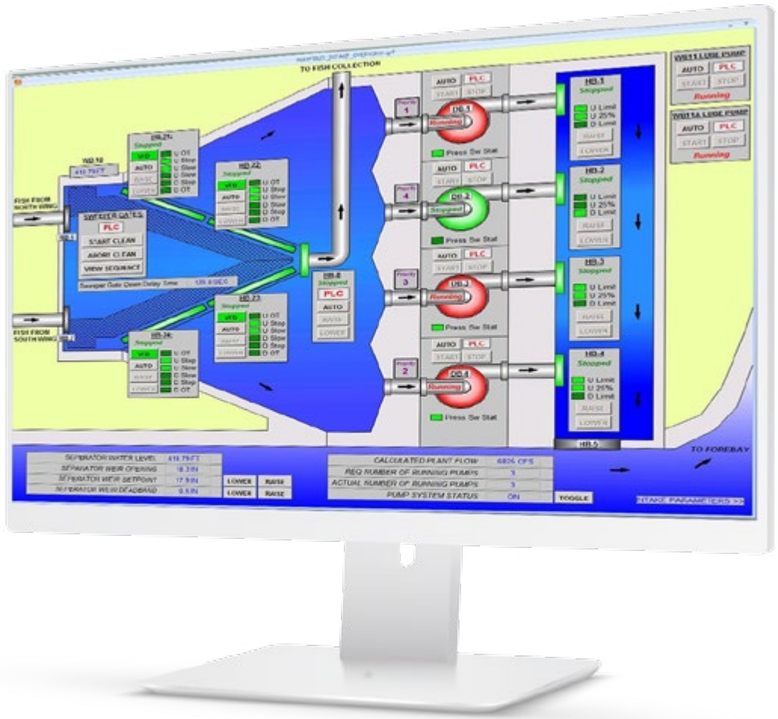
Isolation: Fault and security isolation is at the hardware level. Advanced resource controls preserve performance.

Encapsulation: The entire state of the virtual machine can be saved to files. Users can move and copy virtual machines as easily as moving and copying files.

Hardware independence: Users can provision or migrate any virtual machine to any similar or different physical server.

Partitioning: Users can run multiple operating systems on one physical machine, and divide system resources between virtual machines.





Automation at Tacoma

Tacoma Power serves 160,000 electric utility customers with nine hydro facilities on four rivers. Tacoma's Power Generation Automation team, with three engineers and one engineering technician, is responsible for integration, modernization and maintenance of Industrial Control Systems (ICS) for:

23 hydroelectric generators with generation of 3 billion kilowatt hours of electricity each year

4 fish hatcheries to support wildlife conservation

3 fish collection facilities

9 unmanned hydro facilities

For more than 10 years, the team has used GE's iFIX with approximately 50,000 data points, working with GE partner CB Pacific. Monitoring and control at the generation facilities include lake levels, megawatt values, megavar values, kilovolts, and amps and many other process control variables. For fisheries monitoring and control, the team watches flow, temperatures, pump status, fish counting, running gates, and other areas.

In addition to visualization and control, Tacoma Power uses iFIX for trending, troubleshooting and continuous optimization. Data collection and management is critical for regulatory reporting as well as day-to-day operations. To speed response to hatchery related alarms, operators can access the HMI screens from remote devices.

"We've had a very good experience with iFIX," Ferrin said. "Our staff uses it on a daily basis."

Always looking for ways to improve operations and reduce costs, the team at Tacoma Power decided to explore virtualizing their iFIX HMI/SCADA system.

"We asked ourselves, 'Should we move to a virtual environment?'" Ferrin explained. "Our team is most familiar with a traditional thick client environment, and the industry is still primarily using thick clients. However, we knew that thick clients also had disadvantages."

Weighing the Pros and Cons

While still commonly used, traditional thick client environments are more prone to failure than thin clients—unless users implement industrial computers, which can double hardware costs. Additionally, restoring or upgrading an entire thick client system can take from several hours to several weeks. Patches and other software updates can make thick client environments unreliable. Reinstalling or updating the operating system and HMI software may lead to unpredictable results. Also, a large development space is necessary as each node is a separate piece of hardware with separate software installations. Lastly, thick client environments are more prone to cyber security threats with standard Windows® operating systems.

Lower costs and risks

By utilizing a virtual environment, organizations are less reliant on physical hardware. Virtual environments can be duplicated and loaded onto any virtual host system, independent of the physical hardware. Long-term costs and risk go down with virtualization, including reduced hardware costs and failures. Since thin clients replace the thick clients, no re-imaging is necessary in the event of a failure.

> *"Power companies must be reliable, and our automation systems are key to that reliability, Virtualization makes restoring a system for disaster recovery as simple as loading the entire system image to a virtual host machine. During our decision-making process, the decrease in risk was clear."*
>
> **Ozan Ferrin, Generation Automation Engineering Supervisor, Tacoma Power**

Easier updates, better security

Furthermore, with virtualization, development testing can be handled using snapshots or checkpoints – which allows for testing of patches or other software updates. If any issues occur, the team can reverse changes easily to a previous state. Upon a restart of the host server, all the virtual environments return to their previous state. In general, security updates, malware protections, and antivirus update controls are easier to implement.

"Now, we have one central location to manage all software and operating systems," Ferrin explained. "For all our facilities, our development lab is reduced to a single server which hosts all OSs. Only the necessary thin clients need to be installed during development for remote access to the virtual machines."

Greater flexibility

Duplicating similar systems is as easy as copying and pasting the virtual disk and mounting it to a new virtual system. Additional virtual instances can be created easily if there is a need, such as a dedicated system for fish biologists to remotely access data.

Enhanced support for legacy systems, such as a Windows XP virtual environment, can be loaded onto any virtual host. Virtualization also allows for licensing flexibility, as software keys can be used to activate software and moved between systems as needed.

Learning curve

Implementation does not come without some upfront cost. Virtualization is new to many industrial automation and controls engineers, which means a learning curve for implementation and maintenance. New hires need to have an additional knowledge base beyond traditional systems or be trained.

"Virtualization can be intimidating," Ferrin admitted, "but it isn't as hard as automation engineers initially perceive. They can think of it as a learning opportunity. As virtualization continues to grow in our industry, their knowledge and experience increases their professional value."

Lastly, the cost of initial setup can be higher than traditional systems as a virtual environment requires a more robust server setup. However, according to Ferrin, the long-term decrease in costs and risks far outweighs the initial setup investment.

Moving Forward with Virtualization

To make the business case for virtualization, Ferrin and his team reviewed the costs and benefits with Tacoma Power management. The justification was clear, as the team proved a small upfront investment with savings in the long run through speed, uptime and significant risk reduction.

With approval and support to proceed, Tacoma Power added virtualization to its regular budget for system life-cycle replacement, tapped an IT consultant for some expert advice, and planned their deployment process.

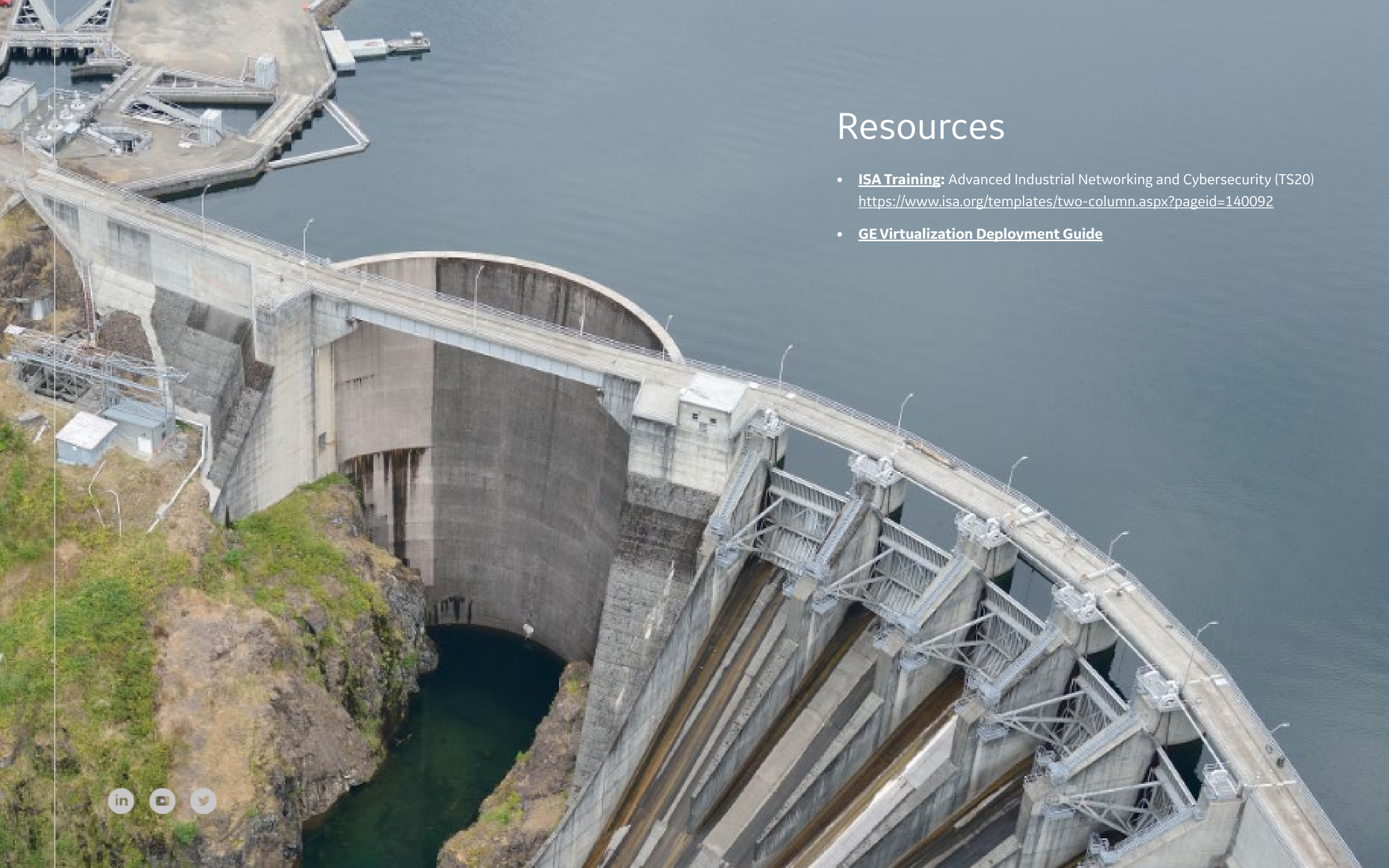
As shown in figure 1, the team implemented the virtualization environment in a phased approach. Tacoma Power started in their development environment – creating a new virtual machine, able to be viewed on two screens with visibility on a terminal. In phase two, the team installed GE's iFIX with soft licensing in the virtual environment. Phase three involved pilot deployment at the first generating plant. The team incorporated the virtual deployment into the plant's regular hardware/software upgrade schedule, which eliminated any possibility of extra disruption, downtime or cost.

"With the success of the pilot, we refined our best practices and developed Standard Operating Procedures for deployment," Ferrin said. "Today, we're continuing to deploy virtualization across all of our plants as part of the regular hardware/software upgrade schedules."

Leading the power industry with virtualization, Ferrin expects to complete migration of all power generation automation systems within five years. With the current implementations under their belt, the team has seen greater reliability, for example, from no fan or power supply failures. If for some reason a thin client were to fail, Tacoma Power would not lose any data. Additionally, the team has been able to combine other applications into the virtual system for use by other peer groups.

"Virtualization is achievable and worth the effort," Ferrin concluded. "Automation and controls engineers should learn, explore and network with experienced technology professionals for experienced information. With the right expertise, you can overcome any challenges with virtualization, decrease long-term costs, and reduce risks. At this point, I can't imagine not having our HMI/SCADA in a virtual environment."

figure 1



Resources

- **ISA Training:** Advanced Industrial Networking and Cybersecurity (TS20) https://www.isa.org/templates/two-column.aspx?pageid=140092
- **GE Virtualization Deployment Guide**

About GE

GE (NYSE: GE) is the world's Digital Industrial Company, transforming industry with software-defined machines and solutions that are connected, responsive and predictive. GE is organized around a global exchange of knowledge, the "GE Store," through which each business shares and accesses the same technology, markets, structure and intellect. Each invention further fuels innovation and application across our industrial sectors. With people, services, technology and scale, GE delivers better outcomes for customers by speaking the language of industry.

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