Thought leadership
White paper

Turnkey Solutions for Grid Modernization

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Powering Business Worldwide

I. How the need to automate is driving utility modernization

Current utility infrastructure is rapidly aging and becoming increasingly more susceptible to extreme weather events, increased reliability needs, and cybersecurity threats. As we move from this aging un-automated grid to an effective and modern digitized grid, utilities are proactively focusing on how to implement and manage the adoption of rapidly changing technology over a vast number of substations.

Compounding these issues, utilities are also faced with a changing workforce. According to a Department of Energy report, changing demands are driving workforce challenges that include large shifts in the skills needs, a skills gap for deploying and using new technologies, as well as broad challenges in recruiting and high levels of workforce retirement.

It is clear that data and analytics hold the power to transform aging utility infrastructure and lay the groundwork for the Smart Grid of tomorrow, but when faced with so many challenges, how can utilities leverage this new intelligence to drive efficiency, reliability and productivity?

A host of modernization technologies are readily available today that target advanced grid intelligence to yield a more resilient and secure grid. These strategies include the implementation of advanced remote terminal units (RTU), modernization of communication systems upgrades. This paper will explore how completing these types of modernization projects can help utilities access real-time data and analytics needed to support a smarter grid. This paper will also explore how infrastructure upgrades can be completed by experienced engineering teams with EPC management services that not only help minimize impact on operations, but also lessen the demands placed on staff and budgets.

II. The challenge of modernizing RTU systems

Some legacy RTU designs are now themselves over 20 years old, with limited hardware capabilities and software that is no longer supported. Most stations have outdated drawings, communication equipment, relays, and meters. Legacy RTUs offer no secure authentication or secure remote connections that meet NERC/CIP requirements, which can leave substations vulnerable from a cybersecurity perspective.

Fundamentally, legacy RTU systems often rely on physical and labor-intensive monitoring that can adversely impact grid reliability and efficiency. Without newer communication protocols, it becomes increasingly difficult to support the automation and Smart Grid capabilities of the future.

Other limitations of legacy RTUs upgrade projects include a lack of engineers who understand both old devices and new technology to implement a seamless project, training of field personnel, and the ability to add multiple devices (spanning different brands, different vintages, and different technologies). In addition, these devices may be obsolete or discontinued by the original manufacturer.

III. Value of a complete Turnkey system replacement

Utility replacement of their legacy system will have profound impact to engineering and operations resources. A turnkey solution delivers best-of-class computational and communication capabilities that fulfill a range of substation automation projects. These upgrades can be made both cost-effectively and with minimum service interruption.

By outsourcing the project, utilities are able to take advantage of:

1. Project and technology expertise from its EPC partner to complete research and provide the best solution
2. Project management to minimize impact on day-to-day operations
3. Scalability to complete multiple projects simultaneously
4. Minimal impact on workforce for project execution
5. Management of cash flow and control of cost overrun for the replacement program

Successful projects, whether managed by external service organizations or internal departments, should include input from broad utility teams to ensure the project ultimately builds an adaptable infrastructure that is managed internally. Key stakeholders in these projects typically include substation design, engineering standards, protection and control transmission group, and IT and other teams depending on the utility. While these participants may have unique needs, they all need to be part of the modernization upgrade conversation. The first and the most important step is listening to and gathering these inputs and perspectives to define specification including short and long-term requirements. All activities including project management, coordination, design, installation and commissioning are managed to this specification to ensure success.

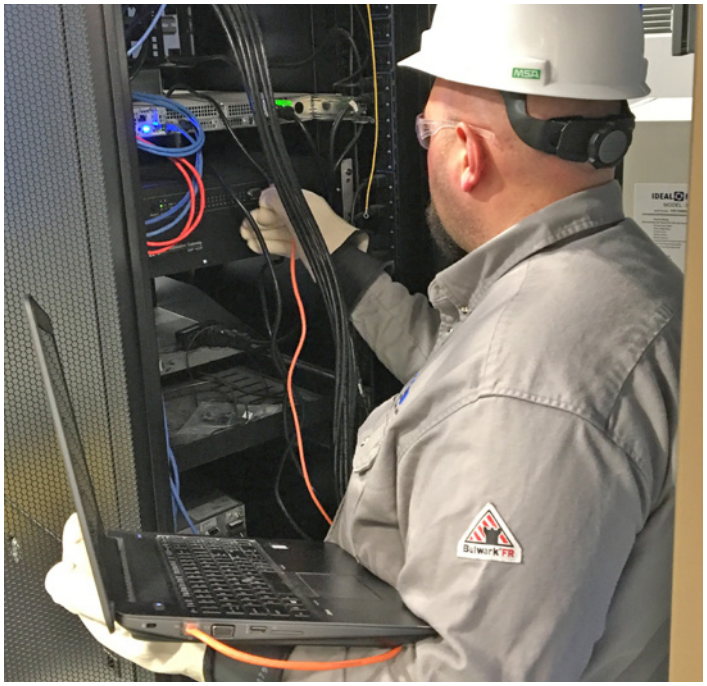

Figure 1. Seek an EPC project partner capable of the full range of responsibilities to best account for the scope of work, assist with sourcing new products and provide long-term benefits.

IV. Modernization Replacement Services: Best Practices

Utilities should seek an EPC project partner capable of the full range of responsibilities to best account for the scope of work, assist with sourcing new products and provide long-term benefits.

The services should be available independent of products and be offered in their entirety or as needed. Specific services should include: equipment assessment, project planning, design and deployment.

The EPC process enables customized solutions for each customer. EPC partner services may include:

1. **Complete project management & accountability**

   From conception to completion: Consistent overview and monitoring progress ensure an on schedule and on budget project completion.

2. **Project coordination and communication**

   Proper coordination of information between all stakeholders assures the needs of stakeholders are met, on time delivery and reduces change orders.

3. **Field visits**

   Early field assessment set the stage for proper design needs, correct layout and cost control.

4. **Current drawing validation**

   Ensures current documentation matches existing field installation and updates as necessary. This is a critical step to establish proper design and minimizes field installation time and error during commissioning

5. **Design and updates**

   Vendor creation of all schematics, layouts, wiring diagrams, installation drawings, configuration files for RTUs and protective relays, and more.

6. **Vendor management**

   One company cannot commonly offer a true turnkey offering for a utility's upgrade project. The EPC approach helps fill these gaps by facilitating equipment procurement across multiple manufacturers.

7. **Quality assurance**

   Assistance completing the QA/QC process, delivery and installation, certification testing, and codes and safety requirements such as NEC, NFPA, and OSHA.

8. **Documentation**

   At the close of the project, EPC should issue site-specific "as built" drawings, operation & maintenance manuals, RTU and relay setting files, test results, warranty certificates to assure compliance with local utility standards and proper hand-off to the operation team.

9. **Review of key learnings**

   An EPC project collaborator will close the project with a review of what was learned - making sure equipment fits, resolving the outdated existing drawing issues and incorporating learnings into the future process.

The EPC process provides streamlined project management to navigate all the noted issues and ensures all system requirements are met, alleviating many complexities individual utilities face.

V. Comparison of outsourcing vs. in-house for each segment of project

When undertaking a legacy modernization replacement project, many utilities feel they have to wear multiple hats. However, by sourcing a proven project collaborator with EPC project management capabilities, utilities can meet any challenge that spans design engineering, project management and other areas.

EPC solutions for grid modernization afford a number of core values. Not only do they reduce project complexity, but they also streamline vendor management – saving utilities valuable time, money and resources that can be channeled back into focusing on providing their core services or addressing other pressing needs.

By bringing EPC on instead of hiring one full-time employee, utilities can assure full benefits are integrated into the workforce without the

burden of the hiring process, overhead or transitioning of employee responsibilities. EPC also provide broader awareness, expertise and bandwidth, which can be a vital support to the CEO and leadership.

For example, rather than adding ten engineers for a short-term project, utilities can simply hire a EPC as a consultant to manage the project. The EPC assures that a high volume of work is completed in a short amount of time, while employee schedules are fully maintained.

Another core benefit is time savings – many utilities simply don't have the resources or the expertise available internally to complete multiple modernization projects. They feel it would take a long amount of time to do the research needed and coordinate the vendors required. However, experts complete these tasks regularly, and can therefore work through the specific project efforts much more quickly.

Table 1. Advantages of outsourcing

Phase	Phase Goal	Advantages
Assessment	Document current state of substation and project scope	• Time savings of field engineering for document review and field assessment • Cost control • On time delivery
Project Planning	Finalize project costs, schedule, plans, and stakeholder review	• Procurement single contact for materials and services vs contacting multiple vendors • Project coordination between stakeholders (engineering, procurement, operations, maintenance, planning) completed • Direct relationships develop when working on multiple substations
Design	Engineering designs, procurement, configurations, system studies	• Knowledge of latest technology and familiarity with all vendors • Customer approval on all drawings – maintain design authority • Pre-testing of configuration files prior to field installation for troubleshooting (decrease outage time)
Project Execution	All equipment installation & commissioning	• Single point of contact for all installation & commissioning (one vendor managing any subcontractors) • Completed per utility standards – both technical and safety
Close-Out	Test reports and documentation	• As built drawings per utility requirements • In service settings file for future reference or updates
Overall Approach		• Initial project requires time for training on requirements and internal introductions Subsequent projects do not require any additional training • Outsourced resources are scalable for multiple projects being completed in parallel, not resource constrained • Cost is from capex budget = included in rate case

VI. Case Study

The outsourcing concept discussed in this paper was utilized by an electric utility modernizing its electric grid through communications and SCADA system upgrades.

The electric utility's substations relied on outdated analog communications and monitoring equipment for substation communication and controls. The utility embarked on a project to update its communication infrastructure including remote terminal units and telecom racks. These modernization efforts would enhance power reliability and real-time response to events.

The first step in the project was the site walk through and definition of the project scope with all appropriate utility teams. During the site visit, existing substation drawings were compared against field equipment and on-site drawings. In addition, site measurements were taken to ascertain space availability. The EPC partner then provided a detailed project scope document and proposal – including outage schedule, equipment bill of material, design requirements, installation and commissioning.

Throughout the process, it was imperative to work closely with the key stakeholders at the utility to ensure approval of drawings per customer codes and standards. RTU and relay programming was performed per master SCADA standards. Involving all key stakeholders early on and throughout the project allowed cost control, in addition to outage and on-time delivery of the project. The project also utilized several experienced subcontractors, which were overseen by EPC. This is a benefit to the utility project team as there was a single point of contact and smooth project management of all aspects of the project, even with multiple sites being completed in parallel. EPC was able to scale up to meet projects resource requirement in order to complete multiple projects simultaneously, which allowed critical project timeframes to be met.

VII. Conclusion

The primary focus for utilities is always operational availability with success measured in service continuity and customer satisfaction. For these reasons, some utilities postpone or extend modernization project schedules due to concern that an outage would cause diversion of resources from operations to the capital project. With a full service partner, this concern can be contained.

Leveraging a modernization and EPC services provider can bring experienced personnel to the field to significantly simplify a variety of undertakings, such as managing a reconditioning or modernization project from start to finish. By removing the burden of project management services from the utility, these turnkey providers offer a single point of accountability with the expertise to minimize the risk of project delays and failures. Additionally, by bringing one contract vendor on instead of hiring one full-time employee, utilities can assure full benefits are integrated into the workforce without the burden of hiring or training. The result is a safer, more reliable and cost-efficient project delivery.

When searching for a project partner, aspects to look for include: the ability to provide centralized coordinated management of all procurement, installation, startup and commissioning of the products and systems required to implement RTU replacement/modernization. Whether the project includes single or multiple sites, vendors should also offer the capabilities and the expertise to function as a single-source service provider – allowing utilities to focus on providing the core services their business depends on.

To learn more about EPC project management services, visit www.eaton.com/service

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