

WHITE PAPER / **IMPROVING HYDROELECTRIC PROJECTS**

# CREATING OPERATIONAL EFFICIENCIES WITH PROACTIVE PROJECT CONTROLS

BY **Christopher Gross, PE**

Today's developers of hydroelectric power plants have the potential to create operational efficiencies during construction that earlier generations could scarcely imagine. Proactive project controls systems that address management of documents, risks, costs, schedule and changes are central to their success.



Historically, large hydroelectric power plant projects got off to a slow start.

Projects typically began with planners and engineers working in isolation to design the project and produce the documents needed for construction contracting. Often there were disconnects in the level of engineering and procurement details released during the bid phase of subcontractor work packages. Project data was largely not accessible to anyone other than those developing it.

As a result, submitted estimates, proposals and schedules often required significant rework once a subcontractor was awarded a scope of work. Delays were common as the subcontractor execution team was onboarded. Even then, construction teams had limited time — often only days — to plan fieldwork. Opportunities to ask questions, identify risks and provide cost-saving alternatives were limited.

Thanks to the insights gained through advanced project management systems and early collaborative planning, the days of slow project starts are over. Advanced project management and project control systems help to simplify the development of hydroelectric projects. When coupled with the early integration of construction with design, engineering and procurement resources to discuss overall scope and planning, they unlock the potential to affect project efficiency, safety and success.

## DOCUMENT CONTROL

Over the course of a major hydroelectric project, thousands of documents are generated, many of which are shared multiple times among many parties. The more contact points a document has, the greater the chance that someone eventually responds to the wrong version.

That is why hydroelectric projects need well-defined policies and procedures in place for document control. Electronic mechanisms for document handling and version management are especially critical if drawings are to be checked out to more than one party at a time.

This process begins during early planning, when the engineering team is defining the project's document tracking and reporting requirements and then tailoring



the project controls system to meet them. Systems are typically designed or adapted to pull all project documentation into a central repository accessible to all authorized parties. To avoid surprises and set clear expectations, each party involved in the project should be trained in and agree to document control policies and procedures from the outset.

## ADVANCED WORK PACKAGING

Work packaging today involves much more than carving out work assignments and establishing a process for project execution.

Advanced work packaging (AWP) makes it possible to dissect an overall project scope and then integrate it into engineering and procurement work packages that prioritize design, procurement, construction and commissioning. Construction and installation work packages are automatically populated with the drawings and materials as they are completed.

AWP then goes a step further. With 5D technologies, which link 3D models with schedule constraints and cost-related information, teams can visualize construction and receive real-time feedback on the physical and functional aspects of the design. Area conflicts are flagged, as are disconnects with materials and equipment. 5D technologies also give teams the opportunity to identify atypical work conditions — such as elevated construction or congested workspaces — that require additional preparation.

The ability to address these conflicts before entering the field can reduce the hours spent working on the construction site. With fewer hours in the field, there is less risk to the workforce. Datacentric execution and virtual project delivery capabilities also make it possible to enhance safety, improve efficiency and reduce costs by:

- **Engineering out hazards.** An effective AWP planning process identifies potential hazards early on so procedures can be designed to address safety issues and teams can be prepared before construction begins. Addressing risk directly in the plan removes undue burden later at the craft supervision level, where big-picture visibility may be lacking.
- **Improving schedule insight.** The use of 3D modeling produces granular AWP components and packages that provide contractors access to a wealth of information on what will be installed, where it will go and how it fits in the schedule. Sharing AWP metadata of designs, drawings and fabrication requirements improves clarity on installation requirements and assignments, which leads to greater worker efficiency.
- **Integrating field knowledge.** Early construction team engagement allows projects to tap into field knowledge from the outset and avert unnecessary implementation challenges. Taking an early deep dive into raceway routing, for example, helps identify appropriate routing structures and support placements. These details can be broken down into smaller work areas in the AWP process for all teams to understand and implement.
- **Streamlining purchasing.** Using the AWP process, construction teams gain access to material schedules and upcoming installation work packets, enabling them to organize work assignments while awaiting deliveries and to be prepared when equipment arrives.

## CHANGE MANAGEMENT

Changes are inevitable during the life cycle of a hydroelectric project. Because even minor changes can have a ripple effect throughout a project, an effective project control system includes tools for managing change. A change in mechanical design could, among other things, impact the mounting location for a junction

box, which could impact the cabling and raceway to the junction box. Identifying changes sooner minimizes the impact to the other engineering disciplines.

Effective project control systems allow project stakeholders to understand program changes as they occur. They are designed to provide visibility and disseminate accurate information, providing stakeholders the data needed to assess alternatives and make evidence-based decisions, starting in the contract phase and continuing through project closeout.

Executed properly, a change management system can streamline changes to scope, design and drawings. It can also minimize friction between team members seeking to determine who is responsible for the change and any added costs it might impose.

## RISK MANAGEMENT

Proactive risk management efforts can mitigate hazards and other threats to a project's successful and timely completion. Managing risk on a major hydroelectric project, however, requires more than building contingency funds into the project budget. And even that should be verified using risk analysis. With a proactive approach, stakeholders can foresee potential threats and make course corrections early to control any impact to cost or time frame.



During project execution, it is necessary to maintain a risk register, where risks are identified and documented, along with the actions taken to respond to and manage them. Because risks are constantly changing — with some risks developing into full-blown problems and others receding while new risks emerge — keeping the register up to date is critical. More than simply tracking risks, the register should be designed to apply data collected from various sources and facilitate communication across project teams. Risks increase when communication fails or data cannot be verified.

### SCHEDULE MANAGEMENT

Delivering expected project outcomes on time requires a detailed project schedule that maps all activities according to an agreed-upon contracting strategy. A supporting work breakdown structure tracks project scope details to monitor and provide alerts on tasks performed by all companies. With schedule management software and dashboards, no task is overlooked, and everyone involved understands where and when to take action.

Coordination of this kind minimizes rework and wasted days. Tying every piece of the project to a project management tool that disseminates schedule and other pertinent information to field crews in real time facilitates project progress.

### COST MANAGEMENT

Hydro projects of all sizes require rules of credit to be identified upfront so that project controls can help track cost and schedule performance accurately. Judging scope management performance by the quantity of change orders is not a preferred method for these contracts. Instead, costs should be carefully monitored and changes identified and managed well before they cause issues.

For larger projects, owners should expect robust cost forecasting as part of project controls. Disciplined monthly cost forecasting, when implemented, provides the insight and supports the confidence needed to present project updates to stakeholders.

Technology also can play a role in cost management, as project management tools are making the collection and management of data more effective. Efficient data gathering and sharing, and transparency into that project data, improves collaboration and saves costs.

### CONCLUSION

Developing a hydroelectric project involves managing risk. Developers who implement advanced project controls can play a major role in preempting or mitigating many of these risks. The real-time communication benefits offered by advanced project controls create additional opportunities for operational efficiencies when developers partner with engineer-procure-construct (EPC) firms experienced in hydroelectric power design and that offer the dedicated resources needed to streamline project execution.

Early engagement makes it possible for the design and construction team to better understand project challenges and the decision process used to reach the solutions they are called upon to implement. Integrating technology and platforms across disciplines makes it easier to adapt work packages as circumstances change, all without hindering project progress or team coordination. Together, early team engagement and project controls help projects begin — and remain — on the fast track to success.

### BIOGRAPHY

**CHRISTOPHER GROSS, PE**, is a senior electrical engineer at Burns & McDonnell. With more than 15 years of experience, he has provided engineering project management and electrical engineering design support for control and relay system upgrades and power plant improvement projects for multiple investor-owned, municipal and cooperative utilities. He earned bachelor's degrees in both electrical and computer engineering.

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