Project of the Year Submissions

Date Received 11/30/2021

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Score: _____

Title: **Yards Creek Generating Station**

Company / Owner: First Energy (Initial Owner)
1720 Metropolitan Street,
Pittsburgh, PA 15233

Category

☐ Commercial	☐ Education	☑ Energy	☑ Environment
☐ Industrial	☐ Innovation	☐ Medical	☐ Modernization
☐ Sustainable	☐ Transportation	☐ Water / Wastewater	Other:

Lead Agents

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Technical Affiliation:

mascaro
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Yards Creek Generating Station

Pumped Storage Generating Station Reservoir Repair

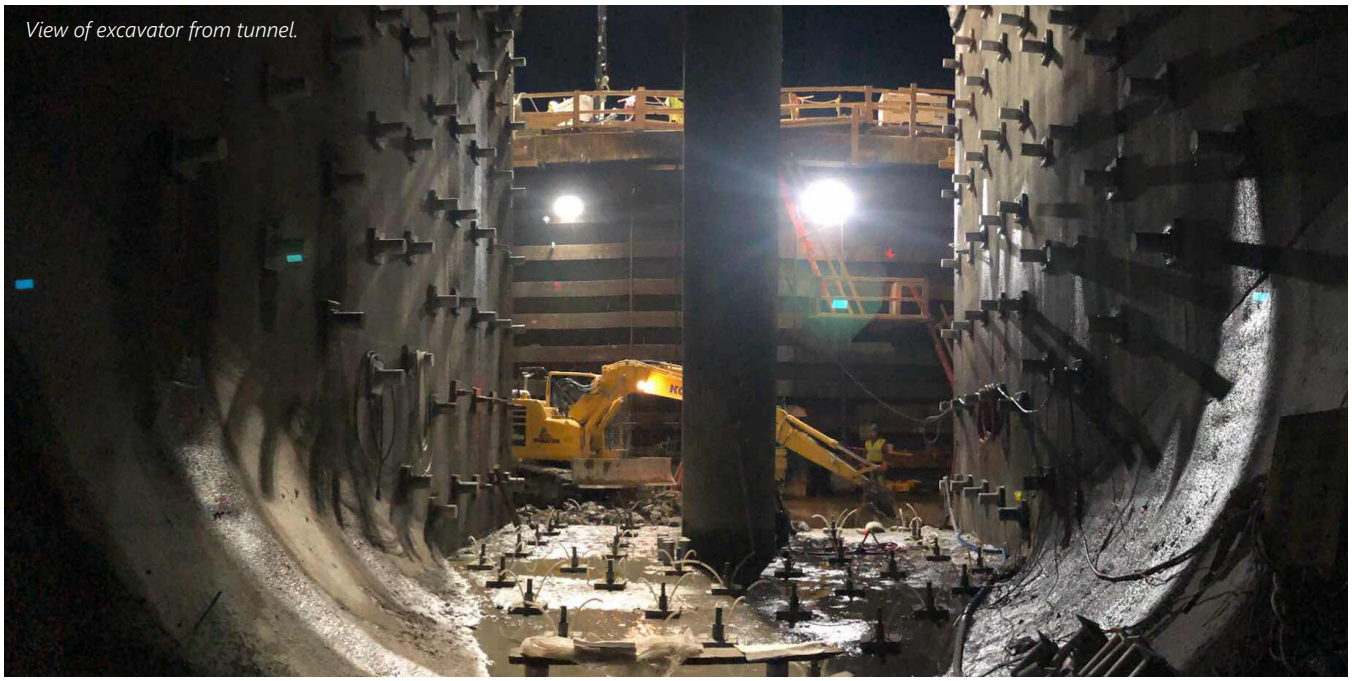
The Yards Creek Generation Station, a pump storage hydro facility, is in Hardwick Township, Warren County, NJ – the Delaware Water Gap region of the New Jersey Skylands. The facility consists of two reservoirs created by earth-fill embankment dams. The upper and lower reservoirs are separated by an elevation of 700 feet. Water is conveyed between the plant and the upper reservoir via an 1,800-foot-long, 18-foot diameter steel pipe. At full capacity, the plant releases approximately 5 million gallons of water per minute at a velocity of 24 miles per hour.

Commercial operation of the facility began in 1965 with upgrades made in the 1990s. A study was conducted relating to the safety features of the plant. It was determined that safety integrity had to be increased in the event of a catastrophic failure. Mascaro was selected as the general contractor to install the upper reservoir emergency shutoff gate for the power generating station. Work involved construction of a new separate structure in front of the intake. The structure features two 66,000-pound gates that operate remotely with controls and supervisory control systems to operate the gates. When the detection system within the penstock senses leakage, the gates would be activated and would shut within a few minutes to prevent catastrophic flooding downstream.

A crane was used to hoist an excavator into the intake to perform the demolition of the sidewalls.

The project construction was performed in stages during three outages: 2018 Outage – 129 Days, 2019 Outage – 93 Days, 2020 Outage 36 Days. Work was performed on a two-shift schedule six to seven days per week.

- The first phase of work included the installation of temporary cofferdams, a temporary bypass pump, slope mesh to protect workers from rocks falling off the walls, rock anchors, and wheel gate embedded plates. The team demolished the center pier, intake sidewall and slab, and the concrete trash rack beams. The existing tunnel was reinforced with 1.5-inch rock anchors so that in the event of a pipe failure downstream, coupled with the rapid shutoff of the gates, the tunnel would not experience structural or catastrophic damage. All the demolition was located at the bottom of the intake, 120 feet straight down. This involved major use of crane operations. A crane was used to hoist an excavator into the intake to perform the demolition of the sidewalls. The center wall was removed using an engineered wire saw cut and lift plan. Over 30,000-pounds of concrete were removed from the pit during the select saw cutting process. Work also included the control building and duct bank to the gauge house.
- Phase 2 consisted of the reinstallation of the rock slope protection, temporary trash rack removal, concrete shaft construction, concrete roof construction, bulkhead guide frame installation, and final removal of the temporary cofferdam.
- The third phase involved the installation of the wheel gate frames, wheel gate upper guides, wheel gates, and hoist as well as the supply, installation, and integration of a new supervisory control system to operate the gates.



View of excavator from tunnel.

Project Challenges: *The project was unique from the onset.*

- The upper reservoir, a man-made lake on top of the hill, has a channel that funnels the water into the intake. Construction of the gate took place within this channel. A temporary coffer dam and bypass pumping system was installed to work in the channel. The pumping system had two high-volume pumps that could pump 5,000 gallons per minute. Safety was a critical factor on this project. A pop-up thunderstorm could leave workers in two feet of water instantly. Special safety measures were put in place to protect everyone from the start. *(Please refer to the Special Safety Measures of the submission.)*
- The intake structure area of the project was an 81-foot by 76-foot footprint. The new intake structure was 107 feet tall with 95 feet of the new structure below grade. To enter the site, you walked out a 20-foot scaffold plank to reach the 120-foot-tall stair tower.
- Crane operation was critical to the success of this project. Crane operations were restricted at 20mph wind speeds and halted at 30mph wind speeds. The top of the intake dam was at the treeline elevation and positioned the boom of the crane well above the treeline in the area. There were periods where work would be halted for two to three days at a time. The ridgeline where the site is located is the first ridge of substantial elevation inland from the Atlantic Ocean. All weather systems moving west from the Atlantic Ocean including late season hurricane related weather and Nor-Easter Snow had a major impact.
- There was no cell phone service or internet connection. The satellite connection was spotty at best. A satellite phone was utilized in case of emergencies and was tested once a month with the guard shack.
- The entire area was inhabited by endangered timber rattle snakes and an endangered species of turtle. The State of New Jersey required the project to have a full-time herpetologist (someone who specialized in the study of reptiles and amphibians) on site who inspected the job site prior to workers' arrival, as well as to monitor snakes and turtles and relocate them when necessary. Most snakes were along the access road, except for several that were found on the site, including one that startled workers after being found beneath a temporary toilet. The snakes were about five feet long and two to three inches in diameter.
- Entry to the site involved a steep, two-mile access road. Due to the snake population, every load of concrete, every truck, everything that entered or exited the site, had to be escorted by the herpetologist. It was a slow process; special care had to be taken not to run over the snakes. Through the three-year period, there was only one reportable event made to the New Jersey Department of Envi-

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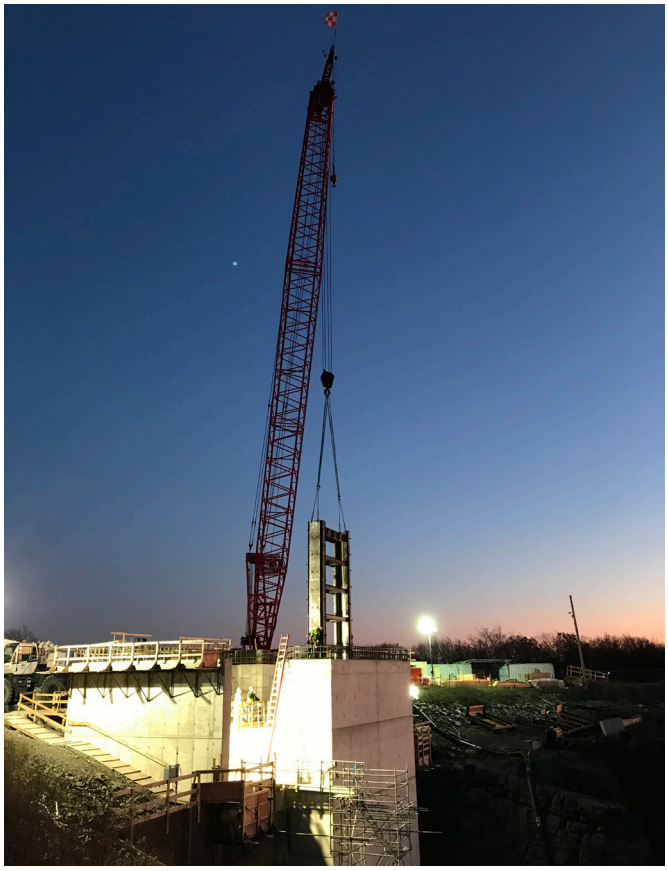

Crane operation was critical to the success of this project.

The project involved several mass concrete placements.

Detailed and custom-built formwork was supplied by Job Site Supply.

ronmental Protection where a snake was run over while hiding out under the tire of a parked truck.

- The project involved several mass concrete placements. This involved finding not only a concrete plant that could support large placements, but also one that was nearby to ensure the material would arrive quickly. The challenge was to get the concrete there in a timely fashion and get it to the top of the mountain via the tedious escort process.
- Merco (rock/tunneling contractor) designed and built some equipment specifically for the project to enable the installation of horizontal and vertical rock anchors to reinforce the interior of the existing structure. A drill head and bracket were redesigned to be mounted on the forks of a forklift so that it could be rotated 360 degrees and locked into place at the desired position and angle for the placement of the rock anchors.
- Job Site Supply (formwork supplier) detailed and custom-built the formwork for the aggressive schedule. Knowing wind would restrict the use of the crane, the custom formwork allowed us to take advantage of the quick setting of the forms when the winds would die down, even for an hour, so we could then set the next lift of formwork – affording us with a productive day.
- During the third year, 36-day outage, there were 15 critical lifts – each lift over 30,000 pounds in a one-month period – each requiring its own special safety plan and review. Each lift involved a detailed process requiring weights and drawings, and stand-down meetings with the team which took about half a shift. In total approximately 474,000 lbs of new equipment was installed.

Special Safety Measures:

- There was an intense 2-1/2-hour project orientation for everyone before the project started to ensure that all were trained appropriately. This included confined space training for those that would enter the intake structure.
- Mascaro was required to meet First Energy's safety requirements. A JSSP (Job Site Specific Safety Plan) was required for each major task prior to initiation and completion. This involved a very detailed plan and a meeting to review each task with First Energy Safety and the Plant Manager. The JSSPs were performed in addition to Mascaro's required daily JSAs (Job Safety Analysis). Weekly team meetings were held to discuss the scope and required JSSPs. A running list of JSSPs were in place and if more were needed, they would be added to the list. Each subcontractor had to submit their own safety plan for each task.

Slope mesh was installed to protect workers from falling rocks.

Installation of south wheel gate frame

- Due to working in a confined space, there was a site-specific emergency action plan developed and instituted. This included addressing the control and monitoring of water levels upstream of the work area, monitoring weather and rain, monitoring water coming through the temporary coffer dam protection, and the use of by-pass pumps to ensure there was no risk of overcoming the coffer dam and flooding the work area. A temporary fence was installed across the 18-foot diameter tunnel to protect any workers, debris, or tools from getting washed down the tunnel in the event of a flood. This plan included different phases based on water levels, equipment/protection status, and forecasts to make sure none of the workers would be in danger.
- Atmospheric monitoring was done throughout the entire project. Proper ventilation had to be maintained due to workers working in the confined space while operating diesel-powered equipment. Extensive precautions were also taken to prevent diesel spillage on site.
- For the first year, Mascaro was required to have a rescue team on site during installation of the temporary cofferdam. There were two third-party rescuers on site.

Commercial Success:

The complexity of the project required a lot of detailed planning that went into the demolition portion of the project that first year. The second year, a lot of time was spent planning for better access plans, and multiple form work and reinforcing scenarios were reviewed. Mascaro determined that the best forming system was with Job Site Supply, who redesigned custom formwork for this project so the team could move quickly. This enabled the team to come up with a new design to access and form the roof using planks and adding a temporary structural beam. Mascaro installed the roof in the second year (a cast-in-place slab) that was not expected to happen, so it was an overall success. Mascaro continues a great relationship with First Energy and look forward to working with them in the future.

Benefit to Society:

Installation of the emergency shut off gate provided the plant with a way to isolate the upper reservoir that holds about 1.5 billion gallons of water from its penstock. The emergency shut-off gate provides a safety net in the event of a catastrophic event that alleviates the flooding of the lower portion of the plant site and the residential neighborhood downstream of the plant.

Project Statistics

- Supplied and erected two temporary steel cofferdams 23 feet wide and 30 feet tall with bypass piping.
- Installation of channel dewatering system capable of around 5,000 gallons per minute.
- Demolition of 310 cubic yards of structural concrete 95 feet below grade.
- Structural excavation – 1,650 cubic yards.
- Rock anchors – 164 total, installed in the penstock tunnel. Average length of 15.5 feet, 108 horizontal, 20 overhead, 36 in the intake floor. Required custom fabricated drilling equipment to access anchors in the ceiling and horizontal anchors high above the intake floor.
- Structural concrete – 2,530 cubic yards. 30 placements classified as mass concrete and required temperature monitoring. Over 110 IntelliRock sensors were installed and monitored throughout the project.
- Custom fabricated formwork was supplied to form the entire core of the structure at one time.
- Design and installation of formwork and associated temporary supports to construct 3,100 square feet of structural slab 105 feet above the intake floor.
- Concrete Reinforcing – 238 tons.
- Furnished and erected structural steel catwalks, platforms, stairs, and handrails.
- Installation of 200,000 pounds of embedded guide frames at a ± 0.05 in tolerance.
- Supply and installation of new supervisory control systems and precast control building for remote operation of wheel gates integrated with a new penstock leak detection system.
- Installation of two 66,000-pound wheel gates that are lifted by two 37,500 lb hoist assemblies, 12 feet wide by 30 feet tall.
- Total weight of critical lift equipment installed 474,000 pounds.
- 15 critical lifts over 30,000 pounds in a one-month period.
- The project experienced one first aid incident and no recordable injuries with 68,000 manhours.

Project Subcontractors:

Merco – Rock anchor subcontractor
Hatzel & Buehler – Electrical subcontractor
Elcon Technologies – Supervisory control supplier
North Jersey Rebar – Rebar installer
Allegheny Diamond – Saw cutting Subcontractor
Tunstall Engineering – Structural engineer for project specific plans (demolition, lifting, formwork)

Completed photos of the Yards Creek Generating Station Pumped Storage Generating Station Reservoir Repair(above and below)

Below is a link to our webpage of the project. If you scroll down the video is mid-way down the page
https://www.mascaroconstruction.com/projects/heavy-industrial/power/power-generating-station-hydro-electric-plant