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Zebra Mussel Research Technical Notes

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Development of a Zebra Mussel Control Strategy for the Cheatham Power Plant

Background Personnel of the U.S. Army Engineer District, Nashville, developed a strategy for controlling zebra mussels at their power stations. Two aspects were central to the development of this strategy: keeping the facilities operational regardless of the zebra mussels, and implementing environmentally sound strategies that would meet the goals of the National Environmental Policy Act (NEPA).

Purpose The purpose of this technical note is to describe the removable screens and support frames that were installed at Cheatham Lock by Nashville District personnel.

Additional information This technical note was written by Mr. Tony Bivens, Nashville District, and Mr. Tony Dardeau, U.S. Army Engineer Waterways Experiment Station (WES). For more information, contact Mr. Bivens, (615) 736-5868. Dr. Ed A. Theriot, WES, (601) 634-2678, is Manager of the Zebra Mussel Research Program.

Strategy for zebra mussel control The Cheatham Project was the sixth of nine projects with hydropower that were built for the Nashville District. The project was completed in 1960 for the purposes of navigation and hydropower. The plant is of low head design with three 20,000-hp vertical shaft kaplan (propeller-type) turbines with a design operating head of 22 ft. The generators are three-phase, 60-cycle, 13.8-kV units rated at 13,333 kV℘A and 60 rpm.

As is typical with hydropower generators and turbines of this design, excess heat is removed from turbine bearings, generator bearings, and the generator windings by raw water-cooled heat exchangers. The water for the heat exchangers is drawn from the river, circulated, and returned to the river. Much of the piping for these systems is embedded in concrete and has sharp bends. This dependence on raw river water for cooling critical generator and turbine components makes Cheatham and other hydropower plants particularly vulnerable to the effects of zebra mussel infestations. Left unprotected, the Cheatham hydropower plant could be completely shut down due to fouling of the raw cooling-water piping.

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Recognizing the threat to hydropower plants and other facilities, the Nashville District formed a zebra mussel committee to coordinate and direct the District's overall infestation control program. The major components of the strategy developed by the committee are to

- Analyze water chemistry at all facilities to determine susceptibility to infestations.
- Establish a monitoring and detection system at all facilities to detect the arrival of zebra mussel adults and veligers.
- Identify all facility components at risk, develop appropriate long- and short-term infestation controls, and rank various control options.
- Coordinate and prepare environmental documentation (Environmental Assessments (EAs) and Environmental Impact Statements) and obtain National Pollution Discharge Elimination System (NPDES) permits when necessary.
- Design and implement zebra mussel control methods.

The above plan was followed for the Cheatham project. The water analysis indicated that the water chemistry was ideal for zebra mussel infestation development. In fall 1992, laboratory slides to detect veligers and 6- by 6-in. ceramic substrates to detect adults were suspended in the intake area. Soon afterward, an inventory was made of all project components subject to infestation, and appropriate infestation control methods were developed. Project components subject to infestation were ranked according to their importance to the operation and the expense or difficulty of removing mussels. It was determined that the hydropower plant raw water systems must not be allowed to become infested.

The Nashville District Hydropower Group studied previous experiences with zebra mussel infestations at hydropower facilities, including those of Ontario Hydro, and consulted with scientists at WES and the Tennessee Valley Authority (TVA). They determined that treatment of raw water piping systems with aqueous sodium hypochlorite (10 or 12 percent solution) was the best current treatment method.

In spring 1992, the Nashville District developed a design for chlorine injection systems that would be installed at raw water systems at all hydropower plants in the District. Principal components of the system are a variable rate chemical injection pump that feeds the chlorine into the raw water system at its source; storage tanks designed to hold a 30-day supply of chlorine; an analyzer that measures chlorine concentration in the discharge water, and automatically signals a program logic controller to adjust the chemical feed pump to maintain the desired chlorine concentration; and a control panel containing a strip chart recorder that continuously records chlorine concentration in the discharge water.

In summer 1992, Prominent Fluid Controls, Inc., of Pittsburgh, PA, was contracted to fabricate and install chlorine injection systems for the raw water piping systems for Cheatham and Barkley Power Plants. Installation of the systems has been completed, and final operational tests are being conducted.

Upon detection of veligers at the power plant, the chlorine injection systems will be activated. Initially, the system will be operated to produce a total residual chlorine level at the raw water system discharge point of 0.5 ppm on a continuous basis. However, personnel at Cheatham Power Plant will experiment with different concentration levels and injection intervals to determine a suitable protocol for their plant.

In addition to the technical aspects of zebra mussel infestation control, the environmental aspects must also be considered. At the same time the chlorine injection systems were being designed and installed, an Environmental Assessment was being conducted by personnel of the Nashville District and the TVA for all power generation facilities being operated by both organizations. During the process of conducting the EA it was determined that Cheatham Power Plant would be required to obtain an NPDES permit from the state of Tennessee to operate the chlorine injection systems. The permit applications have been submitted and are now being processed. In the event that an infestation begins prior to the completion of the NPDES permits, it will be necessary to request interim permission from the state of Tennessee to operate the chlorine injection systems.

Cheatham Power Plant, having protected its most vulnerable components, the cooling raw water systems, is now prepared for zebra mussel infestations. However, in addition to the raw water systems, many other components will be affected by zebra mussel infestation. Unlike the raw water systems, however, they are physically accessible for the application of other control methods.

Conclusions

Zebra mussel infestations pose a major threat to all electric power production facilities. Facilities that rely on single-pass raw water cooling systems are particularly at risk. However, with thorough study and planning, electric power production facilities can continue operations unaffected as zebra mussel infestations occur.

Existing technologies can be adapted to provide effective zebra mussel infestation controls. Environmentally sound methods must be developed.

Environmental concerns must be a part of planning for zebra mussel control methods. Federal facilities will have to conduct Environmental Assessments, and those facilities where chlorine or other chemical injection systems will be used must obtain NPDES permits. Facility managers must be aware that the EA study and the NPDES application process should be started as soon as possible.