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Zebra Mussel Research Technical Notes

Section 4 — Miscellaneous Technical Note ZMR-4-05

June 1993

Strategies Employed by the Power Industry to Reduce or Eliminate Problems Caused by Zebra Mussels

Background and purpose

The U.S. Army Engineer Waterways Experiment Station (WES) sponsored a workshop on zebra mussels and the power industry on October 27, 1992, in Jackson, MS. The purpose was to review strategies being employed by the power industry to deal with zebra mussels at their facilities. In addition, the workshop provided an opportunity for those working on zebra mussel control to meet others in the field with similar interests and problems. Abstracts of presentations made at the meeting are presented in this technical note.

Additional information

The abstracts in this technical note were written by Mike Harrington, Jim Knowlton, Jack Mattice, Renata Claudi, and Tony Bivens. Contact the individual authors or Dr. Andrew C. Miller, WES, (601) 634-2141, for additional information. Dr. Ed Theriot, WES, (601) 634-2678, is Manager of the Zebra Mussel Research Program.

Preparing for Zebra Mussels at the River Bend Power Station, Louisiana

Michael A. Harrington, Supervisor, Environmental Services

The original design of River Bend Station's cooling water system provided only for clarification of river water followed by sulfuric acid addition sufficient to prevent scaling and shock chlorination as necessary for normal operations. The turbine condenser cooling water and service water systems shared a common cooling tower system and clarifier make-up system. Approximately 2 years before commercial operation began, River Bend Station modified the chlorination system to provide for continuous low-level chlorination of the service water system to prevent infestation from the Asian clam. This modification included continuous dechlorination of the blowdown, and eventually included dispersants and corrosion inhibitors to mitigate the rapid corrosion proceeding throughout the service water system.

During 1992, in conjunction with a chemical cleaning of the service water system, River Bend Station modified the cooling water system to provide complete isolation of the service water system from contact with the river. In this configuration, service water is made up entirely of high-quality well water with appropriate treatment against corrosion and fouling. However, the river water still cools the condenser as well as the bank of heat exchangers that cool the

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service water system. Therefore, River Bend Station is susceptible to impacts from infestation from zebra mussels.

River Bend Station formed a task group in May 1992 to review available data on mitigation and prevention strategies. Given that River Bend Station already implements dechlorination of the cooling system blowdown to the river, the task group selected continuous low-level injection of sodium hypochlorite and sodium bromide-with-surfactant solutions at the river water intake to protect approximately 3 miles of buried intake water pipeline and to satisfy the oxidant demand of the clarifier make-up water for more efficient water production.

In December 1992 the task group will present to the executive staff three options for providing this chemical injection. Implementation of the selected option is planned for spring 1993.

Thermal Backflushing to Control Zebra Mussels at Steam Stations

E. F. Neuhauser and M. A. Rhode, Niagara Mohawk Power Corporation, Syracuse, NY

J. J. Knowlton (Presenter), R. J. Wahanik, and M. Borden, Gilbert/Commonwealth, Inc., Reading, PA

D. P. Lewis, Aquatic Sciences, Inc., St. Catharines, Ontario, Canada

G. Mackie, Mackie and Associates Water Systems Analysts, Guelph, Ontario, Canada

Other than thermal treatment, the use of various chemical treatments to control zebra mussels (*Dreissena polymorpha*) in both the United States and Canada is well documented and appears to be effective under a number of different protocols. However, concerns over the potential impact of these treatments to receiving water bodies has motivated industry to investigate alternative or complementary control approaches. The control of zebra mussels by thermal treatment is an alternative approach to chemical treatment that could be effective while producing minimal harm to the receiving water body.

To remove the zebra mussel infestation in the circulating water system at Niagara Mohawk Power Corporation's Dunkirk Steam Station, it was proposed to increase the temperature of the intake water used for steam condenser cooling from 55 to 65°F (13 to 18°C) to at least 95°F (35°C). The construction of the circulating water system at the Dunkirk Station is such that, by adjusting some of the gates in the system, it is possible to redirect the main condenser heated discharge water back to the intake structure and to the screenhouses, instead of discharging into the Dunkirk Harbor. This redirecting of the condenser discharge water to the intake structure/screenhouse has resulted, during previous treatments, in an increase in circulating water intake temperatures to at least the anticipated temperatures required to kill zebra mussels. To prevent equipment damage, the maximum intake temperature was limited to approximately 100°F (38°C).

Biological and temperature monitors were placed throughout the circulating water system during the first test. These monitors were used to establish a control base of mussels present at Dunkirk Station prior to thermal treatment and then to monitor mussel activity associated with temperature changes.

This research and development project to control zebra mussels by thermal treatment at Niagara Mohawk Power Corporation's Dunkirk Steam Station yielded results that can be used in several ways. The primary goal of the project was to follow up on the experience gained during previous thermal treatments and to establish a base of information for future use. The main benefits will be in the application of results to other similarly designed power generating stations and in the design of new generating facilities.

EPRI Zebra Mussel Update - October 1992

Jack Mattice, Ecological Studies Program, EPRI, Palo Alto, CA

Activities with respect to fouling or the control of fouling by zebra mussels at electric utilities have involved three Divisions (Environment, Generation and Storage, Nuclear Power) of the Electric Power Research Institute (EPRI). Coordination of efforts is accomplished by an informal Zebra Mussel Task Force that regularly considers the recommendations of a Utility Advisory Group comprising over 25 utility management and technical staff.

Several products are already available: a report (GS-6995) documenting early information about the mussels in the U.S. and European experiences; a video (EA91-03) highlighting information about the mussels in the United States and potential control methods; and a report (TR-100434) documenting papers and discussions at the EPRI- sponsored "Electric Utility Zebra Mussel Control Technology Conference" in Chicago in October 1991. Scheduled to be released in calendar year 1992 are reports that identify the hazards of existing zebra mussel control chemicals (cofunded by three utilities) and document existing information on monitoring and control of the mussels. The Nuclear Power Division has also supported examination of a number of surface-active chemicals for zebra mussel control, but the high cost of testing required to support NPDES permitting has cast doubt on the likelihood that the most promising chemical will be brought to market. EPRI is also investigating whether further documentation of decision processes used at utilities near the invasion locus will be helpful to utilities that have not experienced problematic fouling. Finally, the EPRI Zebra Mussel database allows on-line searches for information about zebra mussels.

Overview of Ontario Hydro's Zebra Mussel Research Program

Renata Claudi, Ontario Hydro, Toronto, Ontario, Canada

Ontario Hydro is the principal supplier of electricity to the Province of Ontario. It serves 3.6 million customers, with an in-service capacity of 28,200 megawatts. Ontario Hydro has seven fossil, five nuclear, and four hydraulic stations in the Great Lakes Basin and surrounding watershed. In addition, there are 60 inland hydraulic stations and numerous dams.

A zebra mussel research program has been implemented at Ontario Hydro in response to the needs of the operating facilities to control the infestation of water systems and fouling of external structures. As the largest single user of raw water from the Great Lakes Basin, Ontario Hydro recognized the need to control zebra mussels early in 1989. At that time, very little was known in North America about the zebra mussel life cycle and potential impact. European utilities were consulted, but as we now know, zebra mussels are not perceived to be a problem in Europe at this time.

To satisfy the immediate need for control, chlorination was identified as the most effective interim measure to prevent the fouling of systems that draw water from the aquatic environment. Because of the current regulatory environment, this solution is considered short term, and Ontario Hydro was compelled to initiate comprehensive research aimed at providing alternative methods of control. Many alternative control measures, both chemical and nonchemical, were considered.

Also considered were the potential effects of the control measures and of zebra mussels on station operations. A multidisciplinary team involving aquatic biologists, chemists, corrosion specialists, and civil and mechanical engineers from the various departments of Ontario Hydro was asked to address the problem. Some of the research also involved collaborative studies with universities, U.S. utilities, the American Water Works Association, and Canadian industries.

By the end of 1993, Ontario Hydro will spend almost $2.5 million toward research on methods of zebra mussel mitigation. This is, in part, prompted by the stance adopted by the provincial environmental regulatory agency (the Ministry of the Environment) on the use of chlorine.

The Ministry has issued Ontario Hydro facilities a permit to chlorinate service water streams during the zebra mussel breeding season to prevent settlement. One of the conditions of this permit is that Ontario Hydro will explore other, potentially more environmentally acceptable mitigation strategies. Since 1990, many mitigation options have been examined.

Nashville District's Zebra Mussel Infestation Control Program

Tony H. Bivens, U.S. Army Engineer District, Nashville, Nashville, TN

The U.S. Army Corps of Engineers owns and operates 75 hydroelectric power plants in the United States. Virtually all of these are subject to zebra mussel infestation. The Nashville District manages nine of the Corps' hydropower plants located on the Cumberland River and its tributaries. The Nashville District will be the first Corps District to experience zebra mussel infestation of Corps-owned hydropower projects.

The Nashville District has developed a Zebra Mussel Infestation Control Program. The program consists of an overall control strategy, a monitoring program, an inventory of all project components subject to infestation (along with evaluation of the effects and applicable control methods), and an action plan for the implementation of controls.

The first priority under the Nashville District Infestation Control Program is the protection of those project components which, if infested, would result in the shutdown of a hydropower plant or the closure of a navigation lock. The power plant raw water systems fall squarely in this category.

The Nashville District has chosen chlorine injection as the method to protect the power plant raw water systems from zebra mussel infestations. The chlorine injection systems are designed with a high degree of automation. The systems are now being installed at all nine Nashville District hydropower plants at an estimated cost of $1 million. Total annual operating costs for the systems are expected to range from $100,000 to $500,000. Operation of the systems will require NPDES permits for the discharge of chlorine.