

# **THERMAL POLLUTION RESEARCH PROGRAM**

**STATE OF THE ART NEWSLETTER**

**No. 4**

**JULY 1971 - JUNE 1972**

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**Environmental Protection Agency  
National Environmental Research Center, Corvallis  
Pacific Northwest Water Laboratory**

NATIONAL THERMAL POLLUTION RESEARCH PROGRAM

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National Environmental Research Center, Corvallis  
National Thermal Pollution Research Program  
200 S.W. Thirty-Fifth Street  
Corvallis, Oregon 97330

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## NEWSLETTER

*S•P•E•C•I•A•L    B•U•L•L•E•T•I•N*

Thermal policy of EPA was announced by John R. Quarles, Jr., Assistant Administrator for Enforcement and General Counsel, in an address to Edison Electric Institute's Eighth Biennial Financial Conference, May 16, 1972. In part, Mr. Quarles said:

"Thermal pollution is also of major concern. The return of large amounts of cooling water to the natural environment can create a heatload highly disruptive or destructive to a fragile aquatic environment. The Environmental Protection Agency has had thermal policy actively under consideration for many months. We have recently established the policy that each discharge of waste heat to the aquatic environment shall be evaluated on a case-by-case basis. Where our analysis indicates that once-through cooling damages or will damage the environment, EPA will insist on a commitment to offstream cooling as a prerequisite to either continued operations or to EPA concurrence with company investment plans. In other cases in which we believe that damage will not occur, but in which there is a clear probability we shall insist on the establishment of an effective monitoring system to detect damage before it becomes serious.

Design for new plants should incorporate all features necessary for environmental protection. Inclusion of such factors at the planning and design stage will markedly lower costs from the expensive backfitting process. We are putting the power generating industry on notice of the need for control of thermal pollution. If any company chooses to ignore environmental requirements in its planning, it will be deliberately running the risk of increasing costs due to backfitting and possibly of not being permitted to operate during the backfitting. We realize that the additional costs to your industry of complying with these environmental measures will be great, but they are reasonable, and necessary to get the job done."

Copies of the full statement are available from EPA's Office of Public Affairs, Washington, D.C. 20460.

## RESEARCH HIGHLIGHTS

Environmental Systems Corporation of Knoxville, Tennessee, developed, tested and demonstrated an electro-optical system for quantitative measurement of particle size and mass of drift from cooling towers. The system uses a pulsed laser light-scattering technique. Also, isokinetic sampling equipment was improved for quantitative sampling of dissolved solids mass in tower exhaust.

Data from operating towers show drift rate on the order of 0.00X% of circulating flow rate. Natural draft towers drift less than mechanical draft towers and the predominate particle sizes are considerably smaller.

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Vanderbilt University completed a report on "Effects of Geographical Location on Cooling Pond Requirements and Performance." Energy budget parameters developed from records at 88 stations throughout the U.S. are depicted on a series of 28 maps. Monthly trends in these parameters are also presented.

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Stimulated by the increase in number and size of closed-cycle cooling systems the thermal research program began studies of potential hazards of blowdown and its control. Dr. Ronald Garton (formerly with this program) reports on "Biological Effects of Cooling Tower Blowdown" and describes assay procedures for evaluating mixtures of natural and added chemicals.

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Significant progress is reported in thermal modeling. Models for predicting the physical movement and dispersion of waste discharged below the water surface had top priority in FY-72. Drs. Mostafa Shirazi and Lorin Davis have critically reviewed data and analyses from numerous sources, unified the approaches, and now present the material in a series of nomograms readily usable by non-specialists in fluid dynamics and computer sciences. These nomograms with accompanying narrative and example problems constitute a 230-page digest that is being published by EPA.

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Experiments on the co-flow submerged discharge situation have been completed in cooperation with the U.S. Geological Survey. A team at the St. Anthony Falls Hydraulic Laboratory provides a comprehensive analysis of the surface discharge problem.

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Assistance to the operating arm of EPA continues to be a major activity. The National Thermal Pollution Research Program has devoted considerable effort to applying its expertise in reviewing those portions of AEC Environmental Impact Statements which relate to the engineering and economics of cooling systems for nuclear power plants. Thirty-one drafts have been reviewed;

the flood continues unabated. Considerable assistance has also been provided to EPA's enforcement efforts in the development of discharge permits and the preparation of testimony in the Houston Lighting and Power case.

The technical staff of the National Thermal Pollution Research Program is "on-call" for consultation and advisory services to EPA Headquarters and Regional Offices, and to State and local agencies as appropriate. Requests from sources outside of EPA should be routed through the respective Regional Administrator.

## NEW HARDWARE, CONCEPTS AND TRENDS

The Marley Company announces "The Parallel Path Wet-Dry Cooling Tower." The versatile design and flexibility in operating alternatives are certainly conducive to elimination or minimization of potential fogging problems and to conservation of water resources.

Dry cooling towers for steam electric generation are being considered more seriously than before in the U.S. The Atomic Energy Commission recently issued a report prepared by R.W. Beck and Associates entitled, "Cost Comparison of Dry-Type and Conventional Cooling Systems for Representative Nuclear Generating Plants."

Potomac Electric Power Company has placed an order for a natural draft salt water tower at the Chalk Point Plant (660 MWe). The contractor, Marley, guarantees drift at 0.002% of the circulating flow. This is two orders of magnitude less than the antiquated 0.2% some utilities and their consultants are still quoting in Environmental Impact Statements. Get with it, boys!

The market for spray cooling systems must be good, judging from the new suppliers entering the market.

The general consensus of participants at the National Conference on Waste Heat Utilization, Gatlinburg, Tennessee, October 27-29, 1971, was that the greatest potential contribution lies in the context of total energy utilization and conservation or multiple uses of water. With the possible exception of agriculture, direct beneficial uses of waste heat by entrepreneurs is not going to solve the nation's thermal pollution problems.

More offstream cooling is planned by electric utilities. Cooling plans of projected steam units 300 MWe and larger, as reported by FPC in response to Order 382-2, indicate that only 39.5% of new units are planned for once-through cooling. These data include units for which construction has begun as of April 1, 1972, or is scheduled to begin within two years. By the time all licenses and permits are obtained, this 39.5% figure may be substantially reduced.

Two utilities in the Northwest warrant our praise. For the Trojan Plant on the Columbia River, Portland General Electric has agreed to ensure that all discharges, including cooling tower blowdown, are free from zinc, chromates, and chlorine. Phosphates will be limited to about 5 lbs/day. Pacific Power and Light's Centralia Plant in Washington is unique in that it has only two liquid discharges --the sewage treatment plant and coal-pile drainage. Cooling tower blowdown is used as makeup to the ash handling and coal washing operations. These two operations in turn have recycling systems to save on consumptive use of water. Other nominations for our "Good Neighbor Award" are welcome.

## SEMINARS, WORKSHOPS AND SYMPOSIA

A workshop on "Methods for Predicting the Physical Movement and Dispersion of Submerged Waste Discharges in Water" was held July 11-14 at the U. S. Environmental Protection Agency's National Environmental Research Center, Corvallis.

Although the technology presented at the workshop was developed primarily for dealing with heat emission, it is equally applicable to many other forms of waste.

The workshop was conducted by Drs. Mostafa Shirazi and Lorin Davis, both of the National Thermal Pollution Research Program. Drs. Shirazi and Davis have reviewed data and analyses from numerous sources, unified the approaches, and presented the material in a series of nomograms readily usable by non-specialists in fluid dynamics and computer sciences.

The nomograms provide estimates of physical spread and temperature distribution around the waste discharge point, and they can be used for setting achievable water temperature standards, designing monitoring programs, pre-design feasibility analysis, and outfall performance estimates.

Physical facilities at Corvallis limits the number of participants to twenty-eight. Several applicants could not be accommodated. A second session can be scheduled, probably at another location, if sufficient interest develops.

## NEW GRANTS AND CONTRACTS

July 1971 - June 1972

STUDY FOR THE STOCHASTIC CALCULATION OF WATER EQUILIBRIUM TEMPERATURE: Environmental Systems Laboratory, Sunnyvale, California. Awarded December 1971 --to develop a statistical model for predicting water temperature variations as a function of meteorological changes. Completion of this research, scheduled for August 1972, will improve capability for predicting thermal response and recovery from proposed discharges and for more efficiently designing cooling ponds.

THERMAL POLLUTION CONTROL SYSTEM NOMOGRAPHS: Hittman Associates, Inc., Columbus, Maryland. Awarded March 1972 --to develop sets of nomographs to be used to determine cost and effectiveness of thermal pollution control alternatives. Alternatives covered will include open and closed-cycle spray canals, cooling ponds, mechanical and natural draft wet towers, and mechanical and natural draft dry towers. Completion of these nomographs, scheduled for December 1972, will allow State and Federal regulatory personnel to run feasibility and cost analysis for discharge permit applications without recourse to complex computer programs.

## NEW PUBLICATIONS

July 1971 - June 1972

*NOTE: A complete listing of publications of the National Thermal Pollution Research Program can be obtained from the Librarian, EPA, Pacific Northwest Water Laboratory, 200 SW 35th Street, Corvallis, Oregon 97330.*

1. STATE OF THE ART NEWSLETTER NO. 3, Thermal Pollution Research Program, January - June 1971.
2. RECENT DEVELOPMENTS IN THERMAL WASTE CONTROL, by Frank H. Rainwater, Proceedings of 1971 Intersociety Energy Conversion Engineering Conference, Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, N.Y. 10001. August 1971.
3. BIOLOGICAL EFFECTS OF COOLING TOWER BLOWDOWN, by Ronald R. Garton, Ph.D., presented at 71st National Meeting, American Institute of Chemical Engineers, February 20-23, 1972, Dallas, Texas.
4. BASIC DATA REPORT ON THE TURBULENT SPREAD OF HEAT AND MATTER, by R. S. McQuivey, USGS, T. N. Keefer, USGS, M. A. Shirazi, EPA. United States Department of Interior, Geological Survey, Water Resources Division, in cooperation with U.S. Environmental Protection Agency, National Thermal Pollution Research Program, open-file report. August 1971.
5. DRY COOLING TOWERS FOR STEAM ELECTRIC POWER PLANTS IN ARID REGIONS, by Mostafa A. Shirazi, to be published in Journal of Water Research.
6. WORKBOOK OF THERMAL PLUME PREDICTION, VOL. 1: SUBMERGED DISCHARGES, by M.A. Shirazi and L.R. Davis. April 1972.
7. POLLUTIONAL ASPECTS OF GEOTHERMAL RESOURCES DEVELOPMENT. A Staff Report by Alden G. Christianson, National Thermal Pollution Research Program. March 1972.
8. EVALUATING THERMAL POLLUTION CONTROL ALTERNATIVES, by Bruce A. Tichenor, to be presented at Second Institute of River Mechanics, Colorado State University, August 2, 1972.
9. INDUSTRIAL WASTE STUDIES PROGRAM: SUMMARY REPORT ON THE STEAM GENERATION AND STEAM-ELECTRIC POWER GENERATION, January 31, 1972. EPA, Office of Water Programs.
10. TEMPERATURE PREDICTION IN STRATIFIED WATER: MATHEMATICAL MODEL-USER'S MANUAL, Supplement to Water Pollution Control Research Series, 16130DJH01/71.

11. DEVELOPMENT AND DEMONSTRATION OF LOW-LEVEL DRIFT INSTRUMENTATION, Environmental Systems Corporation, October 1971, Water Pollution Control Research Series 16130GNK10/71.

12. SURFACE DISCHARGE OF HEATED WATER, University of Minnesota, St. Anthony Falls Hydraulic Laboratory, December 1971, Water Pollution Control Research Series 16130FSU12/71.

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*Requests for publications not otherwise noted should be addressed to:  
Librarian, National Environmental Research Center, 200 SW 35th Street,  
Corvallis, Oregon 97330.*

#### Other Significant Publications

1. WASTE HEAT UTILIZATION, Proceedings of the National Conference, October 27-29, 1971, Gatlinburg, Tennessee, edited by Marvin M. Yarosh. Available as CONF-711031 for \$6.00 from National Technical Information Service, Springfield, Virginia 22151.

2. COOLING TOWERS, American Institute of Chemical Engineering.

3. INFORMATION SOURCES ON WATER QUALITY INCLUDING THERMAL POLLUTION, ASCE Committee on Thermal Pollution, Journal of the Sanitary Engineering Division, ASCE, June 1972, pp. 569-578.

4. HEATED EFFLUENT DISPERSION IN LARGE LAKES: STATE-OF-THE-ART OF ANALYTICAL MODELING, PART I: CRITIQUE OF MODEL FORMULATION, by A. J. Policastro and J. V. Tokar, January 1972. ANL/ES-11, Argonne National Laboratory.

5. THERMAL PLUMES IN LAKES, compilations of field experience by J.V. Tokar, Argonne National Laboratory, ANL/ES-3, August 1971.

6. MATHEMATICAL MODELING OF NUCLEAR PLANT THERMAL EFFECTS IN LAKE CHAMPLAIN, by R.W. McLay, M.S. Hundal, F. Martinek, and E.B. Henson. ASME preprint 71-WA/PWr-4, July 1971.

7. COST COMPARISON OF DRY-TYPE AND CONVENTIONAL COOLING SYSTEMS FOR REPRESENTATIVE NUCLEAR GENERATING PLANTS, R.W. Beck and Associates, March 1972.

## WHO'S WHO IN THERMAL POLLUTION CONTROL

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Mr. W. C. Tallman	Chairman, Electric Power Council on Environment President, Public Service Co. of New Hampshire, PO Box 330, Manchester, New Hampshire 03105
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