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WSRC-RP-90-1254

R/D TASK PLAN: RESPONSE OF FISH TO DIFFERENT SIMULATED TEMPERATURE RATE LIMITS (U)

L.D. Wike

January 1991

Westinghouse Savannah River Company
Savannah River Site
Aiken, South Carolina 29808

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INTRODUCTION

The objective of the program is to determine the maximum temperature rate increase that can be tolerated by fish without loss of the ability to escape rising water temperatures. This data will form the basis for recommended power ascension rates during reactor restart. Activities required to meet the program objective include the task of simulating a range of possible temperature rate increases in the laboratory and analyzing the response of fish in an experimental environment . In addition to the primary task, scoping activities will be conducted to evaluate laboratory process control equipment, behavioral data collection equipment, and collect specific behavioral energetics data.

DISCUSSION

Reduction of the rate of power ascension is one of the options to be implemented for mitigation of fish kills in L Lake and Pond C during reactor restart (Paller, 1990). The relationship of acclimation, preferred, avoidance, and lethal temperatures largely determine how fish will react to increasing thermal loading in their habitat. Laboratory experiments are needed to determine maximum rates of power ascension that can be sustained while allowing maximum escape time for fish in the effluent areas.

Task Description

Customers: Task customers are the Reactor Restart Division (RRD) and the Ecology Group (EG) of the Environmental Sciences Section.

Deliverables: The deliverable for RRD will be a document containing recommendations for optimal temperature ascension regimes and a summary of the research results used as a basis for the recommendations. The deliverable for EG will be a detailed report of the research methods and results.

Requirements: This activity is defined as a task by Section 3.1 or QAIP 2-3, Manual 1Q31 (WSRC, 1990) because it supplies data for use

in an application defined as critical by the customer as per section 3.3 of the same document. Due to the defined critical nature of the task, accuracy and quality requirements associated with the task and its deliverable, the report to RRD, will be those necessary to provide recommendations based on sound, repeatable, and documented experimental data. Task activities requiring control for accuracy and quality are defined as key parameters under Prerequisites (following) and the Task QA Plan.

Prerequisites: Prerequisites are limited to the following key parameters:

1. Temperature control and measure ment system calibration and op eration
2. Laboratory notebooks
3. Supporting documentation
4. Procedures - to include training on system operation
5. Experimental data - to include temperature and fish behavior
6. Final reports.

Activities pertinent to the key parameters are defined in Task Activities (following).

Task Activities

Task activities are segregated into four categories; laboratory set-up, QA related activities, experimental data collection, and data analysis and report preparation.

Laboratory set-up: The physical plant necessary for the task is nearly completed. Modifications to the storage bay transforming the Par Pond Laboratory into a wet lab are nearly completed. The modifications included removal of excess equipment, insulation of the outside walls and ceiling, and installation of wall-mounted heating/cooling units. All major equipment has been purchased and most has been received. Laboratory requirements include: water supply from Par Pond, floor drains, holding tanks, experimental troughs and aquaria, room temperature control, adequate power for water heating and cooling equipment, photoperiod control, and adequate counter and storage space. These requirements have been or will be met upon completion of the modifications. A safety inspection of the entire Par Pond facility has been completed.

QA related activities: QA related activities are those necessary to satisfy requirements related to the key parameters identified under Prerequisites (above) and are as follows:

1. Temperature control and measurement system calibration and operation. Cali bration of temperature control and mea surement equipment will be carried out as per manufacturers procedures and specifications and documented accord ing to CP&ET-QAIP-12 of Manual 1Q31. Operation of the system will be done according to manufacturers methods.
2. Laboratory notebooks. Laboratory notebooks will be maintained as per CP&ET-QAIP-17 of Manual 1Q31.
3. Supporting documentation. Supporting documentation, including copies of equipment manufacturers methods and procedures, experimental protocol, and other pertinent laboratory notebook in formation will be maintained as per CP&ET-QAIP-17 of Manual 1Q31.
4. Procedures. Procedures are limited to those supplied by the manufacturer of the laboratory equipment. These manuals will be referenced in the laboratory notebook, but will be maintained by the task leader instead of in the supporting documenta-

tion due to potential copyright infringement associated with copying of licensed material. Specific laboratory procedures (ESSOPs) for the experimental protocol will be developed and included in the supporting documentation.

5. Experimental data. Data will be maintained on magnetic media and where possible on paper hard copy as per CP&ET-QAIP-17 of Manual 1Q31.
6. Final reports. Final reports will be prepared and submitted as per CP&ET-QAIP-6 of Manual 1Q31.

Experimental Data Collection: Fish (young of the year and juvenile bluegill and redbreast sunfish) will be collected by seine and kept in holding tanks at the Par Pond Lab (Building 735-7G). Fish will be maintained at the temperature at which they were collected for two days to acclimate to the change in conditions and reduce the stress incurred during collection. After two days the temperature at which the fish are held will be adjusted by two degrees per day until the desired initial experimental temperature is reached. The fish will then be held two additional days at this final acclimation temperature before being introduced into the experimental troughs. The experimental troughs will consist of a fiberglass trough (8' x 2' x 10') through which water at the acclimation temperature is circulated. Temperature increase regimen will be controlled by a process control system operating through and IBM XT or comparable computer. After a period of acclimation to the trough, temperatures will be raised following a pattern chosen from the range of possible scenarios of temperature ascension during reactor restart. The experiment will run until the maximum temperature specified is reached and maintained for a set period of time. During the process of temperature increase, behavior of the experimental organisms will be observed and noted. Loss of righting ability and mortality will be recorded and time of onset will be noted. The process control system will collect and time stamp temperature data, allowing correlation of behavior changes and mortality with temperature and time spent at that temperature. A series of simulations chosen from the range of possible restart sequences will be run and an optimum sequence will be identified.

Data Analysis and Report Generation: Behavioral effects and mortality will be analyzed for each replicate of the different simulation runs. Comparisons will be made between the different scenarios to evaluate the optimum rate of temperature ascension. Data will be analyzed as soon after each simulation as possible in order to help determine parameters for additional simulations. A report summarizing the results of the experimental runs and recommending an optimum temperature ascension rate will be prepared and submitted to RRD as soon as a sufficient number of different scenarios have been simulated and analyzed. An in-depth technical report will then be prepared to be issued as an EG technical report.

Responsibilities: Responsibility for completion of the task lies with the task leader and the Ecology Group of the Environmental Sciences Section, Savannah River Laboratory.

REFERENCES

Paller, M.H., *A Remedial Action Plan for Fish Kills in L Lake and Pond C (U).* WSRC-RP-90-473. Westinghouse Savannah River Company, Aiken South Carolina, 1990.

WSRC Manual 1Q31, *Chemical Processes and Environmental Technology Quality Assurance Implementation Procedures (U).* Westinghouse Savannah River Company, Aiken South Carolina, 1990.

ATTACHMENT 1.
TASK QUALITY ASSURANCE PLAN

ATTACHMENT 1: TASK QA PLAN

Task Title: RESPONSE OF FISH TO DIFFERENT SIMULATED TEMPERATURE RATE LIMITS (U)

Task Leader: Lynn D. Wike

Key Parameters:

(1) Temperature control and measurement system calibration and operation
(2) Laboratory notebooks
(3) Supporting documentation
(4) Procedures
(5) Experimental data
(6) Final reports.

Additional Comments: None

Documents Requiring Customer Approval:

Report to RRD
ESS/EG Technical Report

Anticipated Records:

(1) Task Technical Plan
(2) Task QA Plan
(3) Uniquely identified notebooks
(4) Supporting documentation
(5) Procedures required to perform activity
(6) Procedures list
(7) Data, magnetic and hard copy where available
(8) Index to records package

Approvals:

Lynn D Wike — Task Leader — Date 11/5/90

T B Gladden — Group Manager — Date 12/5/90

D B Moore — Section Manager — Date 12/6/90

S. R. Zolin — Cognizant Quality Function — Date 12/10/90

TASK QA PLAN CHECKLIST

Task Title: Response of fish to different simulated temperature rate limits (U)

Task Leader: Lynn D. Wike

Key Parameters	Temp. control & measurement system calib. and operation		Lab notebooks		Supporting doc.		Procedures		Exp. data		Final reports
Organization											
Program											
Design Control											
Procurement											
CP&ET-QAIP-4&7											
Procedures											
CP&ET-QAIP-5											
Document Control											
CP&ET-QAIP-6											X
ID & Control of Items											
CP&ET-QAIP-8											
M&TE											
CP&ET-QAIP-12	X										
Handling, Storage, & Shipping											
Nonconformance											
CP&ET-QAIP-15	X		X		X		X		X		X
Records											
CP&ET-QAIP-17			X		X		X		X		
Software											

The following QA criteria are not applicable to the referenced Task Plan:
CP&ET QAIP-1, 2, 3, 9, 10, 11, 13, 14, 16, 18, 19, 20.

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