

WATERTRAK, A COMPUTERIZED LIQUID
WASTE TREATMENT SYSTEM STATUS AND
PERFORMANCE MONITORING PROGRAM

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ABSTRACT

Because of continuing problems in the radwaste system operations of a large number of plants currently operating, there is an increasing need to provide greater quantities of radwaste system information to plant operators and managers. Current and more complete information is required to enhance the operation and performance of the radwaste treatment systems, to assess the current system status, to plan for changing plant conditions and to diagnose actual or impending problems. The information needs include: real-time system status monitoring, equipment performance monitoring, report generation for operators and plant management, and training information. The nature and quantity of information required makes this program well-suited for a computer-aided engineering application.

INTRODUCTION

WATERTRAK is a computer-based data system for radioactive liquid waste tracking and radwaste system performance optimization. WATERTRAK will provide information required to improve the operation and management of the radwaste treatment system. The program performs five (5) major functions, as follows:

- 1) System status monitoring function will provide system and equipment status on a real-time basis in a given flow diagram format using color graphics.
- 2) Equipment performance monitoring function will provide real time equipment status and performance data.
- 3) Report generation function will provide information in a wide range of daily, weekly and monthly reports.
- 4) WATERTRAK will provide computer assisted instructions to improve plant operations and personnel efficiency under training function.
- 5) All radwaste related records can be stored under record keeping function of the program.

Process parameters and performance analysis functions are presented in digital displays, bar graphs, and trending plots. Reports are displayed in tabular and graphical formats on the system color graphics terminal and in hardcopy. The training function includes system flow diagrams, procedure checklists, and limiting operating conditions. The hardware for the complete computer system includes: the process data transfer controller, the system computer, the color graphics terminal and printer/plotter.

WATERTRAK maintains records on leakages from within primary containment, as well as records on any liquids discharged, volume of waste processed, the amount of water recycled, and the amount of

water which required reprocessing. This additional data can often help a utility to define when a liquid waste problem exists.

WATERTRAK will maintain all data required 1) to assist in monitoring the radwaste system operations; 2) helping to identify sources of increased water volumes; 3) to identify changing conditions thereby helping to reduce operating costs to maintain plant technical specifications. This program provides printed reports in any format desired by a utility user. Specifically, the program has the following functions:

- Process Monitoring Data Base
- Process Control Algorithms
- Application Programming Support
- Scheduling By Group
- Operator Console Functions
- User Defined Displays
- Historical Trending and Averaging
- Reporting and Plotting
- Event History

These functions are implemented almost exclusively by FORTRAN coded tasks and subroutines. The only exceptions to the exclusive use of FORTRAN code are those which concern themselves with device input/output efficiencies. This high level language concept of implementation provides for simple modification when required by yet undetermined needs for future functional requirements.

WATERTRAK is designed to provide nuclear plant radwaste operators and plant managers with increased information and knowledge regarding the operation and performance of the radwaste systems. The increased knowledge and awareness of the radwaste system and the interface with the other plant systems will improve the operations and performance of the radwaste and related systems. This should result in lower operating costs, increased processing capability, better operational planning, improved plant problems, and fewer operational mistakes.

OPERATIONAL OVERVIEW

The man-machine interface is menu-driven to allow the user to select from the major functions. Subfunctions within each of the major functions are also menu-driven with second level menus from which to select specific features. The system is accessed from the radwaste control area by a high resolution color-graphics terminal. The required data input for the status and performance monitoring and the report generation functions is continuous from system process instrumentation. The input for the training and diagnostic and record keeping functions may be manually input at the terminal or from data libraries within the program. The system and equipment status and performance monitoring functions operate on a real-time basis and are displayed in color process flow diagram format. Current performance parameters and data are displayed in digital and graphical formats as required for the particular parameters and components. The report generation functions present the pertinent information in the desired format at the system terminal and in hardcopy at a printer/plotter. All information, flow diagrams, data plots, etc., displayed on the CRT screen can be obtained in hardcopy from the operator's keyboard.

The plant subsystems monitored by WATERTRAK are:

- Waste Collection
- Equipment Drain
- Condensate Demineralizer (Including Regeneration)
- Chemical Waste
- Laundry Drain
- Solids Handling
- Reactor Water Clean-up
- Fuel Pool Clean-up
- Make-up Water Treatment
- Condensate Storage

The equipment included in the performance monitoring function includes:

- Tanks
- Filters
- Demineralizers
- Evaporators

This paper focuses on the following major information and data management functions.

- System Status Monitoring
- Equipment Performance Monitoring
- Report Generation
- Training
- Record Keeping

System Status Monitoring

For each subsystem monitored by WATERTRAK, a flow diagram showing major components, flow-paths and valves can be displayed on the terminal screen. The flow diagram will include, in graphical format and digital readout, the following information as applicable to the particular subsystems:

- Tank Levels
- Water Inventories*
- Flow Paths in Operations
- Valve Positions
- Sludge Inventories*
- Sump Input Summaries (GPD)*
- Process Parameters
 - Influent conductivity
 - Demineralizer effluent conductivity
 - Flow rate
 - Filter totalized flow
 - Filter ΔP
 - Demineralizer totalized flow
 - Total crud removed*
 - Total dissolved solid removal*
 - Total activity on filter cake
 - Total activity on demineralizer resins
 - Sump effluent conductivity
 - Total activity in evaporator concentrates
 - Total activity on filter sludges and resins
- Alert Messages
 - Process parameters exceeding normal limits
 - Sump input frequency increasing
 - Excess water inventory

* Calculated Values

Equipment Performance Monitoring

This portion of the program will provide real-time equipment performance data. The purpose of this display is to provide information to the operator concerning current equipment status and performance. This will allow the operator to assess the current operating conditions and make operational decisions based on current performance conditions.

The following parameters would be displayed for each of the following process components.

- Filters
 - Flow rate
 - ΔP
 - Total crud removed vs. average*
 - Totalized flow vs. average*
 - Influent suspended solid vs. average*

- * Demineralizers

- Influent conductivity vs. average*
- Effluent conductivity vs. average*
- Totalized flow vs. average*
- Total dissolved solids removed vs. average*
- Remaining ion exchange capacity*
- Projected run lengths*

- * Evaporators

- Feed rate
- Totalized feed volume vs. average*
- Steam temperature vs. design
- Liquor temperature
- Evap. pressure
- Overhead conductivity vs. average*
- pH vs. design
- Cooling water flow rate vs. design
- Cooling water inlet and outlet temp. vs. design
- Boiling point rise vs. average*
- Influent conductivity
- Totalized condensate
- Condensate volume
- Solid concentration
- Distillate flow rate
- Steam/liquor ΔT
- Waste volume
- Specific gravity of bottoms

- * Equipment Performance Histories

- Filters

1. ΔP vs. gallons treated vs. average - each run
2. Clean and end point ΔP - each run
3. Lbs. crud removed vs. ΔP vs. average - each run
4. Lbs. crud removed vs. average - each run
5. Clean ΔP vs. number runs

- Demineralizers

1. Total gallons treated per run vs. average
2. Dissolved solids removed vs. average - each run
3. Kgr/ft³ vs. average - each run
4. Effluent Conductivity vs. gallons treated vs. average - each run
5. ΔP vs. gallons treated vs. average - each run

- Evaporators

1. Feed rate vs. time
2. Liquid level vs. time
3. pH vs time
4. Operating pressure vs. time
5. Steam temperature vs. time
6. Bottoms temperature vs. time
7. Bottoms concentration per batch
8. Overhead conductivity vs. time

- * Reg. Guide 1.21 Release Reports

Training

In this function, computer assisted instruction will be provided. This will be achieved when an ALARM signal is displayed or recorded for a process and/or discrete values.

- * Interactive instructions addressing:

- System descriptions with flow diagrams
- Design bases
- Processing modes with flow diagrams
- System and equipment limitations
- Operations with flow diagrams

- * Interactive Operating Procedure Training

- Subsystems with flow diagrams
- Processing equipment

* Calculated values

Report Generation

In the report generation function, the number and type of reports can be varied quite widely. The following is a representative listing of reports likely to be required:

- * Daily Plant Water Balance

- * Daily Subsystem Reports

- Input source summary vs. average (gallons/sump)
- Treated waste volume vs. average
- Tank inventories vs. average
- Discharge/recycle volumes vs. average
- Total influent suspended solids vs. average
- Total influent dissolved solids vs. average

- * Weekly Backwash Summaries

- Waste collector filter
- Floor drain filter
- Spent fuel pool clean-up filter
- Reactor water clean-up
- Condensate demineralizer resin cleanings
- Condensate Demineralizer regenerations
- Total evaporator bottoms solidified

- * Monthly Subsystem Reports

- Input source summary vs. average
- Total waste volumes treated by subsystem
- Number of backwashed/regenerations
- Total dissolved solids removed
- Total suspended solids removed
- Total solid waste volumes

Record Keeping

The number of radwaste-related records which can be stored, retrieved and printed is quite varied and can be customized to a user's needs. The following lists a number of record keeping jobs in which many utilities have expressed an interest.

- Radwaste Equipment Maintenance Histories
 - Valves
 - Pumps
 - Filters
 - Demineralizers
 - Instrumentation
 - Piping
 - Tanks
- Radwaste Consumable Inventories
 - Drums
 - Liners
 - Boxes
 - Resins
 - Chemicals
 - Filter media
- Radwaste Personnel & Training Records
- Emergency Notification List & Phone Numbers
- Radwaste Radiation Exposure Summaries
- Operating Costs
 - Consumables
 - Transportation
 - Disposal
 - Mobile services