WASTE ACCEPTANCE DECISIONS AND UNCERTAINTY ANALYSIS AT THE OAK RIDGE ENVIRONMENTAL MANAGEMENT WASTE MANAGEMENT FACILITY

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ABSTRACT

The Waste Acceptance Criteria (WAC) Attainment Team (AT) routinely provides the U.S. Department of Energy (DOE) Oak Ridge Operations with Go/No-Go decisions associated with the disposition of over 1.8 million yd^3 of low-level radioactive, TSCA, and RCRA hazardous waste. This supply of waste comes from 60+ environmental restoration projects over the next 15 years planned to be dispositioned at the Oak Ridge Environmental Management Waste Management Facility (EMWMF).

The EMWMF WAC AT decision making process is accomplished in four ways: (1) ensure a clearly defined mission and timeframe for accomplishment is established, (2) provide an effective organization structure with trained personnel, (3) have in place a set of waste acceptance decisions and Data Quality Objectives (DQO) for which quantitative measures are required, and (4) use validated risk-based forecasting, decision support, and modeling/simulation tools.

We provide a summary of WAC AT structure and performance. We offer suggestions based on lessons learned for effective transfer to other DOE.

INTRODUCTION

Cost-effective use of the U.S. Department of Energy (DOE) Oak Ridge Operations Environmental Management Waste Management Facility (EMWMF) is accomplished, in part, by the efforts of the Jacobs Company LLC (BJC) EMWMF Waste Acceptance Criteria (WAC) Attainment Team (AT).

To accomplish this, the EMWMF WAC AT relies on (1) a clearly defined mission and timeframe for accomplishment, (2) an effective organization structure with trained personnel, (3) approved waste acceptance criteria which require quantitative assessment; and (4) validated statistical forecasting, decision support, and modeling/simulation tools.

OPERATIONAL CONTEXT

The operational context of the WAC AT is presented in Figure 1, [1, 7]. Remedial action (RA) or Decontamination and Decommissioning (D&D) projects are budgeted and scheduled to disposition specific waste volumes with some contaminant concentration to the EMWMF. The primary unit of waste to be considered for EMWMF WAC attainment is the waste lot (WL). A WL can be all or some of the waste of a

particular waste stream removed from a CERCLA site, from an entire waste stream down to a single truckload of waste, a set of drums of waste, or even a single drum of waste.

Under current EMWMF plans and schedules, the WAC AT examines more than 100 WL from 60+ projects over the time frame FY02 – FY15. WAC AT decisions are made for WL planning on disposition during a three year window from the current FY and for the life cycle of the projects. The risk and effectiveness figures of merit are binary: either a WL meets, or it does not meet, the EMWMF WAC. Constraints, such as WL variances, alternative scope plans, etc. associated with these decisions are recorded as part of determining the figures of merit.

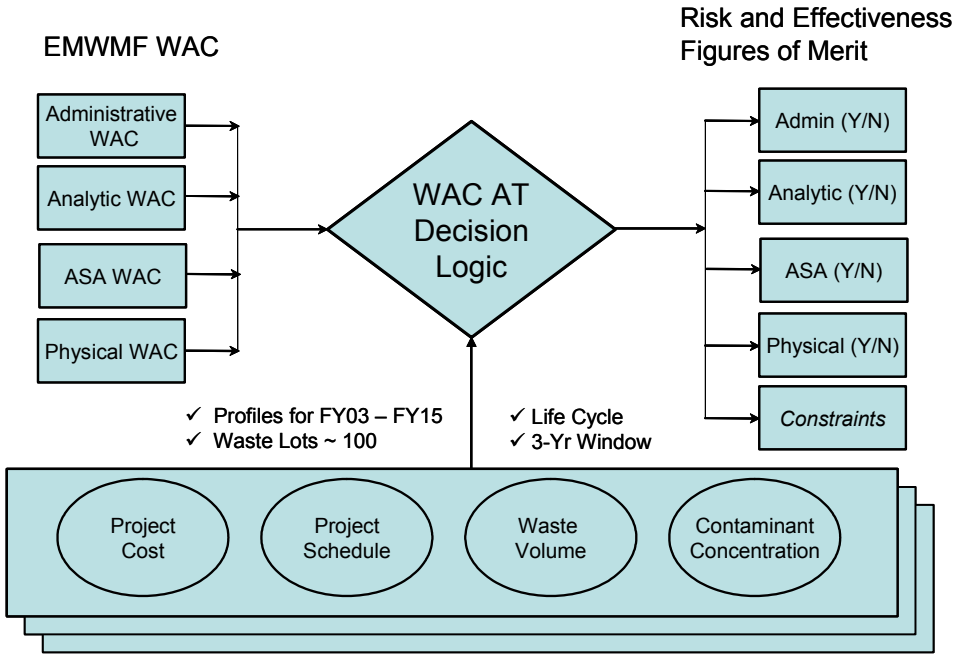

Fig. 1. Context of WAC Attainment Team Mission

MISSION STATEMENT

The mission of the WAC AT is: "determine if a WL waste profile meets the EMWMF WAC." The timeframe is of WAC AT performance is FY03 through FY15 at which time the EMMWF mission is is expected to be completed.

To accomplish this mission, the WAC AT addresses three fundamental questions:

- Does a waste lot (WL) meet the EMWMF WAC?
- What is the expected volume of waste a project will supply to the EMWMF?
- What factors influence the answers to the above questions?

The primary role of the WAC AT is at the front-end of the EMWMF life cycle, namely in the planning for the supply of waste to be dispositioned to the facility. How the WAC AT performs this role is precisely the scope and the intent of this paper.

There are four goals the WAC AT must meet to accomplish the mission statement. The functional relationship to these goals is presented in Table I.

- Approve the WL for disposal
- Develop new, or modify existing, WAC when necessary
- Maintain the tools and systems required to meet EMWMF Data Quality Objectives (DQO)
- Communicate existing WAC, and provide consultation and interpretation with regard to the EMWMF WAC

Table I. WAC AT Goals and Specific Functions

Goal	Specific Functions
Approval	▪ Ensure waste profiles provide sufficient information to assess WAC compliance ▪ Ensure projects have used DQO process to assess/evaluate data ▪ Verify WL meet Administrative, Auditable Safety Analysis (ASA) derived, and Analytic WAC ▪ Confirm that the waste lots either plan to meet all Physical WAC, or have negotiated variances with the EMWMF operations subcontractor
Development or Modification	▪ Coordinate supplemental administrative WAC with regulators ▪ Develop Physical, ASA, or Analytic WAC for site-related contaminants (SRC)
Systems and Tools	▪ Incorporate Waste Generation Forecast (WGF) volume data ▪ Use Waste Acceptance Criteria Forecasting and Analysis Capability System (WACFACS) to: - Calculate WL Sum of Fractions (SOF) - Calculate EMWMF Volume-Weighted Sum of Fractions (VWSF) - Verify that the waste lots meet the Analytic WAC DQO
Communication	▪ Communicate expectations and requirements for WAC attainment ▪ Remain independent of RA or D&D projects ▪ Interface with EMWMF concerning in-place waste volumes

The WAC AT deals with short-term and long-term waste disposition decisions, cost evaluations, and uncertainty and variability analyses. At any given time, the WAC AT can quantify risk-based performance standards, projected and in-place disposal volumes, and EMWMF schedule demands for a multitude of RA or D&D projects.

The WAC AT applies a measurement-based strategy that focuses on process improvement and variation reduction associated with waste supply and waste acceptance at the EMWMF. In this context, the WAC AT functions as a Six Sigma organization. All decisions are disciplined, and the decisions rely on data-driven approaches and methodologies. The WAC AT implements the DMAIC process (define, measure, analyze, improve, and control). The WAC AT organizational elements and the roles and responsibilities are presented in Table II.

Table II. Organizational Elements and Roles/Responsibilities

Organization	Responsibility
US DOE	▪ Overall responsibility for EMWMF WAC compliance ▪ Delegated to BJC
BJC	▪ Projects oversee RA and D&D actions ▪ Waste Operations oversees EMWMF operations ▪ WAC AT approves waste lots for disposal ▪ Planning and Controls provides strategic planning interfaces
RA/D&D Projects	▪ Comply with all WAC for wastes disposed in the EMWMF ▪ Certify wastes meet all applicable administrative WAC or that appropriate waivers from administrative WAC have been obtained through their CERCLA documentation

Organization	Responsibility
	▪ Certify that all reported analytic WAC parameters are correct ▪ Certify that the parameters used to demonstrate compliance with the ASA-derived WAC concentrations are correct
EMWMF Operations Subcontractor	▪ Certify that all remaining physical WAC have been met ▪ Verify that the wastes are from an approved waste lot and that all required RA project certifications have been made ▪ Employ the use of a database to track total volumes disposed for each waste lot and to track the total volume of suitable fill used ▪ Export data to WACFACS to quantify the volumes of waste lots disposed and suitable fill used in the EMWMF
WAC AT	▪ The prime contractor entity responsible for approving or rejecting waste lots for disposal in the EMWMF

WAC ATTAINMENT TEAM ORGANIZATION AND TRAINING

The WAC AT is a flat functional organization composed of cross-trained and multi-qualified personnel. Fig. 2 depicts the functional organization and skills requirements. Not all skill areas require a full-time team member, and one individual often provides expertise in multiple areas. The number and mix of team personnel is dependent upon the demand placed by projects that plan to disposition waste at the EMWMF.

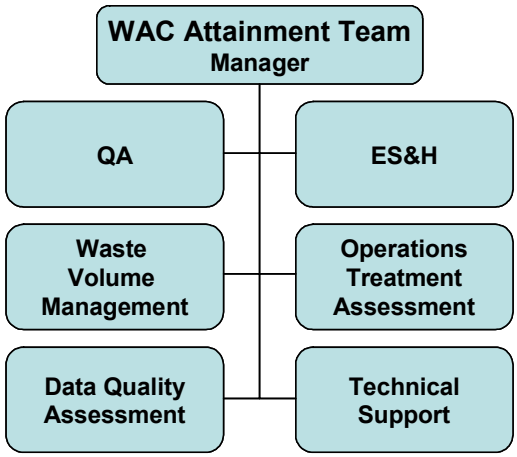

Fig. 2. WAC Attainment Team Organization

All WAC AT personnel are trained commensurate with their roles and responsibilities. Personnel are provided with continuing education and training to ensure that job proficiency is maintained. Specific required reading assignments are made by the WAC AT Manager for each WAC AT member. Position descriptions are available for team members having primary responsibility for the key skill areas. Additional training is prescribed for WAC AT members assigned field assessment responsibilities. Training in the following subject matter areas is directly relevant to WAC AT processes:

- Environment, safety, and health
- Environmental regulations
- Sampling and analyses, DQO, Data Quality Assessment
- Statistical and systems analyses

WASTE ACCEPTANCE CRITERIA, KEY DECISIONS, AND QUANTITATIVE TOOLS

All WAC AT key decisions address the question "does the WL meet the EMWMF WAC?" All WL must meet four WAC: Administrative, Analytic, Auditable Safety Analysis (ASA), and Physical [7].

Many of the WAC decisions are pass/fail – either the WL passes or fails. Other decisions, however, are explicitly based on risk-based criteria and are stated as such. The overall logic the WAC AT follows is presented in Fig. 3.

- A pass/fail decision is the Administrative WAC. These WAC are derived from regulatory agreements, and RA projects must demonstrate compliance with all the requirements of this WAC. The sole means of obtaining a variance to an administrative WAC is to obtain a formal exemption within the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) documentation for the project. For example, an exemption from Resource Conservation and Recovery Act of 1976 (RCRA) land disposal restrictions (LDR) within a Record of Decision (ROD) is an acceptable means of complying with the requirement to meet RCRA LDR.

- The ASA WAC requires risk-based decisions. For example, as part of the ASA-derived WAC compliance, the RA projects must use the 95%-Upper Confidence Limit (UCL-95) of concentrations to calculate the associated Sum of Fractions (SOF). In cases where measured concentrations are not available for all radionuclides known or suspected to be present at an RA site, it is acceptable for RA projects to subtract the concentrations of measured or inferred radionuclides (e.g., daughters in secular equilibrium) from gross alpha and gross beta concentrations. The remainder of each can then be divided by the most restrictive unmeasured alpha or beta-emitting radionuclide that is suspected to be present in the waste lot. These fractions are then summed with the fractions of measured or inferred radionuclides to calculate the ASA-derived SOF.

- The Analytic WAC requires the most sophisticated risk-based decisions. The Waste Acceptance Criteria Forecasting and Analysis System (WACFACS) is the principal analytical tool used by the WAC AT to support Analytical WAC, [2, 6]. WACFACS is a decision support system that explicitly addresses operational uncertainties and variabilities, namely uncertainties in terms of WL schedule and scope and variability in waste volumes and waste stream concentrations. As illustrated in Figure 4, WACFACS capitalizes on the variability and the variabilities and uncertainties present in WL constituents and volume data. These uncertainties are propagated to compute a WL Sum of Fractions (SOF), the Volume Weighted Sum of Fractions (VWSF), and the 95%-Upper Confidence Limit (UCL-90) for the VWSF. Other quantitative tools and approaches used as part of WACFAC are discussed in [3, 4, 8, 9, 10, 11].

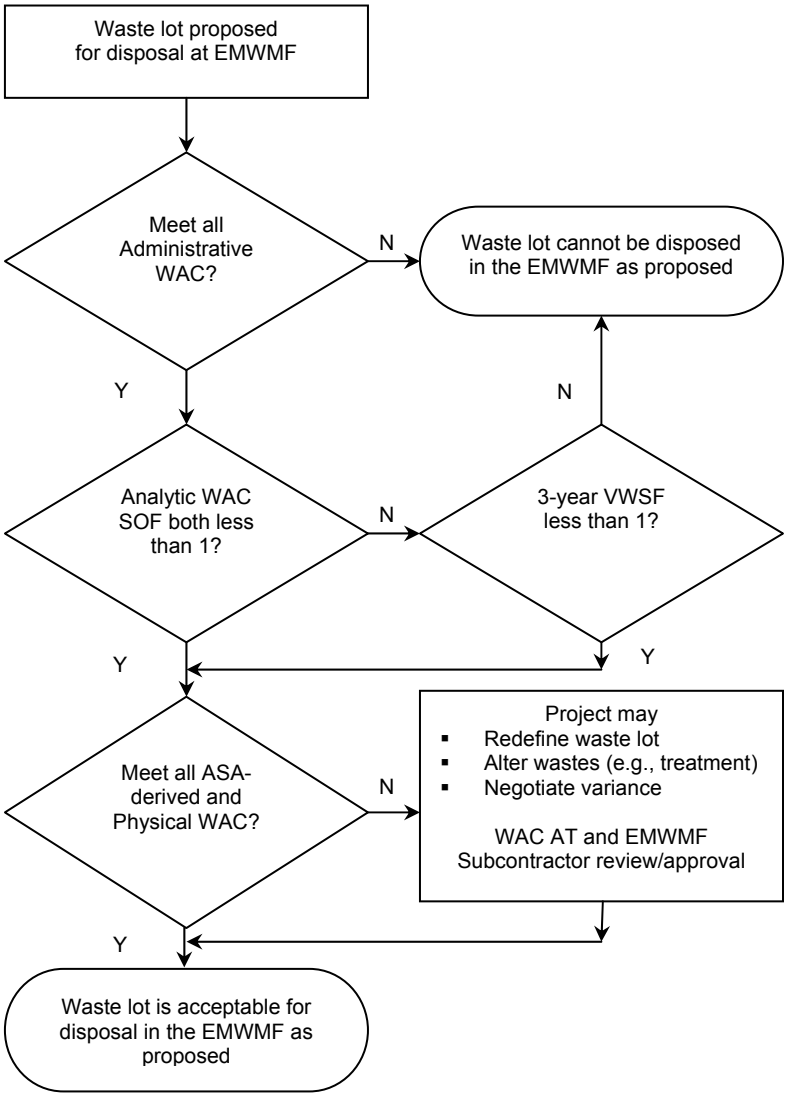

Fig. 3. WAC Attainment Team Decision Process

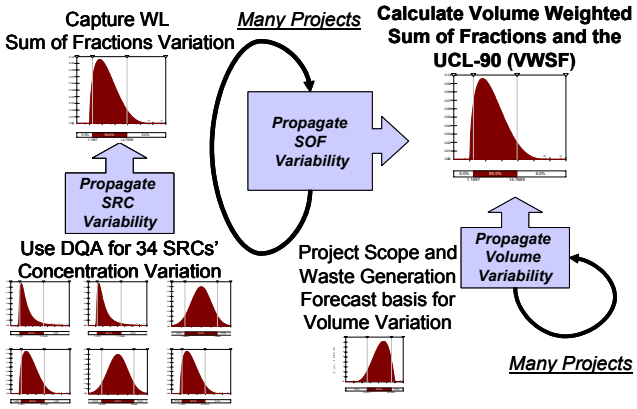

Fig. 4. WACFACS Logic

Waste lot decisions are made using WL-provided waste profiles. The actual WAC AT decision for approval or rejection of a waste lot is communicated using the EMWMF WAC AT Waste Lot Decision Form (the Form). The Form is disseminated to the RA or D&D projects, the EMWMF project and subcontractor, DOE, and regulators when an evaluation is completed. The Form clearly identifies the project name, the WACFACS Identification number, volume, and other information provided by the project. The WAC AT indicates whether the waste lot is "approved" or "rejected". If "approved," the Form may contain conditions for approval (e.g., "approved based upon project plans to segregate hot spots in accordance with the project Waste Management Plan"). If "rejected," the Form may indicate any required additional information necessary for approval of the waste lot, or observations regarding the potential for some of the proposed wastes to be acceptable as a separate waste lot.

DATA QUALITY OBJECTIVES FOR THE ANALYTIC WAC

The Analytic WAC requires specific DQO decisions that have been negotiated and agreed to by the EMWMF stakeholders. The WAC AT is responsible for ensuring the DQO are met by all waste lots. As the operations of the EMWMF mature, requirements for waste lots may change, and DQO Decisions may be refined. The WAC AT assesses the adequacy of the DQO decisions on an annual basis and makes additions, refinements, or deletions, as needed, if approved by the Federal Facility Agreement parties.

The DQO Decisions are:

- DQO Decision 1: Does the waste lot data meet the form and format required by the WAC Attainment Team?
- DQO Decision 2: Is the existing waste lot characterization data sufficient to assess the waste lot SOF?
- DQO Decision 3: Using a graded approach for the effects of SOF uncertainties on the VWSF, can the waste stream be disposed at the EMWMF?

Using WACFACS and WL data to address the DQO Decisions, the WAC AT assesses waste lot SOF and the EMWMF VWSF, examines significant parameters of future EMWMF waste streams with those of EMWMF-disposed waste to forecast the VWSF at various times in the future, and performs sensitivity analysis to identify critical future waste streams impacting the VWSF.

LESSONS LEARNED

Key WAC AT lessons learned are: (1) deal with uncertainties, (2) work with RA and D&D project personnel, and (3) apply Six-Sigma management principles. In all areas, the WAC AT has achieved significant success. Since the WAC AT operates, by definition, as a Six-Sigma organization, we only discuss key elements of the first two areas.

<u>Deal with Uncertainties</u>

- *Meet DOE accelerated clean-up efforts*. The WAC AT accomplishes this by (1) quarterly configuration management updates of all project disposition schedules and associated volumes, (2) quantifying variability associated with volume disposition and contaminant concentrations, and (3) focusing on a realistic window of opportunity (three years into the future). While it may seem less than obvious, when large uncertainties exist, the WAC AT and the RA or D&D project have the largest number of options and disposition alternatives. For the 3-year window of interest, the WAC AT uses WACFACS to rapidly identify projects, constituents, and schedules affect the success of DQO 3.

Based upon a balance between the disposition alternatives and the expected ability of a project to be approved for waste disposition, the WAC AT is able to prune the alternatives from many to one or two. Such an exercise is routinely accomplished in real-time, and the efficacy of the approach has resulted in successful stakeholder acceptance.

- *Use Information Technology management tools.* The WAC AT deals with uncertainties by employing data administration/warehousing procedures, software configuration management, and independent verification/validation of input data. We require information that is a combination of objective, usable, and trustworthy data and software. Quarterly configuration management ensures there is one version of the truth associated with the schedule and volumes expected to be dispositioned to the EMWMF during any time period. Regular evaluation of new data management/warehousing solutions versus integrating with older assets is performed. Data requirements are specifically prioritized for use by the WAC AT thus ensuring the data is available when needed and in the proper quality, form, and format. Data maintenance is an issue within the WAC AT, and the cost of ownership and the time spent on such maintenance is minimized as reasonably as possible.

Work with RA and D&D Project Personnel

- *Ensure the WAC AT functions as a Core Team*. The WAC AT serves as the single point of contact for all EMWMF waste lot disposition. Strategic and operational interface with Oak Ridge DOE personnel, the State of Tennessee Department of Environmental Conservation (TDEC) personnel, and US EPA personnel is routinely accomplished in formal and informal settings. As has been evidenced by the well-executed WAC AT operations, this approach is effective over the long term of organizational and personnel changes.

- *Coordinate data quality requirements and results with projects*. The WAC AT requires sound information for effective and timely decision making. This information is provided by projects. Use of existing information, to include process knowledge and historical sampling and analysis results, is the starting point. When supplemental information is required, the WAC AT supports the project DQO and the associated data quality assessment. If such an interface is not accomplished, the WAC AT is at risk of not receiving the required information, and the project wastes precious resources.

- *Maintain flexibility in the definition of project waste lots*. The WAC AT supports projects in a dynamic refinement of waste lots. For example, a D&D project may initially define a waste lot that consists of all process equipment and building debris. Since DQO 3 is a function of both volume and the SOF, separation into two waste lots increases the likelihood that each will be accepted at the EMWMF. The waste lots may be dispositioned in parallel and not interfere with project operations.

CONCLUSION

The WAC AT provides sound and effective decision making to support the disposition low-level radioactive, TSCA, and RCRA hazardous waste at the EMWMF. A process is in place to ensure the WAC AT follows a clearly defined mission and timeframe for accomplishment. The organization is effectively structured with trained personnel. Waste acceptance criteria, decisions, and DQO are quantitative and approved by all stakeholders. Validated risk-based forecasting, decision support, and modeling/simulation tools are employed to reach all WAC AT decisions.

There is no other operational waste disposition facility in the DOE complex that uses such an integrated approach as the EMWMF WAC AT. It is hoped that existing and planned facilities will capitalize on our experience to tailor procedures, tools, and structure to meet the accelerated clean-up strategy and their site-specific requirements.

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