ENVIRONMENTAL TECHNOLOGY VERIFICATION (ETV)
DRAFT TECHNOLOGY EVALUATION WORKPLAN PROTOCOL
FOR
RECHARGEABLE HOUSEHOLD BATTERIES:
PERFORMANCE, TOXICITY, DISPOSAL OPTIONS, AND COSTS

EXAMPLE TECHNOLOGY:
RAYOVAC RENEWAL® RECHARGEABLE ALKALINE HOUSEHOLD BATTERIES

DATE: 7/21/98

NOTICE:

This Test Plan was developed to address data gaps regarding consumer battery performance, as measured by energy capacity, using laboratory tests developed by industry through American National Standards Institute (ANSI) consensus methods. The Test Plan was also designed to address data gaps regarding a specific federal test for hazardous waste characterization and disposal: the Toxicity Characteristic Leaching Procedure (TCLP) Test. The Test Plan was not designed to determine the pollution prevention potential or life cycle analysis of household or consumer batteries. In addition, the actual testing deviated from this Test Plan. Information on the tests and performance can be found in the Rayovac Renewal® Certification Report (April 6, 1998, California Department of Toxic Substances Control), and the ETV Report (March 1999, U.S. Environmental Protection Agency). This Test Plan is being provided only as an example for guidance purposes.

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A. **PROJECT MANAGEMENT**

1. TITLE AND APPROVAL SHEET

Department of Toxic Substances Control	US Environmental Protection Agency
Mr. Tony Luan Assignment Manager ______________________	Ms. Norma Lewis Technical Project Manager ______________________
Mr. John Wesnousky Technical Review Panel ______________________	Mr. Sam Hayes Quality Assurance Officer ______________________
Mr. Terry Escarda Technical Project Manager ______________________	
Dr. Wolfgang Fuhs Technical Review Panel ______________________	

2. DISTRIBUTION LIST

Mr. Tony Luan, DTSC/OPPTD (Primary Decision Maker)
Ms. Cindy Dingman, DTSC HML (QA/QC Reviewer)
Dr. Bart Simmons, DTSC/HML (Potential Lab Service Provider)
Mr. Clay Booher, DTSC/OPPTD (Project Reviewer)

Ms. Norma Lewis, US EPA (Technical Project Manager)
Mr. Sam Hayes, US EPA (QA/QC Officer)
Mr. Gregory J. Carroll, US EPA (Project Reviewer)
Ms. Penelope Hansen, US EPA (Project Reviewer)

Mr. Ray Balfour, Vice-President, Rayovac Corporation

3. PROJECT/TASK ORGANIZATION (see **Figure 1**)

Department of Toxic Substances Control

Assignment Manager-	Tony Luan has final DTSC authority and oversight of planning team's activities.
Project Manager -	Terry Escarda is responsible for overseeing implementation of the Technology Evaluation Workplan, coordinating project team meetings, ensuring that necessary resources are provided for planning team decisions, and for preparing project reports.
QA/QC Member-	Cindy Dingman is responsible for ensuring the data collection system meets QA/QC requirements.
Laboratory Activities -	Bart Simmons is Chief of DTSC's Hazardous Materials Laboratory and is responsible for overseeing laboratory QA/QC procedures.
Planning Team Members -	All team members are responsible for participating in plan preparation activities, project meetings and reviewing project reports. Each member of the project team was selected based on experience, responsibility, or authority.

US Environmental Protection Agency

Project Manager -	Norma Lewis is responsible for providing US EPA oversight and review of the Technology Evaluation Workplan, workplan implementation and data evaluation reports.
QA/QC -	Sam Hayes is responsible for providing US EPA QA/QC review of the QAPP and data analysis.
Project Reviewers -	US EPA project team members are responsible for reviewing DTSC project team activities and reports.

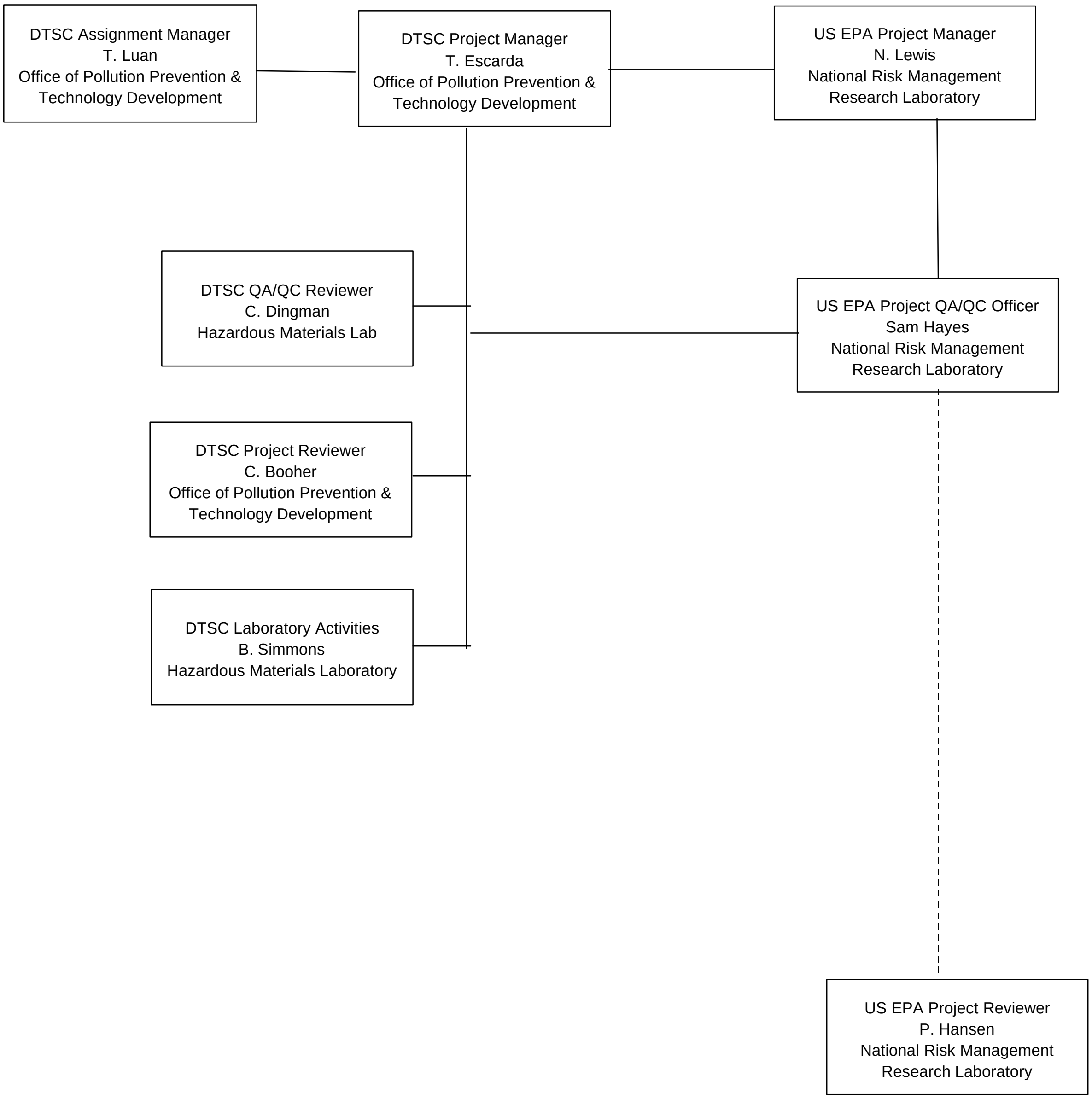

Figure 1. Project Organization Chart

4. PROBLEM DEFINITION/BACKGROUND

Problem Background

Household batteries, also referred to as consumer or dry cell batteries, are a problematic hazardous waste stream being considered for special waste management and reclamation strategies by the U.S. and state governments. The term "household battery" is used to define the general type of battery, not specific uses; many household batteries are used in industrial, commercial, and institutional settings. Often, there is no collection or recycling system for these batteries, leading to costly disposal in hazardous waste landfills, treatment in incinerators, or illegal disposal in less protective municipal landfills, composting facilities, or elsewhere.

In a 1992 report to the California Integrated Waste Management Board (CIWMB), Ernst and Young projected that approximately 684 million household batteries will be sold in California in the year 2000. (These figures were calculated based on national sales figures and using California's percentage of the nation's population.) Of these, approximately 117 million are nickel-cadmium. However, the largest portion, 465 million, are projected to be *primary* (non-rechargeable) *alkaline* batteries: zinc-manganese electrodes in an alkaline, typically potassium hydroxide, electrolyte. Rechargeable batteries are defined as *secondary*.

The concern with household batteries is the toxicity and mass of metals, not the batteries percentage of the municipal solid waste stream (approximately 0.005 percent by weight). Extremely toxic heavy metals such as mercury, lead, cadmium, nickel, and silver are of greatest concern.

Problem Definition

Used household batteries are a problem due to the mass and toxicity of heavy metals such as mercury, lead, nickel, cadmium, and silver. Also, recycling programs are virtually non-existent, thus most household batteries, even those that are hazardous waste, are disposed in municpal landfills, composting facilities, or incinerators.

Problem Resolution

Rayovac has developed and introduced to the market a secondary alkaline battery system: the Renewal$_{®}$ Rechargeable Alkaline Battery System (Renewal$_{®}$ System). The Renewal$_{®}$ System technology consists of rechargeable alkaline batteries, a charging device and method, and pertinent designer and consumer literature. Rayovac claims that its Renewal System prevents pollution by reducing the number of primary alkaline batteries requiring disposal. Rayovac claims that the Renewal System accomplishes this by significantly extending battery life through recharging, thus reducing the mass of batteries to be disposed. The Renewal System replaced Rayovac's nonrechargeable alkaline batteries with rechargeable alkaline batteries by modifying both the physical and chemical structure of the batteries.

Rayovac used several approaches to ensure reversilibility, including designing the cell to be anode (zinc) limited, and providing electronic means to prevent overdischarge of the manganese dioxide ($MnO_{2)}$ electrode in some devices that use Renewal cells. Recharging capability was further accomplished by reducing the amount of active ingredients, zinc and manganese dioxide, thereby increasing the internal void space so that hydrogen gas generated during recharging could be contained within the battery, thus preventing rupture and leakage of alkaline electrolyte. Silver was added to act as a catalyst in recombining the hydrogen gas and lead was added to the zinc gelling agent as a metal corrosion inhibitor.

5. PROJECT/TASK DESCRIPTION

The project objectives are to validate the technology claims (enclosed in **Appendix A**) proposed by Rayovac, and to acquire other technology performance information relevant to this evaluation.

There are two measurements required to validate Rayovac's claims: laboratory chemical analyses of Rayovac's Renewal batteries, and laboratory performance evaluation of Rayovac's Renewal System. No field tests, site visits, user interviews, or surveys are planned for this project.

Laboratory analyses are required to determine whether Rayovac's Renewal batteries pose a significant potential risk to human health and the environment. This could be the case if a significant increase in toxicity or mobility occurred with the reformulated primary alkaline batteries. In this project, the US EPA hazardous waste toxicity characteristic test, the Toxicity Characteristic Leaching Procedure (TCLP), and associated metals analyses, will be used to verify Rayovac's claims that the levels of metals are below the TCLP action levels.

The battery performance claims will be validated through testing by an independent laboratory using industry accepted standard tests to the extent possible. Currently, there are no industry accepted tests for performance of rechargeable alkaline batteries because this product only recently became commerically available. Therefore, testing procedures for non-rechargeable alkaline batteries, Rayovac charging practices, and rechargeable nickel-cadmium batteries (ANSI C18.2M-1991) will be used to derive test methods for performance of rechargeable alkaline batteries.

The tests primarily will be derived from American National Standard Institute (ANSI) C18.1M-1992 Dry Cells and Batteries -- Specifications, as developed by the National Electrical Manufacturers Association (NEMA). The performance will be measured in terms of hours of cumulative energy capacity over a finite number of discharge/charge cycles using defined initial and cutoff voltages at specified resistances. Section B2 discusses in detail the rationale for choosing and modifying the ANSI capacity tests.

A workplan outline identifying the activities required to evaluate Rayovac's technology is shown in **Figure 2**. The main activities are laboratory chemical and perfomance testing. Following these activities, the project team members will meet, discuss data results, and/or identify additional data needs. DTSC's Project Manager will prepare evaluation summaries following each major activity in the workplan, and a verification statement and report will be prepared. Section 7 identifies the supporting documentation and records required for the Project Team's evaluation.

A schedule for implementing the workplan is shown in **Figure 3**.

6. QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT

The project objectives are to validate the claims (enclosed in **Appendix A**) proposed by Rayovac, and to acquire other technology performance information relevant to this evaluation. The first objective is of highest importance to the evaluation of this project, followed by the second objective. As shown in **Figure 4**, there are no definite pass/fail criteria for verifying this project. The implications of all negative decisions are similar which include alternative actions that could be taken to continue the project, i.e., discuss results with the project team and Rayovac to modify claims and/or change operational procedures.

Laboratory analyses may be performed by either DTSC's HML, or US EPA's analytical laboratory. Alternatively, Rayovac may retain an independent certified analytical laboratory. As stated in the Foreword, both HML and US EPA laboratory Quality Assurance/ Quality Control (QA/QC) procedures conform to the requirements and guidelines of ANSI/ASQC E-41994. In general, an independent certified contract laboratory will be considered acceptable if at least one of the following conditions exist:

1. A competent certifying body having jurisdiction performs the laboratory certification;

2. The laboratory participates in a proficiency program in an appropriate field, and produces results;or

3. The laboratory produces QA/QC data with the results.

In general, when performing analyses for which no standard methods exist, or must be modified, the mehod will be considered acceptable if the method is either:

1. accepted by an appropriate government agency;

2. accepted by professional consensual organizations; or

3. documented in scientific peer-reviewed literature.

In addition, to be considered independent, the data shall be submitted directly to the verification project manager by the laboratory.

Figure 2. Workplan Outline for Rayovac Verification Project

1. Conduct Modified ANSI Capacity Tests

- contract with qualified independent testing facility. (Rayovac)
- collection of battery samples from commercial outlet. (testing facility)
- perform ANSI C18.1M - 1992 Capacity tests for sizes AAA, AA, C, & D. Modified to be continuous, to use Rayovac charging units, and to charge for 16 hours, then continue tests for 25 cycles.

- Review Laboratory data (Project Team)

- Prepare Summary of Results (DTSC Project Manager)

2. QA/QC Review of Procedures and Data - (QA/QC Project Team Members)

3. Identify Outstanding Issues, Recommend Further Actions, and Resolve

- (Project Team Members and Rayovac)

4. Draft Evaluation Report & Proposed Verification Statement - (DTSC Project Manager)

5. Conduct Internal and External Report Review - (Project Team Members)

6. Incorporate Significant Comments into Final Report & Verification Statement - (DTSC Project Manager)

7. Issue Verification Statement - (US EPA)

Figure 3. Rayovac's Technology Certification/Verification Schedule

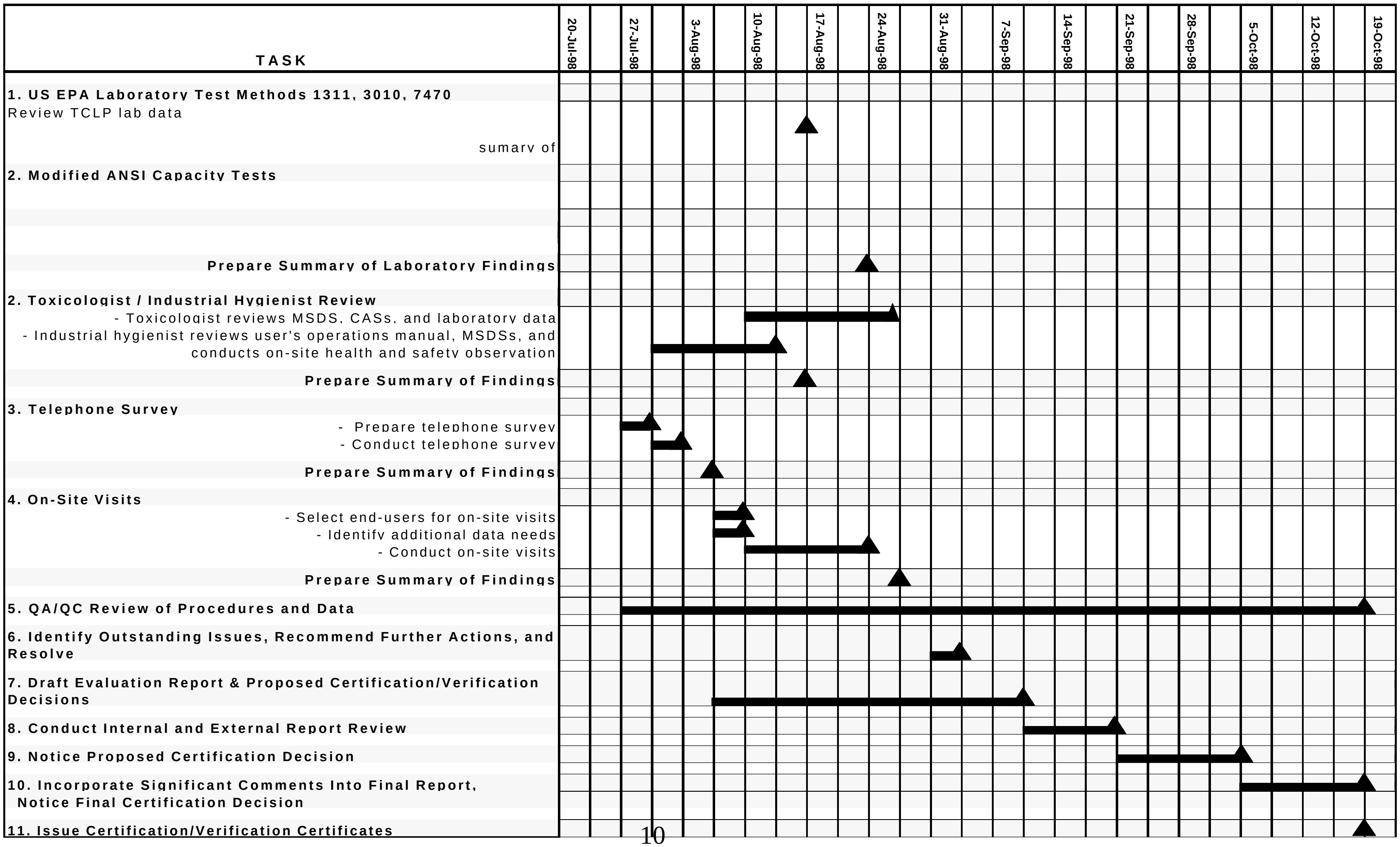

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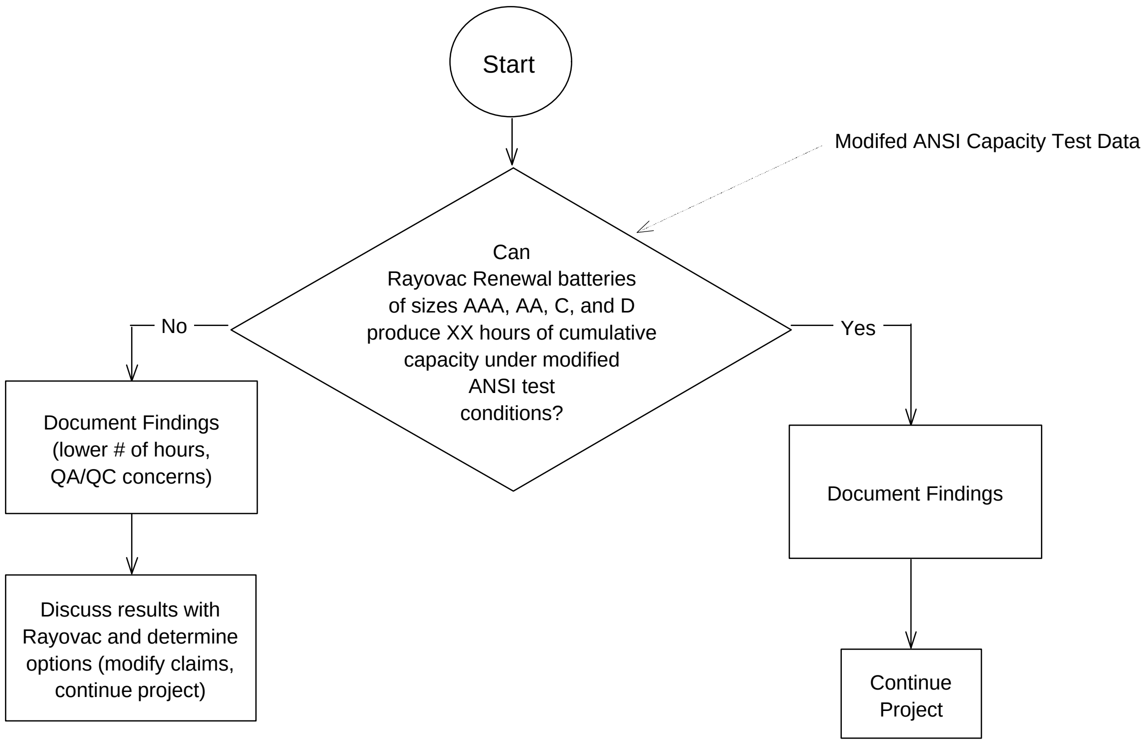
Figure 4. Multiple Decision Flowchart #1



7. DOCUMENTATION AND RECORDS

There are two data records that are important to the assessment of this project which include:

- laboratory data provided by an independent certified chemical analysis laboratory; and
- performance testing by an independent qualified battery performance testing facility.

The laboratory data packages will consist of records documenting the sampling, transporting, chain-of-custody, storing, testing, recording and analysis of data and QC results.

If a contract laboratory is used, data control practices consistent with the requirements of Section A6 shall be used. For information, the following summarizes DTSC HML's laboratory data control practices (**Appendix F**):

- Requestor completes Authorization Request Form. This form is used to identify type of lab tests needed and assigns Laboratory Authorization Number.
- Requestor, at time of sample collection, completes Hazardous Materials Sample Analysis Request. This form documents when and where sample was collected, sample container type and size, what analysis are required, and provides for chain-of-custody. The Laboratory Authorization Number is also identified on the this form. Sample labeling is also required.
- HML receives and logs in sample (internal tracking system). A chemist is then assigned and logs out sample upon time of testing.
- Upon evaluation, a laboratory data package is generated which includes the following documentation:
  - Laboratory Analytical Report
  - Laboratory Quality Control Report
  - Sample Analysis Request Form
  - Internal Sample Tracking Form
  - Raw Data
  - Sample Preparation Form
  - Standard Preparation Form
  - Notes from Laboratory Notebook
  - Instrument Analysis Log
- Laboratory data package is copied and sent to the requestor. Original laboratory data package is archived indefinitely both in hard and electronic copy at HML.
- Requestor completes Sample Disposal Form upon completion of project.

B. MEASUREMENT / DATA ACQUISITION

1. SAMPLING PROCESS DESIGN

The Rayovac Verification Project sampling design includes:

- sampling Rayovac Renewal batteries for leachable metals using the federal Toxicity Characteristic Leaching Procedure (TCLP) and appropriate metals analyses, as discussed in Section B.4.a; and

- conducting performance tests, as measured by cumulative hours of service, using modified ANSI battery performance tests, as discussed in Section B.4.b.

The schedule for conducting lab tests is shown in **Figure 2.** See the next section for specific sampling requirements.

2. SAMPLING METHODS REQUIREMENTS

2.a. <u>Analytical Testing</u>

Samples of Rayovac batteries will be collected by either a representative from the regulatory agencies, or by a representative from an independent certified analytical laboratory. In either case, the samples will be representative of commerically available lots in a retail outlet. Sufficient batteries will be purchased such that TCLP and applicable metals analyses, and standard QA/QC procedures can be performed. Only whole batteries will be used for samples because the metals in batteries are not uniformly distributed. Sample size and preparation shall be conducted according to the Rayovac method “Cell Crushing Preparation for Testing Primary Whole Cells and Batteries,” (**Appendix B**).

Note: no standard method exists for preparing dry cell batteries for analysis; however, HML has reviewed Rayovac’s procedure and is satisfied that it meets the requirements for obtaining representative samples.

Samples may be prepared and anlalyzed at either a regulatory agency’s laboratory, for example, HML, or at an independent certified analytical laboratory. “Independent” is defined as a laboratory not owned or operated by Rayovac Corporation; however, Rayovac may choose to contract with a certified analytical laboratory. In this case, the data will be considered independent if the reports are submitted directly to the regulatory agency without prior handling by Rayovac Corporation.

The regulatory agencies reserve the right to obtain samples for verification of the independent laboratories results. If samples are analyzed by HML, the following procedure will be followed: A separate Sample Analysis Request Form (i.e., chain-of-custody form) will be completed for each sample submitted to HML. Information regarding sample type, batch number, sample quantity, container size and type, and other field information will be recorded in this form.

The following are laboratory addresses and contacts.

DTSC HML
700 Heinz St., Suite 150
Berkeley, California 94710
Contact: Ms. Pam Schiro
Phone: (510) 540-3101
Fax: (510) 849-5271

Contract Lab (TBD)

2.b. Performance Testing

Battery samples will be obtained in the same manner as those used in analytical tests; however, the number of batteries obtained will be specified by the ANSI specification sheets for capacity testing of primary alkaline batteries for sizes AAA, AA, C, and D (**Appendix E**).

Performance Testing will be conducted by an independent laboratory qualified in capacity testing for batteries. In the past, Rayovac has contracted with Tracor Lab, and DTSC has already reviewed Tracor's qualifications. See **Appendix D** for Tracor's Statement of Qualifications. Again, results will be considered independent if the testing facility submits the raw data, calculations, and reports directly to the regulatory agencies; Rayovac may take split lots to run tests at their own facility if desired. It is expected that Tracor will perform the capacity tests. Tracor's address and contact person is listed below:

Tracor, Inc.
Tracor Applied Sciences, Inc.
Energy & Environmental Services Division
Tracor Battery Technology Center
1601 Research Boulevard
Rockville, Maryland 20850
Contact: Dr. Richard Walk (301) 838-6220

3. SAMPLE CUSTODY REQUIREMENTS

DTSC and USEPA have established procedures for maintaining the control and integrity of samples from collection, preservation, transportation, laboratory services, storage, and disposal. DTSC's laboratory sample control procedures are identified in **Appendix F**. These procedures or equivalent sample control procedures by a lobratory meeting the criteria of Section A2 will be followed. DTSC's HML sample custody requirements are briefly discussed below:

A Sample Analysis Request (SAR) is required upon submittal of the sample to the laboratories. The SAR also includes the sample chain-of-custody record. Once the SAR is received, a sample control number is assigned to the sample.

DTSC assigns an authorization number (AN) prior to receiving a sample for analysis. The AN is assigned based on designated laboratory, fiscal year, and the number of requests to date. For example, the control number SCN 2000 would indicate that DTSC's HML in southern California is the designated laboratory to receive the sample, the sample is received in the 1997-1998 fiscal year (designated by "N"), and that this is the 2000th sample received to date. Once a sample is received at the laboratory, DTSC will assign a sample number which is based on the sequential number of samples received.

4. ANALYTICAL METHODS REQUIREMENTS

4.a. Analytical Test Methods

Table 1 identifies the analytical test methods to be used in analyzing the sample batteries. A description of the test methods and the targeted compounds are found in **Appendix C**.

Table 1. Project Laboratory Test Methods

Test Method	Target Compound(s)
EPA Test Method 3010	Ag, As, Ba, Cd, Cr, Pb, Se
EPA Test Method 7470	Hg
EPA Test Method 1311	TCLP Extraction

4.b. Performance Test Methods

Table 2 identifies the performance (capacity) test methods to be used in analyzing the sample batteries. The background and rationale for choosing and modifying the ANSI capacity tests are described below:

One measure of battery performance is initial capacity expressed in terms of service life using a given load (electrical resistance), schedule (for intermittent tests), and discharge to a specified end point voltage. "Initial" tests are intended to show the conditions of fresh batteries, and shall be started within 30 days of purchase from the commercial outlet. Specific tests have not been developed for secondary alkaline batteries. In their absence, batteries are charged for 16 hours, and standard tests for primary batteries are repeated between recharges. Sixteen hours was chosen for charge period per the manufacturer's recommendation, and is consistent with Section 12.2.10 of ANSI C18.1M -1992 (**Appendix E**). See **Appendix G** for Rayovac literature on charging practices.

Prior to 1992, ANSI capacity test methods specified that the tests be continuous in nature -- the batteries were continuously drained from the nominal voltage to the specified cutoff voltage. However, in actual practice devices are typically used for a certain time period, then rested. In 1992, the standard was changed to more accurately reflect actual practice, i.e., intermittent test schedules were developed. Continuous tests are considered conservative with respect to battery performance compared to present-day tests because in the current tests the batteries are not being given a chance to recover before being discharged to the cutoff voltage. For these modified tests, recharging will be performed using the Rayovac charging unit, and will be charged for 16 hours, then the next testing cycle shall begin.

The size and type of batteries and conditions of use determine the test specification to be applied. Tests shall be conducted in accordance with ANSI C18.1M-1992 Section 12 (Capacity Tests) and the applicable battery specification sheet for each size battery. The test specification that best represents any particular use is that which most nearly duplicates the load, schedule, and end-point voltage when in actual use. **Tables 3** contains the ANSI C18.1M-1992 battery capacity tests, for 1.5V alkaline manganese dioxide batteries, sizes AAA, AA, C, and D. For example, the four variations of testing of size D alkaline manganese dioxide batteries are based on typical uses of portable lighting, toys, personal tape recorders/cassette players, and transistor radios. To approximate the requirements of a cassette player, the test conditions are at a resistance of 3.9 ohms, test schedule of one hour per day, and an end-point of 0.9 Volts (V).

For this project, no testing is proposed for intermittent testing because all tests will be continuous. (Note: Section 12.2.10 of ANSI C181M -1992 provides recommendations for hours on-load and off-load per 24 hour continuous testing when formulating new tests.) Also, no pulse testing is proposed for photoflash applications.

Table 2. Project Laboratory Capacity Test Specifications
1.5 Volt Alkaline Manganese Dioxide Dry Cells
ANSI C18.1M-- 1992 (Modified)

Battery Size	Load (Ohms)	EndPoint (Volts)	Typical Use	Battery Specification Sheet
AAA	10	0.9	Tape Recorders	20-0413-1752
AA	3.9	0.8	Motor & Toys	20-0571-1988
	10.	0.9	Tape Recorders	
	75.	0.9	Transistor Radio	
C	3.9	0.9	Portable Lighting	20-1031-1969
	3.9	0.8	Toys	
	6.8	0.9	Tape Recorders	
D	2.2	0.9	Portable Lighting	20-1346-2421
	2.2	0.8	Toys	
	3.9	0.9	Tape Recorders	
	39	0.9	Transistor	

NOTE: The priority tests are the categories of motors and toys, and tape recorders. The reasons for this are that the tests which require the endpoint voltage to be 0.8V (motors and toys) are more demanding, tape recorders are a large part of the market, and transistor radios require the longest amounts of time to test because of the very slow drain on the batteries.

Four cells of each size battery will be tested for 25 discharge/charge cycles for each consumer application for which Rayovac desires verification. Tests will conform with ANSI C18.1M-1992 specifications except that tests will be continuous, not intermittent, and charging will be conducted using Rayovac's commerically available charging units. The PS1 charging unit will be used for testing the AAA and AA sizes, and the PS2 charging unit will be used for testing C and D sizes. The batteries will be charged for 16 hours, then the next testing cycle shall begin.

If a cell delivers less than 50 percent of the mean run time, the cell shall still be tested as per the other cells. The testing facility shall report the statistics for the full group of four cells, and the remaining group of three cells. At the conclusion of performance testing, Rayovac may perform additional analyses or testing to determine why the cell did not perform as expected.

Battery performance shall be reported as for each cell as hours of service per cycle, average hours of service per cycle for the four cells, cumulative hours of service after 25 cycles for each cell and the average cumulative hours of service after 25 cycles for the four cells. Minimum and maximum cumulative hours of service, and standard deviation shall also be reported. Data shall be reported as tables and charts.

5. QUALITY CONTROL REQUIREMENTS

DTSC HML's quality control practices are outlined in **Appendix F**. If a contract laboratory is retained, the laboratory shall be qualified as per Section A2, and shall use quality control practices consistent with the guidelines referenced in the Foreword.

6. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Any change-out of instrumentation will be documented in maintenance log or chemist/analyst log and a copy provided in the laboratory report.

Performance testing equipment shall conform to specifications of Section 12 (Capacity Test Requirements) of ANSI C18.1M-1992 (**Appendix E**).

7. INSTRUMENT CALIBRATION AND FREQUENCY

DTSC HML's instrument calibration for inorganic analysis is shown in **Appendix F**. If a contract laboratory is retained, the laboratory shall be qualified as per Section A2, and shall use instrument calibration and frequency practices consistent with the guidelines referenced in the Foreword.

For performance testing, the testing facility shall adhere to at the instrumentation requirements specified in ANSI C18.1M - 1992, and to at least the specifications outlined in the Tracor Statement of Qualifications (**Appendix D**)

8. DATA ACQUISITION REQUIREMENTS (NON-DIRECT MEASUREMENTS)

There are no types of data that will be acquired from non-direct measurements in this project.

9. DATA MANAGEMENT

All records used in sample collection, packaging, transportation, chain-of-custody, lab analysis and sample control, to final reporting will be filed with the appropriate laboratory and copies with DTSC's Project Manager (see **Appendix F** for sample and data control). The laboratories will keep all records in both electronic and hard copy format. Data and reports shall be submitted directly to DTSC's project manager concurrently to being submitted to Rayovac.

Reports generated by DTSC's Project Manager will be kept with the Project Manager in both hard and electronic format. Electronic reports will by copied to diskette for back-up and filed with DTSC's Assignment Manager.

All reports and data generated from this project will be centrally filed with OPPTD at a minimum of 3 years following certification/verification. At this time, DTSC's Assignment Manager will have the authority to transport the report and supporting data to State Archives.

C. **ASSESSMENT / OVERSIGHT**

During implementation of the workplan, Figure 3, DTSC's Project Manager will provide a weekly update to DTSC's Assignment Manager. The US EPA Project Manager and Rayovac will be updated biweekly on the project's status, either by telephone or e-mail. DTSC's Project Manager will frequently interface with the Project Team's QA/QC member on data collection procedures, data quality, and data analysis.

Following each major task, DTSC's Project Manager will prepare a "Summary of Findings". A copy of the Summary will be forwarded to each Project Team Member, Assignment Manager, and US EPA Project Manager and Quality Assurance (QA) Officer for review and comments. Following completion of the Workplan, the "Summary of Findings" will be combined into a Draft Evaluation Report. DTSC's Project Manager will provide a copy of the Draft Evaluation Report to the Project Team members, US EPA Project Manager and QA Officer, and Rayovac. DTSC's Project Manager will then conduct a project review meeting to discuss the final results of the project and draft a certification/verification decision. If inadequacies in the data are noted at this time, the Draft Evaluation Report will note these inadequacies and offer: 1) recommendations for additional field tests; 2) suggested language reducing the scope of the certification/verification; and/or 3) proposed language for negative certification/verification decisions. The Draft Evaluation Report is then forwarded to the Technical Review Panel.

D. **DATA VALIDATION AND USABILITY**

1. DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

The sampling design is outlined in section B2. No deviations from the sampling design are anticipated. However, if any of the following conditions occur, then the sample laboratory analysis will be void:

- sample was collected or prepared in a non-indedpendent manner;
- sample contamination occurred; or
- QA/QC procedures were not followed.

Sample preservation, analytical methods, and data integrity will be validated by laboratory chemist, analyst, and supervisor and documented in the laboratory data package.

2. VALIDATION AND VERIFICATION METHODS

Validation and verification will be conducted by several members of the Project Team and at different stages of the project. Validation and verification are defined for this project as follows:

Validation - examining results of analytical tests and surveys to determine if data supports applicant's claims.
Verification - confirming that procedures and activities outlined in the project workplan were followed in generating data.

The project team will verify and validate the procedures and data generated by a contract laboratory. Cindy Dingman from DTSC Hazardous Materials Laboratory [(510) 540-2329] will verify and validate the procedures and data generated by DTSC's Hazardous Materials Laboratory (**Appendix F** discusses some key indicators that DTSC considers when determining validity of data), or by the independent certified analytical laboratory.

3. RECONCILIATION WITH DATA QUALITY OBJECTIVES

Laboratory metals analyses will be used to determine if a potential significant threat to public health or the environment exists. A potential significant threat to public health or the environment shall be deemed to exist if any metals levels are above the TCLP regulatory action levels. If the review of laboratory data indicates a threat to public health and the environment, the results will be discussed with Rayovac and a decision will be made as to whether to continue with the project. Project team does not anticipate any threats to public health and the environment; previous results reported by Rayovac to state agencies have below the action levels.

Performance data will be used to determine how many hours of service the various size batteries can deliver based on a finite number of discharge/charge cycles, continuous tests, and prescribed charge times with commercially available chargers, and ANSI capacity tests modeling selected consumer applications. The simulated consumer applications are either toys, portable lighting, portable transistor radios, or portable tape recorder/players, based on battery size.

Appendix A

Draft Verification Claims for Rayovac Renewal System

1. DRAFT METALS LEVELS CLAIMS

The California DTSC and US EPA verify that, in a single sampling and analysis event of four total samples, using the federal Toxicity Characteristic Leaching Procedure (US EPA Method 1311), and associated metals analytical methods (USEPA Method 3010 - Acid Digestion, and US EPA Method 7470 - Mercury), the following levels of metals for Rayovac's Renewal batteries, sizes AAA, AA, C, and D, were determined:

Metal	Size AAA	Size AA	Size C	Size D	Regulatory Threshold
Arsenic	*	*	*	*	5.0
Barium	*	*	*	*	100.0
Cadmium	*	*	*	*	1.0
Chromium	*	*	*	*	5.0
Lead	*	*	*	*	5.0
Selenium	*	*	*	*	1.0
Silver	*	*	*	*	5.0
Mercury	*	*	*	*	0.2

* To be reported

These results were obtained by purchasing samples of Rayovac Renewal batteries at a commerical retail outlet, preparing the batteries in accordance with the Rayovac "Cell Crushing Preparation for Testing Primary Whole Cells and Batteries," and performing the analytical tests and Quality Control. No extrapolations of these results to all Rayovac Renewal batteries can be made because the sample number was not large enough to be statistically valid.

2. DRAFT CUMULATIVE CAPICITY CLAIMS

The Rayovac Renewal® Rechargeable Alkaline Battery System consists of the Renewal® batteries, currently available as 1.5 volt (nominal) in sizes AAA, AA, C, and D; the Power Station™ PS1 and PS2 charging units, and pertinent technical and consumer literature. The Renewal® System can reduce the quantity of disposed primary alkaline batteries of the same size in most applications for which the primary alkaline batteries are appropriate. Under standard laboratory capacity test conditions (ANSI C18.1M-1992, "Dry Cells and Batteries - Specifications for Primary Cells," modified to be continuous instead of intermittent, and to allow for charging using the Renewal charging unit, after 25 charging cycles to specified voltage cutoff points at specified resistance loads that simulated typical consumer product applications, the Renewal® System's batteries supplied **XX** cumulative hours of service. The actual number of obtainable cumulative hours of service, and the number of recharge cycles necessary to obtain those hours of service, depends on a number of factors, such as depth of discharge, frequency of charging, type of application, and other user practices.

Appendix B

Rayovac Crushing Preparation for Testing Primary Whole Cells and Batteries

Appendix C

Project Analytical Laboratory Test Methods

Appendix D

Tracor Corporation Statement of Qualifications

Appendix E

Performance Capacity Test Methods: ANSI C18.1M-1992 (Modified)

Appendix F

DTSC HML Data Quality Control Practices

Appendix G

Rayovac Literature:

Note to Designers & Charging Recommendations