



Final Accreditation Report Version 3.0

for

Remedial Action Cost Engineering and Requirements
(RACER™)

Prepared for:

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Document Version	Revisions	Date	Changes
Version 1.0: Draft Document	--	2 August 2013	Draft 1
Version 1.0: Draft Final Document	Contractor incorporated comments from AFCEC/CZR	1 April 2014	Draft 1
Version 2.0: Draft Final Document	Contractor incorporated comments from AFCEC/CZR	16 April 2014	Draft 2
Version 3.0: Draft Final Document	<ul style="list-style-type: none"> - Contractor incorporated comments from AFCEC/CZR - Merged Section 4 (Accreditation Assessment) with Section 7 (Accreditation Resources). Subsequently renumbered sections. - Updated participants list in Section 5 - Added Distribution List (appendix F) 	22 April 2014	Draft 3

ACCREDITATION REPORT EXECUTIVE SUMMARY

This report justifies the approval of accreditation for the Remedial Action Cost Engineering and Requirements (RACER) cost estimating tool. RACER is a common use parametric cost estimating tool used to develop cost-to-complete estimates for environmental liabilities.

Accreditation was last performed on RACER 2001, version 3.0.0 and remained in effect for subsequent releases certified by the RACER Steering Committee (RSC). Subsequent version releases were certified by the RSC; however, significant updates to RACER cost models in 2008 along with updates to Department of Defense Instruction (DoDI) 5000.61 and accreditation documentation product templates produced by the Department of Defense Modeling & Simulation Coordination Office (DoD M&S CO) prompted the RSC to again obtain accreditation. For this effort, the RACER version analyzed for suitability is RACER 2008 (version 10.0.2).

The accreditation process ensures that RACER is suitable for use for its intended purpose. In addition, accreditation ensures that documentation supporting this claim is adequately maintained. Specifically, that:

- 1) Verification activities are planned, designed, performed, and documented
- 2) Validation activities are planned, designed, performed, and documented
- 3) Management of Verification and Validation (V&V) activities are executed and documented
- 4) Changes to the above are documented

The results of V&V activities demonstrate that RACER shall maintain its status as accredited to provide an automated, consistent, and repeatable method to estimate and document the program cost for the environmental cleanup of contaminated sites and to provide a reasonable estimate for program funding purposes consistent with the information available at the time of the estimate preparation. Accreditation shall remain valid for all future versions of RACER, provided:

- 1) DoD policy on model VV&A does not substantively change,
- 2) Verification activities are performed for each version, and adequate supporting documentation is maintained, and
- 3) Validation activities are performed as required for changes to model algorithms, and adequate supporting documentation is maintained

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The DoD M&S CO establishes recommended standards for VV&A documentation. These standards, if utilized, simplify the ongoing maintenance of VV&A documentation, and follow best practices for VV&A set by industry leading subject matter experts in modeling & simulation. It is recommended that supporting documentation be maintained in accordance with the templates provided by the M&S CO. The RSC should review and update the following documents:

Document
<i>RACER System Contingency Plan and Operating Procedures, Version 2002</i>
<i>Guidance for Verification and Validation of RACER Software, Version 2.0</i>
<i>RACER Management Plan (Final), September 2011</i>
<i>RACER Verification & Validation Plan</i>

The updating of VV&A documentation does not negatively affect the ability of the tool to produce cost estimates for its intended purpose and, as such, the tool is recommended for accreditation.

1. PROBLEM STATEMENT

US Government agencies are required to estimate future environmental cleanup costs; these cost estimates are then used as the basis for reporting outstanding environmental liabilities, as well as program and budget requirements. Defense Environmental Restoration Program (DERP) Management Guidance (March 2012), states that cost modeling tools may be used to develop cost estimates; however, it requires that computer models used for estimating costs for environmental liabilities are verified, validated, and accredited in accordance with the requirements specified in DoDI 5000.61, *DoD Modeling and Simulation (M&S) Verification, Validation and Accreditation* (December 2009).

Remedial Action Cost Engineering and Requirements (RACER) is a parametric cost estimating tool that can be used to develop cost-to-complete estimates. RACER began development in 1991 and was first released for Government use in 1992. The 1990 Chief Financial Officer's (CFO) Act, along with subsequent legislation, required federal agencies to improve financial management and reporting, and to provide accurate, complete, reliable, timely, and auditable financial information. A trained user can prepare such cost-to-complete estimates using RACER.

Enhancements and new technologies have been added to RACER over the past 22 years. The version of RACER to undergo Validation in 2009, RACER 2008, is a single-user desktop application developed using Microsoft® (MS) Visual Basic (VB) 6.0 and MS Access. The most current version is RACER 11.1—a single-user desktop application developed using MS VB.NET and MS Access. The cost models were not altered when RACER moved from the VB 6.0 development platform to the VB.NET development platform.

In accordance with the definitions specified in DoDI 5000.61, RACER is a common use M&S application “provided by a DoD Component to two or more DoD components.” The US Air Force is the RACER Proponent.

The purpose of this Accreditation Report is to document V&V activities for the RACER application in accordance with DoDI 5000.61. Maintaining ongoing accreditation of RACER is paramount to showing it can be used to develop accurate, complete, reliable, timely, and auditable cost estimates.

This report has been prepared in accordance with the Accreditation Report template, provided by the DoD M&S CO. Sections not applicable to RACER have been omitted.

1.1 Intended Use

In 2001 Headquarters (HQ) Air Force Civil Engineer Support Agency (AFCESA) accredited RACER for the following intended use:

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To provide an automated, consistent, and repeatable method to estimate and document the program cost for the environmental cleanup of contaminated sites and to provide a reasonable estimate for program funding purposes consistent with the information available at the time of the estimate preparation.

In the 1990s, Congress passed sweeping financial management reform legislation including the CFO Act of 1990, the Government Performance and Results Act (GPRA) of 1993, the Government Management Reform Act (GMRA) of 1994, and the Federal Financial Management Improvement Act (FFMIA) of 1996. Such legislation aims to improve financial management, promote accountability and reduce costs, and emphasize results-oriented management. These Acts require each executive agency to prepare and submit to the Director of the Office of Management and Budget a complete, accurate, and auditable financial statement for the preceding fiscal year. Environmental liability estimates are one source of the financial information reported on agencies' annual financial statements as well as on the DoD Annual Report to Congress. As such, the environmental liability estimates must be accurate, complete, reliable, timely, and auditable.

Cost-to-complete (CTC) estimates form the basis of the environmental liability line items reported in the annual financial statements and must be updated annually. Environmental liabilities are reported on Notes to each Agency's balance sheets. For several DoD and non-DoD agencies, RACER is one of the primary methods used to create standardized cost estimates for current and future environmental liabilities.

1.2 M&S Overview

RACER employs a patented parametric cost modeling methodology using over 113 technology-specific cost models (technologies) that represent various applications related to site remediation.¹ Each of the technologies is based on generic engineering solutions for environmental projects, technologies, and processes. These generic engineering solutions were derived from historical project information, industry data, government laboratories, construction management agencies, vendors, contractors, and engineering analysis. When creating an estimate in RACER, the user enters site-specific information to tailor the generic engineering solutions to reflect project-specific conditions and requirements. The tailored design is then translated into specific quantities of work, and the quantities of work are priced using current price data. Assemblies in the RACER database correlate with costs reported in the Government Cost Book (formerly the Unit Price Book, or UPB), published by the Tri-Service Automated Cost Engineering Systems (TRACES) Committee.

To aid in localizing RACER estimates, national average unit costs for assemblies in the RACER database are derived primarily based on the Government Cost Book. The area cost factor (ACF) for

¹ There are 113 RACER cost models available to the standard RACER user. US Air Force users approved to use the Military Munitions Response Program (MMRP) Supplemental Investigation technology have 114 cost models available in RACER 2008.

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the estimate and a safety level cost adjustment are applied to calculate the adjusted unit price for each assembly to arrive at the adjusted direct cost. Direct costs are marked up using a series of factors relating to various aspects of the work.

Suggested configuration changes to RACER are controlled according to the following two plans: the Software Configuration Management Plan for RACER Software System (Version 4.0, dated February 26, 2003 - DRAFT) and the RACER Change Management Plan (Version 2.01, dated July 2007; updated in 2011 and consolidated into the larger RACER Management Plan, dated September 2011).² The Configuration Management Plan applies to changes to the structure of the application (source code, underlying data, requirements, model algorithms, application versioning, etc.), whereas the Change Management Plan describes the relevant parties and their roles and responsibilities.

For RACER, Change Management processes ensure that changes to the application are approved and documented. Changes to RACER that have been approved are included in an annual update. The RACER Management Plan provides a process where all participating federal agencies have involvement and RACER continues development in a manner consistent with fulfilling the site cleanup needs of actively participating agencies. All enhancements and revisions to the application, database, processes, and documentation are fully coordinated with participating federal agencies through the use of the RACER Management Plan.

1.3 M&S Application

RACER is a cost estimating tool that can be applied to all phases of remediation. It operates through a number of technology-specific cost models that allow the user to input data that correlates with the anticipated work, resulting in assembly quantity calculations.

The following are categories of remediation that can be estimated using RACER:

- Pre-Studies
- Studies
- Removal Action/Interim Corrective Measures
- Remedial Design/Corrective Measures Design
- Remedial Action/Corrective Measure Implementation
- Operations and Maintenance
- Long Term Monitoring
- Site Close-out

² At the time the RACER Validation Report and RACER V&V Report were prepared, the Change Management Plan was one of three documents that describe the overall business management of RACER; in 2011 those three documents were combined into one larger RACER Management Plan.

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After completing an estimate, users can generate a wide variety of reports documenting the estimated cost for the project. Additionally, estimates can be imported into the US Army Environmental Command (USAEC) and the US Army Corps of Engineers (USACE) management systems. Generating reports and importing estimate information into management systems are the two most common methods used by agencies for documenting and tracking CTC information.

1.4 Accreditation Scope

The following excerpt from the RACER V&V Plan prepared by Earth Tech, Inc. (May 2008) provides the following justification for accreditation of RACER:

There are four primary reasons for getting RACER accredited. The first three reasons listed deal with meeting regulatory requirements. The final reason listed deals with increasing confidence in decision making.

- *The Air Force Audit Agency found that RACER did not conform to DoDI 5000.61 – DoD Modeling and Simulation Verification, Validation, and Accreditation³*
- *DoDI 5000.61 requires that M&S used to support the major DoD decision making organizations and processes...(DoD Planning, Programming, and Budgeting System) shall be accredited for that use*
- *Air Force Instruction (AFI) 16-1001 requires accreditation*
- *Increases credibility in the M&S outputs and reduces the risk of using the M&S. Overall this increases the confidence level of decisions made based on the outputs.*

RACER has undergone a number of changes since the 2001 V&V evaluation and system accreditation. A listing of these changes is included in the RACER V&V Report dated 2009 and Appendix B of the Final RACER V&V Plan (2008). The Final RACER V&V Plan (2008) also discusses the current state of the cost models and other RACER functionality.

Recent RACER releases have included the elimination of obsolete cost models and the development of new cost models. Available reports have also been expanded. The most frequently used models were re-engineered for RACER 2008 based on the collection of and comparison to historical project cost data. The default markup template and the markup process were completely redefined as well.

Each release of RACER includes updated assembly prices, area cost factors, per diem rates, and escalation factors. The RACER 2008 release includes extensive redefinition and updating of assembly costs using information from the most recent version of the Government Cost Book.⁴ Each assembly has been defined using Cost Book line items that improve documentation and maintainability of cost data within RACER. Except for a small number assemblies for which costs and supporting data are provided by USACE or the Air Force, all assemblies were defined using Cost

³ This statement can also be found in *RACER Accreditation Recommendation, Price Waterhouse Coopers, 2001*

⁴ At the time of the RACER 2008 release, this was the 2006 Cost Book.

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Book line items.⁵ Previous RACER releases included a mix of assemblies defined using the Cost Book and assemblies that relied on other data sources, thus the updated methodology is an improvement.

2. M&S REQUIREMENTS AND ACCEPTABILITY CRITERIA

Verification

Application testing must follow approved methods and standards; also, when tested, the models must meet these design specifications. For RACER, the Software Testing Plan (August 2007) describes the testing process for the application; the Software Test Results Report (October 2007) describes the results of the three phases of testing (alpha, beta, and final acceptance). The testing goals, as outlined in the Software Testing Plan, are shown in Table 2.0 below. These goals also serve as acceptability criteria for the verification portion of the V&V.

Table 2.0. Defect Goals for RACER testing, as Stated in the Software Testing Plan⁶

Defect Classification	# Allowed in Alpha Build	# Allowed in Beta Build	# Allowed in Released Version
Critical	3	2	0
Necessary	No stated goal	No stated goal	0
Cosmetic	12	6	3

Validation

The Tri-Service Parametric Model Specification Standard (April 1999) establishes criteria and standards for developing and updating parametric cost models like those used in RACER. The ranges of accuracy, as stated by the Association for the Advancement of Cost Engineering (AACEI), and as also reported in the Tri-Service Parametric Model Specification Standard, for preliminary (order of magnitude), secondary (budget), and definitive estimates are displayed in Table 2.1, below.

Description	Range
Preliminary (Order of Magnitude)	+ 50% to - 30%
Secondary (Budgetary)	+ 30% to - 15%
Definitive	+ 15% to - 5%

Table 2.1. AACEI Ranges of Accuracy

The following statement is from the Tri-Service Parametric Model Specification Standard:

⁵ A complete discussion of the sources of RACER Assembly Definitional Data can be found in Section 3.1 of the Final Database Update Report for RACER 2008 (August 2007)

⁶ Section 3.1.2 of the Final Software Testing Plan (August 2007)

Due to the lack of information in environmental remediation work, a parametric cost model would be used as a Preliminary or Order of Magnitude Estimate and should be evaluated as such. However, in some instances, including more complicated models that involve secondary parameters, it may be contained in the Secondary or Budget Estimate category.

Therefore, the acceptability criteria for the validation portion of the V&V are that RACER estimates should fall within -30% and +50% of actual costs.

3. M&S ASSUMPTIONS, CAPABILITIES, LIMITATIONS, & RISKS/IMPACTS

3.1 M&S Assumptions

RACER uses a patented methodology to generate parametric cost estimates. RACER technologies are based on generic engineering solutions for environmental projects, technologies, and processes. These solutions, and the resulting RACER estimates, are constrained by the amount and the accuracy of the project data gathered to create each of the cost models in the application. The project data used to support model (technology) development (“Historical Cost Data”) is collected by the development contractor, reviewed by the RACER Technical Review Group (TRG), and incorporated into a “technology addendum.” A “technology addendum” is created by the development contractor for each RACER cost model and reviewed for accuracy by the RACER TRG.

The accuracy of RACER estimates is further constrained by several additional factors:

- **The User.** The user preparing the estimate must be knowledgeable (i.e., officially trained) in the use of RACER.
- **What Was Known About the Project.** The user must know, at a minimum, all of the “required parameters” to be entered into each cost model. If assumptions are made about the values of required parameters, the accuracy of the assumptions will impact the accuracy of the resulting estimate.
- **Inaccurate Use of the Application.** Individual users will inevitably segregate project components differently. One user might, for example, add individual assemblies to account for waste disposal; a different user might employ the Residual Waste Management technology to account for these costs; a third user might employ the Load & Haul technology. Agencies can increase consistency amongst estimates by ensuring all of its users are uniformly trained and knowledgeable about RACER.
- **Changes in Project Scope.** RACER estimates are designed to be point-in-time estimates. If the project scope changes between estimate preparation and project execution, the accuracy of the estimate may be subject to change.
- **Changes in Design Standards.** RACER is continually updated to incorporate field-proven techniques for environmental remediation. Newer technologies, unique approaches,

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and experimental methods are not available as parametric models in RACER. If a project employs such techniques, the project may not accurately be estimated in RACER.

3.2 M&S Capabilities

In 2001, HQ AFCEA accredited RACER for the following intended use:

To provide an automated, consistent, and repeatable method to estimate and document the program cost for the environmental cleanup of contaminated sites and to provide a reasonable estimate for program funding purposes consistent with the information available at the time of the estimate preparation.

For all subsequent released version of RACER, the intended use remains the same.

3.3 M&S Limitations

The accuracy of the RACER models is constrained by the following:

- The amount of project data gathered to create each of the cost models in RACER
- The accuracy of project data gathered to create each of the cost models in RACER
- The accuracy of the algorithms employed in each RACER model
- The accuracy of the data used to populate the parameters of each cost model
- The training level/knowledge of the user preparing the estimate
- The methodology employed by the user to segregate project components and correlate those components to individual RACER cost models
- Whether the remediation technologies employed in the actual project are available for cost modeling in RACER.

RACER creates a point-in-time estimate based on generic engineering solutions that are known at the time. Unknowns can contribute to decreased accuracy.

3.4 M&S Risks/Impacts

The risk associated with developing and utilizing RACER for its intended use (creation of parametric cost estimates) is that the estimates will not be accurate enough to meet the standard for a preliminary estimate (-30%/+50%), as described in Section 2 of this document.

Verification involves testing the application to ensure it is functioning as intended and producing the associated documentation defining procedures, algorithms, etc. The risk associated with not performing this testing is that problems will be difficult to identify and correct without the proper testing and documentation.

Validation allows the opportunity to compare actual project costs with RACER cost estimates, and to verify the soundness of the generic engineering solutions presented in the algorithms within RACER. The risk associated with not performing validation activities is that there is then no benchmark to be used to evaluate the accuracy of the tool.

Overall, VV&A represents a best practice in the development of parametric models and will allow continued enhancement of RACER as a calibration tool.

4. ACCREDITATION RECOMMENDATIONS

Based on the documents reviewed, RACER meets the purpose for which it is intended—the ability to produce automated, consistent, and repeatable CTC estimates in support of environmental liabilities reporting and program funding purposes. The purpose of this Accreditation Report is to document that V&V activities for RACER have been performed in accordance with DoDI 5000.61.

It is recommended that RACER maintain its status as accredited to provide an automated, consistent, and repeatable method to estimate and document the program cost for the environmental cleanup of contaminated sites and to provide a reasonable estimate for program funding purposes consistent with the information available at the time of the estimate preparation.

Maintaining ongoing accreditation of RACER is paramount to showing it can be used to develop accurate, complete, reliable, timely, and auditable cost estimates. The documents supporting VV&A of RACER, described herein, should be maintained on a regular basis, and updated to reflect suggested formats provided by the DoD M&S CO. It is recommended that the RACER Steering Committee plan resource allocations accordingly to ensure ongoing maintenance of these documents.

The updating of VV&A documentation does not negatively affect the ability of the tool to produce cost estimates for its intended purpose and, as such, the tool is recommended for accreditation.

Accreditation shall remain valid for all future versions of RACER, provided:

- 1) DoD policy on model VV&A does not substantively change,
- 2) Verification activities are performed for each version, and adequate supporting documentation is maintained, and
- 3) Validation activities are performed as required for changes to model algorithms, and adequate supporting documentation is maintained

5. KEY PARTICIPANTS

Per Section 4 of the Guidance for Verification and Validation of RACER Software, Version 2.0, the following are roles, assignments, and key responsibilities.⁷

5.1 Accreditation Participants

⁷ The organizations listed as Accreditation Authority and Accreditation Agency have been updated to reflect current Air Force organization, thus differ slightly from the Section 4 of the reference document.

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Role: Accreditation Authority

Assignment: AFCEC/CL

Key Responsibilities:

- Identifies pertinent parameters and constraints that impact the V&V planning and implementation process, including M&S acceptance and accreditation measures of effectiveness/measures of performance (MOEs/MOPs).
- Determines the need to form a TRG for review of V&V plans and results.
- Selects or approves personnel that are involved in the M&S VV&A activities—e.g., verification, validation, or accreditation Agents, optional TRG members, other subject matter experts (SMEs), etc.
- Approves, funds, and monitors the implementation of all V&V activities that directly support the upcoming accreditation decision.
- Documents M&S application accreditation decisions after review of supporting accreditation reports.
- Ensures completion and dissemination of appropriate V&V or accreditation reports.
- Makes and documents the model accreditation decision.

Role: Accreditation Agent

Assignment: AFCEC/CZR

Key Responsibilities:

- Serves as a source of advice and expertise to the accreditation authority concerning VV&A issues.
- Assists accreditation authority in identifying M&S acceptance and accreditation MOEs/MOPs.
- Performs M&S accreditation assessment and determines any deficiencies between documented M&S capabilities and accreditation requirements which require further V&V.
- Assists accreditation authority in determining the need to form a TRG and, as the accreditation authority's representative, chairs subsequent TRG proceedings.
- Ensures, as the accreditation authority's representative during the V&V planning and implementation process, that the approved plan will provide sufficient V&V to support the accreditation decision while remaining within accreditation authority-established constraints.
- Prepares accreditation report documentation, based on the accreditation assessment, along with any additional V&V and Independent V&V (IV&V) activities and independent endorsements from bodies with appropriate technical/domain expertise, for accreditation decision, and afterwards disseminates the completed accreditation report.
- Forwards a copy of the accreditation report to the appropriate M&S V&V Manager for update and archiving purposes.

5.2 V&V Participants

Role: V&V Manager

Assignment: RACER program manager. The V&V Manager may utilize contract support to fulfill responsibilities.

Key Responsibilities:

- Oversees all executed V&V activities supporting the model acceptance/accreditation requirements defined by the accreditation authority.
- Provides expertise on current and previous V&V efforts and baseline V&V status (established for legacy models), to all HQ Air Force, Major Command (MAJCOM), Forward Operating Area (FOA), or any other DoD, federal component, or model's user community.
- Develops a long-range plan that prioritizes V&V activities for known model deficiencies and upcoming model enhancements/upgrades.
- Coordinates the V&V requirements related to proposed model maintenance, upgrade, and configuration changes.
- Establishes, operates, or maintains a repository of all current and historic V&V information and provides V&V status updates.
- Advocates for resources needed to carry out the previously described V&V management responsibilities. This could include some "cost sharing" arrangements with the model's user community.
- Maintains all V&V results in a centralized location available via the M&S Resource Repository (MSRR).
- Ensures the MSRR is consistent and compatible to the DoD MSRR and available to all model users. Repository operations must facilitate M&S community queries and data access to establish the current model version's baseline V&V status, model VV&A, and usage history.

Role: Verification Agent and/or Validation Agent

Assignment: The US Army RACER POC is assigned. The US Army RACER POC will utilize USACE Hazardous, Toxic, and Radioactive Waste Cleanup (HTRW) Center of Expertise (CX) Omaha support to fulfill responsibilities. For RACER 2008, USACE HTRW CX Omaha is the Verification Agent. The Validation Agent is the Army RACER POC.

Key Responsibilities:

- Serves as a source of advice and expertise to the accreditation authority and accreditation agent concerning V&V issues.
- Develops a plan, including resource requirements, that addresses the V&V deficiencies identified by the accreditation agent while remaining within the accreditation authority-identified constraints. If this is not possible, the agent(s) will work with the accreditation

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- agent to develop risk reduction and V&V plans that together will meet accreditation authority acceptance criteria and constraints.
- Provides a suggested list of TRG members to the accreditation authority and accreditation agent, and actively participates in any subsequent TRG meetings.
 - Performs all V&V activities and prepares the final V&V report for submission to the accreditation agent and the V&V Manager.
 - Forwards the V&V report and supporting documentation to the accreditation agent for inclusion into the accreditation report. A copy of this report and documentation is forwarded to the appropriate M&S V&V Manager for update and archiving purposes.

5.3 Other Participants

Application Sponsor/User: RACER Steering Committee and TRG (for RACER 2008, composed of US Army, US Air Force, USACE (Omaha), US Department of Energy (DOE), US Navy)

RACER Developer: Earth Tech, Inc.⁸

Data Source: USACE (Huntsville)

Technical Review Group: US Army, US Air Force, USACE (Omaha), DOE, Environmental Protection Agency (EPA), US Navy

SMEs: US Army, US Air Force, USACE (Omaha), DOE, EPA, Naval Facilities Engineering Command (NAVFAC)

6. ACCREDITATION ASSESSMENT AND RESOURCES

6.1 Accreditation Resources Expended

This subsection identifies the resources used to accomplish the accreditation. The information provided here includes the name of the document/deliverable, the list of required resources (e.g., SMEs) used to accomplish it, completion dates, and the POC.

Document/Deliverable	Required Resources	Delivery Date	POC
<i>RACER System Contingency Plan and Operating Procedures, Version 2002</i>	SMEs and contractor support	April 2002	Earth Tech, Inc., Greenwood Village, CO
<i>Guidance for Verification and Validation of RACER Software, Version 2.0</i>	SMEs and contractor support	March 2006	Booz Allen Hamilton, San Antonio, TX
<i>Final Software Requirements Document For RACER 2008 Enhancements</i>	SMEs and contractor support	February 2007	Earth Tech, Inc., Greenwood Village, CO

⁸ The RACER 2008 developer was Earth Tech, Inc.; Earth Tech, Inc. is now known as AECOM.

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Document/Deliverable	Required Resources	Delivery Date	POC
<i>Final Technical Memorandum Evaluation of the Markup Template for RACER 2008</i>	SMEs and contractor support	May 2007	Earth Tech, Inc., Greenwood Village, CO
<i>RACER Business Management Plan, Version 3.01</i>	SMEs and contractor support	July 2007	Booz Allen Hamilton, San Antonio, TX
<i>RACER Change Management Plan, Version 2.01</i>	SMEs and contractor support	July 2007	Booz Allen Hamilton, San Antonio, TX
<i>RACER Quality Management Plan, Version 2.01</i>	SMEs and contractor support	July 2007	Booz Allen Hamilton, San Antonio, TX
<i>RACER 2008 Alpha Build</i>	SMEs and contractor support, TDY Funding	August 2007	Earth Tech, Inc., Greenwood Village, CO
<i>Final Software Testing Plan, RACER 2008 Maintenance and Support</i>	SMEs and contractor support	August 2007	Earth Tech, Inc., Greenwood Village, CO
<i>RACER 2008 Beta Build</i>	SMEs and contractor support, TDY Funding	September 2007	Earth Tech, Inc., Greenwood Village, CO
<i>Software Test Results Report for RACER 2008, Final Acceptance Testing Results</i>	SMEs and contractor support	October 2007	Earth Tech, Inc., Greenwood Village, CO
<i>RACER 2008 Final Release</i>	SMEs and contractor support	November 2007	Earth Tech, Inc., Greenwood Village, CO
<i>Revised Final Database Update Report for RACER 2008</i>	SMEs and contractor support	November 2007	Earth Tech, Inc., Greenwood Village, CO
<i>Revised Sensitivity Analysis Report for Final Version of RACER 2008</i>	SMEs and contractor support	November 2007	Earth Tech, Inc., Greenwood Village, CO
<i>RACER Verification & Validation Plan</i>	SMEs and contractor support	May 2008	Earth Tech, Inc., Greenwood Village, CO
<i>RACER 2008 Final Technology History Report</i>	SMEs and contractor support	July 2008	Earth Tech, Inc., Greenwood Village, CO
<i>Final Validation Report for RACER Services and Verification and Validation</i>	SMEs and contractor support	September 2009	Booz Allen Hamilton, San Antonio, TX
<i>Final Verification and Validation (V&V) Report for RACER Services and Verification and Validation</i>	SMEs and contractor support	September 2009	Booz Allen Hamilton, San Antonio, TX

6.2 Actual Accreditation Milestones and Timeline

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This subsection provides a table of the overall program timeline with program, development, V&V, and accreditation milestones.

Document/Deliverable	Delivery Date
<i>RACER System Contingency Plan and Operating Procedures, Version 2002</i>	April 2002
<i>Guidance for Verification and Validation of RACER Software, Version 2.0</i>	March 2006
<i>Final Software Requirements Document For RACER 2008 Enhancements</i>	February 2007
<i>Final Technical Memorandum Evaluation of the Markup Template for RACER 2008</i>	May 2007
<i>RACER Business Management Plan, Version 3.01</i>	July 2007
<i>RACER Change Management Plan, Version 2.01</i>	July 2007
<i>RACER Quality Management Plan, Version 2.01</i>	July 2007
<i>RACER 2008 Alpha Build</i>	August 2007
<i>Final Software Testing Plan, RACER 2008 Maintenance and Support</i>	August 2007
<i>RACER 2008 Beta Build</i>	September 2007
<i>Software Test Results Report for RACER 2008, Final Acceptance Testing Results</i>	October 2007
<i>RACER 2008 Final Release</i>	November 2007
<i>Revised Final Database Update Report for RACER 2008</i>	November 2007
<i>Revised Sensitivity Analysis Report for Final Version of RACER 2008</i>	November 2007
<i>RACER Verification & Validation Plan</i>	May 2008
<i>RACER 2008 Final Technology History Report</i>	July 2008
<i>Final Validation Report for RACER Services and Verification and Validation</i>	September 2009
<i>Final Verification and Validation (V&V) Report for RACER Services and Verification and Validation</i>	September 2009
<i>Final RACER Management Plan</i>	September 2011

7. ACCREDITATION LESSONS LEARNED

The development and fulfillment of any successful and streamlined process necessarily includes adjustments to its steps. This section provides a summary of the adjustments and lessons learned during the accreditation process.

- To simplify ongoing maintenance, RACER management documents should be updated to reflect templates and naming conventions provided by the M&S CO. Contractors tasked to support VV&A activities should be directed to these standard templates in their contract Statements of Work/Performance Work Statements. Contract deliverables should be reviewed against these templates. Particularly, the document titled "Guidance for VV of RACER," which serves as the RACER Accreditation Plan, should be referred to as such throughout RACER management and V&V documentation.
- The M&S CO has a staffed Help Desk available to answer inquiries related to VV&A. The RSC and TRG should refer to this resource when future questions arise.
- DoDM 4715.20 (DERP Management Guidance) states that Components are responsible for ensuring VV&A activities are performed; however, DoDI 5000.61 states that the proponent is responsible for VV&A. This contradiction should be clarified. Further, the RSC member

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agencies should seek clarification as to whether it is acceptable for components to utilize tools accredited by other components, or if each component must perform VV&A on a tool in order to utilize it for preparing CTC estimates.

APPENDIX A M&S DESCRIPTION

This appendix contains pertinent detailed information about the M&S being assessed.

A.1 M&S Overview and A.2 M&S Development and Structure

Model development and structure are described in the Technology Addendum for each RACER cost model, in the Final Software Requirements Document for RACER 2008 Enhancements, February 2007, and in the RACER 2008 Final Technology History Report, 24 July 2008. These documents are prepared and maintained by the development contractor.

A.3 M&S Capabilities and Limitations

M&S Capabilities and Limitations are discussed in the RACER V&V Report as follows.⁹

Model Capabilities

In 2001, HQ AFCEA accredited RACER for the following intended use:

To provide an automated, consistent, and repeatable method to estimate and document the program cost for the environmental cleanup of contaminated sites and to provide a reasonable estimate for program funding purposes consistent with the information available at the time of the estimate preparation.

For the 2008 version of RACER addressed in this report, the intended use remains the same.

Model Limitations

The accuracy of the RACER models is constrained by the following:

- The amount of project data gathered to create each of the cost models in the application
- The accuracy of project data gathered to create each of the cost models in the application
- The accuracy of the algorithms employed in each RACER model
- The accuracy of the data used to populate the parameters of each cost model
- The training level/knowledge of the user preparing the estimate
- The methodology employed by the user to segregate project components and correlate those components to individual RACER cost models
- Whether the remediation technologies employed in the actual project are available for cost modeling in the RACER application.

RACER creates a point-in-time estimate based on generic engineering solutions that are known at the time. Unknowns can contribute to decreased accuracy.

A.4 M&S Use History

Model use history is described in the *RACER 2008 Final Technology History Report (24 July 2008)*.

⁹ Minor alterations to the original text have been made to reflect updates and changes to terminology since publication; the updates do not alter the integrity or intended purpose of the original text.

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A.5 Data**A.5.1 Input Data**

Data entered as model input (“parameters”) are described in the *Technology Addendum* for each RACER cost model. These documents are prepared and maintained by the development contractor. The actual values to be entered for these parameters are based on best available site information maintained by individual US Government installations.

A.5.2 Output Data

Model output data are costs. The costs are derived from the algorithms utilized in each technology. The algorithms utilize user input data to define which assemblies are to be used, and the quantities of these assemblies. The algorithms that generate the costs are described in the *Technology Addendum* for each RACER cost model. These documents are prepared by the development contractor and maintained by the Air Force.

A.6 Configuration Management

Details of RACER configuration management are described in the *Software Configuration Management Plan for RACER Software System* (Version 4.0, dated February 26, 2003 - DRAFT).

APPENDIX B M&S REQUIREMENTS TRACEABILITY MATRIX

The Requirements Traceability Matrix for RACER 2008 was developed by the development contractor and included in the Final Work Plan for RACER 2008 Maintenance and Support (April 30, 2007). The matrix matches contract requirements to the relevant document reference within the project work plan and acceptability criteria and their measures and metrics to each M&S requirement. The M&S Requirements Traceability Matrix provides a visual demonstration of the degree to which a relationship can be established between the M&S requirements and associated acceptability criteria for accreditation.

Contract Requirement	Work Plan (WP) Document Reference (Section)
Project Scope	2.0
Project Objectives	2.1
Major Requirements	2.2
Proposed Business Process Model	2.3
Specific Exclusions	2.4
Assumptions, Dependencies, and Constraints	2.5

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Contract Requirement	Work Plan (WP) Document Reference (Section)
Resource Allocation	2.6
Deliverables	2.7, 7.0
Project Organization	2.8
Project Controls	3.0
Software Development Plan	3.1
Change Control Procedures	3.2
Action Tracking / Issue Management	3.3
Progress Tracking	3.4
Status Reports & Meetings / Problem Reporting	3.5
Meetings	3.6
Client Access	3.7
Project Reviews	3.8
Problem Reporting	3.9
Period of Performance	4.0
Work Breakdown Structure	5.0

APPENDIX C BASIS OF COMPARISON

The basis of comparison is described in detail in Section 2 of the *Final Validation Report for RACER Services and Verification and Validation*, June 2009.

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APPENDIX D REFERENCES

Accreditation Agent Role in the VV&A of Legacy Simulations, VV&A Recommended Practices Guide (RPG) Core Document, Department of Defense Modeling & Simulation Coordination Office, 15 September 2006

Department of Defense Manual, Number 4715.20, *Defense Environmental Restoration Program (DERP) Management*, dated March 9, 2012

DoDI 5000.61, *DoD Modeling and Simulation (M&S) Verification, Validation, and Accreditation (VV&A)*, 9 December 2009

Final Database Update Report for RACER 2008, Earth Tech, Inc., Greenwood Village, CO, August 2007

Final Software Requirements Document for RACER 2008 Enhancements, Earth Tech, Inc., Greenwood Village, CO, February 2007

Final Software Testing Plan, RACER 2008 Maintenance and Support, Earth Tech, Inc., Greenwood Village, CO, August 2007

Final Verification and Validation (V&V) Report for RACER Services and Verification and Validation (V&V), Booz Allen Hamilton, San Antonio, TX, September 2009

Final Work Plan, RACER 2008 Maintenance and Support, Earth Tech, Inc., Greenwood Village, CO, April 30, 2007

Guidance for Verification and Validation of RACER Software, Version 2.0, Booz Allen Hamilton, March 2006

M&S VV&A RPG Core Document: Introduction, 31 January 2011

Military Standard 3022, *Documentation of Verification, Validation, and Accreditation (VV&A) for Models and Simulations*, January 28, 2008

RACER 2008 Final Technology History Report, Earth Tech, Inc., Greenwood Village, CO, July 2008

RACER 10.2 Development, Distribution, and Support, Task No. 10 Meetings and Briefings, September 25, 2009

RACER Accreditation Recommendation, Price Waterhouse Coopers, 2001

RACER Change Management Plan, Version 2.01, Booz Allen Hamilton, San Antonio, TX, July 2007

RACER Management Plan (Final), Booz Allen Hamilton, San Antonio, TX, September 2011

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RACER Verification & Validation Plan, Earth Tech, Inc., Greenwood Village, CO, May 2008

Software Configuration Management Plan for Remedial Action Cost Engineering & Requirements (RACER) Software System (Version 4.0) Draft, Earth Tech, Inc., February 26, 2003

Software Test Results Report for RACER 2008, Final Acceptance Testing Results, Earth Tech, Inc., Greenwood Village, CO, October 2007

Supplemental VV&A Product Formats, Recommended Practices Guide Templates, VV&A Recommended Practices Guide (RPG) Core Document, Department of Defense Modeling & Simulation Office, September 15, 2006

Tri-Service Parametric Model Specification Standard, Project Time & Cost, Inc., April 1999

V&V Agent Role in the VV&A of Legacy Simulations, VV&A Recommended Practices Guide (RPG) Core Document, 15 September 2006

APPENDIX E ACRONYMS AND ABBREVIATIONS

This appendix identifies all acronyms and abbreviations used in this document.

Acronym / Abbreviation	Definition
A7CAN	(former) Air Force Civil Engineer Asset Management & Operations Division, Natural Infrastructure Branch
AACEI	Association for the Advancement of Cost Engineering
ACF	Area Cost Factor
AFCEC	Air Force Civil Engineer Center
AFCESA	Air Force Civil Engineer Support Agency
AFI	Air Force Instruction
CESC	Civil Engineer Support Center
CFO	Chief Financial Officer
CTC	Cost-to-Complete
CX	Center of Expertise
DERP	Defense Environmental Restoration Program
DoD	Department of Defense
DoDI	Department of Defense Instruction
DOE	Department of Energy
EPA	Environmental Protection Agency
FFMIA	Federal Financial Management Improvement Act
FOA	Forward Operating Area
GMRA	Government Management Reform Act
GPRA	Government Performance and Results Act
HQ	Headquarters
HTRW	Hazardous, Toxic, and Radioactive Waste Cleanup
IPR	In Progress Review
IV&V	Independent Verification and Validation
M&S	Modeling and Simulation
MAJCOM	Major Command
MMRP	Military Munitions Response Program
MS	Microsoft®
MSRR	Modeling and Simulation Resource Repository
NAVFAC	Naval Facilities Engineering Command
POC	Point of Contact
RACER	Remedial Action Cost Engineering and Requirements
RPG	Recommended Practices Guide
RSC	RACER Steering Committee
STR	Software Test Results
TDY	Temporary Duty (Travel)
TRACES	Tri-Service Automated Cost Engineering Systems
TRG	Technical Review Group
UPB	Unit Price Book
USACE	United States Army Corps of Engineers
USAEC	United States Army Environmental Command
USAF	United States Air Force
V&V	Verification and Validation

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Acronym / Abbreviation	Definition
VV&A	Verification, Validation, & Accreditation
VB	Microsoft® Visual Basic
VB.NET	Microsoft® Visual Basic, as implemented on the Microsoft® .NET Framework
WP	Work Plan

APPENDIX F DISTRIBUTION LIST

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APPENDIX G ACCREDITATION PLAN

Guidance for Verification and Validation of RACER Software, Version 2.0, March 2006, prepared by HQ AFCEA/Civil Engineer Support Center (CESC), Tyndall AFB, Florida

APPENDIX H V&V REPORT

Final V&V Report for RACER Services and Verification and Validation, 23 September 2009, prepared by Booz Allen Hamilton under contract to USAEC, Aberdeen Proving Ground, MD