**CACIE Tool #NN** – **CIE Source Rerouting Tool**

**reroute\_sources\_cie.f**

**Version** **1.0**

**QA**: **QA**

# Description and Purpose

The CIE Source Rerouting tool redistributes wastewater volumes and contaminant inventories (H-3, I‑129, Sr-90, Tc-99, total U, Cr, NO3 and CN) for the 216‑U‑10 Pond system and the 216-B-3 Pond system. The 216-U-10 Pond system consisted of the following sites: 216-Z-1D Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, 216-U-14 Ditch, 216-U-10 Pond, and 216-U-11 Ditch. The 216-Z-1D, 216-Z-11, 216-Z-19, and 216-U-14 Ditches were influent ditches to 216-U-10 Pond, and 216-U-11 Ditch was used for pond overflow. The 216‑B‑3 Pond system consisted of the following sites: 216-B-3 Pond and expansion lobes 216‑B‑3A, 216-B-3B, and 216-B-3C.

Wastewater and contaminant releases for H‑3, I‑129, Sr-90 and Tc-99 to the 216-U-10 Pond and 216-B-3 Pond systems were estimated in ECF-HANFORD-17-0079, *Hanford Soil Inventory Model (SIM-v2) Calculated Radionuclide Inventory of Direct Liquid Discharges to Soil in the Hanford Site’s 200 Areas*, herein referred to as SIM-v2. Contaminant releases to the 216-U-10 Pond and 216-B-3 Pond systems for total U, Cr, NO3 and CN were estimated in CP-64710 (Chemical Inventory Data Package) herein referred to as chemical inventory. Partitioning of infiltration and contaminant inventory between the lobes of the 216-B-3 Pond system, and between the 216-U-10 Pond and its influent ditches, is based on pond/ditch areal extent. The methodology is documented in ECF-HANFORD-19-0032, *Distribution of Infiltration in the 216-U-10 and 216-B-3 Pond Systems 1944 to 1997*.

The CIE Source Rerouting tool calculates infiltration fractions for each site of the 216-U-10 Pond system and uses the results to partition wastewater volumes and contaminant inventories. For the 216-B-3 Pond system, calculations of infiltration fractions for each pond lobe were performed separate from the CIE Source Rerouting tool (ECF-HANFORD-19-0032). Infiltration fractions for the 216-B-3 Pond system are read from an input file.

The CIE Source Rerouting tool reads the SIM-v2 and chemical inventory files and extracts wastewater volumes and contaminant release inventories for the 216-U-10 Pond, 216-U-14 Ditch, 216-Z-1D Ditch, 216‑Z‑11 Ditch, 216-Z-19 Ditch, and 216-B-3 Pond; reads the 216-B-3 Pond system infiltration fractions file and extracts infiltration fractions for each 216-B-3 Pond system site; calculates infiltration fractions for each 216-U-10 Pond system site; calculates rerouted rates (i.e., infiltrated water and contaminant inventory) for each site in the 216-U-10 Pond and 216-B-3 Pond systems; and generates a file containing the rerouted rates for each site (U‑10\_B-3\_CIE\_reroute\_rates.csv). The tool also generates three files that can be used for checking the results (U-10\_B-3\_CIE\_reroute\_in.dat, U‑10\_B-3\_CIE\_reroute\_fractions.dat, and U-10\_B-3\_CIE\_reroute\_rates.dat).

# Functional Requirements

The following are the functional requirements of the CIE Source Rerouting tool:

FR-1: Read the name of the SIM-v2 inventory file, the chemical inventory file and the 216-B-3 Pond system yearly infiltration fractions file from the command line.

FR-2: Open and read the 216-B-3 Pond system file of yearly infiltration fractions.

FR-3: Open the SIM-v2 inventory file and read wastewater volumes and H‑3, I‑129, Sr-90 and Tc-99 inventories for 216-U-10 Pond, 216-U-14 Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, 216‑Z-1D Ditch, and 216-B-3 Pond.

FR-4: Open the chemical inventory file and read total U, Cr, NO3 and CN inventories for 216‑U‑10 Pond, 216-U-14 Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, 216‑Z-1D Ditch, and 216-B-3 Pond.

FR-5: Calculate influent fractions by year for the 216-U-14 Ditch, 216-Z-11 Ditch, 216‑Z‑19 Ditch, and 216‑Z-1D Ditch (influent fraction = influent ditch volume / sum of all influent ditch volumes).

FR-6: Calculate infiltration fractions for the 216-U-14, 216-Z-11, 216-Z-19 and 216‑Z-1D Ditches based on the influent rates (see FR-5) and relative site areas for those sites that were active in any given year (infiltration fraction = ditch area / [ditch area + pond area \* influent fraction]).

FR-7: Based on the overflow threshold volume, partition the water entering the 216-U-10 Pond in any given year into that portion infiltrating from 216-U-10 and that portion overflowing to 216‑U‑11 Ditch (if the water entering 216-U-10 Pond is greater than 7,013,071.9534295 m3, then overflow = water entering 216-U-10 Pond minus 7,013,071.9534295 m3, else overflow = 0).

FR-8: Calculate reroute rates (i.e., infiltrated water and contaminant inventory) for each site (216-U-10 Pond, 216-U-11 Ditch, 216-U-14 Ditch, 216-Z-11 Ditch, 216-Z-19 Ditch, 216‑Z-1D Ditch, 216-B-3 Pond, 216-B-3A Pond, 216-B-3B Pond, and 216-B-3C Pond). For the 216-U-10 Pond influent ditches and for the 216-B-3 Pond lobes: infiltration volume or inventory = influent volume or inventory \* infiltration fraction. For 216-U-10 Pond: infiltration volume or inventory = total influent volume or inventory minus the total influent ditch infiltration volume or inventory. (See FR-7 for the equation for overflow volume to 216-U-11.)

FR-9: Save reroute rates for each site to an output file.

# Software Requirements Specifications

FORTRAN, Linux Intel(R) Fortran Intel(R) 64 Compiler

Compiler Options: -o OutputFileName

Special Considerations: None

# Software Design Description

The general sequence of steps in the code is as follows:

1. Initialize variables.
2. Read the 216-B-3 Pond system infiltration fractions file.
3. Read the SIM-v2 inventory file.
4. Read the chemical inventory file.
5. Calculate influent fractions to partition the 216-U-10 Pond area based on relative volumes from the influent ditches operational with any given year.
6. Calculate infiltration fractions for the 216-U-10 Pond system influent ditches (216-Z-1D, 216-Z-11, 216-Z-19, and 216-U-14) using site area and the influent fractions from step 5.
7. Calculate overflow from the 216-U-10 Pond to the 216-U-11 Ditch.
8. Save the infiltration fractions for the 216-U-10 Pond and 216-B-3 Pond systems sites to an output file (for checking).
9. Calculate the reroute infiltration volumes and inventories for the 216-U-10 Pond and 216-B-3 Pond systems.
10. Save the reroute infiltration volumes and inventories to an output file.

Site areas and active years used in the calculations are listed in Table 1 for the 216-U-10 Pond system.

Arguments:

Path and file name for SIM-v2 Inventory  
Path and file name for Chemical Inventory

Path and file name for 216-B-3 Pond system infiltration fractions

Input Files:

1. Radionuclide Inventory csv file (Command Line Argument 1) – File containing SIM-v2 wastewater volumes and H‑3, I‑129, Sr-90 and Tc-99 inventories for the 216-U-10 Pond system sites and 216-B-3 Pond
   1. Format example:

Inventory Module,SIMV2 site name,CA site name,Source Type,Volume [m3],Discharge/decay-corrected year,C-14,Cl-36,H-3,I-129,Np-237,Re-187,Sr-90,Tc-99,U-232,U-233,U-234,U-235,U-236,U-238,Th-230 (decay only),Ra-226 (decay only)

1. Chemical Inventory csv file (Command Line Argument 2) – File containing total U, Cr, NO3 and CN inventories for the 216-U-10 Pond system sites and 216-B-3 Pond
   1. Format example:

Inventory Module,SIMV2 Site Name,CIE Site Name,Source Type,Year,Volume Mean [m3],Cr [kg],NO3 [kg],U-Total [kg],CN [kg]

1. B-3 Pond Fractions csv file (Command Line Argument 3) – Yearly infiltration fractions for the 216-B-3 Pond system sites
   1. Format Example, no spaces between comma and columns values:

Year,B-3\_frac,B-3A\_frac,B-3B\_frac,B-3C\_frac  
1945,1,0,0,0  
1946,1,0,0,0

Output Files:

1. U-10\_B-3\_CIE\_reroute\_in.dat – Influent rates for the 216-U-10 Pond system sites (for checking only)
2. U-10\_B-3\_CIE\_reroute\_fractions.dat – infiltration fractions for the 216-U-10 Pond system sites and 216-B-3 Pond system sites (for checking only)
3. U-10\_B-3\_CIE\_reroute\_rates.dat – Rerouted source values (space delimited) for the 216-U-10 Pond system sites and 216-B-3 Pond system sites (for checking only)
4. U-10\_B-3\_CIE\_reroute\_rates.csv – Rerouted source values (comma delimited) for the 216-U-10 Pond system sites and 216-B-3 Pond system sites

Tool Runner:

The following is the shell script configuration that will be passed as an argument to the Tool Runner for qualified runs:

{path to repository}/tools/cie-reroute/linux/reroute\_sources\_cie\_linux-intel-64.exe path/to/{radionuclide inventory csv file} path/to/{chemical inventory csv file} path/to/{B-3 Pond fractions csv file}

Code Review:

A code walkthrough/review was completed by John P. McDonald on 8/10/2020; no issues were found. No impacts to other repository tools or shared library dependencies were identified for the CIE Source Rerouting tool

| Table 1. 216-U-10 Pond System Site Areas and Active Years | | | |
| --- | --- | --- | --- |
| Site | Area (m2)1 | First Active Year | Last Active Year |
| 216-Z-11 | 658.304592447 | 1959 | 1970 |
| 216-Z-19 | 650.081659045 | 1971 | 1981 |
| 216-Z-1D | 4163.16491928 | 1944 | 1948 |
| 216-U-14 | 41007.6853106 | 1944 | 1984 |
| 216-U-10 | 194229.402893 | 1944 | 1984 |
| 216-U-11 | 67237.8559196 | 1944 | 1956 |
| 216-Z-1D-South | 2144.24717683 | 1949 | 1958 |
| 216-U-14-South | 20959.2514744 | 1985 | 1994 |
| Source: ECF-HANFORD-19-0032, *Distribution of Infiltration in the 216-U-10 and 216-B-3 Pond Systems 1944 to 1997*. | | | |

# Requirements Traceability Matrix

The requirements traceability matrix for the CIE Source Rerouting tool is presented in Table 2.

| Table 2. Requirements Traceability Matrix | | |
| --- | --- | --- |
| Functional Requirement ID | Test ID | Test Case |
| QA Level | CACIE CIE Source Rerouting - IT-1 | Installation Test (Table 3) |
| FR-1  FR-2  FR-9 | CACIE CIE Source Rerouting - AT-1 | Acceptance Test (Table 4): Confirm that the output files “U-10\_B-3\_CIE\_reroute\_in.dat”, “U 10\_B-3\_CIE\_reroute\_fractions.dat”, “U‑10\_B-3\_CIE\_reroute\_rates.dat” and “U-10\_B-3\_CIE\_reroute\_rates.csv” are generated and contain data. |
| FR-1  FR-2  FR-3  FR-4  FR-5  FR-6  FR-7  FR-8  FR-9 | CACIE CIE Source Rerouting - AT-1 | Acceptance Test (Table 4): Compare the results in the output files with the expected results. |

# Installation Test Plan and Acceptance Test Plan Cases

The installation test plan for the CIE Source Rerouting tool is presented in Table 3 and the acceptance test plan for the CIE Source Rerouting tool is presented in Table 4.

| Table 3. CIE Source Rerouting Installation Test Plan | | | |
| --- | --- | --- | --- |
| **CIE Source Rerouting Installation Testing**  **CACIE-CIE Source Rerouting – IT-1** | | **Date:** | |
| **Tool Runner File Location for this test:**  **[PUT LINK TO THE DIRECTORY HERE]** | | **Test Performed By:** | |
| **Testing Directory: [PUT LINK TO THE DIRECTORY HERE]** | | | |
| Test Step | Test Instruction | Expected Result | Test Result  (Pass/Fail) |
| Tools Code Repository Directory: | | | |
| Navigate to the testing directory | | | |
| 1 | Invoke Tool runner and test installation of the tool:  *./CACIE\_reroute\_sources\_cie\_IT-1.sh* | | |
| 2 | Verify Tool Runner is invoked and executed. | Tool Runner log is created  (filename: reroute\_cie\_install\_test.log) |  |
| 3 | Verify CIE Source Rerouting Tool executes | Check that the following files are generated:   U-10\_B-3\_CIE\_reroute\_rates.csv U-10\_B-3\_CIE\_reroute\_rates.dat U-10\_B-3\_CIE\_reroute\_fractions.dat U-10\_B-3\_CIE\_reroute\_in.dat |  |

| Table 4. CIE Source Rerouting Acceptance Test Plan | | | |
| --- | --- | --- | --- |
| **CIE Source Rerouting Acceptance Testing**  **CACIE-CIE Source Rerouting – AT-1** | | **Date:** | |
| **Tool Runner File Location for this test:**  **Z:\v4-2Test\reroute\_testing\CIE**\**formal\_testing** | | **Test Performed By:** | |
| **Testing Directory: Z:\v4-2Test\reroute\_testing\CIE\formal\_testing** | | | |
| Test Step | Test Instruction | Expected Result | Test Result  (Pass/Fail) |
| Navigate to the Testing Directory | | | |
| 1 | Execute, using a Linux terminal, the shell script ***run-cie\_reroute.sh*** in the testing directory. | Verify that the following output files were generated and contain data:  U-10\_B-3\_CIE\_reroute\_fractions.dat  U-10\_B-3\_CIE\_reroute\_in.dat  U-10\_B-3\_CIE\_reroute\_rates.csv  U-10\_B-3\_CIE\_reroute\_rates.dat |  |
| The first part of this test consists of high-level checks of the infiltration fractions determined for each ditch and pond. | | | |
| 2 | Import file **U-10\_B-3\_CIE\_reroute\_fractions.dat** into a spreadsheet (space-delimited). | | |
| 3 | Verify that the values for “Z-11\_frac\_infilt,” “Z-19\_frac\_infilt,” “Z-1d\_frac\_ infilt,” and “U-14\_frac\_infilt” are nonzero and less than or equal to 1.0 from the first to the last active year (inclusive) for each site as listed in Table 1, and that the values are zero for all other years. Note: the 216-Z-1D Ditch was reconfigured in 1949 so it is represented in Table 1 as two entries, “216-Z-1D” and “216-Z-1D-SOUTH” with different areas for the partitioning calculations. Thus, the full period of operation for 216-Z-1D was 1944 to 1958. Similarly, the 216-U-14 Ditch was reconfigured and is represented in Table 1 with two entries, “216-U-14” and “216-U-14-SOUTH” with different areas. Thus, the full period of operation for 216-U-14 was 1944 to 1994. | Nonzero values less than or equal to 1.0 should occur during the operational years and zero values for the nonoperational years. |  |
| 4 | Verify that for each of the years 1944 through 1952, and each of the years 1959 through 1984, the values for “U-10\_infilt\_ frac” are 1.0 and the values for “U-11\_infilt\_ frac” are zero. | For each of the years 1944 through 1952, and each of the years 1959 through 1984, the values for “U-10\_infilt\_ frac” should be 1.0 and the values for “U-11\_infilt\_frac” should be zero. |  |
| 5 | In an empty column of the spreadsheet (e.g., column ‘O’), enter a formula to sum “U-10\_infilt\_frac” and “U-11\_ infilt\_frac” for each of the years 1953 through 1958 and verify the result for each year is 1.0. | The sum of “U-10\_infilt\_frac” and “U-11\_infilt\_frac” for each year from 1953 through 1958 should be 1.0. |  |
| 6 | Verify that the values for “B-3\_infilt\_ frac,” “B-3A\_infilt\_frac,” “B-3B\_infilt\_ frac,” and “B-3C\_infilt\_frac” are zero for 1944. | The values for “B-3\_infilt\_ frac,” “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_infilt\_ frac” should be zero for 1944. |  |
| 7 | Verify that for each of the years 1945 through 1982, the values for “B-3\_infilt\_ frac” are 1.0 and the values for “B-3A\_infilt\_ frac,” “B-3B\_infilt\_ frac,” and “B-3C\_infilt\_ frac” are zero. | For each of the years 1945 through 1982, the values for “B-3\_infilt\_ frac” should be 1.0, and the values for “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_ infilt\_frac” should be zero. |  |
| 8 | In an empty column of the spreadsheet (e.g., column ‘P’), enter a formula to sum “B-3\_infilt\_frac,” “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_infilt\_ frac” for each of the years 1983 through 1994 and verify the result for each year is 1.0. | The sum of “B-3\_infilt\_frac,” “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_infilt\_ frac” should be 1.0 for each of the years 1983 through 1994. |  |
| 9 | Verify that for each of the years 1995 through 1997, the values for “B-3C\_infilt\_ frac” are 1.0. | For each of the years 1995 through 1997, the values for “B-3C\_infilt\_frac” should be 1.0. |  |
| The second part of this test consists of spot checks of the infiltration volumes and contaminant releases for selected years. These checks verify that the volumes and release inventories are correct which indicates that the areal extents of the sites used in the calculations are correct and that the correct partitioning fractions were determined. | | | |
| 10 | Import file **U-10\_B-3\_CIE\_reroute\_rates.csv** into a spreadsheet. (Note: It is suggested the spreadsheet be custom sorted by “Discharge/decay-corrected year” and then by “CIE site name” to facilitate looking up values by year; or alternatively, the spreadsheet can be filtered by “Discharge/decay-corrected year” for each spot check year.) | | |
| 11 | This part examines the partitioning of releases to the 216-U-10 Pond System with the 216-Z-1D Ditch active. | | |
| 11.1 | Examine the volumes discharged (field “Volume [m3]”) for 1944 and compare to the expected results. | Volumes (m3) by site:  216-U-10: 1.32E+05  216-U-14: 2.65E+04  216-Z-1D: 3.20E+03 |  |
| 11.2 | Examine the Cr release inventories (field “Cr”) for 1944 and compare to the expected results. | Cr released by site (kg):  216-U-10: 2.86E-01  216-U-14: 8.21E-02  216-Z-1D: 3.37E-06 |  |
| 12 | This part examines the partitioning of releases to the 216-U-10 Pond System after the reconfiguration of the 216-Z-1D Ditch to a shorter length (and, therefore, a smaller area) and when volumes to 216-U-10 are large enough that overflow to the 216-U-11 Ditch occurs. No partitioning calculations are performed for the 216-B-3 Pond System because the main pond was the only lobe active, so this check verifies that the SIM-v2 volume and inventories for 216-B-3 are written to the output file unaltered. | | |
| 12.1 | Examine the volumes discharged (field “Volume [m3]”) for 1955 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 1.43E+06  216-U-10: 7.01E+06  216-U-11: 2.61E+06  216-U-14: 1.94E+06  216-Z-1D-SOUTH: 1.23E+05 |  |
| 12.2 | Examine the Sr-90 release inventories (field “Sr-90”) for 1955 and compare to the expected results. | Sr-90 released by site (Ci):  216-B-3: 1.70E-02  216-U-10: 1.01E-01  216-U-11: 3.75E-02  216-U-14: 3.71E-02  216-Z-1D-SOUTH: 3.43E-05 |  |
| 13 | This part examines the partitioning of releases to the 216-U-10 Pond System with the 216-Z-11 Ditch active. | | |
| 13.1 | Examine the volumes discharged (field “Volume [m3]”) for 1961 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 3.44E+06  216-U-10: 2.17E+06  216-U-14: 4.34E+05  216-Z-11: 8.70E+03 |  |
| 13.2 | Examine the Tc-99 release inventories (field “Tc-99”) for 1961 and compare to the expected results. | Tc-99 released by site (Ci):  216-B-3: 4.25E-03  216-U-10: 7.49E-05  216-U-14: 2.02E-05  216-Z-11: 3.92E-11 |  |
| 14 | This part examines the partitioning of releases to the 216-U-10 Pond System with the 216-Z-19 Ditch active. | | |
| 14.1 | Examine the volumes discharged (field “Volume [m3]”) for 1976 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 3.42E+06  216-U-10: 5.23E+06  216-U-14: 1.08E+06  216-Z-19: 2.06E+04 |  |
| 14.2 | Examine the uranium (total) release inventories (field “U”) for 1976 and compare to the expected results. | U released by site (kg):  216-B-3: 2.24E-01  216-U-10: 3.01E-01  216-U-14: 2.25E-02  216-Z-19: 5.80E-03 |  |
| 15 | This part examines the partitioning of releases to the 216-B-3 Pond System with the 216-B-3, 216-B-3A and 216-B-3B lobes active. | | |
| 15.1 | Examine the volumes discharged (field “Volume [m3]”) for 1984 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 4.41E+06  216-B-3A-RAD: 8.00E+05  216-B-3B-RAD: 1.10E+05  216-U-10: 3.05E+05  216-U-14: 6.44E+04 |  |
| 15.2 | Examine the H-3 release inventories (field “H-3”) for 1984 and compare to the expected results. | H-3 released by site (Ci):  216-B-3: 4.99E-01  216-B-3A-RAD: 9.05E-02  216-B-3B-RAD: 1.24E-02  216-U-10: 6.65E+00  216-U-14: 1.40E+00 |  |
| 16 | This part examines the partitioning of releases to the 216-B-3 Pond System with the 216-B-3, 216-B-3A and 216-B-3C lobes active. | | |
| 16.1 | Examine the volumes discharged (field “Volume [m3]”) for 1994 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 1.61E+06  216-B-3A-RAD: 4.88E+05  216-B-3C-RAD: 4.78E+06  216-U-14-SOUTH: 1.10E+05 |  |
| 16.2 | Examine the Nitrate release inventories (field “NO3”) for 1994 and compare to the expected results. | NO3 released by site (kg):  216-B-3: 8.43E+02  216-B-3A-RAD: 2.56E+02  216-B-3C-RAD: 2.50E+03  216-U-14-SOUTH: 2.91E+04 |  |
| 17 | This part examines the releases to the 216-B-3 Pond System with only the 216-B-3C lobe active. This check verifies that the SIM-v2 volume and inventories for 216-B-3 are written to the output file for the 216-B-3C lobe unaltered. | | |
| 17.1 | Examine the volume discharged (field “Volume [m3]”) for 1996 and compare to the expected result. | Volume (m3) by site:  216-B-3C-RAD: 5.47E+06 |  |
| 17.2 | Examine the I-129 release inventory (field “I-129”) for 1996 and compare to the expected result. | I-129 released by site (Ci):  216-B-3C-RAD: 1.34E-06 |  |

# Acceptance Test Report

To complete the Acceptance Testing use Appendix A. The test case is described as follows:

* Acceptance Test 1 is in Table A-1. It uses the same input data as will be used in the production run. The expected results consist of high level checks of the results and spot checks of infiltration volumes and inventories for specific years that address each operational configuration of the 216-U-10 Pond and 216-B-3 Pond systems.

Details of the test, when it was conducted, by whom, and if it Passed or Failed is in Table A-1 of Appendix A.

# User Guide

Refer to Section 4 of this software management plan for a full description of the required inputs for the CIE Source Rerouting tool. It is recommended that a shell script is used to execute the tool. The recommended structure of this shell script is shown below:

TOOL=<path/to/reroute\_sources\_cie\_linux-intel-64.exe>

RAD\_INVFILE=<path/to/radionuclide\_inventory\_file>

CHEM\_INVFILE=<path/to/chemical\_inventory\_file>

B3INFFRACFILE=<path/to/b3/infiltration/fraction/file>

$TOOL $ RAD\_INVFILE $ CHEM\_INVFILE $ B3INFFRACFILE

# Tool Versions

This section details changes incorporated into each version of the CIE Source Rerouting tool.

* 1.0 – Tool was developed.

# Appendix A

**Completed Acceptance Test Cases**

**Tool Runner Log**

###Executing reroute Tool###

###Executing Fingerprint Tool###

INFO--08/12/2020 02:40:45 PM--Starting CA-CIE Tool Runner. Logging to "./cie\_reroute\_proprocesser.log"

INFO--08/12/2020 02:40:46 PM--Code Version: 1ec22e8121e9d52b5d52c3eac4d4c47f5f77d454 v3.2b: /opt/tools/pylib/runner/runner.py<--1bcfd6779e9cbdb82673405873a8e5e81514ae27

INFO--08/12/2020 02:40:46 PM--Code Version: 1ec22e8121e9d52b5d52c3eac4d4c47f5f77d454 v3.2b: /opt/tools/pylib/fingerprint/fingerprint.py<--e9692a4faec2ee264fe50417b6b6a516ba82b2f6

INFO--08/12/2020 02:40:46 PM--QA Status: QUALIFIED : /opt/tools/pylib/runner/runner.py

INFO--08/12/2020 02:40:46 PM--QA Status: QUALIFIED : /opt/tools/pylib/fingerprint/fingerprint.py

INFO--08/12/2020 02:40:46 PM--Invoking Command:"python3.6" with Arguments:"/opt/tools/pylib/fingerprint/fingerprint.py F\_CP-61786\_R1\_sorted\_mar42020.csv --output ./cie\_reroute\_proprocesser.log --outputmode a"

INFO--08/12/2020 02:40:46 PM--Username:cfarrow Computer:olive Platform:Linux 4.4.0-38-generic #57~14.04.1-Ubuntu SMP Tue Sep 6 17:20:43 UTC 2016

Fingerprint generated at 2020-08-12 14:40:46.147112

F\_CP-61786\_R1\_sorted\_mar42020.csv f91b90c8db64311bd94048ac23c22196a2a9dcb6aac776df4b8a91518e9ac8f1

###Finished Process###

###Executing Fingerprint Tool###

INFO--08/12/2020 02:40:46 PM--Starting CA-CIE Tool Runner. Logging to "./cie\_reroute\_proprocesser.log"

INFO--08/12/2020 02:40:46 PM--Code Version: 1ec22e8121e9d52b5d52c3eac4d4c47f5f77d454 v3.2b: /opt/tools/pylib/runner/runner.py<--1bcfd6779e9cbdb82673405873a8e5e81514ae27

INFO--08/12/2020 02:40:46 PM--Code Version: 1ec22e8121e9d52b5d52c3eac4d4c47f5f77d454 v3.2b: /opt/tools/pylib/fingerprint/fingerprint.py<--e9692a4faec2ee264fe50417b6b6a516ba82b2f6

INFO--08/12/2020 02:40:46 PM--QA Status: QUALIFIED : /opt/tools/pylib/runner/runner.py

INFO--08/12/2020 02:40:46 PM--QA Status: QUALIFIED : /opt/tools/pylib/fingerprint/fingerprint.py

INFO--08/12/2020 02:40:46 PM--Invoking Command:"python3.6" with Arguments:"/opt/tools/pylib/fingerprint/fingerprint.py Appendix\_B\_of\_CP-64710\_07242020.csv --output ./cie\_reroute\_proprocesser.log --outputmode a"

INFO--08/12/2020 02:40:46 PM--Username:cfarrow Computer:olive Platform:Linux 4.4.0-38-generic #57~14.04.1-Ubuntu SMP Tue Sep 6 17:20:43 UTC 2016

Fingerprint generated at 2020-08-12 14:40:46.418446

Appendix\_B\_of\_CP-64710\_07242020.csv 34846a4628c0a86bf64ca7278fcc4762e46d868a4a5aadc9ff32b20e6b80fb0f

###Finished Process###

###Executing reroute##

INFO--08/12/2020 02:40:46 PM--Starting CA-CIE Tool Runner. Logging to "./cie\_reroute\_proprocesser.log"

INFO--08/12/2020 02:40:46 PM--Code Version: 1ec22e8121e9d52b5d52c3eac4d4c47f5f77d454 v3.2b: /opt/tools/pylib/runner/runner.py<--1bcfd6779e9cbdb82673405873a8e5e81514ae27

INFO--08/12/2020 02:40:46 PM--Code Version: 1ea680997e05e72a7d50050d566ba6830d110e85 Local repo SHA-1 has does not correspond to a remote repo release version: ../../../../CA-CIE-Tools-TestRepos/repo\_reroute\_sources\_cie.f/tools/cie-reroute/linux/reroute\_sources\_cie\_linux-intel-64.exe<--886b4e414dc0aea967f1e14484043cdb0c0b7d2b

INFO--08/12/2020 02:40:46 PM--QA Status: QUALIFIED : /opt/tools/pylib/runner/runner.py

INFO--08/12/2020 02:40:46 PM--QA Status: TEST : ../../../../CA-CIE-Tools-TestRepos/repo\_reroute\_sources\_cie.f/tools/cie-reroute/linux/reroute\_sources\_cie\_linux-intel-64.exe

INFO--08/12/2020 02:40:46 PM--Invoking Command:"../../../../CA-CIE-Tools-TestRepos/repo\_reroute\_sources\_cie.f/tools/cie-reroute/linux/reroute\_sources\_cie\_linux-intel-64.exe" with Arguments:"F\_CP-61786\_R1\_sorted\_mar42020.csv Appendix\_B\_of\_CP-64710\_07242020.csv B-3\_Pond\_Fractions.csv"

INFO--08/12/2020 02:40:46 PM--Username:cfarrow Computer:olive Platform:Linux 4.4.0-38-generic #57~14.04.1-Ubuntu SMP Tue Sep 6 17:20:43 UTC 2016

###Finished Process###

###Executing Fingerprint Tool###

INFO--08/12/2020 02:40:46 PM--Starting CA-CIE Tool Runner. Logging to "./cie\_reroute\_proprocesser.log"

INFO--08/12/2020 02:40:46 PM--Code Version: 1ec22e8121e9d52b5d52c3eac4d4c47f5f77d454 v3.2b: /opt/tools/pylib/runner/runner.py<--1bcfd6779e9cbdb82673405873a8e5e81514ae27

INFO--08/12/2020 02:40:46 PM--Code Version: 1ec22e8121e9d52b5d52c3eac4d4c47f5f77d454 v3.2b: /opt/tools/pylib/fingerprint/fingerprint.py<--e9692a4faec2ee264fe50417b6b6a516ba82b2f6

INFO--08/12/2020 02:40:46 PM--QA Status: QUALIFIED : /opt/tools/pylib/runner/runner.py

INFO--08/12/2020 02:40:46 PM--QA Status: QUALIFIED : /opt/tools/pylib/fingerprint/fingerprint.py

INFO--08/12/2020 02:40:46 PM--Invoking Command:"python3.6" with Arguments:"/opt/tools/pylib/fingerprint/fingerprint.py ./U-10\_B-3\_CIE\_reroute\_rates.csv --output ./cie\_reroute\_proprocesser.log --outputmode a"

INFO--08/12/2020 02:40:46 PM--Username:cfarrow Computer:olive Platform:Linux 4.4.0-38-generic #57~14.04.1-Ubuntu SMP Tue Sep 6 17:20:43 UTC 2016

Fingerprint generated at 2020-08-12 14:40:46.918865

./U-10\_B-3\_CIE\_reroute\_rates.csv 1c66b0c1dbc4bd685a1ec76f6f980f0f044046842cca8c892879ea6e5b298450

###Finished Process###

| Table A-1. CIE Source Rerouting Acceptance Test Plan | | | |
| --- | --- | --- | --- |
| **CIE Source Rerouting Acceptance Testing**  **CACIE-CIE Source Rerouting – AT-1** | | **Date: 12 August, 2020** | |
| **Tool Runner File Location for this test:**  **Z:\v4-2Test\reroute\_testing\CIE\formal\_testing** | | **Test Performed By: Christopher Farrow** | |
| **Testing Directory: Z:\v4-2Test\reroute\_testing\CIE\formal\_testing** | | | |
| Test Step | Test Instruction | Expected Result | Test Result  (Pass/Fail) |
| Navigate to the Testing Directory | | | |
| 1 | Execute, using a Linux terminal, the shell script ***run-cie\_reroute.sh*** in the testing directory. | Verify that the following output files were generated and contain data:  U-10\_B-3\_CIE\_reroute\_fractions.dat  U-10\_B-3\_CIE\_reroute\_in.dat  U-10\_B-3\_CIE\_reroute\_rates.csv  U-10\_B-3\_CIE\_reroute\_rates.dat | PASS |
| The first part of this test consists of high-level checks of the infiltration fractions determined for each ditch and pond. | | | |
| 2 | Import file **U-10\_B-3\_CIE\_reroute\_fractions.dat** into a spreadsheet (space-delimited). | | |
| 3 | Verify that the values for “Z-11\_frac\_ infilt,” “Z-19\_frac\_infilt,” “Z-1d\_frac\_ infilt,” and “U-14\_frac\_infilt” are nonzero and less than or equal to 1.0 from the first to the last active year (inclusive) for each site as listed in Table 1, and that the values are zero for all other years. Note: the 216-Z-1D Ditch was reconfigured in 1949 so it is represented in Table 1 as two entries, “216-Z-1D” and “216-Z-1D-SOUTH” with different areas for the partitioning calculations. Thus, the full period of operation for 216-Z-1D was 1944 to 1958. Similarly, the 216-U-14 Ditch was reconfigured and is represented in Table 1 with two entries, “216-U-14” and “216-U-14-SOUTH” with different areas. Thus, the full period of operation for 216-U-14 was 1944 to 1994. | Nonzero values less than or equal to 1.0 should occur during the operational years and zero values for the nonoperational years. | PASS |
| 4 | Verify that for each of the years 1944 through 1952, and each of the years 1959 through 1984, the values for “U-10\_infilt\_ frac” are 1.0 and the values for “U-11\_infilt\_ frac” are zero. | For each of the years 1944 through 1952, and each of the years 1959 through 1984, the values for “U-10\_infilt\_ frac” should be 1.0 and the values for “U-11\_infilt\_frac” should be zero. | PASS |
| 5 | In an empty column of the spreadsheet (e.g., column ‘O’), enter a formula to sum “U-10\_infilt\_frac” and “U-11\_ infilt\_frac” for each of the years 1953 through 1958 and verify the result for each year is 1.0. | The sum of “U-10\_infilt\_frac” and “U-11\_infilt\_frac” for each year from 1953 through 1958 should be 1.0. | PASS |
| 6 | Verify that the values for “B-3\_infilt\_ frac,” “B-3A\_infilt\_frac,” “B-3B\_infilt\_ frac,” and “B-3C\_infilt\_frac” are zero for 1944. | The values for “B-3\_infilt\_ frac,” “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_infilt\_ frac” should be zero for 1944. | PASS |
| 7 | Verify that for each of the years 1945 through 1982, the values for “B-3\_infilt\_ frac” are 1.0 and the values for “B-3A\_infilt\_ frac,” “B-3B\_infilt\_ frac,” and “B-3C\_infilt\_ frac” are zero. | For each of the years 1945 through 1982, the values for “B-3\_infilt\_ frac” should be 1.0, and the values for “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_ infilt\_frac” should be zero. | PASS |
| 8 | In an empty column of the spreadsheet (e.g., column ‘P’), enter a formula to sum “B-3\_infilt\_frac,” “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_infilt\_ frac” for each of the years 1983 through 1994 and verify the result for each year is 1.0. | The sum of “B-3\_infilt\_frac,” “B-3A\_infilt\_frac,” “B-3B\_ infilt\_ frac,” and “B-3C\_infilt\_ frac” should be 1.0 for each of the years 1983 through 1994. | PASS |
| 9 | Verify that for each of the years 1995 through 1997, the values for “B-3C\_infilt\_ frac” are 1.0. | For each of the years 1995 through 1997, the values for “B-3C\_infilt\_frac” should be 1.0. | PASS |
| The second part of this test consists of spot checks of the infiltration volumes and contaminant releases for selected years. These checks verify that the volumes and release inventories are correct which indicates that the areal extents of the sites used in the calculations are correct and that the correct partitioning fractions were determined. | | | |
| 10 | Import file **U-10\_B-3\_CIE\_reroute\_rates.csv** into a spreadsheet. (Note: It is suggested the spreadsheet be custom sorted by “Discharge/decay-corrected year” and then by “CIE site name” to facilitate looking up values by year; or alternatively, the spreadsheet can be filtered by “Discharge/decay-corrected year” for each spot check year.) | | |
| 11 | This part examines the partitioning of releases to the 216-U-10 Pond System with the 216-Z-1D Ditch active. | | |
| 11.1 | Examine the volumes discharged (field “Volume [m3]”) for 1944 and compare to the expected results. | Volumes (m3) by site:  216-U-10: 1.32E+05  216-U-14: 2.65E+04  216-Z-1D: 3.20E+03 | PASS |
| 11.2 | Examine the Cr release inventories (field “Cr”) for 1944 and compare to the expected results. | Cr released by site (kg):  216-U-10: 2.86E-01  216-U-14: 8.21E-02  216-Z-1D: 3.37E-06 | PASS |
| 12 | This part examines the partitioning of releases to the 216-U-10 Pond System after the reconfiguration of the 216-Z-1D Ditch to a shorter length (and, therefore, a smaller area) and when volumes to 216-U-10 are large enough that overflow to the 216-U-11 Ditch occurs. No partitioning calculations are performed for the 216-B-3 Pond System because the main pond was the only lobe active, so this check verifies that the SIM-v2 volume and inventories for 216-B-3 are written to the output file unaltered. | | |
| 12.1 | Examine the volumes discharged (field “Volume [m3]”) for 1955 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 1.43E+06  216-U-10: 7.01E+06  216-U-11: 2.61E+06  216-U-14: 1.94E+06  216-Z-1D-SOUTH: 1.23E+05 | PASS |
| 12.2 | Examine the Sr-90 release inventories (field “Sr-90”) for 1955 and compare to the expected results. | Sr-90 released by site (Ci):  216-B-3: 1.70E-02  216-U-10: 1.01E-01  216-U-11: 3.75E-02  216-U-14: 3.71E-02  216-Z-1D-SOUTH: 3.43E-05 | PASS |
| 13 | This part examines the partitioning of releases to the 216-U-10 Pond System with the 216-Z-11 Ditch active. | | |
| 13.1 | Examine the volumes discharged (field “Volume [m3]”) for 1961 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 3.44E+06  216-U-10: 2.17E+06  216-U-14: 4.34E+05  216-Z-11: 8.70E+03 | PASS |
| 13.2 | Examine the Tc-99 release inventories (field “Tc-99”) for 1961 and compare to the expected results. | Tc-99 released by site (Ci):  216-B-3: 4.25E-03  216-U-10: 7.49E-05  216-U-14: 2.02E-05  216-Z-11: 3.92E-11 | PASS |
| 14 | This part examines the partitioning of releases to the 216-U-10 Pond System with the 216-Z-19 Ditch active. | | |
| 14.1 | Examine the volumes discharged (field “Volume [m3]”) for 1976 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 3.42E+06  216-U-10: 5.23E+06  216-U-14: 1.08E+06  216-Z-19: 2.06E+04 | PASS |
| 14.2 | Examine the uranium (total) release inventories (field “U”) for 1976 and compare to the expected results. | U released by site (kg):  216-B-3: 2.24E-01  216-U-10: 3.01E-01  216-U-14: 2.25E-02  216-Z-19: 5.80E-03 | PASS |
| 15 | This part examines the partitioning of releases to the 216-B-3 Pond System with the 216-B-3, 216-B-3A and 216-B-3B lobes active. | | |
| 15.1 | Examine the volumes discharged (field “Volume [m3]”) for 1984 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 4.41E+06  216-B-3A-RAD: 8.00E+05  216-B-3B-RAD: 1.10E+05  216-U-10: 3.05E+05  216-U-14: 6.44E+04 | PASS |
| 15.2 | Examine the H-3 release inventories (field “H-3”) for 1984 and compare to the expected results. | H-3 released by site (Ci):  216-B-3: 4.99E-01  216-B-3A-RAD: 9.05E-02  216-B-3B-RAD: 1.24E-02  216-U-10: 6.65E+00  216-U-14: 1.40E+00 | PASS |
| 16 | This part examines the partitioning of releases to the 216-B-3 Pond System with the 216-B-3, 216-B-3A and 216-B-3C lobes active. | | |
| 16.1 | Examine the volumes discharged (field “Volume [m3]”) for 1994 and compare to the expected results. | Volumes (m3) by site:  216-B-3: 1.61E+06  216-B-3A-RAD: 4.88E+05  216-B-3C-RAD: 4.78E+06  216-U-14-SOUTH: 1.10E+05 | PASS |
| 16.2 | Examine the Nitrate release inventories (field “NO3”) for 1994 and compare to the expected results. | NO3 released by site (kg):  216-B-3: 8.43E+02  216-B-3A-RAD: 2.56E+02  216-B-3C-RAD: 2.50E+03  216-U-14-SOUTH: 2.91E+04 | PASS |
| 17 | This part examines the releases to the 216-B-3 Pond System with only the 216-B-3C lobe active. This check verifies that the SIM-v2 volume and inventories for 216-B-3 are written to the output file for the 216-B-3C lobe unaltered. | | |
| 17.1 | Examine the volume discharged (field “Volume [m3]”) for 1996 and compare to the expected result. | Volume (m3) by site:  216-B-3C-RAD: 5.47E+06 | PASS |
| 17.2 | Examine the I-129 release inventory (field “I-129”) for 1996 and compare to the expected result. | I-129 released by site (Ci):  216-B-3C-RAD: 1.34E-06 | PASS |

# Appendix B

**Completed Installation Test**

| Table B-1  **CIE Source Rerouting Installation Test Plan** | | | |
| --- | --- | --- | --- |
| **CIE Source Rerouting Installation Testing**  **CACIE-CIE Source Rerouting – IT-1** | | **Date:** | |
| **Tool Runner File Location for this test:**  **[PUT LINK TO THE DIRECTORY HERE]** | | **Test Performed By: [FIRST & LAST NAME]** | |
| **Testing Directory: [PROVIDE LINK TO TESTING DIRECTORY]** | | | |
| **Test Step** | **Test Instruction** | **Expected Result** | **Test Result  (Pass/Fail)** |
| Tools Code Repository Directory: | | | |
| Navigate to the testing directory | | | |
| 1 | Invoke Tool runner and test installation of the tool:  *./CACIE\_reroute\_sources\_cie\_IT-1.sh* | | |
| 2 | Verify Tool Runner is invoked and executed. | Tool Runner log is created  (filename: reroute\_cie\_install\_test.log) |  |
| 3 | Verify CIE Source Rerouting Tool executes | Check that the following files are generated:   U-10\_B-3\_CIE\_reroute\_rates.csv U-10\_B-3\_CIE\_reroute\_rates.dat U-10\_B-3\_CIE\_reroute\_fractions.dat U-10\_B-3\_CIE\_reroute\_in.dat |  |