

**PROJECT PLAN FOR
GEOCHEMISTRY PROJECT**

Prepared for

**Nuclear Regulatory Commission
Contract NRC-02-93-005**

Prepared by

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**Revision 3
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Revision: 3

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Date: March 1994

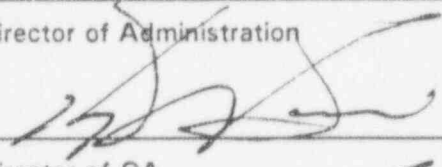



Title: PROJECT PLAN FOR GEOCHEMISTRY PROJECT

EFFECTIVITY

Revision 3 of this document became effective on August 28, 1992.
This document consists of the pages and changes listed below.

| <u>Page No.</u> | <u>Change No.</u> | <u>Date Effective</u> |
|-----------------|-------------------|-----------------------|
| Title Page | 6 | 03/15/94 |
| ii | 6 | 03/15/94 |
| iii - vi | 3 | 07/30/93 |
| 1 - 10 | 0 | 08/28/92 |
| 11 - 19 | 3 | 07/30/93 |
| 20 - 21 | 6 | 03/15/94 |
| 22 - 24 | 3 | 07/30/93 |
| 25 | 6 | 03/15/94 |
| 26 - 28 | 3 | 07/30/93 |
| 29 | 6 | 03/15/94 |
| 30 - 32 | 3 | 07/30/93 |
| A1 | 5 | 12/10/93 |
| A2 - A5 | 6 | 03/15/94 |

Supersedes: Revision 3, Change 5 - December 1993

| | | | |
|---|------------------|--|------------------|
| Director of Administration  | Date: 3/12/94 | Deputy Technical Director for SE&I  | Date: 3/15/94 |
| Director of QA  | Date: 3/12/94 | Technical Director  | Date: 3/12/94 |

3.2.4 Task 4: Semi-Annual Research Report Preparation

3.2.4.1 Objective

The objective of this task is to publish the results of research activities relevant to the Geochemistry Research Project in a timely manner. This task is designed to support the cost of the preparation and production of this project's input into the CNWRA's Semi-Annual Research Reports and Geochemistry Research Project Topical Report.

3.2.4.2 Justification

Timely dissemination of information generated by the CNWRA's research projects to the scientific community, particularly those in HLW programs, is important because of the time constraints involved in site characterization and other studies leading to licensing a HLW repository. This information may be useful to scientists and engineers in other programs and can also provide CNWRA investigators with a faster feedback from peers and other potential users regarding their work. Semi-annual research reports also provide NRC program management with a detailed description of progress.

3.2.4.3 Activities

A report on the progress and results of the Geochemistry Research Project will be prepared every six months. This report will be incorporated in the CNWRA's Semi-Annual Research Report. The final report for the project to be submitted in April 1994 (see section 3.3) will summarize the accomplishments of this project, the extent to which objectives were met, and proposals for future work. The final report will comprise a topical report covering the major research topics: ion exchange studies, zeolite phase relations, and mass transfer modeling. This report will be sent to external reviewers for peer review. A revision of the report based on results of the peer review will be submitted to NRC in September 1994.

3.3 SCHEDULES, MILESTONES, AND DELIVERABLES

The milestones, with the schedules, for the four tasks are listed in Table 3-2. The first three digits of the milestone number denote the project and task number (e.g., 014 indicates Task 4 of this, the first specific research project); the following three digits identify the year in which the milestone is due. In cases where multiple deliverables may be needed to support a single activity, an additional three digits have been added to indicate the sequential number of the deliverable within the activity. Results of research activities conducted under the Geochemistry Research Project will be reported in the form of semi-annual research reports and topical reports as discussed under Task 4.

Activities under Task 2 will continue through the end of FY93. Modifications and verifications of the controlled version of EQ3/6 released by LLNL were completed in FY92. Applications of this code to understand geochemical processes which are important in the Yucca Mountain system, as well as the systematic and critical evaluation of thermodynamic data used in those applications, will continue through FY93.

Table 3-2. List of Milestones and Completion Dates

| Milestone Number | Milestone Type | Deliverable Description | Completion Date |
|------------------|----------------|--|-----------------|
| 014320-004 | Major | Semi-Annual Report 1992—2 | 02/12/93 |
| 014340-002 | Major | Semi-Annual Report 1993—1 | 08/13/93 |
| 014094-002 | Major | Topical Report on Geochemistry | 04/04/94 |
| 014095-001 | Intermediate | Peer Reviewed Topical Report on Geochemistry | 09/30/94 |

Activities under Task 3 will also continue through the end of FY93. Ion exchange experiments at 25°C, as well as some limited experiments at higher temperatures, will be completed. An evaluation of zeolite solid solution thermodynamic properties and a comparison of these values with those derived from component-summation methods will be undertaken in FY93 and FY94. Evaluation of the potential importance of ion exchange processes to the retardation of radioisotopes such as ¹³⁷Cs and ⁹⁰Sr in the Yucca Mountain system will also be conducted in FY94.

Phase equilibrium and dissolution kinetic experiments at 25°C involving Na-analcime and Na-clinoptilolite will continue through the end of FY93.

Preparation and peer review of the final topical report for the project will continue through FY94.

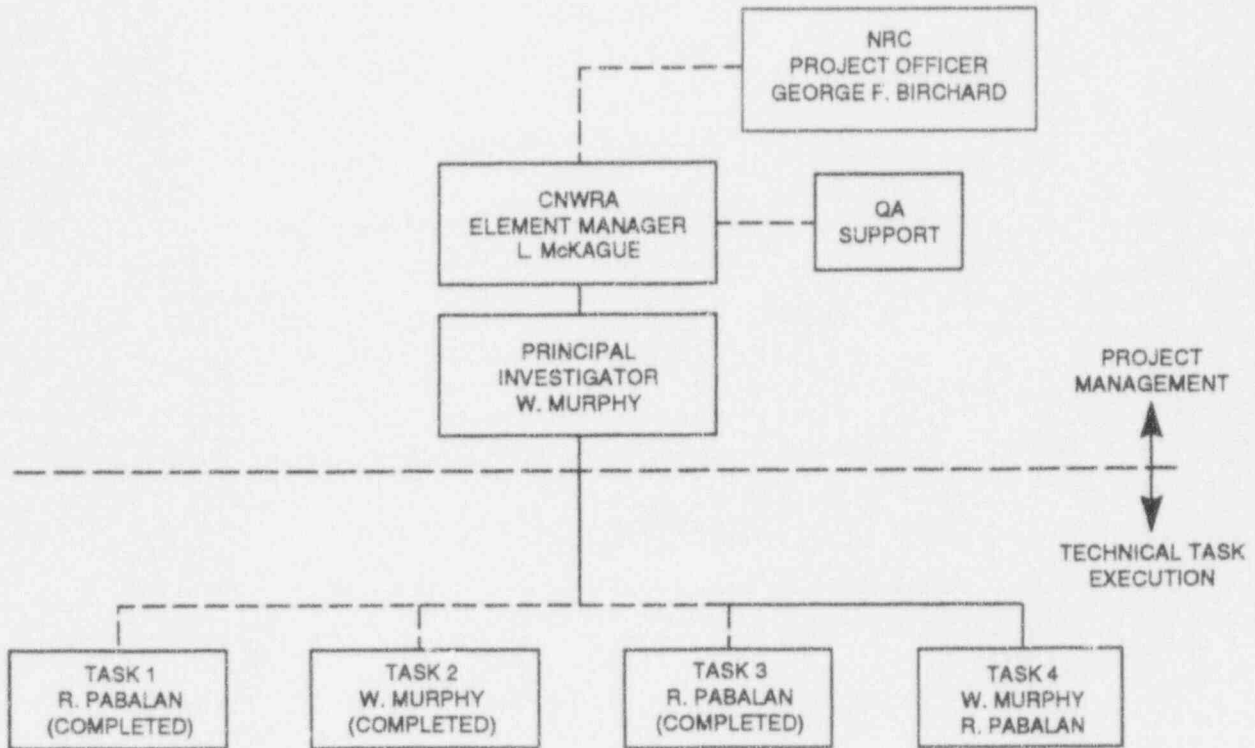


Figure 4-2. Project Staff Support

4.2.4 Data Interpretation and Analysis

Interpretation of data, both from CNWRA experiments and from other sources, will be conducted as specified in CQAM Section 3.9. Routine calculations will be documented and verified in accordance with QAP-014, "Documentation and Verification of Routine Calculations."

Table 4-1. Travel Requirements

| Purpose/Destination | FY94 | |
|---------------------|-----------|-------------------|
| | No. Trips | No. Man-days/Trip |
| Foreign TBD | 1 | 5 |
| US TBD | 1 | 5 |
| Boston, MA | 1 | 5 |

Table A-1. Geochemistry Estimated Spending Plan FY94

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total |
|-----------------------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|
| Center P14 | 153 | 102 | 153 | 306 | 306 | 306 | 357 | 0 | 0 | 0 | 0 | 0 | 0 | 1,684 |
| Center P13 | 294 | 310 | 310 | 2,363 | 2,363 | 2,363 | 969 | 1,046 | 1,046 | 1,046 | 1,085 | 1,085 | 1,085 | 15,364 |
| Center P12 | 247 | 247 | 247 | 2,289 | 2,289 | 2,289 | 3,310 | 1,021 | 1,021 | 1,021 | 1,021 | 1,021 | 1,021 | 17,042 |
| Center P11 | 0 | 0 | 0 | 1,066 | 1,066 | 1,066 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 4,688 |
| Center Tech | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Center Clerical | 82 | 82 | 82 | 195 | 195 | 195 | 195 | 0 | 0 | 0 | 0 | 0 | 0 | 1,027 |
| Center Labor | 777 | 742 | 793 | 6,219 | 6,219 | 6,219 | 5,044 | 2,280 | 2,280 | 2,280 | 2,319 | 2,319 | 2,319 | 39,806 |
| Center Burden | 339 | 324 | 346 | 2,718 | 2,718 | 2,718 | 2,204 | 996 | 996 | 996 | 1,013 | 1,013 | 1,013 | 17,395 |
| Center Overhead | 748 | 714 | 763 | 5,987 | 5,987 | 5,987 | 4,856 | 2,195 | 2,195 | 2,195 | 2,232 | 2,232 | 2,232 | 38,325 |
| SwRI P14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI P13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI P12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI P11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Tech | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Labor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Burden | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Overhead | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ADP Services | 394 | 389 | 476 | 928 | 928 | 928 | 1,458 | 529 | 529 | 529 | 4,437 | 4,437 | 4,437 | 8,672 |
| Machin Shop | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Material/Supply | 16 | 17 | 16 | 0 | 0 | 0 | 71 | 71 | 71 | 71 | 71 | 71 | 74 | 549 |
| Quality Assur. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Report Services | 59 | 60 | 59 | 124 | 124 | 124 | 838 | 714 | 714 | 714 | 714 | 714 | 715 | 5,674 |
| Telephone & Tgram | 1 | 0 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Travel | 0 | 0 | 0 | 0 | 0 | 5,643 | 1,618 | 0 | 0 | 0 | 0 | 0 | 0 | 7,261 |
| Consultants | 0 | 0 | 0 | 0 | 0 | 0 | 4,437 | 4,437 | 4,437 | 4,437 | 4,437 | 4,437 | 4,437 | 31,059 |
| Clear Prem Pay | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Temporary Svcs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Est excl. CFC Fee | 2,334 | 2,246 | 2,454 | 15,978 | 15,978 | 21,621 | 20,526 | 11,222 | 11,222 | 11,222 | 11,315 | 11,315 | 11,317 | 148,750 |
| Center CFC | 49 | 47 | 50 | 362 | 362 | 362 | 318 | 144 | 144 | 144 | 146 | 146 | 146 | 2,509 |
| SwRI CFC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tot Estimate Cost | 2,383 | 2,292 | 2,504 | 16,370 | 16,370 | 22,013 | 20,844 | 11,366 | 11,366 | 11,366 | 11,461 | 11,461 | 11,463 | 151,258 |
| Fee | 187 | 180 | 196 | 1,358 | 1,358 | 1,838 | 1,745 | 954 | 954 | 954 | 962 | 962 | 962 | 12,609 |
| Tot Cost with Fee | 2,570 | 2,472 | 2,700 | 17,728 | 17,728 | 23,850 | 22,589 | 12,320 | 12,320 | 12,320 | 12,423 | 12,423 | 12,425 | 163,867 |
| % Completion | 1.57% | 1.51% | 1.65% | 10.82% | 10.82% | 14.55% | 13.78% | 7.52% | 7.52% | 7.52% | 7.52% | 7.52% | 7.52% | 100.00% |
| Cumulative Cost | 2,570 | 5,042 | 7,743 | 25,471 | 43,198 | 67,049 | 89,538 | 101,857 | 114,277 | 126,597 | 138,019 | 151,442 | 163,867 | 163,867 |
| Cumulative Completion | 1.57% | 3.08% | 4.72% | 15.54% | 26.36% | 40.92% | 54.70% | 52.22% | 69.74% | 77.26% | 84.84% | 92.42% | 100.00% | 100.00% |

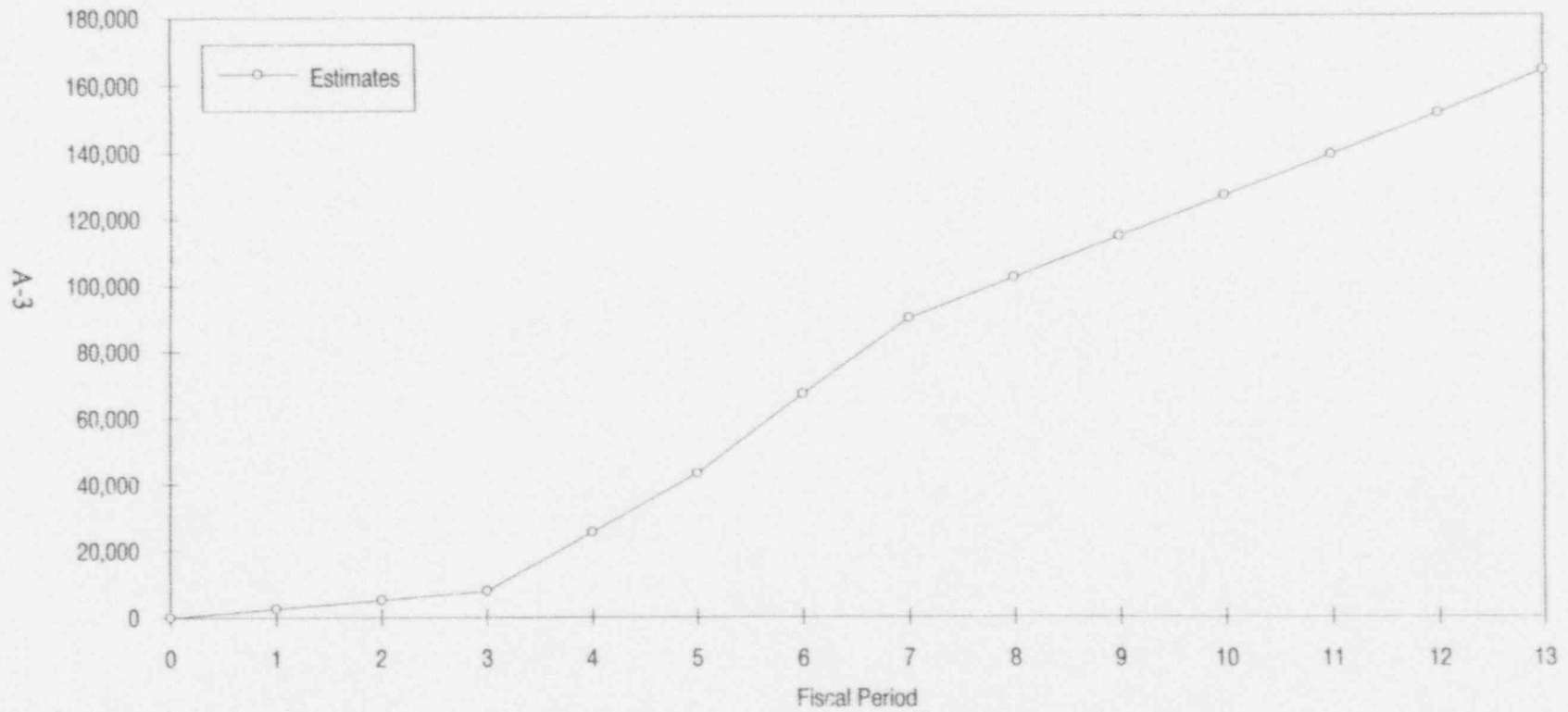


Figure A-1. Geochemistry Estimated Spending Plan, FY94

Table A-2. Geochemistry Estimated Labor Plan, FY94

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total |
|--------------------|----|----|----|-----|-----|-----|-----|----|----|----|----|----|----|-------|
| Center Labor | 3 | 8 | 8 | 8 | 61 | 61 | 25 | 27 | 27 | 27 | 28 | 28 | 26 | 367 |
| Center PI-4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Center PI-3 | 8 | 8 | 8 | 74 | 74 | 74 | 107 | 33 | 33 | 33 | 33 | 33 | 33 | 551 |
| Center PI-2 | 0 | 0 | 0 | 50 | 50 | 50 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 220 |
| Center PI-1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Center Tech | 8 | 8 | 8 | 19 | 19 | 19 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| Center Clerical | 27 | 26 | 27 | 210 | 210 | 210 | 168 | 70 | 70 | 70 | 71 | 71 | 71 | 1,301 |
| Total Center Labor | 27 | 26 | 27 | 210 | 210 | 210 | 168 | 70 | 70 | 70 | 71 | 71 | 71 | 1,301 |
| SwRI Labor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI PI-4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI PI-3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI PI-2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI PI-1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Tech | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total SwRI Labor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table A-3. Geochemistry Task 4 Estimated Spending Plan, FY94

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | Total |
|-----------------------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|---------|
| Center PI-4 | 153 | 102 | 153 | 306 | 306 | 306 | 357 | 0 | 0 | 0 | 0 | 0 | 0 | 1,684 |
| Center PI-3 | 294 | 310 | 310 | 2,363 | 2,363 | 2,363 | 969 | 1,046 | 1,046 | 1,046 | 1,065 | 1,065 | 1,065 | 15,364 |
| Center PI-2 | 247 | 247 | 247 | 2,289 | 2,289 | 2,289 | 3,310 | 1,021 | 1,021 | 1,021 | 1,021 | 1,021 | 1,021 | 17,042 |
| Center PI-1 | 0 | 0 | 0 | 1,066 | 1,066 | 1,066 | 213 | 213 | 213 | 213 | 213 | 213 | 213 | 4,688 |
| Center Tech | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Center Chemical | 82 | 82 | 82 | 195 | 195 | 195 | 195 | 0 | 0 | 0 | 0 | 0 | 0 | 1,027 |
| Center Labor | 777 | 742 | 793 | 6,219 | 6,219 | 6,219 | 5,044 | 2,280 | 2,280 | 2,280 | 2,319 | 2,319 | 2,319 | 30,806 |
| Center Burden | 339 | 324 | 345 | 2,718 | 2,718 | 2,718 | 2,204 | 996 | 996 | 996 | 1,013 | 1,013 | 1,013 | 17,395 |
| Center Overhead | 748 | 714 | 763 | 5,987 | 5,987 | 5,987 | 4,856 | 2,195 | 2,195 | 2,195 | 2,232 | 2,232 | 2,232 | 38,365 |
| SwRI PI-4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI PI-3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI PI-2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI PI-1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Tech | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Labor | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Burden | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| SwRI Overhead | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ADP Services | 394 | 385 | 476 | 928 | 928 | 928 | 1,458 | 529 | 529 | 529 | 529 | 529 | 529 | 8,672 |
| Machine Shop | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Material/Supply | 16 | 17 | 16 | 0 | 0 | 0 | 71 | 71 | 71 | 71 | 71 | 71 | 74 | 549 |
| Quality Assur | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Report Services | 59 | 50 | 59 | 124 | 124 | 124 | 838 | 714 | 714 | 714 | 714 | 714 | 716 | 5,674 |
| Telephone & Tgram | 1 | 0 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Travel | 0 | 0 | 0 | 0 | 0 | 5,643 | 1,618 | 0 | 0 | 0 | 0 | 0 | 0 | 7,261 |
| Consultants | 0 | 0 | 0 | 0 | 0 | 0 | 4,437 | 4,437 | 4,437 | 4,437 | 4,437 | 4,437 | 4,437 | 31,059 |
| Cler Perm Pay | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Temporary Svcs | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Est excl. CFC, Fee | 2,334 | 2,246 | 2,454 | 15,978 | 15,978 | 21,621 | 20,526 | 11,222 | 11,222 | 11,222 | 11,315 | 11,315 | 11,317 | 148,750 |
| Center CFC | 49 | 47 | 50 | 392 | 392 | 392 | 318 | 144 | 144 | 144 | 146 | 146 | 146 | 2,509 |
| SwRI CFC | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Estimate Cost | 2,383 | 2,292 | 2,504 | 16,370 | 16,370 | 22,013 | 20,844 | 11,366 | 11,366 | 11,366 | 11,461 | 11,461 | 11,463 | 151,258 |
| Fee | 187 | 180 | 196 | 1,358 | 1,358 | 1,838 | 1,745 | 954 | 954 | 954 | 962 | 962 | 962 | 12,609 |
| Total Cost with Fee | 2,569 | 2,472 | 2,700 | 17,728 | 17,728 | 23,850 | 22,589 | 12,320 | 12,320 | 12,320 | 12,423 | 12,423 | 12,425 | 163,866 |
| % Completion | 6.82% | 1.51% | 1.65% | 10.82% | 10.82% | 14.59% | 13.79% | 7.52% | 7.52% | 7.52% | 7.58% | 7.58% | 7.58% | 100.00% |
| Cumulative Cost | 2,569 | 5,041 | 7,742 | 25,470 | 43,197 | 67,048 | 89,637 | 101,956 | 114,276 | 126,596 | 139,018 | 151,441 | 163,866 | |
| Cumulative Completion | 6.82% | 3.08% | 4.72% | 15.54% | 26.36% | 40.92% | 54.70% | 62.22% | 69.74% | 77.26% | 84.84% | 92.42% | 100.00% | |