

**PROPOSED ANALYSIS AND DESIGN TASKS FOR THE DHLWM
ADVANCED COMPUTER REVIEW SYSTEM**

Prepared for

**Nuclear Regulatory Commission
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Prepared by

**Rawley D. Johnson
Robert L. Marshall**

**Center for Nuclear Waste Regulatory Analyses
San Antonio, Texas**

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1 INTRODUCTION

In response to the need to review the large amount of technical data already accumulated, with much more expected in the years ahead, it is imperative that the Division of High-Level Waste Management (DHLWM) acquire appropriate computer capabilities and develop associated staff expertise. To partially meet that need, the NRC decided to implement a pilot program to acquire advanced computer technology.

In fulfilling its regulatory responsibility under the NHPA, the NRC has promulgated requirements in 10 CFR Part 60 that will necessitate both probabilistic and deterministic analyses. A sophisticated technical review capability is required to determine compliance with these requirements. A memorandum from the Executive Director to the Commissioners on "Staff Expertise and Capabilities to Utilize Analytical Codes" (SECY-91-247) establishes the basis of the need for this sophisticated review capability (NRC EDO, 1991a).

1.1 BACKGROUND

The DHLWM has determined functional needs for computer hardware and software to support its regulatory responsibilities and precicensing consultation role with DOE which are documented in "DHLWM Computer Hardware and Software Functional Needs and Some Proposed Specific Needs" (Chery, 1990). The planned system is called the DHLWM Advanced Computer Review System, and it has been selected as one of the pilot programs for early implementation of advanced computer technology in the NRC.

The CNWRA informally participated in the development of that report by providing information on CNWRA computer capabilities and interfaces in supporting the NRC DHLWM. The CNWRA began formal work on this project in March of 1992 (Chery and Fortuna, 1992) and submitted the final "Functional Needs Update and Status Report for the DHLWM Advanced Computer Review System" (Johnson, 1992a) on May 28, 1992. Following a briefing on June 8, 1992, to DHLW management and their approval of that report, a "Design and Implementation Plan for the DHLWM Advanced Computer Review System" (Johnson, 1992b), was prepared to support design and implementation of the system. Following the submittal of this draft report on July 23, 1992, briefings were held on August 10, 11 and 12, 1992, with management of the DHLWM, Office of the Nuclear Material Safety and Safeguards (NMSS), the Office of the Executive Director (EDO), and the Office of the Controller (OC), respectively. The report was reviewed and approved and funds were authorized to initiate procurement of the systems by August 15, 1992. Since that time, the majority of the FY92 system components have been ordered and are expected to be installed in September 1992.

1.2 PURPOSE OF THIS REPORT

The purpose of this report is to identify and describe ongoing system analysis and design activities that the CNWRA can provide for the DHLWM, should they need and request them. In order to clearly define the scope of work and delineate the responsibilities of the multiple organizations supporting the DHLWM system, it may be helpful to contrast the design activities of the CNWRA with the support activities of the other organizations. The analysis and design activity provided by the CNWRA is focused primarily on assuring adequate system capability for the future. The operational and

maintenance support provided by other organizations on-site is oriented to more immediate solutions of the day-to-day system and end-user problems.

Additional detail is provided in the next section on support responsibilities by briefly describing the planned Information Resources Management (IRM) and DHLWM support for the system. The remainder of the report is focused only on the CNWRA proposed tasks which are described in Section 2, with the organization, travel, and schedule and cost information included in Sections 3, 4 and 5, respectively.

1.3 SUPPORT RESPONSIBILITIES

The primary organization responsible for the overall day-to-day on-site support of the system is IRM, as is stated in the following assumption take from the CNWRA design report (Johnson, 1992b).

"The Office of Information Resource Management (IRM) will provide the resources required to support the operation and maintenance of a network that supports workstations, such as Reduced-Instruction-Set-Computer-(RISC)-based configurations with UNIX operating systems and X-Windows-based Graphical User Interface (GUI), personal computers (PCs), and wide-area network communications".

1.3.1 IRM Support

IRM will provide their own full time staff to DHLWM for operation and maintenance support. They will also coordinate the services of specific vendors and contractors in providing training of their own staff and services to DHLWM technical staff. Some of the major activities to be accomplished by IRM and their vendors and contractors are discussed in the following sections.

1.3.1.1 Procurement

Procurement of the system is being made by IRM based on the design provided to DHLWM by the CNWRA and will entail the following activities:

- Determine configuration for procurement
- Verify configuration with suppliers
- Order equipment
- Inventory equipment upon delivery.

1.3.1.2 Installation

Installation of the system and integration of all necessary commercial hardware and software products and services with the end-user application will be made by IRM with support from the vendors and contractors. The vendor will be helpful in physically installing the new computer on the network, but there are a number of additional tasks that need to be performed by IRM to integrate the new computer into the network. Some of the installation activities are:

- Physical installation

- Physical connection to LANs and WANs
- Installation of base operating system
- Installation of administrative functions
- Installation of commercial off-the-shelf software package(s)
- Installation of custom engineering and scientific codes
- Interface software development.

1.3.1.3 Ongoing Operation and Maintenance

Ongoing operation and maintenance support will be provided by IRM and their vendors and Contractors. Vendors will provide the customary system maintenance on contract. Specific services for integration support and special software will be contracted. Some of the common activities are:

- User support and problem resolution
- Configuration of software and hardware to support end-users
- Management of mass storage
- Monitoring and tuning of system performance
- Developing operational procedures
- Investigating and testing software and hardware upgrades
- Designing backup procedures and implementing them rigorously
- Reducing the system administration burden by centralizing user account management.

1.3.1.4 Training

IRM staff and DHLWM staff will need training on the UNIX system operation and maintenance provided by the selected vendors. Training should include familiarization with software development and services required to support technical computing for DHLWM.

1.3.2 DHLWM Support

In regard to the DHLWM support responsibilities three assumptions were made in the design report, as described in the following sections.

1.3.2.1 On-Going Technical Computer Hardware and Software Requirements

The first assumption was that the "NRC DHLWM technical staff will be provided with the computer hardware and software that is required to support DHLWM functional needs."

The CNWRA design and implementation plan to support DHLWM functional needs was reviewed and approved by NRC management. Thus, the procurement process has been initiated by IRM to provide the computer hardware and software to support DHLWM functional needs.

In the design process, every effort was made by the CNWRA to include all of the hardware and software items necessary for proper configuration, installation, testing and operation. However, in a complex system such as this, it is possible to overlook certain items or not be able to procure the exact item. Therefore, it is essential to have the capability to procure items in an ongoing manner and to be prepared to support some interface software development. This approach has been taken to avoid developing interface software to the maximum extent possible, to minimize costs and save time in the implementation schedule.

1.3.2.2 Development of Codes in UNIX Environment

The second assumption was that the ". . . NRC technical staff will be expected to use available methods, models and codes and to develop them also."

The DHLWM technical staff will receive training from IRM, selected vendors and contractors in the UNIX Operating System and its development environment. They will then be expected to apply their specific application knowledge and experience to use available methods, models and codes and to develop them also, when applicable.

The custom developed scientific and engineering codes, of course, are essential to the end users applications and will continue to be developed. It is also expected that there will be other software necessary in the future on an ongoing basis.

1.3.2.3 Use of Codes Under Configuration Control in Program Operations

The third assumption was that the ". . . NRC technical staff will be trained and provided with necessary and appropriate experience to become competent with model theories, data requirements, program operation, and analysis of results."

The DHLWM requested that CNWRA Operations Plans include NMSS technical and Research activities that address specific uses of scientific and engineering codes by end-users in DHLWM and at the CNWRA. These are primarily configuration control of codes and seminars and workshops. The latter two activities will increase staff competence with model theories, data requirements, program operation and analysis of results.

These support and organization responsibilities are highlighted in Table 1-1 and the next section describes additional analysis and design activities proposed by the CNWRA.

Table 1-1. Support Responsibilities

| Responsible Organization | On-Going Support Tasks | | | | | | |
|--------------------------|------------------------|----------------------------------|----------------|----------------------------------|----------------------|----------------------|---------------------|
| | Procurement | Installation | Operation | Maintenance | Training | System Integration | Analysis and Design |
| IRM | Total System | Coordinate Vendor and Contractor | Support User | Coordinate Vendor and Contractor | | | |
| Vendor | | Vendor System | | Vendor System | Vendor Products | | |
| Contractor | | | | Third Party Products | Third Party Products | Third Party Products | |
| DHLWM | | | End User Codes | Develop/ Maintain User Codes | | End User Codes | |
| CNWRA | | | | | Total System | Total System | Total System |

2 CNWRA TECHNICAL SUPPORT TASK DESCRIPTIONS

The proposed DHLWM Advanced Computer Review System will consist of high-performance computer workstations integrated with the staff's PCs communicating across the Agency Wide Area Network and the Internet. This system will be capable of accessing DOE databases. The system will also support retrieval of technical and performance evaluations and engineering designs in digital form. The system will use advanced scientific visualization, geosciences information manipulation (including software for complex natural system modeling), and sophisticated engineering design.

In designing the system, the planned functionality was grouped into three areas (discussed in Sections 2.1, 2.2 and 2.3). Two additional areas (discussed in Sections 2.4 and 2.5) are included on (i) Alternatives for Management of the Reference Document Database and (ii) Training.

2.1 TECHNICAL SUPPORT FOR HIGH-PERFORMANCE TECHNICAL COMPUTING

2.1.1 Analysis and Design of System Upgrades

Design and implementation plans will be developed by the CNWRA based on its analysis of requirements and existing capabilities within DHLWM.

2.1.2 Implementation of Network Information Service (NIS)

The CNWRA can provide support in the configuration of the NIS on the DHLWM network of SUN workstations. Implementing NIS would simplify the burden of managing accounts and passwords on the SUN workstations across the network by providing management of accounts, passwords, and other system information from one master SUN workstation.

2.1.3 Installation and Customization of CNWRA Controlled Codes

The CNWRA has gained considerable expertise in its use and modification of codes such as TOUGH and PORFLOW in the task work performed for DHLWM and Research. The CNWRA can provide support in the configuration and modification of such codes for use on the high performance workstations.

2.1.4 Application of Surface and Volumetric Modeling Codes (ISM and IVM/GMP)

The CNWRA has used the Interactive Surface Modeling (ISM) and Interactive Volumetric Modeling/Geologic Modeling Program (IVM/GMP) on the Silicon Graphics workstation on a number of tasks. The DOE has used the two packages extensively in the characterizations of the Yucca Mountain surface and subsurface area. The CNWRA can provide expertise in the customization and use of the two packages as DHLWM acquires and analyzes DOE ISM and IVM/GMP datasets.

2.1.5 Access and Manipulation of External Databases and Data Files

DHLWM staff will use very large DOE technical databases and data files. The CNWRA could supply expertise in the design and implementation of access protocol procedures for large databases to support the access and manipulation of those data files from a variety of organizations.

2.1.6 Connectivity to External Computers

The CNWRA can prepare user guides for DHLWM technical staff to use in accessing other computers.

2.1.7 Configuration Control/Management

As codes and models and their corresponding data sets are used and modified, certain steps must be taken to ensure the reproducibility of versions of the code and document the creation of specific versions of the code. The CNWRA has produced a configuration control plan and has formed a configuration control board to manage the changes made to CNWRA controlled codes. The CNWRA is implementing tools to automate the creation and distribution of distinct versions of the same code and provide difference analysis showing the changes made between versions of the same controlled code. The CNWRA can provide support to the DHLWM in the establishment of configuration control procedures and the implementation of automated tools to aid that process.

2.1.8 Code Development/Modification

The CNWRA has considerable expertise on the analysis and modification of codes and models as an outgrowth of the Iterative Performance Assessment task. The CNWRA can provide help in the use of tools such as syntax analyzers and code structuring utilities to better document and manage the development process.

2.1.9 Software Evaluation

The CNWRA can provide support in the evaluation of new software for application areas in which the CNWRA has performed task work. Examples include remote imagery, engineering design review, data visualization, geologic (including structural) mapping, and other areas.

2.2 SUPPORT FOR UPGRADING OF DHLWM PERSONAL COMPUTERS (PCS) AND INTEGRATION WITH AUTOS

2.2.1 LAN Integration

The CNWRA is cooperating with the Network Development Branch of IRM to integrate the CNWRA LANs and Southwest Research Institute's (SwRI) Mainframes with the Agency WAN and the DHLWM AUTOS LAN to support the collaboration between the DHLWM and the CNWRA. The CNWRA can provide support for connectivity between the DHLWM PCs and workstations and the CNWRA PCs, workstations, and mainframes. This includes use of the TCP/IP protocols for file transfer, terminal session, and remote execution.

2.2.2 Optical Storage

Given the large number of voluminous technical databases and files the DHLWM will be required to access and manipulate as part of the regulatory process, optical storage would provide the most economical form of storage media. If such quantities of local storage become necessary, the CNWRA could provide expertise for the evaluation of optical storage components and software.

2.2.3 Multimedia

Some of the multimedia technologies, such as animation, video capture and digital audio, might have significance in the communications and display of analyses performed by the DHLWM as part of the regulatory process. The CNWRA could provide expertise in the evaluation and design of technologies to support such areas.

2.3 SUPPORT FOR AGENCY WIDE AREA NETWORK CONNECTIVITY

The primary support for WAN connectivity will come from IRM. IRM will assist in the connection of workstations to the WAN, assigning network addresses consistent with the NRC naming convention, monitoring the LAN segments for network errors, and provide for the day-to-day network operations needs. There are certain key areas of support that the CNWRA might assist in, as described in the following sections.

2.3.1 Network Security

The requirement to connect with the Internet results in the exposure of the workstation to any individual on the Internet wishing to gain access or cause harm. Security measures must be taken at various points in the WAN to prevent damage. At the interface point between the Agency and the Internet, precautions such as "firewall" machines or secure routers can provide the first level of access control. At the workstation, configuration steps should be performed to prevent access at the workstation level [such as never allowing the receipt of Trivial File Transfer Protocol (TFTP) and never authorizing the File Transfer Protocol (FTP) "ANONYMOUS" account]. Finally, subscription to the Computer Emergency Response Team (CERT) alerts from Carnegie-Mellon University provide for notification of security weaknesses and fixes for specific operating systems and timely information on threats. The CNWRA and SwRI can provide network security expertise based upon the development of secure networks for other government agencies.

2.3.2 Network Capacity and Traffic Analysis

As the DHLWM accesses more DOE databases and performs more collaborative work with the CNWRA, the amount of data being transmitted and response times should be monitored. The CNWRA will work with IRM to monitor the traffic between San Antonio, White Flint and Crystal City to ensure adequate performance of that segment of the WAN.

2.4 ALTERNATIVES FOR MANAGEMENT OF THE REFERENCE DOCUMENT DATABASE

The application requirements for reference document databases at the DHLWM and the projected user and system capacity require more detailed analysis to support the design and implementation of an appropriate system. DHLWM database submissions and user access to NUDOCS, TDI, Waste package Review Database, Hydrologic Transport Section file and images resulting from scanning HLW documents must be specifically defined in regards to indexing, managing full text and storing images.

It is recommended that any alternatives considered for the management of the DHLWM reference document databases be coordinated with the initiatives already begun as a result of the January 16, 1991, report by the Office of the Inspector General (OIG). In this report the OIG recommends that IRM use NUDOCS to meet the requirements of offices that maintain search and retrieval systems similar to NUDOCS and if the offices' requirements could not be met with NUDOCS, the OIG recommended that IRM propose feasible approaches to meeting those requirements.

Therefore, alternatives considered by DHLWM for their reference document databases should take advantage of the following IRM reports and proposed systems approaches addressing some of the concerns raised in the OIG report. The two reports developed on an IRM contract project are:

- "Requirements Analysis of Text Management Needs for the Nuclear Regulatory Commission," prepared by Applied Management Systems, Inc., September 12, 1991.
- "Preliminary Draft Final Report of the Text Management Prototype Project" by Applied Management Systems, Inc. and Pinkerton Computer Consultants, Inc., June 4, 1992, with Attachment 1.

2.4.1 Analysis of the IRM Developed Concept

The IRM developed concept, in the context of these studies, would consist of the following if implemented by DHLWM:

- DHLWM reference databases would be installed under the operation and control of their office.
- Selected data would be shared between the DHLWM reference databases at the discretion and under the control of the DHLWM.
- Access to the NRC's official documents would remain as set forth in the current Agency Document Repository (NUDOCS).
- A distributed processing approach would be taken (as opposed to a distributed database approach). The document repository would contain all the records and full text of the Agency's official documents. The DHLWM reference databases would only contain the unofficial or local documents of DHLWM as well as working copies of any official documents desired by DHLWM. A great deal of the processing of searches would be

performed on the DHLWM systems and the document repository would be used to provide the text and header information of the applicable official documents.

It is proposed that the CNWRA support the DHLWM in evaluating the Text Management Prototype System needs from two perspectives:

- Its technical ability to provide the features required by DHLWM, and
- The reaction of DHLWM to the usefulness of those capabilities.

2.4.2 Design of the Reference Document Database

Based on the results of the evaluation outlined in Section 2.4.1, the CNWRA could develop a design and implementation plan for the appropriate alternative for management of the Reference Document Database. This plan would include an interface for Licensing Support System (LSS) submissions, when it is available, and adequate maintenance and access support for DHLWM intradivisional reference document databases.

2.5 TRAINING

As described in Section 1.3, adequate support for the UNIX high-performance technical computing should be provided by IRM. The CNWRA can provide training related support and consultation in the following three areas that go beyond normal vendor support and are specific to the end-user systems and applications. They are as follows:

- System integration plans for IRM, vendor and contractor support
- Operating procedures for IRM and the DHLWM
- End-user documentation for specific applications for the DHLWM.

Most of this training and consulting would require IRM and DHLWM staff to be available at the CNWRA for specified periods of time. This on-the-job training using the same or similar systems to the DHLWM at the CNWRA would permit hands-on time for the trainee on an integrated and operational system. Operating procedures and documentation for end-users can be provided in specific areas where there is a need and the CNWRA has the proper expertise in the application area available.

3 ORGANIZATION

3.1 ORGANIZATIONAL STRUCTURE AND RESPONSIBILITY

The organizational structure, responsibilities, management and control techniques applicable to the technical assistance and research activities at the CNWRA are fully described in the CNWRA Management Plan. Mr. Rawley D. Johnson would be the CNWRA program element manager for this program and Mr. Robert L. Marshall would be the Principal Investigator. The task support, direction, and resource allocation relationships are shown in Figure 3-1.

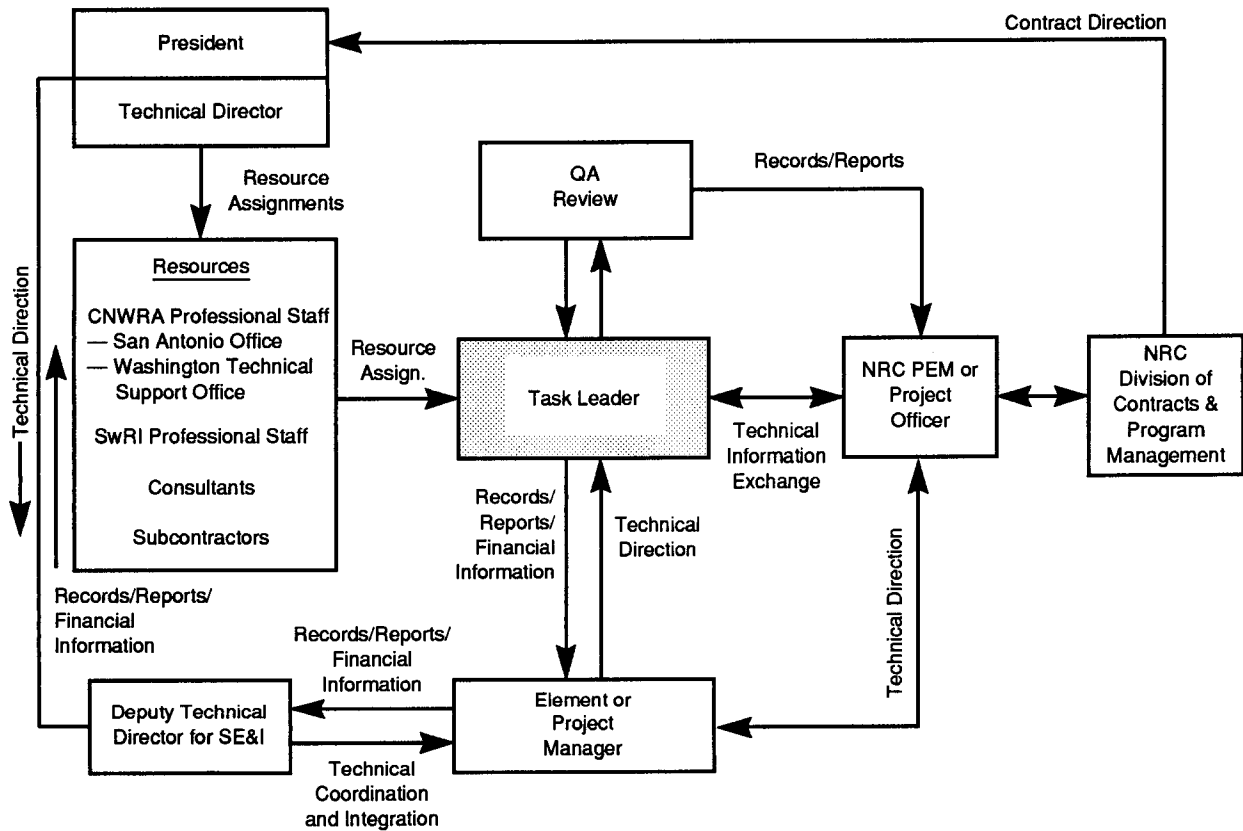


Figure 3-1. CNWRA Management Process for Direction and Control of Projects

The project staff support and the project organization are shown in Figure 3-2.

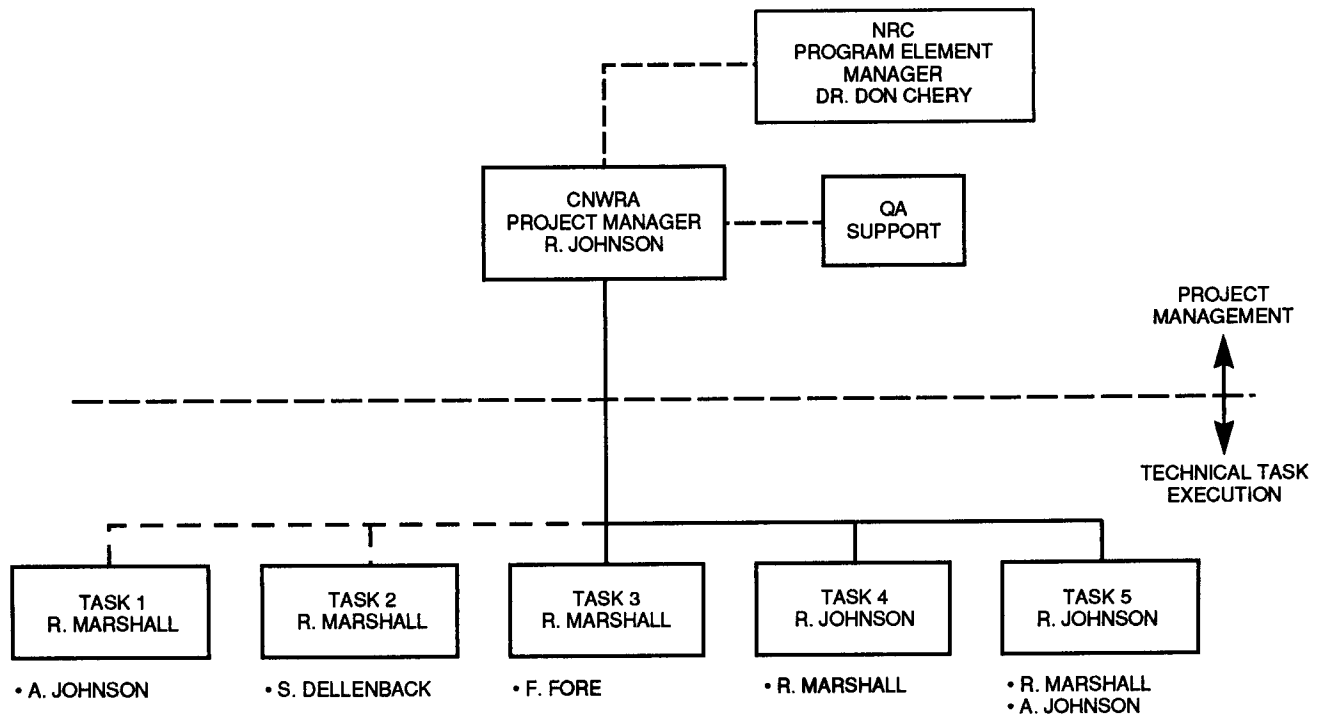


Figure 3-2. Project Staff Support and Organization

3.2 QUALITY ASSURANCE

System analysis and design activities will be conducted in accordance with the applicable portions of the CNWRA Quality Assurance Manual (CQAM) and applicable Operating Procedures. Quality Assurance (QA) requirements applicable to project activities are identified in the Quality Requirements Application Matrix, which is issued periodically to Project Managers and Principal Investigators, as specified in Quality Assurance Procedure (QAP)-013, "Quality Planning." QA requirements, including those identified below, apply to work conducted by CNWRA personnel, other Divisions of SwRI, subcontractors, and consultants. Personnel performing activities affecting quality will be qualified in accordance with QAP-007, "Professional Personnel Qualification."

3.3 PERSONNEL

The key personnel, their experience, and estimated percentage of time allocated for this program are listed below.

3.3.1 Key Personnel

Table 3-1. Key Personnel

| Staff | Expertise | Percentage of Time |
|-----------------|--|--------------------|
| Rawley Johnson | Program Management Information Systems Technical Computing | TBD |
| Robert Marshall | Information Systems Technical Computing | TBD |
| A. Johnson | SUN MicroSystems Silicon Graphics | TBD |
| S. Dellenback | Novell Networks/UNIX Systems | TBD |
| F. Fore | WAN/Internet | TBD |

3.3.2 Support Personnel

In addition to the key personnel, other staff will be used on an as-needed basis within the overall constraint of authorized fiscal resources. Provision is made in the plan for consultation support from such staff.

3.4 SPECIAL RESOURCES

Special computational, data management, and visualization capabilities are available at the CNWRA and via remote computing facilities using telecommunications to support this project. The major computer resources supported by a trained staff are:

- Computer and Telecommunications (CTC) which includes an IBM 4381 and VAX 8700 operating on a Fiber Optic network at SwRI with an INTERNET link to a variety of supercomputers;
- CNWRA Local Area Network (LAN) with Network File Server (NFS) and the TCP/IP protocol on the SwRI network with leased line connections to the NRC for High-Performance technical computing, database access and electronic communications;
- Workstations on the CNWRA LAN include the Silicon Graphics IRIS 4D/210 with Dynamic Graphics ISM and IVM software systems, SUN SparcStation 2 with MVE/BSP, GeoSec, and ESRI Arc/Info software systems and a digitizing table, SUN IPX/IPC with SUN OS C, FORTRAN, X-Windows, and PS/2 PCs with OS/2 C, C + +, FORTRAN and X-Windows.

4 TRAVEL

The CNWRA will have at least one meeting or telephone conference every month with the NRC project officer to discuss and review the progress of the overall project. Additional meetings and telephone conferences will occur as often as is necessary to accomplish the specific task of work successfully. However, due to the overlapping nature of the technical support work and the multiple organizations involved, every attempt will be made to define and limit travel to presentations of deliverables and demonstrations of results of analysis and design efforts for specific tasks as they are defined.

Meetings will need to be held at the NRC to use specific hardware and software in its operating environment, however, most of the hardware and software to be used should already be available at the CNWRA. In the analysis and design tasks that have been described, the work can be done at the CNWRA or the NRC may provide the necessary hardware and software systems for proper analysis at the CNWRA.

5 SCHEDULE AND COST

The schedule and cost for the proposed support cannot be detailed at this time but will be developed as the DHLWM requests the CNWRA to provide specific analysis and design tasks.

5.1 SCHEDULE

The schedule in Table 5-1 contains the latest list of major milestones received from the DHLWM for the system. It includes FY93 and FY94 and consists primarily of activities directly related to the High-Performance Technical Computer System. It does not include a specific entry, for example, for evaluating the alternatives for the management of the DHLWM Reference Document Database or for other tasks that may need to be performed as described in Section 2.

Table 5-1. Major Program Milestones for Implementing the DHLWM Advanced Computer Review System

| Date | Milestone |
|----------------------------------|---|
| August 1990 | Report on "DHLWM Computer Hardware and Software Functional Needs and Some Proposed Specific Needs" was delivered by NRC DHLWM |
| May 1992 | Report on "Functional Needs Update and Status Report on the DHLWM Advanced Computer Review System" by CNWRA |
| July 1992 | Report on "Design and Implementation schedule for the DHLWM Advanced Computer System for Technical Review" by CNWRA |
| September 1992 | Procurement by IRM of the FY92 Equipment, Software and Associated Systems |
| September 1992 December 1992 | Inventory and installation of purchased systems by IRM for DHLWM |
| September 1992 September 1993 | Connect DHLWM Advanced Computer LAN Connection to AUTOS LAN Connection to WAN |
| October 1992 December 1992 | Procurement and installation by IRM of the FY93 equipment and associated software |
| June 1993 July 1993 | Procurement by IRM of FY93 equipment, software and associated systems with reprogrammed funds |
| October 1993 September 1994 | Procurement and installation by IRM of the FY94 equipment and associated software |

5.2 COST

The technical support costs allocated for the High-Performance Technical Computing System for FY92, FY93 and FY94, respectively by the DHLWM are \$100K, \$150K and \$200K, not including training. Estimates of the cost for CNWRA to perform requested analysis and design tasks will be made based upon each specific request.

6 REFERENCES

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