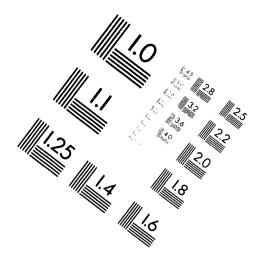
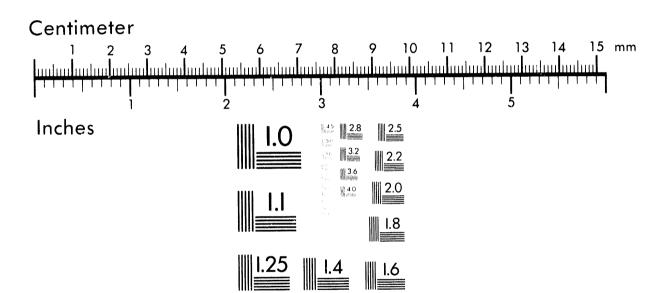


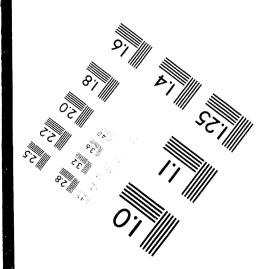


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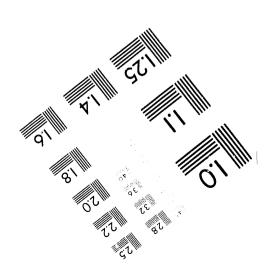




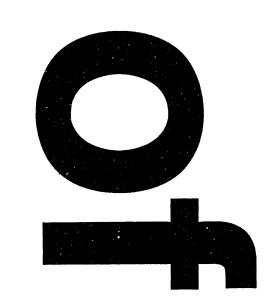


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Oak Ridge Environmental Information System (OREIS) Functional System Design Document

Date Issued-March 1994

Prepared by
Oak Ridge Environmental Information System (OREIS)
Oak Ridge National Laboratory

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GLOSSARY

Coverage: (1) A digital analog of a single map sheet forming the basic unit of data storage in ARC/INFO. In a coverage, map features are stored as primary features (such as arcs, nodes, polygons, and label points) and secondary features (such as tics, extent, links, and annotation). Maps feature attributes are described and stored independently in feature attribute tables. (2) A set of thematically associated data considered to be a unit. A coverage usually represents a single theme or layer, such as soils, streams, roads, and land use.

Data Coordinator: OREIS staff responsible for coordinating tabular and geographic data transmittals with site personnel.

Data Custodian: A person appointed within an environmental program or project to be responsible for the supervision and maintenance of the data. The data custodian serves as the interface between the data generator and OREIS staff, authorizes changes and updates to OREIS data, and serves as the point of contact when questions arise concerning data from the program or project.

Data Generator: A person within an environmental program or project who initiates the sampling, measurement, or construction activities that generate data and who is considered a course for data residing in OREIS. This person authorizes the release of data to data custodians when satisfied that the data are complete and have been validated.

Data harmonization: A process used to convert data to a common format for secondary use.

Data loading: The process of entering data received from data sources into the OREIS data base.

Data Manager: Person responsible for coordinating all activities involved with managing tabular and geographic data in OREIS.

Data review: A process to ensure that data transmitted to OREIS are validated, complete, and consistent with their metadata and with the OREIS variable names and codes before data are loaded.

Data transmittal package: A set of written results of data processing and evaluation activities conducted by OREIS staff on data submitted by a program or project. The package consists of a summary of the OREIS processing, a listing of potential data problems, and the results of the data evaluation.

External interfaces: OREIS contacts or interfaces with (1) data sources or suppliers of data and (2) data users.

Macro: A set of procedural commands that directs a software application to perform a specific operation or set of operations. Macros are typically written in a high level, and often vendor-specific, language.

Metadata: Information about measurement and geographic data that helps to define data usability and associated context.

Point: A single x,y coordinate that represents a geographic feature too small to be displayed as a line or area (e.g., well sites).

Privileged user accounts: In UNIX, the accounts that have privileges beyond the normal users; root has read, write, and execute privileges on the system; daemon, sys, and bin are other privileged user accounts that are used to provide system services, such as printing, which require more access rights than a normal user.

Secondary use: Use of data from the OREIS data base by any individual or group not associated with the original data collection or its management.

Systems Administrator: OREIS staff member who is responsible for all activities associated with planning, installation, configuration, and maintenance of the OREIS system.

EXECUTIVE SUMMARY

The OREIS Functional System Design document provides a detailed functional description of the Oak Ridge Environmental Information System (OREIS). It expands the system requirements defined in the OREIS Phase I—System Definition Document (ES/ER/TM-34). Documentation of OREIS development is based on the Automated Data Processing System Development Methodology, a Martin Marietta Energy Systems, Inc., procedure written to assist in developing scientific and technical computer systems.

This document focuses on the development of the functional design of the user interface, which includes the integration of commercial applications software. The data model and data dictionary are summarized briefly; however, the *Data Management Plan for OREIS* (ES/ER/TM-39), a companion document to the Functional System Design document, provides the complete data dictionary and detailed descriptions of the requirements for the data base structure.

The OREIS system will provide the following functions, which are executed from a Menu Manager: (1) Preferences, (2) View Manager, (3) Macro Manager, (4) Data Analysis (Assisted Analysis and Unassisted Analysis), and (5) Spatial Analysis/Map Generation (Assisted ARC/INFO and Unassisted ARC/INFO). Additional functionality includes interprocess communications, which handle background operations of OREIS.

1. INTRODUCTION

1.1 PURPOSE

The purpose of the Functional System Design document is to provide a detailed functional description of the Oak Ridge Environmental Information System (OREIS). It expands the system requirements defined in the OREIS Phase I—System Definition Document. Documentation of OREIS development is based on the Automated Data Processing System Development Methodology² (ADP SDM), a Martin Marietta Energy Systems, Inc. (Energy Systems) procedure that was written to assist in developing scientific and technical computer systems.

During the initial development phase of OREIS, a centralized system design was selected from other system design alternatives, and the major requirements for OREIS were established. As part of these initial studies, major system functions were defined and included the following: controlled data import and export, data storage and retrieval, data analyses and summaries, spatial analyses (GIS), 2-D/3-D graphics, report generation, map generation, and user interface and query menus.

According to ADP SDM guidance, the functional system design activities expand and further define the requirements of the system and provide the necessary planning to develop or produce the computer system design. The ADP SDM guidance further states that the functional system design activities should define the logical system flow, the logical data organization, the system inputs and outputs, the processing rules, and the operational characteristics of the system without regard to the software or hardware that will support the operation of the system and without regard to the physical organization of the data or the programs that will accept the input data, execute the processing rules, and produce the required output. The functional system design for OREIS, however, deviates from this approach because of early decisions to use commercially available application software and to select the hardware and software for OREIS that would best provide the major system functions listed above.

The functional system design for OREIS, therefore, *includes* the functional capabilities offered by the selected hardware (i.e., the Sun workstation and X terminals) and the selected software, which is ORACLE for the relational data base management system (RDBMS); SAS for the data analysis and data management facilities; ARC/INFO, a geographic information system, for the spatial analysis system and 2-D map generation capabilities; and DevGuide for the graphical user interface (GUI). The functions not provided by the commercially developed application software are the top-level, integrated user interface; the menu manager; the view manager; the macro manager; and the customized queries and report formats. The design of these functions is the focus of the first version of this document. Future versions of this document will address the automation of data review, harmonization, and loading, which currently is done manually, and the incorporation of application software to support the 3-D function and subsurface modeling.

The design for the data base, including data storage and retrieval, is discussed only briefly in this document. The details of the data base design are found in the *Data Management Plan* for OREIS.³ The business system rules relating to the information structure (e.g., what data

and information are coming into the system, what are going out of the system, and what are being shared by whom), the information/data flow of daily operations (e.g., procedures and requirements for performing data-related functions and for determining who has access to data), the procedure used with any automated portions of the system, and the procedures for system access are provided in the *Data Management Plan for OREIS* and in separate procedures for transmitting data⁴; making changes to the data base structure⁵; obtaining access to OREIS⁶; registering OREIS users⁷; and data backup, archival, and recovery of data.⁸

1.2 OREIS BACKGROUND INFORMATION

OREIS is mandated by the Department of Energy Oak Ridge Operations (DOE-ORO), Environmental Restoration (ER) Division, to fulfill the data requirements prescribed in both the Federal Facility Agreement⁹ (FFA) and the Tennessee Oversight Agreement¹⁰ (TOA) and to support data management activities for all five facilities managed by Energy Systems. These facilities include the three Oak Ridge Reservation (ORR) facilities [Oak Ridge National Laboratory (ORNL), the Y-12 Plant, and the K-25 Plant) and the gaseous diffusion plants located at Paducah, Kentucky, and Portsmouth, Ohio.

The FFA, a tripartite agreement between DOE, the U.S. Environmental Protection Agency (EPA) Region IV, and the State of Tennessee, requires DOE to maintain one consolidated data base for environmental data generated at DOE facilities on the ORR. According to the FFA, the consolidated data base is to include data generated pursuant to the FFA and data generated under federal and state environmental permits. The TOA further defines DOE's obligations to develop a quality assured, consolidated data base of monitoring information that shall be shared on a near real-time basis with the state by way of electronic processing.

OREIS is the centralized data management component of the ER Program and is being developed to provide consolidated, consistent, and well-documented environmental data and data products to support ER's planning, decision making, and reporting activities.

1.3 OREIS SCOPE

The development of OREIS is broadly structured into three components: a data base, an information system, and operational standards and procedures.

1.3.1 Data Base

A goal of the OREIS data base is to make environmental data electronically available in a consistent and documented format for secondary use. Secondary use is defined as use of data in OREIS by any individual or group not associated with the original data collection or its management. The scope of data for OREIS includes the environmental data needed to support the information needs of current program sponsors and to meet regulatory requirements. The current phase of data collection and data loading efforts focuses on two areas: (1) environmental measurements data that support ER reports and that are deliverables to EPA under the FFA and (2) geographic information system (GIS) data to support the ER program. Future phases of the system will expand the scope of the data. Planning for the integration of the environmental compliance data as part of OREIS is underway. Historical

sources of environmental data are candidates for inclusion into OREIS depending on funding, sponsor priorities, and potential for secondary use of the data. For more information on the data base structure and the data dictionary, refer to the Data Management Plan for OREIS.³

1.3.2 Information System

The information system provides the means by which data are made available to the users. The information system includes both the commercial hardware and software and the OREIS-developed user interface. Data are made available to users via two methods: (1) the user interface, which provides on-line computer access to data and applications software and (2) a service organization, which processes off-line requests from users and delivers data and data output to the user within a specified time.

1.3.3 Standards and Procedures

The standards and procedures component defines and delineates the operating environment of the OREIS system for both users and operations staff. The standards and procedures contain the requirements (i.e., business rules) for implementing various functions of the system.

2. REQUIREMENTS

Significant requirements for OREIS have been identified and show what the proposed system is to accomplish. Topics addressed are data outputs, system deliverables, and user interface. Refer to the OREIS Phase I—System Definition Document¹ for more details about the overall OREIS requirements. Some of the requirements in the document¹ have been revised to reflect the requirements in this version of OREIS.

2.1 DATA OUTPUTS

The requirements for data outputs are provided below.

- OREIS must have the ability to generate electronic copies of data for regulatory agencies (e.g., EPA) and for system users.
- OREIS must support standard export data formats used by commercially available software programs.
- OREIS must support reporting requirements of regulatory agencies [e.g., the Interchange File Format (IFF), the data export protocol of EPA]. OREIS data output must be available on a variety of media (e.g., disk, printer).

2.2 SYSTEM DELIVERABLES

The requirements associated with system deliverables include the following:

- OREIS must include a capability for programmers to automate the generation of standard reports. This report generation capability must readily allow for the adaptation of existing reports for new reporting requirements.
- OREIS must produce graphics (charts and plots) for reports, presentations, and scientific analysis.
- OREIS must have the capability for generating statistics for scientific analyses and hypothesis testing.
- OREIS must allow the selection of graphical information from available base maps.
- OREIS must display maps electronically, provide plotting capabilities, and support spatial
 processing and analysis of geographic data.
- OREIS must provide an application to allow users to define and execute procedures.
- OREIS must allow creation of predefined reports from SAS, ORACLE, and ARC/INFO.
- OREIS must provide the capability to develop queries of the data base.

- OREIS must have the capability of overlaying geographic information on electronic maps and photos.
- The OREIS design should attempt to integrate as many user-defined functions as possible within a common applications environment.
- Compatibility and consistency between the components of OREIS should be emphasized so that the system will require minimal development, support, and maintenance.
- The OREIS design should meet the functional security requirements specified in Sect. 7.

2.3 USER INTERFACE

The requirements related to the user interface are as follows:

- The OREIS user interface should provide an easy-to-use graphical user interface system that supports both novice and experienced users.
- OREIS should provide as much consistency between software tools as possible.
- Users must have menu options that subset the data to be included in the OREIS product being generated. Subsetting the query can, for example, include the selection of (1) a site, environmental media, sampling location, well, borehole, tanks, or other identifier; (2) an analyte or groups of analytes; (3) a result based on a qualifier; (4) a data quality flag; (5) individual samples; and (6) a range of sampling dates and a range of result values.
- OREIS must allow users to save a data query definition for use at a later time. Users must be able to define a query for one OREIS product and save that query so it can be used for another application.
- Users must be able to supplement the OREIS data analysis toolset by writing and including their own programs (e.g., SAS) and import/export supplemental data files.

3. OREIS EXTERNAL INTERFACES

3.1 DATA USERS

OREIS has an external interface with both on-line and off-line users. A procedure on accessing data in OREIS⁶ describes the initial interface with both types of OREIS users. Off-line users submit requests for data and data products to the OREIS staff for processing; this currently is a manual function. OREIS staff then use the same tools and functions as on-line users to process the request.

On-line users and OREIS user support staff are given READ-ONLY access to the data and use the system to query the data base electronically and generate data products. Data products include electronic copies of data, hardcopies of data, summaries, or analyses. The automated functions for queries and reports are provided in the following section.

3.2 DATA SOURCES

OREIS also has an external interface with data sources. OREIS interfaces with a number of divergent data sources, including the ER Program at each site; each site's subcontractors; ER's Aerial Survey Program, which produces aerial surveys for the ORR; the U.S. Geological Survey (USGS); and, eventually, environmental compliance and monitoring programs at each site.

The primary data sources for OREIS are the ER Programs at each site. The details of the interaction with the ER site programs are provided in the procedure on transmitting data to OREIS⁴. In brief, the ER site program submits data to the OREIS staff, the OREIS staff reviews the data for completeness and potential problems, problems are resolved through consultation with the ER site program, the data are harmonized for inclusion into OREIS, a summary of OREIS processing is sent back to the ER site program, the ER site program authorizes release of the data, and the data are loaded into the production data base. As mentioned previously, these processes—data review, data harmonization and conversion, and data loading—are currently being conducted manually. Functions may be added in future releases of OREIS to automate these processes.

The amount of effort to review, harmonize, and load OREIS data is directly proportional to the similarity of data management between the data sources and the OREIS system. In an effort to increase the similarity between OREIS and the ER site programs, the OREIS program has supplied the ER sites with OREIS-compatible hardware and software and is working with the sites and their subcontractors to create data input programs for data types they do not currently maintain in electronic format. To aid communication and accountability, each site has appointed a contact person for all problems, questions, and change authorizations.

4. OREIS USER INTERFACE

4.1 SCOPE

The scope of the OREIS user interface development efforts includes developing, testing, and documenting the user interface capabilities of the system; developing reporting formats for data products; and developing query menus.

The single most important factor in designing a user interface is an understanding of user capabilities and requirements for the system. A user survey conducted by OREIS during the system definition phase of development indicated that the potential users of the system had various levels of computer capabilities and a wide range of needs that were expected to be met by the OREIS system. To better define user requirements for the user interface, a second user survey was conducted and results were reflected in the development of the user interface tools. A copy of the user survey form and a report on the results of this survey are in Appendix A.

4.2 PHASED DEVELOPMENT

The user interface will be developed in phases as determined by user requirements. Initially, the user interface will concentrate on creating an environment that supports users with expert computer and environmental capabilities and on supplying limited capability to users with novice computer expertise. During the initial phases of development of the user interface, only the output needs of on-line users will be addressed; no attempt will be made to tie the needs of the data management staff or the system managers to the user interface.

The initial capabilities for expert users will consist of providing

- fourth generation tools, such as ORACLE Data Browser, SAS, ARC/INFO, and ArcView;
- user's guides for these tools;
- utilities to export or import data for user-specific needs;
- the ability to capture and recall user-defined macros/queries/analysis programs developed during a session using the various application software components; and
- a means for sharing user-defined macros/queries/analysis programs.

The initial phases of the user interface will offer novice users

- reporting features designed for meeting regulatory requirements;
- a query capability, including some predefined statistical analysis; and
- predefined GIS-developed maps.

Later phases of the OREIS user interface are expected to provide

- extended user interface capabilities based on user feedback and requests to OREIS staff through user services;
- extended remote user capabilities and support;
- hardware and software upgrades to capitalize on new technology developments;

- extended map and image data libraries;
- 3-D data analysis and display tools including subsurface modeling;
- distributed data base access;
- extended data base export formats;
- extended context-sensitive help with systems and data;
- automation of portions of the data loading tools;
- auto logging and recovery of user activities;
- privileged access to portions of the data; and
- support for other hardware platforms, such as PCs, Macintosh, and other workstations and operating systems (e.g., Windows/NT, OS/2).

5. FUNCTIONS OF THE OREIS SYSTEM

The OREIS system provides the following functions: (1) Preferences, (2) View Manager, (3) Macro Manager, (4) Data Analysis, and (5) Spatial Analysis/Map Generation. Additional functionality includes interprocess communications, which handles background operations of OREIS. These functions and their relationships are shown in Fig. 1 and are discussed in the sections below.

To provide the user with a set of powerful and flexible tools to analyze environmental information, a GUI tool is used to create a series of menus. These menus give the user access to the primary software packages. Use of the GUI tool will simplify the steps required to move between the functions of OREIS. Steps required to use the primary software packages include setting the system environment variables and specifying the location of work and disk areas, as discussed in Sect. 5.1.

OREIS includes a menu system for its user interface to help reduce the requirements for user training and support and to encourage the use of the system by the infrequent user.

5.1 PREFERENCES

The Preferences function allows various parameters to be set that are specific to the user's working environment. Categories of defaults that can be set by the user include (1) personal details (e.g., full name, mail stop, telephone number, electronic mail name, organization), (2) tool settings (e.g., directory names, device types, and tool configuration), and (3) the OREIS environment (e.g., options available on screens, start-up views).

5.2 VIEW MANAGER

The View Manager function provides the user with a means to manage (e.g., create, edit, import, copy, delete) ORACLE views and to indicate to other OREIS applications the current working view. A view represents the specifications of the data that are to be extracted from the data base and the criteria for subsetting the data. From a user's perspective, a view may be thought of as a named standard query language (SQL) query. The subset of data represented by a view may then be accessed by other components of OREIS for statistical or geographical analyses, graphing, or reporting.

The View Manager provides a set of views designed and incorporated into the OREIS view list that represents subsets of data that are commonly requested by users. Novice users may access these data subsets on an "as is" basis. However, more advanced users may create their own tailored queries using the OREIS viewmaking application (View Builder) within View Manager. Additionally, expert users may use queries generated by View Builder as a starting point and then use the ORACLE Data Browser product to further customize the views.

Upon entry to View Manager, the information contained in the ORACLE table, OREIS VIEW, will be extracted from the data base. Scrolling lists of OREIS view names and

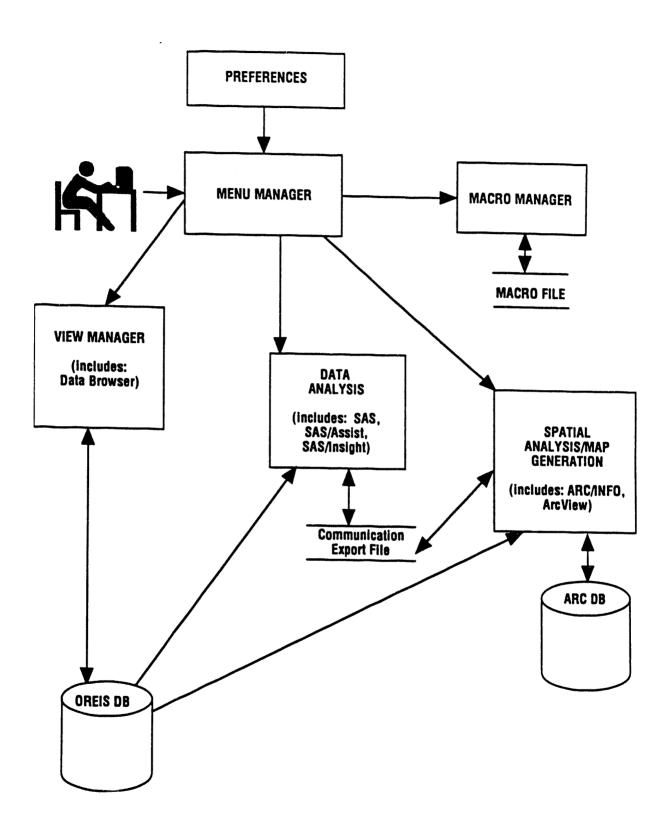


Fig. 1. Functional components of OREIS.

user-owned view names will be displayed. When a view name in either of the lists is highlighted, the following information pertinent to that view will be displayed to the right of the view: description, owner name, date created, date last modified, date last accessed.

The options available under View Manager are described below.

- CREATE permits the user to create simplistic views with a simple "point-and-click" interface. The user is prompted to specify the data elements that should be extracted from the data base and the selection criteria for those data elements. The selection criteria are specified by choosing elements from pick lists representing all valid values for the criteria. The pick list feature permits users with little or no experience with relational data bases to easily specify the subset of data they wish to analyze. The selection of this option invokes the OREIS View Builder application with no arguments in the foreground (i.e., enters a wait state) and refreshes the list of OREIS views after the user is returned to the main menu of the OREIS View Manager.
- EDIT permits the user to modify a view. Used in conjunction with the copy option, users can modify (i.e., customize) the OREIS predesigned views to better fit their specific needs. Upon selection of this option, the system ensures that a view has been selected from the user view list and then invokes the OREIS View Builder in edit mode. If a user selects a view to edit from the OREIS view list, the user will get a popup that says that only views from the user view list can be edited.
- IMPORT permits the user to incorporate a view that has been created via another application, such as ORACLE Data Browser or SQL, into the supportive framework of the OREIS user interface. Upon selection of this option, the system prompts the user to select an ORACLE view from a list of views owned by the user and not already stored within OREIS. The system then prompts the user for a description of the view. The information concerning the view is then inserted into the OREIS view table. The type of view is recorded as unknown (as opposed to a laboratory, field, or biota results view). The list of views owned by the user is then refreshed.
- COPY permits the user to create a personal copy of a view provided by OREIS. Upon selection of this option, the system ensures that a view has been selected from the list of OREIS views and then prompts the user for a new view name. OREIS then copies all information concerning the selected view with a new name, owner, date created, date last modified, and date last accessed. The list of views owned by the user is then refreshed.
- DELETE permits the user to remove old and unwanted view information from the user's owned views. Upon invocation of this option, the system ensures that a view has been selected from the list of views owned by the user. The system then prompts the user for confirmation of the deletion and, if confirmation is received, deletes all information pertaining to the selected view and refreshes the view lists. If the user does not confirm the deletion, no further action is performed.
- SELECT VIEW enables the user to indicate which set of data is currently being analyzed. Upon selection of this option, the View Manager ensures that a view has been selected and then updates the OREIS data base to indicate that the user is currently working with the selected view.

- BROWSE RESULTS permits the user to invoke the ORACLE Data Browser application in such a way that the selected view is preloaded into the application. Upon selection of this option, the system ensures that a view has been selected from one of the view lists and then invokes the ORACLE Data Browser tool with the selected view. This procedure is done automatically so it is transparent to the user.
- REFRESH LIST reconstructs and displays both view lists (OREIS and user) based upon the current contents of the OREIS data base.
- EXIT takes the user out of View Manager and returns the user to the OREIS Main Menu.

5.3 MACRO MANAGER

Macro Manager provides users with a means of quickly and easily invoking a set of OREIS system macros or predefined user macros and a means of integrating new macros into OREIS. This approach helps to satisfy the requirements for developing a user interface for OREIS users who have various levels of computer and environmental expertise. Macro Manager is used to execute macros that create predefined reports from SAS, ORACLE, and ARC/INFO in a noninteractive mode and to initialize SAS, ORACLE, and ARC/INFO to a preselected state or a combination of both.

Users can organize the macros according to the characteristics of the output they produce (e.g., maps, data, graphics) and by the purpose for invoking them (e.g., compliance report). This type of organization allows the user to quickly determine which macro is most applicable to the product being produced. Keyword searches on selection criteria are provided (e.g., all macros that select biota information). This selection feature will become essential as more and more macros are developed and stored in OREIS.

A distinction is made between macros that have been quality assured and fully integrated into OREIS (i.e., central-domain macros) and those that been developed by sites for site-specific uses (i.e., site-domain macros) or by individuals (i.e., personal-domain macros). Central-domain macros will be maintained by OREIS and will be available to the OREIS user community. Site-domain macros will reside on site systems and will be maintained by the sites. Personal-domain macros will reside in the user's work area and will be maintained by the user. Site- and personal-domain macros will not be available for use through OREIS. However, OREIS users and operators of site systems may submit their macros to OREIS for review. If these macros meet vigorous validation and verification reviews, they may be integrated into OREIS as a central-domain macro. The set of available OREIS macros will be updated at periodic intervals in a controlled and methodical manner. Documentation of newly integrated macros will be distributed to OREIS users at the time of release.

Modifying an existing macro to create a new macro requires a moderate level of computer expertise and familiarity with the underlying applications tools. Creating a new macro from scratch requires substantial experience. The capabilities to add additional parameters, integrate newly developed functions, and define new display types gives experienced users the ability to enhance and customize the system to meet their needs.

An OREIS macro is a series of ASCII commands that performs a predefined set of operations within the OREIS environment. Each command line in this macro is either an OREIS interprocess communication command or an application macro. Application macros are written in an application-specific language (e.g., a SAS procedure, an ARC/INFO Arc Macro Language [AML] procedure). Each macro must have the following information associated with it: title, domain, description, requirements for executing, category, file name, and contents. Naming standards for macros will be addressed in the next phase of OREIS.

Macro categories include the following.

- ARC/INFO starts an ARC/INFO process with the AML macro as a command line argument.
- SAS starts a SAS process with SAS program name as a command line argument.
- INTERACTIVE MACROS list the macros to execute. The list may include ARC/INFO, SAS, SQL views, UNIX shell scripts, and OREIS interprocess communication commands.
- BATCH (noninteractive) executes a series of UNIX commands or scripts. This macro type is typically used to generate predefined reports.

Macro Manager includes the following options.

- MODIFY GROUPS allows the user to organize the macros into macro groups. The user defines the group and selects which macro to include in the group.
- SELECT allows selection of macros that are stored in the user's macro selection list defined on the macro set-up screen. The selection criteria will be based upon the category and area of the macro.
- DETAILS allows the user to look at the predefined macros and associated descriptions.
- EDIT allows the user to create and or modify his own macros.
- EXECUTE allows the user to execute a macro.

5.4 DATA ANALYSIS

SAS is the OREIS data analysis tool and allows users to review, manipulate, summarize, organize, graph, and present data. SAS provides the capability to perform the following:

- DATA MANAGEMENT. Sorting, merging, transformation, mathematical calculations, modifying, browsing, and statistical calculations.
- DATA MANIPULATION. Data listings, frequency counts, tables, row/column totals and subtotals, and customized reports.
- STATISTICS. Simple, multivariate, nonparametric, categorical, correlation, regression, analysis of variance, discriminant functions, canonical correlation, factor analysis,

nonparametric tests, general linear models, categorical modeling, univariate, and exploratory data analysis.

 GRAPHICS. Scatter plots, bar charts, line graphs, 3-D graphs, simple maps, and user programs.

All of these operations are performed on commonly accessible data sets (tables) and are available through one or more components of the data analysis function: (1) Assisted Analysis and (2) Unassisted Analysis.

SAS can be invoked from the OREIS main menu or from other methods/applications. Because of the integrated nature of the OREIS GUI interface, SAS can be invoked when the user selects certain options. For example, if the user is in ARC/INFO and selects the "Export to SAS" button to export data, the OREIS GUI looks to see if SAS is executing. If not, the Assisted Analysis menu of the OREIS GUI is started automatically. If the user is executing a predefined procedure that involves an interactive SAS session either at the start or end of the procedure, SAS will be invoked. The procedure will not automatically end the SAS session upon completion. If the user invokes a procedure that requires SAS, but does not need any user input (i.e., batch job), SAS is invoked by a shell script in the background.

A communications export file allows SAS and ARC/INFO to communicate. SAS can create a communication export file containing OREIS location IDs. This file can be transferred to ARC/INFO and the location IDs can be used to display map coverages. Refer to Sect. 5.6 for details of the communication between SAS and ARC/INFO.

5.4.1 Assisted Analysis

Assisted Analysis is designed for users unfamiliar with OREIS and is comprised of menus that guide users through specifications for data processing, analysis, file import/export, interfacing with other OREIS tools, assisting in execution of predefined SAS programs, helping to customize the user's OREIS session, and reporting. The menus are detailed and include advanced features, such as scrollable lists, for choosing variable names and data sets as appropriate.

During processing, SAS program code is generated for the user based on responses received from questions asked of the user. Available options allow more experienced users to save and retrieve the program code for later use or revision. The program step operation is not available through Assisted Analysis, and the data management operation is limited to data subsetting, sorting, browsing, and using predefined output facilities.

The Assisted Analysis is integrated with the SAS/ASSIST product. In keeping with the philosophy of SAS/ASSIST, calls to OREIS-specific applications have been added to the basic ASSIST menus. These OREIS additions to SAS/ASSIST are as follows:

• EXECUTE VIEW. This option executes the currently selected view. Only one view can be executed at a time. SAS/AF supplies the necessary code to generate the view and execute the view, which is used to create SAS data sets. This function can be executed as often as needed to build a series of views. The OREIS user receives a message from the SAS display manager that the view has been built.

- GO TO. This option allows the user to transfer program control to any of the other OREIS component parts (e.g., ARC/INFO, ORACLE Data Browser).
- EXPORT DATA. This option allows the user to create an export file of the current SAS
 data set. The options for the export file include Tab Delimited, Comma Delimited,
 CPORT SAS data set (generic SAS data set that can be read on any platform executing
 SAS).
- SAS/INSIGHT. This option allows the most recently created SAS data set to be made current. If only a view has been selected, the user will need to create a SAS data set using this view before SAS/Insight can be used.
- RECALL SAS CATALOG. This option loads information on past sessions' work along with OREIS-specific data sets. The user sees personal or OREIS reports, graphics, screens, directories, or SAS code.
- SAS/ASSIST. This option gives the user the standard SAS/ASSIST GUI tool, while keeping the user's current SAS environment.
- IMPORT DATA. This option allows the user to import data from non-OREIS files (e.g., tab-delimited files, comma separated files, and import SAS data sets from other SAS platforms).
- SAVE SESSION. This option saves the current SAS catalog of all the current work of the user.

5.4.2 Unassisted Analysis

Unassisted A alysis (i.e., base SAS) is designed for more experienced users and includes a programming language for (1) interactively executing programs and reviewing results, (2) managing and editing graphic/text output, and (3) saving and re-displaying outputs at a later time on a variety of devices. Batch mode processing is available for tasks that require longer processing periods.

This dynamic component is designed for experienced users desiring to interactively explore data and identify trends, outliers, or interactions. Users can concurrently display bar graphs, 2-D and 3-D scatter plots, a tabular view of the data, and graphs about the distribution and relational statistics. From any one of these displays, the user can dynamically select subsets of the data set. As the observations are selected from one display, the same observations are highlighted in all other displays (e.g., graphs and tables). Graphs of more than one type can be displayed concurrently and dynamically redefined to provide the users with a customized view of the data.

5.5 SPATIAL ANALYSIS/MAP GENERATION

The GIS is implemented in OREIS with ARC/INFO and ArcView, both products of Environmental Systems Research Institute (ESRI). ArcView provides a friendly "point and click" interface for users with all levels of expertise who wish to view geographic data and its associated tabular attributes. ArcView is limited, however, in its functionality. It is not possible

to edit tabular or geographic data or create contours in ArcView, nor can the current version of this product provide any spatial analysis or communicate with the ORACLE RDBMS. While the user can manipulate the display by spatial and logical subsetting of the data and by changing parameters such as line color, line type, and point symbols, publication quality maps cannot be produced using ArcView. These functions are provided by ARC/INFO, and the results can be easily viewed in ArcView.

ARC/INFO provides the full functionality associated with a GIS (e.g., point-in-polygon, buffering, map composition, contour creation, 3-D representation, transport of geographic data to standard coordinate conversions, and communication with an external RDBMS). ARC/INFO is not, however, as intuitive as ArcView. It is typically driven from the command line, although its internal macro language does provide the ability to customize a GUI complete with menus, pick lists, buttons, slider bars, icons, and other such GUI features. At the command-line level, the user will be able to make use of all the ARC/INFO capabilities.

For the initial production phase of OREIS, no direct access to ORACLE by the ARC/INFO user interface will be provided. All ORACLE data extraction shall be in the Data Browser and SAS components of the user interface. Permanent point locations for the OREIS data points are maintained in the LOCATION table in the OREIS ORACLE data base. Coordinates contained in ORACLE are only accessed by system management or administrative level staff, first to create the initial point coverages, and thereafter only for periodic updates. The geocoverage updates are handled via an AML. Periodic updates of the "official" GIS point coverages are driven by ORACLE updates. As mentioned above, these point coverages are then related to the ORACLE tables via extractions from ORACLE by SAS, which are turned into communication export files and linked with coverages in ARC/INFO. Refer to Sect. 5.6 for details on the communication between SAS and ARC/INFO.

The GIS user interface has been developed using ARCTOOLS, a part of ARC/INFO. Map composition and customization functions are intrinsic in ARCTOOLS and therefore are an integral part of the GIS user interface. Some general standard map layouts are provided in a public area that can be accessed and customized by users for their projects, then saved in their work areas. Specialized AMLs can be developed to produce certain map products with little or no control required by the user.

Spatial functions such as polygon overlay and buffering are normally done via ARCTOOLS. AML coding is required for user friendly contouring. Menu control of contouring capabilities is incorporated as part of the OREIS user interface. Any new coverages generated by the user are confined to the user's workspace. Later phases of the OREIS user interface will provide other ARCTOOL functions. ARCTOOLS currently provides most of the spatial functions that users will need. Examples of these functions are cartographic plotter output, postscript output, input and output of GIS and CAD files (e.g., DXF and DGN), and reporting results after applying some spatial functions. The appropriate user interface widgets and file management are implemented for contouring, along with easy presentation of the contoured results, profiles, etc. The OREIS ARC/INFO functionality layout is shown in Fig. 2.

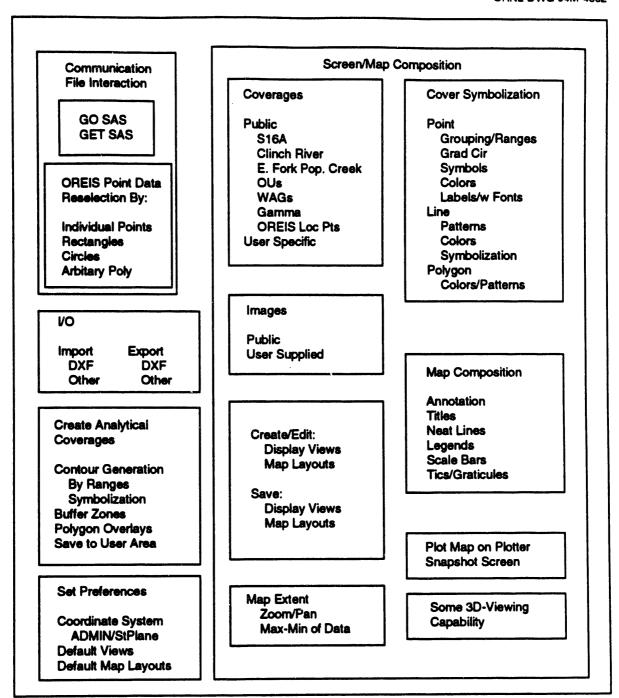


Fig. 2. OREIS ARC/INFO functionality.

5.6 SAS AND ARC/INFO COMMUNICATIONS

A communications export file allows two-way communication between SAS and ARC/INFO. In SAS, a communication export file can be created containing OREIS location IDs and measurement data associated with these locations. The thematic variables associated with the points are carried along as attribute columns. Transfer of the file is made back to ARC/INFO where the communication export file is imported and linked to the OREIS point coverage. ARC/INFO reads the communication export file and uses the location IDs to display the selected portion of the map. These data are used to extract a subset of all available sampling locations. The subset is then displayed. Subset point coverages can be saved in the user's workspace.

In ARC/INFO, a spatial subset can be performed by using circles, rectangles, or polygons to define the boundary of the subset or, alternatively, by selecting individual features. After the selection is made, a new communication export file is written containing the new subset of location IDs. Transfer of the file is passed to SAS. SAS reads this new file, combines it with the current view to create a new view, and then reselects the data from the OREIS data base based on the new view.

5.7 INTERPROCESS COMMUNICATIONS

Additional functionality includes interprocess communications (IPC), which handles background operations of OREIS, allowing component parts of OREIS to be integrated.

Internally the OREIS system makes use of UNIX IPC to enable commercial software products to communicate with each other. The IPC facility provides message passing among the key OREIS components (i.e., OREIS menus, SAS, and ARC/INFO) that allows transfer of control among these components and execution of sequences of software functions under central control (macro scripts).

Although most IPC processes are hidden within the software, the user does make direct use of IPC in three areas: (1) use of the communication export file, (2) transfer controls to allow changing the active software component, and (3) the Task Status Manager.

Functions provided by the communication export file are described below.

- READ EXPORT FILE. Assisted Analysis and Assisted ARC/INFO reads the working communication export file.
- READ INITIAL EXPORT FILE. Reads the initial communication export file instead of the working communication export file. This allows the user to restart at the beginning of his current interactive session (i.e., Assisted Analysis, Assisted ARC/INFO).
- WRITE EXPORT FILE. Assisted Analysis, Assisted ARC/INFO, or View Manager writes the working communication export file.

Software component transfer controls incorporate the following functions.

- GO TO SAS. Sends an IPC command to Assisted Analysis to become active. The current process (i.e., Assisted ARC/INFO, OREIS menus) becomes inactive (goes into an IPC listen mode).
- GO TO ARC/INFO. Sends an IPC command to Assisted ARC/INFO to become active. The current process (i.e., OREIS menus, Assisted Analysis) becomes inactive (goes into an IPC listen mode).
- GO TO VIEW MANAGER. Sends an IPC command to View Manager to become active. The current process (i.e., Assisted ARC/INFO, Assisted Analysis) becomes inactive (goes into an IPC listen mode).
- GO TO LISTEN MODE. Puts the current application into the IPC Listen/Wait mode so it can respond to IPC commands sent from other software components (i.e., Assisted ARC/INFO, Assisted Analysis, Macro Manager).
- GO TO MACRO MANAGER. Sends an IPC command to Macro Manager to become active. The current process (i.e., Assisted ARC/INFO, Assisted Analysis) becomes inactive (goes into an IPC listen mode).

The Task Status Manager provides a small window that displays the status (Unavailable, Interactive, Batch, or Waiting) of the major OREIS software components linked by IPC. Controls also are provided by the Task Status Manager for the user to use the following functions:

- MAKE SAS INTERACTIVE. If SAS is in a Listen (Waiting) Mode, this function uses
 IPC communications to make Assisted Analysis leave a Listen Mode and come under
 interactive user control.
- MAKE ARC/INFO INTERACTIVE. If Assisted ARC/INFO is in a Listen (Waiting) Mode, this function uses IPC communications to make Assisted ARC/INFO leave a Listen Mode and come under interactive user control.

6. LOGICAL DATA MODEL AND DATA DICTIONARY SUMMARY

The Data Management Plan for OREIS,³ a companion document to this document, contains detailed information about the logical data model and publishes the data dictionary for the system. However, a brief summary of these topics is presented in this section.

The OREIS data base model is designed to store and retrieve environmental data as typically collected by characterization and monitoring programs. Because there are many variations on how data are collected and processed by contributing projects, the model has some redundancy and generous keys to be robust enough to accommodate the variety of data collection conditions. In addition, the model contains linkages between the measurement data and the related metadata and between measurement data and geographic data.

The OREIS data base model has a core set of 10 entities (Fig. 3) to store measurements and associated context information (e.g., analysis methods, sampling conditions, station description). In addition, there are entities containing data processing information, project documentation, data base updates, data dictionary entries, GIS entities, and other information supporting the measurement records. The OREIS data model has been revised based on the experience with the prototype data base and experience gained through loading data that have been transmitted to OREIS.

Projects assign designations or IDs to all the stations that they establish or use. OREIS will assign an internal station ID to ensure uniqueness. Sampling programs define one or more sampling events that consist of one or more field measurements or collection of samples. Each sampling event is associated with a station. Samples are submitted to laboratories for analysis. Each sample may be partitioned with one or more analytical methods used to produce results for one or more parameters. In addition to the analytical method, results have attributes such as qualifiers, units of measure, and detection limits. Stations can be wells, boreholes, tanks, monitoring stations, or other sample collection points. The characteristics, including such things as location, depth, date established, and construction method, are defined in separate entity tables and are linked to the station table.

Descriptions of OREIS tables from the OREIS data dictionary³ are in Appendix B.

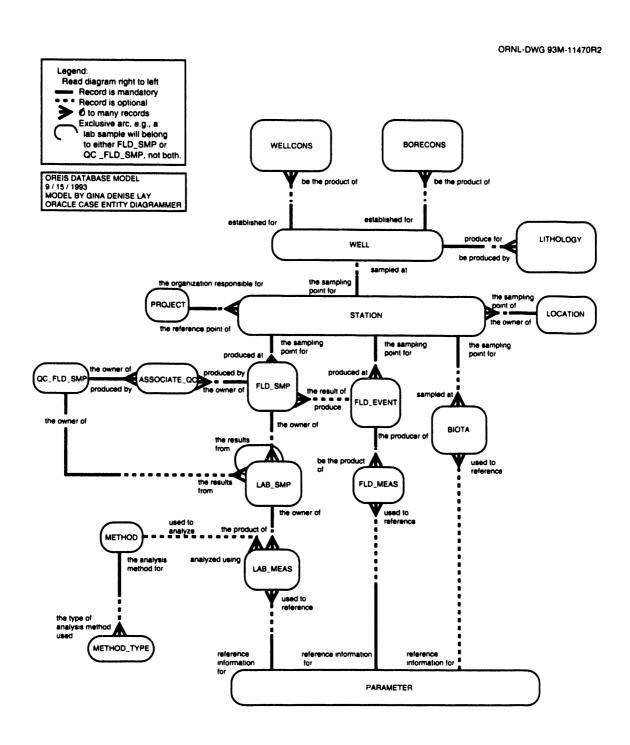


Fig. 3. OREIS Version 2.0 entity relationship diagram.

7. FUNCTIONAL SECURITY REQUIREMENTS

The following section describes some of the protection mechanisms that must be maintained or handled properly to ensure the functional security of OREIS.

7.1 ACCESS CONTROL

7.1.1 User Authorization

• Users must obtain authorization to access OREIS by completing the OREIS User Registration form. This request must be approved by the Deputy Program Manager or designee. All on-line users must possess an Energy Systems user ID (UID) from the Computing & Telecommunications Services Division. Refer to the procedure on obtaining access to OREIS for more details on who authorizes access to OREIS. Refer to the procedure on registering OREIS users for more details on who manages access to OREIS and on rules for verifying users.

7.1.2 User Privileges

- General users have READ and EXECUTE privileges to the OREIS tables, data sets, and software modules developed by the OREIS software project team. General users do not have access to transaction data base tables. Modifications to the data are made only by persons authorized by the Data Manager. The OREIS data base staff has READ and WRITE privileges to the OREIS tables, data sets, and transaction data base tables. The OREIS Data Base Manager has READ, WRITE, and DELETE privileges to the OREIS tables, data sets, and transaction data base tables.
- OREIS is available during normal working hours (Monday through Friday). System downtime may be scheduled as needed to perform hardware or software maintenance.

7.1.3 Unsuccessful Access Attempts

• Unsuccessful access attempts by privileged user accounts are logged in the system logs.

7.1.4 Access Denials and Operating System Errors

- Access denials and operating system errors are recorded in the system logs. Modifications
 to authorization data are manually recorded in the authorization data logbook.
- System logs record the UID, machine ID, date, time, and an error message.
- The authorization data logbook records the user's name, date added, notification code, UID, and date removed.

7.2 PERSONAL ACCOUNTABILITY OF INDIVIDUAL USERS

7.2.1 Accountability Methods

- System logs record privileged account accesses and access denials and operating system errors.
- Transaction data base tables record modifications to OREIS data.

7.2.2 Retention Requirements

- System logs are retained 4 to 6 weeks, at which time they are reviewed and then deleted, if applicable. However, any system log found containing security variance type information is retained.
- Transaction data base tables are retained for approximately 1 year. The Data Base Manager authorizes the deletion of any transaction data base information.
- The authorization data logbook records are retained indefinitely.

7.2.3 Review Requirements

• System logs are reviewed weekly by the System Administrator. Any system log found containing security variance type information is retained on-line in a directory specified by the System Administrator. A record of review is maintained specifying who authorized the deletion of system logs containing no security variance type information.

7.2.4 Contents of Log Entries or Audit Trails

- System logs record the UID, machine ID, date, time, and an error message.
- Transaction data base tables record the original record contents, date, update/delete code, who authorized the change, and a brief description of what was changed.

7.3 CONTROL OF AUTHORIZATION AND SEPARATION OF RESPONSIBILITY

• Refer to the procedure on obtaining access to OREIS⁶ for details on who authorizes access to OREIS. Refer to the procedure on registering OREIS users⁷ for details on who manages access to OREIS and on rules for verifying users.

7.4 DATA INTEGRITY

7.4.1 Periodic Inventories

Not applicable.

7.4.2 Periodic Audits

• Audit reports are generated and reviewed periodically by the OREIS Data Manager.

7.4.3 Input and Processing Checks

• The OREIS Data Coordinator receives the Data Transmittal Package from the Data Custodian or Data Generator, initiates the processing, and records the receipt of the package. An OREIS staff member checks the data for consistency and completeness. Steps are followed to perform a quality assurance check on the data, move the data to OREIS, generate requested formatted data packages, edit the data, and perform any other functions necessary. Refer to the instructions on the processing and review associated with data transmitted to OREIS¹¹ for more details on data validation and error handling.

7.5 CLASSIFIED AND UNCLASSIFIED SENSITIVE INFORMATION

All CRT screens and reports (both hardcopy and electronic) generated by the OREIS software are handled as UNCLASSIFIED NONSENSITIVE.

7.6 SECURITY OF EXTERNAL INTERFACES TO THE APPLICATION SOFTWARE SYSTEM

- Refer to the procedure on the processing and review associated with data transmitted to OREIS¹¹ for details on data received, data transmitted, and proper controls.
- An authorized Data Change Request form must accompany the data listing containing marked changes. Receipt of the data is logged and the contents of the data are examined and prepared for processing. Refer to internal instructions on updating OREIS from TRANS tables¹² for more details on how background batch processing is handled.

8. DESIGN CONSTRAINTS

8.1 REMOTE ACCESS

Access to the OREIS user interface is available only through X Window System emulation. Hardware and software may limit the system functions that can be accessed by the user, if non-X access is performed. Removing this constraint will be addressed in later development phases.

8.2 SELECTED HARDWARE/SOFTWARE ENVIRONMENT

The existing architecture of OREIS consists of Sun Microsystems, Inc., computers executing the SunOS (Solaris) operating system. Programming languages include C, FORTRAN, UNIX scripts, ARC/INFO (GIS) (AML), ORACLE (RDBMS) (Pro*C, SQL, PL/SQL), and SAS (data analysis). Other data query/view products include ARCVIEW (GIS) and ORACLE Data Browser.

9. LOGICAL DATA ACCESS VIEWS

The relationship between the various OREIS entities is illustrated in Fig. 3, the OREIS Version 2.0 entity relationship diagram (ERD). The following personnel have specific privileges associated with these entities:

- The OREIS Data Base Manager has READ, WRITE, and DELETE privileges to all entities on the ERD.
- The OREIS Data Base staff have READ and WRITE privileges to all entities on the ERD.
- The OREIS general user has READ privileges to all entities on the ERD.

10. REFERENCES

- 1. Oak Ridge Environmental Information System (OREIS) Phase I—System Definition, Document ES/ER/TM-34, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee.
- 2. Automated Data Processing Systems Development Methodology, Vols. 1 and 2, K/CSD/INF/86-3, Computing and Telecommunications Division, Martin Marietta Energy Systems, Oak Ridge, Tennessee.
- 3. Data Management Plan for the Oak Ridge Environmental Information System (OREIS) Version 2.0, ES/ER/TM-39, Rev. 1, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, (Draft issued September 30, 1993).
- 4. Transmitting Data to OREIS, ER/C-P2701, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, February 12, 1993.
- 5. Submitting, Reviewing, and Implementing Changes to the OREIS Data Structure, ER/C-P2703, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, February 12, 1993.
- 6. Obtaining Access to OREIS, ER/C-P2702, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, February 12, 1993.
- 7. Registration of OREIS Users, OREIS-P2900, Oak Ridge Environmental Information System, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, April 6, 1993.
- 8. Back-up, Archival, and Recovery Processes of OREIS, OREIS-P2800, Oak Ridge Environmental Information System, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, April 6, 1993.
- 9. Federal Facility Agreement for the Oak Ridge Reservation, DOE/OR-1014, U.S. Environmental Protection Agency Region IV, U.S. Department of Energy, Tennessee Department of Environment and Conservation, Atlanta, Georgia, January 1, 1992.
- 10. Tennessee Oversight Agreement between the United States Department of Energy and the State of Tennessee, May 13, 1991.
- 11. Processing and Review Associated with Data Transmitted to the OREIS, OREIS-12801, Oak Ridge Environmental Information System, Environmental Restoration Division, Martin Marietta Energy Systems, Inc., Oak Ridge, Tennessee, June 3, 1993.
- 12. Updating OREIS from TRANS Tables (internal instructions).

APPENDIX A

OREIS Customer Survey

OREIS Customer Survey

The development of the OREIS system is based on defining functional requirements and designing an associated user interface based on informal and formal input from potential users. A questionnaire was developed to acquire formal input from representative user groups to more fully understand the characteristics of OREIS users. Individuals were selected by their respective ER Site Managers to represent OREIS customer groups at each of the five sites. These five individuals were usually involved with data activities associated with several different programs so that all the programs included within the scope of OREIS were represented by the five respondents. The representatives were all associated with environmental restoration information activities with most of the individuals also involved groundwater, risk assessment, and environmental compliance programs. At least one of the five representatives was also involved with programs associated with GIS, waste management, or decontamination/decommissioning. The survey was conducted by the OREIS User Interface Team in April and May of 1993, using a written form, attached, and personal interviews.

The survey results characterize over 200 potential users as compiled by the five representatives. Potential users fully represent the variety of data activities that are being included in the development of OREIS. The majority of potential users were identified as either technical support personnel (41%) or managers (25%). A breakdown for all categories of users is presented in Fig. 1.

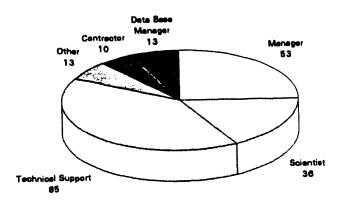


Fig. 1. Types of users.

Potential users were also classified as to their principal association with a program. The majority (39%) identified with environmental monitoring/compliance programs. However, this statistic may be an artifact of the survey in that all the potential users at the Paducah site

identified themselves with monitoring/compliance programs. Environmental Restoration was the primary affiliation (29%) for the other individuals, other affiliations are shown in Fig. 2.

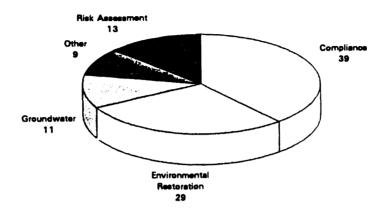


Fig. 2. Types of programs.

The survey requested information to indicate the importance to users of the analysis functions that are being included in OREIS. Six broad OREIS functions were identified and the survey respondents asked to indicated the average percentage of time that their group would be spending with each function. Data query and GIS were the dominant functions with graphical display and report generation receiving the least use. Respondents indicated that statistical analysis and software development functions would receive intermediate usage. The percentages with an indication of the range of responses is given in Table 1.

Table 1. Estimated percentage of time that potential users may spend using the major types of functions provided by OREIS

Function	Average Percent	Range	Standard Deviation
GIS	21	40	15
Statistical Analysis	19	45	16
Graphical Displays	12	25	8
Report Generation	14	30	11
Software Development	17	55	20
Data Query	23	50	16

The survey also requested and acquired names of individuals at each site associated with major data types included in OREIS. These contacts will be used by the OREIS user interface team to acquire additional information about user requirements associated surface water, groundwater, soils/rock, air, biota, lithology, borehole, and well data.

To provide guidance to developing the user interface, the survey requested information on the level of expertise that typical users currently had and whether that level of expertise would change after a year of having OREIS available. Both expertise in environmental science and in computer science were surveyed. In the area of environmental science expertise, the majority of users (approximately 51%) may have a broad technical understanding of the environmental data but are not directly involved in data analysis. Approximately 28% of the users would understand the environmental data and have a primary interest in data analysis. The remaining nontechnical users (21%) would be individuals with little knowledge about environmental data. The projected mix among technical users (45%), analytical users (36%), and non-technical users (19%) was about the same after one year of operation.

As anticipated, the level of computer expertise was projected to change significantly with users becoming more experienced as the OREIS system becomes available and is used. In addition, the number of users was projected to increase from 184 to 241 within a year of OREIS availability. Initially typical OREIS users were classified as either being novices (41%) with no computer knowledge or being experienced (41%) with a medium degree of computer skills including being familiar with basic operating system commands and having used commercial software packages, such as WordPerfect, Freelance, or Lotus 123 (Fig. 3).

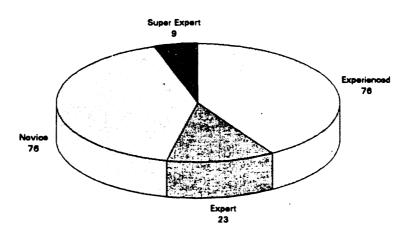


Fig. 3. Present computer expertise.

Although experienced, these individuals have very limited programming experience. Initially there were few users that were identified as being expert users (13%) with a high degree of computer skills and capable of independently learning and using the fourth generation languages that are part of OREIS (i.e., SQL, SAS macros, and ARC/INFO commands as used with ORACLE Browser, SAS Assist, and ArcView, respectively) or OREIS-skilled users (5%) who currently using the languages incorporated within OREIS.

The projected mix of individuals indicates fewer novice users (reduced from 42% to 15%) and an increase in all classes of users with computer skills (i.e., experienced users—49%, expert users—19%, and OREIS-skilled users—17%) (Fig. 4). This result is interpreted to indicate that the OREIS users expect to become more skilled rather than remaining "non-experts" and depending on extensive "user-friendly" OREIS capabilities. The implication of this observation is that OREIS needs to balance the efforts in documentation and training with those associated with developing a user-friendly interface.

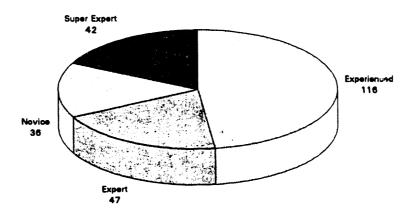


Fig. 4. Projected computer expertise.

OREIS Customer Survey/Interview Individual Contact Information Name: Date completed: Plant Address Mail Stop: Room Number: Building:___ Telephone:_____ FAX:____ Electronic Mail Address/Mailname: Please check the type(s) of programs you as an individual are associated with: _ Environmental Restoration Environmental Monitoring/Compliance Decontamination/Decommissioning Waste Management Risk Assessment Groundwater Other (Please Specify) Organizational Information The following questions address information about the organization you are representing. We recognize that these are only estimates. Enter a number which best represents the number of users that fall into the following categories. The total should sum to the number of people you are representing including vourself. Manager Regulator Scientist/Analyst _ Technical Support Staff __ Database Manager __ Other (Please Specify) _____ Enter a number which best represents the number of people associated with the following **Environmental Restoration** Environmental Monitoring/Compliance Decontamination/Decommissioning Waste Management

Risk Assessment Groundwater

OREIS Customer Survey/Interview

he following are functions that will be available in the OREIS. On the left estimate the percent of time your organization may spend using these functions. We would also like for you to estimate the amount of repetitiveness associated with each function.

(N=None: L=Low. M=Medium, H=High)

N L M H

Geographical Information System

Statistical Analysis

Graphical Displays

Report Generation

Software Development

Data Query

Other (Please specify)

There are various times that we anticipate needing specific types of information or the opinion of your associates. We would appreciate your recommendation in providing contacts for the following data types.

Data Type	Logical Contact
Surface Water	
Ground Water	
Soils/Rock	
Air	
Biota	
Lithology	
Borehole Completion	
Well Construction	
other(s)	

OREIS Customer Survey/Interview

This section of the survey is an initial attempt to create both present and projected propers of the largeted users of the OREIS. This section consists of two areas of interest. The first is in regards to environmental science expertise and the second is computer usage. The groupings and definitions are listed below. Each section is divided into subgroups. The first subgroup is the "as-is" or present status of your associates, and the second subgroup is the "to-be" or projected rating that you would anticipate your associates having after a year of experience with the OREIS. This information will be utilized to determine characteristics of the user interface for the initial system prototype. For each section please enter the number of personnel that you represent who fall into each category.

As-Is/P	resent Environmental Science Expertise
	Analytical User is a scientist who understands the "why" of the environmental data and whose primary interest in the data for analysis.
	Technical User is someone whose job requires a broad understanding of environmental data terms and definitions, but is not directly involved in data analysis
	Nontechnical User is one who knows little or nothing about environmental data.
	Total number of employees represented
To-Be	or Projected Environmental Science Expertise
	Analytical User is a scientist who understands the "why" of the environmental data and whose primary interest in the data for analysis.
	Technical User is someone whose job requires a broad understanding of environmental data terms and definitions, but is not directly involved in data analysis
=====	Nontechnical User is one who knows little or nothing about environmental data.
	Total number of employees represented

OREIS Customer Survey/Interview

Le-Is/P	resent Computer Emertise
	Super Expert User is one who is capable of using ORACLE Browser, SAS Assist, and ArcView or a fourth generation language without further training.
	Expert User is one who has a high degree of computer expertise and would be capable of independently learning to use ORACLE Browser, SAS Assist, and ArcView or a fourth generation language.
	Experienced User is one who has a medium degree of computer expertise, is aware of basic computer capabilities, and is familiar with basic operating system commands. This person has experience with commercial software packages, such as WordPerfect, FreeLance, Lotus 1 2 3, but has limited experience in programming.
	Novice User is one who knows little or nothing about computers.
	Total number of employees represented
To-Be/	Projected Computer Expertise Super Expert User is one who is capable of using ORACLE Browser, SAS Assist, and ArcView or a fourth generation language without further training.
	Expert User is one who has a high degree of computer expertise and would be capable of independently learning to use ORACLE Browser, SAS Assist, and ArcView or a fourth generation language.
	Experienced User is one who has a medium degree of computer expertise, is aware or basic computer capabilities, and is familiar with basic operating system commands. This person has experience with commercial software packages, such as WordPerfect FreeLance, Lotus 1 2 3, but has limited experience in programming.
	Novice User is one who knows little or nothing about computers.
****	= _ Total number of employees represented

APPENDIX B

OREIS Table Descriptions from the OREIS Version 2.0
Data Dictionary

OREIS Version 2.0 Tables

Entity Name

Description

ALIAS_SOURCE

The ALIAS SOURCE table contains translations of the names given to the data fields/columns by the data sources to the OREIS table and column names. Because the OREIS database consists of data from different sources, similar variables are often assigned different names or units. This table documents the conversion of data names necessary to load data into OREIS. It includes the data source names, the OREIS names, etc.

ASSOCIATE_QC

The ASSOCIATE_QC table is used in OREIS to resolve the duplicate qc field samples that can occur at a particular station for one sampling event or sample ID.

ASSOCIATE_QC_XACTION

Audit Trail Records for ASSOCIATE_QC.

BIOTA

The BIOTA table contains data from measurements of plant and animal materials. Measurements are often summarized as averages. The table includes sample type, sample method, quaindicators, length, weight, etc.

BIOTA_XACTION

Audit Trail for Biota Records.

BORECONS

The BORECONS table includes borehole construction information. The table includes the depth, diameter, contractor, construction method, etc.

BORECONS_XACTION

Audit Trail for Borehole Characteristics.

CODE

The CODE table contains the codes used in OREIS tables and their descriptions.

CODE_XACTION

Audit Trail for Code Records.

OREIS Version 2.0 Tables (continued)	
Entity Name	Description
CONTACT	The CONTACT table contains data about various data generators and data users associated with OREIS. The table includes the contact's name, address, phone number, e-mail address, OREIS user access profile, etc. OREIS user access profiles define the types of data a user may access and the types of operations that user may perform.
CONTACT_XACTION	Audit Trail for Contact Records.
CRITERIA	The CRITERIA table contains a set of regulatory standards that can be compared to monitoring results on a parameter by parameter basis
CRITERIA	for specific sites to indicate whether the monitoring results have exceeded various regulatory levels. The table may also contain alias names and codes and their regulatory references.
CRITERIA_XACTION	Audit Trail for Regulatory Criteria, Standards, ARARS.
DATASET	The DATASET table contains metadata for a dataset. It includes OREIS identifiers, a dataset description, references to supporting materials, etc.
FLD_EVENT	The FLD_EVENT table contains data about a measurement event. A measurement event is an occasion where environmental parameters are measured without collecting a sample. Examples are flow rate, depth, temperature (see FLD_MEAS). The table includes the measurement method and type, the date and time of the measurement, etc.
FLD_EVENT_XACTION	Audit Trail for Field Event records.
FLD_MEAS	The FLD_MEAS table contains the measurement data for the environmental parameters collected in a measurement event (see FLD_EVENT). It includes results, qa qualifiers, etc.
FLD_MEAS_XACTION	Audit Trail for Field Sample Measurements.

Entity Name	Description
FLD_SHP	The FLD_SMP table contains data about a sampling event. A sampling event is an occasion where field samples are collected for analysis. A field sample is an environmental specimen that is collected in the field. It may be analyzed in the field and it may be bottled/bagged for shipment to a laboratory for analysis. There are separate field samples for each combination of filtered/unfiltered, original/duplicate, splitting/compositing, depth, and medium. The term sampling event is used to group these combinations for reporting and analysis. The table includes the sample method, sample type, depth, date and time collected, etc.
FLD_SHP_XACTION	Audit Trail for Field Sample Log Sheets and Calibration Logs
LAB_MEAS	The LAB_MEAS table contains data about a laboratory sample. A laboratory sample is an environmental specimen that is collected in the field and sent to a laboratory for analysis. The laboratory assigns a sequence number when the sample is received. The table includes bottle number, dilution factor, data about the laboratory, etc.
LAB_MEAS_XACTION	Audit Trail for Analytical Lab Heasurements.
LAB_SHP	The LAB_SMP table describes samples that are submitted for laboratory analysis. There must be an entry in the FLD_SMP for each sample processed by the laboratory. A laboratory sample is an environmental specimen that is collected in the field and sent to the laboratory for analysis. Each laboratory assigns a sequence number to the sample as it is received. A lab sample is tied to a field sample.
LAB_SMP_XACTION	Audit Trail for Lab Instrument, Sample Custody Form, Log Sheet, and Ground Water Log Sheets.
LITHOLOGY	The LITHOLOGY table contains data about the lithology of a borehole. It includes a lithological description and classification of cuttings and cores taken from boreholes.
LITHOLOGY_XACTION	Audit Trail for Lithology Data.

Entity Name

Description

LOCATION

The LOCATION table contains data about unique sampling points. Each point has an OREIS-assigned identifier that is unique for a specific project. Most locations are points described by x, y coordinates, but a location could be a line or a polygon where measuring events occur. The table includes geographic coordinates, the type of station, etc.

LOCATION_XACTION

Audit Trail for Sampling Locations.

METHOD

The METHOD table contains data about standard analytical methods. It includes the method number, method description, and the name of the document that contains the method data. Non-standard methods are not included.

METHOD TYPE

The METHOD_TYPE table contains detailed information about the method. The type of chemical (e.g., anion, other inorganic), and the chemical parameters associated with the method are included in this table.

METHOD_TYPE_XACTION

Audit Trail for Method Type Records.

METHOD_XACTION

Audit Trail for Method Records.

PARAMETER

The PARAMETER table contains coded values for a chemical, chemical mixture, analyte, or type of environmental measurement. The table contains CAS and non-CAS numbers, the descriptive name, pseudo-CAS numbers, the compound group for the parameter, etc.

PARAMETER_XACTION

Audit Trail for Parameter_Xaction Records.

PROJECT

The PROJECT tables contains data about specific projects. A project is an environmental program responsible for collecting samples and creating regulatory reports. A project is defined by its site (or facility), sponsor, and project domain (either the geographic domain of the project within a site or its thematic domain). The table includes the project name and description, the site name, activity dataset names and numbers, etc.

Entity Name	Description
QC_FLD_SMP	The QC_FLD_SMP table contains data about the trip blank, field blanks, and the rinsates used during a specific sampling event. See FLD_SMP table for a description of a sampling event.
QC_FLD_SMP_XACTION	Audit Trail for QC_FLD_SMP records.
STATION	The STATION table contains data about the locations associated with a project. There could be several stations identified with a project over time. The table includes OREIS identifiers and the OREIS assigned station ID.
STATION_XACTION	Audit Trail for STATION data.
TRANSMITTAL	The TRANSHITTAL table contains data about each dataset that is transmitted to OREIS. It includes OREIS identifiers, source identifiers, OREIS data processing information, etc.
WELL	The WELL table contains data about the current status of a well or borehole. It includes the well type, well use, well status, etc.
WELLCONS	The WELLCONS table contains well construction data. It includes the depths and diameters associated with the various casings, materials used in the construction, etc.
WELLCONS_XACTION	Audit Trail for Well Construction Log and Ground Water Sample.
WELL_XACTION	Audit Trail for WELL data.

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