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**TECHNICAL DATA MANAGEMENT  
AT THE YUCCA MOUNTAIN  
SITE CHARACTERIZATION PROJECT**

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**ABSTRACT**

The Department of Energy/Office of Civilian Radioactive Waste Management (DOE/OCRWM) is responsible for the characterization of Yucca Mountain, Nevada, to determine its potential as a site of a high-level radioactive waste repository. The characterization of Yucca Mountain encompasses many diverse investigations, both on-site and in laboratories across the country. Investigations are being conducted of the geology, hydrology, mineralogy, paleoclimate, geotechnical properties, and archeology of the area, to name a few.

Effective program management requires that data from site investigations be processed, interpreted and disseminated in a timely manner to support model development and validation, repository design, and performance assessment. The Program must also meet regulatory requirements for making the technical data accessible to a variety of external users throughout the life of the Project. Finally, the DOE/OCRWM must make available the data or its description and access location available for use in support of the license application and supporting documentation. To accomplish these objectives, scientific and engineering data, generated by site characterization activities, and technical data, generated by environmental and socioeconomic impact assessment activities, must be systematically identified, cataloged, stored and disseminated in a controlled manner.

The Yucca Mountain Site Characterization Project (YMP) has developed a method of controlling technical data management which

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ensures that data are 1) traceable from origin to use in the license application and supporting technical documentation, 2) readily available in a consistent, useful format within the Project, and 3) reported in a timely fashion to outside parties. Records systems alone cannot accomplish this. The YMP uses the power of a well defined Information Management system to support the demands of technical data management. The technical data management function identifies system requirements, authorities, user interfaces, information availability, and cost and schedule constraints, so that information management functions can build and maintain the most appropriate technical data management systems for the Program. A close working relationship ensures that, together, information management and technical data management functions can support the Program requirements.

## **BACKGROUND**

The Nuclear Waste Policy Act of 1982 (NWPA) established a national policy for safe storage and permanent disposal of spent fuel and high-level radioactive waste. Congress assigned primary responsibility for development of a radioactive waste management system to the Department of Energy (DOE). The concept of a deep geologic repository was selected as the safest and most feasible method for permanent disposal of high-level radioactive waste.

The DOE/Office of Civilian Radioactive Waste Management (OCRWM) was formed in 1983 to administer the responsibilities delegated to the DOE by the NWPA. In February 1983, DOE/OCRWM identified Yucca Mountain, Nye County, Nevada, as one of nine potentially acceptable repository sites. The sites were evaluated as to their suitability for site characterization. In May 1986, the number of potential sites was reduced to three locations in Nevada, Washington and Texas. In 1987, based upon further evaluations, the NWPA was amended directing the DOE to characterize only the Yucca Mountain site and to suspend characterization studies at the other two sites.

The Yucca Mountain Site Characterization Project Office (YMPO) in Las Vegas, Nevada, is responsible for the scientific investigations to determine if Yucca Mountain is a suitable repository site. The Yucca Mountain Site Characterization Project (YMP) involves the scientific investigation of Yucca Mountain and surrounding areas, the engineering analysis of natural and man-made barriers to the movement of radionuclides to the accessible environment, and the evaluation of the environmental and socioeconomic impacts of a waste repository to the site and the State of Nevada.

The YMP work force includes scientists from diverse disciplines as well as engineers and other support personnel employed by the DOE/OCRWM, its contractors, several national laboratories, the United States Geologic Survey, and many colleges and

universities. Each of these geographically separated organizations is responsible for different, often closely related, portions of the site characterization process. Therefore, the development of an effective technical data management system, which is available for use regardless of physical location, requires either a telecommunication system linking all participants to the appropriate data bases or a system of controlled distribution of those data bases. The feasibility studies, design acquisition, development and implementation of these telecommunication links are the function of information management within the YMP. Close integration between the requirements of the technical data management system and the information management system must be established and maintained during the life of the Project. The current telecommunication system available to the Project links all Project participants and the Nevada Test Site through a hub at the DOE Operations Office, in Las Vegas, Nevada. The Las Vegas hub is linked to DOE/OCRWM, which is also connected to other major Program sites throughout the country. However, additional integration must still be completed before all participants may have on-line access to tabular portions of the Project-wide Technical Data Base. Specific controls must be established to ensure that the integrity of the technical data is not compromised during distribution of the spatial data or tabular data from the Technical Data Base.

The testing, engineering analyses, and modeling required to determine if Yucca Mountain is a suitable and licensable site for the potential deep geologic repository are extensive. A 6,000 page document, the Yucca Mountain Site Characterization Plan, was written to describe the numerous surface, underground and climatological studies that must be performed to evaluate the site's suitability. During site characterization, the DOE/OCRWM must also evaluate environmental and socioeconomic conditions that are not defined in the Site Characterization Plan. The actual data required to support site characterization activities and socioeconomic and environmental impact assessment activities are identified and described in the Site Characterization Program Baseline (SCPB) and associated study plans, as well as the Environmental Monitoring Plan, the Radiological Monitoring Plan, the Socioeconomic Monitoring Plans, the Environmental Field Activity Plans, and other planning documents.

The diversity of the scientific, engineering and other technical programs was delineated above. The time and budgetary constraints associated with this Project make sharing of technical data within the scientific and engineering community absolutely critical to the successful solution of the complex scientific problem challenging the Project.

Site characterization will require approximately ten (10) years, assuming that no disqualifying condition is uncovered prior to

the completion of characterization activities. Throughout that time, contractor companies and Project personnel will change, as they have during the early evaluation and preparation phases of the Project. In addition, samples or data acquired or developed by one contractor or laboratory may be used by one or more other contractors or laboratories for further analysis. Therefore, to effectively manage and report the diverse types of information collected during site characterization, the YMP has developed a tracking system which provides the access to and traceability required for effective use of the information in subsequent analyses.

The NWPA as amended, specifies that the licensing process for construction authorization must be completed within a three-year time period (with a possible one-year extension). That period of time is shorter than that typically required to license most nuclear power plants -- on the average 10 years. Because of the short licensing time frame, data must be made available to interested parties in advance of the submission of the license application so that independent investigations may be performed to substantiate or dispute the findings and positions of the DOE. To facilitate these exchanges, the DOE/Nuclear Regulatory Commission (NRC) Site-Specific Procedural Agreement for Geologic Repository Site Investigation and Characterization (Site Specific Agreement) of June 1985 was developed. One of the requirements is that the DOE publish a data catalog quarterly that identifies all data that are acquired and developed by the YMP. Agreements with other interested parties, such as affected units of local government, also specify the requirement to make data available on a timely basis.

These requirements to provide access to the data by others must be tempered by the need of the organization acquiring the data to have exclusive access to the data for a period of time that allows for analysis and appropriate reviews. Premature release of data may result in the use of erroneous data. Years of litigation could result where the Project must refute conclusions based on erroneous data. Therefore, while the data must be reported to the Automated Technical Data Tracking System (ATDT) within a short time span, distribution of that data may be delayed to ensure proper reviews.

The YMP is different from the other operations that provide data to be used to support a license application that is to be submitted to the NRC. The YMP involves the collection and analysis of scientific and engineering data to prove the viability of the site as a natural barrier to radionuclide migration, rather than construction of a power plant. Even though power plants have had to do siting studies, no facility has relied on the natural barriers of the site to the degree that the repository will. Nor has any other facility been required to function for 10,000 years.

While some of the site characterization activities will rely on "cutting edge" technology and some of the country's top scientists to gather and analyze data, exemplary scientific work alone is not enough. Project staff and their contractors have to follow stringent Quality Assurance procedures to ensure that all data are verifiable and traceable. The NRC will require traceability of those scientific samples and data gathered or generated during site characterization that support the licensing process. This process will require similar methods for ensuring traceability of data to those used within the nuclear power industry.

Technical Data Management has defined a three-tiered approach to the management of technical data: a Project Technical Data Base, a Project Reference Information Base, and the ATDT. The Technical Data Management Plan describes these management tools and their interactions with Project participants. Figure 1.0 shows the YMP Technical Data Management System.

#### **YUCCA MOUNTAIN PROJECT TECHNICAL DATA BASE**

When one considers the number of investigators working on the YMP and the interdependencies of their analyses, it becomes obvious that data transfer must be controlled. There must be an intermediate process, where data are maintained in an electronic format and the release or transfer of these data is done in a controlled manner. The Project Technical Data Base provides this standard, controlled source for the actual scientific and engineering data values collected by the Project. The data maintained by the Technical Data Base are used to support further analyses and development of mathematical models. The data maintained by the Technical Data Base are usually reduced or interpreted data, with pointers to the records of the original raw data values maintained in the YMP records system. The level of information and the particular parameters which must be submitted to the Technical Data Base are based on the information requirements specified in the SCPB and associated study plans, Environmental Monitoring Plan, Radiological Monitoring Plan, Socioeconomic Monitoring Plan, Environmental Field Activity Plans, and other planning documents.

Due to the variety of scientific information generated by Project activities, the Project Technical Data Base currently consists of three components, each suited to a specific type of information. Technical data best stored in tabular form are maintained in a relational data base, the Site and Engineering Properties Data Base (SEPDB). The SEPDB stores geologic, hydrologic, and rock



property data resulting from tests performed on rock core samples and field measurements.

Spatial or map-like data are maintained in a geographic information system, the Geographic Nodal Information Study and Evaluation System (GENISES). It is capable of storing and linking both spatial information describing geographic features and descriptive information about those features. The spatial information is stored as geographic points, lines, and polygons which can be graphically presented as maps. A relational data base management system is used to store the descriptive information. The listing of "normalized" parameters acts as an interface table between the SEPDB and GENISES. GENISES is a very powerful tool for the Project because it not only facilitates creation of maps, but can be used for analyses of spatial relationships between map-based features. GENISES will serve a dual function within the Project, acting as a part of the Technical Data Base to control site characterization data and as a management tool in tracking and evaluating activities on the site.

Selected thermodynamic/geochemical data needed to support models of geochemical reactions involving the waste package and repository geochemical environment are maintained in the Geologic and Engineering Materials: Bibliography of Chemical Species (GEMBOCHS) data base. GEMBOCHS is a relational data base that currently contains compositional and thermodynamic data for over 2000 chemical species. These data are used in various geochemical modeling codes to assist the Project in predicting the chemical effects of irreversible fluid-rock reactions that may occur within the post-emplacement repository environment at Yucca Mountain.

System requirements for the Technical Data Base include establishment of standards for data transmission to and from the Technical Data Base, integration of the component systems, and definition of access protocols and user interfaces. A Technical Data Parameter Dictionary is being developed from a normalized parameter listing to establish the standards for data transmission to the Project Technical Data Base. It defines the standard parameter name and descriptive information needed to provide consistency in the format of technical data submitted to the Technical Data Base components. As an example, it provides definitions of the various parameters, identifies aliases, establishes standard reporting units and preferred measurement systems, and provides unit conversion factors. The information maintained in the Parameter Dictionary ensures that data are useful and meaningful to the user community and that it may be readily transferred between Technical Data Base components.

## **PROJECT REFERENCE INFORMATION BASE**

The Project Reference Information Base is a compilation and descriptive summary of fully interpreted Project technical data or information. The Reference Information Base usually contains a representative data value or an accepted range of data values derived from the full data set maintained in the Project Technical Data Base. It provides summary level descriptions of site characteristics, design configurations, the engineered barrier system, and performance analyses. The Reference Information Base serves as one of the primary reference volumes for design engineers. The Reference Information Base is maintained as a controlled document and will be continually revised and updated as site characterization progresses and the understanding of the site evolves. Reference Information Base contents should stabilize as the various sections of the license application are written. It will then serve as a technical basis or source of technical information during the license application process.

System requirements for the Reference Information Base include the establishment of on-line access to the document, development of a search capability, and definition of access protocols and user interfaces.

## **AUTOMATED TECHNICAL DATA TRACKING SYSTEM**

On a complex, large Project like the YMP, it is imperative that technical data be carefully tracked and the linkages from one stage of the investigations to another be traceable. In addition, the question of what data are available to support a particular position or analyses is difficult to answer without calling a number of investigators. To facilitate the process, the YMP has created the Automated Technical Data Tracking system (ATDT). Beginning at the initial acquisition of technical data, whether in the field or laboratory, the technical data are reported to the ATDT. The process of data development is also reported in the ATDT, including data reduction, synthesis, interpretation, and eventual submittal to the Project Technical Data Base. The basis of the Automated Technical Data Tracking system is the Technical Data Information Form. The Technical Data Information Form is a multipurpose form that provides information for the ATDT regarding data acquisition and development, the submittal of information to the Project Technical Data Base components, and the transfer of data among participants or to outside parties. Information for the Technical Data Information Form is provided by the Principal Investigator for entry into the ATDT. The Technical Data Information Form is available both in hard copy and on-line as an ATDT data entry screen.

The ATDT does not contain the actual data values collected by

investigators. Instead, it includes metadata or descriptors (information) about data. The system acts as an index to Project technical data. The metadata in the ATDT include the following information:

- o the Principal Investigator who acquired or developed the data;
- o a description of the data;
- o cross-references to related groups of data;
- o citation information, including report numbers for published data;
- o the parameter and parameter category;
- o the governing program plan and Site Characterization Plan activity number, if appropriate;
- o constraints, limitations, or assumptions related to the data;
- o test numbers and sample identifiers;
- o information related to the transfer of the data to a Technical Data Base and other recipients (date of transfer, transfer media, etc.);
- o the date and place of acquisition or development;
- o the method of acquisition or development; and
- o the location where the data may be examined.

All technical data acquired and developed by the Project will eventually be included in the Project's records management system. The ATDT will provide links to the actual data records in the records system.

#### **FLOW TO THE LICENSING SUPPORT SYSTEM**

On August 5, 1987, the Nuclear Regulatory Commission announced the formation of a High-Level Waste Licensing Support System Advisory Committee ("negotiating committee"). The negotiating committee was chartered to develop recommendations for revising the Commission's Rules of Practice in 10 Code of Federal Regulations Part 2 for the adjudicatory proceeding on the application for a license to receive and process high-level radioactive waste at a geologic repository. The negotiating committee sought consensus on the procedures that would govern the high-level waste licensing proceedings, including the use of a Licensing Support System (LSS). The LSS is intended to be an electronic information system that would contain, in a standardized form, information supporting the DOE license application, as well as the potentially relevant documents generated by the Nuclear Regulatory Commission and other parties to the licensing proceedings. The LSS will include a header -- or bibliographic and control information descriptor -- and ASCII Text and/or optical images, when appropriate.

The ATDT provides the traceability needed to assemble technical

data record packages for submission to the DOE/OCRWM records management process and the LSS. As data are acquired or developed, transferred within the Project or to outside parties, or submitted to the Technical Data Base, it is grouped into logical segments and placed in a Participant Data Archive. The segment is assigned a unique technical data tracking number and that number along with basic descriptive information about the data and its acquisition or development are entered into the ATDT. Data that are used multiple times can be referenced, using the technical data tracking number, in all relevant records packages after the first. Related data groups are also cross-referenced using the data tracking number. This provides the necessary chain of custody for data that supports technical reports and programmatic documents. It also provides traceability for correcting or supplementing data that have been transferred to others.

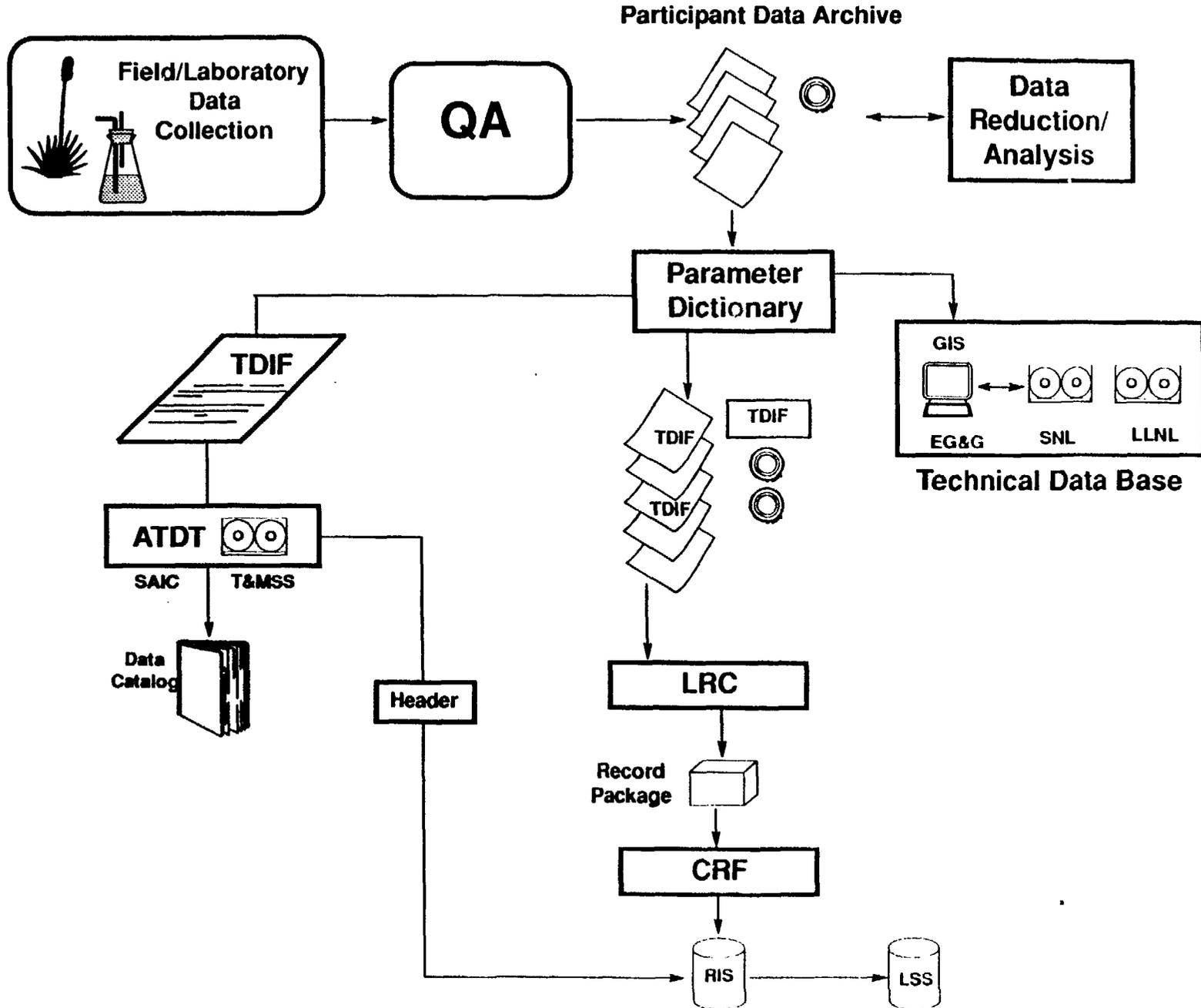
The descriptive information on the Technical Data Information Form provided by the Principal Investigator includes the primary information necessary for the Licensing Support System. As data segments are gathered into records packages (usually upon the completion of an interim or final technical report), the technical data tracking numbers are used to assemble the supporting data. The package is then transmitted to the records management professionals for processing into the DOE/OCRWM records management database and systems. Since the descriptive information is provided by the appropriate Principal Investigator, it is more likely to characterize the data more accurately than descriptions provided by indexers less familiar with the data. The metadata in the ATDT can be migrated to the DOE/OCRWM records management database for eventual transmission to the LSS. The ability to migrate the metadata saves time and money. It also decreases the possibility of errors that cause the data to be difficult to retrieve.

Figure 2.0 depicts the flow of metadata into and through the ATDT to the records management system.

## **SUMMARY**

The YMPO, as the local Nevada representative of the DOE/OCRWM, is responsible for the characterization of Yucca Mountain, Nevada, to determine if it is a suitable site for the location of the first high-level radioactive waste repository. Site characterization involves extensive scientific investigations and engineering analyses. The data generated by the YMP are both technically and administratively complex. The DOE/OCRWM must

# TECHNICAL DATA TRACKING



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Figure 2.0

ensure that traceability is retained from the samples, through the data generated during the course of site characterization, to the conclusions based upon that data.

The Project must also identify and provide access to the data it generates in a timely manner. Those data need to be available to other Project contractors or laboratories to enable each to perform its assigned work. Data must also be made available to the Nuclear Regulatory Commission, the State of Nevada and other interested parties throughout the investigation period to facilitate the licensing process. Additionally, the DOE/OCRWM must submit the data and its description and access location to the LSS for use in support of the license application and supporting documentation.

The Technical Data Base provides a centralized source for Project data. Not all data exchanged within the YMP will be in the Technical Data Base, but a description of any exchanged data will be in the ATDT. A description of all data sent to the Technical Data Base is also identified in the ATDT.

The Reference Information Base provides summary level descriptions of site characteristics, design configurations, the engineered barrier system, and performance analyses. The Reference Information Base serves as one of the primary reference tools for design engineers. The Reference Information Base will serve as the technical basis or source of information during the licensing process.

The entries in the ATDT, which describe these data and the exchange or transmittal of them, provide the necessary linkages to ensure traceability and management control. The metadata in the ATDT contains the basic information required for the LSS headers. By providing automated linkages between the ATDT and the records management system, the DOE can provide the data descriptions and location information to the LSS in a cost effective and efficient manner. Because the scientists and engineers who generate the data provide the metadata, the most accurate descriptions of the data are available in all of these systems for program and licensing use.

The Technical Data Management System provides the key elements to identify and control data, to maintain the chain of custody, to ensure traceability to source data, to enable the correction or augmentation of previous data, and provide data to all parties who need it in a timely manner.

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