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ASSESSMENT OF ENGINEERING PROCESSES AND PROCEDURES

Prepared For

U. S. DEPARTMENT OF ENERGY
YUCCA MOUNTAIN PROJECT
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
Under Contract DE-AC28-07RW12384

By Longenecker & Associates, Inc.

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Executive Summary

Longenecker & Associates (L&A) conducted an independent assessment of the Yucca Mountain Project (YMP) engineering processes and procedures under Contract DE-AC28-07RW12384.

This assessment involved both a review of the Office of Civilian Radioactive Waste Management (OCRWM) and Bechtel SAIC Company, LLC (BSC) engineering processes and procedures, and an evaluation of samples of OCRWM/BSC Work Products to determine the adequacy of compliance to Department of Energy (DOE) and Nuclear Regulatory Commission (NRC) statutes, regulations, and applicable policies; and the effectiveness from both performance-based and risk-based standpoints. This approach was taken to provide a static view of how and what OCRWM/BSC does to be compliant with OCRWM performance metrics/measures, and a dynamic view of the design methods such as quality, safety, life cycle design considerations, and other effectiveness and efficiency parameters that might impact the facility once it is operational.

This assessment included a thorough review of OCRWM and BSC engineering processes and procedures, an evaluation of sample work products, and consideration of relationships and interfaces between OCRWM and BSC to determine if there are barriers that may adversely affect engineering work.

In summary, the key issues addressed and our conclusions are:

Issue 1. Are the engineering processes and procedures used by OCRWM and BSC for the design and licensing of the Yucca Mountain Repository adequate and efficient?

> Our assessment concluded that the policies and procedures are adequate, the implementing organizations are structured appropriately for the work, and there are no major barriers that will prevent successful completion of the engineering work. However, some of the processes prescribed by the procedures could be streamlined to improve efficiency. This effort can be accomplished during the normal procedure revision process as the project proceeds.

Issue 2. Are the engineering processes and procedures used by OCRWM and BSC for the design and licensing of the Yucca Mountain Repository being adequately implemented?

> The assessment concluded that OCRWM and BSC adequately implemented the engineering procedures and processes for the products evaluated by the assessment team.

- ***Issue 3. Are the engineering processes and procedures consistent with the YMP requirements (the Quality QARD which is based on 10CFR 63)?***

  The engineering processes and procedures of both OCRWM and BSC are generally consistent with the requirements of the YMP QARD. Personnel in both OCRWM and BSC are knowledgeable of the QARD content and attentive to meeting its requirements. OCRWM and BSC management reinforces line ownership of quality and the line organization's accountability for the quality of their work products. The YMP QA program contains the required major quality assurance elements, including appropriate training, design control, document control, procurement control, records management, corrective action, and self-assessments/audits.

Issue 4. Does the staff of both organizations, OCRWM and BSC, have adequate knowledge of the engineering processes and procedures, as determined by personnel interviews?

The team's reviews and interviews found personnel at all levels to be generally knowledgeable of the procedures and committed to their effective use.

The Assessment Team observed the strengths and good practices listed below.

- The projectized approach selected for managing the preparation and development of engineering material to support a License Application (LA) is a sound approach that provides management good visibility of progress and issues.
- The OCRWM team is proactive in establishing Integrated Project Teams (IPT) to effectively deal with project issues.
- The OCRWM team is proactive in dealing with emergent issues not already covered by existing policies and procedures.
- The BSC operations and construction groups play an important role in reviewing engineering designs and products. The groups provide a source of nuclear power plant experience and skills that are required for the engineering work.
- The training program of BSC is consistent with current best practices in the industry as promulgated by Institute of Nuclear Power Operations (INPO), and is used effectively to improve the performance of the BSC engineering organization.
- The OCRWM Waste Management Office (WMO) has developed a total systems model that can be used to perform a broad-based system modeling and assessment of both off-site and on-site repository operations.

These strengths and good practices are described in greater detail within the report.

The assessment team observed the following opportunities for improvement.

- Some technical issues remain unresolved for long periods of time, and the closure time for corrective actions is long compared to industry standards. OCRWM management should continue to stress the importance of identifying and resolving issues promptly; and the corrective action program should be further improved to reduce times for closing corrective actions and to promote openness and efficiency in configuration management of the LA.
- The number and volume of the policies and procedures is large and the documents lack structure in terms of commonality. As a result, understanding their applicability to one's work can be difficult. End users of these documents should continuously identify opportunities to streamline and improve them.
- A strong culture of "schedule ownership" such that all work is built around a demanding, credible schedule is a critical success factor for any project. The assessment team did not find conclusive indications of such a culture in some parts of the program. Efforts to strengthen this culture should be continued by DOE.
- There is a need for better integration of activities across organizations and organizational subgroups, including the Lead Laboratory.
- Comprehensive, consistent, up-to-date documentation of requirements and interfaces is needed. The DOE processes and procedures for defining, using, and changing the design basis and design criteria need to be improved as the DOE role moves from that of managing owner to that of a design authority/NRC licensee.
- The YMP engineering procedures allow several different change methods, spread over several different procedures, which presents a challenge for effective configuration management. The method of making changes should be standardized.
- BSC should evaluate their current application of the self-assessment program and revise the program appropriately to assure that it focuses on identifying and addressing events with high safety and mission significance.
- One design basis document defining the expected radiological sources and one document containing the personnel dose goals and limits should be developed.
- Securing and retaining qualified personnel for the OCRWM program will be a challenge in light of the growing number of other nuclear power projects and the annual funding uncertainties surrounding the OCRWM program. Obtaining multi-year program funding should continue to be a high priority of DOE management.

Each of the items listed above is discussed in greater detail, including references to relevant objective evidence, within the report.

Acronyms and Terms

ACN	Administrative Change Notice
ALARA	As low as reasonably achievable
AMR	Analysis and Modeling Report
BOP	Balance of plant
BSC	Bechtel SAIC Company, LLC
CAP	Corrective Action Program
CBCN	Criteria/Bases Change Notice
CDIS	Controlled Document Information System
DOE	Department of Energy
DEM	Discipline Engineering Manager
DM	Discipline Manager
DPC	Dual Purpose Canister
DRM	Document Review Matrix
EGS	Engineering Group Supervisor
FEP	Features, Events, and Processes
ITS	Important to Safety
ITWI	Important to Waste Isolation
IDD	Interface Definition Document
IED	Information Exchange Document
INPO	Institute of Nuclear Power Operations
IPT	Integrated Project Team
ISM	Integrated Safety Management
LA	License Application
L&A	Longenecker & Associates
L&A EPP	Longenecker & Associates Engineering Processes and Procedures
NRC	Nuclear Regulatory Commission
OCE	Office of the Chief Engineer
OCS	Office of the Chief Scientist
OCRWM	Office of Civilian Radioactive Waste Management
PCSA	Pre-closure Safety Analysis
QARD	Quality Assurance Requirements and Description
RAO	Regulatory Authority Office
SNL	Sandia National Laboratory

SSC	System, structure, and component
TAD	Transportation, Aging, and Disposal
WMO	Waste Management Office
YMP	Yucca Mountain Project

1. Introduction

The US DOE-OCRWM selected L&A to assess YMP Engineering Processes and Procedures, under Contract DE-AC28-07RW12384. To perform the assessment L&A established teams (Attachment 1) to review procedures, processes, and products and to interview personnel, to determine if the:

- engineering processes and procedures used by OCRWM and BSC for the design and licensing of the Yucca Mountain Repository are adequate and efficient
- engineering processes and procedures used by OCRWM and BSC for the design and licensing of the Yucca Mountain Repository are being adequately implemented
- engineering processes and procedures are consistent with the YMP requirements (the QARD which is based on 10CFR 63)
- staff of both organizations, OCRWM and BSC, have adequate knowledge of the engineering processes and procedures, as determined by personnel interviews.

The Longenecker & Associates Engineering Processes and Procedures Assessment Team (L&A EPP) was impressed with the courteous professional behavior of the entire OCRWM team. The OCRWM team provided requested information, as well as their time during interviews, that provided the basis for this assessment. We hope that the information contained herein will assist senior management in evaluating their current engineering processes and procedures, and in implementing opportunities for improvement.

2. Purpose

The purpose of this document is to report the results of the assessment of YMP engineering processes and procedures.

The objective of the assessment was to determine the adequacy and efficiency of the engineering processes and procedures used by OCRWM and BSC for the design and licensing of the Yucca Mountain Repository and to determine the adequacy of their implementation. The procedure and process reviews:

- assessed the adequacy of each process and the procedure(s) which documented the process
- assessed the efficiency of the process as documented by the procedure
- evaluated samples of work products produced by OCRWM and BSC
- determined, through interviews, the adequacy of knowledge and implementation of the engineering process and procedures by both OCRWM and BSC.

3. Scope

The assessment covers two organizational areas. The first evaluates OCRWM engineering processes and procedures, the OCRWM organization, and the OCRWM implementation of the processes and procedures. The second evaluates BSC engineering processes and procedures, the engineering work products produced by the BSC organization, and BSC's implementation of the processes and procedures. The assessment also includes a consideration of relationships and interfaces between OCRWM and BSC, including the Lead Laboratory, to determine if there are barriers that adversely affect engineering work.

The methodology used in the assessment is provided in Attachment 3.

4. Assessment Key Point Summary

The following observations are summaries of key outcomes of the OCRWM engineering process and procedures assessment. There are additional important observations that are summarized in the individual report sections below, and more detail, as well as objective evidence, is provided in the discussion of each topical area.

4.1. Observations of Good Performance

4.1.1. Projectized Approach

The management approach employed by OCRWM is to identify and manage work activities as smaller projects within the overall project during licensing and preliminary engineering, and to manage all major acquisitions as individual projects during the final design, procurement, and construction. This "projectized" approach is being effectively implemented by the Management Plan for the Yucca Mountain Licensing Application, YMP/04-01, Rev. 04, ICN0, dated February 2007.

4.1.2. Integrated Project Teams

The WMO, having the lead in the development of a performance specification for the Transportation, Aging, and Disposal (TAD), formed a group that functioned as an IPT to develop the performance specification. This engineering process followed appropriate procedures, developed a plan, and ultimately the performance specification (*Transportation, Aging, and Disposal Canister System Performance Specification*, WMO-TADCS-000001, Rev. 0, DOE/RW-0585, dated June 2007). The performance specification met requirements and was developed in a timely manner.

OCRWM established a group that functioned as an IPT to develop and implement a License Application Management Plan (*Management Plan for Development of the Yucca Mountain License Application,* YMP/04-01, REV 04, ICN 0, dated February 2007) to assure that the LA is developed in sufficient technical and design detail, is technically correct, and that the design meets applicable regulatory requirements, and is submitted on schedule. The IPT consists of OCRWM (including engineering), BSC (including engineering), Lead Laboratory, and Legal Counsel Staff dedicated to the generation of Safety Analysis Report Sections, and review of engineering design described in assigned sections of the LA Safety Analysis Report.

4.1.3. BSC Team Support

The BSC Team was proactive in the initiation and development of TDR-MGR-MD-000037, *Post Closure Modeling and Analyses Design Parameters,* dated June 4, 2007, needed for engineering design. The report is based upon thorough review of appropriate Analysis and Modeling Reports (AMRs); Features, Events, and Processes (FEPs); and Lead Laboratory documents.

4.1.4. BSC Experience and Training

The BSC operations and construction groups are currently small, but they play an important role in reviewing engineering designs and products. The groups provide a source of nuclear power plant experience and skill that is needed for the engineering work. The BSC training program is consistent with current best practices in the industry as promulgated by INPO, and is used effectively to improve the performance of the BSC engineering organization. Engineering management has been supportive of training their employees.

4.2. Opportunities for Improvement

4.2.1. Project Execution Plan dated May 2006 needs updating

The Yucca Mountain Project Execution Plan has a responsibility assignment matrix for various engineering processes (Figure 2 on page 16) that needs to be completed.

The flow down of requirements from Level 0 to Level 3, and into the Technical Baseline needs to be clearly presented consistent with other OCRWM engineering documents and procedures.

Additional documentation is required to clarify the interfaces in engineering processes involving the Office of the Chief Engineer, the Office of the Chief Scientist, and the Lead Laboratory. Such documentation is required to maximize effective utilization of resources needed to identify and resolve technical and engineering design issues in a timely manner as they arise.

4.2.2. Post-closure Nuclear Safety Basis

Improved integration of the responsibility, accountability, and processes for interfaces between the Office of the Chief Scientist, including the Lead Laboratory (that was formed approximately one year ago), and the YMP is needed to maximize utilization of resources. Specifically, the integration of the Lead Laboratory into YMP activities deserves continuing management attention. An example is the Lead Laboratory role in the Technical Management Review Board (TMRB).

The TMRB was created primarily to serve the purpose of the Management and Operations Contractor (BSC). Therefore, the current BSC TMRB Charter (Revision 6) and procedure (CC-PRO-1001) focus primarily on the member views and information needs of the Management and Operations Contractor members. The TMRB does not appear to fully utilize the Lead Laboratory as a proactive, participating member of the Yucca Mountain Project Team with differing views and ideas that may contribute to the success of the project.

> It is suggested that management consider approaches to improve integration of the Lead Laboratory into the Project more effectively in the future.

5. Section Summaries and Discussion of Results

5.1. OCRWM Assessment Results

5.1.1. Organization and Staff Capability

OCRWM is a basic functional organization. The Office of the Director has a number of direct reports from different geographical locations (i.e., Washington, DC and Las Vegas, NV). Although limited in number, the staff is well qualified by education and experience, trained in the requirements for effective configuration management, and knowledgeable of the interfaces within the OCRWM Organization. The OCRWM Staff, in concert with its direct support contractor, is capable of overseeing the technical quality of the engineering design work and performing design reviews of engineering products generated by contractors. Although it is a challenge to manage such a large, geographically diverse project, and to establish and maintain a safety and "can-do" project culture, based upon team interviews with OCRWM staff and direct observations, the Program Director keeps abreast of project activities, encourages the team to identify issues promptly, and is available to resolve issues promptly after they are identified.

The OCRWM Staff hold college degrees in the physical sciences, and many have graduate degrees. All have five or more years experience in related technical fields. Some have earned professional certification in Project Management from the Project Management Institute, and the OCRWM Organization has candidate Federal Project Directors in various stages of training and certification.

The *Office of Civilian Radioactive Waste Management Mission and Functions Statement*, PGM-CRW-AD-000003, Revision 1, dated May 2006 identifies the responsibilities of each OCRWM Office.

The management approach employed by OCRWM is to identify and manage work activities as smaller projects within the overall project during licensing and preliminary engineering, and to manage all major acquisitions as individual projects during the final design, procurement, and construction. This "projectized" approach is being effectively implemented by the *Management Plan for the Yucca Mountain License Application*, YMP/04-01, Rev. 04, ICN0, dated February 2007.

The Yucca Mountain Project utilizes a configuration management process to ensure consistency in the design requirements, physical configuration, and required documentation in compliance with ANSI/EIA-649-1998, National Consensus Standard for Configuration Management. The configuration management process is consistent with DOE-O-413.3. Although this process is adequate for the current OCRWM project activities being managed by BSC, careful attention will be required to maintain adequate configuration management control as responsibility is transferred from BSC to DOE as an NRC licensee.

When the LA is submitted, it will be under configuration management control directed by the Office of Chief Engineer (OCE). An Engineering Support group, reporting to the OCE, is responsible for implementation of configuration management.

The OCRWM staff knows their assigned tasks and the schedule commitments, and they are working to achieve Project goals.

The OCE has identified several key discipline vacancies including the need for requirements management and configuration management. OCE is presently working to fill a key slot for a system engineer[1]. Additional staff members have been added over the past two years, and more staff members will be needed as current staff retires and OCRWM begins to take the role of NRC licensee and design authority for the repository. The assessment team did not review long-term plans for the OCRWM organization to become a licensee because these plans have not been developed and approved as would be expected at this point in the project's life cycle. Although the Office of the Chief Engineer has several open requisitions now, qualified staff is difficult to hire because there is strong competition for qualified engineers in the commercial nuclear industry. However, building a strong federal management team is a high priority of DOE management.

The Office of the Chief Scientist in the OCRWM organization currently has a staff of twelve with two open positions, and DOE anticipates adding an additional five people next year. He indicated that the YMP Technical Data Management System is the responsibility of the Lead Laboratory and falls within his purview.

The WMO generally has adequate personnel resources with no unfilled slots.

In 2006, OCRWM was reorganized to its current configuration. Since that time, roles and responsibilities have been defined, as well as internal and external interfaces. Additional staff has been added, and plans are being formulated for the organization to become an NRC licensee. Thus, the organization has experienced significant changes and addition of staff. It is anticipated that further organizational changes and staff additions, particularly in the areas of design and engineering will occur as OCRWM takes on the responsibilities of an NRC licensee.

5.1.2. Organization Detail - Office of the Chief Engineer

The *Yucca Mountain Project: Project Execution Plan,* PLN-MGR-AD-000006, Revision 1, dated May 2006 (PEP) is a key document defining the engineering

[1] Staffing situations discussed throughout this report are snapshots as of the time the L&A EPP Assessment Team conducted interviews.

processes, procedures, and interfaces that are applicable to the OCRWM Project. This document needs to be updated to effectively serve this dynamic Project. OCRWM Procedure LP-REG-02-OCRWM, *Identification and Maintenance of Monitored Geologic Repository System Requirements,* Revision 3 ICN 2, dated July 14, 2006, provides a mechanism for identifying such information that could be added to the PEP

For example, Figure 2, Yucca Mountain Project Responsibility Assignment Matrix (page 16) was not complete at the time of our assessment. For such a dynamic project that is adding new staff, it would be helpful to document responsibilities and accountabilities, as is done in the BSC PMEP (*Repository Project Management Execution Plan*, PLN-MGR-AD-000010, Rev. 00F, February 2007), and keep the PEP up-to-date. Perhaps, issuing interim documents, or addenda, between annual revisions would be an efficient approach.

Although INPO[2] recommends that procedures be updated every one to two years for nuclear power plants, this is such a dynamic project that more frequent changes may be required. In this regard, BSC pointed out that their procedures are updated frequently based on self-assessments, corrective actions, etc.

The OCE, and the staff, are very experienced in the YMP. They know the requirements and the interfaces in the OCRWM organization. They have a good working relationship with the contractor (BSC), and the Office of the Chief Scientist (OCS), including the Lead Laboratory. The OCE deliverable products to the OCRWM for fiscal years 2007 and 2008 are identified in letter CCU.20070410.0003 to Ted Feigenbaum, President and General Manager, BSC, from Mark Williams, Contracting Officer's Representative. The OCE Deliverable Products List includes products that are LA products and LA Support products. The OCE has two "hot bunks" in the BSE office, where the "INFOWORKS" computer database can be accessed to identify supporting calculations. This also provides an opportunity for the OCE staff to interface with BSC design engineering staff.

The PEP reviewed (*Yucca Mountain Project: Project Execution Plan*, PLN-MGR-AD-000006, Revision 1, dated May 2006) does not clearly document the roles, responsibility, and accountability of the OCRWM staff for execution of the PEP.

The document, *Action Item: Assess the CRWMS technical baseline for currency, integration, and accuracy* [Reference Email Kouts to Harrington, subject: “Technical Baseline Assessment,” dated 4/24/07] was reviewed for requirements flow down from Level 1 [CRD] to Level 2 or 3 requirements documents. The L&A EPP assessment compared the following three diagrams and found they are not consistent.

[2] INPO 86-009, Revision 01, "Guidelines for the Organization and Administration of Nuclear Power Stations," Chapter VII, Document Control, Section C.2, Procedures

1. Table 1 is from the *Yucca Mountain Project: Project Execution Plan*, PLN-MGR-AD-000006, Rev. 1. It is Table 2, Project Technical Baseline Element, on page 49 of that OCRWM document.
2. Figure 1 is from EG-PRO-3DP-G04B-00005, Rev. 4, Attachment 1 (a BSC Engineering document).
3. Figure 2 is from *Civilian Radioactive Waste Management Requirements Hierarchy and Management Plan*, a draft document prepared by the Office of Waste Management. It is Figure 3, CRWMS Requirements Document Baseline with a Detailed View of the Contractor-Level Baseline, from that document.

Table 1. Project Technical Baseline Element

Level	Organization	Technical Baseline Documents
0	**SAE**	Public Law (i.e., NWPA, etc.) Code of Federal Regulations
1	**OCRWM Director**	Civilian Radioactive Waste Management System Requirements Document (DOE 2002a[1]) Key Elements from the Yucca Mountain Project Conceptual Design Report (BSC 2002[2])
2	**YMP Project**	Yucca Mountain Site Characterization Project Requirements Document (YMP-RD) (YMP 2001[3]) Conceptual Design Asset Functional and Operational Requirements and Design Solution for Level 2 Change Control (Arthur 2003[4]) (Functional and Operating Requirements)
3	**Contractor**	Project Requirements Document (Canon and Leitner 2003[5]) (including Requirements Allocation Matrix documents)

[1] DOE 2002a, *Civilian Radioactive Waste Management System Requirements Document,* DOE/RW-0406, Rev. 5, DCN 05, Washington, D. C., U.S. Department of Energy, Office of Civilian Radioactive Waste Management.
[2] BSC (Bechtel SAIC Company) 2002, *Yucca Mountain Project Conceptual Design Report*, TDR-MGR-MD-000014, Rev. 00, Las Vegas, Nevada, Bechtel SAIC Company, LLC.
[3] YMP (Yucca Mountain Site Characterization Project) 2001, *Yucca Mountain Site Characterization Project Requirements Document* (YMP-RD), YMP/CM-0025, Rev. 4, DCN 02, Las Vegas, Nevada, Yucca Mountain Site Characterization Office.
[4] Arthur, W. J., III, 2003, “Level 2 Directed Baseline Change (DOE/RW-0600, Rev. 0),” Letter from W. J. Arthur, III (DOE/ORD) to J. T. Mitchell (BSC), March 6, 2003, OPC&M:JCD-0610, 0307036365, with enclosure.
[5] Canori, G. F., and Leitner, M. M., 2003, *Projects Requirements Document*, TER-MGR-MD-000001, Rev. 01, Las Vegas, Nevada, Bechtel SAIC Company.

A check of the Controlled Document Identification System (CDIS) for current Level 1 and Level 2 requirement documents did not identify any of the documents listed on Table 1 as being applicable in August 2007.

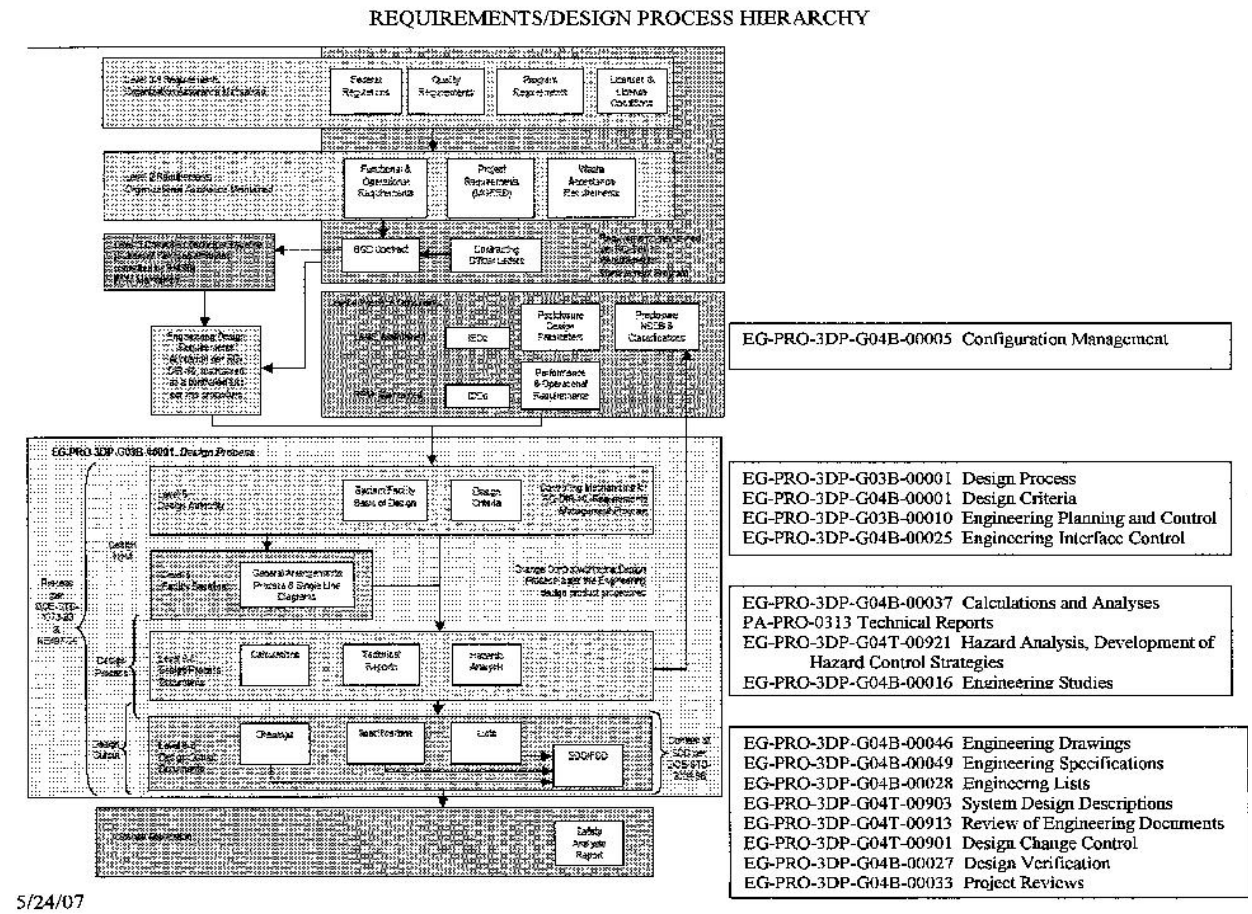

Figure 1. Attachment 1 from *Configuration Management*, EG-PRO-3DP-G04B-000005, Rev. 4

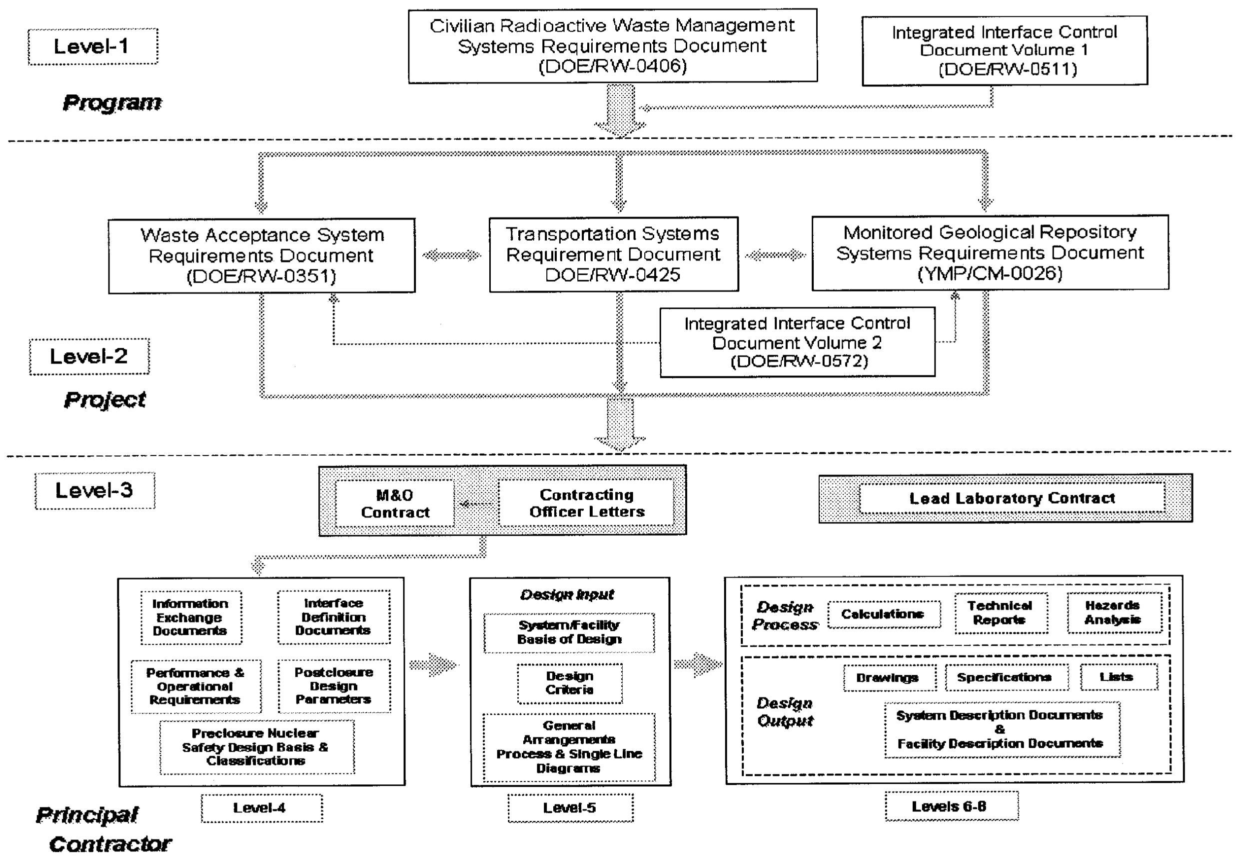

Figure 3. CRWMS Requirements Document Baseline with a Detailed View of the Contractor-Level Baseline

Figure 2. From Office of Waste Management Draft Document

Requirements document hierarchy below the Level 1 CRD and subsequent flow down of requirements into Level 2 or 3 documents is inconsistent in the documents listed above. In particular, Level 2 and 3 document interfaces with NNPP and EM requirements are unclear. There is no specific reference within upper level requirements documents to the Integrated Interface Control Documents, DOE/RW-0511 and DOE/RW-0572, (IICD), Volume 1 and 2.

Requirements documents prepared by RW-9 are not being specifically included in documents showing the flow down of requirements to BSC Level 4 requirements. For example, the transportation system potentially impacts repository design because special rail cars are likely to be used for transporting TADs. This rolling stock is likely to impact surface facilities because of size and weight, as well as rail lines at the repository. It does not appear that the TSRD (*Transportation System Requirements Document,* DOE/RW-0425, Revision 4, dated October 2006}, a Level 2 document, is specifically referenced in DOORS (*Engineering Design Requirements Allocation Matrix List*, document number 000-3DR-MGR0-00400-000, Revision 000, March 2006). Of course, project requirements documents are being revised and reissued frequently because the Project is dynamic. As another example, the *Monitored Geologic Repository Requirements Document*, YMP/CM-0025, Revision 3 DCN 02, is not referenced in the PEP Table 1 (noted above), while it is referenced in the other two diagrams. Project requirements, however, are transmitted to the DOE/OCRWM contracting officer and published through contract documents. OCRWM is aware of the need to improve the flowdown of requirements and is addressing it through the corrective action program.

Furthermore, the draft document prepared by DOE/OCRWM, *Civilian Radioactive Waste Management Requirements Hierarchy and Management Plan,* dated February 2007, had not yet been issued by July because comments had not been resolved. This document provides clarification needed for the document hierarchy and requirements flow down discussed above, as well as providing OCRWM core values. Comments should be resolved and a suitable document issued as soon as possible.
The OCRWM Execution Plan consists of several major components identified in the PEP. Every project requires participation and teamwork from each major component. This PEP does not document the interfaces with the OCS and the Lead Laboratory in sufficient detail for efficient interactions. To promote teamwork and to increase the efficiency of interactions between the project team, especially as new staff is being added to the project, it is suggested that management consider including this additional information in the next revision of the PEP.

The L&A EPP Assessment Team interacted with other offices within OCRWM and were able to make some observations. The observations of those interactions are included in Attachment 4.

5.2. BSC Assessment Results

5.2.1. Overview

A broad review of the surface facilities layout and the scope of activities for the repository indicates that the required functions for surface operations have been accounted for. The design requirements are contained in the design basis documents.

The BSC organizational structure is typical for the management of a large project, with a strong matrix into Discipline Engineering to support the project design. The work of Repository Project Management (RPM) is divided into three projects (Nuclear Facilities, Balance of Plant (BOP), and Subsurface) and each project manager has one or more project engineers reporting to him.

The Engineering Manager provides engineers to the three projects from the discipline engineer pool, and each engineering discipline is represented on each project team. The resource determination (i.e., number of engineers) is determined by the work scope and schedule.

The overall BSC engineering organization evaluation is presented using the methodology described in Attachment 3.

5.2.2. BSC Ability to Define and Use Design Bases

Section Summary

The processes and procedures in use by BSC Engineering are appropriate for defining, using, and changing the design bases and the design criteria (see Checklist 1 [Attachment 2]). Changes to the Basis of Design are procedurally reviewed for overall cost and schedule impact before authorization. The procedures adequately control the flow down of requirements.

Change to the TAD requirements has implications for the surface facilities. In a proactive approach, BSC has developed a document titled *Post Closure Modeling and Analysis Design Parameters Report*. The report is a consolidation of the science design requirements for systems, structures, and components (SSCs). It identifies those science requirements that need to be broadened through expanded definition or tolerances confirmed by scientific analyses or testing.

Including Integrated Safety Management (ISM) reviews as part of BSC engineering packages is considered a strength.

Detailed Discussion

One of the cornerstones for successfully designing and licensing the Yucca Mountain Repository is to define, use, and subsequently control changes to the design basis and the design criteria documents. It is evident from our review of the engineering processes that a significant effort has been made to ensure that the design basis and design criteria are documented and used for every facility's structures, systems, and equipment. This is flowcharted in the "Requirements/Design Process Hierarchy," (EG-PRO-3DP-G04B-00005, *Configuration Management*) which correlates the process-level procedures for performing engineering work with the YMP Level 0-8 requirements flow down. Only after using the appropriate engineering procedures for the design process is information allowed to enter the LA. The L&A EPP Assessment Team considers the procedures that control the design basis to be acceptable (see Checklist 1 in Attachment 2).

The BSC engineering group controls the flowed-down YMP requirements using EG-PRO-3DP-G04B-00001, *Design Criteria*, and these are defined starting at Level 4, which is under the control of BSC for design work. The implementing procedures for the repository design engineering require that design criteria and the basis of design be verified for all work.

Higher-level changes to the Basis of Design (Levels 0-2) are strictly controlled by OCRWM and assessed for overall project cost and schedule impacts before being authorized. Level 3 is BSC controlled. Changes at Levels 1, 2, and 3 must be reviewed by change control boards specific to each level with close communication between BSC and OCRWM in this process. YMP Management levels of approval escalate as changes are identified for requirements at Levels 1, 2, and 3. The L&A EPP Assessment Team has reviewed these current engineering processes and procedures (Attachment 5) and determined that when the procedures are correctly used by BSC they will provide effective control over design basis requirements and design criteria used in repository design engineering and in the LA.

YMP conducted an extensive review of how to optimize the material handling, resulting in CD-1, which introduced the TAD canister. Due to the changes in the design basis to incorporate use of the TAD canister, a considerable amount of engineering design rework has been required, especially to the surface nuclear facilities. BSC has established schedule milestones for changing conceptual designs for components, margin definitions, and certain safety analyses to maintain the overall schedule for preparation of the LA sections.

An engineering design criterion (resulting from CD-1) is that 10% of the fuel will arrive at the Yucca Mountain Repository in Dual Purpose Canisters (DPCs) and that approximately 90% of the fuel will arrive in TADs. Deviations from this criterion can potentially affect the systems and equipment for spent fuel handling at YMP. As a contingency, BSC engineering has designed sufficient margin into the nuclear facilities to accommodate up to 25 percent DPCs and 75% TADs at YMP, if it were to be required in the future.

The bases for design in many critical engineering design areas are dependent on the results of scientific studies, carried out by, or under contract to, the Lead

Laboratory. The results are published in TDR-MGE-MD-000037, *Postclosure Modeling and Analyses Design Parameters Report*, as established criteria. This determination requires close interfacing between repository engineering and the scientific studies to ensure that facility design criteria are correctly established. The trade-offs and options for considering margins in scientific studies are difficult to specify within existing constraints for basic research, most of which is geologically oriented. For example, a "bounding" study of storage location heat transfer might result in overly conservative limits on canister fill and facility design. If, however, the Lead Laboratory does provide a “range” instead of a “point,” the design will be re-evaluated.

The BSC Team, with the support of the OCE staff, was proactive in the initiation and development of the *Post Closure Modeling and Analyses Design Parameters,* TDR-MGR-MD-000037, dated June 4, 2007, needed for engineering design. When the BSC/OCE Team realized that the draft report, *Post Closure Safety Basis*, did not meet their needs for post-closure design criteria, the BSC/OCE Team developed a report outlining their needs for appropriate design criteria. This report is an interface definition document as defined in CC-PRO-2001, *Technical Interface Control,* and it is a Level 4 Technical Baseline document prepared in accordance with applicable procedures. The report is based upon thorough review of appropriate AMRs, FEPs, and Lead Laboratory documents. This is an essential document needed to address potential gaps between the safety and design criteria utilized by engineering design, and the scientific tests and analyses performed by the National Laboratories during earlier phases of the project. There is an on-going effort to add tolerances to the Information Exchange Documents (IEDs) based on sensitivity studies performed by the Lead Laboratory. This proactive teamwork among project members is considered a good practice.

In a report dated January 20, 2006, Secretary of Energy Bodman described the results of a DOE review that noted an effective ISM System was not implemented at the working levels at many of the DOE facilities. The five core functions of an ISM System are broad enough to be integrated into most work: define the scope, analyze the hazards, develop and implement hazard controls, perform the work, and provide feedback and improvements. The BSC procedure for the overall design process (EG-PRO-G03B-00001, *Design Process*) invokes these core functions for the hierarchy of engineering procedure controls. Even though application of ISM is primarily targeted towards mitigating hazards during the performance of field work, the consideration of ISM during the engineering design process is a precursor for future implementation of the engineering designs, and is considered a good practice by BSC. The description of the ISM system and the need for ISM reviews as part of engineering design packages is also considered a good practice, and meets the guidelines in Checklist 1 (Attachment 2).

5.2.3. BSC Ability to Execute Effective Configuration Management

Section Summary

The configuration management process and procedures in use by BSC are appropriate to effectively control design and meet the review guidelines in Checklist 1 (Attachment 2). There are several areas for improvement, including some INFOWORKS processes, control of document reviews, procedure streamlining, and clearer definitions for the various tools for document changes.

Detailed Discussion

Translating knowledge of the basis of design and design criteria into actual engineering work products requires effective configuration management at all levels of the YMP team. The high-level configuration control procedures, CC-DIR-10, *Configuration Management Program*, and EG-PRO-3DP-G04B-00027, *Configuration Management*, set the direction for the lower tier implementing engineering procedures, and effectively define the necessary configuration management requirements consistent with current industry standards. The implementing procedures reviewed (Attachment 5) invoke the document control process as prescribed.

The BSC document control function relies heavily on the responsible engineer (originator) to maintain control of his in-process work product, with the expectation of using INFOWORKS as the control tool. The BSC document control supervisor has developed a very thorough methodology for independently verifying the completeness of every document's references and approval requirements prior to submitting the product as a record to CDIS. This verification criterion, which is comprehensive and complete, is obtained from NRC documents, the DOE contract and regulations, and from BSC company procedures. This verification occurs after the originator has completed the procedural requirements for a final version.

The originator decides when to bring a work in progress (draft) into INFOWORKS, prior to the Review Copy, but the draft is entered into the EPRR drawing log when initiated. The Review Copy, per procedure, is the baseline for formal comments (using the Document Review Matrix [DRM]) and resolutions, and must be entered into INFOWORKS. This action may occur at various points in the design work. There are specific control points (e.g., 25%, 50%) assigned to each stage of a drawing’s life cycle (e.g., ready for review) and the EPRR drawing log allows a project engineer to independently track the status of a work in progress.

The current configuration management process meets the guidelines provided in Checklist 1 (Attachment 2), the control and processing system is adequate, and no deficiencies were identified in the review. Nevertheless, there is room for enhancement of the process.

- The DRM is maintained on the Engineering website in accordance with procedure. The current procedural guidance for which groups review an engineering product is that the Preparer, the Discipline Engineering Managers (DEM), and the Engineering Group Supervisor (EGS) decide using both the DRM and judgment for guidance. This process allows the potential for inconsistency in reviews. An opportunity for improvement is for the DRM to be strengthened to ensure that the minimum necessary review functions are specified.
- The method in INFOWORKS of notification for review is not readily integrated with access to the document to be reviewed. The software generates a notification to the reviewer that he has a task, but then the reviewer must separately look up which document he is to review. If review schedule changes are necessary, they must be handled outside the controls of INFOWORKS. Training on this process should be reinforced to reduce the potential for human errors.
- The current document control supervisor has been reassigned, and it is not apparent that a successor with his level of knowledge about the process and software for INFOWORKS has been trained. He may be able to assist with some issues remotely, but this may be a vulnerability to rapid and effective processing of review drafts, as well as record filing and document retrieval. This is not an issue under the control of BSC Engineering, but it is important to ensure a viable succession candidate is trained.
- The procedures listed in Attachment 5 for configuration management were reviewed and found acceptable. In particular, ENG-PRO-3DP-G04B-0027 is the procedure which addresses most configuration issues for Engineering. However, there appear to be a large number of procedures (by title) throughout the YMP organization that describe some facet of configuration control. This presents the opportunity for confusion by the users since a significant responsibility for the process is placed on the originator. It also presents the possibility of inconsistency among procedures, since some may reflect older processes. BSC/OCRWM should identify and review every active configuration management procedure to eliminate duplication, consolidate where possible, and ensure consistency.
- In order for engineering work to proceed in a timely fashion (in the event that a procedural step cannot be readily implemented or if a change is rapidly needed), it is prudent to allow, under strict controls, deviations from procedures to change design information. The tools to allow such changes must be clearly defined and assigned the correct levels of approvals. It is noted that, spread across several procedures, engineering is allowed to use Criteria/Bases Change Notices (CBCNs), Calculations and Analyses Change Notices, and Administrative Change Notices (ACNs) for this purpose. The following observations pertain to these tools.

- The CBCN (EG-PRO-3DP-G04B-00001, *Design Criteria*) does not require a reviewer. Since design bases can be changed with this document, a required review should be added to the procedure.

- The definition of what is allowed under an ACN (PA-PRO-0313, *Technical Reports*) is not clear, and should be included in the procedure.

- Procedures allow twenty CBCNs and ten ACNs before a document revision is necessary. These are applied to relatively large documents and they tend to be focused changes (e.g., they do not overlap). This number of allowable changes is not normally considered acceptable. For changes to other documents (e.g., drawings) these numbers would not be acceptable. It is recommended that BSC management review the number of allowable changes and make revisions as necessary.

- As a generic observation, the L&A EPP Assessment Team noted that most engineering and project procedures were rather long and, in many cases, contained references to a large number of supporting procedures. The length of the engineering procedures is driven by the requirement for all aspects of the project to be “traceable and transparent” (QARD and 10CFR Part 63). This generally results in additional language to add clarity and explanation for the work described.

  An unnecessarily long and detailed, knowledge-based procedure can make training new employees more difficult and can increase the risks of human errors. An example of this is CC-PRO-2001, *Technical Interface Control*. This is a critical process that is judged by the L&A EPP Assessment Team to meet the guidelines in Checklists 1 and 2 (Attachment 2). However, this 22-page procedure for the correct use of Interface Definition Documents (IDDs) and IEDs could be improved for ease of use.

- While CC-PRO-2001 is an example, most BSC Engineering procedures share the characteristics of being lengthy. The procedures can be and are used effectively as they are. The opportunity for improvement is not intended to suggest a massive, resource-intensive procedure revamping, which can be disruptive to the organization. Rather, end users of these documents should continuously identify opportunities to streamline and improve them. Self-assessments should be used to monitor the effectiveness of any procedure improvements.

5.2.4. BSC Ability to Perform Design Engineering and Make Design Changes

Section Summary

The BSC Engineering organization has developed adequate processes and procedures for performing engineering design work for the YMP. These procedures are consistent with the guidelines in Checklist 1 (Attachment 2). The BSC engineering staff is trained to the procedures, consistent with the guidelines in Checklist 2 (Attachment 2), and this program has strengths. The engineering products reviewed implement the procedure requirements, and are consistent with the guidance in Checklist 3 (Attachment 2).

Currently, Licensing engineers are writing the LA sections using engineering input. BSC performs an engineering review on all LA sections that utilize engineering input.

Strong project management will be required as these designs are completed to ensure consistency among design bases and safety analyses performed for the LA.

The functions performed by the Systems Engineering Group and the Pre-closure Safety Analysis Group (PCSA) are effective in support of engineering design and preparation of the LA. The PCSA Group is providing risk-informed input. These groups are considered a strength for the YMP.

The use of the Operations Group and the Construction Group in the review of engineering design products is a strength because they provide needed operations, maintenance, and construction experience to the engineering design group. As an example, the calculated occupational dose for a few radiation workers in the Wet Handling Facility is approximately 3.9 R/year. This is considered by Operations not to be as low as reasonably achievable (ALARA), and efforts are continuing to reduce this dose using design changes. (Following the assessment, OCRWM staff noted that Canister Receipt and Closure Facility #1 Worker Dose Assessment, 060-00C-CR00-00100-000-00A, Section 7.4, Recommendations, states: “It is recommended that further ALARA design considerations be included in the final design to achieve the ALARA design goal. Opportunities for dose reduction could include the possibility of additional shielding for higher dose operations, use of more automation, and use of remote monitoring/surveillance techniques.” This and additional documents provided demonstrate that the ALARA issue is recognized in existing project documentation as needing further attention [see Table 5-6 in Attachment 5.])

Detailed Discussion

Using the general guidance in Checklists 1 (all three parts) and 2 (Attachment 2), the L&A EPP Assessment Team performed a broad review of the engineering program in place at the YMP and of the engineering teams performing the repository design and licensing using the processes and procedures upon which the program is based.

Following review of the initial grouping of procedures provided by BSC, the review was expanded to include the entire listing of procedures and related documents in Attachment 5. In order to explore the understanding of these procedures within the BSC organization and to identify how work is performed using the procedures, the L&A EPP Assessment Team conducted interviews at all levels within the BSC organization. The list of the individuals interviewed is provided in Attachment 6.

There are some specific topics that require additional discussion regarding the implementation of the BSC engineering procedures, and there are a few organizational observations that round out our assessment, as follows:

- The BSC organization utilizes an industry standard matrixed engineering project approach to meeting the LA schedule milestones. One difference is that a change was made approximately 8 months ago to have the licensing engineers, in consort with the nuclear facilities project engineer, write the first draft of the LA sections from engineering inputs. Engineering reviews are conducted on each technical LA draft, and the Phase 3 drafts are reviewed by the appropriate discipline-engineering group to assure accuracy.
- The current design approach (parallel efforts) is documented in letter CCU.20061003.0014 to Mark H. Williams; Director, Regulatory Authority Office (RAO), from Richard M. Kacich, Manager Licensing and Nuclear Safety, dated September 29, 2006. On a large, complex project, such as YMP, it is important for project management to clearly communicate decisions such as this one on the level of design to all levels of the project team. This will help achieve alignment of the team in using this information to complete safety analyses, risk evaluations, and draft LA sections. Project management should also establish a clear goal for the completion of designs and verification of final designs with licensing commitments. It is important to establish accountability for final design with the Licensee and its agent, before considering changes to design initiated during the licensing review process.

- The safety analyses are performed by the Preclosure Safety Analysis Team using licensing and engineering procedures. Interface documents are used to support reviews of the effects of any changes to baseline information and design.

  The L&A EPP Assessment Team observed that the working cooperation between the engineering and safety analysis groups is very good.

- The L&A EPP Assessment Team noted in the procedures review that a function in engineering design assurance is assigned to Systems Engineering. This function is to flow down, decompose and allocate Level 0-4 requirements into the Bases of Design and the design criteria.

The functions that an effective Systems Engineering group performs support not only the BSC organization, but the OCRWM organization as well. The support is summarized in the following discussion.

Typically, the engineering design for a product or task is about 20% complete when Systems Engineering is brought in to begin reviews. They start with the project requirements review process, and verify the essential elements needed for the design of the SSCs, and what the design criteria must be. This ensures that the facility conceptual designs will meet the requirements (for example, Systems Engineering has looked at the range of fuel storage and transport casks potentially coming to YMP, and reviewed the conceptual designs for compatibility). They review the design criteria for the project and the application of industry practices for engineering design.

Systems Engineering also performs overall project reviews of each facility project (surface, subsurface and BOP) to ensure compliance with requirements, and to ensure that the as-designed facility meets design requirements. (In July 2007, they were planning 14 reviews with five completed.) Discipline Engineering Managers are responsible for doing the design reviews and SE is a part of the review team.

Systems Engineering reviews Level 3 block flow diagrams for each facility project. The systems review does not rely on a detailed design completion because the conceptual designs are often similar among buildings (e.g., HVAC basic design).

Systems Engineering maintains close working relationships with the EGSs and has regular contacts with the licensing engineers, especially the PCSA Group.

The L&A EPP Assessment Team offers the following observation and opportunity for improvement:

The importance of the SE group to the successful development of the LA should be re-enforced by OCRWM project management.

The use of Systems Engineering is considered a good practice and it is recommended that a broader functional description be included in their scope to assist with the Requests for Additional Information after the LA is submitted to NRC.

- Although not a part of the BSC Engineering Group, the organization that performs the Safety Analyses for the repository design is a critical support group. As it is currently configured, the PCSA Group is performing a function critical to the success of the LA. The LA under NUREG 1804, Rev. 2, is required to be risk informed. This group, in addition to doing the SAs, is also doing the fragility modeling of the facilities and processes to ensure the criteria in 10CFR63 are being reflected in the design.

10CFR63 criteria are used for safety, probability of an event, and dose consequences for the associated level of risk. Inputs are received from design engineering as part of the EDR review procedures. Practical approaches are used to analyze different event scenarios, design changes are identified that bound event consequences, and are recommended to engineering. The Safety Analysis group maintains effective interfaces with Engineering during the design-criteria development process. There is a judicial council process used for a few difficult issues, to get a resolution that can be approved by management. Most issues are resolved at the working levels, for example, with responsible EGSs and the Project Engineers.

The risk based methodology is consistent with industry standards, using the most current and applicable data for equipment failures (up to a Level 3 PRA quality), and considers event sequences and categorizations. This group also has responsibility for dose calculations and criticality evaluations.

The PCSA Group is considered a strength in the overall BSC organization, and the close working relationships with engineering are critical for a successful LA. The visibility and support of this group with overall project management should be increased.

- The BSC Construction group, although a parallel organization to Engineering, nonetheless has a very important role in the review of engineering designs for both constructability and practical equipment specifications. Although there is no planned repository construction until 2011, this group has the responsibility to review engineering products for constructability and to preview drawings before they are sent out for formal review. They are also part of the formal review process. The interface between engineering and construction is considered a strength.

- The BSC Operations group is another parallel organization to engineering, but with critical interface input. Repository operations start with receipt of the initial spent fuel. The activities ongoing at the site now are not the responsibility of this group. The current functions of Operations include writing the conduct of operations process and procedures, and support and reviews for project meetings, LA sections, and most engineering products. Operations is not required to review engineering calculations, but does review P&IDs. Operations also includes the maintenance function. Operations considers that they work well with Engineering, and this area is also considered a strength.

5.2.5. BSC Ability to Define and Effectively Use Interfaces Throughout the YMP Organization

Section Summary

The BSC process and procedures for defining and using engineering interfaces is effective and meets the guidelines in Checklist 1 (Attachment 2). The application of IEDs and IDDs is necessary in engineering design, but these procedures are somewhat complex, and the procedures should be reviewed and the process monitored through self-assessments to identify opportunities for simplification or other process improvements of the controlling procedure.

Detailed Discussion

The definition of interfaces for engineering work, both internal and external to the engineering organization, is critical for ensuring that bases of design are communicated, used correctly in work, properly reviewed by affected organizations, and then managed to meet overall project goals. This function overlaps to some extent with project management, and more than other engineering areas, requires effective interpersonal communication.

The YMP procedures specify and define the required interfaces for the project work, both at the OCRWM/BSC level and within BSC Engineering and Licensing. For example, CC-PRO-2001, *Technical Interface Control*, defines the use of IDDs and IEDs. This is a very important concept to the engineering process. EG-PRO-3DP-G04B-00025, *Engineering Interface Control*, flows down the guidance from CC-PRO-2001, and describes the interfaces with outside agencies.

The use of IDDs and IEDs meets the general guidance in Checklist 1 (Attachment 2), but may be simplified during future revisions. The effectiveness of the IDDs and IEDs should be monitored through self-assessments.

The OCRWM/BSC policy is to stay with the industry body of knowledge wherever possible for their databases (i.e., Electric Power Research Institute) and not depend only on internal DOE sources. The TAD design effort is an example of this, referring to information obtained from the cask vendors.

As an enhancement to the effective design and future operation of the repository, a systematic review and system modeling of the overall spent fuel receipt-handling methodology under the TAD concept should be performed consistent with CD-1. This can be performed with the Total System Model developed by the WMO. This is considered a proactive study by OCRWM to develop planning estimates for how the spent fuel will be moved among the nuclear facilities and to ensure storage capacities are sufficient for continuous processing of TADs and other shipping casks. This study will also help prepare for the eventual repository operating responsibilities that will transfer to OCRWM.

Good communication was observed by BSC in the following areas:

- The interface between the Nuclear Facility Project (NFP) and the Subsurface Project is well defined. For example, it is clear that NFP owns the buildings while the Subsurface Project owns the Transport Emplacement Vehicle (TEV).
- The engineering interface with the LA Project is working well. One author is assigned per section. As an example of the scope of engineering input, Nuclear Facilities identified approximately 900 engineering products required to support the LA.
- Communications continue between peers, but commitments and deliverables are transmitted formally. This is a good practice.

BSC recognizes that there are opportunities to enhance their communications with the Science side of the project. This was discussed in Section 5.1.2 as part of the results from the OCRWM team review.

5.2.6. BSC Ability to Perform Effective Project Management, Including Communication and Control of External Organizations

Section Summary

In a strongly matrixed organization like BSC's, the project management function is an essential focus for ensuring that engineering work is completed consistent with the project goals. When several organizations are working together, such as BSC, OCRWM, and the Lead Laboratory, it is even more critical for project managers to foster teamwork and follow procedures. This section discusses the L&A EPP Assessment Team review of the overall project management function.

The process and procedures for engineering work properly consider the function of the project engineers and the project manager in the conduct of engineering design, consistent with Checklist 1 (Attachment 2). The higher-level organizational process documents describe the goals and objectives for the project management of the YMP.

Detailed Discussion

Project Organization

Engineering and Licensing communicate well in their work towards preparing the LA. The Licensing group functions as project manager for the preparation of the sections required for the LA. The LA is organized into 71 sections. DOE is the principal author of four sections, Lead Laboratory 18 sections, and BSC the remaining 49. LA development is proceeding in four phases: storyboard (completed February 28, 2007), Draft, Final Draft, and Final-Final. The LA addresses Surface Facilities, Subsurface Facilities, Pre-closure, Post-closure, and Programmatic activities.

Project Schedule

There are conventional tools for statusing progress on LA milestones that are in use for YMP. Paramount is the Project Schedule, which is the central tool for tracking completion of critical milestones for the LA.

OCRWM believes they can provide a sound schedule and cost estimate if they have a good technical baseline. A past problem has been establishing a well-defined baseline and then managing the baseline. Control of the baseline is proceduralized, and any change requests are screened through a detailed review process, including Change Control Boards. The current project leaders believe strongly in establishing and maintaining the technical baseline, schedule, and costs and then holding people accountable to meet them.

The schedule milestones are set by the Project with engineering input on product delivery. The percent complete information for engineering products is determined via the Engineering Progress and Performance Report by the EGSs. Products may have different levels of completeness, but still contain an acceptable level of LA information. This particular position is discussed elsewhere in this report (Section 5.2.3).

There are monthly meetings on overall schedule progress, with the OCRWM Program Director's direct reports and BSC EGSs, for surface, sub-surface, and BOP projects. The current version of the integrated schedule was issued in the Fall of 2006, which is considered the Baseline Schedule.

All project work is done to this schedule, modified by recovery plans; however progress is measured against the Baseline Schedule, not the recovery plans.

The recovery plans progress is monitored at the responsible engineer level. An exception is BSC Engineering, where the schedule forecast dates are the recovery plan dates.

Schedule "Ownership" has proven to be one of the cultural changes that has helped the commercial nuclear plants to gain control of scope, cost (resources), and priorities. Plant staff across all groups participate in scheduling and feel strong ownership that they can and will do what is necessary to meet milestones.

This concept of schedule ownership by the YMP team was evaluated by the L&A EPP Assessment Team in interviews and observations of the OCRWM-led Monthly Project Meeting. The results of this subjective evaluation indicate that there does not appear to be a strong uniform culture of schedule ownership, and there is not a unanimous project sense of urgent teamwork toward meeting schedule milestones.

Most interviewees concurred that BSC owns the schedule for meeting the LA products, but ownership for product delivery is perceived by some to be at the General Manager level. Some interviewees consider that the OCRWM Program Director owns the schedule. Others think that different groups own their own parts of the schedule (e.g., Licensing owns it for BSC; Lead Laboratory owns it [presumably for their part]).

A strong culture of "schedule ownership" such that all work is built around a demanding, credible schedule is a critical success factor for any project. Efforts to strengthen this culture should be continued by DOE.

Project Status Tools

The project uses a formal risk management process including a Risk Register. Project Controls owns the Risk Management procedures and the Lead Laboratory participates in the process. The Risk Register underwent a major update as a result of the CD-1 decision.

The schedule status is tracked using conventional project tools, including:

- an established earned value system, reported in a project overview report; the report is presented monthly to the OCRWM Program Director
- progress is measured by completion of sections of the LA and the corresponding number of drawings completed in support of the LA
- BSC EGSs regularly update estimates for projected BSC engineering resources and capabilities and

provide these to the project engineer, the schedule reflects input from all BSC users

- BSC Licensing produces a LA Monthly Report that is effective in providing a good summary of progress, this report is considered a strength
- a monthly project status meeting brings responsible groups together to review schedule progress.

5.2.7. The Ability to Complete the Engineering Organization Inputs for the License Application on the Defined Schedule

Section Summary

The L&A team assessment did not identify any specific issues that would represent a barrier to successful completion of the engineering inputs to the LA.

Several issues require continuing and appropriate management attention to ensure that they are resolved and do not become barriers.

Engineering Support of LA

In the previous sections of the BSC team assessment, above, there were several engineering activities identified that require management attention. These activities are tied to LA schedule milestones, and require effective recovery plans or increased attention to meet the LA submittal date.

These activities are currently identified to the project managers and can be managed effectively to provide support for the LA sections preparation consistent with schedule milestones.

5.2.8. YMP Surface and Sub-Surface Workscope Definition

Section Summary

This section provides a context of the scope of BSC engineering. Based on interviews, the L&A EPP Assessment Team believes that the work scope is well defined with clear responsibilities assigned within BSC Engineering.

Detailed Discussion

The work scope for BSC Engineering is well defined. The safety analysis has provided classifications with respect to Important to Safety (ITS) and Important to Waste Isolation (ITWI) and BSC Engineering is working within the parameters. While there is a potential for changes, this is being accommodated in the work scope using well-defined and appropriate procedural controls.

There are many facilities associated with the “surface” scope of work; some for conventional maintenance support and storage, and some unique to the repository. The BOP facilities are under one project manager, and represent conventional engineering design. Among the significant BOP facilities are:

- Transportation and Receiving Building
- Rail Car and Truck Staging Areas
- Central Control Facility.

The nuclear facilities are under another project manager, and include many SSCs that are ITS or ITWI. The following major surface facilities comprise the Nuclear Facility Project.

- Initial Handling Facility (IHF): This facility is designed to handle naval reactor SNF canisters and DOE HLW canisters. The IHF is capable of placing these canisters into waste packages and transferring the packages via the TEV to emplacement.
- Wet Handling Facility (WHF): The facility is designed to accommodate fuel assembly receipt and canistering, and repackaging of canister fuel from ISFSIs no longer able to off-load and reload the fuel into TADs. The WHF is designed to handle a total of 4,500 tonnes (bare fuel) and 1,500 tonnes in DPC throughput for the life of the project.
- Canister Receipt and Closure Facility (CRCF) No. 1: The facility is designed to receive TADs and canistered waste. There are three identical CRCFs designed to take 90% of the commercial SNF inventory that is targeted to be in TAD canisters and 100% of the DOE SNF (in canisters) and DOE HLW canister inventory.
- Receipt Facility: The Receipt Facility transfers TADS and DPCs from transportation casks into shielded transfer casks or aging overpacks for transfer to the WHF, CRCF, or Aging Facility.
- Diesel Generator Facility: The emergency generator is required to run the active HVAC systems in case of a canister drop, breach, and release.
- Low Level Waste Facility: The building and surrounding area for handling and packaging low level radioactive waste (e.g., high-efficiency particulate air filters; unloaded DPCs; contaminated tools, rags, clothing).

- Aging Pad: This pad is designed to accommodate 21,000 tonnes of heavy metal of commercial SNF.

The L&A EPP Assessment Team did not put primary focus on detailed design issues associated with facilities, unless the issues impacted the engineering organizational performance.

Subsurface Project issues revolve around the Waste Package. The Subsurface Project performs analyses of the Waste Package (with the TAD inside). Analysis of the TAD and other containers is performed by others.

5.2.9. Organizational/Institutional Features

Section Summary

During the reviews, the L&A EPP Assessment Team performed a broad overview of the BSC organization. An important caveat to this section is that the review and comments pertain to Engineering only. For example, the Training comments should not be extrapolated to training for all of BSC. The same is true for the corrective action program and self-assessment process.

Staffing levels have been increasing to support LA preparation. Overtime levels are varied among the different groups, which is to be expected for this type of project. There is an ongoing effort to hire additional staff.

In general the mood of the interviewees was upbeat and positive.

Training of engineers meets accepted standards. Engineering is directly involved in several “continuous improvement” programs including the corrective action program, self-assessments, value engineering, and Six Sigma.

An opportunity for improvement is for BSC to evaluate their current application of the self-assessment program and revise the program appropriately to assure that it focuses on identifying and addressing events with high safety and mission significance.

Detailed Discussion

Staffing

The BSC organization is a matrix organization (Repository Project Management) within a Functional Organization reporting to a General Manager. The General Manager has nine direct reports including his Deputy General Manager. The organization is similar to organizations used by many large companies throughout the United States, and in general it appears to be working very well.

An increase in staffing will be required for the NRC licensing and subsequent start of facility operations. Additional trained people will be required in several areas including operators, mechanics, construction personnel (including QC), and regulatory staff. Competing industry activities may be a problem in future hiring, and OCRWM needs to address this.

BSC (as do the other members of the YMP team to varying degrees) has a staffing challenge in that annual funding for a long-term project leads to uncertainty. While the total YMP mission spans decades, annual Congressional decisions on funding does not support effective long-term planning or job security for employees.

Securing and retaining qualified personnel for the OCRWM program will be a challenge in light of the growing number of other nuclear power projects and the annual funding uncertainties surrounding the OCRWM program. Obtaining multi year program funding should continue to be a high priority of DOE management.

Engineering Functions

The Mechanical Engineering group is organized into three subgroups: Mechanical Handling and Mechanical Systems, HVAC, and Fire Protection. The Mechanical Engineering group within BSC currently has about 50 personnel. Thirty-five report to the Nuclear Facilities Project, ten to the Subsurface Project, and five to the BOP Project. Discipline Engineering is responsible for procedure development.

The Nuclear and Radiological group includes a separate group of radiological engineers who are responsible for performing ALARA reviews, evaluating potential dose reductions. The group produces radiological and contamination zone calculations and drawings (overlay sketches identifying the zones in the specific cask receiving, handling, and transfer buildings). The group supports the licensing efforts by attending daily and weekly status meetings.

The BSC engineering staff, which accesses a database comprised of industry best practices, such as that developed by INPO, is currently at approximately 285 people with a goal of increasing to 335.

Training

Based on our review and on Checklist 1 (Attachment 2), the L&A EPP Assessment Team believes that the engineering training requirements for BSC are consistent with the current best practices in the industry as promulgated by INPO. In fact, some aspects exceed requirements. For example, every engineer is required to perform a supervised calculation to ensure he/she knows the procedure.

Engineering management has been very supportive of training their employees. If an engineer misses a training session, an e-mail is automatically sent to his/her supervisor. Attendance is very good.

Training needs are assessed, and a required course list is established for each group. Training, which takes approximately six months to complete, is tracked by each individual, and engineers who are involved in establishing the training curriculum do not perform unsupervised work until training requirements are completed. Since all groups use the same procedures, training is consistent.

Applicable information on the training program for engineers is summarized below:

- training programs are electronic (approximately 10%) and classroom
- training utilizes the Systematic Approach to Training based training program for guidance
- the training department is stable with little staff turnover
- safety related training must be completed immediately
- continuing training is conducted quarterly and is based on what has changed or lessons learned. It is now done in the classroom.

Calculation training is the result of an Engineering self-assessment. OSA-EG-2007-017, *Effectiveness Review for Condition Report 3235*, which stated:

> "Subsequent to completing the first part of this effectiveness review, Engineering recognized that the corrective actions to Condition Report (CR) 3235 need reinforcement. A hands-on calculation training class was created that includes issues related to transparency and traceability. This is an Engineering management imposed mandatory course for all engineers, although it is still in progress at the time of this assessment. As of February 23, approximately 70% of Engineering and 13% of the PCSA Group have completed the course . . ."

This course requires that the engineer and supervisor attend together, and actual problems are worked on during the training. This format provides instant feedback on the supervisor's expectations to the engineer. The CR completion date for the training of April 2007 was met. The previous course was taught in large classes. The new course is taught in small classes (10-12 students with supervisors present).

The training program is used effectively to help in corrective actions to improve the performance of the BSC engineering organization. Examples of CRs from self-assessments that resulted in some specific training/briefing corrective actions include:

- CR 9576 Self-Assessment Subsurface and Procurement: Self-assessment recommends some training needs. The CR states the same. This training was provided in twelve sessions commencing on January 12, 2007, and concluding on January 29, 2007. A record was kept of the attendees (235).
- CR 8445 Self-Assessment Communications with Design and Engineering 5/31/2006 to 7/21/2006: The Discipline Manager (DM) will conduct briefings with each of his functional DEM and then to their associated staff personnel. The briefing will address the roles and responsibilities as described in the RPM execution plan and the working relationship between DEM and Project Engineers (PE). The briefing objective will be to enhance the knowledge and understanding of the RPM execution plan as it relates to the engineer, DEM, and PE.

Continuous Improvement

The L&A EPP Assessment Team reviewed the Corrective Action Program (CAP) and other process improvements as they pertain to the BSC engineering function. The Engineering Process Improvement Organization is responsible for coordinating the corrective action, self-assessment, lessons learned, value engineering and sustainable development, and Six Sigma programs within the Engineering Organization. The review, which included many discussions with OCRWM, BSC Engineering, Process Improvement, and QA, indicated that the programs in Process Improvement appear to be operating in a satisfactory manner. There are some potential improvements that can make the CAP more effective.

Four to five years ago the YMP had two CAP programs: the Operations and Management Contractor (BSC) and OCRWM. However, the programs were combined, and in 2006, the combined program was reviewed to INPO 0707 guidelines, which established its current direction. Approximately 2000 CRs (which is considered average for a program of this size) are generated each year. These include all levels, with most of them being improvement recommendations. The following are the definitions for the various CR levels from AP-16.1Q, *Condition Reporting and Resolution*.

- **Level A - Significant Adverse Condition:** An adverse condition that, if uncorrected, could have a serious effect on safety, operability, or the ability to isolate waste. Significant adverse conditions also include conditions involving actual or potential consequence that have a serious impact on public or personnel health and safety, the environment, facility operations, or quality.
- **Level B - Adverse Condition:** An inclusive term used to define a problem requiring management attention. Adverse conditions include failures, malfunctions, deficiencies, defective items, and nonconformances.

- **Level C - Minor Adverse Condition:** An adverse condition that involves lesser significance and has minimal effect on the safe and reliable operations of the facility, personnel, or the ability to isolate waste. These include adverse conditions where the cause is known and understood, as well as "Trend Only" conditions.
- **Level D - Opportunity for Improvement:** A condition that does not meet the definition of an adverse condition. This includes conditions that are submitted for internal organizational tracking of actions as well as Trend Only conditions.

The allowed closure times for the CRs are long compared to industry standards. As a result, the program does not benefit consistently from resolving issues for the defined Corrective Actions in a timely manner. Table 2 presents information on CRs closed between July 31, 2006, and June 13, 2007. It is clear that Engineering leads the BSC organization in closing CRs. The time from when the CR comes into Engineering's control (cause analysis and planning) until it leaves the organization (overseeing implementation of the last corrective action), is reasonable.

Table 2. Condition Report Processing

	All BSC		**Repository Project Management**		**Engineering**	
Level	Count	Average Time to Close (Calendar Days)	Count	Average Time to Close (Calendar Days)	Count	Average Time to Close (Calendar Days)
A	2	296	1	303	1	303
B	49	323	9	184	4	202
C	593	133	145	136	51	78
D	680	105	128	81	87	44

The CAP process appears to be rather slow and cumbersome. QA is involved in the closing of all CRs; a CR screen team reviews all CRs; and the Management Review Committee (MRC), which includes the General Manager of BSC, reviews all level A and B CRs. The CR screen team, which requires consensus for a disposition, appears to be inconsistent in its standards for closure, in particular for Level C and D actions. The nature of the process is cumbersome, since reaching a disposition with 10 to 12 people on the screen team with different perspectives, can be difficult.

In an effort to help address the timely closure of CRs and to generally improve the CAP system, CAP users, coordinators, responsible managers, and quality engineers recently submitted a list of suggestions to management for CAP improvements. This is a positive development.

An opportunity for improvement is for the CAP to be further streamlined to reduce times for closing corrective actions.

BSC/OCRWM senior management engagement on the CAP system is considered by the BSC employees to be very good. In addition, the BSC trend program that tracks CRs and causes is considered excellent.

Overall, there is a perception among the project team that while the CAP is improving, it is improving too slowly.

Self-Assessments (GM-PRO-4000)

Self-assessments are performed in the Engineering organization as part of the overall BSC program (GM-PRO-4000). From October 2005 through April 2007 Engineering performed 40 self-assessments. The L&A EPP Assessment Team reviewed 35 of them.

The self assessment conclusions included routine findings, human performance issues, attention to detail, and procedural improvements. There are some non-significant issues. The major assessments have more substance, and it appears from our review that many of the needed improvements are being implemented.

Each self-assessment generated at least one CR. The number of CRs per self-assessment is approximately three. There were no Level A or Level B CRs generated, and only a handful of Level Cs. The number of assessors ranged from one to four, with an average of two to three. The CRs tended to be for clean-up of products, procedure revisions, and communications/training. Each self-assessment started with an assessment plan and ended with a report ranging from 7 to 138 pages (including all tables, supporting information). Assessment techniques included interviews, questionnaires, and product reviews. Each self-assessment report is reviewed and approved by Engineering management.

An opportunity for improvement is for BSC to conduct a review of the current application of the self-assessment program to determine the effectiveness of the findings/recommendations (number of CRs and levels) in identifying mission critical issues.

Level D CRs are opportunities for improvement. Engineering is able to keep the closure time low by completing the CR when the task is planned. For example, CR 8445 and CR 9576 were generated to have some training or briefing to address concerns from two self-assessments. One of the CRs was closed in ten days and a second closed in forty days, while the briefings extended for some weeks. The two we reviewed in detail documented that the briefings were done and who attended.

The conclusions from one self-assessment are noteworthy. OSA-ENG-2006-005, Self-*Assessment of Engineering Requirements Management, Allocation, and Implementation*, stated, “The purpose…was to evaluate the effectiveness of RPM Engineering in managing requirements appropriately, and whether RPM Engineering has been allocating and implementing requirements…” The table below identified as Table 3 is from the self-assessment. The L&A EPP Assessment Team had two observations concerning the self-assessment:

- The version of the requirements document was not found in the self-assessment report. It is essential that the version be identified because the requirement documents are revised periodically.
- This type of self-assessment should be done periodically because the requirements change over time and new documents are issued. As an example, DOE/RW 0425, *Transportation System Requirements Document*, Rev. 4, was issued in October 2006 (after the self-assessment in March 2006). A second document, DOE-RW 0333, *Quality Assurance Requirements and Description*, has been revised twice (June 2006 [effective October 2006] and July 2007) since the self-assessment.

Table 3. Sample Requirements for Evaluation

Requirement Source	# Requirements Allocated to Engineering	# Requirements Trace Completed	# Requirements Sampled	% Requirements Sampled	# Requirements Sampled Acceptable	% Requirements Sampled Acceptable
DOE/RW-0406 (CRD)	13	13	7	54%	7	100%
[a]DOE/RW-0351 (WASRD)	45	0	0	0%	0	N/A
[a]DOE/RW-0511 (IICD)	49	0	0	0%	0	N/A
DOE/RW-0600 (YMP PF&OR)	100	96	5	5%	5	100%
YMP/CM-0025 (YMP-RD)	55	39	2	5%	2	100%
DOE/RW-0333P (QARD)	94	87	5	6%	5	100%
10 CFR 20	13	13	1	8%	1	100%
10 CFR 63	22	17	1	6%	1	100%
10 CFR 72	3	3	1	33%	1	100%
10 CFR 73	32	18	1	6%	1	100%
10 CFR 434	171	168	9	5%	9	100%
[a]10 CFR 835	6	0	0	0%	0	100%
29 CFR 1910	696	201	10	5%	10	100%
29 CFR 1926	1	0	0	0%	N/A	N/A
40 CFR 146	3	0	0	0%	N/A	N/A
40 CFR 262	0	0	0	0%	N/A	N/A
NAC 477	43	26	2	8%	2	100%
DOE O 151.1B CRD 1	1	1	1	100%	1	100%
DOE O 252.1	3	3	1	33%	1	100%
DOE N 413.2	2	2	1	50%	1	100%
DOE O 413.3	3	2	1	50%	1	100%
DOE O 420.1A CRD	101	91	5	5%	5	100%
DOE O 430.1A CRD	3	3	1	33%	1	100%
DOE O 430.2A CRD	4	4	1	25%	1	100%
DOE O 440.1A CRD	4	4	1	25%	1	100%
1DOE O 473.1	19	19	1	5%	1	100%
TOTAL	1486	810	57	7	57	

Notes: [a] Requirement has been allocated to RPM Engineering after January 1, 2006 cutoff date.

5.2.10. General Understanding of Organizing and Flow of Work

Section Summary

The BSC process and procedures for control of engineering workflow are adequate and consistent with the Checklist 1 guidance (Attachment 2).

The documentation of anticipated project specific radiological design bases, including goals for maximum worker radiation dose exposure, and the description of anticipated waste forms needs improvement. One document defining the expected radiological sources during handling, and personnel dose limit goals should be developed and factored early into the design process. If, during the course of design, it is discovered that dose limit goals are exceeded, this information should be communicated to management and the ALARA Committee for resolution."

Detailed Discussion

To ensure that the BSC Engineering organization maintains high quality engineering products, the control tool used is the DRM. It identifies which documents each discipline group and supporting groups need to either review and/or approve. Key members of the staff are also assigned to interface directly with each project. Attendance at the project meetings keeps them informed of ongoing activities. EGSs attend the Plan of the Day Meetings.

Subsurface facility functions are based more on science studies than are the surface facilities that are based on basic engineering and construction practices. The subsurface project has 290 engineering deliverables to support the LA. As of July 2007, they had completed 190 and were on schedule to complete the remainder.

One function that is critical to the flow of work is the radiological analysis. This function is performed by a dedicated group in the BSC engineering organization, responsible for analysis of source terms from the waste stream; shielding for pre- and post-closure sources; radiological effects for field operations of the design (including ALARA considerations); producing radiation zone drawings for areas, buildings, and evolutions; coordinating with HVAC design; and interfacing with Licensing for the LA. This group has a close interface with the Manager of Operations to define operability concerns. They also work with Operations relative to the ISMS process, although Design Engineering determines project hazards. Design basis radiological information has been maintained by OCRWM for years, and is considered better than industry power plant data for spent fuel work. There are several examples in this area where improvements can be helpful.

There is not currently a single document which defines a list of all waste sources and forms. Because of the broad range of storage containers that will potentially come to the repository, the radiological analyses must use worst-case assumptions in their dose calculations for shipping containers.

One design basis document defining the expected radiological sources and one document containing the personnel dose goals and limits should be developed as soon as possible.

The L&A EPP Assessment Team considers that the BSC engineering organization maintains procedures and interfaces that are effective in establishing the flow of work, consistent with the guidelines of Checklist 1 (Attachment 2). In some cases, internal processes and project interfacing supplement this control.

Attachment 1

Longenecker & Associates Engineering Processes and Procedures Assessment Team

Donald Prigel	L&A, Assessment Team Leader
Raymond Crawford	L&A, Group Leader
Ralph Phelps	L&A, Group Leader
James Zach	L&A, Group Leader
Douglas Chapin	MPR Associates, Inc.
Alvin Clegg Crawford	L&A
Mark Dehring	Fluor Corporation
Robert Prieto	Fluor Corporation
Gary Tjersland	NAC International

Attachment 2

Assessment Checklist

INTRODUCTION

The overall engineering assessment is guided using three detailed checklists that are synthesized into lines of inquiry checklist**.**

The **Lines of Inquiry Checklist** provides a convenient, standardized baseline for the three assessment teams to direct their procedural reviews and their personnel interviews. In particular, many of the engineering and project management functions for the repository will be performed by different responsible groups, using the same, or similar, procedures and training. By establishing lines of inquiry for the assessment teams, common threads in the organizations can be readily identified, and the areas for more comprehensive inquiry identified. The detailed checklists can then be used to assist in exploring the extent of any issues, including interface or process functions. The results of the lines of inquiry assessments can also be used by the three teams to perform an overall repository project functional evaluation.

The **Lines of Inquiry Checklist** and the three detailed **Checklists** are described as follows:

Lines of Inquiry Checklist is a high-level summary roadmap created from the major topical categories of the detailed checklists, with a few additional qualitative and broader-scope questions included. This format allows many topics to be addressed in a free-flowing format, so that a review can be focused on those functional areas specific to the group being reviewed, and areas for further inquiry identified.

Checklist 1 is generic and can be used both for DOE OCRWM procedurally controlled engineering functions, and for contractor (e.g., BSC) and subcontractor procedurally controlled support functions.

Checklist 1 is intended to apply to the engineering performed for the licensing and operation of the repository, and can be used to assess engineering processes and procedures for above and below ground design and construction, receipt and handling equipment design of approved containers, design of storage systems, engineering project management, and related engineering activities.

Checklist 2 is designed to test, by staff interviews and by document reviews, the organizations' knowledge and understanding of the processes and procedures, and the level of training received on these procedures. The information determined through application of **Checklist 1** is the basis for the interviews in **Checklist 2**.

Checklist 3 is designed to test, by review of specific completed (or possibly, in progress) engineering design products, whether the engineering design processes and procedures from **Checklist 1** have been applied effectively, completely and correctly in the responsible organizations' work.

In summary, this approach serves as the high-level road map to find answers to meet the needs of DOE Office of Civilian Waste Radioactive Waste Management. The lines of inquiry are supported by the detailed checklists.

Lines of Inquiry Checklist

1. Is the organizational hierarchy mapped to functional activities?

2. Is there appropriate configuration management for the mission work?

3. Is there appropriate document control for the mission work?

4. Is there ongoing risk assessment for the mission work?

5. Is there a documented Design Basis for the repository?

6. Is there a documented licensing basis based on regulatory and contractual requirements and does it flow down into lower tier documents?

7. Is there a documented list of common assumptions for design and licensing?

8. Is there a design/licensing reconciliation?

9. Is there a Quality Assurance Program in place for Engineering Design work on the repository?

10. Is there a process or procedure in place that clearly defines the interfaces for engineering work?

11. Do the engineering processes and procedures incorporate an ISM System in accordance with DOE requirements?

12. Is there a process and/or procedures in place to describe the overall engineering project management for the repository?

13. Are the appropriate procedures in place for performing engineering design?

14. Is there an engineering-support training program in place that meets requirements and prepares the staff to produce quality products that meet requirements?

15. In your organization (BSC/DOE), are there good practices that should be commended and/or weaknesses that should be addressed?

16. What are the strengths and/or weaknesses of DOE/BSC? (Ask each to comment on the other.)

Overview: CHECKLIST 1 – Assess Engineering Processes and Procedures

The scope of **Checklist 1** specifically addresses NRC regulated engineering requirements, and the principles used are based on good engineering practices currently in use at NRC-regulated nuclear power facilities.

Checklist 1 is separated into three parts, representative of the essential elements for performing regulated engineering work:

Part 1 examines whether the organizational infrastructures are in place to support and perform the engineering project management work and the engineering design work necessary for the LA.

Part 2 examines whether the responsible organizations and their infrastructures have the appropriate and necessary engineering (and if appropriate, engineering project management) procedures in place to perform the engineering support work for the LA.

Part 3 examines whether the responsible organizations have in place the necessary staff and supervision training requirements and controls to ensure that the engineering work can be effectively performed within the infrastructure using the engineering processes and procedures.

CHECKLIST 1 – Assess Engineering Processes and Procedures

Part 1 – Is the infrastructure correct and in place for performing engineering work?

The infrastructure is defined as those work management processes and their supporting organizational functional units necessary to ensure that the performance of engineering project management, engineering design and the supporting engineering analyses meets the requirements.

The mission work of OCRWM (that is addressed in this assessment) is to identify the functional and operational requirements for the repository, consistent with all applicable regulations, to establish and maintain the technical baseline for the repository, and to provide, using contracted services, the engineering, and other technical services to establish and maintain the repository design and licensing bases. The mission directive to be implemented by BSC, as engineering contractor, is to effectively execute the engineering design, under approved and licensable design bases and criteria, using approved processes and procedures for the engineering work.

A. Is there appropriate configuration management for the mission work?

Configuration management ensures consistency is maintained among the design requirements, the physical repository configuration, and the repository configuration documentation.

1. Is there a process to integrate current science?
2. Is there a process to integrate all aspects of the project including transportation?
3. Is there a process to identify and document the design basis, the design criteria, design changes, non-conformances, licensing requirements, and other applicable regulatory and contractual requirements?
4. Is there a process to evaluate alternative options prior to establishing a design?
5. Is there a process to select and approve the best solution from the alternatives evaluation?
6. Is there a process to change design requirements?
7. Are there processes to generate and/or revise calculations and analyses?
8. Is there a process for peer reviews and for independent reviews?
9. Is there a process to change the authorization basis?
10. Is there a process to change the safety analysis report?
11. Is there a procedure to include relevant scientific information in the design basis?
12. Is there a process in place for changing the physical configuration?

   a. Engineering Design activities?
   b. Document Controls?
   c. Materials controls?
   d. Construction controls?

13. Is there a process to change repository configuration information?
    a. Can required design information be identified and retrieved?
    b. Is there a process for review and approval of design documentation?
    c. Is there a process for controlling drawing changes and updating drawings?
    d. Is there a process for calculations and analyses reviews and independent reviews?
    e. Is there a process for Document Control that includes unique document identification, document review and approval, and the required review and approval authorities?
    f. Is there a central Records Management Facility, or equivalent records storage location?
    g. Do Records storage locations meet requirements?
    h. Is there a user-friendly procedure for search and retrieval of repository engineering design and design bases information?

B. Is there a documented Design Basis for the repository?

Design basis is the high-level functional requirements, interfaces, and expectations for the repository based on regulatory requirements or analyses.

Design authority is the organization responsible for establishing the design requirements, for design control and technical adequacy of the design process.

1. Are there organization charts which clearly show the functional responsibilities of the OCRWM?
2. Are there organization charts that clearly show the functional responsibilities of the design-engineering contractors?
3. Is there an overall repository technical interfaces flowchart or equivalent?
4. Has a management hierarchy been established and documented, including the design and licensing authority?
5. Is there a requirements document and/or a procedure to add to or update requirements based on regulatory reviews?
6. Is there a requirements management plan for control of the licensing and engineering design bases?

7. Is there a design bases document or composite document for each functional requirement of the repository?
8. Is there a procedure or document to define the relationship among the repository functions of packaging, transportation, receipt, and underground storage?
9. Is there a procedure or process for establishing and documenting the design bases/criteria for operation and closure of the repository?
10. Is there a procedure to perform and document the classification of systems, structures, and components?
11. Is there a procedure or process to model the principles of probability and risk assessment for the repository?
12. Is there a PRA model for the repository so that the design bases, design criteria, and alternative evaluations are risk-based?

C. Is there a documented licensing basis based on regulatory and contractual requirements and does it flow down into lower tier documents?

Licensing basis is regulator-approved (NRC) authorization basis information.

Contractual requirements may exceed or supplement regulatory requirements. They may incorporate specific cost effective or waste generator options as part of the repository design and operation.

1. Is there a process to ensure that the engineering design basis documents are traceable to the requirements?
2. Is there a process or procedure to ensure that the safety analyses are appropriate and correct for the engineering designs?
3. Are there definitions for safety-related and important-to-safety systems, structures and components, and if so, do the engineering processes and procedures reflect them?
4. Is there a documented agreement with the regulator as to what information is essential to the licensing process?
5. Is there a requirement to use NUREG-1804, Revision 2, in the engineering design and technical development of the repository?
6. Are there controls in place to assure the engineering information that is provided to the regulator is reviewed, approved at appropriate levels and controlled?
7. Is there a procedure for controlling superseded information, which includes identifying current issues and removing or clearly marking superseded issues?

D. Is there a Quality Assurance Program in place for Engineering Design work on the repository?

1. Do the engineering processes and procedures appropriately reference quality assurance requirements?
2. Is there an active process to address condition reports?

E. Is there a process or procedure in place that clearly defines the interfaces for engineering work?

1. Interfaces among the flow of documents required for engineering design?
2. Interfaces among the functional groups performing the design?
3. Interfaces among the required reviewers?
4. Interfaces among design, construction, and testing?
5. Interfaces with those responsible for design, those regulating design, and those waste generators using the repository?

F. Do the engineering processes and procedures incorporate an ISM System in accordance with DOE requirements?

1. Is there an overall policy or process for describing how ISMS is addressed?
2. Do procedures address personnel safety, radiation protection safety requirements and environmental protection considerations as appropriate?

G. Is there a process and/or procedures in place to describe the overall engineering project management for the repository?

1. Is there an organizational chart that clearly shows functional relationships and responsibilities?
2. Are there corresponding functional and organization charts for contractor (BSC) and subcontractor organizations?
3. Are the specific engineering project responsibilities and authorities clearly specified in process and/or procedures for the responsible organizations?
4. Are the engineering project interfaces clearly established and proceduralized? This includes required interfaces for mission work both within OCRWM, BSC, subcontractors, and other DOE or supporting government agencies having a responsibility for some aspect of repository engineering work.
5. Is there a process for ensuring that budget requirements for specific engineering work are coordinated with overall mission budget planning and authorization?
6. Are processes and procedures in place for project managers to use for engineering work planning, schedule including use of milestones, and earned value controls?

7. Are procedures in place for engineering project status reports?
8. Do the functional organization charts clearly show the lines of communication required by all groups responsible for engineering mission work?
9. Are review and approval requirements for engineering work proceduralized?
10. Is there a single point of contact between OCRWM and the regulator for making repository engineering commitments?
11. Is there a procedure for ensuring regulatory commitments are documented in the design and licensing bases (that is, a commitment management system)?

Part 2 - Do the responsible organizations and their infrastructures have the appropriate and necessary engineering procedures in place to perform the engineering support mission work and directives for the LA?

The processes and procedures for effective engineering design work at NRC regulated facilities are considered facility design development, or facility design changes. These procedures require definition of design requirements, development of design bases, establishing design criteria, setting functional requirements and margins, performing the design, including analyses, calculations, a very detailed system interactions review, design reviews, independent reviews, and specifying test acceptance criteria.

The engineering design process also requires as applicable, performance of safety analyses to verify design acceptability, defense in depth concepts, and failure modes and effects analyses. Consequences of specified design bases events and operational transients must be analyzed and shown acceptable. A probability and risk assessment model is used to evaluate the bounds for safety and design requirements.

A. Are the appropriate procedures in place for performing engineering design?

1. Is there a master, or process control procedure, in place to describe the specific engineering design methodology to use for an identified engineering design change, analysis or calculation?

   It is prudent to employ a grading process for specific engineering tasks, since certain activities may not require the maximum levels of design review. However, such a grading process must include the specific criteria for assigning a task to a specified engineering design methodology, and there must be a specific procedure for performing the methodology selected in the grading.
2. For each engineering design methodology allowed for repository work, is there a process description that clearly describes the procedural steps, reviews and approvals required?
3. Is there a procedure in place requiring a documented design basis for the engineering work to be performed?
4. Is a procedure in place to perform a preliminary scope of engineering work (or equivalent) based on the “design basis”?
5. Does the scope of work include:
   - Reference to all required and appropriate procedures?
   - Specific engineering design methodology to be used?
   - Design criteria?
   - Design assumptions?
   - QA interface and requirements?
   - Safety analysis requirements?
   - System interaction requirements?

- Probability and risk assessment evaluations?
- Configuration control?
- Operation and maintainability criteria?
- Environmental, health and safety criteria?
- Test and performance acceptance criteria?

6. Is there a procedure in place to ensure that the safety basis established for a specific engineering task is consistent with requirements in the safety analysis for the LA?
7. Is there a procedure in place for performing safety evaluations for engineering work in accordance with the requirements of 10CFR50.59?
8. Is there a procedure in place to perform engineering analyses and calculations?
9. Is there a procedure in place for documenting use of engineering judgment?
10. Does the procedure for engineering calculations and analyses require engineering reviews, independent reviews, and peer reviews as applicable to the specific work?
11. Is there a procedure or industry standard referenced for performing independent and peer reviews?
12. Is there a process or procedure in place that requires and specifies the configuration control of all engineering design, including supporting analysis and calculations?
13. Is there a document review and approval matrix procedure which clearly specifies the functional responsibilities for engineering design documentation?
14. Is there a procedure to ensure that all regulatory requirements and licensing criteria for the specific engineering task have been established, documented and approved by NRC?

After a scope of work has been developed that meets the licensing or contractual requirements, and has been reviewed for correctness, cost and schedule, the specific work can be authorized to proceed into the final engineering design stage. The final engineering design must be procedurally controlled to ensure that the design will meet the design and safety bases and criteria, the repository configuration information will be updated correctly to match the design, and that the design will be correctly installed in accordance with the engineering requirements.

The final engineering design process has essential elements which ensure that work proceeds in an orderly and documented fashion. The commercial nuclear plants use a design change package (DCP) which relies heavily on checklists for each stage of the work; however checklists are not a requirement. The completed DCP is also an effective way to maintain configuration control.

The following assessment items are associated with a final engineering design package, which may include analyses, calculations and probability-based safety assessments.

15. Is there a procedure, and/or supporting procedures in place for development of a final engineering design package (or equivalent) that includes the following attributes:
    a. The specific methodology to be used for configuration management?
    b. Safety analyses performed with acceptable results?
    c. Clear definition of design bases and design criteria?
    d. Verification and/or concurrence with all engineering design input assumptions?
    e. Industrial and personal safety and OSHA criteria?
    f. Probabilistic risk assessment outcomes?
    g. Appropriate quality levels assigned to systems, structures and components in the engineering design?
    h. Cost and schedule tracking systems established?
    i. Industry and other applicable engineering standards specified?
    j. Multiple, discreet steps are used in the engineering design evolution? This typically requires a 10 percent, 50 percent, 90 percent, and final design review by the review team.
    k. Assign a multi-discipline design review team based on the scope of the specific engineering work?
    l. Conduct independent and/or peer reviews of specific design calculations or resolutions?
    m. Specify and conduct system interaction reviews? This typically includes topical areas such as seismic design, external events (wind loads, flooding, etc.), fire, high energy line breaks, environmental qualification, etc.
    n. Are there specific procedures that describe the requirements for each type of system interaction, according to the regulations?
    o. Specify and conduct failure modes and effects analyses?
    p. Prepare materials specifications?
    q. Evaluate constructability and transient safety concerns?
    r. Establish test acceptance criteria?
    s. Engineering drawing change verification?
    t. LA change review and approvals if required?
    u. Provisions are established for tracking the design change through to completion and recording?

16. Is there a procedure in place for constructing or installing the engineering design change package?

    The engineering design change package is not the document which describes how the construction or installation work is to be performed for the repository. A specific work package must be developed and controlled using a specific procedure, which incorporates the principles of ISM, including environment, health, and safety.

17. Are there procedures for field installation standards to be employed at the repository?
18. Are there procedures for testing and operability verification?
19. Is there a process or procedure for engineering change installation closeout and final acceptance?
20. Is there a process or procedure for maintaining communication of status and/or changing requirements among BSC and OCRWM project managers and the responsible engineering and construction managers for engineering design changes?

Part 3 - Do the responsible organizations have in place the necessary staff and supervision training requirements, controls and procedures to ensure the engineering work can be effectively performed within the infrastructure from Part 1 and using the engineering processes and procedures from Part 2?

One of the quality assurance requirements for regulated facilities is to have a demonstrable training program for staff supervising and performing engineering design work. Most commercial nuclear facilities meet this requirement by following the engineering training program established by INPO.

The INPO program is based on five principles: analyze the training needs based on job task analyses, design the content requirements for the training, develop the training courses and materials, implement the training, including records, and then evaluate the results of the training and adjust as necessary.

The entry conditions for the program are a Bachelor's degree in an engineering or related science discipline.

Personnel may not perform unsupervised (independent) engineering work until they have completed the required training for the specific task.

A. Is there an engineering support training program in place that meets requirements?

1. Is there a program basis document or procedure (Training Master Plan) in place that describes the engineering training requirements?

2. Is there a training matrix in place for each engineering group, including contractors and subcontractors, for verifying individual training requirements and status of certification?
3. Are the engineering training program and procedures in use consistent with or based on INPO requirements or equivalent DOE requirements?
4. Are individual training qualifications readily available to each engineering supervisor?
5. Are individual training records up to date?
6. Is there a central training organization(s) with a computerized data base for tracking status of training?
7. Is there an effective engineering mentorship program in place for on the job requirements?
8. Is there a procedure or program that requires continuing training for engineers, and is the continuing training based on performance analyses?
9. Is training used as a mitigating tool for deficiency reports and corrective actions?

This completes **Checklist 1** for assessing Engineering Processes and Procedures. The checklist concept is dynamic, and items may be added or changed based on outcomes during the assessment process, or based upon feedback or interview results.

The reference materials for executing **Checklist 1** are those procedures, organizational charts, and desk instructions supplied by OCRWM and BSC.

The **Checklist 1** evaluations do not address the correctness or completeness of specific materials prepared to support the license application. The assessment under **Checklists 1** and **2** is designed to examine the processes and procedures and the staff and contractor readiness to perform the engineering work necessary for preparing and supporting the contents of the license application. The review of specific products under **Checklist 3** is designed to evaluate how well the processes work. Recommendations for improvement will address both compliance and content issues as applicable, but will not attempt to correct the content of the engineering work packages.

Overview: CHECKLIST 2 – Assess Engineering Staff

The scope for **Checklist 2** is to perform a qualitative assessment of the readiness of both OCRWM and BSC, engineering supervision and staff to effectively implement the processes and procedures developed to support the repository license application and to perform the engineering and construction work to meet the requirements.

The reason this assessment is qualitative is that interviewees are not expected to have rote responses to questions. Rather, the questions are structured to prompt discussion of the subject topic and to allow each respondent to express both positive and negative aspects of both his experience and the effectiveness of his role with the overall engineering team.

This discussion-level response allows identification of trends in the organization performance, as well as identification of specific issues. It also promotes identification of areas for improvement, and areas that might need immediate attention.

The discussion approach to interviews creates a more relaxed environment; we do not want anyone to feel they are being "tested" but rather that they are being given an opportunity to demonstrate the effectiveness of their part in a project of critical importance to the nuclear industry.

The approach for **Checklist 2** is essentially to follow the broad threads from **Checklist 1** regarding processes, then for specific areas, such as design reviews, probe deeper into the application of the procedures relating to the execution of the process. This will also reveal information on the inner workings of the organizational structure and how smoothly it is actually functioning.

CHECKLIST 2 – Assessment of Engineering Staff

PRECAUTIONS:

The following precautions apply to the use of **Checklist 2**:

- The list of questions is very long. Every question need not be discussed with every interviewee.
- Not every question applies to every interviewee. Some questions are more important for supervisory and management personnel.
- Many questions may be answered by referring to and using steps from the approved procedures. This is desirable for some questions.
- Some questions may appear to be repetitious, but in discussing the issues, different aspects of the processes can be examined.
- If the course of interviewing reveals that a specific topic, process or procedure requires either more or less investigation, the discussion questions can be modified or not discussed as appropriate.
- When evaluation of responses reveals a trend relevant to engineering effectiveness, emphasis should be placed on discussing the specific questions to clarify the issue.

Part 1 – Questions pertaining to knowledge and use of the infrastructure

1. What is your understanding of the overall mission for engineering support of the repository?
2. What is your understanding of the mission and goals for your specific engineering support function?
3. Are the functional relationships of the engineering and project organizations clearly described?
4. Do you feel that the required interfaces in the overall organization are clearly described? (This includes TAD cask design, transportation, etc.)
5. Is communication effective within the overall design and project engineering organizations?
6. Is communication effective among the various groups, such as projects, licensing, transportation, etc., with whom project and design engineering interfaces?
7. Describe your understanding of how the overall project management works with the engineering functional organizations to ensure goals and schedule milestones are met and reported.
8. Describe your understanding of how the overall engineering organization's required resources are communicated and met?
9. Describe your understanding of the decision-making individuals and their functional positions in the organization for:

- Approvals of the various engineering support products.
- Approvals for changes to the design or licensing bases
- Binding agreements with the regulator (NRC), i.e., commitments
- Approvals to proceed with design changes
- Acceptance of design change implementation and test results.

10. What is your understanding of the DOE generic guidance on an ISM System?
11. What is your understanding of design engineering's participation in the field implementation (construction) and testing of engineering products?
12. Is there a strong implementation of quality assurance in applicable engineering products?
13. Describe how configuration management is achieved for the various engineering products? This question is directed towards the big picture, the flow of documents and their storage and retrieveability. The review and approval process is addressed in the questions on design change packages.
14. Who (functionally) owns the documented design basis for the repository?
15. Who (functionally) ensures that the information in the LA matches and is supported by engineering analyses and designs?

<u>Part 2</u> – Questions pertaining to the application of procedures for engineering work

1. Describe how the scopes of engineering support work for the various aspects of the repository are defined and integrated (e.g., above ground, below ground, facilities, etc.).
2. What are the different design engineering tools available for specific tasks on the repository (e.g., design change package, substitute part, part dedications, etc.)?
3. Do you use a specific work plan for developing an engineering product (e.g., scope of work document)?
4. When do you use peer reviews?
5. When do you use inter-discipline reviews?
6. When do you use independent reviews?
7. Describe your understanding of the requirements for engineering document review and approval, and where you would find them?
8. Describe how you would seek out, review and incorporate relevant scientific information in the engineering support products?
9. Describe how input assumptions to engineering products are approved, documented, and communicated.

10. Describe the process to maintain configuration control during overlapping design engineering tasks (i.e., when interfacing projects are being designed at the same time).
11. Describe the process for obtaining required reviews and approvals on the various engineering products.
12. Describe the process for performing and approving a safety analysis or 10CFR50.59 evaluation when required for an engineering work product (e.g., modification or analysis).
13. This is a very broad question, and should be discussed using the applicable procedures as necessary: Describe the overall process for a repository modification or design change. (**Checklist 1**, **Part 2**, **Question 14** may be used as a guideline for discussion.)
14. Are you required and/or encouraged to make use of industry standards for engineering support work?

Part 3 – Questions pertaining to training and readiness for work

1. Do you consider that you are trained and qualified to perform independent engineering design and analyses for the repository?
2. What training have you received relevant to your engineering support work on the YMP?
3. If you supervise support staff, how do you verify training qualifications?
4. If you are responsible for contractors, or if you are a contractor, how do you ensure workers are appropriately trained?
5. Do you use pre-job briefings?
6. Have you received any continuing or refresher training for engineering or project work?
7. Have you received any teamwork training?

This completes **Checklist 2** for assessing the knowledge and readiness of OCRWM engineering support staff and BSC, engineering support staff to perform engineering support tasks for YMP.

The reference materials for **Checklist 2** are the processes and procedures identified and provided by OCRWM and BSC, and any procedures subsequently identified through execution of **Checklist 1**.

Overview: CHECKLIST 3 – Review of Engineering Work Products

The scope for **Checklist 3** is to select several relevant engineering work products from both OCRWM and BSC, either completed recently, or currently being completed and with substantial progress, and perform an evaluation of how effectively they implement the processes and procedures established for performing engineering support work on the repository. These engineering work products should include analyses, calculations and design changes or modifications

The objective for this evaluation is to examine how effectively the procedural requirements examined in **Checklists 1 and 2** are implemented. The review approach will incorporate appropriate guidance in ANSI N45.2.11 – 1974 for design engineering, and NUREG-1055 for design and construction of nuclear power plants, and other relevant industry guidelines. The **Checklist 3** evaluation is not a quality assurance check and is not a comprehensive review of licensing requirements and commitment identification.

For engineering products that are to be used in support of the LA, including safety analyses, it is expected that verbatim compliance with procedures is used. An indicator of a negative trend would be extensive application of deviation requests from procedural requirements.

Checklist 3 is constructed to be very simple in concept. The experience of the evaluator in performing, reviewing, and implementing engineering products is a significant contributor in the actual direction of the product review. It is not the intent of **Checklist 3** to evaluate every application of procedural requirements to the work, but to verify strategic sections where experience has shown that use of inadequate procedures or not following procedures can result in safety, configuration or constructability problems.

If, in the course of performing the reviews in **Checklist 3**, a non-conformance is identified in a quality affecting engineering product, this will be documented and reported in accordance with requirements.

CHECKLIST 3 – Review of Engineering Work Products

For each selected engineering work product:

1. Is the format and content selected for the engineering work product appropriate for the task?
2. Are the requirements specified?
3. Is the design basis defined?
4. Are the design criteria identified?
5. Has a safety analysis been performed?
6. Is the product representative of the task requirements in the LA?
7. Have necessary interface requirements been defined and performed?

8. Have all relevant system interactions been evaluated?
9. Has relevant scientific information been appropriately evaluated and included?
10. Have the systems, structures, and components been appropriately classified?
11. Has risk assessment modeling been performed?
12. Has the appropriate quality assurance level been defined?
13. Does the modification or design change address personnel safety, radiation protection, and environmental considerations?
14. Are input assumptions clearly specified?
15. If the product selected is a modification or design change package, have the applicable steps in the relevant procedure(s) been implemented? In particular:
    a. Verification of assumptions
    b. Engineering design reviews at multiple stages of the design, with comments resolved and/or incorporated
    c. Independent or peer reviews
    d. Failure modes and effects
    e. Materials specifications
    f. Constructability reviews
    g. Test acceptance criteria
    h. Appropriate overall reviews and approvals
    i. Document updates and revisions
16. If the product selected is a quality affecting calculation or engineering analysis, has the procedure been followed verbatim?

This completes **Checklist 3** for assessing the implementation of engineering processes and procedures into engineering work products.

The reference materials used for the evaluations performed for **Checklist 3** are the processes and procedures identified and provided by OCRWM and BSC, and any procedures subsequently identified through execution of **Checklist 1.**

Attachment 3

Assessment Methodology

OCRWM (TEAM 1)

The assessment of OCRWM responsibilities and performance was assigned to a single team that was supplemented, as appropriate, by other team members assessing either the surface or the subsurface facilities. This proved to be an effective methodology for introducing different viewpoints into the assessment process, and enhancing our overall understanding of the activities, responsibilities and accountability between OCRWM and BSC. This team assessed activities of the following OCRWM Offices: Office of the Chief Scientist; Office of the Chief Engineer; RAO; and the WMO. The team did not interview persons or review procedures specific to the following OCRWM offices: Infrastructure Management, Office, Yucca Mountain Site Operations Office, Office of Logistics Management, Disposal Operations Office, or the Lead Laboratory. The OCRWM Staff work to the same procedures regardless of task, and the information flow across interfaces uses the same process and procedures for everyone. The product reviews and team interviews confirmed this. Consequently, the discussion of observations in this section applies only to those offices of the OCRWM organization assessed. The other portions of the OCRWM organization are not within the scope of this assessment.

The assessment reviewed the functional interface with the Lead Laboratory (Sandia National Laboratory (SNL)), who has responsibility to establish scientific input information to the post-closure Basis of Design for certain structures, systems, and components. It should be noted that personnel from the Lead Laboratory were not interviewed as part of this assessment. BSC is the design authority and has the overall responsibility for the design and construction of the repository, which includes both subsurface and surface facilities, and the pre-closure safety analysis.

Initially, Checklists specifically designed as guidance for evaluating engineering organizations were developed. These checklists are provided in Attachment 2. Using the Checklist guidance, the L&A team reviewed the engineering processes and procedures provided by BSC and OCRWM. This review identified procedural and organizational areas for further evaluation. In addition, using the organizational charts supplied by BSC and OCRWM, an initial list of personnel was developed for the first round of interviews. The procedure reviews were used to identify areas where interviews would provide clarifying information, and the Checklists were used to help guide the line of questioning. The list of those interviewed is provided in Attachment 6.

Following the first round of interviews, the L&A team discussed results, and identified potential strengths, weaknesses, and trends. These discussions led to requests for additional procedures and documents for review and established the direction for the second round of interviews, which were conducted on June 11 to 13, 2007. The list of those interviewed during the second round is also provided in Attachment 6. Staff of the WMO were interviewed June 27, 2007.

The OCRWM organization assessment considered the following topical areas:

- The ability to execute effective configuration management;
- The ability to review design engineering products;
- The ability to define, and effectively use, interfaces throughout the OCRWM organization;
- The ability to perform effective Project Management, including management of the two-way flow of information across interfaces; and
- The ability to complete review of the engineering organization inputs for the LA on the defined schedule.

The outcome of this assessment of the OCRWM engineering function uses the above five topics in the broadest context of flow of work, flow of information, people capabilities, and accountability for quality work.

BSC ENGINEERING ASSESSMENT (TEAMS 2 AND 3)

The assessment scope for the surface facilities (Team 2) evaluated the BSC engineering organization, its engineering processes and procedures and the interfaces with OCRWM for the Nuclear Facilities and the Balance of Plant Projects. The assessment also reviewed the functional interface with the Lead Laboratory for scientific studies, SNL, who has responsibility to establish input information to the Basis of Design for certain structures, systems, and components. BSC has the overall responsibility for the design and construction of the repository, which includes both subsurface and the surface facilities.

For purposes of this assessment, BSC responsibilities were assigned to two teams, one for surface and one for subsurface facilities. However, there proved to be total commonality in the processes and procedures used for engineering design and analyses and for interfacing for all repository facilities. The personnel involved in engineering design are administratively assigned to a BSC DM, but functionally report to a BSC project engineer for task assignments. The discipline engineers are all trained to work to the same procedures regardless of task, and the information flow across interfaces uses the same process and procedures for everyone. The product reviews and team interviews confirmed this. Consequently, the discussion of observations in this section applies generically to the BSC engineering organization.

The surface facilities include both the Nuclear Facilities and the BOP facilities. The Subsurface facilities include the storage locations, access to them and the equipment for canister handling and placement.

Initially, Checklists specifically designed as guidance for evaluating engineering organizations were developed. These checklists are provided in Attachment 2. Using the Checklist guidance, the L&A team reviewed the engineering processes and procedures provided by BSC and OCRWM. This review identified procedural and organizational areas for further evaluation. In addition, using the organizational charts supplied by BSC and OCRWM, an initial list of personnel was developed for the first round of interviews. The procedure reviews were used to identify areas where in-person discussion would provide clarifying information, and the Checklists were used to help guide the line of questioning. The list of those interviewed during the first round on May 21 – 23, 2007 is provided in Attachment 6.

Following the first round of interviews, the L&A team discussed results, and identified potential strengths, weaknesses, and trends. These discussions led to requests for additional procedures for review and established the direction for the second round of interviews, which were conducted on June 11 – 13, 2007. The list of those interviewed during the second round is also provided in Attachment 6.

The BSC engineering organization evaluation outcome is discussed using five topical areas, as follows:

- The ability to define and use design bases, and to execute effective configuration management;
- The ability to perform design engineering and make design changes;
- The ability to define, and effectively use, interfaces throughout the YMP organization;
- The ability to perform effective Project Management, including communication and control of external organizations; and
- The ability to complete the engineering organization inputs for the LA on the defined schedule.

The outcome of the evaluation of the overall YMP engineering function uses the above five topics in the broader context of flow of work, organization and people capabilities, and alignment and assessment of work.

Attachment 4

Observations of OCRWM Offices other than the Office of Chief Engineer

Office of Regulatory Authority

The RAO manages all aspects of the LA development and defense including the preparation, submittal, and defense of the LA. The RAO is supported by other entities within the OCRWM organization, including BSC, OCE, and OCS. The OCRWM organization is projectized to accomplish this objective. The task leader for this projectized management approach is from the OCE and reports directly to the RAO Director. The LA Management Plan (YMP/04-01, Rev 04, ICN 0, dated February 2007) reflects the projectized management approach for incorporating CD-1 and the LA Conceptual Design Reports into the LA and supporting documents. Relevant lessons learned and process improvements from developing previous LA drafts were also incorporated into the project management approach. The LA management plan is the principal YMP communication tool to LA authors and reviewers concerning the process by which the LA should be prepared

OCRWM will eventually become the Licensee for the YMP. To do so, the RW-6 organization RAO plans to fill about 18 new positions.

The RAO has separate specific tasks with BSC and the Lead Laboratory to support LA development. Through the contract, the RAO Director has charged BSC with the responsibility to obtain required LA support from the Lead Laboratory, because BSC was previously in charge of all science work with the National Laboratories, and has incentives to submit an acceptable LA on schedule.

The RAO established a group that functioned as an IPT under the direction of the Task Leader (from the OCE) to develop a License Application Management Plan (*Management Plan for Development of the Yucca Mountain License Application,* YMP/04-01, REV 04, ICN 0, dated February 2007) to assure that the LA is developed in sufficient technical and design detail (letter CCU.20061003.0014 to Mark H. Williams; Director, RAO, from Richard M. Kacich, Manager, Licensing and Nuclear Safety, dated September 29, 2006), it is technically correct, the design meets applicable regulatory requirements and it is submitted on schedule. The IPT consists of OCRWM (including engineering), BSC (including engineering), Lead Laboratory, and Legal Counsel Staff dedicated to the generation of Safety Analysis Report Sections, and review of assigned sections of the LA Safety Analysis Report. The IPT Leader has regularly scheduled meetings, tracks defined performance metrics, and is available to resolve issues when they arise. The IPT Leader has senior management support (OCRWM Director) and active involvement of senior management when necessary to meet the IPT goals. The OCRWM Director has established a senior-level licensing strategy team to assist in effective guidance for LA submittal and defense. This projectized management approach, effectively utilizing an integrated project team to accomplish project goals, is considered a good practice.

Office of Waste Management

The responsibilities of the WMO are identified and described in *Office of Civilian Radioactive Waste Management Mission and Functions Statement*, PGM-CRW-AD-000003, Revision 1, dated May 2006. Among the many responsibilities listed, the following have significant impact on the engineering processes and procedures:

- Manage the standard contracts for disposal of spent nuclear fuel and/or high-level radioactive waste with owners and generators;
- Design and integrate all waste canisters and casks (with the exception of the final waste package which is the responsibility of OCE), including transportation and storage containers/casks;
- Maintain systems analytical and logistical computer codes (e.g., Total System Model);
- Develop and maintain the Program-level technical management requirements;
- Develop and maintain Level 1 technical baseline and provide systems engineering support at the Program level.

In addition, the WMO is the primary interface between the OCRWM project and utilities. The WMO manages the exchange of information between the OCRWM project staff and utilities by providing requested information or setting up meetings, when necessary, to support the engineering design.

The WMO, and the staff, are very experienced in the YMP. They know the program requirements and the interfaces in the OCRWM organization. They have a good working relationship with the contractor (BSC), the OCE, and the OCS, including the Lead Laboratory. The WMO staff exchange information on a regular basis with the rest of the OCRWM project.

The WMO, having the lead in the development of a performance specification for the TAD, formed a group that functioned as an IPT to develop the performance specification. The IPT was composed of key OCRWM staff and their support contractors as appropriate. The IPT consisted of OCRWM staff from the WMO (lead), Engineering, Operations, and Transportation. This engineering process followed appropriate procedures (LP-3.36Q-OCRWM, *CRWMS Technical Requirements Documents,* Rev. 1/ICN: 0, dated May 31, 2007, and LP-3.37Q-OCRWM, *Preparation, Review, and Approval of Performance Specifications*, Rev. 0/ICN: 0, dated July 31, 2006), developed a plan, and ultimately the performance specification (*Transportation, Aging, and Disposal Canister System Performance Specification*, WMO-TADCS-000001, Rev. 0, DOE/RW-0585, dated June 2007). The performance specification was of good quality and was developed in a timely manner. Design requirements from the TAD performance specification were incorporated into Revision 8 of the Civilian Radioactive Waste Management System Requirements Document (CRD), DOE/RW-0406, the Integrated Interface Control Document, Vol. 2[3] , and then a letter was sent to the contracting officer requesting that these design requirements be incorporated into the contract. This is considered a good practice.

The WMO Director prepared a draft document, *Civilian Radioactive Waste Management Requirements Hierarchy and Management Plan,* dated February 2007 that has not yet been issued. This document provides clarification of the document hierarchy and requirements flowdown, as well as OCRWM core values. Comments should be resolved and a final document issued as soon as possible.

Office of Chief Scientist

The responsibilities of the OCS are identified and described in *Office of Civilian Radioactive Waste Management Mission and Functions Statement*, PGM-CRW-AD-000003, Revision 1, dated May 2006. Among the many responsibilities listed, the following have significant impact on the engineering processes and procedures:

- Coordinate all scientific research for the project
- Manage interfaces with other DOE supporting organizations, including the national laboratories
- Provide direction, review, and approval of contractor strategy, and plan for the conduct of performance assessments and results and criteria in licensing proceedings

The OCS, and the Repository Science and Integration staff, are very experienced in the YMP. They know the program commitments and schedule, and are very knowledgeable of the interfaces in the OCRWM project. They have a good working relationship with the contractor (BSC), the OCE, the WMO, and of course, the Lead Laboratory. The OCS Repository Science and Integration (RSI) staff exchanges information on a regular basis (most of it verbally) with the rest of the OCRWM project and the Lead Laboratory. This OCRWM program began essentially as a science project, and the organizational culture is in transition to fulfill the OCRWM mission - certainly a difficult management challenge

Certain parts of the requirements statement for the repository are determined through scientific studies conducted or administered by the Lead Laboratory. This determination requires close interfacing between design engineering and the collection of scientific data in order to ensure that facility design criteria are correctly established

In order to utilize the results of scientific studies as they have evolved over several years in certain topical areas, the science solutions have specified limits for analysis

[3] A copy of the Integrated Interface Control Document, Vol. 2, was not available for review; however this information was provided in an interview with Messrs. Zabransky and Gomberg.

which assume fixed values for certain parameters. This has made it necessary for BSC engineering design to use conservative design criteria for certain aspects of the repository facilities design.

Certainly, all affected parties (OCS, OCE, and BSC) are well aware of these issues arising from "design point solutions," and actions are being taken to address them. A technical work plan for *Postclosure Nuclear Safety Basis*, TWP-WIS-MD-000015, Rev. 04A, dated January 2007, has been prepared, for example. In addition, *A Cross-Disciplinary Process for Selecting Parameters and Setting Reportable Limits in Performance Confirmation*, YMP-PC-001, Revision 00 A, dated April 2007, is issued in draft for review. These technical work plans are prepared according to existing Lead Laboratory procedures. The current plan for the LA indicates that the final documented post-closure nuclear safety basis is not scheduled to be completed before the LA is submitted. The RAO, OCE, and OCS are working to assure that SSCs important to waste isolation are included in the nuclear safety design basis in sufficient time to include this information in the LA. In the meantime, draft information is being used, along with continuous dialogue between Post-Closure Safety Analysis personnel and engineering staff. Although this is an acceptable workaround, this issue is of potential concern for licensing, and requires continuing management attention.

The background on the issue of “point solutions” rather than a “design criteria envelope” identified by the BSC Subsurface Engineering team are contained within the *Post Closure Modeling and Analysis Design Parameters* report and the BSC matrix identifying actions.

The execution of project level controls and communication exhibited some areas of strength, and other areas where improvement would be beneficial to the YMP organization. In particular, the maintenance and tracking of critical schedule milestones can be improved by enforcing recovery plan commitments and by ensuring that all project support groups take ownership of the overall schedule.

YMP, through Licensing, has regular interactions with the NRC. There are Quarterly Management Meetings and (mostly technical) Weekly Conference Calls. The Pre-licensing Agreement signed by both NRC and DOE established "Appendix 7" meetings. These represent the most in-depth exchanges between the organizations. The meetings are open to the public. The value of the technical exchanges is that they have resulted in mutual understanding of deliverables between BSC Engineering and NRC reviewers.

The YMP is a long-term effort. The project should continue to develop a culture of performance that is built around a strong and reliable schedule that is uniformly maintained, statused, and enforced by project management.

Attachment 5

Documents Reviewed

Table Number	Title
5-1	Procedures, Policies, Desktop Instructions, etc.
5-2	Engineering Products Reviewed
5-3	BSC Self-Assessments
5-4	Institute of Nuclear Power Operations Documents Used
5-5	Background Documents
5-6	Additional Documents Related to Occupational Exposure

Table 5-1. Procedures, Policies, Desktop Instructions, etc.

Identifier	Title
000-3DR-MGR0-00400-000	Engineering Design Requirements Allocation Matrix List
AP-16.1Q	Condition Reporting and Resolution
AP-2.19Q	QARD Matrix and Impact Evaluation
AP-17.1Q	Records Management
CC-DIR-10	Configuration Management
CC-PRO-1001	Technical Management Review Board Operations
CC-PRO-2001	Technical Interface Control
EG-DSK-3001	Design Change Request Desktop Information
EG-DSK-3003	Format of Calculations and Analyses and Treatment of Inputs and Assumptions
EG-DSK-3004	Standard Nomenclature
EG-DSK-3005	Notification of Potential Impact within Engineering
EG-DSK-3008	Supplier Document Review
EG-DSK-3010	Engineering Specification Template

Table 5-1. Procedures, Policies, Desktop Instructions, etc.

Identifier	Title
EG-DSK-3012	System Design Description Content and Format
EG-DSK-3013	Desktop Information for using Calctrac
EG-DSK-3014	Performance Data Collection
EG-DSK-3016	Information for Mechanical Handling Block Flow Diagrams
EG-DSK-3017	Mechanical Data Sheets
EG-DSK-3018	Gap Analysis Studies, DDPs and MHDRS
EG-DSK-3019	Engineering Design Requirements Management
EG-DSK-3020	Information for Mechanical Equipment Envelope Drawings
EG-DSK-3021	Information for Mechanical Handling Process and Instrumentation Diagrams
EG-DSK-3701	Application of ALARA in the YMP Design Process
EG-DSK-3901	Three-Dimensional 3D Model Review and Model Freeze Process
EG-DSK-3902	Basic Guidance for 3D Model Review Using SMARTPLANT Review (SPR)
EG-DSK-3903	Development and Use of Engineering Sketches
EG-PRO-1002	Testing Engineered Items and Systems
EG-PRO-1003	Control of Special Processes
EG-PRO-3DP-G03B-00001	Design Process
EG-PRO-3DP-G03B-00010	Engineering Planning and Control
EG-PRO-3DP-G03T-00901	Administrative Corrections to Engineering Documents
EG-PRO-3DP-G04B-00001	Design Criteria
EG-PRO-3DP-G04B-00005	Configuration Management
EG-PRO-3DP-G04B-00016	Engineering Studies
EG-PRO-3DP-G04B-00025	Engineering Interface Control
EG-PRO-3DP-G04B-00027	Design Verification
EG-PRO-3DP-G04B-00028	Engineering Lists
EG-PRO-3DP-G04B-00033	Project Reviews

Table 5-1. Procedures, Policies, Desktop Instructions, etc.

Identifier	Title
EG-PRO-3DP-G04B-00037	Calculations and Analyses
EG-PRO-3DP-G04B-00046	Engineering Drawings
EG-PRO-3DP-G04B-00047	Engineering Deliverables to Construction and Startup
EG-PRO-3DP-G04B-00049	Engineering Specifications
EG-PRO-3DP-G04B-00050	ASME III Design Specifications
EG-PRO-3DP-G04B-00054	Qualification of Personnel Authorized to Perform ASME III Code Certifying Design Activities
EG-PRO-3DP-G04B-00057	Technical Service Contracts
EG-PRO-3DP-G04B-00058	Supplier Engineering and Quality Verification Documents
EG-PRO-3DP-G04B-00061	Disposition of Nonconformance of Deficiency Reports
EG-PRO-3DP-G04B-00062	Disposition of Field Change/Field Change Notice
EG-PRO-3DP-G04B-00063	Supplier Deviation Disposition Request
EG-PRO-3DP-G04B-00090	Value Methodology
EG-PRO-3DP-G04T-00901	Design Change Control
EG-PRO-3DP-G04T-00903	System Design Descriptions
EG-PRO-3DP-G04T-00905	Determination of Quality Levels
EG-PRO-3DP-G04T-00909	Commercial Grade Dedication
EG-PRO-3DP-G04T-00912	Design Authority
EG-PRO-3DP-G04T-00913	Review of Engineering Documents
EG-PRO-3DP-G04T-00921	Hazard Analysis, Development of Hazard Control Strategies
EG-PRO-3DP-G05B-0034	Indoctrination and Training
EG-PRO-3DP-G06B-00001	Material Requisitions
EG-PRO-3DP-G06B-00002	Subcontracts
EG-PRO-3DP-G06B-00005	Bid Evaluation
GM-PRO-4000	Management Self-Assessments and Organizational Self-Assessments

Table 5-1. Procedures, Policies, Desktop Instructions, etc.

Identifier	Title
IA-OCE-2007-01	Engineering Design Control Process, Dated March 15, 2007 (Audit)
LP-2.19Q-OCRWM	Personnel Training and Qualification
LP-3.13Q-BSC	Design Control
LP-3.36Q-OCRWM	CRWMS Technical Requirements Documents and Integrated Interface Control Documents Preparation and Approval
LP-3.37Q-OCRWM	Preparation, Review, and Approval of Performance Specifications
LP-PMC-009-OCRWM	Change Control
LP-PMC-010-OCRWM	Level 2 Change
LP-REG-02-OCRWM	Identification and Maintenance of Monitored Geologic Repository System Requirements
LS-PRO-0201	Preclosure Safety Analyses Process
LS-PRO-0203	Q-List and Classification of Structures, Systems, and Components
LS-PRO-3002	Identification and Evaluation of Defects and Noncompliance
LS-PRO-3003	Preparation of Regulatory Correspondence for U.S. Department of Energy Transmittal to the U.S. Nuclear Regulatory Commission
LS-PRO-3005	Regulatory Guidance Agreements
PA-PRO-0201	Peer Review
PA-PRO-0313	Technical Reports
PGM-CRW-AD-000003	Office of Civilian Radioactive Waste Management Mission and Functions Statement
PLN-MGR-AD-000006	Yucca Mountain Project - Project Execution Plan
PLN-MGR-AD-000010	Repository Project Management Execution Plan
REG-CRW-RG-000007	Agreement Regulatory Guide 1.8, Rev. 3 - Qualification and Training of Personnel for Nuclear Power Plants
RM-PRO-2001	Document Control
RM-PRO-PADC-009	Project Document Control
RM-PRO-PADC-012	Project Design Change Document Control
TDR-MGR-MD-000037	Post Closure Modeling and Analyses Design Parameters

Table 5-1. Procedures, Policies, Desktop Instructions, etc.

Identifier	Title
TDR-MGR-MD-000014	Yucca Mountain Project Conceptual Design Report
TDR-MGR-RL-000002	Preclosure Safety Analysis Guide
TER-MGR-MD-000001	Projects Requirements Document
TPD-ORGAJ-001	BSC Repository Project Management Training Program
TPD-RW-MS-001	Training Program Description - Manager and Supervisor Program Development
TQ-PRO-1001	Personnel Training and Qualification
YMP 04-01	Management Plan for the Yucca Mountain Licensing Application
YMP-PC-001	A Cross-Disciplinary Process for Selecting Parameters and Setting Reportable Limits in Performance Confirmation
BQA-BSC-07-01	Flow Down of Requirements Audit
OQA-BSC-07-01	Audit Report
PGM-CRW-AD-000003	Mission and Functions

Table 5-2. Engineering Products Reviewed

Identifier	Title
000-M60-HMOO-00101	CRCF, RF, WHF and IHF Cask Handling Crane P&ID Sheet 1 of 3
000-M60-HMOO-00102	CRCF, RF, WHF and IHF Cask Handling Crane P&ID Sheet 2 of 3
000-M60-HMOO-00103	CRCF, RF, WHF and IHF Cask Handling Crane P&ID Sheet 3 of 3
000-M60-HMOO-00401	CRCF, RF, WHF and IHF Cask Handling Yoke P&ID
000-MJ0-HMOO-00101	CRCF, RF, WHF and IHF Cask Handling Yoke Mechanical Equipment Envelope P&ID
80-30R-PF00-00100-00A	Subsurface Repository Fire Hazard Analysis
170-MJ0-HAC0-00202-000 Rev. 1	Aging Facility, Vertical DPC Aging Overpack, Mechanical Equipment Envelope, Sheet 2
050-SYC-WH00-00100-000-00A	Tornado Missile Impact on Wet Handling Facility
060-DBC-CR-00-00200-000-00A	CRCF Foundation Design (Canister Receipt and Closure Facility)
200-SYC-RF00-00200-000-00A	RF Tornado Missile Impact on Receipt Facility (RF)
200-SYC-RF00-00100-000-00A	Receipt Facility (RF) Mass Properties
170-MJ0-HAC0-00201-000 Rev. A	Aging Facility, Vertical DPC Aging Overpack, Mechanical Equipment Envelope, Sheet 1
200-SYC-RF00-00300-000-00A	Receipt Facility: Soil Springs and Damping
170-MJ0-HAP0-00201-000 Rev. A	Aging Facility, Mobile Platform, Mechanical Equipment Envelope
170-MJ0-HAC0-00301-000 Rev. A	Aging Facility, Horizontal Aging Module Mechanical Equipment Envelope
060-SYC-CR00-00100-000-00A	CRCF Tornado Missile Impact on Canister Receipt and Closure Facility 1 (CRCF1)
170-MJ0-HAT0-00401-000 Rev. A	Aging Facility, Horizontal STC, Mechanical Equipment Envelope
170-MJ0-HAT0-00501-000 Rev. A	Aging Facility, Mobile Crane, Mechanical Equipment Envelope
000-00C-WHS0-01600-000	Classification of Radiation and Contamination Zones of Geologic Repository Operations Area
000-MJ0-H000-00101-000	RF, CRFC and WHF Cask Transfer Trolley Mechanical Equipment Envelope Plan & Elevations Sheet 1 of 2, DCN 2

Table 5-2. Engineering Products Reviewed

Identifier	Title
000-MJ0-H000-00102-000	RF, CRFC, and WHF Cask Transfer Trolley Mechanical Equipment Envelope Schedule of Casks, Sheet 2
000-MJ0-H000-00101-000	RF, CRFC and WHF Cask Transfer Trolley Mechanical Equipment Envelope Plan & Elevations Sheet 1 of 2, DCN 3
000-MJ0-H000-00102-000	RF, CRFC, and WHF Cask Transfer Trolley Mechanical Equipment Envelope Schedule of Casks, Sheet 2, DCN 1
000-MJ0-H000-00101-000	RF, CRFC and WHF Cask Transfer Trolley Mechanical Equipment Envelope Plan & Elevations Sheet 1 of 2
170-30R-HA00-00200-000	Mechanical Handling Design Report for Surface Aging Equipment
26D-E20-EEE0-00101-000	Emergency Diesel Generator Facility ITS Train A Electrical Equipment Layout
170-MJ0-HAT0-00201-000 Rev. A	Aging Facility, Cask Transfer Trailers, Mechanical Equipment Envelope
170-MJ0-HAT0-00601-000 Rev. A	Aging Facility, Cask Tractor, Mechanical Equipment Envelope
800-SS0-SSE0-00201-000 Rev. B	Repository Subsurface Emplacement Drifts Steel Invert Structure Plan & Elevation
800-30R-HE00-01800-00	Strategies for Recovery After an Off-Normal Event to the Waste Package Transport and Emplacement Vehicle
000-00C-MGR0-03200-000-00A	Stress Intensity Classification: Waste Package Outer Corrosion Barrier Stresses due to Drop with Emplacement Pallet
800-SSC-SSE0-00200-000 Rev. B	Steel Invert Structure - Emplacement Drifts
800-KM0-SS00-00303-000 Rev. A	Subsurface - Underground Layout Configuration for LA Panel 2 Plan
800-KM0-SS00-00302-000 Rev. A	Subsurface - Underground Layout Configuration for LA Panel 1 Plan
800-KM0-SS00-00304-000 Rev. A	Subsurface - Underground Layout Configuration for LA Panel 3 Plan
800-KM0-SS00-00305-000 Rev. A	Subsurface - Underground Layout Configuration for LA Panel 5 Plan
800-SS0-SSE0-00203-000 Rev. B	Repository Subsurface Emplacement Drifts Steel Invert Structure Sections and Details
800-KMR-MGR0-00100-000-000	Repository Subsurface Construction Methodology
800-D00-SSD0-00701-000 Rev. A	Repository Subsurface Turnout, Invert & Rails Plan & Elevation
800-KM0-SS00-00301-000 Rev. A	Subsurface - Underground Layout Configuration for LA General Arrangement

Table 5-2. Engineering Products Reviewed

Identifier	Title
800-D00-SSD0-00702-000 Rev. A	Repository Subsurface Turnout, Invert & Rails Sections
800-D00-SSD0-00705-000 Rev. A	Repository Subsurface Turnout, Invert & Rails Straight Steel Sections
800-KVO-VUO0-00101-000 Rev. A	Repository Subsurface Observation Drift Ventilation Arrangement
800-SS0-SSE0-00202-000 Rev. B	Repository Subsurface Emplacement Drifts Steel Invert Structure Section & Materials
800-D00-SSD0-00703-000 Rev. A	Repository Subsurface Turnout, Invert & Rails Concrete Sections
800-D00-SSD0-00704-000 Rev. A	Repository Subsurface Turnout, Invert & Rails Curved Steel Sections
800-S0C-SSD0-00700-000-00A	Access & Exhaust Mains Isolation Barrier Bulkheads & Airlocks
800-S00-SSD0-00602-000 Rev. B	Repository Subsurface Emplacement Access Door & Turnout Bulkhead Details & Sections
800-S00-SSD0-00601-000 Rev. B	Repository Subsurface Emplacement Access Door & Turnout Bulkhead Elevation and Notes
000-M00-SSE0-00103-000 Rev. B	Interlocking Drip Shield Configuation-3
000-M00-SSE0-00102-000 Rev. B	Interlocking Drip Shield Configuation-2
800-00C-SS00-00400-00-00A	Dose Rate Calculation for Subsurface Ventilation Isolation Barrier
000-00C-SSE0-00900-000-00A	Committed Materials for Emplacement Drift Pallets and Drip Shields
800-S0C-SSD0-00600-000-00B	Emplacement Access Door & Turnout Bulkhead
000-M00-SSE0-00101-000	Interlocking Drip Shield Configuration

Table 5-3. BSC Self-Assessments

Identifier	Title	Comment
OSA-EG-2006-001	Effectiveness of the Interface between the Nuclear and Criticality Groups	
OSA-EG-2006-002	Engineer Process Improvement Processes	
OSA-EG-2006-003	Self Assessment of the Calculation Procedure LP-3.21Q-BSC Used by the Disciplined Engineering Department	
OSA-EG-2006-004	Checking Self-Assessment of Engineering Products	
OSA-EG-2006-005	Self-Assessment of Engineering Requirements Management, Allocation, and Implementation	
OSA-EG-2006-006	Self-Assessment Plan for Effectiveness of the Engineering Progress and Performance Report	
OSA-EG-2006-007	Number not used.	
OSA-EG-2006-008	Organizational Self-Assessment of the Implementation of the Manual Provided in the Project Subcontract Technical Representative (STR) Training	Complimentary of training
OSA-EG-2006-009	Effectiveness of the Corrective Action Program Process within Engineering	1/3 year Jan -April 2006: 44 CRs (non-D) No level A or B
OSA-EG-2006-010	Number not used.	
OSA-EG-2006-011	Effectiveness of Communications Within Design and Engineering	
OSA-EG-2006-012	Effectiveness of the Document Review Matrix	
OSA-EG-2006-013	Effectiveness of the Rollout of New Procedures (Issue & Training)	Based on feedback, procedure training was good for the rollout of all the new procedures.
OSA-EG-2006-014	Self-Assessment of Calculations and Analysis Procedure EG-PRO-3DP-G04B-00037	
OSA-EG-2006-015	Effectiveness of the Trending Process	

Table 5-3. BSC Self-Assessments

Identifier	Title	Comment
OSA-EG-2006-016	Effectiveness of the Design Hazards Analysis Process	
OSA-EG-2006-017	Number not used.	
OSA-EG-2006-018	Effectiveness of Engineering Interfaces for Schedule Preparation and Updates	
OSA-EG-2006-019	Number not used.	
OSA-EG-2006-020	Implementation of ALARA Principles in Design	
OSA-EG-2007-001	Effectiveness Review for CRS 2467 & 5365	Supplier Deviation Disposition Reports
OSA-EG-2007-002	Design & Configuration Management Controls	
OSA-EG-2007-003	Organization's Knowledge & Ability to Implement Procurement Activities	Interview comments
OSA-EG-2007-004	Effectiveness Review for Condition Report CR 7378	
OSA-EG-2007-005	Self-Assessment of Engineering Specification Procedure EG-PRO-3DP-G04B-00049 for Civil/Structural Specifications	
OSA-EG-2007-006	Number not used.	
OSA-EG-2007-007	Effectiveness of the Fire Hazard Analysis Template and Desktop Information	
OSA-EG-2007-008	Engineering Process Improvement Processes	112 lessons learned, 21/25 SA (2006) and 18/22 (2005), Engineering Six Sigma program has exceeded the designated the 2006 target of \$2,000,000, with benefits of over \$2,946,000. During 2006, Engineering was assigned 152 Condition Reports (CRs), an increase of 33% over the 114 assigned in 2005.
OSA-EG-2007-009	Implementation of Basis of Design Pertinent to Electrical and I&C	

Table 5-3. BSC Self-Assessments

Identifier	Title	Comment
OSA-EG-2007-010	Implementation of Project Execution Plan - Engineering, Section 6	
OSA-EG-2007-011	Effectiveness of Preparing Subsurface Design Calculations and Analyses	
OSA-EG-2007-012	Effectiveness of ALARA Training	CR 9926 was entered as Level D. The recommended actions are (1) evaluate to confirm the need for this training per Training dept procedures, (2) require all Las Vegas based Engineering staff, including DEMs and PEs, to take the training by the end of April 2007, and (3) add the class to the Repository Project Management Training Program Description for staff located in Las Vegas.
OSA-EG-2007-013	Application of the Calculations and Analyses Procedure for Electrical and I&C	
OSA-EG-2007-014	Effectiveness of Determination and Application of Discipline Specific Design Criteria and Guidelines	
OSA-EG-2007-015	Effectiveness of the Trending Process	
OSA-EG-2007-016	Human Performance Assessment of Discipline Engineering	
OSA-EG-2007-017	Effectiveness Review for Condition Report 3235	Identified lack of training so created design course midstream.
OSA-EG-2007-018	Integration of Waste Form Requirements and Waste Stream Arrival Scenarios in Design Products	
OSA-EG-2007-019	Self-Assessment of Flowdown of Engineering Allocated Requirements	
OSA-EG-2007-020	CALCTRAC Assumption Tracking System	

Table 5-4. Institute of Nuclear Power Operations Documents Utilized

Identifier	**Title**
INPO SER 4-05	Errors in the Preparation and Implementation of Modifications
INPO 04-002	Effective Engineering Work Management
INPO 86-009	Guidelines for the Organization and Administration of Nuclear Power Stations
INPO AP-929	Configuration Management Process Description
90-009-01	Guidelines for the Conduct of Design Engineering
INPO 05-001	Large Project Implementation Strategies
AP-930	Supplemental Personnel Process Description
INPO 05-002	Human Performance Tools for Engineers
INPO 05-006	Engineering Organization Success Factors

Table 5-5. Background Documents

ANSI/45.2.11-1974	*Quality Assurance Requirements for the Design of Nuclear Power Plants*
ANSI/EIA-649-1998	*National Consensus Standard for Configuration Management*
DOE-O-413.3	*Program and Project Management for the Acquisition of Capital Assets*
DOE-RW-0333	*Quality Assurance Requirements and Description*
DOE/RW-0406	*Civilian Radioactive Waste Management System Requirements Document*
DOE/RW-0425	*Transportation System Requirements Document*
DOE/RW-0511	Integrated Interface Control Document (ICD), Vol I, US DOE SNF & HLW to the Monitored Geologic Repository
DOE/RW-0522	*Training Management Plan*
DOE/RW-0572	Integrated Interface Control Document (ICD), Vol 2, US DOE SNF & HLW to the Monitored Geologic Repository
DOE/RW-0585	*Transportation, Aging, and Disposal Canister System Performance Specification*
NUREG-1055	*Improving Quality and the Assurance of Quality in the Design and Construction of Nuclear Power Plants*
NUREG-1804	*Yucca Mountain Review Plan*
YMP/CM-0025	*Monitored Geologic Repository Requirements Document*
YMP/CM-0026	*Monitored Geologic Repository Systems Requirements Document*
YMP/PC-001	*A Cross-Disciplinary Process for Selecting Parameters and Setting Reportable Limits in Performance Confirmation*

Table 5-6. Additional Documents Related to Occupational Exposure

000-3DR-MGR0-00100-000-006	*Project Design Criteria Document*
51A-00C-IH00-00100-000-00	*Initial Handling Facility Worker Dose Assessment*
060-00C-CR00-00100-000-00	*A Canister Receipt and Closure Facility #1 Worker Dose Assessment*
200-00C-RF00-00100-000-00	*A Receipt Facility Worker Dose Assessment*

Attachment 6

Interviewees

Engineering Procedures and Processes Assessment Team Interviewees

Name	Organization	Title/Position
William Boyle	OCRWM Repository Post Closure Licensing	Supervisor
J. Russell Dyer	OCRWM Office of Chief Scientist	Director (Chief Scientist)
Steve Gomberg	OCRWM Waste Management Office	
Paul G. Harrington	OCRWM Office of Chief Engineer	Director (Chief Engineer)
Christopher A. Kouts	OCRWM Waste Management Office	Director
Kirk Lachman	OCRWM Engineering Support	Engineering Design Supervisor
James Low	OCRWM Engineering Support (RW-5)	
Robert Warther	OCRWM Regulatory Authority Office	
Mark H. Williams	OCRWM Regulatory Authority Office	Director (Regulatory Authority)
David Zabransky	OCRWM Waste Management Office	
Michael J. Anderson	BSC Subsurface Engineering	Thermal/Structural Analysis Engineering Group Supervisor
Nohemi Brewer	BSC Nuclear Facilities Engineering - Electrical/I&C	
H. Michael Carmichael	BSC Quality Assurance	Manager
David B. Darling	BSC Nuclear and Radiological	Discipline Engineering Manager
Michael A. Denlinger	BSC Nuclear Facilities Engineering	Engineering Group Supervisor
Christine Drummond	BSC Training	Training and Qualification Deputy Manager
Dennis M. Dugas	BSC RPM Construction	Manager

Engineering Procedures and Processes Assessment Team Interviewees

Name	Organization	Title/Position
Richard Foster	BSC Discipline Engineering -Engineering Hazards Analysis	Discipline Engineering Manager
Mike Frank	BSC Licensing & Nuclear Safety	Manager Preclosure Safety Analysis
Greg W. Gould	BSC Discipline Engineering (Mechanical)	Shared to Nuclear Facilities
Mark L. Johnson	BSC Subsurface Engineering	Project Engineer
Tracy L. Johnson	BSC Nuclear Facilities Engineering - Mechanical Systems, HVAC, & Fire Protection	Engineering Group Supervisor
Richard Kacich	BSC Licensing and Nuclear Safety	Manager
Leon Kantola	BSC Nuclear Facilities Project	Manager
Roger Keller	BSC (Licensing and Nuclear Safety) Lead Lab - Technical Interface	
Thomas W. Mulkey	BSC Discipline Engineering	Manager
Dale L. Pendry	BSC RPM Operations	Manager
Steve J. Ployhar	BSC Nuclear Facilities Engineering - Mechanical	Senior Engineering Group Supervisor
David S. Rhodes	BSC System Engineering	Discipline Engineering Manager
Dale L. Roberson	BSC Process Improvement	Manager
Gary Robinson	BSC Subsurface Project	Project Manager
Barbara E. Rusinko	BSC Engineering	Design Authority
Robert S. Saunders	BSC Subsurface Engineering	Mining Engineering Group Supervisor
Robert C. Slovic	BSC Nuclear Facilities Engineering	Senior Project Engineer
Richard J. Tosetti	BSC Repository Project Management	Manager
John Tutterrow	BSC Subsurface Engineering	C/S/A Engineering Group Supervisor
Ken Ullman	BSC Office and Administrative Services	Supervisor, Document Control
Robert Vallely	BSC Training and Qualification	Senior Instructor (Engineering)
James S. Whitcraft	BSC Initial Operating Capability Integration	Manager