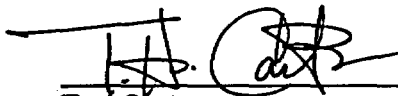



U. S. NUCLEAR REGULATORY COMMISSION  
OBSERVATION AUDIT REPORT OAR-99-05  
OF THE YUCCA MOUNTAIN QUALITY ASSURANCE DIVISION  
AUDIT M&O-ARP-99-12  
OF THE  
CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM  
MANAGEMENT AND OPERATING CONTRACTOR


  
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Enclosure

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## **1.0 INTRODUCTION**

Members of the U.S. Nuclear Regulatory Commission (NRC) Division of Waste Management Quality Assurance (QA) staff observed the U.S. Department of Energy (DOE), Office of Civilian Radioactive Waste Management (OCRWM), Office of Quality Assurance (OQA), Yucca Mountain Quality Assurance Division (YMQAD) performance based audit of the Civilian Radioactive Waste Management System Management and Operating (M&O) Contractor. The audit, ARP-98-12, was conducted on July 12-21, 1999.

The NRC staff objective was to gain confidence that OQA and the M&O are properly implementing the requirements of their QA programs in accordance with OCRWM Quality Assurance Requirements and Description (QARD): DOE/RW-0333P and Title 10 of the Code of Federal Regulations (10CFR), Part 60, Subpart G (which references 10 CFR Part 50, Appendix B).

This report addresses the effectiveness of the OQA audit and the adequacy of implementation of QA controls in the audited areas of the M&O QA program.

## **2.0 MANAGEMENT SUMMARY**

The NRC staff has determined that OQA Audit ARP-99-12 was useful and effective. The audit was organized and conducted in a professional manner. Audit team members were independent of the activities they audited. The audit team was well qualified in the QA and technical disciplines, and its assignments and checklist items were adequately described in the audit plan.

The audit team identified two deficiencies during the audit. One was corrected during the course of the audit and the other was another example of a deficient condition already addressed in CAR LVMO-98-C-002. The NRC staff agrees with the audit team findings. As a result of the audit, no Deficiency Reports (DRs) were issued.

## **3.0 AUDIT PARTICIPANTS**

### **3.1 NRC**

Ted Carter	QA Observer
Mysore Nataraja	Technical Observer
Rob Weber	QA Observer, Center for Nuclear Waste Regulatory Analyses (CNWRA)
Simon Hsiung	Technical Observer, CNWRA

The NRC On-Site Representatives, Bill Belke and Chad Glenn, also participated as observers during portions of the audit.

### **3.2 Audit Team**

Kenneth Gilkerson	OQA/QATSS, Las Vegas, NV	Audit Team Leader
Mike Goyda	OQA/QATSS, Las Vegas, NV	Auditor
Robert Hartstern	OQA/QATSS, Las Vegas, NV	Auditor
James Blaylock	OQA, Las Vegas, NV	Auditor

Paul Harrington  
Frank Bugg

DOE, YMSCO, Las Vegas, NV  
MTS, Booz-Allen & Hamilton  
Associates, Inc

Technical Specialist  
Technical Specialist

#### 4.0 REVIEW OF THE AUDIT AND AUDITED ORGANIZATION

This OQA audit of the M&O was conducted in accordance with OCRWM QA Procedure (QAP) 18.2, "Internal Audit Program," QAP 16.1Q, "Performance/Deficiency Reporting" and AP 16.2Q, "Corrective Action and Stop Work." The NRC staff's observation of this audit was based on the NRC procedure, "Conduct of Observation Audits," issued October 6, 1989.

The processes and activities audited were contained in performance based checklists. The checklists were developed based on the management objectives and critical process steps relative to design activities and deliverables agreed upon with M&O management. The QARD, M&O procedures, and other technical documents were reviewed and used as background information in the development of performance based checklist questions in the assessment of the process.

#### 4.1 Scope of the Audit

The audit team conducted a performance-based audit of activities supporting License Application Design Selection (LADS), Waste Package (WP) Design, Engineered Barrier System (EBS) Design, and the System Description Documents (SDD) process. Consideration was given to the NRC Issue Resolution Status Reports in the planning of this audit as the identified topics apply to them. The following deliverables were evaluated during the audit:

##### Reports

B00000000-01717-4600-00123	LADS Report, Revision 1
B00000000-01717-5705-00095	Disposal Criticality Analysis Methodology Topical Report
BCAA00000-01717-0200-00010	Evaluation of Ground Support Heating & Cooling Cycles
BCAD00000-01717-2200-00002	Continuous Preclosure Ventilation
B00000000-01717-2200-00215	Richards Barrier
B00000000-01717-2200-00216	Waste Package CRMs
B00000000-01717-2200-00211	LADS Canistered Assemblies
B00000000-01717-2200-00220	Waste Package Self Shielding
BCAA00000-01717-0200-00011	Repository Layout Supporting DF#13, Waste Package Self Shielding and
BCA 000000-01717-2200-00002	Repository Horizon Elevation

##### System Design Documents

SU40	Emergency Response
SS26	Subsurface Fire protection
SU02	Waste Handling Building
WP01	Uncanistered SNF Disposal Container
SU55	Performance Confirmation Data Acquisition/Monitoring
SU29	Site Radiological Monitoring System
SU17	Waste Emplacement System
SU16	Carrier/Cask Transport

A performance based audit evaluates products and associated processes to determine the degree to which they meet program requirements and management commitments and expectations. This evaluation of process effectiveness and product acceptability was based upon:

- Satisfactory completion of the critical process steps
- Acceptable results and quality of the end products
- Documentation that substantiates quality of data
- Performance of trained and qualified personnel
- Implementation of applicable QA program elements

#### **4.2 Conduct and Timing of the Audit**

The audit was performed in a professional manner and the audit team was well prepared and demonstrated a sound knowledge of the M&O and DOE QA programs. Audit team personnel were persistent in their interviews, challenged responses when appropriate, and performed an acceptable audit. The NRC staff believes the timing of the audit was appropriate for the auditors to evaluate the ongoing activities and implementation of the QA program.

The DOE audit team and NRC observers caucused at the end of each day. Also, meetings of the audit team and M&O management (with NRC observers present) were held each morning to discuss the current audit status and preliminary findings.

#### **4.3 Examination of QA Programmatic Elements**

Programmatic audit activities were conducted in accordance with the OCRWM QA Audit Plan for Audit M&O-ARP-99-012 and were limited in scope to the design control activities of the M&O contractor in Las Vegas, Nevada. The applicable processes included LADS, WP design, EBS design and the SDD. Since this was a performance based audit, a significant amount of auditing effort focused on the technical aspects. The NRC staff observed that each of the auditors reviewed design process documents identified in the plan and used checklists as a basis for inquiries. In addition, related documentation supporting report conclusions was reviewed to verify data source and status of qualification. Personnel directly responsible for document products or appropriate representatives with sufficient levels of knowledge were interviewed by both programmatic and technical specialists. The checklists used were effective and additional inquiries were made beyond specific checklist items, when appropriate. NRC observers were briefed on audit conduct procedures including the inquiry process and method for raising concerns. The observers were given ample opportunity to provide comments and ask questions.

The audit team reviewed training, education, and experience records for personnel conducting scientific studies to assure such personnel were in compliance with their individual position descriptions. Objective evidence was provided and reviewed by the auditors and it was determined that all personnel were appropriately qualified and assigned design tasks commensurate with their qualifications. In addition, training, education, and experience records for audit team members were also reviewed by the observation team to verify that audit team members had appropriate qualifications and met the requirements of QA Procedure 18.2, "Internal Audit Program".

During the course of the audit, the following products, planning, design review, and data source documents were reviewed by the audit team and observed by the NRC:

**LADS Report, B00000000-01717-4600-00123, Revision 1**

The programmatic auditor examined the review process conducted on Revision 0 of the LADS Report. After Revision 0 was reviewed by the M&O, it was submitted to the DOE for acceptance. Over 300 DOE comments were documented. This number of comments, 200+ of which were considered mandatory and were subsequently incorporated, called into question the adequacy of the review process. The auditors reviewed this process and addressed this observation by making several recommendations regarding the QA Procedure 3-5, "review process."

**LADS Canistered Assemblies, B00000000-01717-2200-00211 and,  
Technical Document Preparation Plan (TDPP), B00000000-01717-4600-00137**

**Waste Package CRMS, B00000000-01717-2200-00216 and,  
Technical Document Preparation Plan (TDPP), B00000000-01717-4600-00140**

**Waste Package Self Shielding, B00000000-01717-2200-00220 and,  
Technical Document Preparation Plan (TDPP), B00000000-01717-4600-00131**

**Shielding Characteristics of Various Materials on PWR Waste Packages,  
B00000000-01717-0210-00008**

**Waste Package Temperature Calculations to Support Waste Package Size Study,  
B00000000-01717-0210-00005**

**Canistered Assemblies - Single Canister Waste Package Calculations,  
B00000000-01717-0210-00016**

**System Description Document (SDD), SU 40, Emergency Response**

**System Description Document (SDD), SU 02, Waste Handling Building**

**Secondary Low-Level Waste Treatment Strategy Analysis**

**Cask/Canister Cooldown System Technical Report**

The observers found that the requirements of QA Procedure 18.2, "Internal Audit Program," were implemented in an effective and satisfactory manner. These planning and implementation activities were accomplished and observed by the NRC team as follows:

(1) Preparation of distribution of a quality assurance audit plan, M&O-ARP-99-12; (2) Preparation of a performance based audit checklist; (3) Coordination and communications with all team members; (4) Conduct of an introductory pre-audit kickoff meeting with the audit team and observers; (5) Conduct of a kickoff meeting with M&O personnel including high level management; (6) Daily caucus meetings held for the audit team and observers; (7) Daily management status meetings held for M&O management; and (8) Conduct of a post audit meeting with M&O management, audit teams members and NRC observers.

#### **4.4 Examination of Technical Activities**

As part of this performance based audit, a technical evaluation was conducted on 10 reports related to the LADS activity. The NRC staff followed the evaluation of the following five reports: (1) Evaluation of Ground Support heating and Cooling Cycles, BCAA000000-01717-0200-00010; (2) Design Feature Evaluation #25 Repository Horizon Evaluation, BCA000000-01717-2200-00002; (3) Richards Barrier, B00000000-01717-2200-00215; (4) Continuous Preclosure Ventilation, BCAD000000-01717-2200-00002; and (5) Disposal Criticality Analysis Methodology Topical Report, B00000000-01717-5705-00095.

For evaluating each of the reports, the audit team's Technical Specialist prepared a comprehensive checklist. Consideration was given to the NRC Issue Resolution Status Reports during the planning of the audit. The M&O contractor's personnel were interviewed. Source of data input, assumptions, and criteria used in the reports were checked and evaluated. A significant effort was also placed on implementation and effectiveness of the document review process. The audit was greatly facilitated by the M&O's staff cooperation and candidness.

The purpose of the "Evaluation of Ground Support heating and Cooling Cycles" report was to evaluate the effects of multiple heating and cooling cycles on rock mass and selected support systems caused by rapid ventilation access. The analysis was conducted using a finite element code ANSYS Version 5.2 and a distinct element code UDEC Version 2.0. Both software packages have been verified and validated according to applicable M&O procedures. The ANSYS program was used for modeling the behavior of the rock mass and ground support systems as a continuum. The ground support systems' analysis included concrete liner and steel sets. The UDEC code was used to simulate the behavior of jointed rock mass as a discontinuum surrounding the emplacement drifts.

The technical specialist evaluated the traceability of some data input used in the analysis. All data were found to be traceable to either the Controlled Design Assumptions (CDA) document or other referenced documents. Each assumption from the CDA is assigned a unique tracking number to facilitate tracking the resolution status of that assumption. The technical specialist did not pursue this issue any further. A data typographical error was found in the document by the technical specialist. The actual data input spreadsheet provided by the investigator indicated that the correct data input was used in the analysis. Consequently, this error is not quality affecting.

The technical specialist investigated the appropriateness of the approach used for the intended objective of the document. As discussed earlier, the objective of the study is to determine the effects of multiple heating and cooling cycles on rock mass and selected support systems caused by rapid ventilation. However, no particular codes or industrial standards were used in the analysis to evaluate the effectiveness of the selected support systems. The investigator used the so called "reference strength" as the basis for such evaluation and explained that steel set may behave differently underground from above ground such that the industrial standards that govern the design for the steel facilities may not be usable for underground design. The technical specialist stated that if such is the case, appropriate standards that are suitable for underground use of steel set should be developed. This question remained unresolved at the end of the audit.

The technical specialist investigated some assumptions made for adopting certain analysis approaches. He found that, in some cases, such assumptions were not clearly substantiated or justified in the document. For example, the analysis was conducted using a two-dimensional

model instead of a three-dimensional model. The technical specialist did not find a clear justification in the document for use of the two-dimensional model.

The technical specialist investigated the applicability of the criteria cited in this document. Some criteria were found subjective and implementation might not be possible. For example, one of the ground support system performance design criteria in the DOE Ground Control SDD states that "The ground support system shall confine and support the rock surrounding each opening so as to minimize the potential for rock falls, fracturing, loosening of blocks, other deleterious rock movements, and surface deterioration of the rock mass." The technical specialist considered this criterion subjective. He maintained that criteria should be stated as measurable values. For another maintenance-related criterion, the technical specialist questioned the technical basis regarding that "no more than 5% of the emplacement drifts will require maintenance during the operational life with a level of confidence of 95%". The technical specialist questioned the technical basis for the 5% value. The answers provided to the investigator by the interviewee and other M&O personnel participating in the audit were not sufficient. There is also an issue of how this 5% value can be implemented due to a lack of specifics as to when maintenance is judged to be required. The particular criterion for defining the need for maintenance is currently not included in the Ground Support SDD. This raises a concern regarding the completeness and adequacy of the subject SDD.

The Design Feature Evaluation #25 Repository Horizon Elevation report was prepared to support the license application design selection process. The purpose of the study was to evaluate the change in performance associated with a change in the repository horizon elevation. A two-tier repository was also evaluated in this study. The technical specialist verified the review process applied to the report for this study. He identified that a piece of data used in the study was correctly extracted from the data base and the data was qualified at the time of use. However, this data was subsequently disqualified because of problems found in the software used to generate the data. At that time, the report was going through the final stage of review and approval. The investigator appeared to be unaware of the change in data qualification status.

The reports for Richards Barrier and Continuous Preclosure Ventilation were audited by one technical specialist. The technical specialist devoted his time in verifying the entire design control process related to these two documents. He evaluated the process used for preparing the Technical Document Preparation Plan (TDPP). In both cases, the TDPP was revised during the study to better reflect the activity/work done. He also investigated the checking process implemented in the review process. The checking record for the Richards Barrier report indicated that the author was allowed to add new material to the document when responding to the comments from the checker even though the added materials were not relevant to the comments. According to the checker interviewed, this approach facilitated the preparation of the report. The control could be accomplished by having the author mark the new materials in the margin and making the checker aware that new material was added. The checker could then check the new material accordingly. The technical specialist appeared to accept this approach. However, this approach may invite the possibility that the checker does not know the existence of the new material, and consequently it is not checked.

Disposal Criticality Topical Report was examined by the technical specialist against the checklist questions. TDPP (May 7, 1998) was requested and obtained by the technical specialist upon NRC technical observer's recommendation and the topical report was compared against the format and content requirements. Similarly, based on a recommendation by the NRC technical

specialist, random tables and figures from the topical report were picked for conducting checks. Typically, sources of information referenced in the tables and figures were verified and accuracy of information presented was verified. Questions were raised on the technical review procedures and generally, satisfactory answers were provided by the interviewees

#### **4.5 NRC Staff Findings**

The NRC staff agreed with technical and programmatic findings, observations, and comments of the audit team. The NRC staff adds the following as open technical questions, that were not fully addressed during the audit.

**Document Hierarchy:** In its effort to review the design control process, NRC staff have been raising the issue of DOE's (and M&O's) document hierarchy for quite some time. (See Issue Resolution Status Report of Repository Design Thermal-Mechanical Effects Key Technical Issue, section 5.1 and item 24 of its Appendix, September 1998.) As a follow up to that effort, the NRC technical observer requested the DOE audit team for the latest version of its document hierarchy that applies to its current activities. In response to this request, a copy of Figure 1- Technical Document Hierarchy for LA Design (a copy is attached to this report for ready reference) was provided to NRC via the NRC Site Representative's office. This proposed technical document hierarchy is expected to become effective when baseline document changes will be made to support a transition from VA to LA (i.e., when MGDS-RD, Rev.3 is baselined). The staff will continue to monitor DOE's progress in establishing a technical document hierarchy for its future design activities.

#### ***Other Questions:***

- How and when do the required Criterion III design reviews apply to work conducted by the M&O considering that only selected products and supporting data will be used for the license application? There was some question as to the applicability of these reviews to all activities regardless of selection for license application. It was noted that 10CFR60 (and also proposed Part 63) requires that 10CFR50, Appendix B, be applied to all aspects of project work including characterization. Therefore, the design control measures of Criterion III, including verification of design adequacy, also apply to the characterization process. Discussions related to this subject were conducted informally between the technical auditors and NRC observers to gain a better understanding of the M&O's review process. In addition, the M&O agreed to state in writing their position on the applicability of design controls. It should be established to what extent design selection activities fall under the definition of characterization. The NRC staff will review the written position that the M&O is expected to submit to DOE (and DOE is expected to furnish to NRC) and document its position on this issue.
- Are criteria provided in the SDD complete and implementable? For example, the maintenance criterion listed in the SDD was cited in the Evaluation of Ground Support Heating and Cooling report as "The emplacement drift shall be designed to minimize maintenance, so that no more than 5% (TBV-335) of the emplacement drifts will require maintenance during the operational lift with a level of confidence of 95% (TBV-335)." However, a criterion to define when a maintenance is required is not provided.



Consequently, whether a 5% or 10% of the emplacement drifts will require maintenance cannot be determined.

- What is the basis that some data inputs are included in the CDA while some are not, for example, the normal and sticking contact stiffnesses between concrete and rock and between steel and rock? These parameters are important in determining the stress level in the concrete and steel set.

## **5.0 Summary of OQA Findings**

The audit team identified two deficiencies during the audit. One was corrected during the course of the audit and the other was another example of a deficient condition already addressed in CAR LVMO-98-C-002. The audit team determined that no significant adverse trends were identified during the audit and overall, the M&O is satisfactorily and effectively implementing an adequate corrective action process relative to Design Control processes. As a result of the audit, no DRs were issued.

### **Deficiency Corrected During the Audit**

A deficiency relative to the traceability of a Technical Document Checklist (B00000000-01717-4600-00123) submitted to records was identified during the audit. A correction to this record was processed by Engineering Document Control (EDC) and subsequently reviewed by the auditor. It was appropriately corrected.

### **Deficiency Resulting from Follow-up**

In reviewing the report on *Repository Horizon Elevation* it was identified that source data identified as "qualified" in the report was determined to be "not qualified" by TDMS prior to issuance of the report. This issue was determined to be another example of a condition cited in CAR LVMO-98-C-002.

## **6.0 Recommendations**

The following recommendations resulted from the audit and are presented for consideration by M&O management.

1. The Analysis BCAA00000-01717-0200-00010, *Evaluation of Ground Support Heating & Cooling Cycles*, was evaluated with the following comments: The analyses did not define what allowable stress levels were in either steel or concrete nor invoke industry consensus standards. Clarity of acceptance criteria needs to be further evaluated. Relative to control of design input, data was incorrectly transcribed from source documents (appeared to be editorial error). In some cases, assumptions were not clearly substantiated or justified (i.e., use of 2D versus 3D model). Additional documents were reviewed for same or similar problems and none were denoted.

It is recommended that management evaluate how acceptance criteria are identified and what industry consensus may apply to design products. The need to clearly justify assumptions needs to be re-emphasized to Design personnel.

2. The audit team raised questions relative to when "Design Verification" and "independent design checking" are performed in accordance with Criterion III requirements and for type of

design products. Issues revolve around past use of "package" concepts for design and current "products" concept and when a design is considered complete. Interviewed personnel provided inconsistent responses relative to performing design verification. After a number of meetings and reviews of the independent checking criteria used by the M&O, it was determined that the actions actually being performed meet the QA program requirements (i.e., QARD, NQA-1, 10CFR50 Appendix B). It is not evident that M&O design procedures clearly depict how the design verification or independent checking requirements are met and for what design products.

It is recommended that the M&O clarify its AP-3.13Q (formerly QAP-3-0) procedure on Design Process and its Design Guidelines Manual (DGM) to clearly address the types of design products that are independently checked and those complex integrated design products that will go through an additional design review in accordance with the Design Verification procedure. It is also recommended that additional training of design personnel be performed to ensure consistent understanding of these processes.

3. Concerns exist relative to the adequacy of TDPPs for LADS QAP-3-5. reports (i.e., WP Self-Shielding and WP CRM reports. TDPPs do not clearly define inputs, criteria requirements, etc., expected to be used in developing the reports. (See Attachment I of procedure). It is recommended that personnel evaluate measures to ensure that enough detail and specifics are provided in the TDPP to drive development of the document.

#### 4. SDDs

Huddle Team Use During SDD Preparation: The procedure for preparation of SDD, NLP-3-33, does not identify the selection and use of huddle teams. These individuals are providing design input into the SDDs based on their knowledge and expertise. The huddle team members are not identified in any of the documentation resulting from the SDD development, except in some of the cover sheets in the Lotus Notes Database. However, the names in some cases are incorrect or do not appear at all.

It is recommended to include the selection and use of the huddle team in NLP-3-33 and identify them in the database or by some other documented method.

CPGPs: The Project Compliance Program Guidance Packages (CPGPs) are developed for each SDD in accordance with NLP-3-36 specifically for use in the SDD development. These packages are developed based on the contents and scope of the SDD. The Packages contain all the applicable NRC "design criteria" that might impact a specific SDD. The Packages have the same process for check, review and approval as other design input. The Packages for several of the Revision 00 SDDs and some Revision 01 SDDs, were not available at the time of the SDD preparation or revision and not included. The procedure for SDD preparation, NLP-3-33, does not require input of the Package if not prepared.

It is recommend that all new or revised SDDs that do not include input from an approved Project CPGPs clearly state this fact in the SDD. In addition, a strategy on completing and including the Packages in the SDDs should be developed.

Lotus Notes Database for SDDs: The Lotus Notes Database identifies SDDs and their revision status on a "cover sheet." The actual approved SDD can be viewed and printed from this database. The database SDD cover sheet also contains the SDD schedule and the members of

the huddle team. None of the cover sheets reviewed contained scheduling information. Several did not contain the names of the huddle team members and in one case, for a SDD Revision 01, the author and huddle team members were those for Revision 00. For one SDD not yet started, which was originally drafted in 1997, the scope and title have been modified, but the attached draft reflects the original SDD title and scope. There is no explanation of why this draft still appears in the database. The auditor was told some portions would help the originator in the future.

It is recommended using this resource to identify the huddle team members and keep all the information up-to-date. Those sections of the cover sheet that will not be maintained should be removed.

5. A process recommendation will be made relative to the methodology(s) utilized by the checking group. The problem is that the imaged check copies do not disclose the markup by the checkers. Most checkers following the DGM identify their "check" and "back checks" in colors that are not picked up by the imaging process. Those "check" copies captured in the RIS are useless and the original maintained as "one of a kind" is difficult to retrieve. Other checkers are marking their copies in black ink which does image. The checking process is currently not being consistently performed (documented).

It is recommended that the Engineering Services meet with Records and agree on a process that will meet the needs and desired efficiencies for both parties.

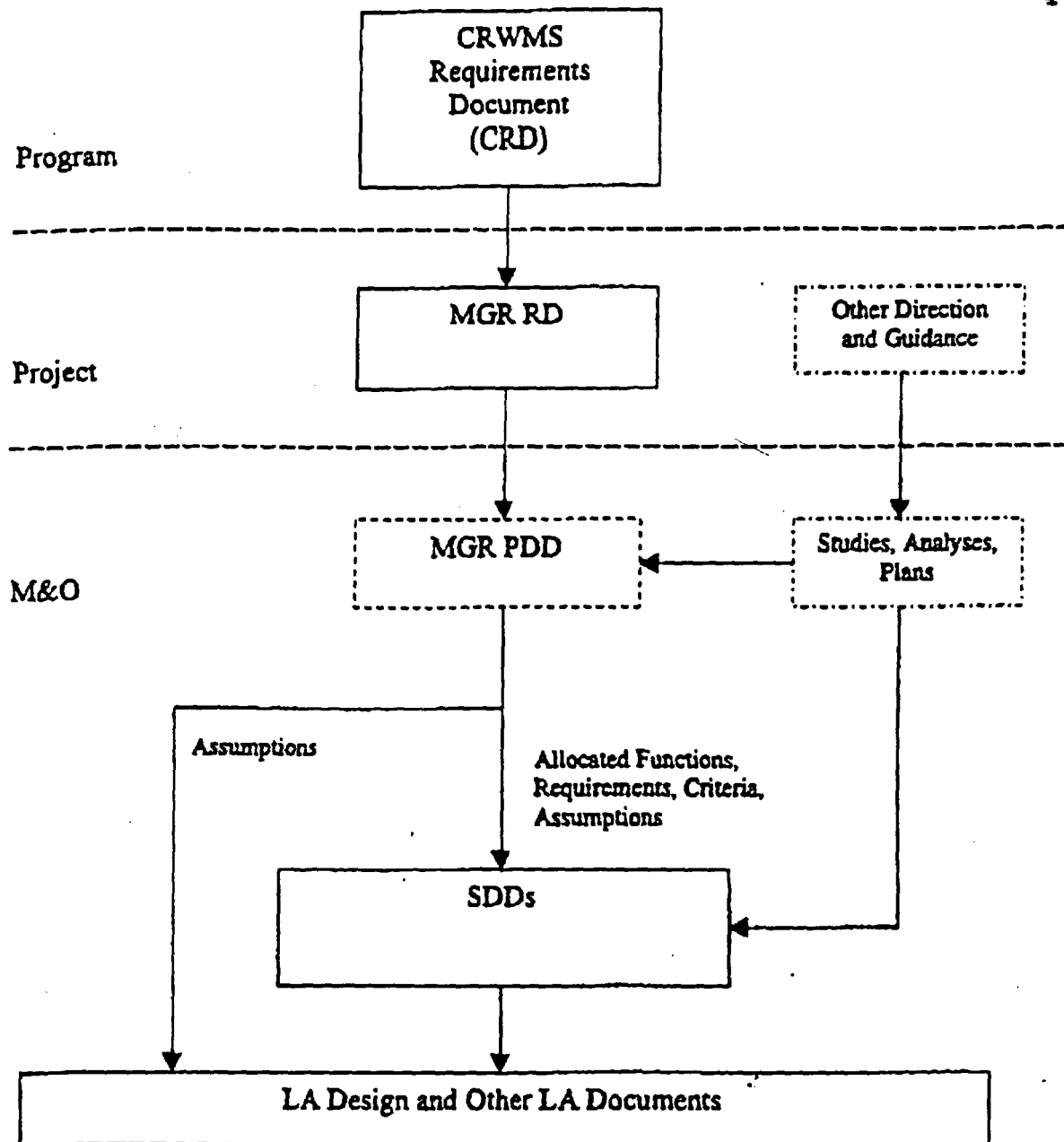


Figure 1. Technical Document Hierarchy for LA Design