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**TECHNICAL SUPPORT DOCUMENT FOR CFR 194.27:  
SPALLINGS CONCEPTUAL MODEL PEER REVIEW**

**U. S. ENVIRONMENTAL PROTECTION AGENCY  
Office of Radiation and Indoor Air  
Center for the Waste Isolation Pilot Plant  
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## EXECUTIVE SUMMARY

This report presents results of U.S. Environmental Protection Agency (EPA) review of the U.S. Department of Energy (DOE) Spallings Conceptual Models Peer Review compliance with the requirements of 40 CFR 194.27 and NUREG-1297. This peer review was undertaken by the Carlsbad Field Office (CBFO) of DOE to evaluate conceptual model changes proposed by DOE for assessing the performance of the Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico. The meeting of the peer review panel was conducted pursuant to a peer review procedure and plan prepared by DOE. The adequacy of DOE's procedure for conducting peer reviews and the peer review plan were reviewed as part of this evaluation. Also examined were the qualifications of the panel members, the criteria for selection of panel members, and the extent to which the peer review process allowed free and unfettered discussion of the topical information by the panel. These evaluations were based on detailed reviews of peer review documentation and observations made during the peer review meeting.

The peer review process was evaluated using a checklist developed by EPA. This checklist was based on the requirements of 40 CFR 194.27 (EPA 1998) including the requirement to conduct the review in accordance with the U.S. Nuclear Regulatory Commission document NUREG-1297, *Peer Review for High-Level Nuclear Waste Repositories* (NRC 1988).

For the purposes of performing the Spallings Conceptual Model Peer Review, DOE's peer review procedure and plan were found to satisfactorily address EPA's requirements. The EPA identified one Finding and one Concern during this assessment. The Finding was related to the adequacy of DOE CBFO procedure MP 10.5 Revision 5. The Concern was directed to the fact that Dr. Frank Hanson of Sandia National Lab, one of the presenters, appeared to attempt to sway the Peer Review panel away from testing the DR\_SPALL code over the range of parameters requested by the panel. His actions potentially could have limited the full and open discussion of issues.

The EPA review team believes that this Finding and the Concern did not hinder the Peer Review Panel from performing an independent assessment of the quality of the DR\_SPALL model for use in WIPP compliance calculations. EPA found that the Peer Review panel was not influenced during its deliberations and that the final peer review report was developed consistent with 40 CFR 194.27 requirements.

## **1.0 INTRODUCTION**

This report describes the degree to which the DOE Spallings Model Conceptual Models Peer Review conforms with the EPA's process requirements for conducting peer reviews. The independent peer review evaluated in this report addressed changes to conceptual models used by DOE to assess the performance of the WIPP in southeastern New Mexico. These changes were proposed by the Department for use in performance assessment (PA) for the first recertification of the WIPP. Recertification is required by Section 8(f) of the WIPP Land Withdrawal Act at five-year intervals following the date of first waste disposal to demonstrate the facility's continuing compliance with regulatory requirements. An earlier peer review was conducted in 1996 and 1997 to support WIPP's original Compliance Certification Application (CCA). Peer review of conceptual models is required by the Agency in 40 CFR 194.27 (EPA 1998). The Agency's requirements for the peer review include conducting the review in a manner that is compatible with the U.S. Nuclear Regulatory Commission (NRC) guidance in NUREG-1297, *Peer Review for High-Level Nuclear Waste Repositories* (NRC 1988).

The scope of this report covers the initial meeting of the peer review panel from July 7 through July 10, 2003 in Albuquerque, NM along with a review of the final Peer Review Report issued in October 2003. This report documents the EPA assessment of the meeting activities and presents conclusions based on attendance at the peer review panel's activities.

The procedural adequacy of the peer review was evaluated in this report using a checklist developed by EPA. The checklist identifies all significant requirements of 40 CFR 194.27 and NUREG-1297 for conducting peer reviews. Some of the requirements in the EPA's peer review checklist were found to address situations that do not apply to this peer review or to the procedure and were identified as not applicable. A copy of the checklist is presented as Attachment 1 of this report. The adequacy of the peer review process to date was determined based on a review of CBFO's peer review procedure, the peer review plan, and observation of the peer review presentations and Peer Panel caucuses.

The following sections of this report document the Agency's reviews of the Department's peer review procedure (Section 2.0) and peer review plan (Section 3.0), followed by an evaluation of the peer review implementation (Section 4.0). Conclusions are presented in Section 5.0.

## **2.0 PEER REVIEW PROCEDURE**

The Spallings Conceptual Model Peer Review meeting was conducted under CBFO Management Procedure (MP) 10.5, Revision 5, "Peer Review" (DOE 2003a). Most of the 40 CFR 194 and NUREG 1297 requirements were repeated in MP 10.5 Revision 5 essentially verbatim; for those requirements the procedure is considered to be in compliance.

The EPA identified one Finding regarding MP 10.5. This Finding, provided in Attachment 2 as Finding #2, relates the failure of the procedure to adequately describe all the peer review activities required under NUREG 1297. The following three specific items were identified as part of this Finding:

1. MP 10.5 does not fully address Section IV of NUREG-1297, in particular Section IV.1, Applicability of Peer Review. NUREG-1297 in Section IV.1.(a) states that “Peer Review should be used when the adequacy of information...cannot otherwise be established through testing, alternative calculations, or through reference to previously established standards and practices”. The fact that MP 10.5 does not address this section of NUREG-1297 does not hinder the use of MP 10.5 for the Spallings Conceptual Model Peer Review, as this peer review was mandated by 40 CFR 194. However, if MP 10.5 is to be used for Peer Review activities in general, such as for waste characterization activities, then Section IV of NUREG-1297 must be addressed for the procedure to be compliant.
2. Step 7.1 in Attachment 1 to MP 10.5 Revision 5 conflicts with step 5.4.1 of the main procedure body. Step 5.4.1 states that the CBFO QA Manager “should conduct assessments...”; step 7.1 of Attachment 1 states the CBFO QA Manager “shall conduct assessments...”. Step 5.4.1 apparently conflicts with Section V of NUREG 1297, which requires assessments.
3. Steps 5.4.4 and 5.4.5 state that the QA Manager will be responsible for assessment/audit coordination with the regulators, and will also be responsible for Observer attendance at Peer Review caucuses. In fact, for the Conceptual Model Peer Review, CBFO QA staff have not been involved in assessment/audit coordination with the EPA team, nor have they been involved with determining the attendance of Observers at the Peer Review caucuses. The EPA is concerned that this wording in the procedure conflicts with the role of the peer review manager.

This Finding did not seriously affect the use of MP 10.5 Revision 5 for conducting this peer review meeting, but could result in more serious deficiencies for future peer reviews.

### **3.0 PEER REVIEW PLAN**

The Spallings Conceptual Models Peer Review Plan (DOE 2003b) describes process and documentation requirements for applying peer review procedure CBFO MP 10.5 to the Spallings Conceptual Models Peer Review. The plan used for this peer review meeting was prepared by Time Solutions Corporation, the peer review contractor to CBFO, to implement CBFO MP 10.5, Revision 5 discussed in Section 2 of this report. The plan described the approach, purpose, and scope of the peer review. The plan was in general conformance with the requirements of NUREG-1297 either through incorporating the requirements of the procedure CBFO MP 10.5 by reference or through repeating the requirements of NUREG-1297 directly in the plan. The EPA team noted that the Peer Review Plan being used did not contain evidence of approval by CBFO prior to use, as

required by Section 6.1.1 of Attachment 1 to MP 10.5 Revision 5. Interviews with the Peer Review Manager and CBFO representatives indicated that the plan had been approved, but that EPA was provided an old copy that did not yet contain the signatures.

The EPA did not identify any findings or concerns related to the peer review plan.

## **4.0 PEER REVIEW IMPLEMENTATION**

### 4.1 Peer Review Meetings and Schedule

The Spallings Conceptual Model Peer Review meeting was conducted at the DOE Training Center located on Kirtland Air Force Base in Albuquerque, New Mexico. The information regarding the proposed Spallings model was presented by staff or contractors of Sandia National Laboratory (SNL), the designated Science Advisor to DOE for WIPP. Most of the technical information presented to the Peer Panel was provided by SNL staff. The peer review meeting began on Monday, July 7, 2003, with Peer Panel orientation. Technical presentations by SNL began following the orientation, and continued through July 10. Several hours were allocated each day for Peer Panel review and internal discussion. The Peer Panel concluded at the end of the presentation and discussion sessions on July 10 that further information was needed from DOE before the panel could reach any conclusions regarding the proposed spallings model. This information included additional model test results using a wide range of input parameters. DOE committed to supply the Peer Panel members with all requested information. The panel members did not have another formal meeting, but deliberated by email, phone and correspondence (See Attachment 4).

The Panel's activities during July 2003 were observed by representatives of EPA, SNL, DOE, the New Mexico Environmental Evaluation Group (EEG), and others. Observers were required to obey strict protocols for interacting with the Panel's activities. Observers were allowed to ask questions and raise issues, but only in writing. All activities related to the peer review were documented on pre-prepared forms and meeting minutes. All information requests from observers were handled by the Peer review Manager, Mr. John Thies of Time Solutions Corporation.

EPA monitored the performance of the peer review after the initial July 2003 meetings. During our review we noted that the final peer review report had an error in an equation in Section 3.2.4, Motion of Mud Equations. The Peer Review panel corrected this error in a letter in March 2004 (See Attachment 5).

### 4.2 Peer Panel Members

The Peer Panel consisted of three individuals:

Dr. Ching Hsie Yew, a professor of Mechanical Engineering with specific experience in oil and gas drilling technology;

Dr. Lawrence Teufel, a Professor of Geology with expertise in rock mechanics and drilling technologies;

Dr. Jonathon Hanson, a consulting Geophysicist with experience in modeling and drilling technologies.

Dr. Yew was selected by the panel as the Chairman.

The panel was selected by a Peer Review Selection Committee consisting of Mr. John Thies (the Peer Review Manager), Dr. Michael Gross, and Dr. Lokesh Chaturvedi. The selection committee presented evidence that these panel members were selected from a list of forty potential panel members based on a combination of technical qualifications, independence, and availability. The selection process was documented on Peer Review Selection/Non-Selection Justification Form provided to the EPA team during the peer review meeting. The qualifications for the three selected individuals were also provided in the form of curriculums vitae.

Only one panel member, Dr. Lawrence Teufel, was observed to have any potential conflict of interest. Dr. Teufel has worked for Sandia National Laboratory in the past, however, his employment ended over five years ago, and he was not a part of WIPP work while at SNL. Dr. Teufel submitted a statement of independence describing his past work experience at SNL that documents his independence; this statement was included with his curriculum vitae.

#### 4.3 Implementation of the Peer Review

The EPA concluded that the peer review was effectively implemented in accordance with the requirements contained in 40 CFR 194 and NUREG 1297. Documentation of the elements reviewed by the EPA is contained in the final EPA peer review checklist provided in Attachment 1. All checklist items except one were either *In Compliance* or *Not Applicable*. The checklist item considered not in compliance at this time is item 13, asking “Does the peer review process show that full and frank discussions between the PRG and the performers of the work are encouraged?” (Ref: NUREG-1297 Section IV. 4.). During the peer review meeting, Dr. Frank Hanson of Sandia appeared to limit the full discussion of issues by the panel by insisting that the panel should not test the new model at parameter values outside the expected range of values for the WIPP. This checklist item is documented as Concern #1.

EPA does not require a response to this Concern. After interviewing the panel members and reviewing the final report, the EPA does not believe Dr. Hanson had a significant effect on the panel’s conclusions. EPA evaluated CBFO’s actions to ensure peer review panels were afforded complete independence and freedom of action at future peer review activities to ensure there is no evidence of systematic limitation of peer review panels.

#### 4.4 Adequacy of Documentation



The following documents were reviewed for this report and found to adequately explain the peer review process.

CBFO procedure MP 10.5, Revision 5, *Peer Review*, controls the peer review process.

The *Waste Isolation Pilot Plant Spallings Peer Review Plan*, developed by Time Solutions Corporation, was prepared to implement the peer review process.

The peer reviewer selection process was adequately documented as follows.

- A signed memorandum was prepared by the Peer Review Manager identifying the three members of the Spallings Peer Review Panel Selection Committee and the basis for selecting each committee member. The selection committee members consisted of the Peer Review Manager, a technical representative, and a quality assurance representative.
- A *Peer Reviewer Selection/Non-Selection Justification Form* was prepared documenting the subject matter to be reviewed, the expertise, experience, and education requirements, the independence requirements, and the schedule commitment requirements of the peer reviewers. This form was accompanied by a list of peer reviewer candidates containing an explanation justifying the elimination of those that were not selected. This list was signed by the three selection committee members. Reasons for not selecting specific individuals included conflict of interest, previous support of the WIPP, equally or more qualified individuals available, and unable to contact.
- A signed memorandum was prepared by the three members of the Peer Panel member selection committee identifying the three Peer Panel members that were selected and the justification for their selection.
- The technical qualifications of each of the selected Peer Panel members were provided as curriculums vitae. These qualifications indicated that the collective expertise and experience of the Panel members was sufficient to adequately address the scope of the review.
- Letter, Vernon Daub, Carlsbad Technical Assistance Contractor, to Mr. Harold Johnson, CBFO Contracting Officers Representative, nominating Mr. John Thies as the Peer Review Manager for the Spallings Conceptual Model Peer review.
- Signed *Determination of Peer Panel Member Independence* forms were included from each selected Peer Panel member. The only panel member with any potential for conflict of interest was Dr. Teufel, who submitted an additional independence statement describing his past activities at SNL. These activities were judged to not present an actual conflict of interest.
- Letter from Harold Johnson, CBFO Contracting Officer representative, to Mr. Vernon Daub, Carlsbad Technical Assistance Contractor, requesting a peer review be performed on the Spallings Conceptual Model. This request identified the scope and requirements for the peer review as described in MP 10.5

Minutes were prepared for both the peer review meetings and the peer review panel caucus sessions. These minutes document the leadership role of the Panel chairperson in determining and guiding the peer review process. The minutes adequately capture the

schedule and flavor of the meetings but contain incomplete information on technical discussions and should not be relied upon as sources technical information.

The final report of the peer review, titled “Spallings Conceptual Model Peer Review Report” was produced in October of 2003 by Time Solutions Corp.(for DOE CBFO). The report adequately describes the scope of the peer review, the criteria for examination, the composition and qualifications of the panel members, the conclusions reached by the panel, and whether there were any dissenting opinions.

## **5.0 CONCLUSIONS**

The EPA concludes that the Spallings Conceptual Model Peer Review was performed in accordance with the requirements of 40 CFR 194 and NUREG 1297.

EPA identified one Concern and one Finding as a result of this review. The Concern and the Finding are documented in Attachment 2. The Concern relates to possible limiting of the free and full discussion of issues by the Peer Review Panel. The Finding is in regard to the adequacy of MP 10.5 to the NUREG 1297 peer review process.

The observation of the peer review, interviews with participants, and documentation reviewed by the EPA supports a determination that the Peer Panel members were appropriately selected, and that the peer review was performed and managed in accordance with NUREG-1297.

## **REFERENCES**

DOE 2003a. Peer Review. *Management Procedure 10.5 Rev 5*. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico, February.

DOE, 2003b. *Waste Isolation Pilot Plant Spallings Peer Review Plan*. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico, February.

EPA 1998. 40 CFR Part 194 Final Rule. *Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40 CFR Part 191 Disposal Regulations: Certification Decision*. U.S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C.

NRC 1988. *Peer Review for High-Level Nuclear Waste Repositories*. NUREG-1297. U.S. Nuclear Regulatory Commission, Washington, DC, February.

Attachment 1  
Peer Review Checklist



	<b>Peer Review Requirements</b>		
<b>#</b>	<b>Question</b>	<b>Comment (Objective Evidence)</b>	<b>Result</b>
	<b><u>194.27 Rule Requirements</u></b>		
1	<p>40 CFR 194.27 “(a) Any compliance application shall include documentation of peer review that has been conducted, in a manner required by this section, for:</p> <p>(1) Conceptual models selected and developed by the Department;</p> <p>(2) Waste characterization analyses as required in Section 194.42(b); and</p> <p>(3) Engineered barrier evaluation as required in Section 194.44.”</p> <p><b>Is this Peer Review a review of one of the topics listed above?</b></p>	This is a Conceptual Model Peer Review per item (1)	Y
2	<p>40 CFR 194.27 “(b) Peer review processes required in paragraph (a) of this section, and conducted subsequent to the promulgation of this part, shall be conducted in a manner that is compatible with NUREG-1297, "Peer Review for High-Level Nuclear Waste Repositories," published February 1988. (Incorporation by reference as specified in § 194.5.)”</p> <p><b>Do the Peer Review procedure document, verify that the peer review performed is compatible with NUREG-1297? See NUREG-1297 checklist below.</b></p>	The peer review was performed in a manner that was in accordance with NUREG 1297. The deficiencies or findings identified during the review did not limit the ability of the panel to perform an acceptable peer review.	Y

<b><u>194.27 Rule Requirements</u></b>			
3	<p>40 CFR 194.27 “(c) Any compliance application shall:  (1) Include information that demonstrates that peer review processes required in paragraph (a), and conducted prior to the implementation of the promulgation of this part, were conducted in accordance with an alternate process substantially equivalent in effect to NUREG-1297 and approved by the Administrator or the Administrator’s authorized representative; and”</p> <p><b>Is this peer review “substantially equivalent in effect to NUREG-1297” and has the Agency approved the procedures used in this peer review?</b></p>	This Peer Review is being done after implementation of 40 CFR 194.27.	N/A
4	<p>40 CFR 194.27 “(c) Any compliance application shall:  (2) Document any peer review processes conducted in addition to those required pursuant to paragraph (a) of this section. Such documentation shall include formal requests, from the Department to outside review groups or individuals, to review or comment on any information used to support compliance applications, and the responses from such groups or individuals.</p> <p><b>Does the Department document processes as noted in (2) above?</b></p>	This Peer Review is being done for one of the purposes listed in paragraph (a) of 40 CFR 194.27, not in addition to those required in that part.	N/A

<b>NUREG-1297: Peer Review Requirements</b>			
<b>#</b>	<b>Question</b>	<b>Comment (Objective Evidence)</b>	<b>Result</b>
<b>Applicability of Peer Review</b>			
5	<p>Is there documentation that is “used when the adequacy of information or the suitability of procedures and methods essential to showing that the repository system meets or exceeds its performance requirements with respect to safety and waste isolation cannot otherwise be established through testing, alternative calculations or reference to previously established standards and practices”?</p> <p>NUREG-1297 Section IV. 1. a.</p>	<p>CBFO is required by 40 CFR 194.27 (a) to perform this Peer Review, so no documentation regarding the investigation of alternatives is necessary.</p>	N/A
6	<p>Is there documentation that the peer review is being conducted in response to one or more of the following conditions?</p> <p>(a) Critical interpretations or decisions will be made in the face of significant uncertainty, including the planning for data collection, research, or exploratory testing</p> <p>(b) Decisions or interpretations having significant impact on performance assessment conclusions</p> <p>(c) Novel or beyond the state-of-the art testing, plans and procedures, or analyses are or will be utilized</p> <p>(d) Detailed technical criteria or standard industry procedures do not exist or are being developed</p> <p>(e) Results of test are not reproducible or repeatable</p> <p>(f) Data or interpretation are ambiguous</p> <p>(g) Data adequacy is questionable—such as, data may not have been collected in conformance with an established QA program</p> <p>NUREG-1297 Section IV. 1. b.</p>	<p>This Peer Review is being conducted in response to the mandate in 40 CFR 194.27.</p> <p>This peer review is evaluating the spallings model, which could have input into decisions and interpretations having significant impact on performance assessment conclusion (see item (b)).</p>	Y

<b>NUREG-1297: Peer Review Requirements</b>			
<b>#</b>	<b>Question</b>	<b>Comment (Objective Evidence)</b>	<b>Result</b>
<b>Applicability of Peer Review</b>			
7	<p>Is this peer review being performed because the adequacy of a critical body of information can be established by alternate means, but there is disagreement within the cognizant technical community regarding the applicability or appropriateness of the alternate means?</p> <p>NUREG-1297 Section IV. 1. c</p>	<p>This Peer Review is being performed as mandated by 40 CFR 194.27.</p>	N/A
<b>Structure of Peer Review Group</b>			
8	<p>(a) Is the size of the peer review group (PRG) consistent with the complexity, importance, and uncertainty of the work reviewed?</p> <p>(b) Does the collective technical expertise and qualifications of the PRG members span the technical issues and areas involved in the work reviewed, including differing bodies of scientific thought?</p> <p>(c) Is the representation of the PRG proportional to the technical areas more central to the work to be reviewed?</p> <p>(d) Does the PRG represent major schools of scientific thought?</p> <p>(e) Has the potential for partiality been minimized by selection of peers to provide balance in the PRG?</p> <p>NUREG-1297 Section IV. 2</p>	<p>A 3 member group size is discussed in selection memo</p> <p>Per resumes, experience includes fracturing, flow mechanics, geology, drilling, and modeling.</p> <p>Focused geological processes and drilling/fracturing.</p> <p>Various backgrounds include industry and academia</p> <p>The panel members have diverse education and experience backgrounds.</p> <p>Verified by discussions with panel and examination of resumes and selection forms</p>	<p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p> <p>Y</p>



<b>NUREG-1297: Peer Review Requirements</b>			
<b>#</b>	<b>Question</b>	<b>Comment (Objective Evidence)</b>	<b>Result</b>
<b><u>Acceptability of Peers</u></b>			
9	<p>Technical Requirement: Does each reviewer have recognized and verifiable technical credentials in the technical area covered?</p> <p>NUREG-1297 Section IV. 3. a.</p>	Per Curriculum Vitae (CV) for each panel member. Each CV claim of employment/education has been checked by Time Solutions Corp per the verification forms.	Y
10	<p>Independence Requirement: Is the PRG independent of the original work to be reviewed?</p> <p>For PRG members not totally independent, is an adequate documented rationale provided?</p> <p>NUREG-1297 Section IV. 3. b.</p>	Only L. Teufel has any past related experience, this being with Sandia but not in WIPP related work within the last 10 years. No panel member has worked on the spall model. L. Teufel has submitted an independence statement describing his past Sandia experience.	Y
<b>Peer Review Process</b>			
11	<p>Does the PRG chairperson determine the peer review process used?</p> <p>NUREG-1297 Section IV. 4.</p>	Observed the peer review chairman, Dr. Yeh, define the roles of each panel member during the panel orientation.	Y
12	<p>Does the PRG evaluate and report on the following?</p> <p>(a) validity of assumptions;</p> <p>(b) alternate interpretations;</p> <p>(c) uncertainty of results and consequences if wrong;</p> <p>(d) appropriateness and limitations of methodology and procedures;</p> <p>(e) adequacy of application;</p> <p>(f) accuracy of calculations;</p> <p>(g) validity of conclusions;</p> <p>(h) adequacy of requirements and criteria.</p> <p>NUREG-1297 Section IV. 4.</p>	The Peer Review Plan contains these charges to the panel; these were also covered in the panel orientation.	Y

13	<p>Does the peer review process show that full and frank discussions between the PRG and the performers of the work are encouraged?</p> <p>NUREG-1297 Section IV. 4.</p>	<p>The orientation briefing encouraged full and open discussion of issues, however, Dr. Frank Hanson of Sandia appeared to limit the full discussion of issues by the panel by insisting on limiting the range of the waste tensile strength parameter. See Concern #1. After interviewing the panel members and reviewing the final report, the EPA does not believe Dr. Hanson had a significant effect on the panel's conclusions.</p>	N
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NUREG-1297: Peer Review Requirements			
#	Question	Comment (Objective Evidence)	Result
<b>Peer Review Process</b>			
14	Are procedures developed for the peer review process?  NUREG-1297 Section IV. 4.	CBFO MP 10.5 Rev 5  Procedure has inadequacies relative to the NUREG peer review process. These are documented in Finding #1	Y
15	Are written minutes of meetings, deliberations, and activities of the PRG prepared?  NUREG-1297 Section IV. 4.	Minutes taken by Time Solutions staff. These were collected by the EPA team.	Y
16	Do procedures provide methods for initiating a peer review?  NUREG-1297 Section IV. 4.	CBFO MP 10.5 Rev 5, section 5.1 Done via letter H. Johnson, CBFO, to V. Daub, CTAC, Jan 29, 2003	Y
17	Do procedures require a planning document that describes the work reviewed, the size and spectrum of the PRG, the method chosen, and the schedule?  NUREG-1297 Section IV. 4.	CBFO MP 10.5 Rev 5, attachment 1	Y
<b>Peer Review Report</b>			
18	Is a written report documenting the results of the peer review issued and signed by each member of the PRG?  NUREG-1297 Section IV. 5.	Spallings Conceptual Model Peer Review Report, Time Solutions Corp.(for DOE CBFO), October 2003.  Concurrence signatures are in appendix D	Y
19	Does the report clearly state the work or issue reviewed and the conclusions reached by the peer review process?  NUREG-1297 Section IV. 5.	Spallings Conceptual Model Peer Review Report, Time Solutions Corp.(for DOE CBFO), October 2003.  Section 1 states work reviewed, Section 2.5 the criteria, section 5 the conclusions.	Y
<b>Peer Review Report</b>			

20	Does the report include individual statements by PRG members reflecting dissenting views and comments, as appropriate?  NUREG-1297 Section IV. 5.	Spallings Conceptual Model Peer Review Report, Time Solutions Corp.(for DOE CBFO), October 2003.  Section 6 is for dissenting views, but there were no dissenting views from the panel.	Y
21	Does the report contain a listing of the reviewers and any acceptability information for each member of the PRG, including potential technical and/or organizational partiality  NUREG-1297 Section IV. 5.	Spallings Conceptual Model Peer Review Report, Time Solutions Corp.(for DOE CBFO), October 2003; Appendices A, B, and C	Y
	NUREG Discussion		
22	Does the QA organization provide surveillance of the peer review process to ensure that procedures conform to NUREG-1297 and that they are followed by the PRG?  NUREG-1297 Section V.	CBFO did not perform a surveillance of this peer review during the meeting. EPA will separately evaluate the implementation of the CBFO QA organization audit and surveillance program as applied to Peer Review activities during audits of CBFO.	N/A
23	Is this peer review used in a confirmatory sense?  NUREG-1297 Section V.	No, this peer review determines the acceptability of models	N/A

Attachment 2  
Concern and Finding Forms

AUDITOR: Ray Wood

DATE: 07/10/03

NQA REQUIREMENT: NQA-3 Peer Reviews		
AUDITEE PROCEDURE: CBFO MP 10.5 Revision 5		
FINDING	CONCERN <b>X-#1</b>	
<p>NQA-3 requires peer review activities for WIPP be performed in accordance with NRC NUREG-1297. NUREG-1297 Section IV. 4 requires the peer review process to encourage full and frank discussions between the PRG (peer review group) and the performers of the work. However, during the peer review meeting, Dr. Frank Hanson of Sandia appeared to limit the full discussion of issues by the panel by insisting that the panel should not test the new model at waste tensile strength parameter values outside the expected range of values for the WIPP</p> <p>EPA does not require a response to this concern. EPA will evaluate CBFO's actions to ensure peer review panels are afforded complete independence and freedom of action at future peer review activities to ensure there is no evidence of systematic limitation of peer review panels.</p>		
AFFECTS QUALITY ASSURANCE:	YES	<b>NO</b>
AFFECTS QUALITY:	YES	<b>NO</b>
ADEQUATE RESPONSE PROVIDED:	YES	<b>NO</b>
CORRECTED DURING AUDIT:	YES	<b>NO</b>

AUDITOR: Ray Wood

DATE: 07/10/03

NQA REQUIREMENT: NQA-1 Element 5, Procedures

AUDITEE PROCEDURE: CBFO MP 10.5 Revision 5

FINDING **X-#1** CONCERN

NQA-1 Element 5 requires “Activities affecting quality shall be prescribed by and performed in accordance with documented instructions, procedures, or drawings of a type appropriate to the circumstances.” The EPA is concerned that MP 10.5 Revision 5 is not appropriate to the circumstances with respect to controlling peer reviews performed under NRC NUREG-1297. In particular, the EPA identified the following:

1. MP 10.5 does not fully address Section IV of NUREG-1297, in particular Section IV.1, Applicability of Peer Review. NUREG-1297 in Section IV.1.(a) states that “Peer Review should be used when the adequacy of information...cannot otherwise be established through testing, alternative calculations, or through reference to previously established standards and practices”. The fact that MP 10.5 does not address this section of NUREG-1297 does not hinder the use of MP 10.5 for the Spallings Conceptual Model Peer Review, as this peer review was mandated by 40 CFR 194. However, if MP 10.5 is to be used for Peer Review activities in general, such as for waste characterization activities, then Section IV of NUREG-1297 must be addressed for the procedure to be compliant.

2. Step 7.1 in Attachment 1 to MP 10.5 Revision 5 conflicts with step 5.4.1 of the main procedure body. Step 5.4.1 states that the CBFO QA Manager “should conduct assessments...”; step 7.1 of Attachment 1 states the CBFO QA Manager “shall conduct assessments...”. Step 5.4.1 apparently conflicts with Section V of NUREG 1297, which requires assessments.

3. Steps 5.4.4 and 5.4.5 state that the QA Manager will be responsible for assessment/audit coordination with the regulators, and will also be responsible for Observer attendance at Peer Review caucuses. In fact, for the Conceptual Model Peer Review, CBFO QA staff have not been involved in assessment/audit coordination with the EPA team, nor have they been involved with determining the attendance of Observers at the Peer Review caucuses. The EPA audit team is concerned that this wording in the procedure conflicts with the role of the peer review manager.

AFFECTS QUALITY ASSURANCE:      **YES**      NO

AFFECTS QUALITY:                      YES      **NO**

ADEQUATE RESPONSE PROVIDED:      YES      **NO**

CORRECTED DURING AUDIT:              YES      **NO**

Attachment 3  
Personnel Interviewed



<u>Name</u>	<u>Position</u>	<u>Entrance Mtg</u>	<u>Interview</u>	<u>Exit Mtg</u>
Mr. John Thies	PR Manager	X	X	X
Dr. Ching Hsie Yew	Panel Chair		X	
Dr. Lawrence Teufel	Panel Member		X	
Dr. Jonathon Hanson	Panel Member		X	
Mr. Steve Casey	PR coordinator	X	X	X

**Attachment 4**  
**DOE Statement: Peer Review Report Generation Process**

## **Spallings Peer Review Report Generation Process Description**

At the conclusion of meetings in Albuquerque, the Spallings Peer Review Panel worked under the direction of Chairman Ching Yew to prepare the various sections of the final report. Communications during this time period were by voice mail and e-mail. A number of working draft sections were prepared and transmitted via the panel members as the sections of the document were assembled. These were viewed simply as working files (some being quite rough) and record copies were not retained as there was no procedural requirement to do so. At the Panel felt that most of the information and personal interaction conducted during the peer review meetings was sufficient to meet their needs for final report preparation, there were no face-to-face meetings during this final phase of report preparation.

**Attachment 5**  
**Spall Peer Review Report Correction Letter**  
**To Section 3.2.4 Motion of the Mud Column**  
**March 2004**

Washington TRU Solutions LLC (WTS)  
Procurement Services  
P.O. Box 2078  
Carlsbad, New Mexico 88221  
Attn: Mario Carrasco

Subject: Spallings Conceptual Model Peer Review

Dear Mr. Carrasco:

An issue has arisen related to the Spallings peer review that was submitted to you in October of 2003. The panel would like to change their submission for Section 3.2.4 (Motion of the Mud Column). Please see the attached replacement for Section 3.2.4.

Please do not hesitate to contact me if you have any questions regarding this correspondence.

Best regards,

John A. Thies  
Vice President,  
Time Solutions Corp.

### 3.2.4 The Post-Penetration Wellbore Flow

In the current SNL model, it is assumed that the gas and spalled waste particles are mixed with drilling mud in the bit cavity forming a slurry; and the slurry is carried up through the wellbore to the surface by the circulating drilling mud. The motion of slurry, which contains mud, gas, salt, and waste particles, in the wellbore is governed by a compressible mixed Navier-Stokes equation. The equations are:

Mass balance equation,

$$\frac{\partial}{\partial t}(\rho V) + \frac{\partial}{\partial z}(\rho V u) = S_{mass} ,$$

Momentum balance equation,

$$\frac{\partial}{\partial t}(\rho V u) + \frac{\partial}{\partial z}(\rho V u^2) = -V\left(\frac{\partial p}{\partial z} - \rho g + F\right) + S_{mom} ,$$

The equation of state of constituents is:

For the mud,  $\rho_m = \rho_{0(m)}[1 + c_m(p - p_0)]$ ,

For the gas,  $\rho_g = \rho_{0(g)} \frac{p}{p_0}$ ,

and, For the salt and waste particles,

$$V_{s,w} = \frac{m_{s,w}}{\rho_{0(s,w)}} .$$

In the above equations,  $u$  is the velocity of flow,  $\rho$  is the density of slurry, and  $V$  is the volume of slurry, i.e.,

$$V = V_{salt} + V_{waste} + V_{mud} + V_{gas} .$$

The effects of pipe friction, type of flow (laminar or turbulent), and slurry viscosity on the flow property are also taken into consideration in the calculation.

The ideal gas law is used in the formulation, the cavity is assumed to grow with drilling, and there is no momentum transfer between the gas and the mud during mixing. These assumptions are certainly reasonable.

The mass-transport formulation above addresses both the down-going and up-going mud columns in a continuous fashion. Implementation can be likened to a conveyor belt

where the first half of the belt is the down-going column and the second half is the up-going. At post-penetration, gas will be released from the repository and enter the mud-column. If spalling occurs, waste material will also enter the stream. It is important to note here that both the down-going and up-going mud columns are subject to the same boundary conditions within the cavity after post-penetration. This is the correct way to do it.

The model is sufficiently robust to adequately address the ballistic model of waste release as an extreme case. Should the repository gas pressure be sufficiently high, it is conceivable that the down-going flow could be choked off at the bit. Under this condition, there would be no mud supply to mix with the gas and waste entering the stream from the cavity. The up-going mud column would be supported only by a gas-waste column. This condition is sometimes referred to as a blow-out condition in oil field drilling.

The panel's opinion is that the above formulation is indeed proper for describing the release of spalled particles from the repository by the circulating mud during drilling. It is sufficiently robust to address all realistic scenarios.