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TECHNICAL SUPPORT DOCUMENT FOR SECTIONS 194.23, 194.32, AND 194.33 REVIEW OF CHANGES TO WIPP PERFORMANCE ASSESSMENT FEATURES, EVENTS, AND PROCESSES IN THE 2014 CRA

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PREFACE

The U.S. Department of Energy (DOE) is required to submit a Compliance Recertification Application (CRA) to the U.S. Environmental Protection Agency (EPA) for the Waste Isolation Pilot Plant (WIPP) facility every five years including an updated assessment of future WIPP performance. During EPA's review of DOE's CRA-2014 performance assessment (PA), events associated with the February 2014 repository fire and radionuclide release have resulted in closed portions of the underground facility. This closure has created a situation where certain parts of the underground facility could not be accessed for ground control. Panel 9 may be abandoned along with plans to install panel closures in panels 3, 4, 5 and 6.

Because the CRA performance assessments are predictions of post-closure repository performance and the EPA knows there will be modifications to the current repository design, modifying the CRA-2014 PA at this time to incorporate alternative parameter values would not add more reality to predictions of repository post-closure performance. Consequently, the EPA adopted the CRA-2014 PA as originally submitted by DOE as the baseline, rather than have DOE conduct a revised PA baseline calculation (PABC). In lieu of requesting a PABC-2014, the EPA requested that DOE conduct a set of sensitivity studies to address some of the significant technical concerns arising from the EPA's CRA-2014 review. The inputs to these sensitivity studies broadly address many of the EPA's technical concerns that could potentially impact long-term repository performance. The Agency has reviewed the results of these studies and determined that there exists an adequate level of confidence—that is, a reasonable expectation—that the repository will continue to comply with EPA regulations.

Additionally, the EPA recommends further work that can be conducted to evaluate many of the technical concerns identified in the EPA's review of the CRA-2014 PA, as well as incorporate future repository design changes. The EPA will work with DOE to determine the best path forward for resolution of EPA's concerns, which could include additional data reviews, independent technical reviews, and possibly additional sensitivity analyses to reach a consensus for the next CRA. It is anticipated that the results of these efforts will be incorporated into the CRA-2019 PA or otherwise be made available during EPA's review of the CRA-2019 PA.

EXECUTIVE SUMMARY

A comprehensive review of features, events, and processes (FEPs) potentially relevant to WIPP repository performance is conducted by the U.S. Department of Energy (DOE) prior to each recertification performance assessment (PA). Each FEP in the baseline list for the prior PA is accompanied by a screening argument that describes how that FEP was addressed in performance modeling. Those FEPs that are related to the changes that have occurred since the prior PA are identified and reviewed to determine if their screening arguments need to be updated to better reflect the changed conditions or if a new FEP needs to be added. The EPA-approved list of FEPs for the CRA-2009 PA was used by DOE as the baseline for identifying FEPs related to changes in the current CRA-2014 PA.

DOE's review concluded that the 245 FEPs in the 2009 baseline adequately addressed the types of features, events, and processes relevant to the CRA-2014 PA and no new FEPs needed to be added. Of the 245 FEPs in the proposed baseline for the CRA-2014 PA, 184 FEPs were unchanged from the CRA-2009 PA and 61 FEPs were updated with new information. EPA accepted DOE's screening classifications and arguments for 38 of the 61 FEPs identified by DOE as changed. For the 23 remaining FEPs, the Agency considered the screening arguments to be incomplete. EPA provided DOE with completeness questions for most of the remaining FEPs to better understand DOE's screening rationale. In addition, EPA had completeness questions concerning five FEPs that the Agency considered to have changed since 2009 but DOE had concluded "no change." Although satisfactory resolutions including modifications to screening arguments were provided by DOE for many of the FEPs that the Agency found to be incomplete, residual concerns remained for 16 FEPs that were not fully resolved.

The Agency concludes that SNL's FEPs baseline review successfully identified most FEPs that have changed since the 2009 baseline and that the Agency's principal concerns relate to incomplete descriptions of those changes in the FEP screening arguments. Although the additional FEPs identified by the Agency are potentially relevant and should have been considered by SNL, none are likely to have had a significant impact on repository performance. The Agency therefore accepts DOE's updated FEP baseline as appropriate for the CRA-2014 PA. However, the Agency expects that the need for more comprehensive screening arguments identified in this report will be resolved by DOE when preparing future FEP baselines. The Agency also expects that in future FEP baseline reviews, DOE will provide more comprehensive information on how the FEPs are addressed in PA.

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LIST OF ACRONYMS

AIC	Active Institutional Control
CARD	Compliance Application Review Document
CCA	Compliance Certification Application
CFR	*Code of Federal Regulations*
CH	Contact-Handled
CMPRP	Conceptual Models Peer Review Panel
CPR	Cellulosics, Plastics, and Rubber
CRA	Compliance Recertification Application
DOE	U.S. Department of Energy
DP	Screened in for disturbed performance scenarios

DRZ	Disturbed Rock Zones
EP	Events and Processes
EPA or the Agency	U.S. Environmental Protection Agency
ERMS	Electronic Record Management System
FEPs	Features, Events, and Processes
HCN	Historic, Current, or Near Future
LANL	Los Alamos National Laboratory
MB	Marker Bed
PA	Performance Assessment
PABC	Performance Assessment Baseline Calculation
PAIR	Performance Assessment Inventory Report
PCS	Panel Closure System
RH	Remote-Handled
ROM	Run-of-Mine
ROMPCS	Run-of-Mine (Salt) Panel Closure System
SDI	Salt Disposal Investigation
SDDI	Salt Defense Disposal Investigation
SNL	Sandia National Laboratories
SO-C	Screened out based on no, low, or beneficial consequence
SO-P	Screened out based on a very low probability of occurrence
SO-R	Screened out based on a regulatory directive
SP	Specific Procedure
SRoR	South Rest of the Repository
TRU	Transuranic
TSD	Technical Support Document
UP	Screened in for undisturbed performance scenarios
WIPP	Waste Isolation Pilot Plant

1.0 INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) repository has been developed by the Department of Energy (DOE) for the permanent disposal of transuranic (TRU) waste. The repository is located in deeply buried deposits of bedded salt in the Salado Formation in southeastern New Mexico. The Environmental Protection Agency (EPA or the Agency) regulates containment of TRU waste at WIPP in accordance with the radioactive waste disposal standards at Code of Federal Regulations (CFR) Title 40, Parts 191 and 194. The WIPP was first certified by EPA as complying with these standards and approved for TRU waste disposal in 1998. The WIPP Land Withdrawal Act requires DOE to submit recertification applications at five year intervals following the first waste shipment in 1999, with the most recent recertification application submitted in March 2014. EPA's decision to recertify WIPP is based in part on the results of an assessment of the projected ability of the facility to meet the Agency's waste isolation standards over the 10,000-year post-closure regulatory time frame. The ability to meet the numerical standards is determined by the results of numerical modeling conducted for the DOE by Sandia National Laboratories (SNL). This modeling simulates the repository's future performance in a process called Performance Assessment (PA). The most recent assessment was included in DOE's 2014 Compliance Recertification Application (CRA) and is called the CRA-2014 PA.

A comprehensive review of features, events, and processes (FEPs) potentially relevant to repository performance was conducted by Sandia National Laboratories (SNL) prior to DOE's original WIPP Compliance Certification Application (CCA) in 1996 (DOE 1996, Appendix SCR). That review used a screening process to identify those FEPs that had the potential to affect repository performance and need to be addressed in post-closure performance modeling of the WIPP facility. The FEPs identified by this process and documentation of the screening process formed the first FEP baseline. SNL has subsequently reviewed and updated this baseline prior to each new PA to help assure that changes occurring since the previous baseline are appropriately addressed and documented. Such changes may occur, for example, as a result of revisions to the repository design, new activities in the repository vicinity that could affect performance, updated repository inventory, and new scientific information.

SNL's reviews are intended to identify new FEPs or changes to existing FEPs and their screening arguments. Relevant FEPs are identified through an in-depth technical review of the potential effects of the changed conditions on repository functionality and are then screened for impact. The identified FEPs are either screened-in for inclusion in the new PA or screened-out. FEPs may be screened-out and not addressed in the new PA if their probability of occurrence is low; if they have no, low, or beneficial consequence on repository performance; or if they are excluded on a regulatory basis. FEPs that are not screened out have the potential to impact repository performance and are retained for consideration in WIPP PA. The DOE screening classifications are defined as follows.

- DP Screened in for disturbed performance (borehole intrusion) scenarios
- UP Screened in for undisturbed performance (no borehole intrusions) scenarios
- SO-C Screened out based on no, low, or beneficial consequence
- SO-P Screened out based on a very low probability of occurrence
- SO-R Screened out based on a regulatory directive

The FEP baseline prepared by DOE for the CRA-2009 PA (DOE 2009, Appendix SCR-2009) is the most recent baseline that has been reviewed and approved by the Agency (EPA 2010a). That baseline consisted of 245 FEPs and was divided into three categories: 70 FEPs were related to the external natural environment such as earthquakes (prefix N); 61 FEPs were related to external human-induced conditions such as potash mining (prefix H); and 114 FEPs were related to internal waste and repository conditions such as the waste inventory (prefix W).

EPA considers a thorough review and update of the previous FEP baseline to help ensure that the WIPP PA remains relevant to current conditions that may affect repository performance. The screening arguments presented in the FEP baseline should provide a description of the features, events, and processes that are reviewed and found to have the potential to affect repository performance. A thorough discussion of the basis for the screening decision, supplemented by references to additional details on how the FEP was incorporated into WIPP PA, provides an overview of how future repository performance is assessed.

2.0 SANDIA NATIONAL LABORATORIES' IDENTIFICATION OF POTENTIALLY RELEVANT FEPS

SNL reviewed the Agency-approved 2009 FEP baseline for DOE to determine if it remained appropriate in consideration of new information that had become available since it was prepared. SNL's review was guided by SNL Specific Procedure SP 9-4, *Performing FEPs Baseline Impact Assessments for Planned and Unplanned Changes* (Kirkes 2013a). In addition to reviewing the previous baseline, SNL reviewed related information published by EPA in CARDs and TSDs for the 2009 recertification decision (EPA 2010b and 2010c) as well as FEP assessment results and PA model modifications made by SNL since 2009. SNL's analysis also evaluated new information from outside the WIPP PA program with emphasis on information relating to human activities in the WIPP vicinity.

2.1 Changes between PABC-2009 and CRA-2014 PAs

DOE's 2009 Performance Assessment Baseline Calculation (PABC-2009) is the most recent Agency-approved PA baseline and was used by DOE as the basis for identifying relevant changes to the CRA-2014 PA. The following changes to the CRA-2014 PA were identified by DOE (2014, Appendix PA-2014, Section PA-1.1).

Replacement of Option D Panel Closure System with the ROMPCS. The design for the waste panel closure system (PCS) was revised to consist of run-of-mine (ROM) crushed salt (new repository features), modeling of the ROM salt panel closures included time-dependent consolidation due to halite creep (a new process), and modeling of the disturbed rock zones (DRZ) around the redesigned panel closures also included time-dependent consolidation (another new process).

Additional Mined Volume in the Repository North End. The volume of the WIPP experimental region was increased by 60,335 m^3 to accommodate proposed experimental programs such as the Salt Disposal Investigation (SDI) experiments (considered as a new repository feature).

Revised Probability of Encountering Pressurized Brine. A revised distribution based solely on drilling data was used for WIPP PA parameter GLOBAL:PBRINE in place of the distribution mandated by EPA in 1998 (a process revision).

Revised Corrosion Rate of Steel. A revised distribution based on a new series of steel and lead corrosion experiments was used for WIPP PA parameter STEEL:CORRMCO2 (a process revision).

Revised Effective Shear Strength of WIPP Waste. A revised distribution based on new experimental results was used for WIPP PA parameter BOREHOLE:TAUFAIL (a process revision).

Waste Inventory Update. Inventory parameters in the CRA-2014 PA were updated to reflect information collected through December 31, 2011 (a new feature).

Updated Drilling Rate and Plugging Pattern Parameters. The drilling rate was increased from 59.8 to 67.3 boreholes per square kilometer over 10,000 years and borehole plugging pattern probabilities were changed based on updated surveys of drilling activity in the Delaware Basin (an event revision).

Revised Repository Water Balance. The repository water balance implementation was refined to include the major gas and brine producing and consuming reactions in the existing conceptual model (a process revision).

Variable Brine Volume. Radionuclide concentrations in brine were revised to be a function of the volume of brine in the repository at the time of intrusion (a process revision).

Revised Radionuclide Solubility and Uncertainty. Radionuclide baseline solubility values were revised to reflect the organic ligand content in the CRA-2014 PA waste inventory and were calculated for several brine volumes. Solubility uncertainties were revised based on recently available results in published literature (a processes revision).

Revised Colloid Parameters. Colloid parameters in the CRA-2014 PA were revised to reflect new data (a process revision).

2.2 SNL FEP Review Results

The results of SNL's FEP review for the CRA-2014 PA are documented in Kirkes (2013b). In compiling the results of the review, SNL distinguished between model changes based on new information, which are reflected in modifications to the FEP baseline, and model changes to improve modeling efficiency or realism, which may not be based on new information and may therefore not be reflected in modifications to the FEP baseline. SNL's review concluded that the 245 FEPs in the 2009 baseline adequately addressed the types of features, events, and processes relevant to the CRA-2014 PA. Therefore, although some screening arguments were updated and the screening classification for one FEP was changed, no FEPs in the 2009 baseline needed to be deleted and none needed to be added. Of the 245 FEPs in the new baseline for the CRA-2014 PA, 184 FEPs were unchanged from the CRA-2009 PA and 61 FEPs were updated with new information, one of which was also updated with a new screening classification. These 61 FEPs are listed in Table 1 along with a summary statement of DOE's reported change and EPA comments on that change.

3.0 EPA REVIEW OF DOE'S CRA-2014 FEP ASSESSMENT

EPA has the following general concerns regarding the CRA-2014 FEP assessment that should be addressed in the next WIPP performance assessment.

- Although some FEP assessments provided sufficient information, some did not fully present all relevant information or did not consider all relevant changes affecting the repository.
- The screening arguments for some FEPs have been carried forward unchanged from past baseline reviews and do not reflect changes that have occurred in the past several years. This particularly applies to information on how some FEPs are accounted for in PA.
- Some FEPs need to be updated to reflect the likely repository design and new knowledge of repository behavior.
- For some FEPs, the screening argument should provide a more complete discussion of the FEP and how it is determined to be screened-in or screened-out. The supporting arguments, along with documents incorporated by reference, should provide a basic understanding of how the FEP is accounted for in PA calculations, where the FEP is accounted for in the repository region and surrounding geosphere, and when in the regulatory time frame the FEP is accounted for.
- For some FEPs that are reported as "no change", EPA disagrees and believes, for example, that major repository design elements such as panel closure bulkheads that will be left in place upon repository closure should at least be mentioned in the FEP documentation with a statement that they are expected to be transient and are not assumed to contribute to post-closure performance.

Many of the FEPs in the baseline identify a generalized category of feature, event, or process. Explanation is required in the screening arguments to explain which aspects of that topic are addressed in WIPP PA. The screening arguments should also provide either directly or by reference additional information on how, where, and when the topic is addressed. An example is the screened-in FEP W20 *Salt Creep.* Salt creep is modeled in WIPP PA but in different ways in different parts of the repository. For example, there are parts of the underground facility where salt creep is expected to occur but is not modeled in PA while in other areas of the repository salt creep is modeled. EPA expects the screening argument for FEP W20 *Salt Creep* to provide this type of information, either directly or by reference.

Most of the Agency's concerns about DOE/SNL's CRA-2014 FEP review process are associated with completeness. For example, the screening arguments for several key FEPs cite the 1996 CCA for further information. The screening arguments supporting the original FEP baseline for the CCA was well researched and comprehensive, however an increasing disparity exists between the evolving PA modeling approaches and the CCA screening arguments that should be corrected. In addition, the FEP screening arguments should identify key changes to repository design even if the changes are beneficial (such as decreased thermal effects of concrete hydration due to elimination of the concrete monoliths) or do not impact post-closure performance (such as the presence of permanent steel bulkheads in the PCS closure design). EPA agrees that beneficial changes may be excluded from PA modeling but should be identified in the FEP baseline.

EPA accepted DOE's screening classifications and arguments for 38 of the 61 FEPs identified by DOE as changed for the CRA-2014 PA. For the 23 remaining FEPs, the Agency accepted the screening classifications but considered the screening arguments to be incomplete. The results of the Agency's review are summarized on Table 1. EPA provided DOE with completeness questions for 21 of the 23 incomplete FEPs to better understand DOE's screening rationale. These questions, DOE responses, and the Agency's evaluations of DOE's responses are presented in Appendix A. In addition, EPA identified five FEPs that the Agency considered to have changed since 2009 but that DOE reported 'no change.' EPA also provided DOE with completeness questions for each of these five additional FEPs to better understand DOE's conclusion that they were unchanged. These five additional FEPs are identified on Table 2 and the associated completeness questions are included in Appendix A. Of the 26 FEPs further addressed as completeness questions, satisfactory resolutions including modifications to screening arguments were provided by DOE for 10 FEPs, the screening arguments for 14 FEPs were found to require additional information, and the completeness questions for two FEPs regarding DOE's revised calculation of GLOBAL:PBRINE were withdrawn because EPA will be requiring changes to that calculation. Upon completion of the Agency's review, the screening arguments for 16 FEPs remained incomplete.

4.0 EPA CONCLUSIONS

The Agency concludes that SNL's FEPs baseline review successfully identified most FEPs that have changed since the 2009 baseline was completed and addresses the principal modeling changes that were necessary to achieve the purpose of the CRA-2014 PA. Although the additional FEPs identified by the Agency are potentially relevant and should have been considered by SNL, none are likely to have had a significant impact on repository performance. The Agency therefore accepts DOE's updated FEP baseline as sufficient for the CRA-2014 PA. However, in future FEP baselines the Agency expects DOE to provide comprehensive and supplemental information in their screening arguments that reflects current repository knowledge and conditions in their supplemental information that is identified in this report to make the screening arguments adequate. The Agency also expects that in future FEP baselines, DOE's screening arguments will identify the changes that have been made, either directly or by reference, in sufficient detail to provide a comprehensive description of the way(s) in which the FEPs are addressed in PA.

REFERENCES

Camphouse, R.C., M. Gross, C.G. Herrick, D.C. Kicker, and B. Thompson 2012. *Recommendations and Justifications of Parameter Values for the Run-of-Mine Salt Panel Closure System Design Modeled in the PCS-2012 PA.* ERMS 557396. Sandia National Laboratories, Carlsbad, New Mexico. May 3.

DOE (U.S. Department of Energy) 1996. *Title 40 CFR 191 Compliance Certification Application for the Waste Isolation Pilot Plant.* DOE/CA0-1996-2184. U.S. Department of Energy, Carlsbad Area Office, Carlsbad, New Mexico.

DOE (U.S. Department of Energy) 2009. *Title 40 CFR 191 Subparts B and C Compliance Recertification Application 2009.* U.S. Department of Energy, Carlsbad Area Office, Carlsbad, New Mexico.

DOE (U.S. Department of Energy) 2014. *Title 40 CFR 191 Subparts B and C Compliance Recertification Application 2014.* U.S. Department of Energy, Carlsbad, New Mexico.

EPA (U.S. Environmental Protection Agency) 2010a. *Technical Support Document for Sections 194.25, 194.32, and 194.33: Review of Changes to the WIPP Performance Assessment Features, Events, and Processes since the 2004 CRA.* Docket No. EPA-HQ-OAR-2009-0330. November 2010. Office of Radiation and Indoor Air, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 2010b. *40 CFR Part 194 Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations: Rectification Decision; Final Notice.* Federal Register, Vol. 75 (November 18, 2010): 70584-595.

EPA (U.S. Environmental Protection Agency) 2010c. *2009 Compliance Recertification Application (2009 CRA) Compliance Application Review Document No. 32: Scope of Performance Assessments.* EPA Docket FDMS Docket ID No. EPA-HQ-OAR-2009-0330. Office of Radiation and Indoor Air. Washington, D.C.

Kirkes, G.R. 2013a. *Activity/Project Specific Procedure SP 9-4: Performing FEPs Baseline Impact Assessments for Planned or Unplanned Changes* (Revision 3, June 19). ERMS 560371. Carlsbad, NM: Sandia National Laboratories.

Kirkes, G.R. 2013b. *Features, Events and Processes Assessment for the Compliance Recertification Application—2014* (Revision 0). ERMS 560488. Carlsbad, NM: Sandia National Laboratories.

Table 1. Modified FEPs in DOE's CRA-2014 Baseline

FEP	DOE Reported Change	EPA Comments	DOE Screening Argument Accepted?
N2 Brine Reservoirs	Updated with new value of parameter GLOBAL:PBRINE	Screening argument accepted; but also see H23 *Blowouts* for related comments.	Yes
N12 Seismic Activity	Updated with new seismic data	Screening argument accepted.	Yes
H1 Oil and Gas Exploration	Updated with new drilling rate	Screening argument accepted.	Yes
H4 Oil and Gas Exploitation	Updated with new drilling rate	Screening argument accepted.	Yes
H3 Water Resources Exploration	Updated with most recent monitoring information	Screening argument accepted.	Yes
H5 Groundwater Exploitation	Updated with most recent monitoring information	Screening argument accepted.	Yes
H23 Blowouts	Updated with new value of parameter GLOBAL:PBRINE	Screening argument considers only boreholes intersecting the waste region (the waste panels) and also pressurized Castile brine. The argument should be supplemented with a discussion of boreholes that could intersect the non-waste regions.	Basis should be supplemented/ modified in next PA
H31 Natural Borehole Fluid Flow	Updated to reflect new plugging probabilities	Screening argument accepted.	Yes
H32 Waste-Induced Borehole Flow	Updated to reflect new plugging probabilities	Screening argument accepted.	Yes
H58 Solution Mining for Potash	Updated with information regarding solution mining activities in the region	The renewed activity at the previously abandoned workings of the Eddy Potash mine provides an opportunity for updating the technical and economic constraints described in the screening argument for this FEP.	Basis should be supplemented/

			modified in next PA
H59 Solution Mining for Other Resources	Updated with new information regarding brine wells in the region	Screening argument accepted.	Yes
W1 Disposal Geometry	Updated with new information regarding additional mined area used for experiments	The screening argument should be modified to more accurately reflect the actual current volume of the underground works. The current screening argument identifies an additional mined volume of 60,335 m^3. However, it is EPA's understanding that this volume is reflective of the cancelled SDI experiment, which has been replaced by the SDDI experiment with a smaller mined volume of about 31,000 m^3. The screening argument should be modified that includes the reduced repository volume due to backfilling and sealing of the western arm of the experimental area with ROM salt.	Basis should be supplemented/ modified in next PA
W2 Waste Inventory	Updated to reflect the inventory data sources used for the CRA-2014 PA	Screening argument accepted.	Yes
W3 Heterogeneity of Waste Forms	Updated to reflect the inventory data sources used for the CRA-2014 PA	The screening argument citation of the CCA as the source of information on the heterogeneity of waste forms ignores changes that have occurred in the past 15 years, including super-compacted waste, mingling RH waste in shielded containers with CH waste, and potentially ignitable nitrate salt waste. The continued reliance on the CCA as an information source should be reviewed and updated.	Basis should be supplemented/ modified in next PA
W4 Container Form	Updated to reflect the inventory data sources used for the CRA-2014 PA	Screening argument accepted.	Yes
W5 Container Material Inventory	Updated to reflect the inventory data sources used for the CRA-2014 PA	The screening argument should be supplemented with an explanation of the implementation in PA of the iron in the inner bulkheads of the ROMPCS.	Basis should be supplemented/

			modified in next PA
W109 Panel Closure Geometry	Updated with new information on panel closure design	Screening argument accepted.	Yes
W110 Panel Closure Physical Properties	Updated with new information on panel closure design	The screening argument should be supplemented that provides a description of the as-emplaced physical properties of the ROM salt now that *in situ* testing has been completed.	Basis should be supplemented/ modified in next PA
W111 Panel Closure Chemical Composition	Updated with new information on panel closure design	The screening argument should be supplemented to include the chemical composition of the steel bulkheads that are part of the panel closure design.	Basis should be supplemented/ modified in next PA
W10 Backfill Chemical Composition	Updated to reflect Implementation of water balance in PA	Screening argument accepted.	Yes
W13 Heat from Radioactive Decay	Updated to reflect the inventory used for the CRA-2014 PA	Screening argument accepted; see details of reduced activity in W15 *Radiological Effects on Waste*.	Yes
W14 Nuclear Criticality: Heat	Updated to reflect the inventory used for the CRA-2014 PA	Screening argument accepted; see details of reduced activity in W15 *Radiological Effects on Waste*.	Yes
W15 Radiological Effects on Waste	Updated to reflect the inventory used for the CRA-2014 PA	Screening argument accepted.	Yes
W16 Radiological Effects on Containers	Updated to reflect the inventory used for the CRA-2014 PA	Screening argument accepted; see details of reduced activity in W15 *Radiological Effects on Waste*.	Yes
W17 Radiological Effects on Shaft Seals	Updated to reflect the inventory used for the CRA-2014 PA	Screening argument accepted; see details of reduced activity in W15 *Radiological Effects on Waste*.	Yes

W112 Radionuclide Effects on Panel Closures	Updated to reflect the inventory used for the CRA-2014 PA	Screening argument accepted; see details of reduced activity in W15 *Radiological Effects on Waste*.	Yes
W18 Disturbed Rock Zone (DRZ)	Updated to include new panel closure implementation	The screening argument cites an outdated discussion in the CCA for information on how the DRZ is accounted for in PA. The screening argument should be updated to cite explanations of the time-dependent healing of the DRZ around the ROMPCS and how the DRZ is accounted for in the different regions of the underground facility, including the waste and non-waste regions.	Basis should be supplemented/ modified in next PA if panel closures are used
W19 Excavation-Induced Changes in Stress	Updated to include new panel closure implementation	Screening argument was combined with that for W18 *Disturbed Rock Zone (DRZ)*; please see comments for FEP W18.	Basis should be supplemented/ modified in next PA if panel closures are used
W20 Salt Creep	Updated to include new panel closure implementation	The screening argument should be supplemented with a discussion of salt creep and consolidation specific to the ROM salt in the ROMPCS and healing of the adjacent DRZ. Such a discussion can be found in Camphouse et al. (2012, Section 2.0. ERMS 557396).	Basis should be supplemented/ modified in next PA if panel closures are used
W21 Changes in the Stress	Updated to include new panel closure implementation	The screening argument should be supplemented with discussions of 1) the coupling between consolidation of the ROM salt in the ROMPCS and healing of the adjacent DRZ, and 2) lateral extrusion of the ROM salt when under compressive stress from drift creep closure.	Basis should be supplemented/ modified in next PA if panel closures are used

W26 Pressurization	Updated to reference new corrosion experiments and associated parameters	Screening argument accepted.	Yes
W28 Nuclear Explosions	Updated to reflect the inventory used for the CRA-2014 PA	The screening argument should be modified to specifically address the quantities of fissile radionuclides in the inventory rather than only providing the generalized statement that there is "a reduction of TRU radionuclides from previous estimates."	Basis should be supplemented/ modified in next PA
W29 Thermal Effects on Material Properties	Updated to reflect the inventory used for the CRA-2014 and planned thermal experiments	Screening argument accepted.	Yes
W30 Thermally-Induced Stress Changes	Updated to reflect the inventory used for the CRA-2014 and planned thermal experiments	Screening argument accepted.	Yes
W31 Differing Thermal Expansion of Repository Components	Updated to reflect the inventory used for the CRA-2014 and planned thermal experiments	Screening argument accepted.	Yes
W72 Exothermic Reactions	Updated to reflect the inventory used for the CRA-2014 and planned thermal experiments	The screening argument should be supplemented with a discussion of the February 2014 exothermic reaction that resulted in a radionuclide release within the repository.	Basis should be supplemented/ modified in next PA
W73 Concrete Hydration	Updated to reflect the inventory used for the CRA-2014 and planned thermal experiments	The screening argument should be supplemented with a discussion of the impact on PA of removing the Option D concrete monoliths and installing no additional explosion walls in the repository.	Basis should be supplemented/ modified in next PA

W113 Consolidation of Panel Closures	Updated screening argument with new information regarding panel closure composition	The screening argument should be supplemented with a discussion of consolidation specific to the ROM salt in the ROMPCS. Such a discussion can be found in Camphouse et al. (2012, Section 2.0. ERMS 557396).	Basis should be supplemented/ modified in next PA if panel closures are used
W114 Mechanical Degradation of Panel Closures	Updated screening argument with new information regarding panel closure composition	Because the steel bulkheads are part of the panel closure system their presence should be acknowledged in the screening argument	Basis should be supplemented/ modified in next PA if steel bulkheads are used with panel closures
W33 Movement of Containers	Updated to reference new inventory data	The screening argument should be supplemented with a discussion of container movement associated with salt creep and roof falls.	Basis should be supplemented/ modified in next PA
W40 Brine Inflow	Updated to reflect water balance implementation in PA	Screening argument accepted.	Basis should be supplemented/ modified in next PA
W41 Wicking	Updated to reflect water balance implementation in PA	Screening argument accepted.	Yes
W42 Fluid Flow Due to Gas Production	Updated to reflect water balance implementation in PA and new steel corrosion rates	Screening argument accepted.	Basis should be supplemented/

			modified in next PA
W43 Convection	Updated to reflect planned thermal experiments	Screening argument accepted.	Yes
W44 Degradation of Organic Material	Updated to reference new inventory data	The screening argument should be supplemented with an expanded discussion of the importance of the availability of brine on the degradation of organic material.	Basis should be supplemented/ modified in next PA
W45 Effects of Temperature on Microbial Gas Generation	Updated to reference new inventory data	The screening argument should be modified to acknowledge the reduced thermal impact of seal concrete hydration because of the elimination of additional explosion walls and the Option D monolith.	Basis should be supplemented/ modified in next PA
W48 Effects of Biofilms on Microbial Gas Generation	Updated to reference new inventory data	Screening argument accepted.	Yes
W47 Effects of Radiation on Microbial Gas Generation	Updated with new radionuclide inventory and information related to the EPA request for additional information on CRA-2009	Screening argument accepted.	Yes
W49 Gases from Metal Corrosion	Updated to reference new corrosion experiments and inventory	Screening argument accepted.	Yes
W 51 Chemical Effects of Corrosion	Updated to reference new corrosion experiments and inventory	Screening argument accepted.	Yes
W53 Radiolysis of Cellulose	Screening argument updated with new radionuclide inventory	The reported reason for the screening argument update is not consistent between Table SCR-1, where the update is due to new radionuclide inventory, and Section SCR-6.5.1.7.2	Basis should be supplemented/

		where the update is due to new cellulose inventory. The screening argument in Section SCR-6.5.1.7.3 refers only to the new radionuclide inventory. The rationales should be consistent.	modified in next PA
W54 Helium Gas Production	Screening argument updated with new radionuclide inventory	Screening argument accepted.	Yes
W55 Radioactive Gases	Updated to reference new inventory data	Screening argument accepted.	Yes
W56 Speciation	Reference made to new solubility calculations based on new inventory components	Screening argument accepted.	Yes
W68 Organic Complexation	Updated to reflect implementation of variable brine volume in PA	Screening argument accepted.	Yes
W69 Organic Ligands	Updated to reflect implementation of variable brine volume, new inventory data	Screening argument accepted.	Yes
W115 Chemical Degradation of Panel Closures	Updated screening argument with new panel closure materials	The screening argument should be supplemented with a discussion of the chemical degradation of the steel bulkheads, which are part of the ROM salt panel closure system.	Basis should be supplemented/ modified in next PA if ROM salt are used with panel closures
W85 Cavings	Updated with new waste shear strength data	Screening argument accepted; however, it is much too brief. Please see general comments.	Yes
W86 Spallings	Updated with new water balance implementation	Screening argument accepted; however, it is much too brief. Please see general comments.	Yes
W89 Transport of Radioactive Gases	Updated to reference CRA-2014 inventory data	Screening argument accepted.	Yes

W93 Soret Effect	Updated based on new inventory data	Screening argument accepted; however, citation of the more detailed information on temperature rise presented in the argument for FEP W29 *Thermal Effects on Material Properties* would improve this screening argument.	Yes

Table 2. Additional Modified FEPs Identified by EPA for the CRA-2014 Baseline

FEP	DOE Reported Change	EPA Comments	DOE Screening Argument Accepted?
H21 Drilling Fluid Flow	No Change	The screening argument considers only boreholes intersecting the waste region (the waste panels). The argument should be supplemented with a discussion of boreholes that could intersect the non-waste regions.	Basis should be supplemented/ modified in next PA
H22 Drilling Fluid Loss	No Change	The screening argument considers only boreholes intersecting the waste region (the waste panels). The argument should be supplemented with a discussion of boreholes that could intersect the non-waste regions.	Basis should be supplemented/ modified in next PA
H28 Enhanced Oil and Gas Production	No Change	The screening argument should be supplemented to address whether enhanced oil and gas production techniques are being used in the Delaware basin and in the vicinity of WIPP.	Basis should be supplemented/ modified in next PA
W25 Disruption Due to Gas Effects	No Change	The screening argument should be supplemented with a discussion of the potential for high waste panel gas pressures to delay the consolidation of the ROM salt, thereby	Basis should be supplemented/

		maintaining a higher permeability in the PCS for a longer period of time.	modified in next PA
W27 Gas Explosions	No change	The screening argument should be updated to address the LANL inventory with nitrates and added organic matter that resulted in an exothermic reaction.	Basis should be supplemented/ modified in next PA

APPENDIX A

EPA Completeness Questions, DOE Responses, and EPA Evaluations of Responses Related to Features, Events and Processes in WIPP Performance Assessment

List of FEP Completeness Questions

INTRODUCTION

This appendix documents EPA's questions and concerns related to features, events, and processes (FEPs) considered by DOE in the CRA-2014 PA. Also included are DOE responses to the Agency's questions and the Agency's evaluation of those responses. As stated in EPA's evaluations of DOE's responses, many of the Agency's concerns were resolved by DOE's responses and were not considered further. Those Agency concerns that were not entirely resolved were given more detailed review to evaluate their potential impacts on repository performance. Unresolved concerns that were considered to have high potential impacts are identified with references to the more detailed evaluations presented in the body of this report and, in most cases, with references to the results of numerical sensitivity studies performed by DOE at EPA's request.

EPA's completeness questions are identified by number as well as by the relevant sections of 40 CFR Part 194 describing the regulatory criteria for EPA's certification and recertification of the WIPP. This appendix provides complete statements of EPA's questions as well as complete copies of DOE's narrative responses. DOE's responses to some questions were accompanied by electronic copies of supporting reference information. This supporting information is not included in this appendix but can be obtained from the relevant EPA Docket identified in the reference citations listed at the end of this appendix.

EPA's General Completeness Question 2-32-G1 and Specific Completeness Questions 2-32-S1 through 2-32-S26 are related to DOE's Baseline FEP Analysis and are documented below. These questions were transmitted to DOE in the Agency's second set of completeness questions dated February 27, 2015. The Agency's completeness questions that are unrelated to FEPs are documented in a separate TSD (EPA 2017).

Reference:

EPA (U.S. Environmental Protection Agency) 2017. *Review of EPA Sensitivity Studies of DOE CRA-2014 WIPP Compliance Recertification Performance Assessment.* Docket No: EPA-HQ-OAR-2014-0609. Prepared by S. Cohen & Associates, Vienna, Virginia, for EPA Office of Radiation and Indoor Air, Washington, DC.

2-32-G1 GENERAL COMMENT
Obsolete FEP Screening Arguments, Curtailed FEP Screening Arguments, and Completeness Considerations.
40 CFR 194.23 Models and Computer Codes

The screening arguments in the CRA-2014, Appendix SCR-2014 for many FEPs have been carried forward from past baseline reviews and do not necessarily reflect changes that have occurred in the past several years. This especially applies to information on how some FEPs are accounted for in PA. Some FEPs need to be updated to reflect a likely repository design and new knowledge of repository behavior.

For some FEPs, the screening argument needs to provide a more complete discussion of the FEP and how it is determined to be screened-in or screened-out. The supporting arguments, along with documents incorporated by references, should provide a basic understanding of how the FEP is accounted for in PA calculations, where the FEP is accounted for in the repository region and surrounding geosphere, and when in the regulatory time frame the FEP is accounted for. Those FEPs with inadequate or curtailed screening arguments are identified in Table 1 of this report.

For some FEPs that DOE has reported “no change”, EPA disagrees and believes that DOE needs to reconsider and update the FEP discussion in the next FEP baseline. Table 1 in the summary portion of this document includes those FEPs in this category that EPA has identified, to date, for which the basis should be supplemented/modified in next PA.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Since the Compliance Certification Application (CCA), Appendix SCR is a screening document for individual FEPs, and therefore contains only the description, screening argument, and decision as to whether the FEP is to be included (screened-in) or excluded (screened-out) within PA scenarios. For those FEPs that are screened-in, an attempt has been made to point to the appropriate location within the compliance documentation that describes and justifies the implementation of the FEP with the appropriate model(s). Because the screening document is quite large, and because FEPs span a myriad of technical and scientific disciplines, attempting to describe the implementation of each FEP within the screening document would: 1) result in a document of unmanageable size, 2) create redundancy within the compliance documentation, and 3) create the opportunity for inconsistency and error within the compliance baseline.

The FEPs baseline is reviewed any time a change to the baseline is proposed, or any time that new data or conditions affect or relate to screening arguments or decisions. Since recertification applications are an opportunity to “roll-up” and account for any changes that have occurred since the last recertification, updates to the FEPs baseline are reflected cumulatively in Appendix SCR. Requests by the EPA to describe the implementation methodology of specific FEPs in Appendix SCR-2014 are not consistent with the current FEP program or format and content of Appendix SCR. The DOE agrees and understands that such information must be included within the compliance documentation; however, Appendix SCR is not the correct place to provide this information, rather pointers needs to be given to the correct source material as appropriate. Such information has historically been found within Chapter 6 of the CCA, Appendix MASS of the CCA, or their updated successor documents (Appendix PA-2004 and Attachment MASS-2004, Appendix PA-2009, Appendix PA-2014, etc.). Again, this is mostly a practical matter that has to do with managing the compliance documentation in a way that avoids duplication and inconsistency.

The DOE will continue to document any new data and information with each Compliance Recertification Application. Whenever new data or new information are available, the affected FEPs and their screening decisions will be updated. This process is consistent with EPA’s comments as provided in its February 27, 2015, letter and accompanying FEPs table. In cases where we update FEPs as a result of addressing EPA's comments, we will provide updated excerpts from Appendix SCR-2014.

EPA Evaluation of Response

Response is complete and sufficient. EPA agrees that screening arguments needs to be complete and consistent with the current configuration of the PA, and can be presented either within the FEP screening document or in documents incorporated in the screening document by reference.

2-32-S1 FEP H21 DRILLING FLUID FLOW.
40 CFR 194.23 Models and Computer Codes

EPA Question

Screening argument considers only boreholes intersecting the waste region. Please supplement the argument with a discussion of boreholes that intersect the non-waste regions and the consequence to PA calculations. Provide references and specific information as to whether boreholes penetrating non-waste regions could result in the transport of radionuclides between the waste and non-waste regions, to overlying units, or to the surface. Provide information, either directly or by reference, as to how deep boreholes penetrating the non-waste and waste regions of the repository are accounted for in the PA.

2-32-S2 FEP H22 DRILLING FLUID LOSS.
40 CFR 194.23 Models and Computer Codes

EPA Question

The screening argument considers flow into the repository from boreholes that intercept pressurized fluid in underlying formations but only for boreholes intersecting the waste region. In the current BRAGFLO model gas and brine readily flow between the waste and non-waste regions. A discussion and analysis of boreholes that could intersect the non-waste regions and their impact on the PA needs to be provided.

2-32-S3 FEP H23 BLOWOUTS.
40 CFR 194.23 Models and Computer Codes

EPA Question

Screening argument considers only boreholes intersecting the waste region and also pressurized Castile brine. In the current BRAGFLO model gas and brine readily flow between the waste and non-waste regions. Please supplement the argument with a discussion and analysis of boreholes that could intersect the non-waste regions on the PA.

DOE Combined Response (from DOE Response Package 5 (DOE RP5 2015b))

Boreholes that intercept the non-waste regions (e.g., the operations and experimental areas) of the repository have been screened out of PA calculations since the CCA (DOE 1996). Additionally, early screening efforts demonstrated that drilling into a non-repository area of the controlled area (independently, within both the Salado and Culebra Formations) resulted in low consequences to the performance of the repository (Wallace 1996 and Economy 1996). No known recent events have occurred or new information become available that would weaken or render these determinations invalid. In fact, a recent analysis by Zeitler (2015), based on BRAGFLO results from the CRA-2014, strengthens the determination of drilling into non-repository areas being of low consequence. This analysis included the impacts of a run-of-mine (ROM) salt panel closure system (PCS).

The current BRAGFLO model does allow for brine and gas flow between the waste and non-waste regions, as has been the case since the CCA. A full discussion and analysis of boreholes intersecting non-waste regions is contained in the Supplemental Peer Review Report (Wilson et al. 1996), in which the Conceptual Models Peer Review Panel (CMPRP) evaluated the conceptual model for the exploration borehole and raised questions regarding the justification for excluding inadvertent intrusions into the operations and experimental areas of the repository from PA calculations. DOE's response to this issue was partially based on the fact that even though intrusions into these areas of the repository could occur, since waste will not be disposed in these areas, releases from cuttings, cavings, and spallings could (by their definitions) not occur since waste will not be disposed in these areas. Radionuclides present in the repository could potentially be transported in brine into the operations and experimental areas and contaminated brine could be brought to the surface during drilling. However, because the operations and experimental areas of the repository are separated from the waste regions by panel closures that will greatly reduce brine flow, insignificant quantities of brine flows across this boundary.

To respond to the CMPRP, the DOE provided intermediate BRAGFLO results that demonstrated that the panel closures effectively limited brine movement. In their Supplemental Peer Review Report (Wilson et al. 1996), the CMPRP stated:

> "…with very few exceptions, the maximum brine flow through a panel seal was found in modeling results to be about 12,000 m^3 following an E1 intrusion, and the expected flow would be about 3,000 m^3. Under undisturbed conditions, the cumulative brine inflow into the operations and experimental areas from all sources ranges from near zero to about 10,000 m^3 (see Figures 3-4 and 3-5). This flow would, on the average, be expected to result in approximately a twofold dilution of brine flowing in from the waste area following an E1 intrusion. Under disturbed conditions with intrusion boreholes penetrating the operations and experimental areas, the inflow of uncontaminated brine and the dilution of contaminated brine would be even greater.
>
> In the event that the operations and experimental areas are penetrated by intrusion boreholes, approximately 12,000 m^3 of brine could conceivably flow from these areas into the waste area. Performance assessment results indicate that total cumulative brine flow into the waste area is typically about 40,000 m^3 following an E1 intrusion at 1,000 years and about 30,000 m^3 following an E2 intrusion at 1,000 years. Given that about six borehole intrusions are expected to occur during the regulatory time frame, the total volume of brine potentially available to flow into the waste area could exceed 100,000 m^3. Although the actual volume of brine inflow will depend on the interrelationships among time of intrusion, repository creep closure, gas generation, repository pressure, and other factors, the modeling results indicate that sufficient brine is potentially available from other sources that an incremental supply of as much as 12,000 m^3 would have no consequential effect on performance assessment results. However, if subsequent model modifications result in significantly smaller fluid volumes in the repository, the significance of this issue should be reevaluated."

Thus, the CMPRP determined that the DOE had satisfactorily demonstrated that representing exploration boreholes and their effects in the experimental and operations areas of the repository was not necessary, and the representation of repository fluid flow and the exploration borehole was adequately incorporated into PA models.

To update the BRAGFLO results that were used by the CMPRP to make its decision, and verify that it remains appropriate to exclude boreholes in the operations and experimental areas from PA calculations, BRAGFLO results from replicate 1 of the CRA-2014 PA calculations are examined. The maximum brine flow through a panel closure is now about 8,000 m^3 following an E1 intrusion, which occurred for brine flow across the panel closure separating the waste panel and southern rest of repository (SRoR) (Figure 1). (BRAGFLO scenarios S2 and S3 consider E1 intrusions.) The expected northward flow across any panel closure is about 1,000 m^3 (for brine flow across the panel closure separating the waste panel and SRoR).[1] For undisturbed conditions (S1), the cumulative brine inflow into the operations and experimental areas from all sources ranges from 700 to 35,000 (Figure 2). This flow would, on average, result in about a seventeen-fold dilution of brine flowing in from the waste area following an E1 intrusion (comparing $(35{,}000 + 700)m^3/2 = 17{,}850m^3$ to $1{,}000m^3$).

1 See Appendix PA-2014, Figure PA-12 for a representation of the BRAGFLO grid and the discrete grid sections (including the SRoR).

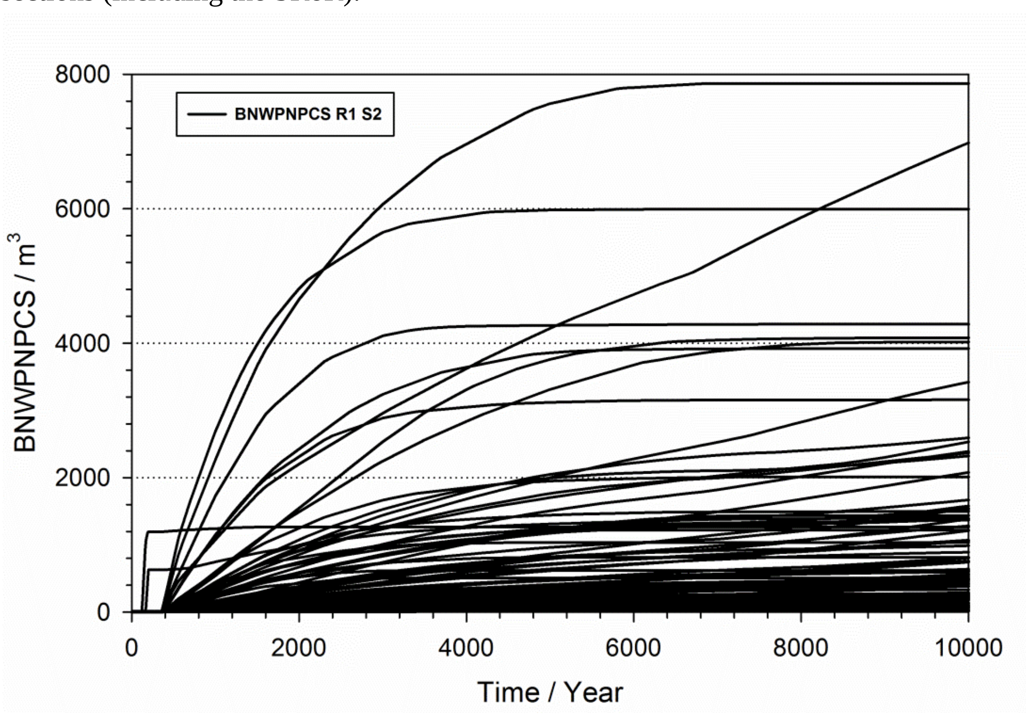

Figure 1. Cumulative brine volume passing northward from the waste panel to the SRoR through the panel closure for the 100 vectors of replicate 1, scenario 2 (E1 intrusion at 350 years) (from Zeitler 2015)

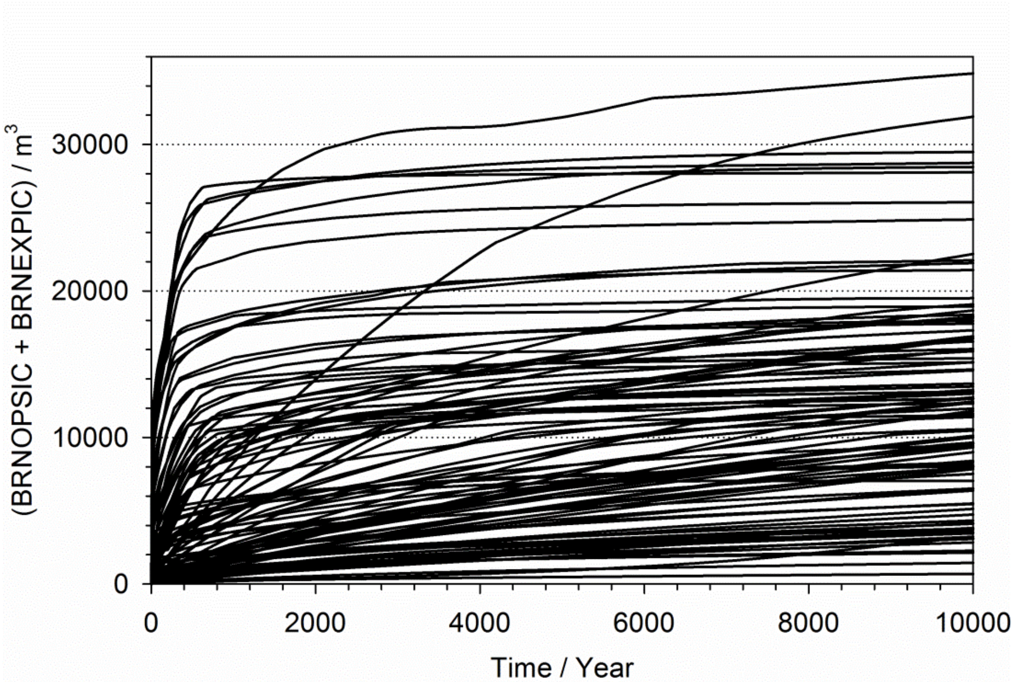

Figure 2. Cumulative brine flow into the experimental and operations areas for the 100 vectors of replicate 1, scenario 1 (undisturbed repository) (from Zeitler 2015)

The CRA-2014 PA results indicate that a total cumulative brine flow into the waste area (including the waste panel, northern rest of repository, and SRoR) is on average about 36,000 m^3 following an E1 intrusion at 1,000 years (S3) and about 20,500 m^3 following an E2 intrusion at 1,000 years (S5). Given that about 7.5 borehole intrusions are expected to occur during the regulatory period, the total volume of brine potentially available to flow into the waste area could exceed 200,000 m^3. Thus, with an incremental supply of only 8,000 m^3, the same conclusion as the CMPRP can reached: [the additional brine volume] "would have no consequential effect on performance assessment results." Compared to the previous analysis, the maximum brine flow across a panel closure has decreased (12,000 to 8,000 m^3) and the total volume of brine potentially available to flow into the waste area has stayed the same (210,000 to 209,500 m^3). Thus, the relative amount of "incremental supply" of brine has decreased from 12,000/210,000=0.0571 to 8,000/209,500=0.038, indicating approximately a 33 percent decrease in the relative amount of brine available in the non-waste regions of the repository. Therefore, boreholes that intersect the non-waste regions of the repository still do not need to be accounted for in PA calculations.

The following text for FEPs H21, H22, and H23 incorporate references to previous screening work (Wallace 1996 and Economy 1996), as well as the new analysis using CRA-2014 described above. Changes to the text for FEPs H21, H22, and H23 are shown in blue font below.

SCR-5.2.1.1 FEP Number: H21 **FEP Title:** *Drilling Fluid Flow*

SCR-5.2.1.1.1 Screening Decision: SO-C (HCN) DP (Future)
Drilling Fluid Flow associated with historical, current, near-future, and future boreholes that do not intersect the waste disposal region has been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system. The possibility of a future deep borehole penetrating a waste panel, such that drilling-induced flow results in transport of radionuclides to the land surface or to overlying hydraulically conductive units, is accounted for in PA calculations. The possibility of a deep borehole penetrating both the waste disposal region and a Castile brine reservoir is accounted for in PA calculations.

SCR-5.2.1.1.2 Summary of New Information
The screening argument for this FEP has been updated to reference new confirmatory screening analyses (Zeitler 2015) that support the determination by the Conceptual Models Peer Review Panel (Wilson et al. 1996) that boreholes into the experimental and operational areas do not need to be considered in PA calculations.

SCR-5.2.1.1.3 Screening Argument

Borehole circulation fluid could be lost to thief zones encountered during drilling, or fluid could flow from pressurized zones through the borehole to the land surface (blowout) or to a thief zone. Such drilling-related EPs could influence groundwater flow and, potentially, radionuclide transport in the affected units. Future drilling within the controlled area could result in direct releases of radionuclides to the land surface or transport of radionuclides between hydraulically conductive units.

Movement of brine from a pressurized zone through a borehole into potential thief zones such as the Salado interbeds or the Culebra could result in geochemical changes and altered radionuclide migration rates in these units.

SCR-5.2.1.1.3.1 Historical, Current, and Near-Future Human EPs

Drilling fluid flow is a short-term event that can result in the flow of pressurized fluid from one geologic stratum to another. However, long-term flow through abandoned boreholes would have a greater hydrological impact in the Culebra than a short-term event such as drilling-induced flow outside the controlled area. Wallace (1996a) analyzed the potential effects of flow through abandoned boreholes in the future within the controlled area, and concluded that interconnections between the Culebra and deep units could be eliminated from PA calculations on the basis of low consequence. Thus, the HCN of drilling fluid flow associated with boreholes outside the controlled area has been screened out on the basis of low consequence to the performance of the disposal system.

As discussed in FEPs H25 through H36 (Sections SCR-5.2.1.5, SCR-5.2.1.6, SCR-5.2.1.7, SCR-5.2.1.8, SCR-5.2.1.9, SCR-5.2.1.10, SCR-5.2.1.11, SCR-5.2.1.12, and SCR-5.2.1.1), drilling associated with water resources exploration, groundwater exploitation, potash exploration, oil and gas exploration, oil and gas exploitation, enhanced oil and gas recovery, and drilling to explore other resources has taken place or is currently taking place outside the controlled area in the Delaware Basin. These drilling activities are expected to continue in the vicinity of the WIPP in the near future.

SCR-5.2.1.1.3.2 Future Human EPs

For the future, drill holes may intersect the waste disposal region and their effects could be more profound. Thus, the possibility of a future borehole penetrating a waste panel, so that drilling fluid flow and, potentially, blowout results in transport of radionuclides to the land surface or to overlying hydraulically conductive units, is accounted for in PA calculations. Drilling events through the experimental and operational regions of the repository are not accounted for in PA calculations as it was determined that they could be excluded due to low consequence (Wilson et al. 1996). This conclusion of low consequence was recently reconfirmed by Zeitler (2015). This new analysis uses the latest PA results and updates the low consequence brine flow justification analyses discussed in Wilson et al. (1996), where it was determined that insignificant amounts of brine flow from the repository to the non-waste areas do not have a consequence on PA results. Additionally, drilling into a contaminated zone outside the waste area but within the controlled area was screened out due to low consequence (Economy 1996).

The units intersected by the borehole may provide sources for fluid flow (brine, oil, or gas) to the waste panel during drilling. In the vicinity of the WIPP, the Castile that underlies the Salado contains isolated volumes of brine at fluid pressures greater than hydrostatic. A future borehole that penetrates a Castile brine reservoir could provide a connection for brine flow from the reservoir to the waste panel, thus increasing fluid pressure and brine volume in the waste panel. The possibility of a deep borehole penetrating both a waste panel and a brine reservoir is accounted for in PA calculations.

Penetration of an underpressurized unit underlying the Salado could result in flow and radionuclide transport from the waste panel to the underlying unit during drilling, although drillers would minimize such fluid loss to a thief zone through the injection of materials to reduce permeability or through the use of casing and cementing. Also, the permeability of formations underlying the Salado are less than the permeability of the Culebra (Wallace 1996a). Thus, the consequences associated with radionuclide transport to an underpressurized unit below the waste panels during drilling will be less significant, in terms of disposal system performance, than the consequences associated with radionuclide transport to the land surface or to the Culebra during drilling. Through this comparison, drilling events that result in penetration of underpressurized units below the waste-disposal region have been eliminated from PA calculations on the basis of beneficial consequence to the performance of the disposal system.

SCR-5.2.1.2 FEP Number: H22 **FEP Title:** *Drilling Fluid Loss*

SCR-5.2.1.2.1 Screening Decision: SO-C (HCN) DP (Future)

Drilling Fluid Loss associated with HCN and future boreholes that do not intersect the waste disposal region has been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system. The possibility of a future *Drilling Fluid Loss* into waste panels is accounted for in PA calculations.

SCR-5.2.1.2.2 Summary of New Information

The screening argument for this FEP has been updated to reference new confirmatory screening analyses (Zeitler 2015) that support the determination by the Conceptual Models Peer Review Panel (Wilson et al. 1996) that boreholes into the experimental and operational areas do not need to be considered in PA calculations.

SCR-5.2.1.2.3 Screening Argument

Drilling fluid loss is a short-term event that can result in the flow of pressurized fluid from one geologic stratum to another. Large fluid losses would lead a driller to inject materials to reduce permeability, or it would lead to the borehole being cased and cemented to limit the loss of drilling fluid. Assuming such operations are successful, drilling fluid loss in the near future outside the controlled area will not significantly affect the hydrology of the disposal system. Thus, drilling fluid loss associated with historical, current, and near-future boreholes has been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system.

In evaluating the potential consequences of drilling fluid loss to a waste panel in the future, two types of drilling events need to be considered – those that intercept pressurized fluid in underlying formations such as the Castile (defined in the CCA, Chapter 6.0, Section 6.3.2.2 as E1 events), and those that do not (E2 events). A possible hydrological effect would be to make a greater volume of brine available for gas generation processes and thereby increase gas volumes at particular times in the future. For either type of drilling event, on the basis of current drilling practices, the driller is assumed to pass through the repository rapidly. Relatively small amounts of drilling fluid loss might not be noticed and might not give rise to concern. Larger fluid losses would lead to the driller injecting materials to reduce permeability, or to the borehole being cased and cemented, to limit the loss of drilling fluid.

For boreholes that intersect pressurized brine reservoirs, the volume of fluid available to flow up a borehole will be significantly greater than the volume of any drilling fluid that could be lost. This greater volume of brine is accounted for in PA calculations, and is allowed to enter the disposal room (see the CCA, Chapter 6.0, Section 6.4.7). Thus, the effects of drilling fluid loss will be small by comparison to the potential flow of brine from pressurized brine reservoirs. Therefore, the effects of drilling fluid loss for E1 drilling events have been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system.

The consequences of drilling fluid loss into waste panels in the future are accounted for in PA calculations for E2 events.

SCR-5.2.1.2.3.1 Historical, Current, and Near-Future Human EPs

Drilling fluid flow will not affect hydraulic conditions in the disposal system significantly unless there is substantial drilling fluid loss to a thief zone, such as the Culebra. Typically, zones into which significant borehole circulation fluid is lost are isolated through injection of materials to reduce permeability or through casing and cementing programs. Assuming such operations are successful, drilling fluid loss in the near future outside the controlled area will not affect the hydrology of the disposal system significantly and will be of no consequence.

SCR-5.2.1.2.3.2 Future Human EPs

The consequences of drilling within the controlled area in the future will primarily depend on the location of the borehole. Potentially, future deep drilling could penetrate the waste disposal region. Hydraulic and geochemical conditions in the waste panel could be affected as a result of drilling fluid loss to the panel. Drilling fluid loss due to drilling through the experimental and operational regions of the repository are not accounted for in PA calculations as it was determined that such drillholes could be excluded due to low consequence (Wilson et al. 1996). This conclusion of low consequence was recently reconfirmed by Zeitler (2015). This new analysis uses the latest PA results and updates the low consequence brine flow justification analyses discussed in Wilson et al. (1996) where it was determined that insignificant amounts of brine flows from the repository to the non-waste areas do not have a consequence on PA results.

Penetration of an underpressurized unit underlying the Salado could result in flow and radionuclide transport from the waste panel to the underlying unit during drilling, although drillers would minimize such fluid loss to a thief zone through the injection of materials to reduce permeability or through the use of casing and cementing. Also, the permeabilities of formations underlying the Salado are less than the permeability of the Culebra (Wallace 1996a). Thus, the consequences associated with radionuclide transport to an underpressurized unit below the waste panels during drilling will be less significant, in terms of disposal system performance, than the consequences associated with radionuclide transport to the land surface or to the Culebra during drilling. Through this comparison, drilling events that result in penetration of underpressurized units below the waste-disposal region have been eliminated from PA calculations on the basis of beneficial consequence to the performance of the disposal system.

For boreholes that do not intersect pressurized brine reservoirs (but do penetrate the waste-disposal region), the treatment of the disposal room implicitly accounts for the potential for greater gas generation resulting from drilling fluid loss. Thus, the hydrological effects of drilling fluid loss for E2 drilling events are accounted for in PA calculations within the conceptual model of the disposal room for drilling intrusions.

SCR-5.2.1.3 FEP Number: H23 FEP Title: *Blowouts*

SCR-5.2.1.3.1 Screening Decision: SO-C (HCN) DP (Future)

Blowouts associated with HCN and future boreholes that do not intersect the waste disposal region have been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system. The possibility of a future deep borehole penetrating a waste panel such that drilling-induced flow results in transport of radionuclides to the land surface or to overlying hydraulically conductive units is accounted for in PA calculations. The possibility of a deep borehole penetrating both the waste disposal region and a Castile brine reservoir is accounted for in PA calculations.

SCR-5.2.1.3.2 Summary of New Information

Blowouts are implemented in PA through the parameter GLOBAL:PBRINE, which represents the probability of an inadvertent intrusion borehole encountering pressurized brine beneath the repository. This parameter has been updated based on new data and analysis as reported in Kirchner et al. (2012). This parameter update does not change the screening argument or decision; H23 *Blowouts* continue to be classified as DP for the future timeframe. The screening argument for this FEP has also been updated to reference new confirmatory screening analyses (Zeitler 2015) that support the determination by the Conceptual Models Peer Review Panel (Wilson et al. 1996) that boreholes (and any associated blowouts) into the experimental and operational areas do not need to be considered in PA calculations. This new analysis uses the latest PA results and updates the low consequence brine flow justification analyses discussed in Wilson et al. (1996), where it was determined that insignificant amounts of brine flows from the repository to the non-waste areas do not have a consequence on PA results.

SCR-5.2.1.3.3 Screening Argument

Blowouts are short-term events that can result in the flow of pressurized fluid from one geologic stratum to another. For the near future, a blowout may occur in the vicinity of the WIPP but is not likely to affect the disposal system because of the distance from the well to the waste panels, assuming that AICs are in place which restrict borehole installation to outside the WIPP boundary. *Blowouts* associated with HCN and future boreholes that do not intersect the waste disposal region have been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system. For the future, the drill holes may intersect the waste disposal region and these effects could be more profound. Thus, *blowouts* that occur in the waste area of the repository are included in the assessment of future activities, and their consequences are accounted for in PA calculations. Blowouts that occur in the non-waste regions of the repository in the future are not included in PA calculations as both Wilson et al. (1996) and Zeitler (2015) have demonstrated that these events are inconsequential to repository performance.

Fluid could flow from pressurized zones through the borehole to the land surface (*blowout*) or to a thief zone. Such drilling-related EPs could influence groundwater flow and, potentially, radionuclide transport in the affected units. Movement of brine from a pressurized zone through a borehole into potential thief zones such as the Salado interbeds or the Culebra could result in geochemical changes and altered radionuclide migration rates in these units.

SCR-5.2.1.3.3.1 Historical, Current, and Near-Future Human EPs

Drilling associated with water resources exploration, groundwater exploitation, potash exploration, oil and gas exploration, oil and gas exploitation, enhanced oil and gas recovery, and drilling to explore other resources has taken place or is currently taking place outside the controlled area in the Delaware Basin. These drilling activities are expected to continue in the vicinity of the WIPP in the near future.

Naturally occurring brine and gas pockets have been encountered during drilling in the Delaware Basin. Brine pockets have been intersected in the Castile (as discussed in the CCA, Chapter 2.0, Section 2.2.1.2). Gas blowouts have occurred during drilling in the Salado. Usually, such events result in brief interruptions in drilling while the intersected fluid pocket is allowed to depressurize through flow to the surface (for a period lasting from a few hours to a few days). Drilling then restarts with an increased drilling mud weight. Under these conditions, blowouts in the near future will cause isolated hydraulic disturbances, but will not affect the hydrology of the disposal system significantly.

Potentially, the most significant disturbance to the disposal system could occur if an uncontrolled blowout during drilling resulted in substantial flow through the borehole from a pressurized zone to a thief zone. For example, if a borehole penetrates a brine reservoir in the Castile, brine could flow through the borehole to the Culebra over the long term and, as a result, could affect hydraulic conditions in the Culebra. The potential effects of such an event can be compared to the effects of long-term fluid flow from deep overpressurized units to the Culebra through abandoned boreholes. Wallace (1996a) analyzed the potential effects of flow through abandoned boreholes in the future within the controlled area and concluded that interconnections between the Culebra and deep units could be eliminated from PA calculations on the basis of low consequence. Long-term flow through abandoned boreholes would have a greater hydrological impact in the Culebra than short-term, drilling-induced flow outside the controlled area. Thus, the effects of fluid flow during drilling in the near future have been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system.

In summary, blowouts associated with historical, current, and near-future boreholes have been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system.

SCR-5.2.1.3.3.2 Future Human EPs—Boreholes that Intersect the Waste Disposal Region

The consequences of drilling within the controlled area in the future will depend primarily on the location of the borehole. Potentially, future deep drilling could penetrate the waste disposal region. If the borehole intersects the waste in the disposal rooms, radionuclides could be transported as a result of drilling fluid flow, e.g., releases to the accessible environment may occur as material entrained in the circulating drilling fluid is brought to the surface. Also, during drilling, contaminated brine may flow up the borehole and reach the surface, depending on fluid pressure within the waste disposal panels; blowout conditions could prevail if the waste panel were sufficiently pressurized at the time of intrusion.

SCR-5.2.1.3.3.3 Hydraulic Effects of Drilling-Induced Flow

The possibility of a future borehole penetrating a waste panel, so that drilling fluid flow and, potentially, blowout result in transport of radionuclides to the land surface or to overlying hydraulically conductive units, is accounted for in PA calculations. The hydraulic effects of drilling through the experimental and operational regions of the repository are not accounted for in PA calculations as it was determined that they could be excluded due to low consequence (Wilson et al. 1996). This determination of low consequence was recently reconfirmed by Zeitler

(2015). This new analysis uses the latest PA results and updates the low consequence brine flow justification analyses discussed in Wilson et al. (1996), where it was determined that insignificant amounts of brine flows from the repository to the non-waste areas do not have a consequence on PA results.

The units intersected by the borehole may provide sources for fluid flow (brine, oil, or gas) to the waste panel during drilling. In the vicinity of the WIPP, the Castile that underlies the Salado contains isolated volumes of brine at fluid pressures greater than hydrostatic. A future borehole that penetrates a Castile brine reservoir could provide a connection for brine flow from the reservoir to the waste panel, thus increasing fluid pressure and brine volume in the waste panel. The possibility of a deep borehole penetrating both a waste panel and a brine reservoir is accounted for in PA calculations.

Future boreholes could affect the hydraulic conditions in the disposal system. Intersection of pockets of pressurized gas and brine would likely result in short-term, isolated hydraulic disturbances, and will not affect the hydrology of the disposal system significantly. Potentially the most significant hydraulic disturbance to the disposal system could occur if an uncontrolled blowout during drilling resulted in substantial flow through the borehole from a pressurized zone to a thief zone. For example, if a borehole penetrates a brine reservoir in the Castile, brine could flow through the borehole to the Culebra and, as a result, could affect hydraulic conditions in the Culebra. The potential effects of such an event can be compared to the effects of long-term fluid flow from deep overpressurized units to the Culebra through abandoned boreholes. Wallace (1996a) analyzed the potential effects of such interconnections in the future within the controlled area (but that do not intersect waste), and concluded that flow through abandoned boreholes between the Culebra and deep units could be eliminated from PA calculations on the basis of low consequence.

These changes have been added to Enclosure 4, *CRA-2014 Errata Tracking*.

References:

Economy, K. 1996. “Drilling Into a Salado Zone of Contamination Within the Controlled Area; Drilling Into a Non-Salado Zone of Contamination Within the Controlled Area.” Summary Memo of Record for S-9 and NS-6 FEPs Screening. August 21, 1996. ERMS 416368. Sandia National Laboratories, Albuquerque, NM.

Wallace, M. 1996. “Leakage from Abandoned Boreholes.” Summary Memorandum of Record for NS-7b, SWCF-A 1.1.6.3:PA:QA:TSK:NS-7b. ERMS 240819. Sandia National Laboratories, Albuquerque, NM.

Wilson, C., D. Porter, J. Gibbons, E. Oswald, G. Sjoblom, and F. Caporuscio. 1996. Conceptual Models Supplementary Peer Review Report (December). ERMS 243153. Carlsbad Area Office, Carlsbad, NM.

U.S. Department of Energy (DOE). 1996. Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant (October). 21 vols. DOE/CAO-1996-2184. Carlsbad Field Office, Carlsbad, NM.

Zeitler, T. 2015. "Evaluation of Brine Flow through Panel Closures using CRA-2014 BRAGFLO Results." Summary Memo to Records. June 2015. ERMS Pending. Sandia National Laboratories, Carlsbad, NM.

EPA Evaluation of Response

Response is complete; however, EPA identified concerns with DOE's approach. DOE's arguments are based on a model of the non-waste areas that exaggerates brine inflow from other sources by including the non-physical early time drainage of an essentially saturated DRZ and also by ignoring creep closure of the non-waste area drifts and healing of the surrounding DRZ. The closure and healing processes that are excluded from DOE's assessment will reduce the permeability of the non-waste areas and surrounding DRZ to extremely low values and essentially eliminate fluid inflow to the waste area from those areas. Thus DOE's conclusion is accurate, that penetrations of non-waste areas will not affect repository performance, but not because of non-physical brine volume comparisons but because there will be essentially no permeability for fluid to flow. However, the sensitivity of predicted repository releases to creep closure and healing of the non-waste areas and adjacent DRZs was evaluated by DOE at EPA's request and was found to be small (EPA 2017).

Reference:

EPA (U.S. Environmental Protection Agency) 2017. *Review of EPA Sensitivity Studies of DOE CRA-2014 WIPP Compliance Recertification Performance Assessment.* Docket No: EPA-HQ-OAR-2014-0609. Prepared by S. Cohen & Associates, Vienna, Virginia, for EPA Office of Radiation and Indoor Air, Washington, DC.

2-32-S4 FEP H28 ENHANCED OIL AND GAS PRODUCTION.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please address whether enhanced production techniques are being used in the Delaware basin and in the vicinity of WIPP. Please also address the potential for these techniques to create a preferential pathway for radionuclide releases through a second well.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Enhanced production refers to methods used to enhance production in a well after the primary production rate becomes unsatisfactory. Enhanced production techniques employed in the Delaware Basin include water injection, waterflood, and carbon-dioxide (CO_2) miscible flooding. These techniques have been commonly used in the Delaware Basin, but only small-scale pilot injection[1] occurs near the WIPP. No unitized floods have been identified or planned[2]. As stated in Melzer (2013), carbon dioxide miscible flooding is not an attractive production enhancement technique near the WIPP due to unfavorable reservoir characteristics (channel sands). These same characteristics make widespread waterflooding unlikely as well.

In the mid-1990s, WIPP stakeholders suggested including an injection well into WIPP performance assessment scenarios. The DOE did not agree that the scenario was technically credible, and conducted very conservative analyses assuming a faulty injection well operated at extreme pressures for a very long time period located at the WIPP boundary to simulate a worse-case injection scenario. These analyses concluded that such activities do not jeopardize the ability of the WIPP to perform as expected (Stoelzel and Obrien [1996], and Stoelzel and Swift [1997]). EPA concurred with this analysis in its Technical Support Document for Section 194.32: Fluid Injection Analysis (EPA 1998) and stated, "…fluid injection was appropriately screened out of performance assessment by DOE."

EPA's question asks whether these techniques can create pathways for radionuclide releases through a second well. It is assumed that the second well is located outside the WIPP boundary and then employs enhanced recovery methods later in the life of the well. Due to the reservoir characteristics cited above, only pilot injection (single-point injection) would be employed near the WIPP, not a widespread waterflood project. In this case, water would be injected into the target formation to move oil or gas toward a neighboring producing well (not for disposal purposes). Because injection wells are permitted to pressures safely below the fracture threshold, fractures will not occur and therefore will not create any pathway that would connect the repository to the injection well. In waterflood or "pilot flood" projects such as this, exceeding the

[1] Note: "Pilot injection" refers to a single injection well, not an expansive, multi-injection-site waterflood project intended to influence several producing wells.

[2] Unitization provides for the development of an entire geologic structure or area by a single operator so that drilling and production may proceed in the most efficient and economic manner. Unitized waterfloods are typically designated for large, continuous reservoir types.

fracture threshold is not only in violation of the operating permit[33], but also detrimental to the purposes of enhancing production. Therefore, operators ensure that these threshold pressures are not exceeded. Given these limitations, it is not expected a well near the WIPP employing enhanced production techniques would create a release pathway or connection to the other wells outside the WIPP boundary or waste panels within the boundary. Scenarios where wells within the boundary that do not intersect WIPP waste are explicitly exempted from consideration of enhanced production techniques under 40 CFR 194.33(d), where it states, *"With respect to future drilling events, performance assessments need not analyze the effects of techniques used for resource recovery subsequent to the drilling of the borehole."* (See also Appendix SCR-2014 Section SCR-5.2.1.7, FEPs H60 *Liquid Waste Disposal* – Inside Boundary, and H61 *Enhanced Oil and Gas Production* – Inside Boundary.)

References:

Melzer, L.S. 2013. *An Updated Assessment of the CO2-Enhanced Oil Recovery Potential in the Vicinity of the Waste Isolation Pilot Plant (June)*. Melzer Consulting, Midland, TX.

Stoelzel, D.M., and D.G. O'Brien. 1996. *The Effects of Salt Water Disposal and Waterflooding on WIPP*. Summary Memorandum of Record for NS-7a. ERMS 240837. Sandia National Laboratories, Albuquerque, NM.

Stoelzel, D.M., and P.N. Swift. 1997. *Supplementary Analyses of the Effect of Salt Water Disposal and Waterflooding on the WIPP*. ERMS 244158. Sandia National Laboratories, Albuquerque, NM.

U.S. Environmental Protection Agency (EPA). 1998. *Technical Support Document for Section 193.32: Fluid Injection Analysis* (May). Environmental Protection Agency Office of Radiation and Indoor Air, Washington, D.C.

EPA Evaluation of Response

Response is complete and sufficient. EPA's principal concern was whether hydrofracturing was occurring in the Delaware Basin to enhance oil and gas production. DOE's response does not include hydrofracturing as a technique being used in the Delaware basin as of the cutoff date for inputs to the CRA-2104. Potential impact on WIPP PA is low.

2-32-S5 FEP H58 SOLUTION MINING.
40 CFR 194.23 Models and Computer Codes

EPA Question

This FEP is screened out partially on the basis that solution mining will not occur in low ambient temperature conditions. However, solution mining is occurring in the nearby Eddy mine under similar conditions that exist in the vicinity of WIPP. Please provide text that reconciles the basis

[3] Permits to inject are issued by the New Mexico Oil Conservation Division and limit injection pressures based on depth, fracture pressures, and other rock and reservoir characteristics.

of the screening argument and the conditions at the Eddy mine where solution mining is taking place.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

The official screening decision for this FEP, as stated in Appendix SCR-2014, is based on regulatory grounds under the "future states assumption" found in 40 CFR 194.25. That is, from a strictly *regulatory-based* perspective, the solution mining project currently underway by Intrepid Mining can be screened out because it is located geographically outside of the Delaware Basin boundary, and regulatory guidance is clear that areas outside the basin boundary are, by definition, not in the vicinity of WIPP and therefore not to be considered in compliance applications due to their geographic and geologic differences from the WIPP site. This position is supported by the EPA in its Response to Comments, Section 8, Issue GG (EPA 1998d):

> *"…However, the Agency emphasizes that, in accordance with the WIPP compliance criteria, solution mining does not need to be included in the PA. As previously discussed, potash solution mining is not an ongoing activity in the Delaware Basin. Section 194.32(b) of the rule limits assessment of mining effects to excavation mining. Thus the solution mining scenarios proposed are excluded on regulatory grounds after repository closure. Prior to or soon after disposal, solution mining is an activity that could be considered under Section 194.32(c). However, DOE found that potash solution mining is not an ongoing activity in the Delaware Basin; and one pilot project examining solution mining in the Basin is not substantive evidence that such mining is expected to occur in the near future."*

For many FEPs within WIPP's baseline, screening can sometimes be accomplished based on more than one screening criterion. In such cases, the DOE often opts for the regulatory screening, if appropriate. Such is the case for H58. However, in the interest of completeness and comprehensiveness, the DOE felt it worthwhile to discuss the Intrepid solution mining project in Appendix SCR-2009. The DOE again updated this project's progress in Appendix SCR-2014. DOE has followed the development of this project from its inception, and has verified that the solution mining activity remains outside the Delaware Basin boundary, thus supporting the screening decision of SO-R (screened-out, based on regulatory grounds).

While the screening decision of SO-R is the "decision of record," a technical discussion is also presented about both the probability and consequence of solution mining for potash at the WIPP within Appendix SCR-2014. The DOE feels that while these arguments are not the basis of the current screening decision, they are valuable in understanding the nature and impact of this activity should it occur at or near the WIPP in the future. Appendix SCR-2014 provides additional information regarding the possible consequences of solution mining near the WIPP, however this information does not affect the current screening decision.

References:

U.S. Environmental Protection Agency (EPA). 1998. *Response to Comments: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the 40*

CFR Part 191 Disposal Regulations (May). Environmental Protection Agency Office of Radiation and Indoor Air, Washington, D.C.

EPA Evaluation of Response

Response is sufficient. Although EPA acknowledges the regulatory basis for DOE's screening decision for this FEP, the screening argument also includes a technical discussion concluding that solution mining for potash in the vicinity of WIPP is very unlikely for various technical and economic reasons. However, the solution mining at Eddy Mine provides an opportunity for reconsidering this technical discussion if the mining is occurring despite the technical and economic constraints described in the screening argument. Potential impact on WIPP PA is low.

2-32-S6 FEP W1 DISPOSAL GEOMETRY.
40 CFR 194.23 Models and Computer Codes

EPA Question

In the screening argument please provide evidence that the modeled excavated volume is the expected mined volume of the underground workings at the time of closure.

DOE Response (from DOE Response Package 5 (DOE RP5 2015b))

Consistent with the DOE's response to EPA comment 2-32-G1, this type of information is best left in the supporting documentation, rather than within the screening document. With regard to the actual mined volume modeled in PA, please see DOE's response to EPA Comment 1-23-7 (Franco 2015).

Reference:

Franco, J.R. 2015. Letter to J. Edwards (Subject: Response to Environmental Protection Agency Letter Dated December 17, 2014 Regarding the 2014 Compliance Recertification Application). March 18, 2015. U.S. Department of Energy, Carlsbad Field Office, Carlsbad, NM.

EPA Evaluation of Response

Consistent with DOE's response to Comment 2-32-G1 and with EPA's assessment of that response, in the next FEP baseline the screening argument for this FEP should include a reference to the supporting documentation where the basis for the modeled excavated volume is described and justified as being the expected volume at the time of closure.

2-32-S7 FEP W3 HETEROGENEITY OF WASTE FORMS.
40 CFR 194.23 Models and Computer Codes

EPA Question

The screening argument citation of the CCA as the source of information on the heterogeneity of waste forms ignores changes that have occurred in the past 15 years, including supercompacted waste and mingling RH waste in shielded containers with CH waste. Please update the information to reflect current waste forms.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

The screening argument for W3 Heterogeneity of Waste Forms has been revised to reflect new information regarding the variety of waste forms and types that are approved for disposal. However, the details regarding the implementation of the waste inventory and waste heterogeneity are presented elsewhere within the compliance documentation, and are referenced in the revised Appendix SCR text. Waste heterogeneity from an activity standpoint is accounted for in disturbed performance scenarios (see Appendix PA-2014, Section PA-3.8). Any new information related to the heterogeneity of wastes and variations to their physical form has been updated with each CRA as appropriate. These variations have been discussed historically in other areas of the CCA and subsequent CRAs, as appropriate. This information continues to be represented within the compliance baseline, as all previous compliance submittals and correspondence remain part of the certification basis.

With regard to EPA's specific request about current waste forms, Hansen et al. (2004) discusses the effects of supercompacted waste and heterogeneous waste emplacement on repository performance. In that report, the DOE "assessed the baseline features, events and processes (FEPs) to identify specific components of performance assessment that could be affected by supercompacted waste." The DOE found that "no changes to the waste-related FEPs were warranted in the new performance assessment." The results of that assessment have not been superseded, so the DOE continues to support that finding, and no changes to the waste-related FEPs based on supercompacted waste and heterogeneous waste emplacement are currently warranted. The EPA's review (EPA 2004) and approval (Marcinowski 2004) of this analysis concurred with DOE's findings that these wastes are suitable for disposal in WIPP and are adequately represented within performance assessment.

More recently, the approval to dispose shielded RH containers was granted by EPA in Edwards (2013). This approval was based, in part, upon a bounding analysis (Dunagan et al. 2007) that evaluated the effects of 1) disposing all of the RH waste in the walls as originally assumed; 2) disposing all of the RH waste in shielded containers on the room floors, and 3) disposing half of the RH waste in shielded containers and the other half in the walls. The bounding analysis concludes that the packaging and emplacement of RH waste in shielded containers has no discernible impact to all release pathways (i.e., cuttings, cavings, spallings, direct brine releases, groundwater releases, and total releases).

SCR-6.1.2.1.2 Summary of New Information

The waste inventory used for the CRA-2014 PA calculations has been updated as provided in Kicker and Zeitler (2013). Since these FEPs are accounted for in PA, inventory-related parameters may differ from those used in previous PAs; however, the screening decisions have not changed and these FEPs are represented in PA calculations. The EPA approved the use of the shielded RH container as an allowable disposal container in WIPP (Edwards 2013). The impacts of this container upon WIPP performance were evaluated in Dunagan et al. (2007).

SCR-6.1.2.1.3 Screening Argument

Waste characteristics, comprising the waste inventory and heterogeneity of waste forms, are described in the CCA, Appendix BIR. The waste inventory is accounted for in PA calculations in deriving the dissolved actinide source term and gas generation rates. The distribution of contact-handled transuranic (CH-TRU) and remote-handled transuranic (RH-TRU) waste within the repository leads to room-scale heterogeneity of the waste forms, which is accounted for in PA calculations when considering the potential activity of waste material encountered during inadvertent borehole intrusion (Appendix PA-2014, Section PA-3.8). The DOE implements waste heterogeneity in waste forms through the assumption of random placement of TRU waste in the repository. This assumption includes all waste container forms and types. Details regarding the implementation of this assumption are provided in the CRA-2009, Appendix MASS-2009, Section MASS-21.0. This implementation methodology has not changed as a result of the addition of the shielded RH-waste container.

This change has been added to Enclosure 4, *CRA-2014 Errata Tracking.*

References:

Dunagan, S.C., G.T. Roselle, E.D. Vugrin, and J.T. Long. 2007. *Analysis Report for Shielded Container Performance Assessment*. ERMS 547197. October 31, 2007. Sandia National Laboratories, Carlsbad, NM.

Edwards, J.D. 2013. Letter to J. Franco, Carlsbad Field Office, approving the disposal of the shielded container assembly. September 3, 2013. U.S. Environmental Protection Agency, Washington, D.C.

Hansen, C.W., L.H. Brush, M.B. Gross, F.D. Hansen, B.Y. Park, J.S. Stein and T. W. Thompson. 2004. *Effects of Supercompacted Waste and Heterogeneous Waste Emplacement on Repository Performance*. ERMS 533551.

Marcinowski, F. 2004. Letter to R. P. Detwiler, Carlsbad Field Office, approving the disposal of compressed waste from the Idaho National Environmental and Engineering Laboratory's Advanced Mixed Waste Treatment Facility at the Waste Isolation Pilot Plant. March 26, 2004. U.S. Environmental Protection Agency, Washington, D.C.

Trinity Engineering Associates. 2004. *Review of Effects of Supercompacted Waste and Heterogeneous Waste Emplacement on WIPP Repository Performance, Final Report*. March 17, 2004. U.S. Environmental Protection Agency, Washington, D.C.

EPA Evaluation of Response

Response is complete and sufficient.

2-32-S8 FEP W5 CONTAINER MATERIAL INVENTORY.
40 CFR 194.23 Models and Computer Codes

EPA Question
Please supplement the screening argument with an explanation of the implementation in PA of the material inventory of shielded containers containing RH waste.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Appendix SCR is not intended to provide comprehensive explanations on how a FEP is represented in PA models, but does provide pointers to other compliance documents that contain this information. The implementation and impact of the addition of shielded containers to the inventory was discussed in the CRA-2009, Section 15.6.4.3, and with more recent information in Section 15.8.4.3 of the CRA-2014. Analyses evaluating shielded containers on WIPP performance are found in Dunagan et al. (2007). The masses of shielded container material parameters are represented in PA the same way as for other RH containers. Changes to Appendix SCR-2014 text that points to the implementation details of waste containers within performance assessment has been made and is provided in the revised text below.

SCR-6.1.3.2 FEP Number: W5
FEP Title: Container Material Inventory

SCR-6.1.3.2.1 Screening Decision: UP

The Container Material Inventory is accounted for in PA calculations.

SCR-6.1.3.2.2 Summary of New Information
The masses of container materials associated with the waste inventory for the CRA-2014 have been updated as detailed in Van Soest (2012). The EPA approved the use of the shielded RH container as an allowable disposal container in WIPP (Edwards 2013). The impacts of this container upon WIPP performance were evaluated in Dunagan et al. (2007).

SCR-6.1.3.2.3 Screening Argument
The container material inventory is described in Van Soest (2012) and is accounted for in PA calculations through the estimation of gas generation rates (see Appendix PA-2014, Section PA-4.2.5). In the CCA, Appendix WCL, a minimum quantity of metallic Fe was specified to ensure sufficient reactants to reduce radionuclides to lower and less soluble oxidation states. This requirement is met as long as there are no substantial changes in container materials. The inventory used for the CRA-2014 contains 3.69 x 107 kg of steel in packaging (includes containers) materials. This value is up slightly from 3.59 x 107 kg reported in 2008 (Van Soest 2012). Modeling assumptions related to the implementation of waste container materials can be found in Appendix MASS-2014, Table MASS-5.

This change has been added to Enclosure 4, *CRA-2014 Errata Tracking.*

Reference:

Dunagan, S.C., G.T. Roselle, E.D. Vugrin, and J.T. Long. 2007. *Analysis Report for Shielded Container Performance Assessment*. ERMS 547197. October 31, 2007. Sandia National Laboratories, Carlsbad, NM.

EPA Evaluation of Response

Response complete and sufficient.

2-32-S9 FEP W18 DISTURBED ROCK ZONE (DRZ).
40 CFR 194.23 Models and Computer Codes

EPA Question

The screening argument for this FEP states "This excavation-induced, host-rock fracturing is accounted for in PA calculations (the CCA, Chapter 6.0, Section 6.4.5.3)." The cited CCA text indicates that the DRZ is modeled in the same way around all repository excavations. However, the DRZ is now expected to vary spatially. Provide an updated description of the DRZ in the waste and non-waste locations of the repository.

2-32-S10 FEP W19 EXCAVATION-INDUCED CHANGES IN STRESS.
40 CFR 194.23 Models and Computer Codes

Screening argument was combined with that for W18 Disturbed Rock Zone (DRZ); please see comments for FEP W18.

DOE Combined Response (from DOE Response Package 4 (DOE RP4 2015a))

FEPs W18 and W19 have been screened in since the CCA (Chapter 6.0, Section 6.4.5.3). The status of these FEPs did not change for CRA-2014, and host-rock fracturing resulting from excavation-induced changes in stress has always been included in PA calculations. Its detailed implementation in PA calculations is discussed in other parts of WIPP compliance documentation, as described below. The screening argument for these FEPs (Appendix SCR-2014) refers to the CCA (Chapter 6.0, Section 6.4.5.3) to note that excavation-induced, host-rock fracturing has been included in PA calculations (as a disturbed rock zone, DRZ), but does not describe the specific details of how this fracturing has been implemented in PA calculations. In the "Summary of New Information" for these FEPs (Appendix SCR-2014), AP-164 (Camphouse 2013) is cited as providing a description of the DRZ, including the DRZ in both the waste and non-waste locations of the repository and in locations beyond the panel closures (i.e., operational and experimental areas). Further, Camphouse (2013) describes how the spatial variation in the DRZ is implemented in different parameter values for the DRZ in the waste locations (material DRZ_1) and in the non-waste locations around the ROMPCS (material DRZ_PCS):

> *For the first 200 years post-closure, the disturbed rock zone (DRZ) above and below the ROMPCS maintained the same properties as specified to the DRZ surrounding the disposal rooms (PA material DRZ_1). After 200 years, the DRZ above and below the ROMPCS was modeled as having healed, and was represented by material DRZ_PCS.*

And also:

> *It is expected that healing of the DRZ region above and below the ROMPCS after 200 years will not yield an increase in permeability when compared to the damaged DRZ. A relationship will be implemented in the CRA-2014 PA to enforce that the permeability of material DRZ_PCS is never greater than the permeability of material DRZ_1.*

Although there is an updated implementation and updated parameters for the DRZ, there is no change to the screening argument or screening decision for these FEPs. Consistent with the DOE's response to EPA comment 2-32-G1, this type of information is best left in the supporting documentation, rather than within the screening document.

Reference:

Camphouse, R.C. 2013. *Analysis Plan for the 2014 WIPP Compliance Recertification Application Performance Assessment*. ERMS 559198. Sandia National Laboratories, Carlsbad, NM.

EPA Evaluation of Response

Response Incomplete. Contrary to the DOE response, EPA did not find a discussion of the treatment of the DRZ in locations beyond the panel closures (i.e., in the operational and experimental areas) in Camphouse (2013).
Additional Information Needed: In the future DOE needs to include in the screening arguments for these FEPs, either directly or by reference, descriptions and justifications of how the DRZ is modeled in the operational and experimental areas of the repository.

2-32-S11 FEP W20 SALT CREEP.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with a discussion of salt creep and consolidation to the ROM salt in the ROMPCS, and healing of the adjacent DRZ. Such a discussion can be found in Camphouse et al. (2012, Section 2.0. ERMS 557396). The screening argument for this FEP states that "Salt creep in the Salado is accounted for in PA calculations (the CCA, Chapter 6.0, Section 6.4.3.1)." The cited CCA section discusses these FEPs only in the context of the waste region. In addition, this is the only FEP that addresses DRZ healing, which is expected to vary spatially.

2-32-S12 FEP W21 CHANGES IN THE STRESS.
40 CFR 194.23 Models and Computer Codes

EPA Question

Screening argument was combined with that for W20 Salt Creep; please see comments for FEP W20. Additionally, please supplement the screening argument with discussions of 1) the coupling between consolidation of the ROM salt in the ROMPCS and healing of the adjacent DRZ (DRZ healing cannot occur until the ROM salt is consolidated and applies a back stress sufficient to compress and heal the DRZ); and 2) lateral extrusion of the ROM salt when under compressive stress from drift creep closure.

DOE Combined Response (from DOE Response Package 5 (DOE RP5 2015b))

The screening argument and decision for these FEPs have not changed, however, the following pointers will be placed in Appendix SCR-2014 to more precisely define where the new ROM salt panel closures are described and how they are implemented within PA. Changes are shown in blue font below.

SCR-6.3.1.2 FEP Numbers: W20 and W21 FEP Titles: *Salt Creep* (W20) *Change in the Stress Field* (W21)

SCR-6.3.1.2.1 Screening Decision: UP

Salt Creep in the Salado and any resultant *Changes in the Stress Field* are accounted for in PA calculations.

SCR-6.3.1.2.2 Summary of New Information

Salt creep and changes in stress will affect the consolidation of the ROM salt PCS over time. Modifications to relevant parameters are described in Camphouse (2013a). Implementation of the new ROM salt PCS is described in Appendix PA-2014, Section PA-4.2.8, and Appendix MASS-2014, Section MASS-4.1.3. These changes are downstream of the FEPs screening process, and will not change the screening decision; these FEPs will remain classified UP.

SCR-6.3.1.2.3 Screening Argument

Salt creep will lead to changes in the stress field, compaction of the waste and containers, and consolidation of the long-term components of the sealing system. It will also tend to close fractures in the DRZ, leading to reductions in porosity and permeability, increases in pore fluid pressure, and reductions in fluid flow rates in the repository. Salt creep in the Salado is accounted for in PA calculations (the CCA, Chapter 6.0, Section 6.4.3.1). The long-term repository seal system relies on the consolidation of the crushed-salt seal material and healing of the DRZ around the shaft seals and in and around the panel closures to achieve a low permeability under stresses induced by salt creep. Shaft seal and panel closure performance is discussed further in Section SCR-6.3.5.1 (FEPs W36, W37, W113, and W114).

This change has been added to Enclosure 4, *CRA-2014 Errata Tracking*.

EPA Evaluation of Response

The three parts to Comment 2-32-11 are assessed separately:

1. Response complete and sufficient. DOE has modified the screening argument to provide references to documentation describing the implementation of the new ROM salt PCS that are correct and adequate.
2. **Response Incomplete.** In the future, salt creep needs to be discussed in the context of all repository regions, not just the waste region.

Additional Information Needed: In the future, provide references in the screening argument for this FEP to documents describing and justifying the treatment of salt creep in all repository regions.

3. **Response Incomplete.** In the future, the different treatments of DRZ healing in different repository regions needs to be addressed.
   Additional Information Needed: Provide references in the screening argument for this FEP to documents describing and justifying the treatment of DRZ healing in all repository regions.

The two parts to Comment 2-32-12 are assessed separately:

1. **Response Incomplete.** In the future DOE needs to address the coupling between consolidation of the ROM salt in the ROMPCS and healing of the adjacent DRZ.
   Additional Information Needed: In the future DOE needs to provide references in the screening argument for this FEP to documents describing the coupling between consolidation of the ROM salt in the ROMPCS and healing of the adjacent DRZ.
2. **Response Incomplete.** In the future, DOE needs address lateral extrusion of the ROM salt PCS under compressive stress.
   Additional Information Needed: In the future DOE needs to provide references in the screening argument for this FEP to documents describing lateral extrusion of the ROM salt PCS under compressive stress and its impact on PCS performance.

2-32-S13 FEP W25 DISRUPTION DUE TO GAS EFFECTS.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with a discussion of the potential for high waste panel gas pressures to delay the consolidation of the ROM salt, thereby maintaining a higher permeability in the PCS for a longer period of time.

DOE Response (from DOE Response Package 5 (DOE RP5 2015b))

The current parameters used in the implementation of the ROMPCS are described in Appendix PA, Section PA-4.2.8 and its supporting references. Gas pressurization effects were not considered in the consolidation of the ROMPCS because physical (creep) closure and complete consolidation are expected to occur before significant gas pressures can develop. Figure 6-1 of Camphouse (2013) indicates gas pressures will be below lithostatic pressure for 1000 years or more, supporting this assertion. Because gas pressures are not expected to affect the ROMPCS final permeability, this FEP argument has not been changed.

Reference:

Camphouse, C. 2013. Analysis Package for Salado Flow Modeling Done in the 2014 Compliance Recertification Application Performance Assessment (CRA-2014 PA). Revision 0. April 30, 2013. ERMS 559980. Sandia National Laboratories, Carlsbad, NM.

EPA Evaluation of Response

Response incomplete. DOE's response adequately explains why gas pressure effects are not considered in consolidation of the ROMPCS but did not add this explanation to the FEP screening argument "Because gas pressures are not expected to affect the ROMPCS final permeability…" The purpose of a FEP is to explain the processes that have been considered whether or not they are implemented in PA, thus this response is incomplete. This issue was raised by EPA when reviewing the interim 2012 PCS PA and the argument of no consequence was accepted by EPA along with a DOE commitment that the argument would be included in the FEP baseline.

Additional Information Needed: In the future DOE needs to provide references in the screening argument for this FEP to documents describing and justifying the treatment of gas pressure effects on potentially delaying the consolidation of the ROM salt PCS during creep closure.

2-32-S14 FEP W27 GAS EXPLOSIONS.
40 CFR 194.23 Models and Computer Codes

EPA Comment

Please update the screening argument to reflect the LANL inventory with nitrates and added organic matter that resulted in an exothermic reaction.

DOE Response (from DOE Response Package 5 (DOE RP5 2015b))

The Accident Investigation Board report (DOE 2015) and the Technical Assistance Team report (SRNL 2015) specifically say that there was no evidence of an explosion. Both reports cite the steep angle of repose for the MgO as good evidence that there was no explosion. Both conclude that the radiological release was the result of an incompatible mixture that heated up, pressurizing the drum to the point of venting and igniting nearby flammable emplacement materials. Therefore, the DOE believes that this type of information is best described in FEP W72, *Exothermic Reactions* (see following DOE response to EPA Comment 2-32-S21).

References:

DOE (U.S. Department of Energy). 2015. Accident Investigation Report. Phase 2. Radiological Release Event at the Waste Isolation Pilot Plant, February 14, 2014. April 2015. U.S. Department of Energy, Office of Environmental Management.

SRNL (Savannah River National Laboratory). 2015. Waste Isolation Pilot Plant Technical Assessment Team Report. March 17, 2015. Revision 0. SRNL-RP-2014-01198. Savannah River National Laboratory, Aiken, SC.

EPA Evaluation of Response

Response complete and sufficient. The response adequately explains that there was no explosion. Therefore, the DOE believes and EPA agrees that the screening argument is best presented in FEP W72, *Exothermic Reactions.*

2-32-S15 FEP W28 NUCLEAR EXPLOSIONS.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please modify the screening argument to address whether, in addition to “a reduction of TRU radionuclides from previous estimates”, the quantities of fissile radionuclides have also been reduced.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

This screening argument is based on the lack of a mechanism for rapid compression of fissile mass to a high density; this remains true. It would be reasonable to assume, however, that since the overall TRU inventory has declined, the fissile radionuclide inventory has also declined. In response to the EPA's comment, we have taken the fissile radionuclides as identified in the WIPP TRAMPAC (DOE 2012) as having a fissile gram equivalent of greater than 0.00,[1] and summed the total curies (CH and RH) for these radionuclides from the Performance Assessment Inventory Report-2008 (PAIR)[2] (Crawford et al. 2008) used in the 2009 PABC, and then compared them to the same curie totals[3] from the PAIR-2012 (Van Soest 2012) used in the CRA-2014. Fissile radionuclides have indeed reduced from approximately 3.1 million curies for the PABC-2009 to 2.7 million curies for the CRA-2014. The Appendix SCR-2014 text has been updated with this information and is provided below.

1 See the WIPP TRUPACT Authorized Methods of Payload Control (TRAMPAC), Table 3.1-2.
2 Data from Table A 4 (decayed to 2033) from the PAIR-2008 was used.
3 Data from Table 5-3 and 5-4 (decayed to 2033) from the PAIR-2012 was used.

SCR-6.3.3.2 FEP Number: W28
FEP Title: *Nuclear Explosions*

SCR-6.3.3.2.1 Screening Decision: SO-P
Nuclear explosions have been eliminated from PA calculations on the basis of low probability of occurrence over 10,000 yrs.

SCR-6.3.3.2.2 Summary of New Information
This FEP has been updated to include the most recent inventory information as presented in Kicker and Zeitler (2013). This new information does not change the screening argument or decision for this FEP.

SCR-6.3.3.2.3 Screening Argument
Nuclear explosions have been eliminated from PA calculations on the basis of low probability of occurrence over 10,000 yrs. For a nuclear explosion to occur, a critical mass of Pu would have to undergo rapid compression to a high density. Even if a critical mass of Pu could form in the system, there is no mechanism for rapid compression. Inventory information used for the CRA-2014 is presented in Kicker and Zeitler (2013). The updated inventory information for the CRA-2014 shows a reduction of TRU radionuclides from previous estimates. Fissile radionuclides have reduced from approximately 3.1 million curies for the PABC-2009 to 2.7 million curies for the CRA-2014. Thus, current criticality screening arguments are conservatively bounded by the previous CCA screening arguments (Rechard et al. 1996, 2000, and 2001).

This change has been added to Enclosure 4, *CRA-2014 Errata Tracking.*

References:

Crawford, B.A., D. Guerin, S. Lott, B. McInroy, J. McTaggart, G. Van Soest. 2008. *Performance Assessment Inventory Report*, INV-PA-08, Revision 0. LA-UR-09-02260. Los Alamos National Laboratory, Carlsbad, NM

U.S. DOE (Department of Energy). 2012. *Contact-Handled Transuranic Waste Authorized Methods for Payload Control* (CH-TRAMPAC), Revision 4. December 2012. U.S. Department of Energy Carlsbad Field Office, Carlsbad, NM.

Van Soest, G.D. 2012. *Performance Assessment Inventory Report*, Revision 0, LA-UR-12-26643. Los Alamos National Laboratory Carlsbad Operations, Carlsbad, NM.

EPA Evaluation of Response

Response complete and sufficient.

2-32-S16 FEP W40 BRINE INFLOW.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with information on the impacts of changes in GLOBAL:PBRINE and the PCS on brine inflow.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Consistent with the DOE's response to EPA comment 2-32-G1, this type of information is best left in the supporting documentation, rather than within the screening document. The change in the PA parameter distribution for PBRINE does not affect the screening argument or decision for this FEP. The parameter distribution has changed, however the implementation of PBRINE within PA models has not changed. Therefore, no changes have been made to the screening argument or decision for this FEP.

The impacts on repository performance due to implementation of the PCS were discussed in the DOE's planned change request documentation (DOE 2011) and were specifically approved by EPA (per condition 1 of 40 CFR 194) in its October 8, 2014, Federal Register notice (EPA 2014). Furthermore, EPA agreed with the way DOE addressed FEPs in the PCS change notice in its TSD, which stated,

> *"The Agency agrees that for screened-in FEPs, the details of conceptual and numerical implementation and parameterization can be considered modeling issues, and can be documented and justified in analysis plans and reports. (S. Cohen and Associates 2013)"*

Details regarding the overall impacts of the PCS to WIPP performance can be found at: http://www.epa.gov/radiation/news/wipp-news.html#panelclosure.

References:

S. Cohen and Associates. 2013. *Review of DOE's Planned Change Request to Modify the WIPP Panel Closure System*. November 2013. Vienna, VA.

U.S. Department of Energy (DOE). 2011. Transmittal of Planned Change Request to Panel Closures Redesign, E. Ziemianski, DOE Interim Manager, to J. Edwards, EPA ORIA. September 8, 2011.

U.S. Environmental Protection Agency (EPA). 2014. Title 40 CFR Part 194: Criteria for the Certification and Recertification of the Waste Isolation Pilot Plant's Compliance with the Disposal Regulations; Panel Closure Redesign. Federal Register, vol. 79 (October 8, 2014): 60750-756.

EPA Evaluation of Response

EPA has withdrawn this Completeness Question because of changes to the calculation of GLOBAL:PBRINE that EPA will be requiring.

2-32-S17 FEP W42 FLUID FLOW DUE TO GAS PRODUCTION.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with information on the impacts of changes in GLOBAL:PBRINE and the PCS on the availability of brine in the waste panels.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Consistent with the DOE's response to EPA comment 2-32-G1, this type of information is best left in the supporting documentation, rather than within the screening document. Also, as discussed in the DOE's response to comment 2-32-S16, the change in the PA parameter PBRINE does not affect the screening argument or decision for this FEP. Implementation of PBRINE within PA models has not changed. Therefore, no changes have been made to the screening argument or decision for this FEP.

Information on the impacts of the PCS implementation on Salado flow modeling can be found at: http://www.epa.gov/radiation/news/wipp-news.html#panelclosure.

EPA Evaluation of Response

EPA has withdrawn this Completeness Question because of changes to the calculation of GLOBAL:PBRINE that EPA will be requiring.

2-32-S18 FEP W44 DEGRADATION OF ORGANIC MATERIAL.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with an expanded discussion of the importance of the availability of brine on the degradation of organic material. Changes that affect the availability of brine in a waste panel, such as the water balance implementation, the revised value of GLOBAL:PBRINE, and the properties of the ROMPCS and associated DRZ, will affect this FEP.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Consistent with the DOE's response to EPA comment 2-32-G1, this type of information is best left in the supporting documentation, rather than within the screening document. While changes in the availability of brine to support the degradation processes of organic material will indeed affect the amount of gases generated, these processes are already accounted for in PA calculations. However, the screening argument and decision are not affected by these changes. The implementation of the chemical models that represent these processes is described elsewhere within the compliance documentation and PCS documentation (see Appendix PA-2014, Section PA-4.2.5).

EPA Evaluation of Response

Response incomplete. A generalized discussion of the conditions that influence a FEP is appropriate for the baseline. The cited Section of Appendix PA-2014 discusses brine production but does not discuss the importance of the availability of brine on degradation processes. **Additional Information Needed:** In the future include a reference in the screening argument for this FEP to supporting documentation where the importance of the availability of brine to the degradation of organic material is discussed.

2-32-S19 FEP W45 EFFECTS OF TEMPERATURE ON MICROBIAL GAS GENERATION.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please modify the screening argument to acknowledge the reduced thermal impact of seal concrete hydration because of the elimination of additional explosion walls and the Option D monolith.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

This is a revision to Appendix SCR-2014, Section SCR-6.5.1.1.3.1. The revised text has been changed to read:

> This thermal rise is considered bounding due to the elimination of concrete from the panel closure systems. Because the new panel closures will be constructed of mined salt, the overall mass of concrete emplaced within the repository will be significantly decreased. More importantly, the emplacement of any constructed element (e.g., shaft seals) of the repository will be done at or before repository closure. Therefore, any increase in temperature due to concrete hydration will have abated by the time AICs are assumed to no longer prevent drilling into the repository.

The revised text has been added to Enclosure 4, *CRA-2014 Errata Tracking.*

EPA Evaluation of Response

Response complete and sufficient.

2-32-S20 FEP W53 RADIOLYSIS OF CELLULOSE.
40 CFR 194.23 Models and Computer Codes

EPA Question

The reported reason for the screening argument update is not consistent between Table SCR-1, where the update is due to new radionuclide inventory, and Section SCR-6.5.1.7.2 where the update is due to new cellulose inventory. The screening argument in Section SCR-6.5.1.7.3 refers only to the new radionuclide inventory. Please reconcile the information.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

This is a revision to Appendix SCR-2014. The revised text of Section SCR-6.5.1.7.2 has been changed to read:

> **SCR-6.5.1.7.2 Summary of New Information**
>
> This FEP has been updated with new waste inventory data. Decreasing waste inventory values lower the overall activity for all TRU radionuclides which indicate that radiolysis of cellulose will not be a significant process. The screening argument and decision are not affected by this change in inventory information.

This change has been added to Enclosure 4, *CRA-2014 Errata Tracking.*

EPA Evaluation of Response

Response complete and sufficient.

2-32-S21 FEP W72 EXOTHERMIC REACTIONS.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with a discussion of the impact of exothermic reactions in the waste panels.

DOE Response (from DOE Response Package 5 (DOE RP5 2015b))

It is clear that the event of February 14, 2014, has no effect on compliance with 40 CFR 191 Subparts B and C (or the CRA-2014), primarily because it occurred during the operational timeframe and not the post-closure disposal period. Additionally, this accident was the result of operational and administrative deficiencies and should not be considered a normally anticipated event. Procedural changes and safeguards will be implemented to assure that such incompatibilities will not occur within waste drums in the future. For these reasons, the screening argument has not been changed to assume that such events will occur in the future. The screening argument will, however, be changed to describe the incident and the processes that are understood to have occurred. This event and resulting administrative changes needs to be considered as operational period activities and have no bearing upon the long-term conditions within the repository.

With regard to this specific event, while nitrate is not depleted by anoxic conditions, it does react with cellulose and will likely be reacting during the operational phase of the repository until the nitrate salts are depleted. However, rather than resulting in a thermal runaway, the more likely scenario of nitrate depletion, which has been observed in sibling containers being stored and monitored at LANL, is by smooth oxidation that does not give rise to a thermal runaway. These reactions reduce the nitrate salts, with a concomitant oxidation of the cellulose, to produce carbon and nitrogen oxides and other products of combustion. Although not seen in the gas phase, metal oxides are also produced. The heat of reaction on these monitored drums has not been detected by the external thermocouples because it is dissipated as fast as it is formed. However, the gaseous products are easily detected by gas chromatography, so it is clear that the reaction is ongoing but the rate is slow and therefore the impact is small, resulting in no loss of containment. While the oxidation by nitrate does produce heat, this heat load is already bounded by the CPR being converted to gas (the calorie release from the nitrate oxidation of cellulose is very similar to the calorie release from the air oxidation of cellulose). It is expected that the exothermic heat load from these reactions will be fairly small compared to the heat capacity of the quantity of salt in the repository. The impact of exothermic reactions from the presence of waste with nitrate salts is expected to be insignificant and is not included in PA.
The following text from Appendix SCR-2014 presents an updated screening argument for FEP W72 *Exothermic Reactions* has been provided to reflect the February 2014 event. Changes are shown in blue font.

SCR-6.3.4.1 FEP Numbers: W29, W30, W31, W72, and W73
FEP Titles: *Thermal Effects on Material Properties* (W29) *Thermally-Induced Stress Changes* (W30) *Differing Thermal Expansion of Repository Components* (W31) *Exothermic Reactions* (W72) *Concrete Hydration* (W73)

SCR-6.3.4.1.1 Screening Decision: SO-C

The effects of *Thermally-Induced Stress*, *Differing Thermal Expansion of Repository Components*, and *Thermal Effects on Material Properties* in the repository have been eliminated from PA calculations on the basis of low consequence to performance of the disposal system.

The thermal effects of *Exothermic Reactions,* including *Concrete Hydration*, have been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system.

SCR-6.3.4.1.2 Summary of New Information

This FEP has been updated to include the most recent inventory information as presented in Van Soest (2012). Thermal calculations have been updated with the updated quantities of reactants and provided below. Additionally, planned Salt Disposal Investigations (SDI) experiments as detailed in Patterson (2011) or the Salt Defense Disposal Investigations (SDDI) (Franco 2012) will place heaters in newly excavated tunnels in the northern experimental region of the WIPP. Mining has been completed, but heater tests have not yet commenced. An evaluation conducted by Kuhlman (2011) for the SDI planned change notice (PCN) shows that any thermal pulse from these experiments will be very minimal, on the order of 0.02 °C or less. Therefore, the screening argument and decision for this FEP is unaffected by the conduct of these experiments.

On February 14, 2014, an exothermic reaction involving the mixture of the organic materials (Swheat Scoop® absorbent and/or neutralizer) and nitrate salts occurred inside a waste drum emplaced in Room 7 of Panel 7. This exothermic reaction resulted in pressurization of the drum, failure of the drum locking ring, and displacement of the drum lid. The visual evidence associated with the identified breach was consistent with an exothermic reaction within the drum. This reaction led to pressure buildup of combustible gases within the drum. The drum lid extruded beyond the lid retention ring, deflected the lid, and resulted in rapid release of the materials from the drum. The combustible gases and solids ignited, which then spread to other combustible materials within the waste array, i.e., fiberboard and polyethylene slip sheets, reinforcement plates, stretch wrap, cardboard stiffeners and polypropylene super sack fabric. The cause of this event has been identified by the Accident Investigation Board (DOE 2015) as being a specific deficiency that, "if corrected, would prevent recurrence of the same accident."

SCR-6.3.4.1.3 Screening Argument

Thermally induced stress could result in pathways for groundwater flow in the DRZ, in the anhydrite layers and MBs, and through seals, or it could enhance existing pathways. Conversely, elevated temperatures will accelerate the rate of salt creep and mitigate fracture development. Thermal expansion could also result in uplift of the rock and ground surface overlying the repository, and thermal buoyancy forces could lift the waste upward in the salt rock.

The distributions of thermal stress and strain changes depend on the induced temperature field and the differing thermal expansion of components of the repository, which depends on the components' elastic properties. Thermal effects on material properties (such as permeability and porosity) could potentially affect the behavior of the repository.

Exothermic reactions expected in the WIPP repository include MgO hydration, MgO carbonation, aluminum (Al) corrosion, and cement hydration[1] (Bennett et al. 1996). Wang (1996) has shown that the temperature rise by an individual reaction is proportional to , where *V* is the maximum rate of brine inflow into a waste panel for a reaction limited by brine inflow (or a specified maximum reaction rate for a reaction limited by its own kinetics) and *M* is the quantity of the reactant. MgO hydration, cement hydration, and Al corrosion are assumed to be limited by brine inflow because they all consume water and have high reaction rates. The amounts of reactants are tabulated in Table SCR-3.

1Only materials in the waste are included in these calculations. Other materials such as concrete in shaft seals have not been included because their effects occur prior to final repository closure or shortly thereafter and have no impact on repository performance.

Table SCR-3. **Changes in Inventory Quantities from the CCA to the CRA-2014**

SCR-1.1.1 Inventory	**CCA**	**CRA-2004**	**CRA-2009**	**CRA-2014**
MgO (tons)	85,600a	72,760 (because of the elimination of mini-sacks)a	59,385e	51,430h
Cellulosics (tons)	5,940b	8,120c	8,907f	5,127i
Plastics (tons)	3,740b	8,120c	10,180f	10,487i
Rubber (tons)	1,100b	1,960c	1,885f	1,379i
Aluminum alloys (tons)	1,980b	1,960c	2,030f	504i
Cement (tons)	8,540b	9,971d	13,888g	11872j

a U.S. DOE (2000a)
b U.S. DOE (1996b). Only CH-TRU wastes are considered. Total volume of CH-TRU wastes is 1.1 × 105 m3. This is not scaled to WIPP disposal volume.
c Appendix DATA-2004, Attachment F. Only CH-TRU wastes are considered. Total volume of CH-TRU waste is 1.4 × 105 m3. This is not scaled to WIPP disposal volume.
d This estimate is derived from data in Leigh (2003) and includes both reacted and unreacted cement (1.2 × 107 kg × 1.4 × 105/168485/1000 kg/ton = 9971 tons cement).
e This estimate is derived by assuming that Panel 1 has an MgO excess factor of 1.95, three panel equivalents have a 1.67 excess factor, and the remaining 6 panel equivalents have a 1.2 excess factor, resulting in a 1.416 projected excess factor for a full repository. The projected excess factor is then multiplied by the equivalent cellulose value of 28,098 × (40.3/27) (the MgO molar ratio).
f This value is derived using material densities reported in Leigh et al. (2005b), and total CH-TRU waste volume (1.45 × 105 m3 reported in Leigh et al. (2005a)).
g This value is derived from data in Leigh (2003) and Leigh et al. (2005a). ((1.2 × 107 kg) × 39/29 × (1.45 × 105)/168485/1000 kg/ton = 13,888 tons cement).
h This estimate is derived by assuming that Panel 1 has an MgO excess factor of 1.95, three panel equivalents have a 1.67 excess factor, and the remaining 6 panel equivalents have a 1.2 excess factor, resulting in a 1.416 projected excess factor for a full repository. The projected excess factor is then multiplied by the equivalent cellulose value of 24,334 × (40.3/27) (the MgO molar ratio).
i This value is derived from Van Soest (2012) and contains CH, RH, packaging, and emplacement materials.

j This value is derived from Van Soest (2012) and contains reacted and unreacted cements for both CH and RH wastes.

Similarly, MgO carbonation, which consumes CO_2, is limited by CO_2 generation from microbial degradation. Given a biodegradation rate constant, the total CO_2 generated per year is proportional to the total quantity of biodegradable materials in the repository. For the LANL drums, the mass of added desiccant is a small fraction of the total mass of CPR in the repository, and will not have a significant impact on long-term performance. Using the computational methods in Wang and Brush (1996a and 1996b), the inventory of biodegradable materials has been changed from 23,884 (8,120 + 1.7 × 8,120 + 1,960) tons for the CRA-2004[2] to 28,098 (8,907 + 1.7 × 10,180 + 1,885) tons of equivalent cellulosic materials for the CRA-2009.[1] For the CRA-2014, this value changes to 24,334 (5,127 + 1.7 × 10,487 + 1,379) tons of equivalent cellulosic materials. This decrease in biodegradable materials corresponds to a proportional decrease in CO_2 generation, all other factors (such as brine saturation) being equal. For MgO carbonation and microbial degradation, the calculated temperature rises have been updated for the changes in both microbial gas generation and waste inventory and are presented in Table SCR-4. Temperature rises (ºC) by exothermic reactions are revised as follows.

CCA conditions following a drilling event show that Al corrosion could, at most, result in a short-lived (two years) temperature increase of about 6 °C (10.8 °F) above ambient room temperature (about 27 °C (80 °F)) (Bennett et al. 1996). A temperature rise of 6 °C (10.8 °F) represented the maximum that could occur as a result of any combination of exothermic reactions occurring simultaneously. Revised maximum temperature rises by exothermic reactions for CRA-2014 are still less than 12 ºC (22 °F) (as shown in Table SCR-4). Such small temperature changes cannot affect material properties. Thus, thermal effects on material properties in the repository have been eliminated from PA calculations on the basis of low consequence to the performance of the disposal system.

Table SCR-4. CCA and CRA Exothermic Temperature Rises

Reactant	CCAa	CRA-2004a	CRA-2009a	CRA-2014a
MgO hydration	< 4.5	< 4.7	< 4.2	< 3.9
MgO carbonation	< 0.6	< 0.7	< 0.6	< 0.6
Microbial degradation	< 0.8	< 1.4	< 1.5	< 1.4
Aluminum corrosion	< 6.0	< 6.8	< 6.9	< 3.4
Cement hydration	< 2.0	< 2.5	< 3.0	< 2.7

a All values are in degrees Celsius.

All potential sources of heat and elevated temperature have been evaluated and found not to produce high enough temperature changes to affect the repository's performance. Sources of heat within the repository include radioactive decay and exothermic chemical reactions such as backfill hydration and metal corrosion. The rates of these exothermic reactions are limited by the availability of brine in the repository. In general, the various sources of heat are not great enough to jeopardize the performance of the disposal system.

These changes have been added to Enclosure 4, *CRA-2014 Errata Tracking*.

2 The 1.7 molar conversion rate for plastic is based on analyses presented in Wang and Brush (1996a and 1996b).

EPA Evaluation of Response

Response incomplete. The acknowledgment in the *Summary of New Information* for this FEP that an exothermic reaction did inadvertently occur in the WIPP waste region is appropriate. However, the chemical incompatibilities that resulted in the exothermic reaction are potentially present in other waste drums that remain in the repository from the same waste stream as the drum that experienced the reaction. The potential that exothermic reactions could occur in those drums in the post-closure environment needs to be addressed in this FEP.
Additional Information Needed: In the future DOE needs to supplement the screening argument for this FEP with a discussion of the effects on WIPP performance of the potential that exothermic reactions could occur in the post-closure environment.

2-32-S22 FEP W73 CONCRETE HYDRATION.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with a discussion of the impact on the PA based on a reduced concrete inventory due to DOE now using Option D concrete monoliths in the panel closure system. Update the analysis to include where explosion walls are or will be installed.

DOE Response (from DOE Response Package 5 (DOE RP5 2015b))

The concrete evaluated within the screening argument reflects only that concrete intrinsic to WIPP waste, and does not consider concrete hydration due to panel closures or other engineered repository elements. Concrete hydration as it relates to this FEP is solely due to cement (or concrete) within the waste (see for example Table SCR-3 in Appendix SCR-2014). The reason that concrete hydration from panel closures has not been included in this analysis is because any related thermal rise is considered a short-term phenomenon that will only exist during the operational period, or at the very earliest part of the post-closure disposal period. Now that concrete will not be used in the panel closure system, concrete hydration from engineered elements of the repository is even less important. The same can be said for any explosion walls currently emplaced or that will be emplaced in the future. These elements, which consist of concrete blocks with mortar joints, have no effect on the long-term performance of the repository. What small amount of cement mortar used will have long been reacted during the operational period and will not have any thermal effect during the disposal period.

EPA Evaluation of Response

Response complete and sufficient**.** Potential impact on WIPP PA is low.

2-32-S23 FEP W110 PANEL CLOSURE PHYSICAL PROPERTIES.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please update the screening argument to provide a description of the as-emplaced properties of the ROM salt now that in situ testing has been completed.

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Consistent with the DOE's response to EPA comment 2-32-G1, this type of information is best left in the supporting documentation, rather than within the screening document. The results of in situ testing have not been documented at this time. At this point, the screening argument and decision remain unchanged.

EPA Evaluation of Response

Response incomplete. In the future the screening argument for this FEP needs to include references to supporting documentation where the as-emplaced properties of the ROM salt are described.
Additional Information Needed: In the future DOE needs to include references in the screening argument for this FEP to supporting documentation where the as-emplaced properties of the ROM salt are described.

2-32-S24 FEP W111 PANEL CLOSURE CHEMICAL COMPOSITION.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please update the screening argument to include the chemical composition of the steel bulkheads that are part of the panel closure design.

DOE Response (from DOE Response Package 5 (DOE RP5 2015b))

Steel (iron) bulkheads have been used in each panel for ventilation control and are not considered part of the engineered panel closure system. Their presence is primarily to control ventilation during construction of the ROMPCS. In cases where a block explosion wall has already been emplaced as part of the partial closure process for some panels, a steel bulkhead will not be used, as the block wall will serve as the ventilation barrier. In cases where the block walls exist, ROM salt will be placed directly against the wall. In cases where the steel bulkhead is used, the ROM salt will have a safe stand-off distance so as not to collapse or compromise the steel bulkhead. In either case, these engineered features are not considered long-term functional elements of the ROMPCS, and are not factored into PA parameters used to represent the closures.

Steel (iron) bulkheads are used throughout the mine for ventilation controls, and may or may not be removed prior to repository closure. Any additional iron mass associated with steel bulkheads used in construction of the ROMPCS is inconsequential to repository performance because modeling predictions show un-degraded iron at the end of the 10,000-year performance period (see DOE response to comment 1-23-5). That is, considering only the iron-based alloys in the waste and waste containers results in a significant portion of the iron inventory un-degraded. Therefore, slightly increasing the iron inventory due to additional steel bulkheads or other facility elements will result in even more un-degraded iron at the end of the performance period. Because of this, and the fact that the steel bulkhead is not considered a PCS element, this FEP remains unchanged.

EPA Evaluation of Response

Response is adequate**.** FEPs are intended to address repository features that are included in PA as well as those that are not. The bulkheads have been described to EPA as part of the panel closure system. They are large features that will be within waste panels and their presence needs to be acknowledged in the FEPs baseline. EPA accepts the conclusion that increases in iron inventory due to the bulkheads will be small and do not change repository performance, but the presence of the bulkheads, their chemical composition, and their potential impact on WIPP performance should be described in the next FEP baseline.

2-32-S25 FEP W113 CONSOLIDATION OF PANEL CLOSURES.
40 CFR 194.23 Models and Computer Codes

EPA Question

Please supplement the screening argument with information on consolidation specific to the ROM salt in the ROMPCS. Such a discussion can be found in Camphouse et al. (2012, Section 2.0. ERMS 557396).

DOE Response (from DOE Response Package 4 (DOE RP4 2015a))

Consistent with the DOE's response to EPA comment 2-32-G1, this type of information is best left in the supporting documentation, rather than within the screening document. The screening argument in Appendix SCR-2014 states in Section SCR-6.3.5.1.3: "Consolidation of shaft seals, consolidation of the ROM salt PCS, mechanical degradation of shaft seals, and mechanical degradation of panel closures are accounted for in PA calculations through the permeability ranges assumed for the seal and closure systems (Appendix PA-2014, Section PA-4.2.7 and Section PA-4.2.8)." Appendix PA, Section PA-4.2.8 then cites Camphouse et al. (2012) for more discussion on the ROMPCS consolidation.

EPA Evaluation of Response

Response is complete and sufficient.

2-32-S26 FEP W115 CHEMICAL DEGRADATION OF PANEL CLOSURES.
40 CFR 194.23 Models and Computer Codes

EPA Question

The screening decision for this FEP was changed from UP (screened in) to SO-P (screened out – low probability). Please supplement the screening argument with a discussion of the chemical degradation of the steel bulkheads, which are part of the ROM salt panel closure system. Please also provide technical justification for the changed screening decision in light of the presence of the bulkheads.

DOE Response (from DOE Response Package 5 (DOE RP5 2015b))

As explained in the response to 2-32-S24, the steel bulkhead is not considered an engineered element of the ROMPCS and is only important to control ventilation during construction of the closure. Degradation of the steel bulkhead will proceed throughout the performance period, as it will for all steel in the repository. This has no effect on the long-term properties of the ROMPCS and is not included in PA. However, degradation of steel within the repository is represented in PA and is a desirable process that serves to maintain a reducing chemical environment, which in turn supports lower actinide solubility.

EPA Evaluation of Response

Response is adequate. The bulkheads have been presented to EPA as part of the panel closure system and a discussion of their degradation is a logical part of this FEP. As explained in the EPA assessment of the response to 2-32-S24, the steel bulkheads are present in the waste region and their chemical degradation should be acknowledged in the next FEPs baseline.

SOURCE CITATION FOR EPA FEP COMPLETENESS QUESTIONS

EPA (U.S. Environmental Protection Agency) 2015. Second Set of Completeness Comments for CRA 2014. Letter from Jonathan Edwards (EPA) to Jose Franco (DOE). U.S. Environmental Protection Agency, Washington D.C. Docket No: EPA-HQ-OAR-2014-0609. February 27, 2015. (Second Completeness Letter).

SOURCE CITATIONS FOR DOE COMPLETENESS QUESTION RESPONSE PACKAGES

DOE RP4 (U.S. Department of Energy) 2015a. Response to Environmental Protection Agency Letters Dated December 17, 2014 and February 27, 2015 Regarding the 2014 Compliance Recertification Application. Letter from Jose Franco (DOE) to Jonathan Edwards (EPA). Docket No: EPA-HQ-OAR-2014-0609. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico. May 29, 2015. (Fourth Response Package).

DOE RP5 (U.S. Department of Energy) 2015b. Response to Environmental Protection Agency Letters Dated February 27, 2015 and June 5, 2015 Regarding the 2014 Compliance Recertification Application. Letter from Dana Bryson (DOE) to Jonathan Edwards (EPA). Docket No: EPA-HQ-OAR-2014-0609. Department of Energy, Carlsbad Field Office, Carlsbad, New Mexico. July 15, 2015. (Fifth Response Package).