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TECHNICAL SUPPORT DOCUMENT FOR SECTION 194.23 AND 194.34

REVIEW OF DOE PLANNED CHANGE NOTICE FOR A FIFTH SHAFT AT THE WIPP REPOSITORY

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EXECUTIVE SUMMARY

This Technical Support Document summarizes EPA's analysis of the impacts on the postclosure performance of sinking a fifth shaft and excavating new connecting drifts at the WIPP repository. The new shaft and new drifts connecting the base of the shaft to the existing underground facility will be built in conjunction with a new filter building for the exhaust shaft. These upgrades will expand the capacity of the ventilation system and support resumption of concurrent, full-scale underground operations as part of the post-2014 recovery activities.

The DOE's assessment of the effect of a fifth shaft and connecting drifts on repository performance was documented in an analysis of the impacts on gas pressure and brine saturation in the repository. The DOE did not consider a complete performance assessment to be necessary because pressure and saturation are the primary drivers of repository releases and the planned design changes were expected to result in only minor changes in these parameters. The DOE initially described the new shaft as a ventilation exhaust shaft but its use was subsequently changed to an air intake shaft and later to a general utility shaft. The DOE may equip the shaft for multiple uses during the repository's operational period but such uses are not expected to affect postclosure performance because all shafts will have been permanently decommissioned and sealed upon repository closure.

The DOE modified the BRAGFLO Salado Flow model based on preliminary shaft and drift designs to account for adding a fifth shaft to the four existing shafts and increasing the volume of the repository Operations Area to account for the volume of the new connecting drifts. The results were compared with those of the CRA-2014 baseline performance assessment and showed small, repository-wide decreases in pressure and increases in brine saturation but no indication that significant changes in repository releases would occur. Later design updates increased the diameter of the shaft and decreased the volume of the connecting drifts. Radionuclide releases through the shafts have been negligible in all past performance assessments and remained negligible with the increased diameter. The decreased connecting drift volume would result in even smaller changes in repository pressure and brine saturation, and even smaller changes would therefore be expected in postclosure repository performance.

The EPA believes that the DOE's analysis adequately demonstrated that the fifth shaft and connecting drifts would not significantly affect repository performance impacting long-term releases of radionuclides as modeled in the CRA-2014 baseline PA and that the subsequent design updates included with CRA-2019 further support this conclusion (Veal 2020). For these reasons, the EPA concluded that the new shaft and connecting drifts will not result in non-compliance with the terms of the WIPP certification and did not object to the shaft construction (Veal 2020).

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LIST OF ACRONYMS AND ABBREVIATIONS

CCA	Compliance Certification Application
CFR	*Code of Federal Regulations*
CRA	Compliance Recertification Application
DBR	Direct Brine Release
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
HEPA	High-Efficiency Particulate Air
NMED	New Mexico Environment Department
NWP	Nuclear Waste Partners
PA	Performance Assessment
PCN	Planned Change Notice
ROM	Run-of-Mine
SNL	Sandia National Laboratories
TRU	Transuranic
TSD	Technical Support Document
WIPP	Waste Isolation Pilot Plant

Support for this report was provided by SC&A, Arlington, Virginia, under Contract 68HERD20A0005, Task Order 68HERH20F0404, Task 1132-0003-001-004-02b. Although issues of both technical practice and regulatory intent are addressed in this report, final interpretation of the EPA rule and ultimate acceptance or rejection of the EPA expectations expressed in this report are only within the purview of the Agency.

1.0 INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) repository was developed by the U.S. Department of Energy (DOE or the Department) for the permanent disposal of transuranic (TRU) waste. The U.S. Environmental Protection Agency (EPA or the Agency) provides regulatory oversight of DOE activities at the WIPP that potentially affect postclosure repository performance. This Technical Support Document (TSD) describes the EPA's review of the DOE's plan to add a fifth shaft at the WIPP. This new shaft would supplement the four existing shafts and provide additional operational flexibility for the WIPP underground waste repository.

The WIPP repository is located in deeply buried deposits of bedded salt in the Salado Formation within the Delaware Basin in southeastern New Mexico. The EPA regulates post-closure containment of TRU waste at the 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 ability to meet the Agency's standards is determined in part by the results of computer modeling conducted for the DOE by Sandia National Laboratories (SNL). That modeling simulates the repository's future performance in a process called Performance Assessment (PA). The DOE typically demonstrates the impact of major design changes such as the addition of a fifth shaft by comparing repository performance with the proposed new design with performance before the change was made. This approach was used by the DOE in soliciting EPA concurrence (Veal 2020) with the plan to sink a fifth shaft and excavate connecting drifts between the base of the shaft and the existing underground repository (Shrader 2017).

Background information on the need for a fifth shaft is provided in Section 2 of this TSD. Section 3 describes the new shaft and its proposed uses, and Section 4 describes the Agency's evaluation of the planned modifications. Section 5 provides a summary of the Agency's evaluation.

2.0 BACKGROUND

On February 5, 2014, a diesel salt haul truck caught on fire in the WIPP underground and the facility was evacuated due to the resulting smoke (DOE 2014a). Nine days later on February 14 an exothermic reaction occurred in a waste drum that had recently been emplaced in Room 7 of Panel 7 in the WIPP repository. The reaction resulted in rapid pressure buildup and a breach of the drum (DOE 2014b). The working status of the WIPP waste panels as of February 2014 is shown in Figure 2.1. Radioactive dust blown from the drum was entrained in the ventilation system air and was dispersed along the air flowpath into the southern half of the repository's Waste Area and back to the exhaust ventilation shaft. Dust particles that settled out in transit contaminated the walls, floors, and roofs of the drifts and rooms along this flowpath as well as the walls of the ventilation exhaust shaft. A map showing access restrictions in the WIPP underground due to radionuclide contamination as of November 2016 is presented in Figure 2.2. Fortunately, normal underground operations had not yet resumed following the fire and there were no personnel in the underground at the time of the release (DOE 2014b, Section 2.1).

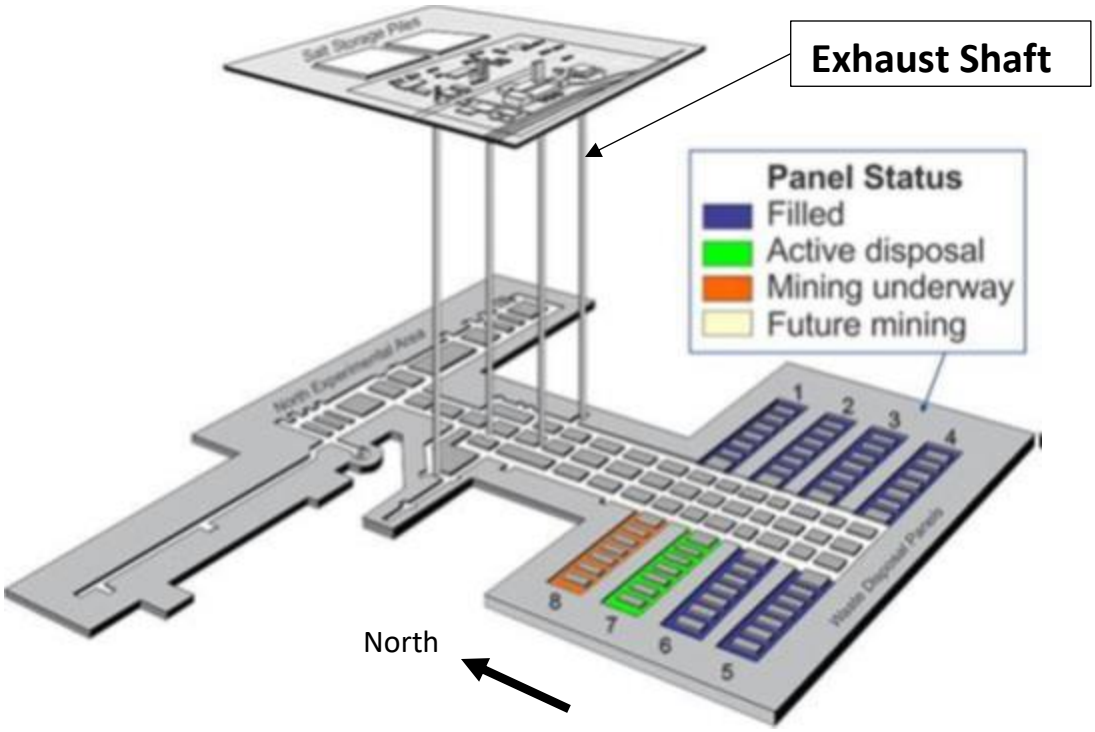

Figure 2.1. Waste panel status as of February 2014.(modified from DOE 2014b, Figure 5)

There are currently four shafts at the WIPP: the ventilation exhaust shaft (mentioned above); the existing air intake shaft; the salt handling shaft; and the waste handling shaft. The salt handling shaft also serves as the principal personnel transport shaft and the waste hoist can also be used to transport personnel. The locations of these shafts are shown in Figure 2.2.

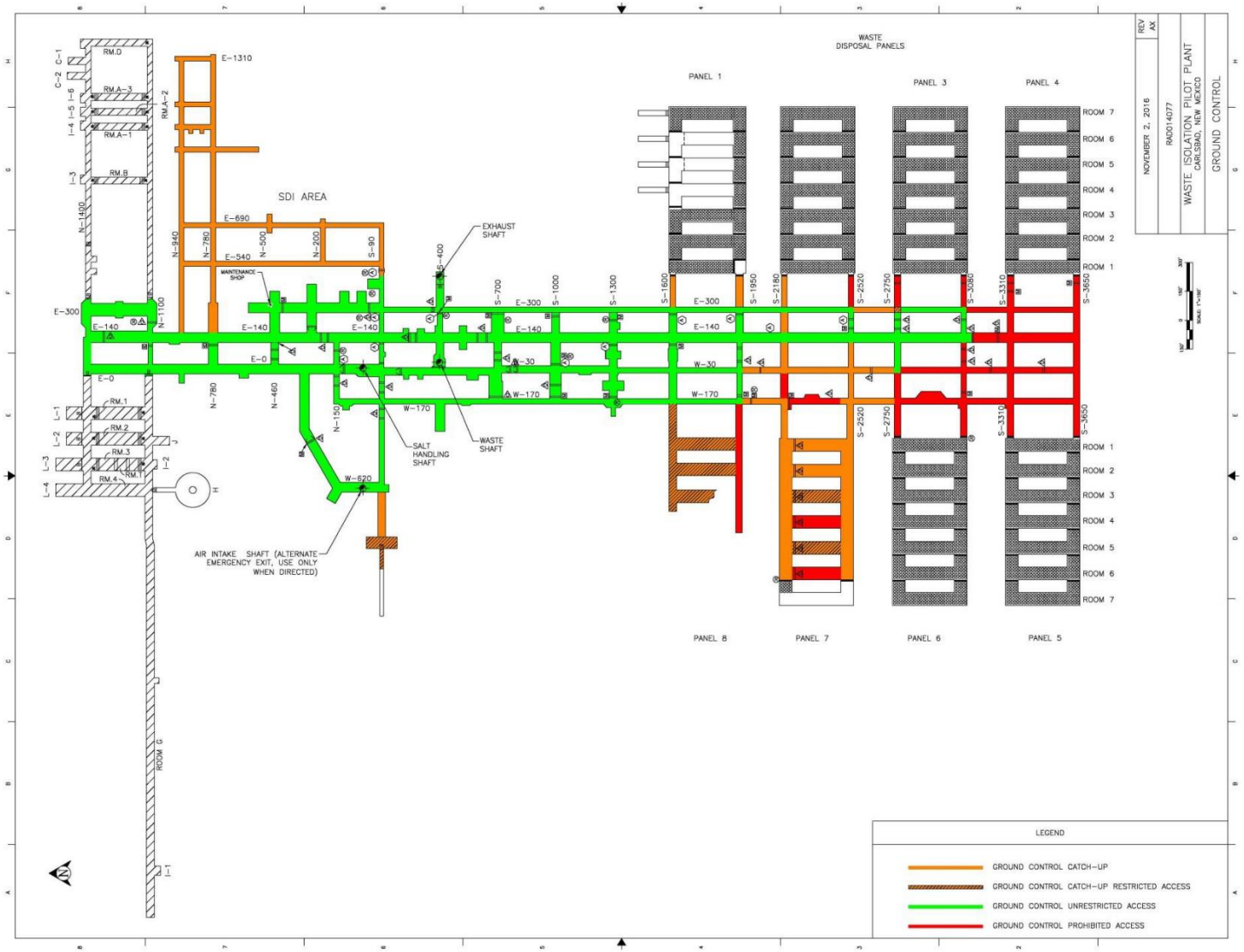

Figure 2.2. Plan view showing access restrictions in the WIPP underground as of November 2016 due to radionuclide contamination. (from DOE-NWP 2016, Enclosure 1)

Since the radiological incident DOE has been running at reduced air flow rates that have required reducing underground mining, maintenance, and waste emplacement activities because concurrent operations were no longer possible. The new shaft and new connecting drifts from the shaft to the existing underground facility will be built in conjunction with a new filter building for the exhaust shaft. The most current design identifies the new shaft as a multifunctional "utility" shaft with the primary role of providing the ventilation capacity needed to support concurrent, full-scale underground operations.

3.0 FIFTH SHAFT DESIGN AND DOE IMPACT ASSESSMENT

A Planned Change Notice (PCN) of the DOE's intent to excavate a new shaft and connecting drifts was transmitted to EPA in September, 2017 (Shrader 2017). An analysis of the impacts of these design changes on repository performance was prepared earlier by Camphouse (2014) and was attached to the PCN. These repository design changes must also be approved by the New Mexico Environment Department (NMED) because of their potential impact on repository operations. The NMED is primarily responsible for regulatory oversight during the operational period of the WIPP while the EPA is primarily responsible for regulatory oversight during the postclosure period, which begins after disposal operations cease. NMED approval was granted in October 2021 (Maestas, 2021).

3.1 Shaft Design

The aforementioned PCN (Shrader 2017) describes the fifth shaft as being located approximately 1,200 feet west of the existing Air Intake Shaft as shown in Figures 3.1 and 3.2. DOE's preliminary plan was to use the new shaft for ventilation system exhaust and it is so described in Camphouse (2014). However, at the time the PCN was prepared, the new shaft was instead planned to be used for ventilation air intake. Shrader (2017) stated that surface-mounted fans are planned to blow air down the shaft into the underground for the primary purpose of serving the construction and disposal ventilation circuits through the new connecting drifts. Exhaust air from the North, Disposal, and Waste Shaft Station Circuits is planned to be routed through the existing Exhaust Shaft and filter building. Exhaust air from the Construction Circuit will not require filtering and is planned to be routed through the existing Air Intake Shaft. The preliminary design called for a shaft diameter of 14 ft and served as the basis for the Camphouse (2014) analysis. As described below, the diameter was later doubled to a minimum of 28 ft when the purpose of the shaft changed to serving as an air intake.

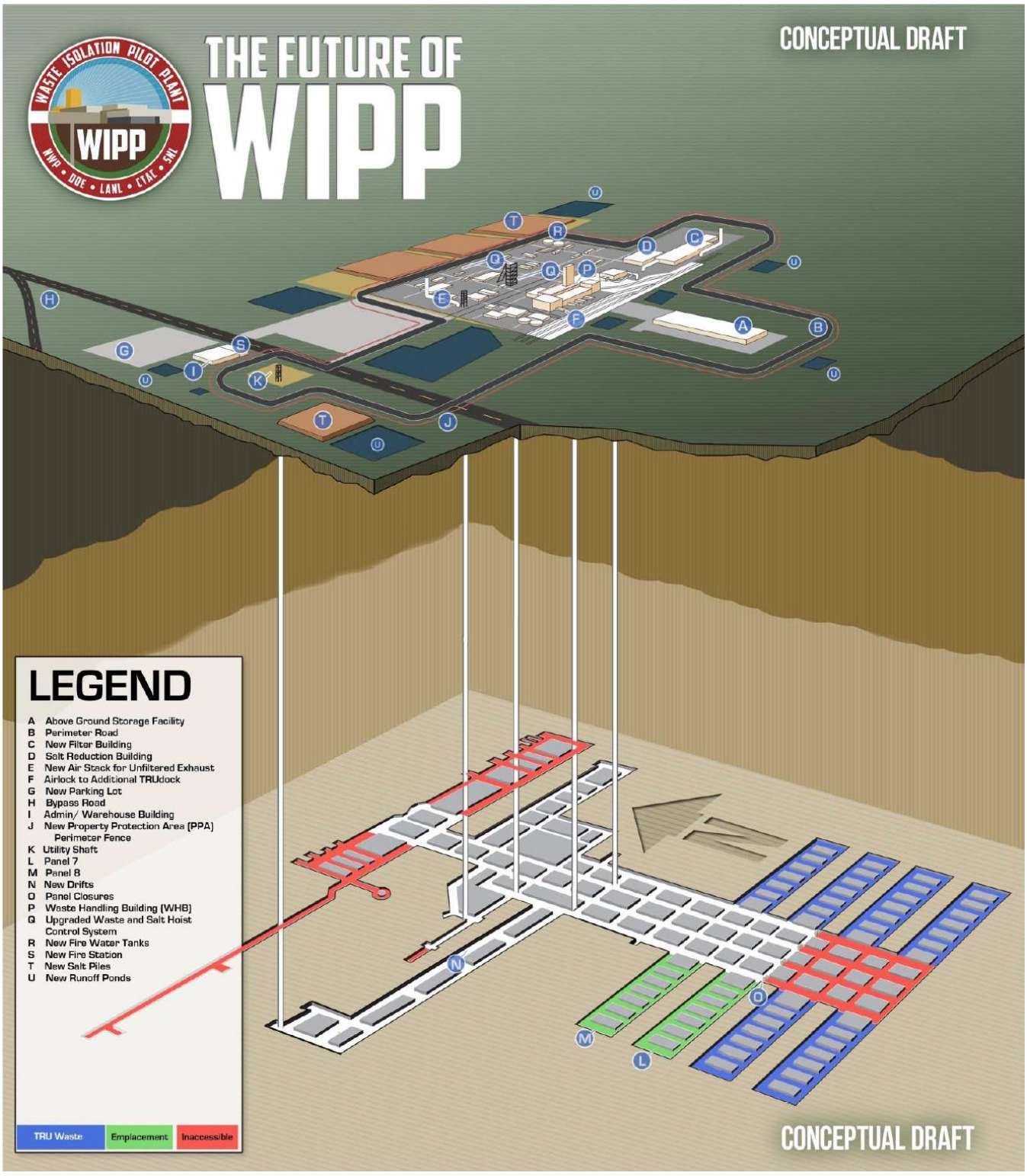

Figure 3.1. Conceptual drawing of planned surface and subsurface design changes at the WIPP facility including the new fifth shaft (K) and new connecting drifts (N). (from DOE 2019b)

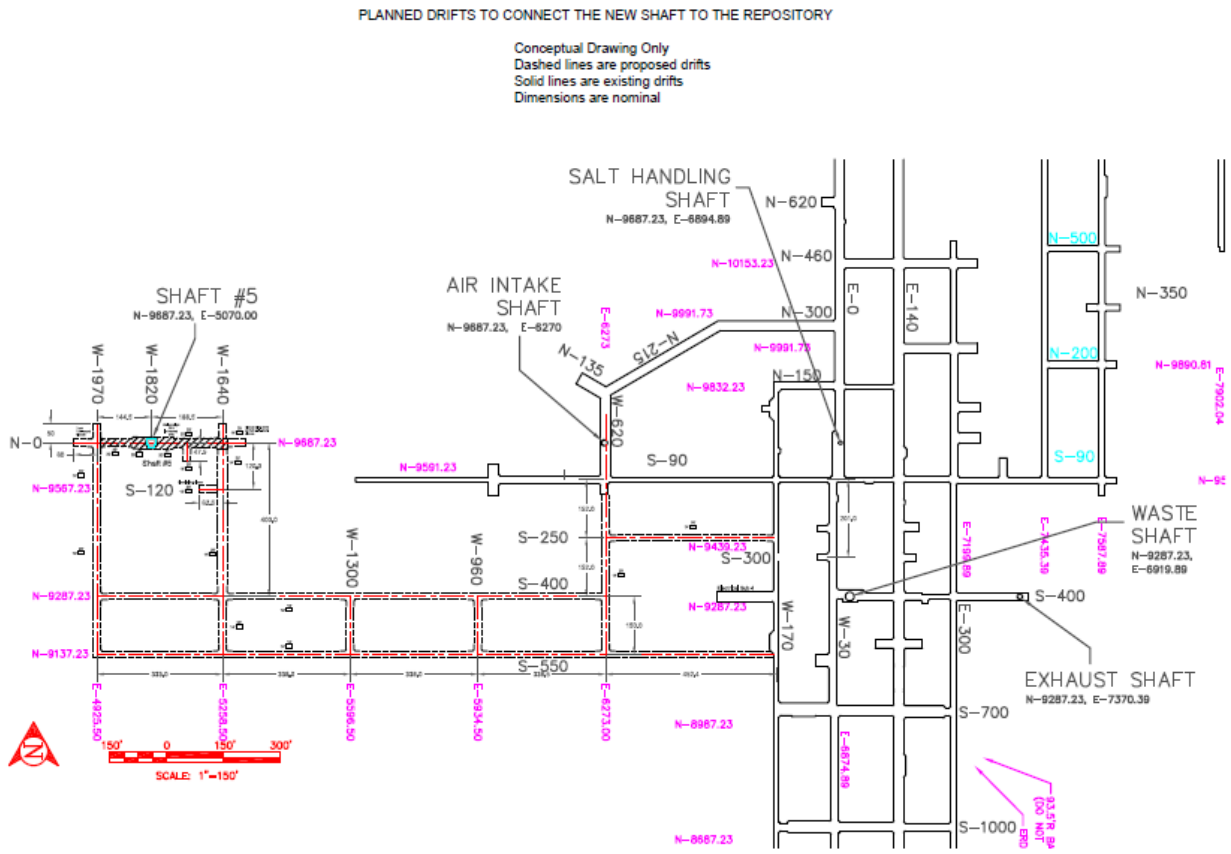

Figure 3.2. Conceptual plan view of the repository Operations Area showing the locations of the new fifth shaft and connecting drifts. (from Shrader 2017, Enclosure 1)

3.2 Impacts on Repository Performance

The DOE PCN (Shrader 2017) identified the following as the principal impacts of the new shaft and connecting drifts on postclosure repository performance.

Host Rock Deformation. Excavation of the new shaft and connecting drifts will redistribute mechanical stress and affect salt creep. The DOE concludes that the greatest impact will be in the vicinity of the shaft and connecting drifts because that is where deviatoric stresses will be greatest. Impacts on the repository Waste Area will be minor because it is at least 1,200 feet away. Geomechanical impacts on the existing shafts will also be minor because the extraction ratio for the new mining (ratio of mined volume to total volume of surrounding intact halite) is very low.

Subsidence. The DOE concludes that subsidence will not significantly increase due to mining of the new shaft and its connecting drifts because of the low extraction ratio and the remote locations of these excavations in the underground facility.

Postclosure Repository Performance. An assessment of the impact of the new shaft and connecting drifts was performed by Camphouse (2014) and a copy was attached to the PCN. Camphouse used the BRAFGLO performance assessment (PA) model to evaluate the impacts of

the preliminary shaft and connecting drift design on brine flow and gas pressure buildup in the repository. Based on the Camphouse (2014) results, Shrader (2017) stated that the new shaft and connecting drifts will decrease mean gas pressure in the southernmost waste panel by less than 4% and increase mean brine saturation in that panel by less than 7%. Schrader considered the resulting changes in release volumes by the various pathways to be minor. Although these results were based on a new shaft diameter that was smaller than the current design diameter (14 ft vs. a minimum of 28 ft), the DOE expects that this design change will not affect the conclusion that the WIPP will continue to meet the regulatory requirements for long-term isolation of TRU waste.

4.0 EPA EVALUATION OF FIFTH SHAFT IMPACTS ON REPOSITORY PERFORMANCE

4.1 Evaluation of Host Rock Deformation

The EPA agrees with the DOE conclusion that host rock deformation due to excavation of the fifth shaft and connecting drifts will not adversely impact postclosure repository performance. In comparison with the 10,000-year duration of the regulatory period, closure of repository drifts by halite creep is expected to occur within the relatively short period of 500 years (see, for example, Reedlunn and Bean 2019). Any increased stress in the waste area will have the beneficial effects of hastening creep closure and more quickly isolating the waste.

4.2 Evaluation of Subsidence

The EPA agrees with the DOE that subsidence due to the new shaft and related connecting drifts will not significantly increase compared with subsidence already expected for the existing facility. Most subsidence is expected to occur over the Waste Area where the extraction ratio is the greatest (Westinghouse Electric Corporation 1994). Subsidence over the Operations and Experimental Areas of the repository where the new shaft and connecting drifts are to be located is expected to be considerably less because of the lower extraction ratio and is not expected to be of concern to postclosure performance.

4.3 Evaluation of Postclosure Repository Performance

4.3.1 Evaluation of Camphouse 2014 Analysis

The DOE's assessment of the effect of a new fifth shaft and connecting drifts on repository performance is documented in Camphouse (2014), which served as the source of most of the following information. A copy of that report was attached to the Shrader (2017) PCN. The Camphouse study used the BRAFGLO Salado Flow performance assessment (PA) baseline model for the CRA-2014 PA (DOE 2014c) to evaluate impacts on brine flow and gas pressure buildup in the repository. The new shaft is described by Camphouse (2014) as a ventilation exhaust shaft but its use was subsequently changed to an air intake shaft as described above. The DOE may also equip the shaft for other uses during the repository's operational period but such uses are not expected to affect postclosure performance because all shafts will have been permanently decommissioned and sealed upon repository closure.

Modification of the BRAGFLO Salado Flow Model. The plugging and sealing designs for the four existing shafts are similar, thus each shaft plug will have essentially the same waste isolation capabilities as the others. For simplification, the four shafts were modeled in WIPP PA as a single shaft with a cross-section area equal to the combined areas of the four individual shafts. This approach was originally proposed by the DOE in the 1996 Compliance Certification Application (CCA; DOE 1996) and was accepted by the EPA. As further described below, the results of past PAs have shown the shaft sealing design to be sufficiently robust such that the repository shafts have yielded no releases that impact the long-term performance of the WIPP facility. Figure 4.1 shows the two-dimensional BRAGFLO Salado Flow model grid used in the CRA-2014 PA. The figure shows the single shaft as being between the Operations and Experimental Areas. The composite shaft is 10 m wide and 9.5 m deep, with a cross-section area of 95 m^2. This same combined area (rounded from 94.9 m^2) was used in the CCA and all subsequent CRAs up to the CRA-2014.

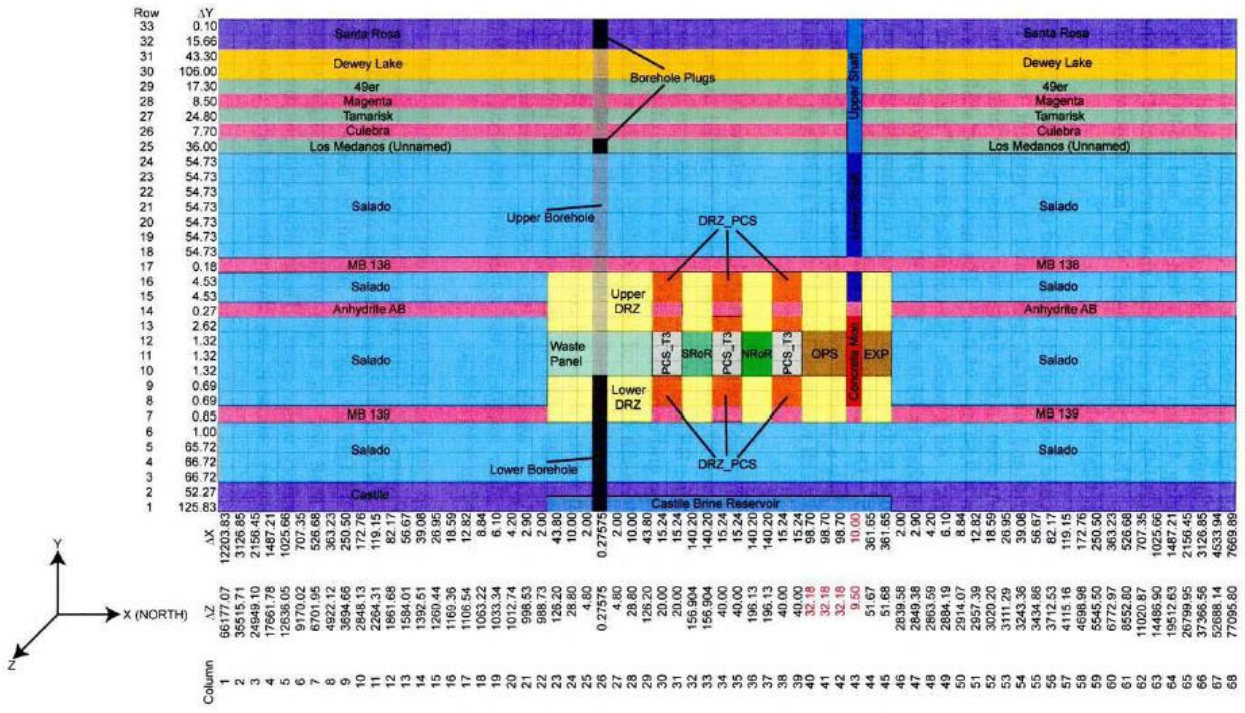

Figure 4.1. BRAGFLO two-dimensional grid used in the CRA-2014 PA. (from Camphouse 2014, Figure 2-1)

The new fifth shaft is planned to be plugged and sealed in the same manner as the four existing shafts and will have the same waste isolation capabilities. The DOE therefore proposed to model the new shaft by adding its cross-section area to the combined areas of the existing shafts in the BRAGFLO grid. Although BRAGFLO is a two-dimensional code, each cell is assigned a depth as well as a height and width, which in practice give each cell a specific volume. The new shaft has a base diameter of 14 ft and a cross-section area of 153.94 ft^2 or 14.3 m^2. Figure 4.2 shows the BRAGFLO Salado Flow model grid used in the CRA-2014 PA with revised dimensions in red that include the fifth shaft. The new composite shaft is 10.7075 m wide (x-direction) and 10.2075 m deep (z-direction), with a cross-section area of 109.3 m^2. The new modeled width and depth were obtained by increasing the original combined width and depth by the same amounts (Camphouse 2014, p. 8). The EPA considers this updated composite shaft approach to be an acceptable extension of the current shaft modeling approach.

In performing this review, the EPA also noted that each shaft has a sump that extends below the level of the repository and is not modeled in BRAGFLO. Upon repository closure, this sump is currently planned to be backfilled with concrete. The Agency questioned whether the omission of this repository design feature has an impact on repository performance calculations and requested the DOE to evaluate this concern in CRA-2019 Completeness Comment CC1-34-8. The text of this comment, the DOE's response, and the Agency's evaluation of that response are presented in Appendix A to this TSD. The Agency found the DOE's response to adequately demonstrate that omission of the shaft sumps in WIPP PA had virtually no impact on repository performance calculations.

The locations of two new drifts connecting the fifth shaft to the repository are shown in red on Figure 3.2. This design was provided to EPA in the 2017 PCN and was apparently not available in 2014 when the Camphouse analysis was prepared. Instead, Camphouse (2014) based his analysis on preliminary conceptual information. The excavated volume of the connecting drifts was calculated by Camphouse (2014, p. 8) assuming there would be two drifts, each 42 feet (~12.8 m) wide, 13 feet (~4 m) high, and 2,640 feet (½ mile or ~805 m) long, with a total length of 5,280 ft and a total volume of 2,882,880 ft^3 or 81,634 m^3. By comparison, the updated scale drawing in Figure 3.2, marked *Conceptual Drawing Only*, shows approximately 5,500 longitudinal feet of new drifts but no drift width and height information. Because the 2014 Camphouse analysis was based on preliminary designs, the EPA considers those results to provide only approximate indications of repository impacts.

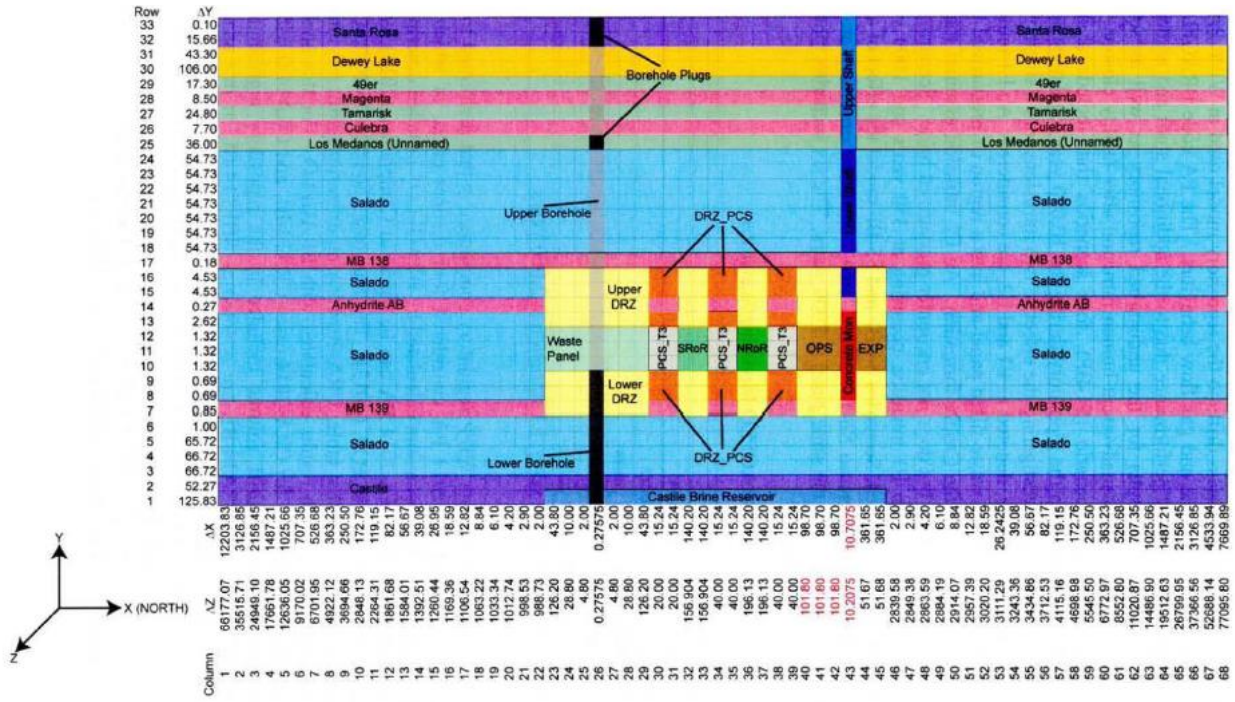

Figure 4.2. BRAGFLO two-dimensional grid used in the new shaft impact assessment. (from Camphouse 2014, Figure 2-2)

Camphouse assumed the new drifts would connect to the repository Operations Area and added their volume to the representation of that area in the two-dimensional BRAGFLO Salado Flow model numerical grid. As seen in Figure 4.1, the Operations Area is represented in the model by three grid columns with three cells in each column for a total of nine cells and a total volume of 37,733 m^3. Camphouse allocated the increased volume equally among the nine cells by retaining the original cell widths (x-direction) and heights (y-direction), and increasing the original cell depth (z-direction) of 32.18 m by 69.62 m to 101.80 m each, as shown in Figure 4.2. This approach recognized the off-axis location of the new drifts and retained the original north-south dimensions of the principal, two-dimensional repository axis. Allowing for slight differences due to rounding, the operations area volume was more than tripled from 37,733 m^3 to 119,367 m^3. The EPA considers the approach taken by Camphouse (2014) to preserve the principal axis dimensions to be appropriate.

Analysis Results. Camphouse (2014) believed that a full WIPP PA was not required to assess the impacts of the planned fifth shaft design change. Rather, he limited the analysis by determining the effects of the design change only on repository gas pressures and brine saturations in the Waste Area using the BRAGFLO Salado Flow model. He justified this approach by noting that the key spallings and direct brine release pathways are sensitive to these pressures and saturations, and that if small changes are observed in these parameters, it can be concluded that the effects on repository releases will also be small. The EPA agrees that the changes in repository dimensions associated with a fifth shaft are essentially mechanical. They are not strongly coupled with repository chemical conditions and EPA therefore accepts this approach.

The baseline for the Camphouse (2014) analysis was the CRA-2014 PA. Four distinct cases were modeled in that PA, of which two were identified by Camphouse as potentially impacting gas and brine flow calculated by BRAGFLO. The four cases considered in the CRA-2014 PA are shown in Table 4-1. In that table, CRA-2014 PA modifications with red font are those that were identified by Camphouse as having the potential to directly impact pressures and brine saturations. Camphouse chose to base his analysis on the BRAGFLO calculations performed for cases CRA14-BL and CRA14-0 with the additional fifth shaft and connecting drift volume included in the repository representation. Calculations corresponding to case CRA14-BL are denoted as SHFT14-BL in his analysis. Similarly, calculations corresponding to case CRA14-0 are denoted as SHFT14-0. In reviewing the analysis results, the EPA has placed primary emphasis on the comparison between CRA14-0 and SHFT14-0 results because the CRA14-0 case was used by the Agency as the new regulatory baseline for its compliance determination of the DOE's 2014 recertification application.

Table 4.1. Cases Considered in the CRA-2014 PA

	CRA-2014 PA Cases			
	Case CRA14-BL	Case CRA14-TP	Case CRA14-BV	Case CRA14-0
CRA-2014 PA changes included	**Replacement of Option D PCS with the ROMPCS** **Inclusion of additional mined volume in the WIPP experimental area** **Updated WIPP waste inventory parameters** Updated radionuclide solubilities and uncertainty, colloid parameters Updated drilling rate and plugging pattern parameters	Replacement of Option D PCS with the ROMPCS Inclusion of additional mined volume in the WIPP experimental area Updated WIPP waste inventory parameters Updated radionuclide solubilities and uncertainty, colloid parameters Updated drilling rate and plugging pattern parameters BOREHOLE:TAUFAIL and GLOBAL:PBRINE parameter distribution refinements	Replacement of Option D PCS with the ROMPCS Inclusion of additional mined volume in the WIPP experimental area Updated WIPP waste inventory parameters Updated radionuclide solubilities and uncertainty, colloid parameters Updated drilling rate and plugging pattern parameters BOREHOLE:TAUFAIL and GLOBAL:PBRINE parameter distribution refinements Variable Brine Volume Implementation	**Replacement of Option D PCS with the ROMPCS** **Inclusion of additional mined volume in the WIPP experimental area** **Updated WIPP waste inventory parameters** Updated radionuclide solubilities and uncertainty, colloid parameters Updated drilling rate and plugging pattern parameters BOREHOLE:TAUFAIL and GLOBAL:PBRINE parameter distribution refinements Variable Brine Volume Implementation **Update to parameter STEEL:CORRMCO2** **Refinement to Repository Water Balance Implementation**
Number of replicates	1	1	1	3

Source: Camphouse 2014, Table 2-2.

Camphouse (2014) describes his analysis results in terms of the six BRAGFLO modeling scenarios. The differences between these scenarios are summarized in Table 4.2. The undisturbed repository assumes no boreholes have intruded the Waste Area. An E1 intrusion assumes an exploratory borehole penetrates a brine reservoir in the underlying Castile Formation and releases pressurized Castile brine into the Waste Area. An E2 intrusion assumes that Castile

brine is not released into the Waste Area. Although Camphouse (2014) provided graphical results of mean pressure and brine saturation for all areas of the repository, the following evaluation will focus on the effects on the modeled Waste Panel shown in Figures 4.1 and 4.2.

Table 4.2. BRAFGLO Salado Flow Modeling Scenarios

Scenario	Description
S1-BF	Undisturbed Repository
S2-BF	E1 intrusion at 350 years
S3-BF	E1 intrusion at 1,000 years
S4-BF	E2 intrusion at 350 years
S5-BF	E2 intrusion at 1,000 years
S6-BF	E2 intrusion at 1,000 years; E1 intrusion at 2,000 years.

Source: Camphouse 2014, Table 2-1

The increased volume of the Operations Area resulted in a decline in repository pressure in all scenarios and in all areas of the modeled repository. The repository pressure increases with time due to gas generation by microbial activity and, in cases where pressurized brine is released into the repository from the underlying Castile Formation, repository pressure is also increased by the presence of Castile brine. Microbial gas generation occurs primarily in the Waste Area of the repository. Pressure increases in the Waste Area can bleed off through the Run-of-Mine (ROM) salt panel closures (which were included for all waste panels in the CRA-2014 PA), through the adjacent disturbed rock zones, and through anhydrite marker beds into the Operations and Experimental Areas of the repository (which were not modeled as creep closing). The increased volume of the Operations Area due to the new connecting drifts increased the volume available for gas expansion, resulting in a decrease in gas pressure. Average gas pressures in the Waste Panel for BRAGFLO scenarios S1-BF, S2-BF, S4-BF, and S6-BF are shown in Figures 4.3 through 4.6. Results for scenarios S3-BF and S5-BF are similar to those for S2-BF and S4-BF, respectively, and are not shown.

The decrease in gas pressure resulted in a small increase in brine flow into all areas of the repository. This brine comes from the surrounding Salado halite and, in the case of Scenarios S2-BF and S6-BF, it also comes from inflows of Castile brine. Cumulative mean brine flow into the Waste Panel for the four aforementioned BRAGFLO scenarios is shown in Figures 4.7 through 4.10.

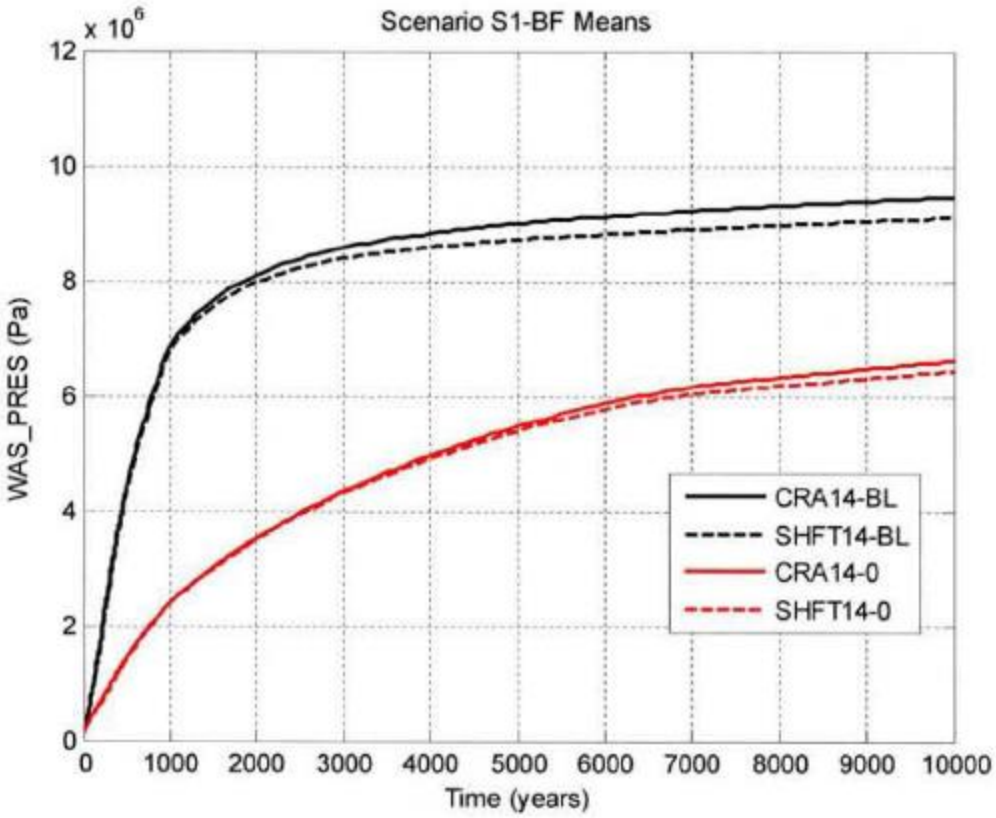

Figure 4.3. Pressure means for the Waste Panel, Scenario S1-BF (from Camphouse 2014, Figure 5-17)

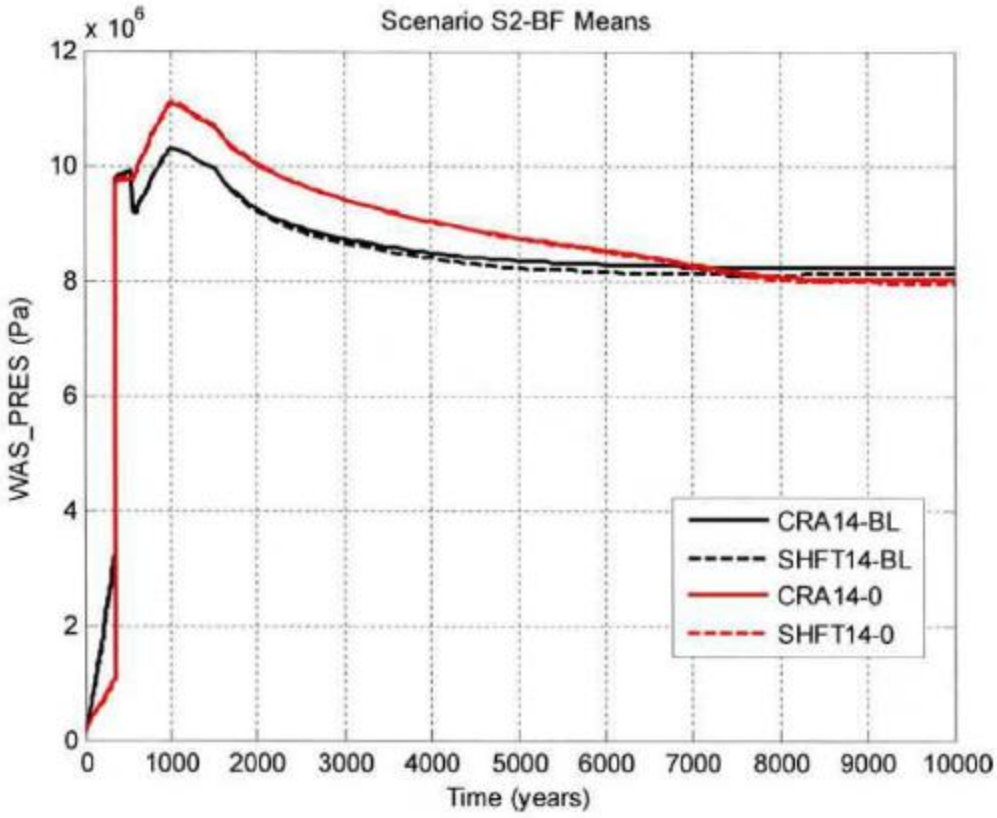

Figure 4.4. Pressure means for the Waste Panel, Scenario S2-BF (from Camphouse 2014, Figure 5-18)

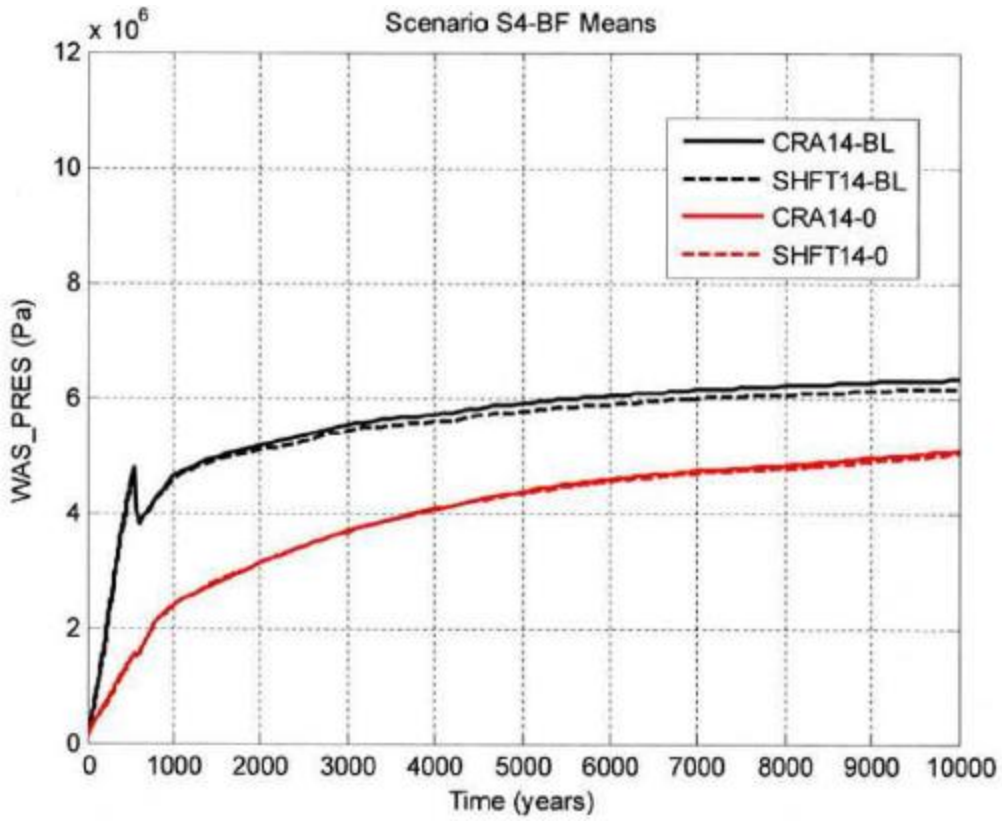

Figure 4.5. Pressure means for the Waste Panel, Scenario S4-BF (from Camphouse 2014, Figure 5-19)

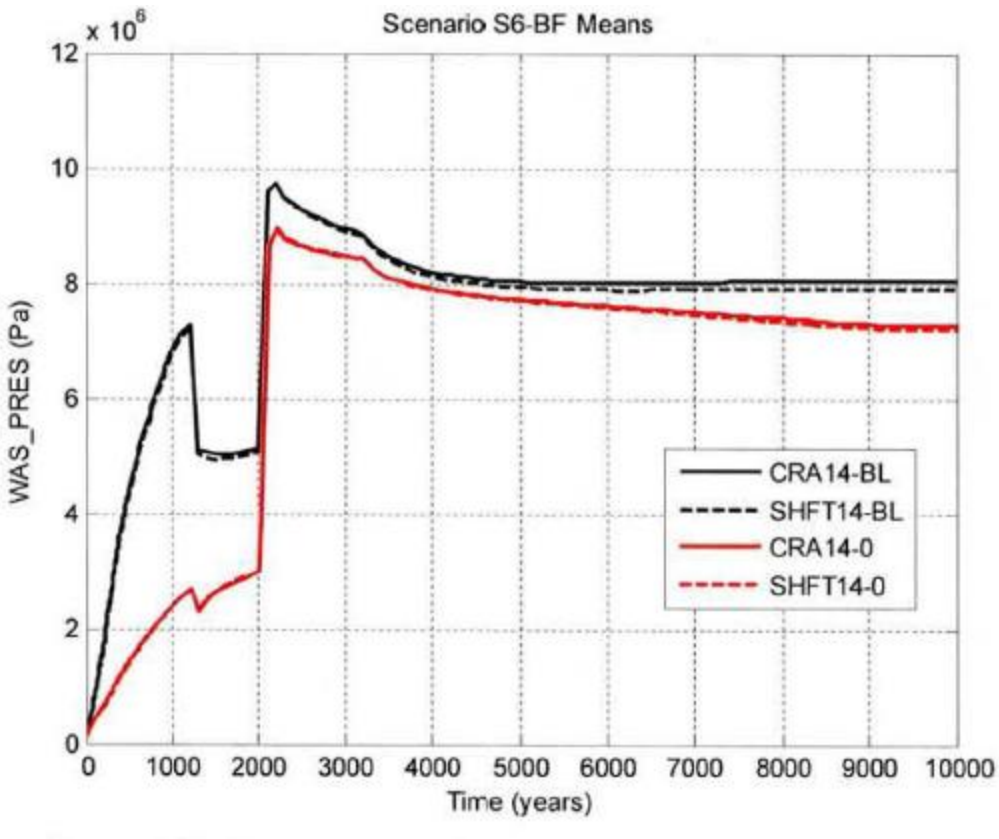

Figure 4.6. Pressure means for the Waste Panel, Scenario S6-BF (from Camphouse 2014, Figure 5-20)

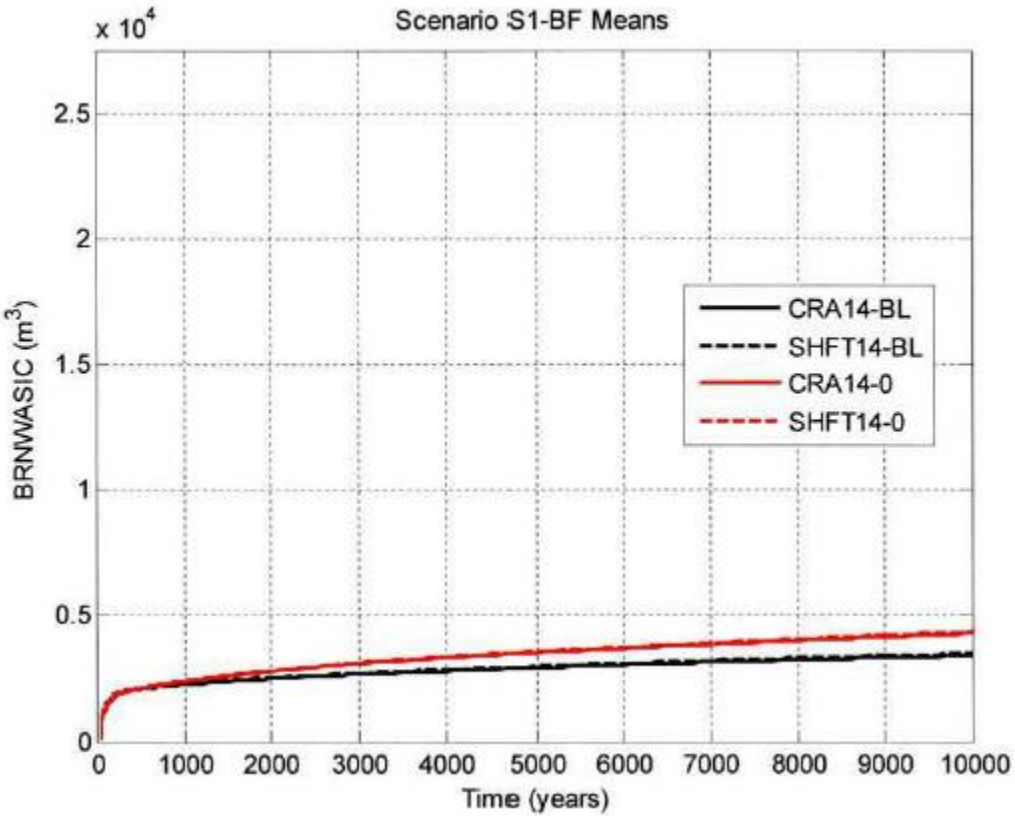

Figure 4.7. Cumulative mean brine flow into the Waste Panel, Scenario S1-BF (from Camphouse 2014, Figure 5-29)

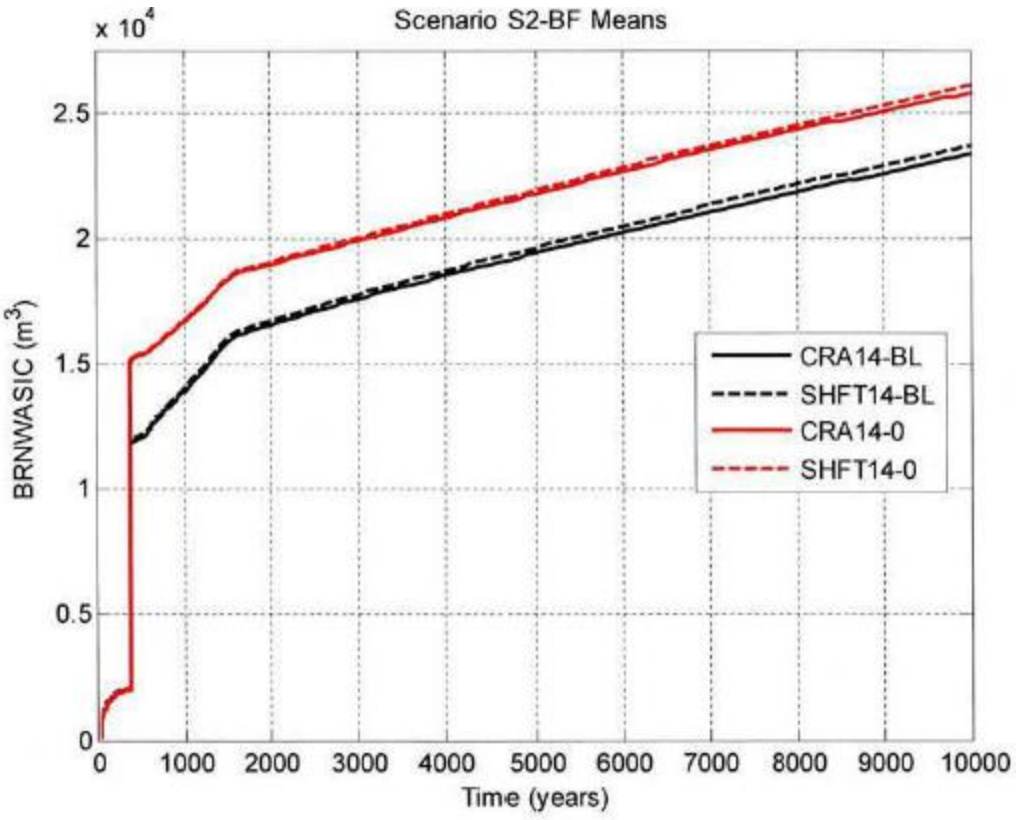

Figure 4.8. Cumulative mean brine flow into the Waste Panel, Scenario S2-BF (from Camphouse 2014, Figure 5-30)

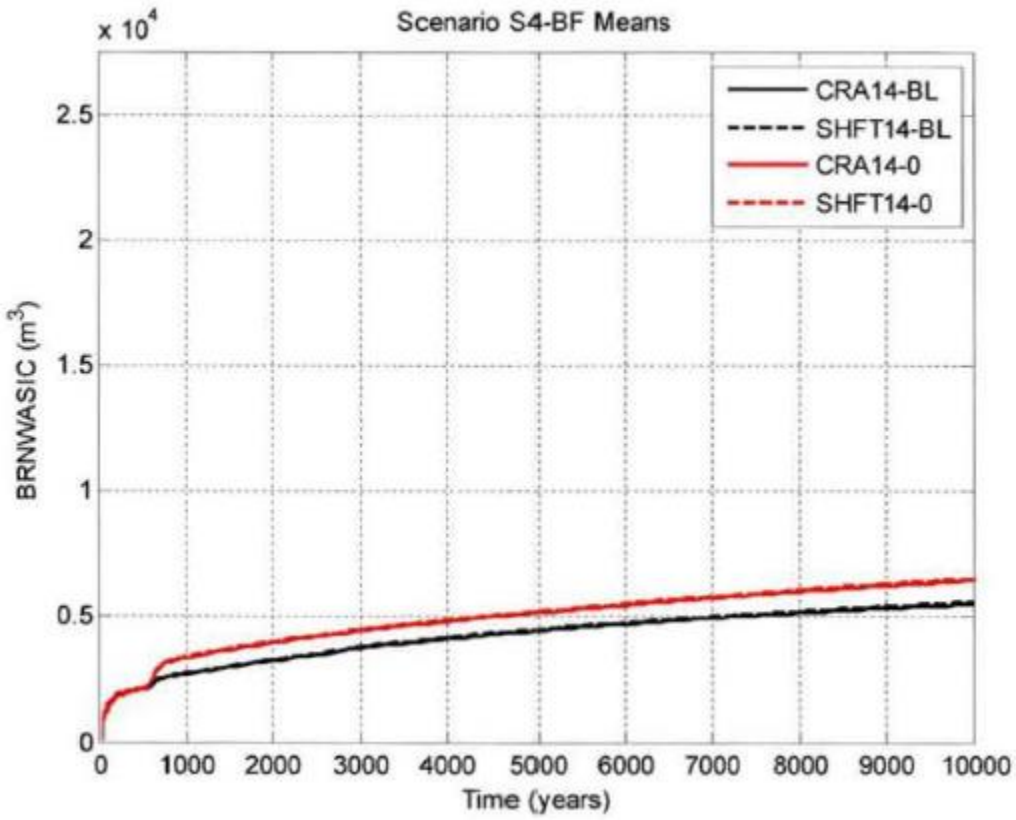

Figure 4.9. Cumulative mean brine flow into the Waste Panel, Scenario S4-BF (from Camphouse 2014, Figure 5-31)

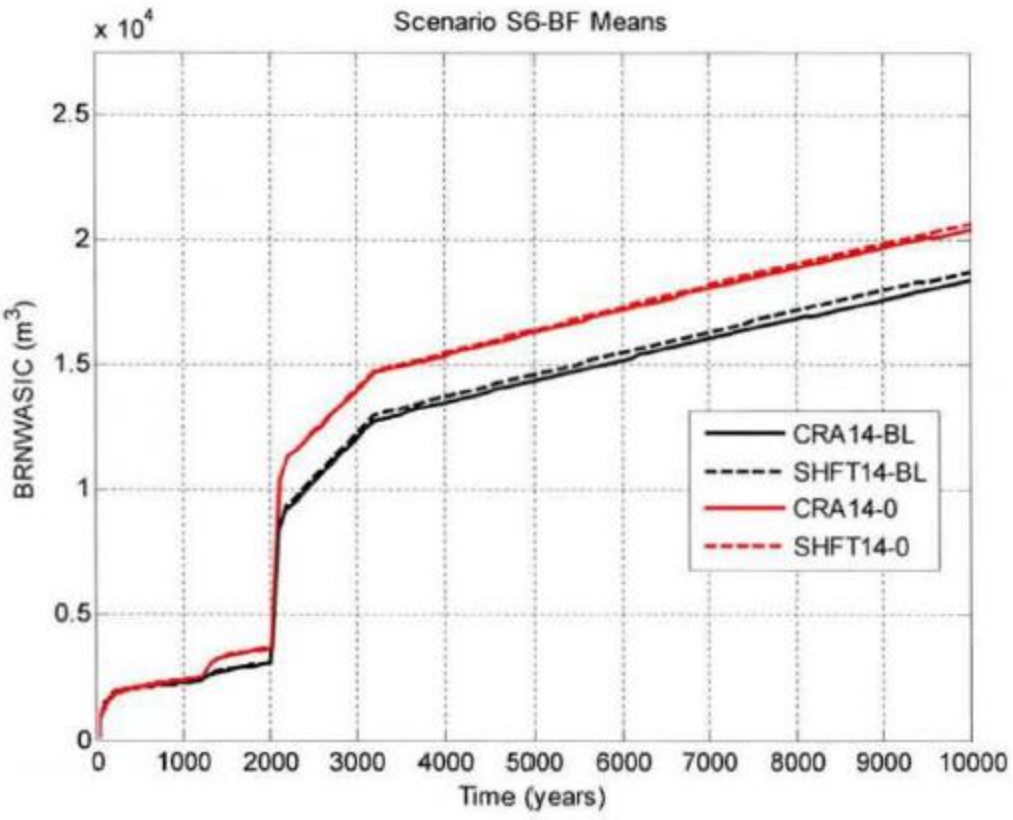

Figure 4.10. Cumulative mean brine flow into the Waste Panel, Scenario S6-BF (from Camphouse 2014, Figure 5-32)

Cumulative mean brine flows up the repository shafts are shown in Figures 4.11 through 4.14. The EPA notes that these flows were very small in the CRA-2014 PA, amounting to between 2 and 3 m^3 in 10,000 years, and were even smaller when the additional shaft and connecting drifts were included in the repository design. Cumulative mean brine flows up the intrusion borehole are shown in Figures 4.15 through 4.17. These flows amounted to hundreds to thousands of cubic meters depending on the intrusion scenario and are much larger than flows up the shaft. Brine flows up the borehole with the new shaft and connecting drifts were nearly identical to those of the CRA-2014 PA without these design changes. The DOE stated that this is because pressures and brine inflows in the Waste Panel that drive flows up the borehole were only slightly affected by the design change due to the relative isolation of the Waste Panel from the fifth shaft and connecting drifts. The EPA agrees with this assessment.

The increase in brine inflow resulted in small increases in brine saturation throughout the repository. The EPA notes that brine saturation is important to WIPP performance because the important direct brine releases cannot occur if brine saturation is below the residual saturation limit where brine is only present in isolated pockets and a continuous brine flow path no longer exists. For reference, the residual brine saturation is sampled as an uncertain, uniformly distributed parameter in WIPP PA ranging between zero and 0.552 in the Waste Area (Kim and Feng 2019, Table 4). As shown in Figures 4.18 through 4.21, mean brine saturations in the

Waste Panel are nearly identical to those in the CRA-2014 PA when the additional shaft and connecting drifts are included in the repository design.

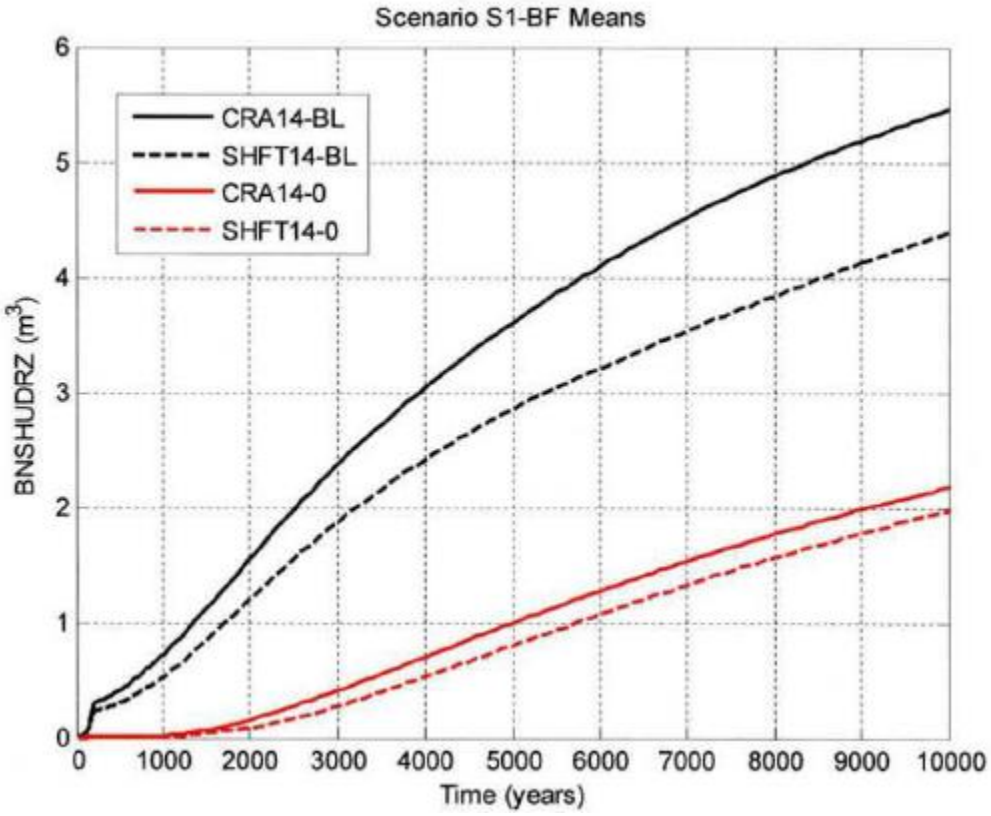

Figure 4.11. Cumulative mean brine flow up the shaft, Scenario S1-BF (from Camphouse 2014, Figure 5-33)

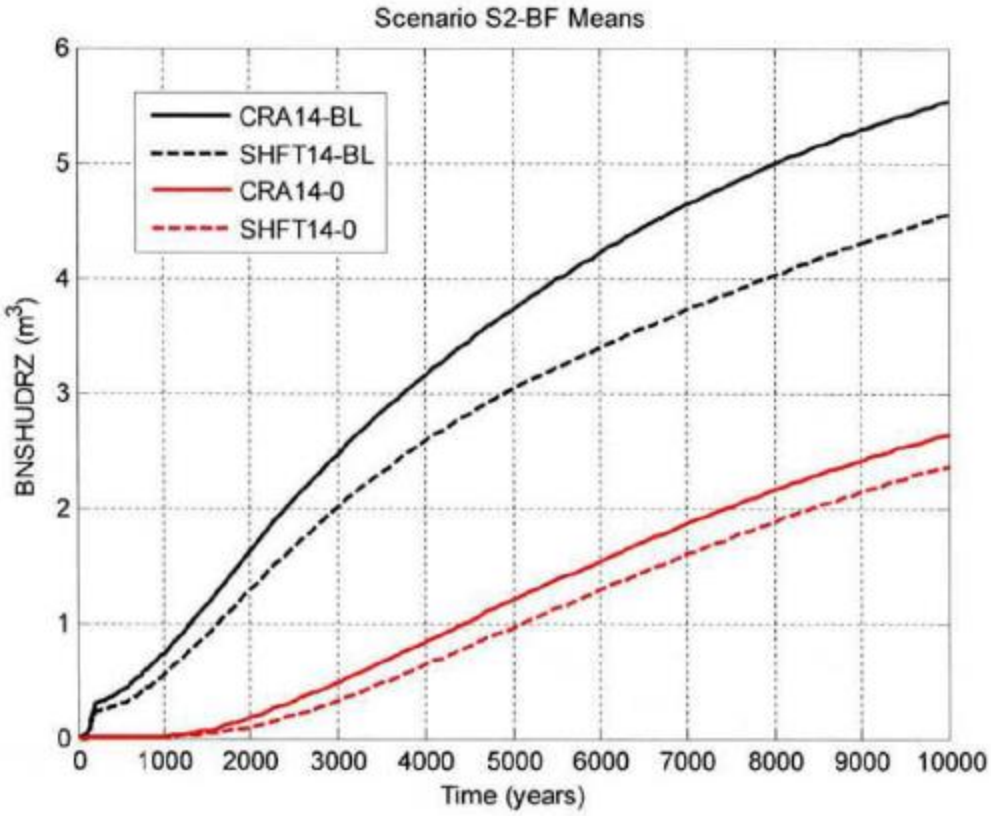

Figure 4.12. Cumulative mean brine flow up the shaft, Scenario S2-BF (from Camphouse 2014, Figure 5-34)

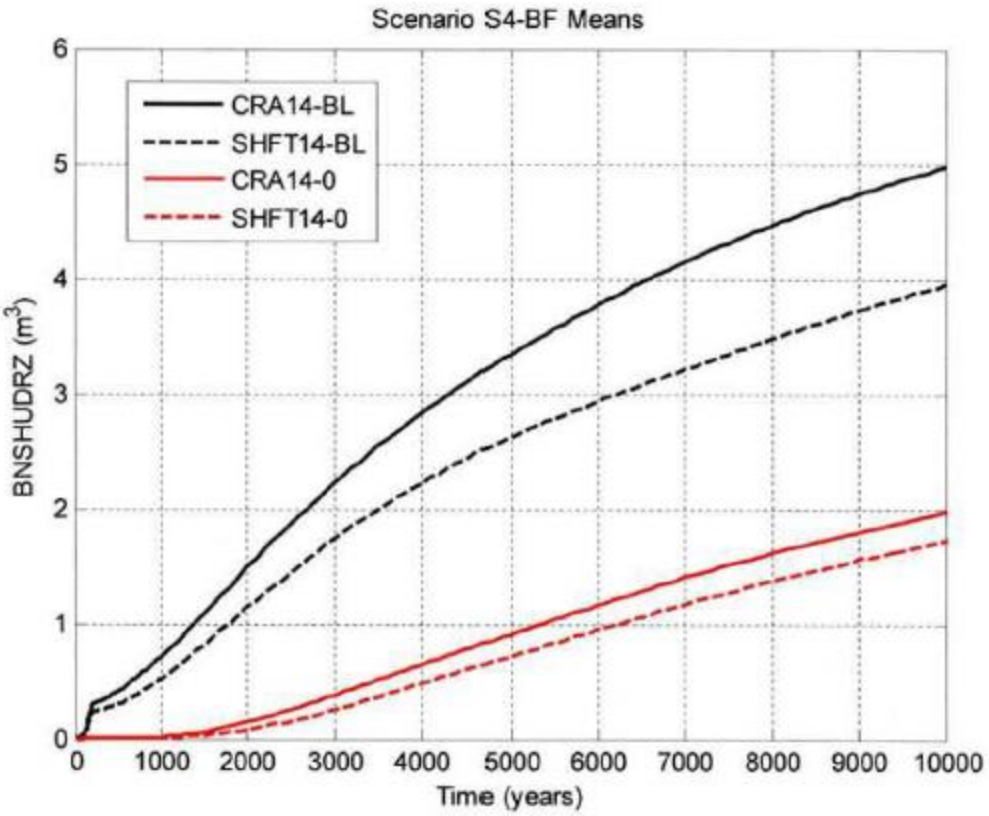

Figure 4.13. Cumulative mean brine flow up the shaft, Scenario S4-BF (from Camphouse 2014, Figure 5-35)

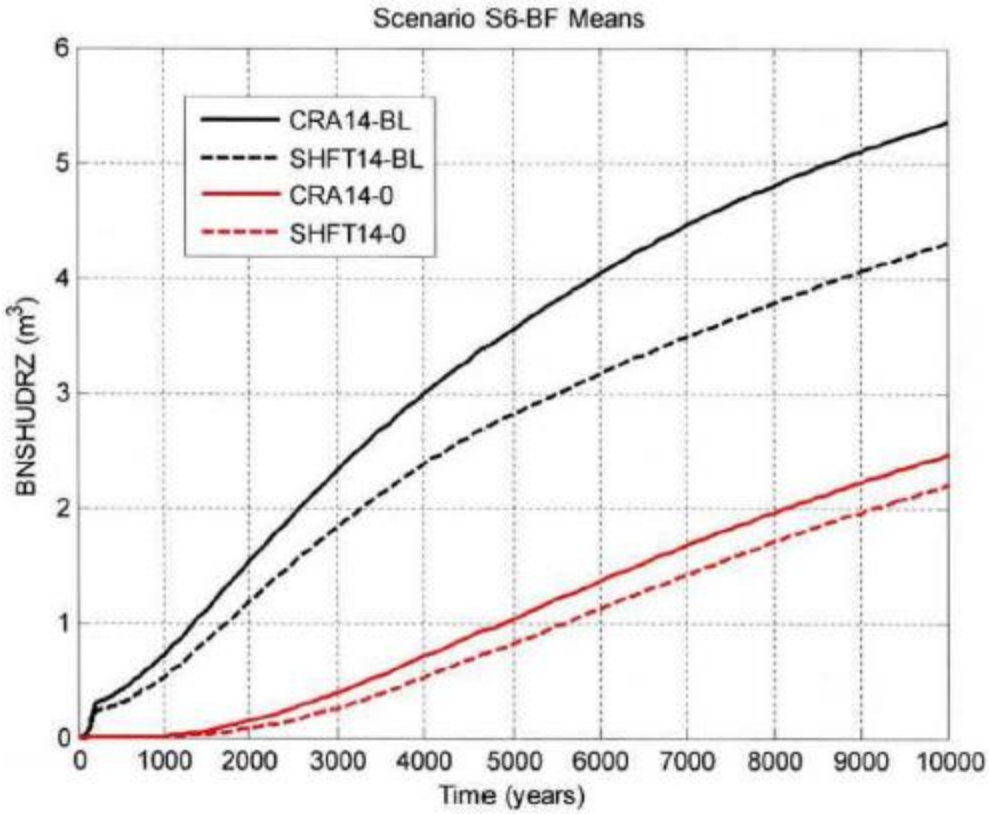

Figure 4.14. Cumulative mean brine flow up the shaft, Scenario S6-BF (from Camphouse 2014, Figure 5-36)

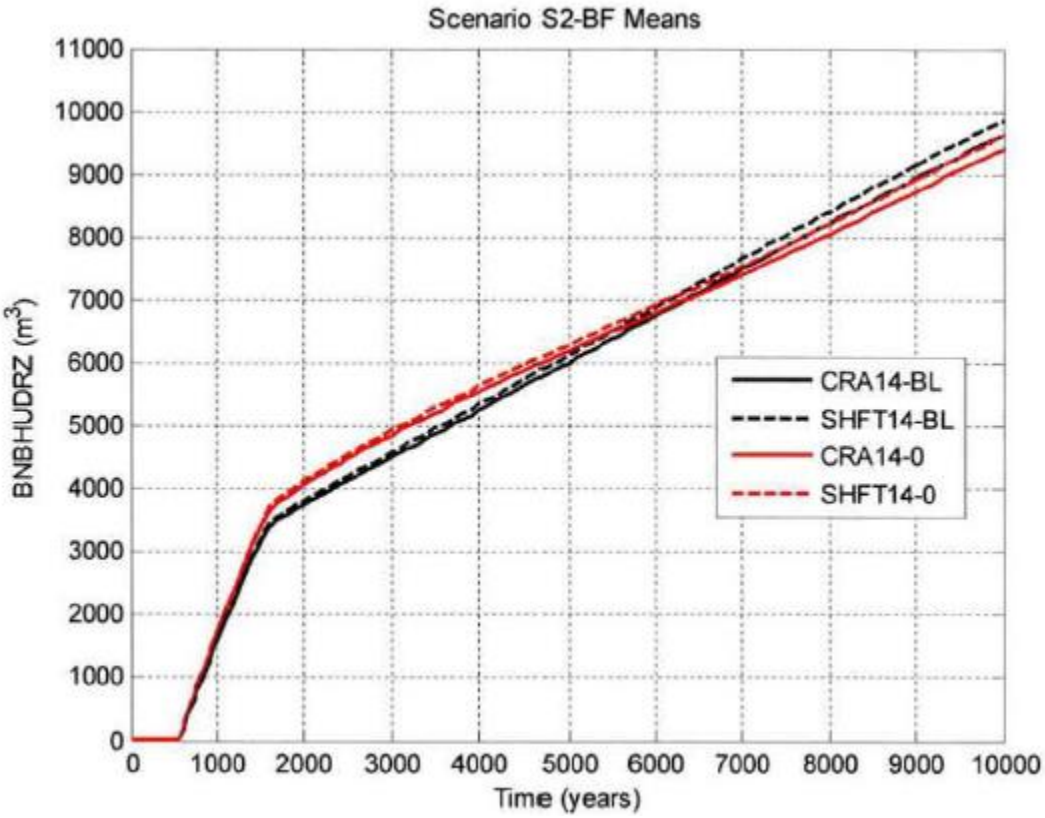

Figure 4.15. Cumulative mean brine flow up the intrusion borehole, Scenario S2-BF (from Camphouse 2014, Figure 5-37)

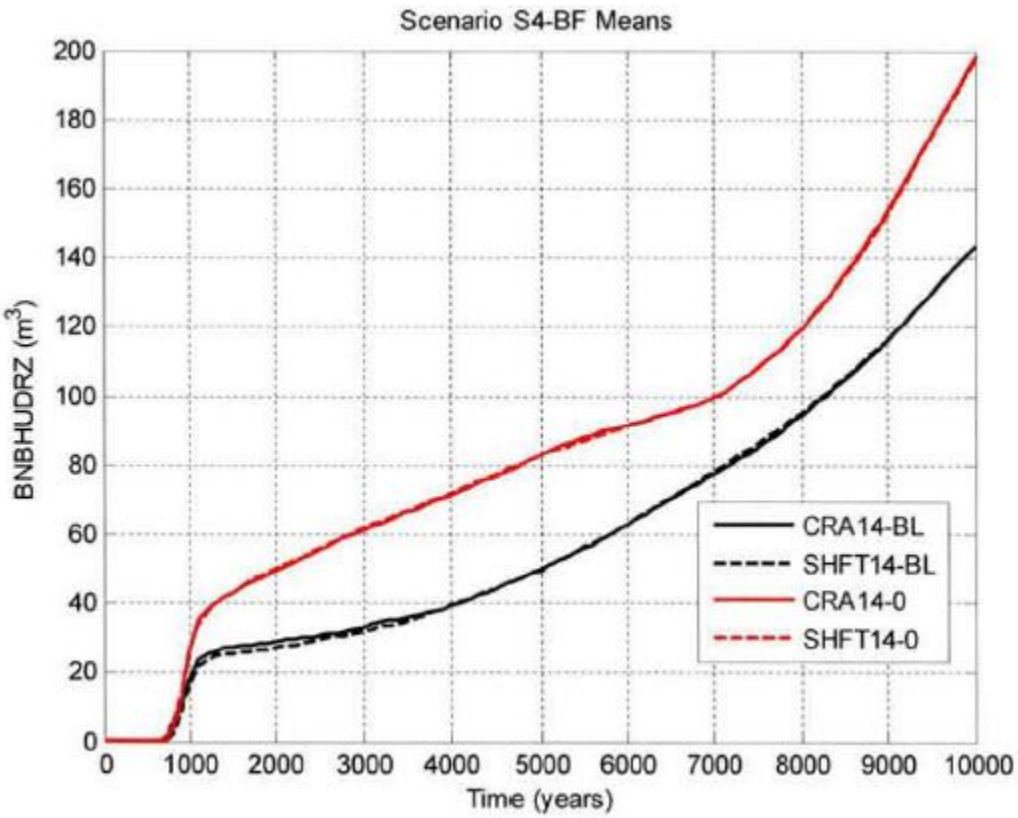

Figure 4.16. Cumulative mean brine flow up the intrusion borehole, Scenario S4-BF (from Camphouse 2014, Figure 5-38)

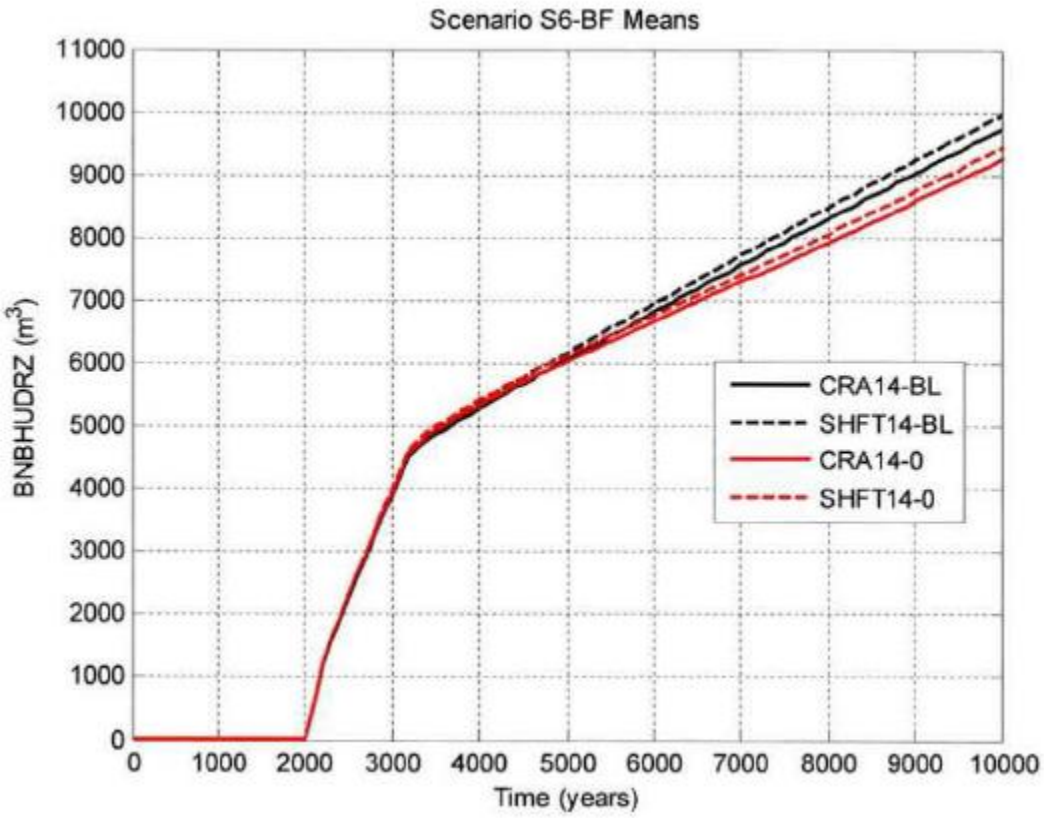

Figure 4.17. Cumulative mean brine flow up the intrusion borehole, Scenario S6-BF (from Camphouse 2014, Figure 5-39)

Regulatory Compliance Impacts. The Agency's evaluation of compliance impacts focuses on a comparison of SHFT14-0 results with the results of the CRA14-0 regulatory baseline. The decreases in repository pressure and increases in brine saturation resulting from the additional shaft and connecting drifts affect the principal release pathways differently. The cuttings and cavings pathways do not depend on repository pressures or brine saturations and therefore are not affected by the additional shaft and drifts. Spallings releases are a function of repository pressure and waste inventory, and would decrease with decreasing pressure.

Direct brine releases (DBRs) are a function of both repository pressure and brine saturation. With regard to repository pressure and as shown in Figures 4.3 and 4.5, the pressure in the baseline CRA14-0 analysis is generally below the 8 MPa minimum pressure required for a DBR in the S1-BF and S4-BF scenarios where there is no Castile brine release. For these scenarios, the lower pressures in the SHFT14-0 analysis will make the occurrence of a DBR even less likely. Figures 4.4 and 4.6 show that when there is a release of pressurized Castile brine into the repository, the pressures are generally at or above the 8 MPa minimum. In these scenarios, the Waste Panel pressures are dominated by the pressure of the Castile brine in both the CRA14-0 and SHFT14-0 analyses and the small decrease due to the new shaft and connecting drifts has essentially no effect. The decrease in repository pressure in the SHFT14-0 analysis therefore either decreases the likelihood of a DBR or has essentially no effect.

With regard to repository brine saturation, when there is no release of Castile brine, the Waste Panel brine saturation may be sufficient for mobility but DBRs generally do not occur because the pressure is too low and the small increases in saturation shown in Figures 4.18 and 4.20 would have no effect. When there is a release of Castile brine into the Waste Panel, Figures 4.19 and 4.21 show that brine saturation as well as pressure are dominated by the released brine and the small increase in brine saturation due to the fifth shaft and connecting drifts has essentially no effect. Similar conclusions based on a different line of reasoning were reached by Camphouse (2014, p. 49).

In addition, the cumulative mean brine flows up the shafts were lower due to a lower repository pressure despite the greater cross-section area available for flow. Cumulative mean brine flows up the intrusion borehole were only slightly increased in scenarios with Castile brine releases and were essentially unchanged in scenarios without such releases. These results are consistent with the small effects the fifth shaft and connecting drifts had on conditions in the Waste Panel.

The EPA concludes that the Camphouse (2014) analysis adequately demonstrated that the fifth shaft and connecting drifts, as envisioned by the DOE in a preliminary design, would not significantly affect repository performance as modeled in the CRA14-0 baseline PA. DOE proposed changes in the design and these design changes are evaluated in Section 4.3.2.

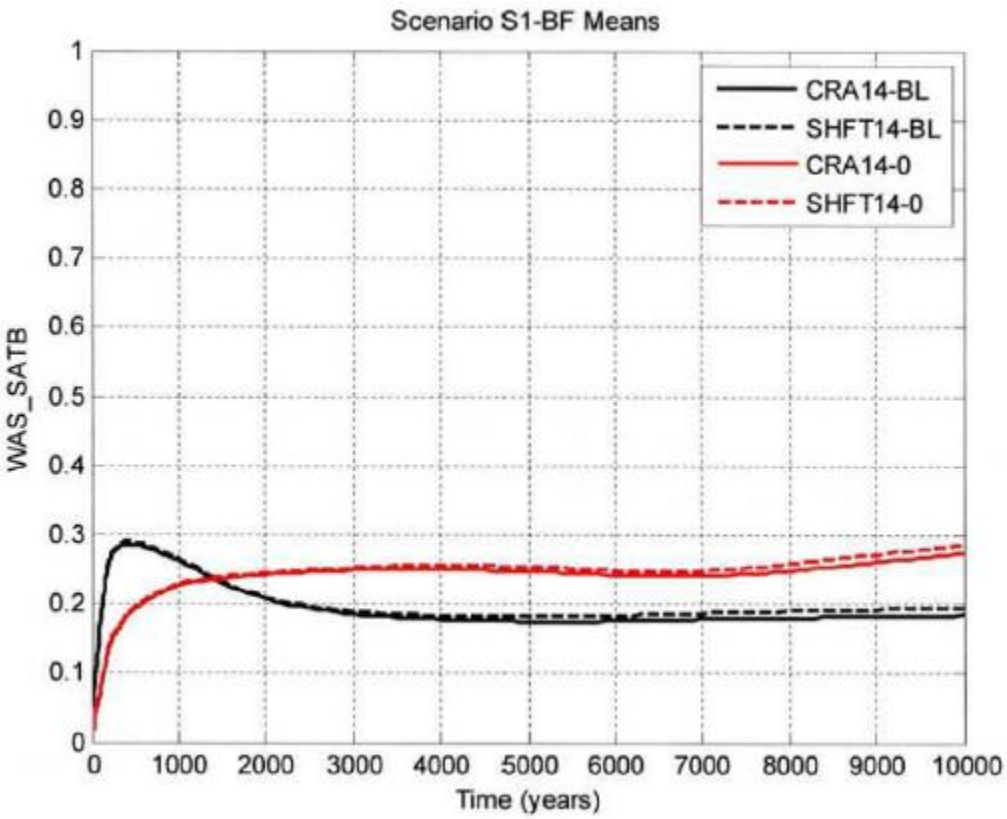

Figure 4.18. Mean brine saturation in the Waste Panel, Scenario S1-BF

(from Camphouse 2014, Figure 5-48)

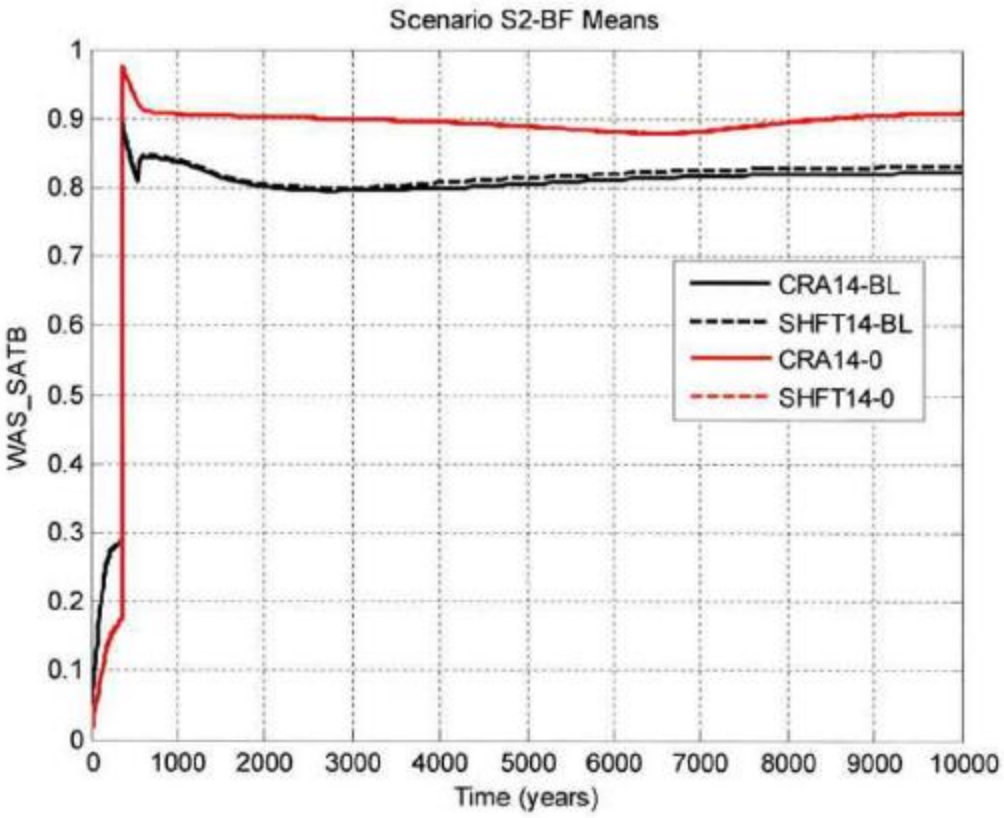

Figure 4.19. Mean brine saturation in the Waste Panel, Scenario S2-BF (from Camphouse 2014, Figure 5-49)

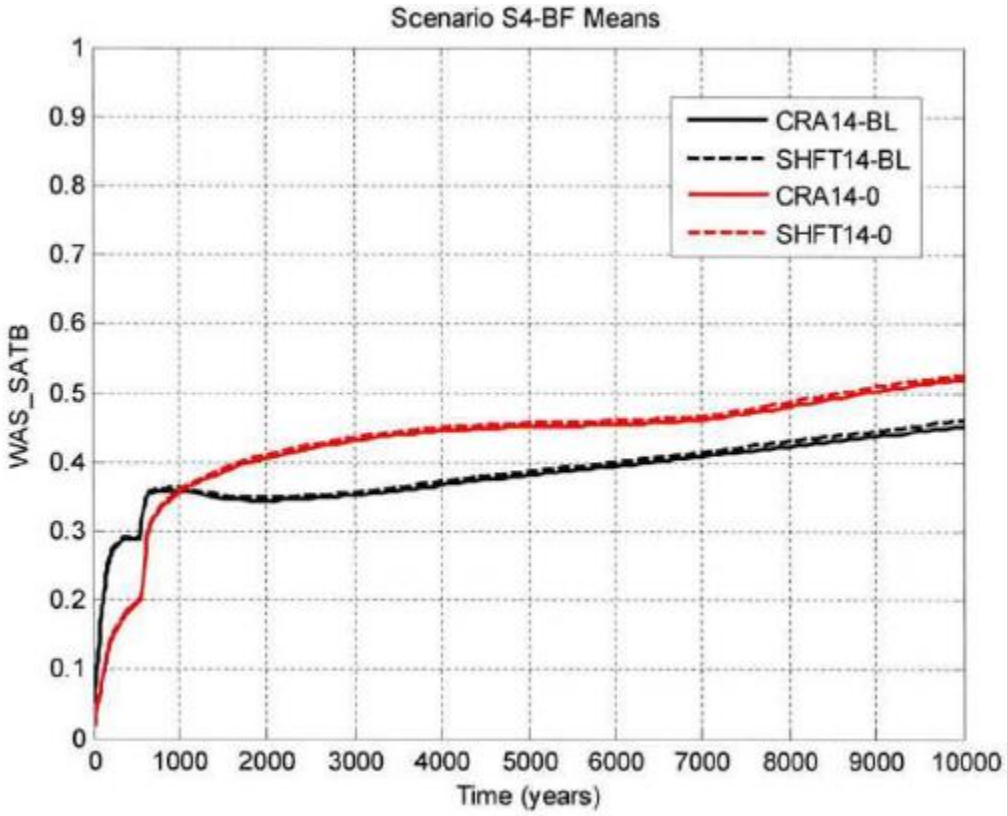

Figure 4.20. Mean brine saturation in the Waste Panel, Scenario S4-BF (from Camphouse 2014, Figure 5-50)

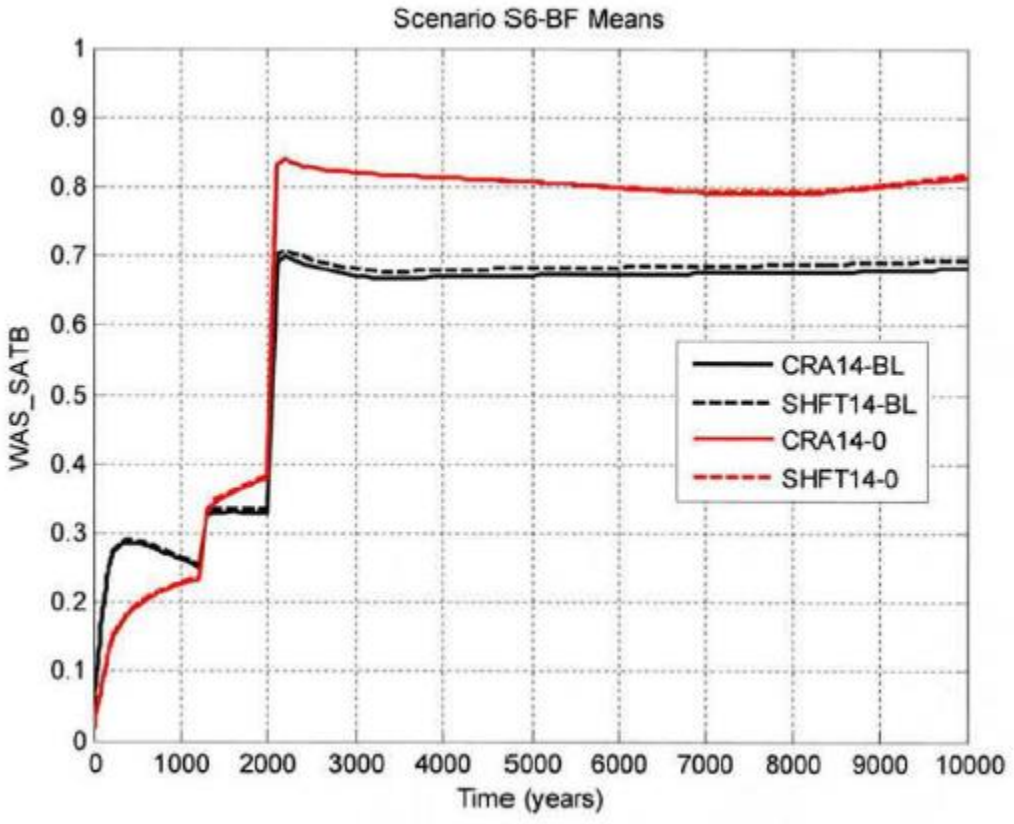

Figure 4.21. Mean brine saturation in the Waste Panel, Scenario S6-BF (from Camphouse 2014, Figure 5-51)

4.3.2 Evaluation of Zeitler 2019 Design Updates

The Camphouse (2014) assessment was made when the design and use of the fifth shaft and connecting drifts were still preliminary. Since that time, a conceptual layout for the connecting drifts was completed and was included in the PCN (Shrader 2017; see Figure 3.2). The base diameter of the shaft was also increased (Zeitler 2019) and the principal use was changed from an exhaust shaft to an air intake shaft (DOE-NWP 2019). However, the ultimate use of the shaft is not relevant to the Agency's concerns of postclosure performance because, as previously noted, at the time of repository closure all shafts will have been backfilled and sealed. Although Zeitler (2019) provided a description of how the revised shaft and connecting drift dimensions were incorporated into the CRA-2019 PA, he did not repeat the Camphouse (2014) analysis with these new values.

Zeitler (2019) identified three principal changes to the design used by Camphouse (2014): the cross-section area of the composite shaft in the BRAGFLO Salado Flow model grid was increased to allow for a larger shaft diameter; the volume of the connecting drifts was decreased to be consistent with the refined conceptual layout; and the volume of the connecting drifts was added to the Experimental Area of the repository in the BRAGFLO grid rather than the Operations Area.

Revised Shaft Cross-Section Area. As previously noted, the Camphouse (2014) analysis was based on a fifth shaft with a constant nominal diameter of 14 ft. The shaft diameter was subsequently changed to vary between 28 and 30 ft over its 658.56 m length. To account for these variations in diameter, Zeitler (2019, Tables 2 and 3) calculated the shaft cross-section area as a length-weighted average equal to 58.06 m^2. When added to the combined cross-section area of the four original shafts of 95 m^2, the new composite cross-section area of the five shafts was 153.06 m^2. To accommodate this increase, Zeitler modified the BRAGFLO model by equally increasing the width and depth of the column of single BRAGFLO model cells representing the shaft by a factor of 1.26933. Thus the cell width increased from 10.00 m to 12.6933 m and the depth increased from 9.50 m to 12.0586 m. The revisions made to the BRAGFLO Salado Flow model grid to accommodate the enlarged fifth shaft are shown in red on Figure 4.22.

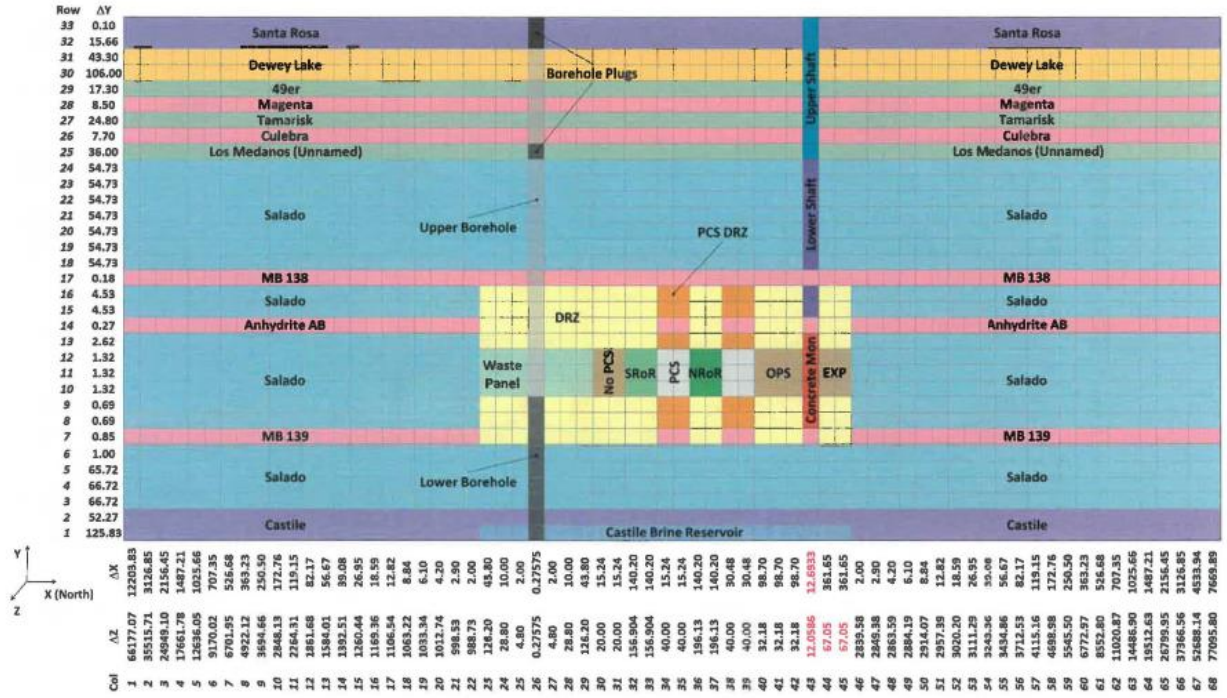

Figure 4.22. Updated BRAGFLO grid incorporating the revised dimensions of the fifth shaft and connecting drifts. (from Zeitler 2019, Figure 2)

The Camphouse (2014) impact analysis described above was based on a composite five-shaft cross-section area of 109.3 m^2 as compared with the updated area of 153.06 m^2. Assuming cumulative brine flow up the shaft increases in proportion to the increase in cross-section area, EPA estimated that the increase in fifth shaft diameter would increase the cumulative brine flow up the shaft in 10,000 years by about 1 m^3. This would increase the aforementioned brine flow range of 2 to 3 m^3 in the Camphouse analysis (see Figure 4.12) to 3 to 4 m^3. Again, this volume is negligible compared with the cumulative brine flow up an intrusion borehole.

Revised Modeling of Connecting Drift Location. The Camphouse (2014) impact analysis described above modeled the connecting drifts as intersecting the repository within the Operations Area and increased the volume of that area in the BRAGFLO Salado Flow model

grid as shown in Figure 4.2. The Zeitler (2019) updated repository design instead increased the volume of the Experimental Area as shown in Figure 4.22, leaving the Operations Area unchanged. Zeitler (2019, p. 8) explains this change by noting that although the connecting drifts will intersect the current repository excavations north of the northernmost set of planned panel closures and the BRAGFLO model combines the two northernmost sets into a single panel closure, the volume of the drifts between these two sets of panel closures is identified in BRAGFLO as the Operations Area. Similarly, the volume of the drifts north of the northernmost set of panel closures is identified in BRAGFLO as the Experimental Area. The locations of these sets of panel closures and the areas identified by Zeitler as "Operations" and "Experimental" are shown in Figure 4.23. Zeitler (2019) concludes that since the new drifts are planned to be located north of the northernmost panel closures, the new drifts should be included as part of the Experimental Area. Although the EPA believes this change could result in slightly higher repository pressures than in the Camphouse (2014) SHFT14-0 analysis because of the greater distance of the Experimental Area from the Waste Panel, the pressures would still be lower than in the CRA14-0 analysis and would not change the conclusions of the Camphouse (2014) study.

Revised Connecting Drift Volume. Camphouse (2014) assumed a volume of 81,634 m^3 for the drifts connecting the fifth shaft to the existing underground repository. That volume was based on a preliminary conceptual design that reasonably approximated the drift lengths but overestimated the drift widths. The currently planned drift widths range from about 15 to 25 ft (4.6 to 7.6 m), whereas Camphouse (2014, p. 8) assumed a width of 42 feet (12.8 m) for all drifts. Zeitler's (2019, p. 8) modifications to the BRAGFLO model's Experimental Area grid were based on a total connecting drift volume of 44,042 m^3. The CRA-2014 BRAGFLO Experimental Area representation consists of six cells with a total volume of 148,011 m^3. The total volume of the expanded Experimental Area using the updated connecting drift volume is therefore 192,053 m^3 (see Zeitler 2019, Table 4). The connecting drift layout and drift dimensions used as the basis for Zeitler's (2019) calculations are shown in Figure 4.24. Although this layout is slightly different from the layout shown in Figure 3.2 that was included in the PCN (Shrader 2017), the differences are minor and would not materially affect postclosure performance.

Zeitler (2019) considered several alternatives for incorporating the additional Experimental Area volume in the BRAGFLO grid. Since the new drifts do not alter the height of the repository excavations, changes to the y-dimension were not considered. Additionally, changes to the x-dimension (north to south cell width dimension) would alter the travel distance from the waste areas to the Land Withdrawal Boundary. This is an important distance with respect to determining compliance and changing it was also not considered. Zeitler therefore incorporated the increased volume by only increasing cell depths in the z-direction for the two grid columns representing the Experimental Area. This was accomplished by assigning a depth of 67.05 m to the Experimental Area cells in the z-direction for the CRA-2019 PA (Zeitler 2019, Table 4). By comparison, Camphouse (2014, p. 8) accommodated a much larger volume change by assigning a depth of 101.80 m to each of the three grid columns representing the Operations Area. The EPA considers the approach taken by Zeitler (2019) to preserve the BRAGFLO principal axis dimensions to be appropriate.

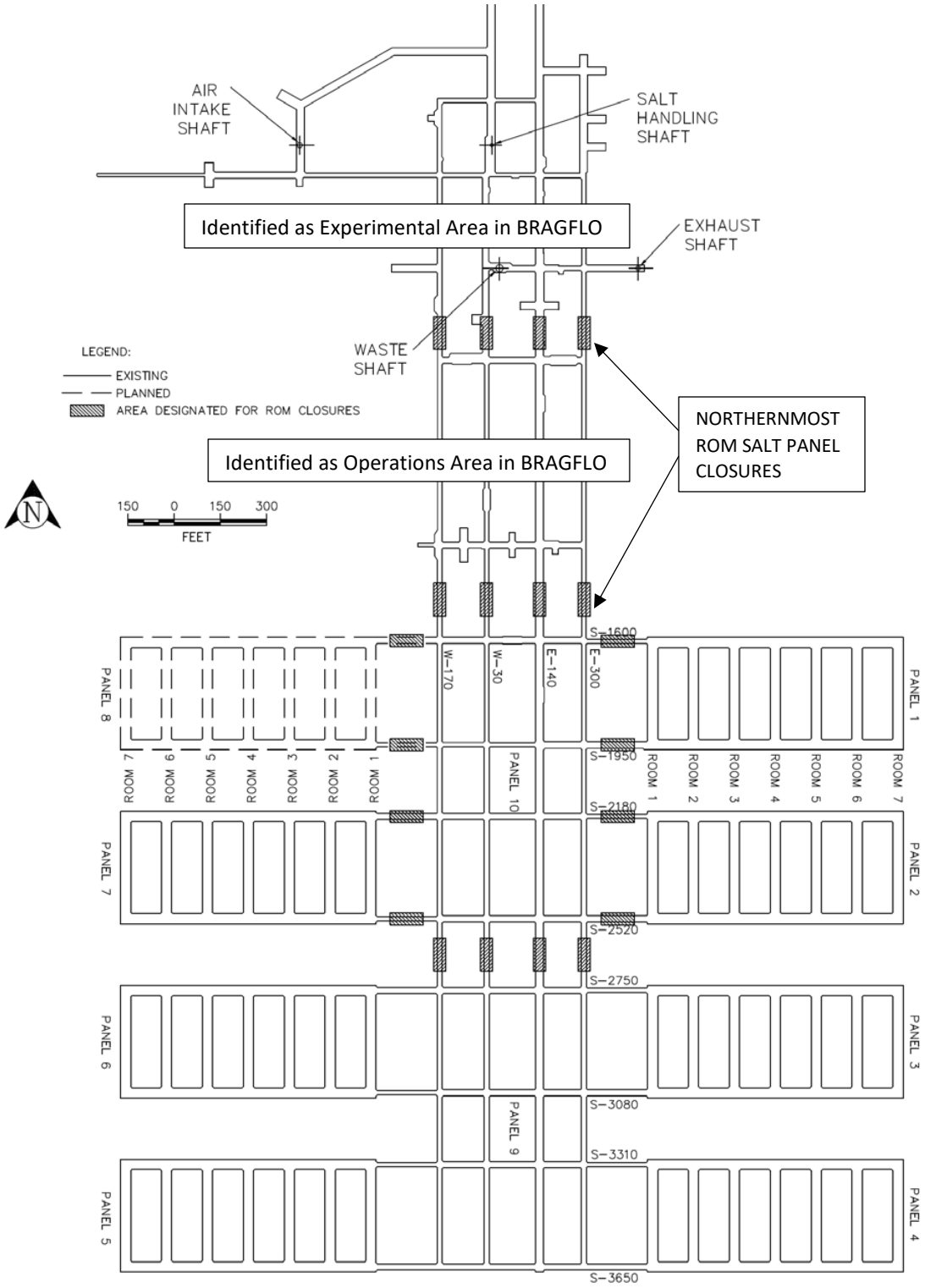

Figure 4.23. Plan view of the WIPP underground showing planned locations of the northernmost ROM salt panel closures. (modified from DOE 2019, Appendix PA, Figure PA-1)

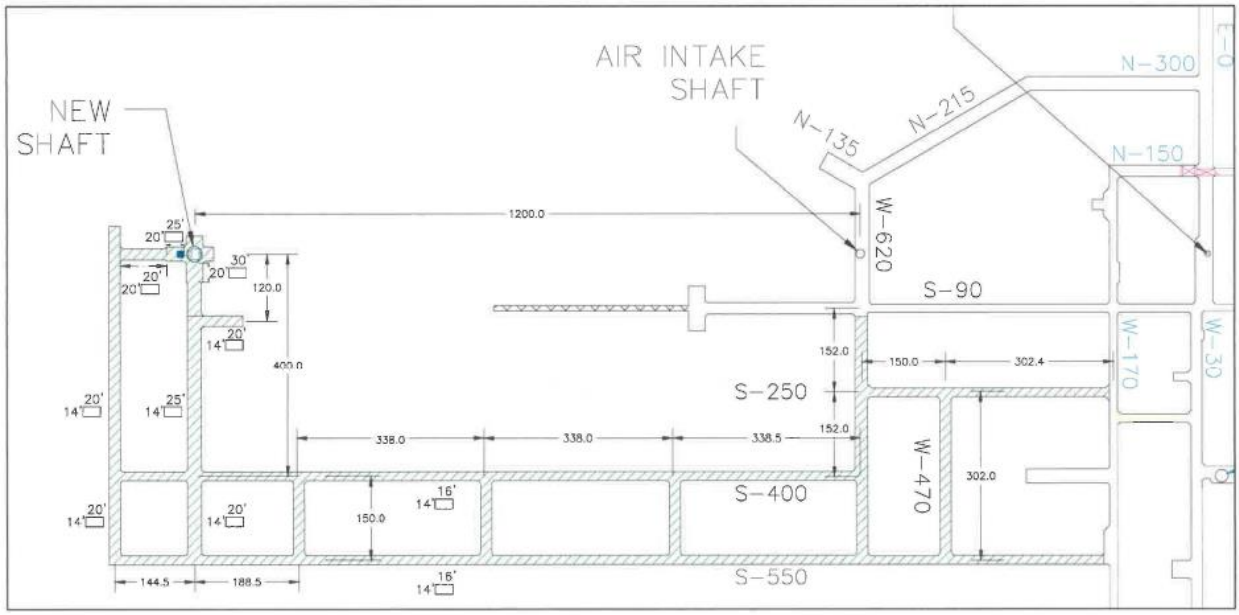

Figure 4.24. Conceptual layout of the connecting drifts to the fifth shaft as of February 2017. (from Zeitler 2019, Figure 3)

4.3.3 Evaluation of New Shaft Implementation in the CRA-2019 PA

The revisions made by Zeitler (2019) to the BRAGFLO Salado Flow model grid to accommodate the enlarged fifth shaft are shown in red on Figure 4.22. The Agency confirmed that these revisions were appropriately incorporated into the CRA-2019 PA through the use of a BRAGFLO grid with the same cell dimension changes as shown in Figure 4.22 (see DOE 2019, Appendix PA-2019, Figure PA-12).

Following receipt of the DOE PCN (Shrader 2017) and design updates (Zeitler 2019), additional Agency questions regarding completeness, disclosure, transparency and scheduling concerns related to implementation of the design changes in the CRA-2019 were transmitted to the DOE. Copies of these questions and the DOE's responses are included in Appendix B to this TSD. Upon review, the Agency accepted DOE's responses as satisfactory. In a letter dated September 28, 2020 (Veal 2020; also included in Appendix B), the Agency concluded that the new shaft will not result in non-compliance with the terms of the certification and does not object to the shaft construction.

5.0 SUMMARY CONCLUSIONS

The DOE PCN for the fifth shaft and connecting drifts identified three categories of impacts on the existing underground excavations: host rock deformation; subsidence; and postclosure repository performance (Shrader 2017). The EPA agrees with the DOE that the effect of the new shaft and connecting drifts on host rock deformation and subsidence in the Waste Area would be minor. The effect of the new shaft and connecting drifts on postclosure repository performance was initially addressed by a Camphouse (2014) study of impacts to repository pressures and brine saturations based on a preliminary design, and design details were later modified by Zeitler (2019) to reflect subsequent refinements.

Camphouse (2014) modified the BRAGFLO Salado Flow model to accommodate the new shaft by adding the cross-section area of the new shaft to the existing, composite cross-section area of the four existing shafts. The simplification of combining the four shafts into one equivalent shaft in the BRAGFLO grid had been approved by EPA and used in all previous WIPP compliance certifications and recertifications. The Agency considers using this same approach to account for an additional shaft to be reasonable and appropriate. Camphouse (2014) accommodated the new connecting drifts by adding the estimated volume of those drifts to the existing volume of the Operations Area in the BRAGFLO model. The Agency also considered this modeling change to be reasonable and appropriate.

The Camphouse (2014) analysis showed that the increased Operations Area volume resulted in minor decreases in pressure and increases in brine saturation within the underground facility as compared with the results of the baseline CRA-2014 PA. The pressure decreased because the increased volume of the Operations Area increased the volume available for gas expansion and the brine saturation increased because lower gas pressures allowed more brine to seep into the repository. The net effect on repository performance was negligible. Cuttings and cavings releases are independent of pressure and saturation and were unaffected. Spallings releases are pressure dependent and were reduced. DBRs have both pressure and saturation thresholds that must be met for a release to occur. The pressure threshold is generally not met in scenarios where a Castile brine release into the repository does not occur and the reduction in pressure makes a DBR under these scenarios even less likely. In scenarios where a release of Castile brine does occur, the released brine dominates both repository pressure and saturation, and small changes in pressure and saturation are generally insufficient to affect the occurrence of a release. The EPA concludes that the Camphouse (2014) analysis adequately demonstrated that the fifth shaft and connecting drifts, as envisioned by the DOE in a preliminary design, would not significantly affect repository performance as modeled in the CRA-2014 baseline PA.

The fifth shaft and connecting drifts were still in the preliminary design stage at the time the Camphouse (2014) analysis was performed. Since then, the design diameter of the shaft was doubled and a preliminary design for the connecting drifts resulted in a decreased drift volume. These changes were documented by Zeitler (2019) for the purpose of incorporating the most recent shaft and drift designs into the CRA-2019 PA. However, Zeitler did not repeat the Camphouse (2014) analysis with these new values.

The shaft diameter was increased from a constant 14 ft in the Camphouse (2014) analysis to 28 to 30 ft in the Zeitler (2019) update. The increased shaft cross-section area was accommodated by increasing the cross-section area of the composite shaft in the BRAGFLO model from about 109 m^2 in the Camphouse (2014) analysis to 153 m^2 in the CRA-2019 PA. This increase in diameter would increase the cumulative brine flow up the shaft in 10,000 years only by an estimated 1 m^3. This volume is negligible compared with the cumulative brine flow of hundreds to thousands of cubic meters up an intrusion borehole.

The volume of the connecting drifts was decreased from 81,634 m^3 in the Camphouse (2014) analysis to 44,042 m^3 in the Zeitler (2019) update. Instead of adding this volume to the Operations Area in the BRAGFLO grid as Camphouse did, Zeitler added it to the Experimental Area. The reason for this change is explained in Section 4.3.2. These changes are expected to result in a smaller pressure decrease in the repository Waste Panel due to the reduced volume of the connecting drifts and because the Experimental Area is farther from the Waste Panel in the BRAGFLO grid. This smaller pressure decrease would result in a smaller increase in brine saturation and an even smaller overall impact on repository performance than was found in the Camphouse (2014) analysis.

The EPA concludes that the Camphouse (2014) analysis adequately demonstrated that the fifth shaft and connecting drifts would not significantly affect repository performance as modeled in the CRA-2014 baseline PA and that the design updates identified by Zeitler (2019) and incorporated in the CRA-2019 PA further support this conclusion. EPA's review concludes that the new shaft and connecting drifts will not result in non-compliance with the terms of the certification. The EPA, therefore, does not object to the shaft construction.

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Appendix A Completeness Comments

EPA Completeness Comment, DOE Response, and EPA Evaluation of DOE Response Related to Shafts at the WIPP Repository

CC1-34-8: BRAGFLO Representation of Shafts and Concrete Monolith Plug

40 CFR §194.34 Results of Performance Assessments

EPA Question (from EPA Completeness Comment Package 1)

Please explain why the concrete monolith filling the composite shaft representation in the BRAGFLO grid stops in the z direction at the repository floor level instead of extending ~125' below it as is the actual case for the sumps underneath the two largest shafts (Waste Shaft and S#5). Would more realistic representation impact flow in the repository and releases?

> *Both the new intake shaft (S#5) and waste handling shaft (WS) have sumps excavated over 100 feet below the repository level and are the largest diameter shafts comprising most of the shafts' excavated volume. Yet the composite representation of the concrete monolith plugging the shafts in the 2D BRAGFLO model does not represent the significant depth of the excavations below the repository level that must also be filled with concrete (125' in the case of the new intake shaft), instead of ending at the base of the repository level. This is below the DRZ and MB 139 represented in the middle. Given the different material properties (porosity, permeability) of the concrete compared to intact Salado halite, and the DRZ, what impact would simulating the concrete monolith to the actual z dimension have on flow*.

DOE Response (from DOE Response Package 2 (DOE RP2 2020))

Note that the concrete monolith does not stop at the repository floor level, it extends 1.38 meters (m) (4.53 feet [ft]) below the repository floor into the DRZ, stopping at the top of Marker Bed 139 (MB-139). Figure 1 shows the BRAGFLO grid used in CRA-2019 (Day 2019).

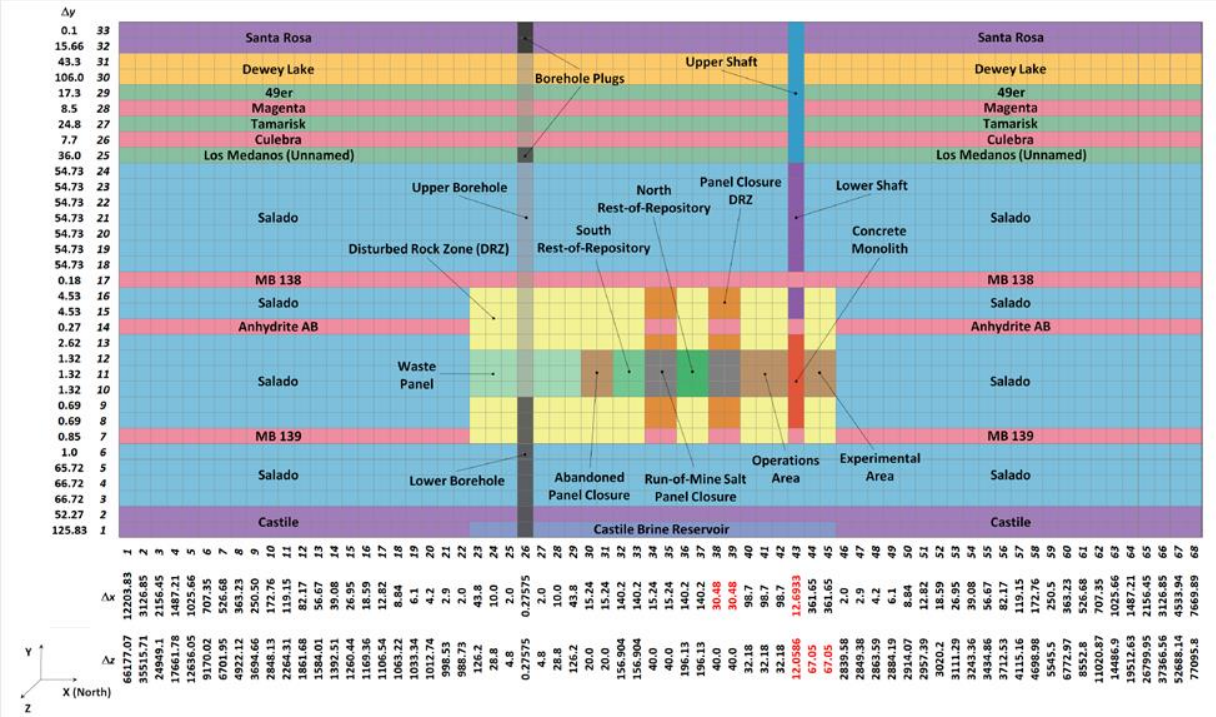

Figure 3 CRA-2019 BRAGFLO Grid (Day 2019)

Conceptually, modeling a three-dimensional repository in two dimensions requires maintaining important features to flow over less important features. In three-dimensions, the primary flow pathway in MB-139 under the experimental area and operations area is assumed to be the horizontal flow. That is, when visualizing MB-139 as a horizontal plane in 3-D space, the few holes that the shafts poke into the plane do not have a major impact on the flow field in MB-139. The flow will tend to go around the concrete monolith that fills the shaft. This is represented in the 2-D flared grid by stopping the concrete monolith at the top of MB-139, thus allowing the dominant north-south flow to continue unimpeded through MB-139.

A simulation study was conducted to investigate the impacts of extending the concrete monolith through MB-139 into the intact Salado. The Salado flow grid used for this simulation study extends the shaft an additional 67.57 m (221.7 ft). In total, the concrete monolith extends 68.95 m (226.2 ft) below the repository flow in this study. The shaft extending 68.95 m below the repository flow far exceeds the 38.1 m (125 ft) that the new shaft extends below the repository floor. This excess extension is due to the resolution of the Salado Flow grid not allowing for a closer representation without re-gridding with new cell dimensions. This excess extension will bound any effects on flow of the lower shaft. Figure 2 shows the Salado flow grid used in this study.

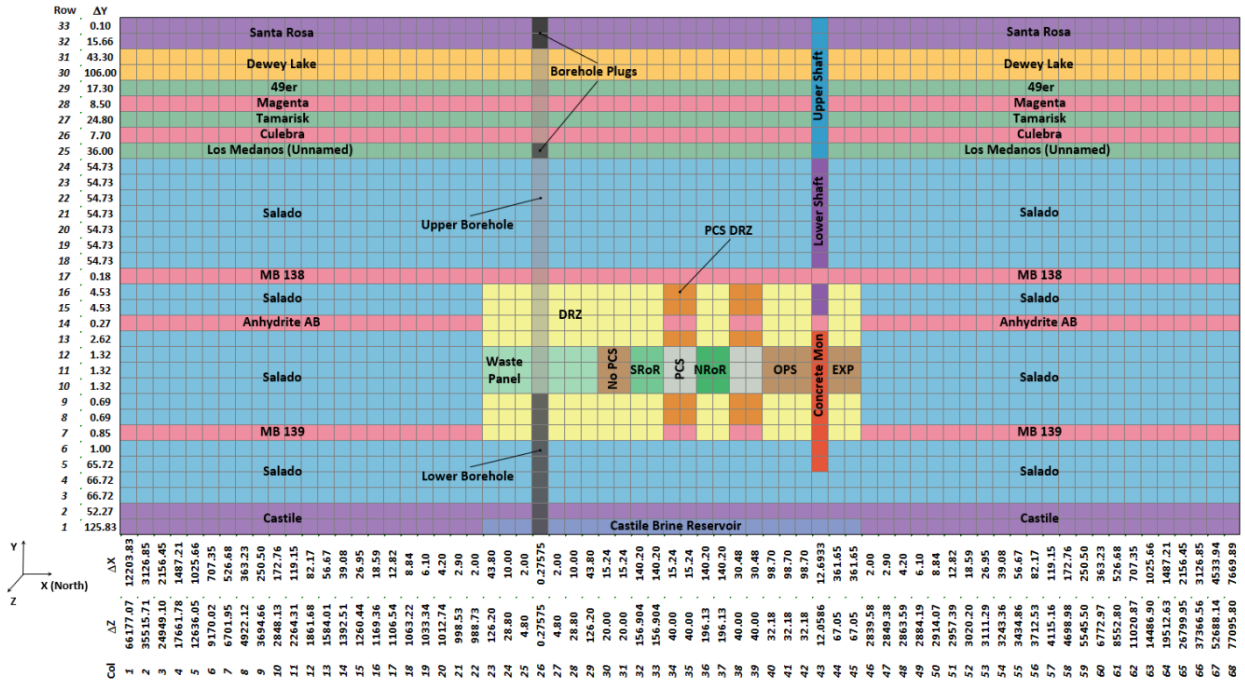

Figure 4 CONC_MON Salado Flow grid with the shaft extended into the intact Salado

The 100 vectors of Replicate 1 were simulated in this study. The only difference between these simulations and CRA-2019 is the extension of the shaft in the Salado Flow grid. These simulation results will be labeled CONC_MON in all figures. The results will be compared to the CRA-2019 results. Files associated with this study are archived on the WIPP PA cluster at /nfs/data/CVSLIB/WIPP_EXTERNAL/cra19_comments/Files/CC1-34-8.

Figure 3 through Figure 7 show the mean brine pressures for the undisturbed scenario (S1-BF) compared to the results of CRA-2019. In the three waste areas (WP, SROR, and NROR) there is no noticeable difference between the CONC_MON brine pressure results and the CRA-2019 brine pressure results. The operations and experimental area also show no noticeable difference in brine pressure.

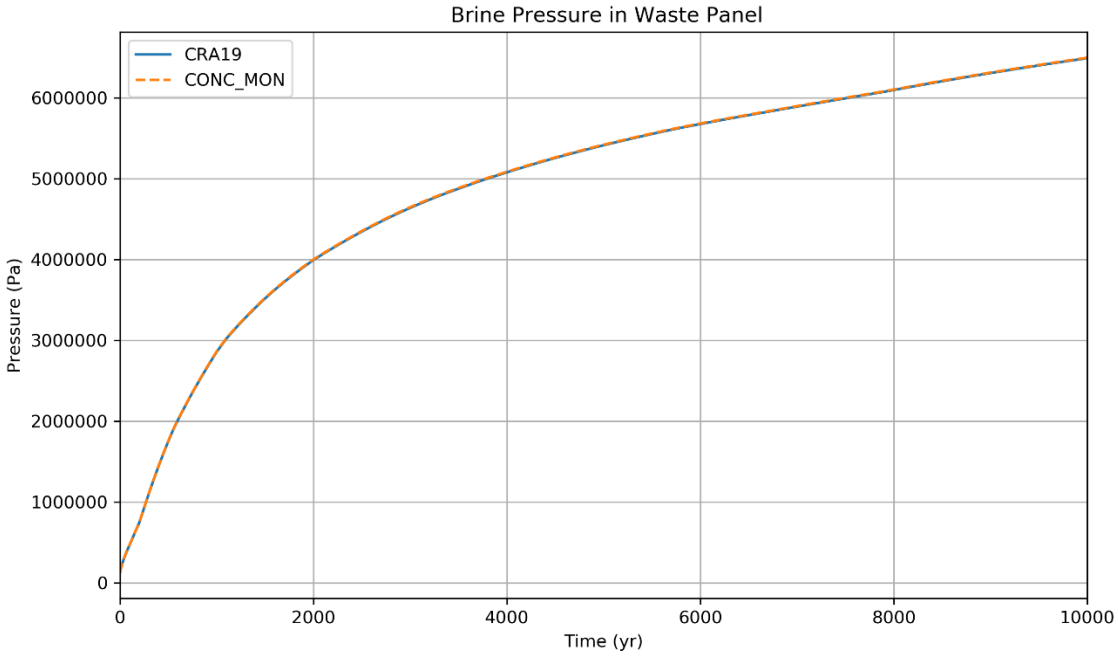

Figure 5 Mean Waste Panel Brine Pressure (Pa) for undisturbed scenario (S1-BF)

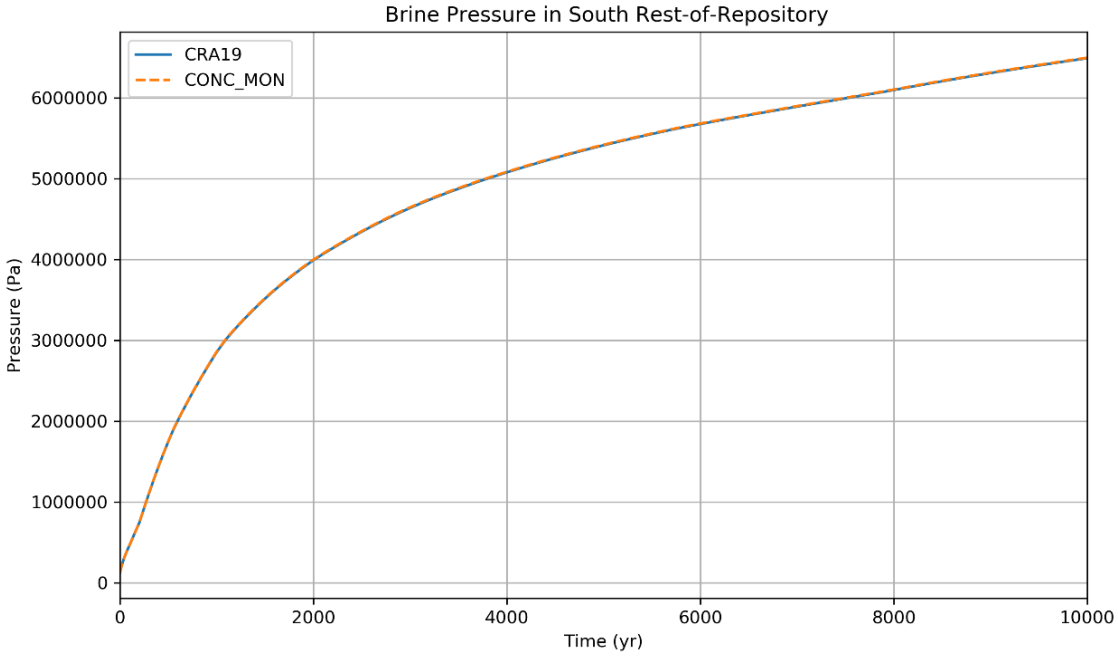

Figure 6 Mean South Rest-of-Repository Brine Pressure (Pa) for undisturbed scenario (S1-BF)

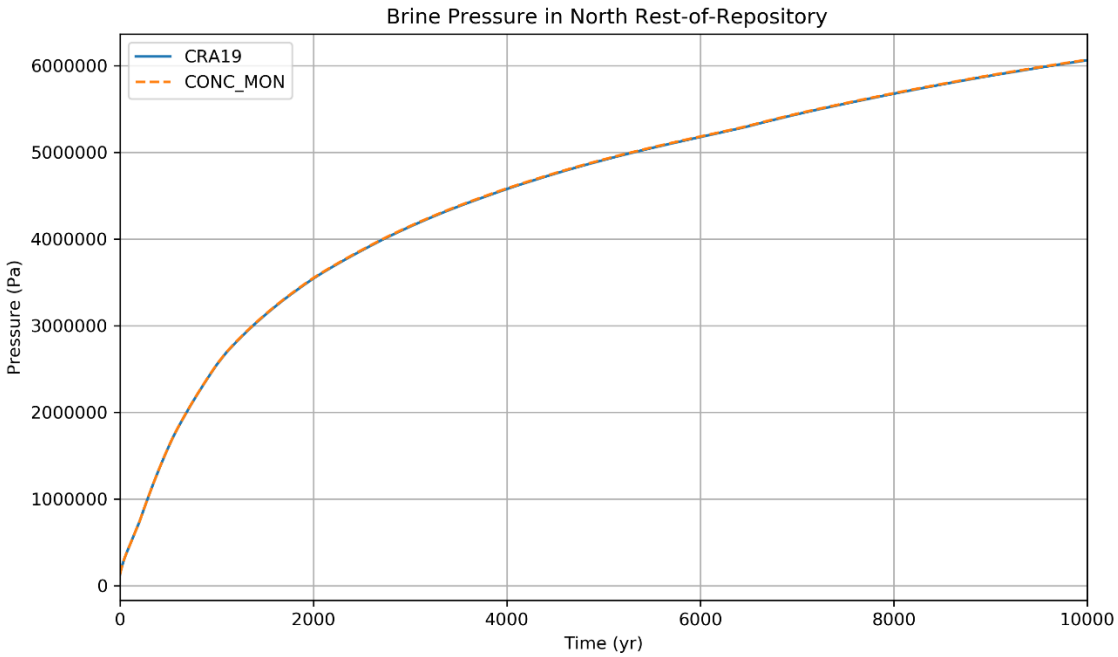

Figure 7 Mean North Rest-of-Repository Brine Pressure (Pa) for undisturbed scenario (S1-BF)



Figure 8 Mean Operations Area Brine Pressure (Pa) for undisturbed scenario (S1-BF)

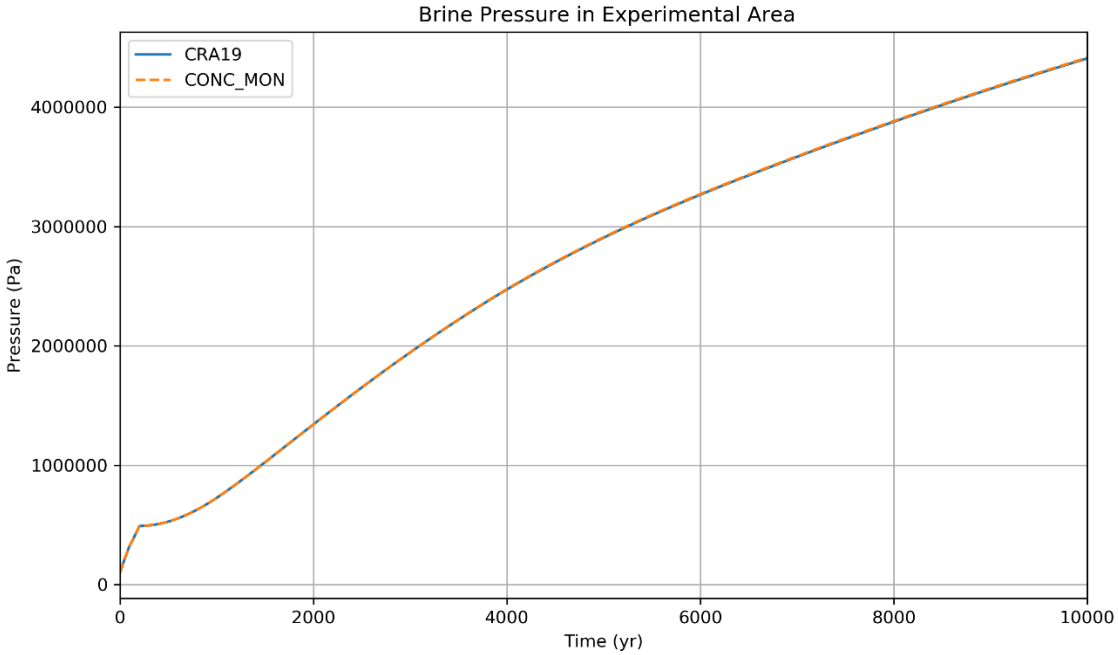

Figure 9 Mean Experimental Area Brine Pressure (Pa) for undisturbed scenario (S1-BF)

Figure 8 though Figure 12 show the mean brine saturations for the undisturbed scenario. Very small differences can be seen in the brine saturations, most prominently in the South Rest-of-Repository and Experimental area. It is noted that the mean saturation values for the undisturbed scenario are very low (less than the mean residual brine saturation of 0.276), so these slight differences are not considered impactful. Figure 13 shows the mean brine flow up the shaft. Lengthening the shaft has no impact on brine flow up the shaft for the undisturbed case.

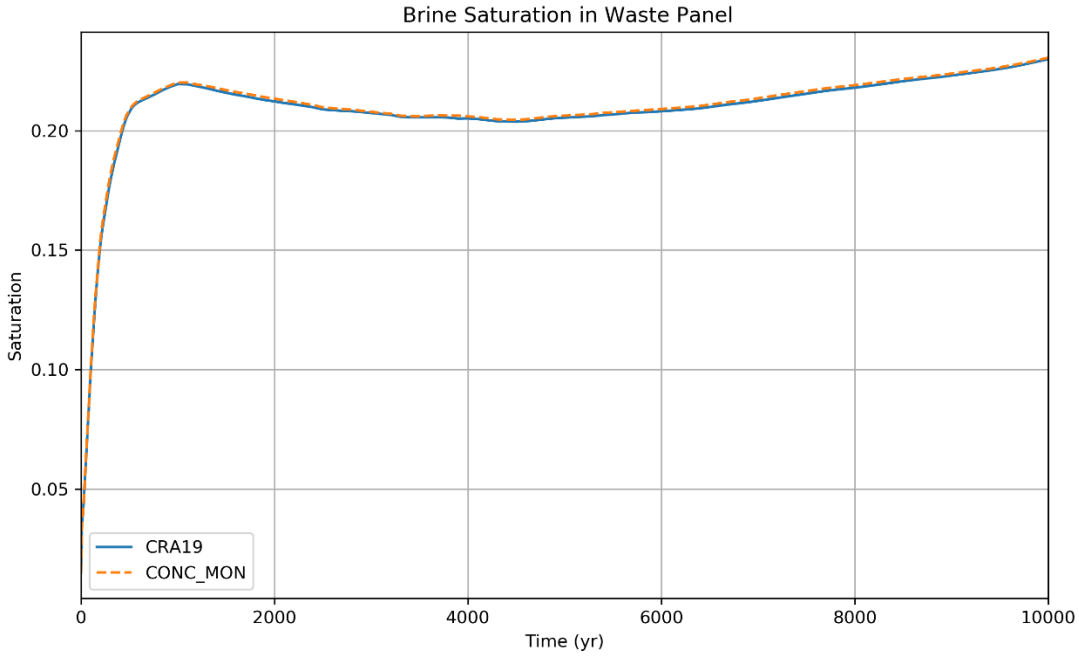

Figure 10 Mean Waste Panel Brine Saturations for undisturbed scenario (S1-BF)

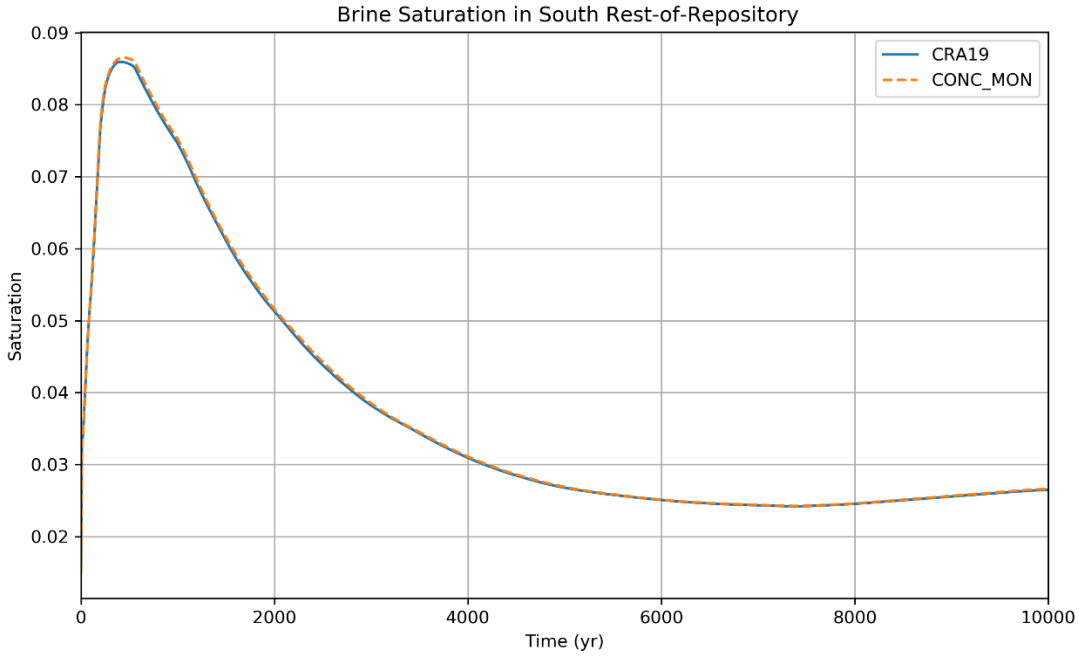

Figure 11 Mean South Rest-of-Repository Brine Saturations for undisturbed scenario (S1-BF)

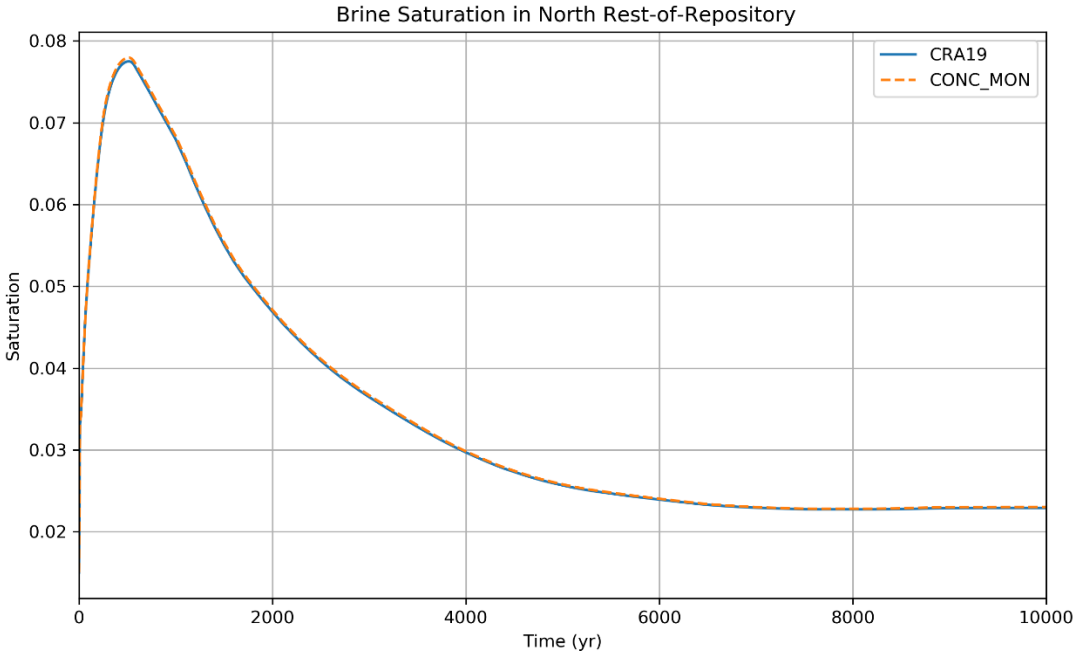

Figure 12 Mean North Rest-of-Repository Brine Saturations for undisturbed scenario (S1-BF)

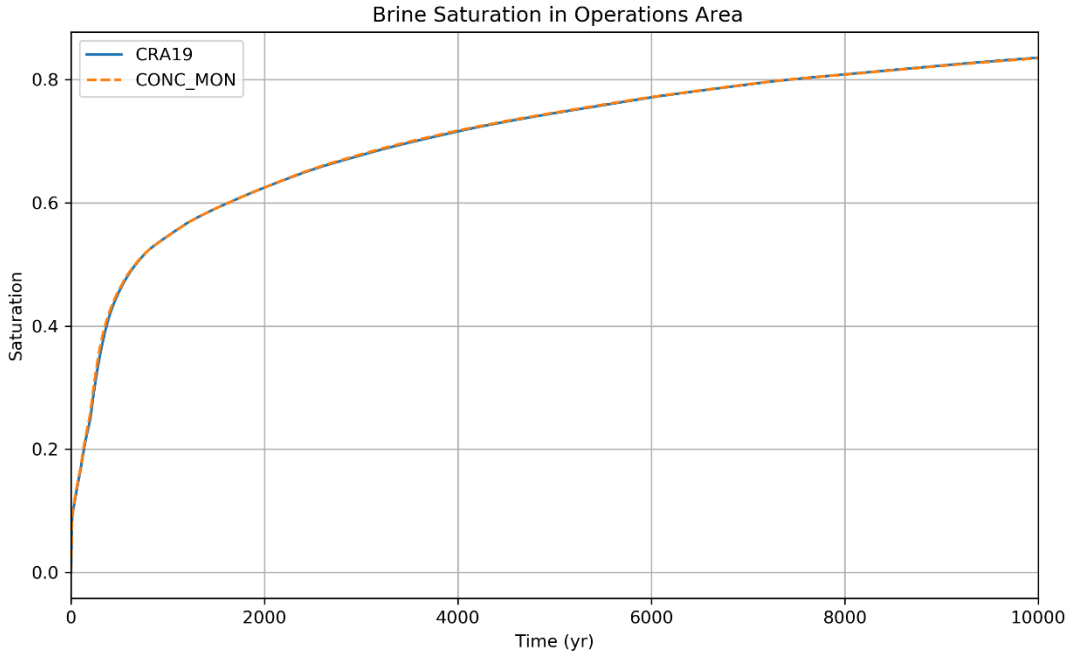

Figure 13 Mean Operations Area Brine Saturations for undisturbed scenario (S1-BF)

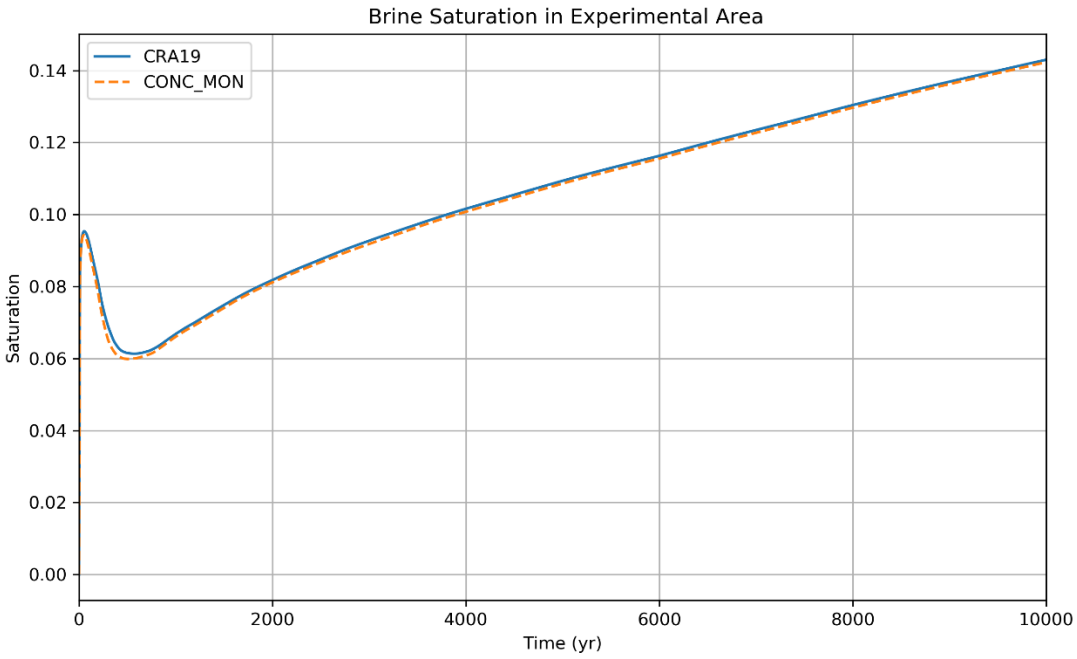

Figure 14 Mean Experimental Area Brine Saturations for undisturbed scenario (S1-BF)

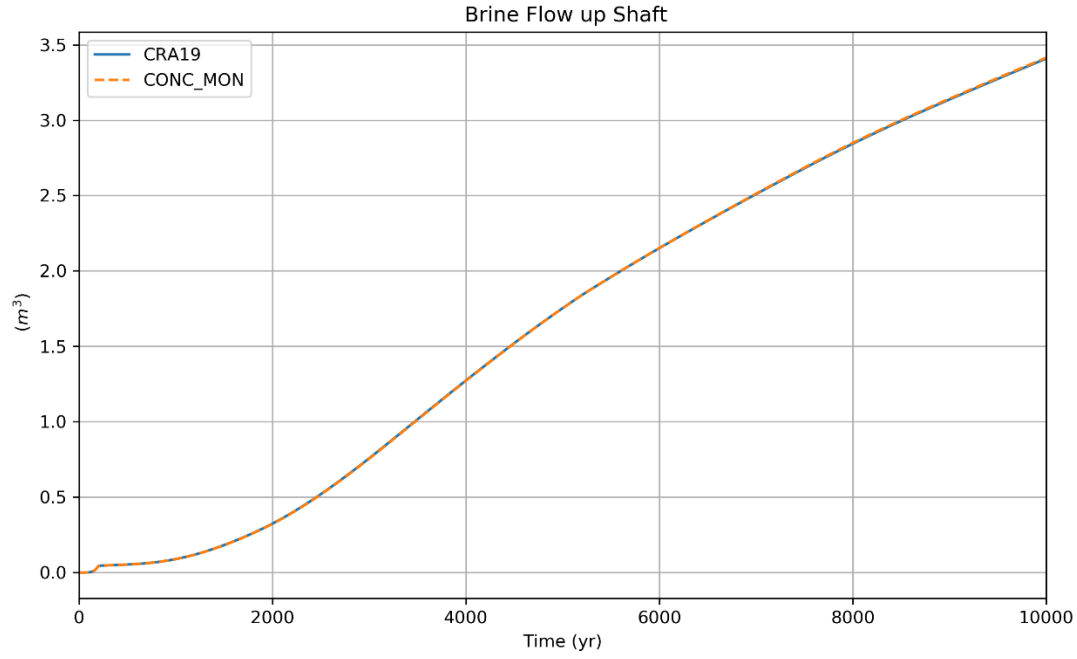

Figure 15 Mean Brine flow (m_3) up the shaft for undisturbed scenario (S1-BF)

Results from a scenario with an E1 intrusion are shown below. Scenario S2-BF results are shown here, scenario S3-BF results show similar behaviors, as do scenario S6-BF. Figure 14 through Figure 18 show the mean brine pressures in each repository area. No noticeable differences are seen between the CONC_MON results and the CRA-2019 results.

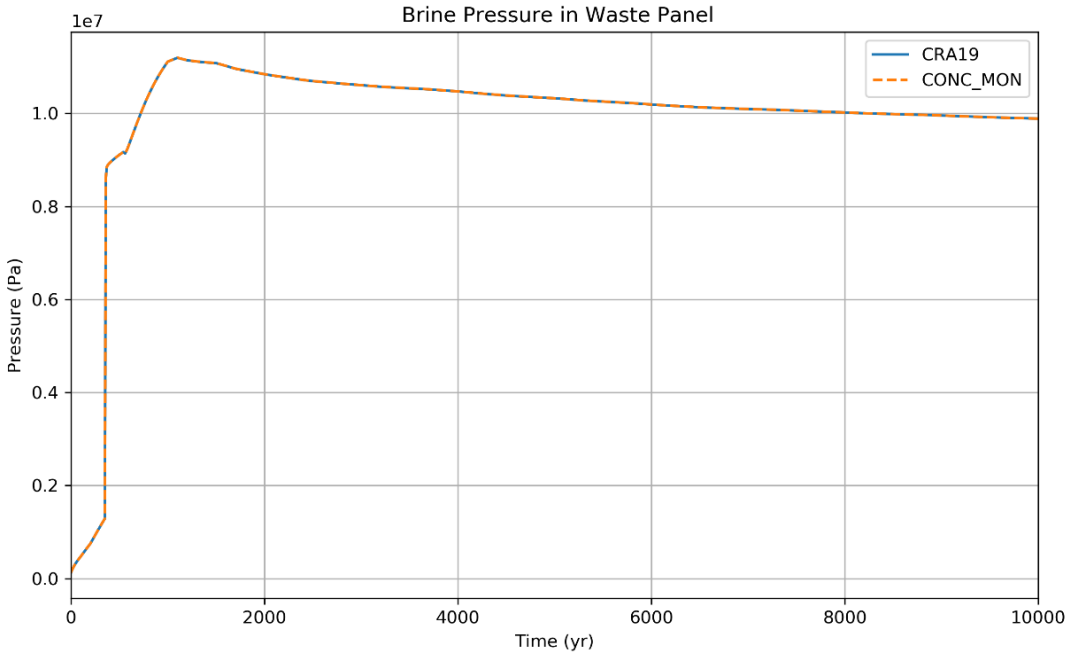

Figure 16 Mean Waste Panel Brine Pressure (Pa) for scenario with E1 intrusion (S2-BF)

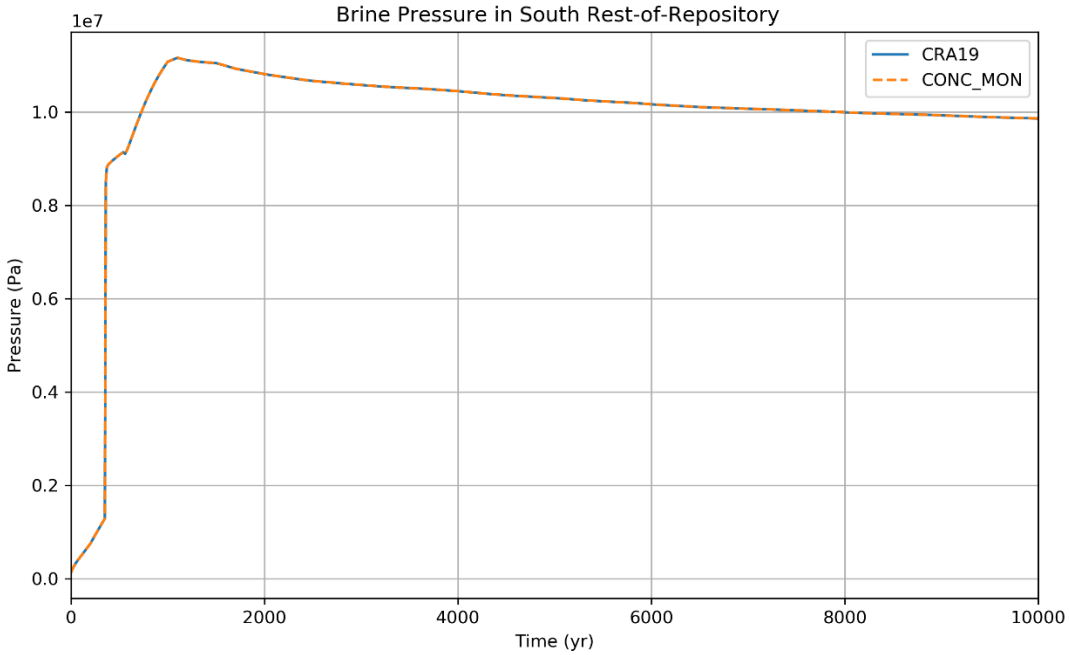

Figure 17 Mean South Rest-of-Repository Brine Pressure (Pa) for scenario with E1 intrusion (S2-BF)

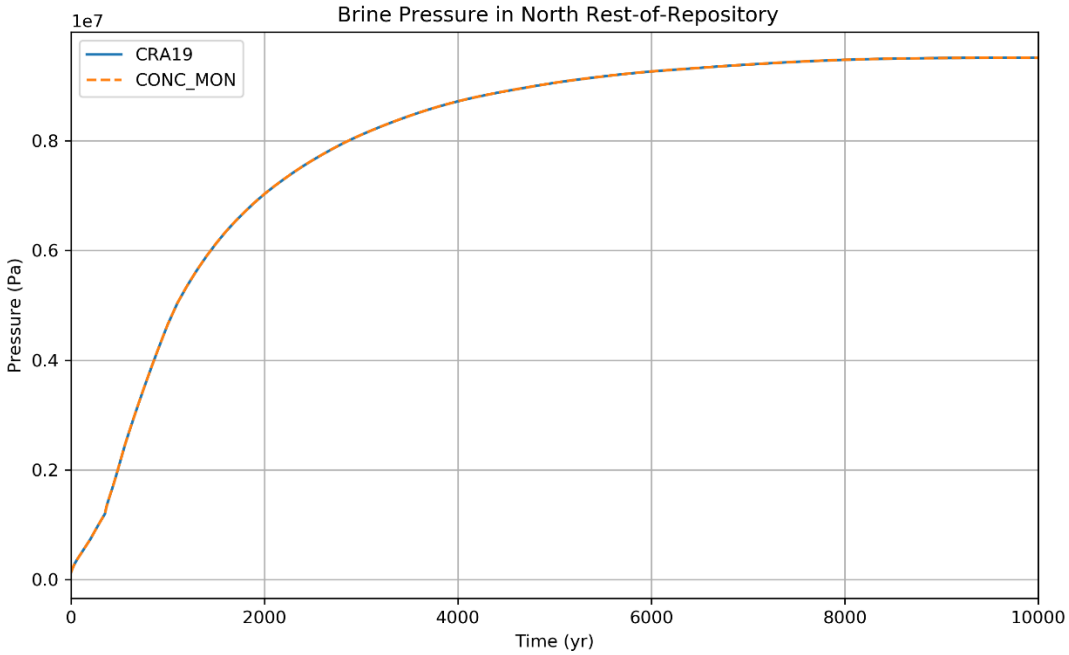

Figure 18 Mean North Rest-of-Repository Brine Pressure (Pa) for scenario with E1 intrusion (S2-BF)

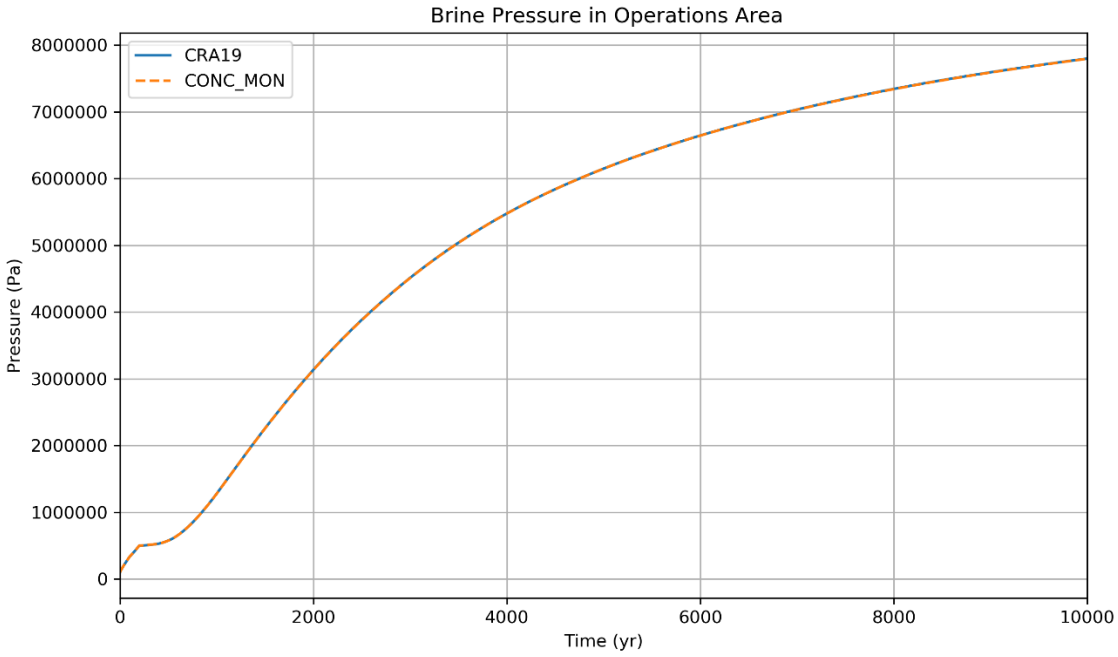

Figure 19 Mean Operations Area Brine Pressure (Pa) for scenario with E1 intrusion (S2-BF)

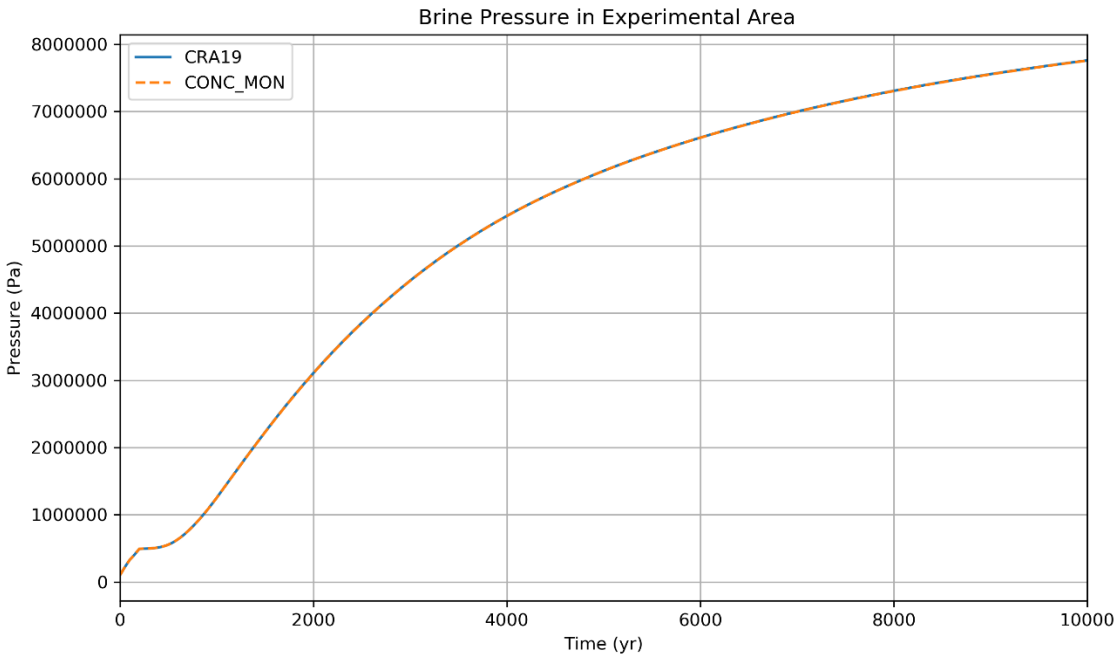

Figure 20 Mean Experimental Area Brine Pressure (Pa) for scenario with E1 intrusion (S2-BF)

Figure 19 through Figure 23 show mean brine saturations for scenario S2-BF. No noticeable differences are seen in the three waste area brine saturations. Slight differences are seen in the Operations and Experimental area brine saturations. These differences are small enough to not be

considered impactful. Figure 24 shows no noticeable differences in mean brine flow up the shaft due to lengthening the shaft.

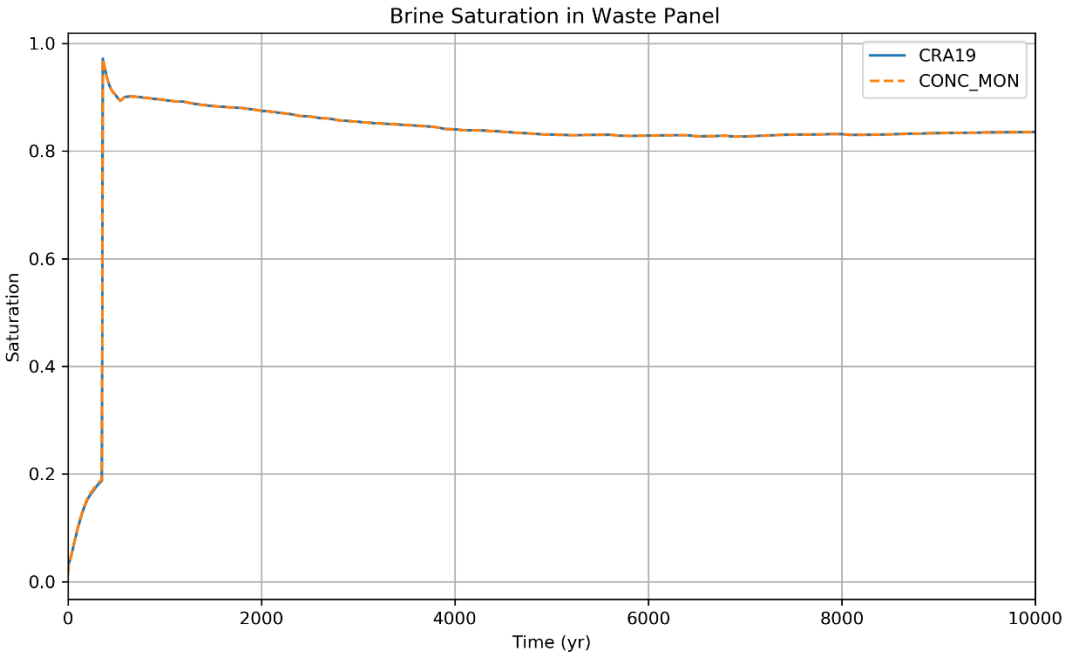

Figure 21 Mean Waste Panel Brine Saturations for scenario with E1 intrusion (S2-BF)

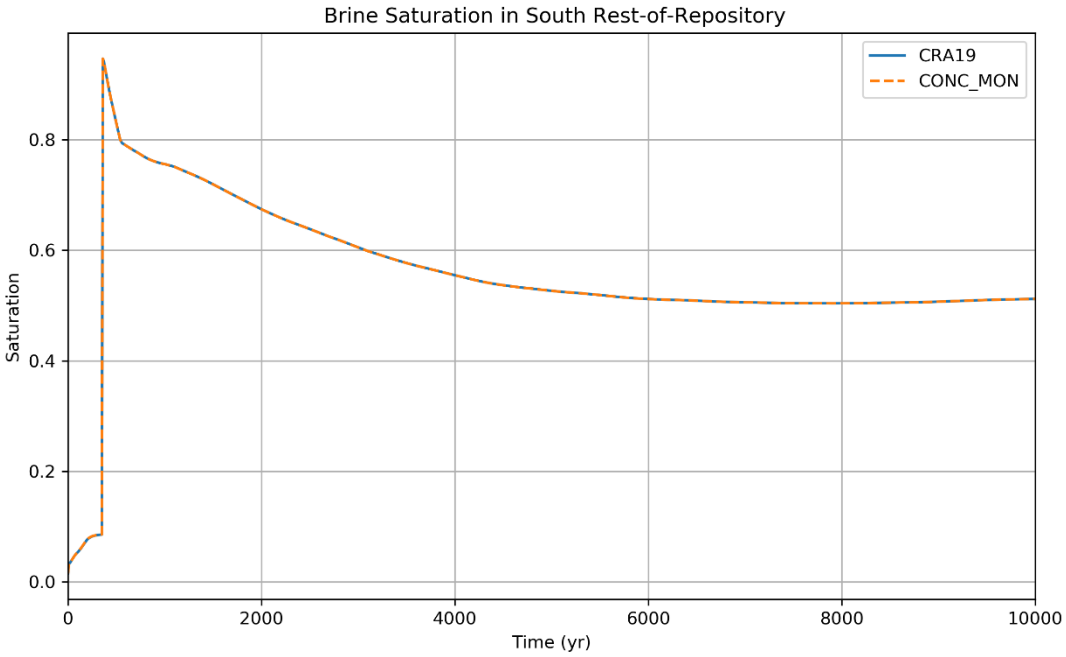

Figure 22 Mean South Rest-of-Repository Brine Saturations for scenario with E1 intrusion (S2-BF)

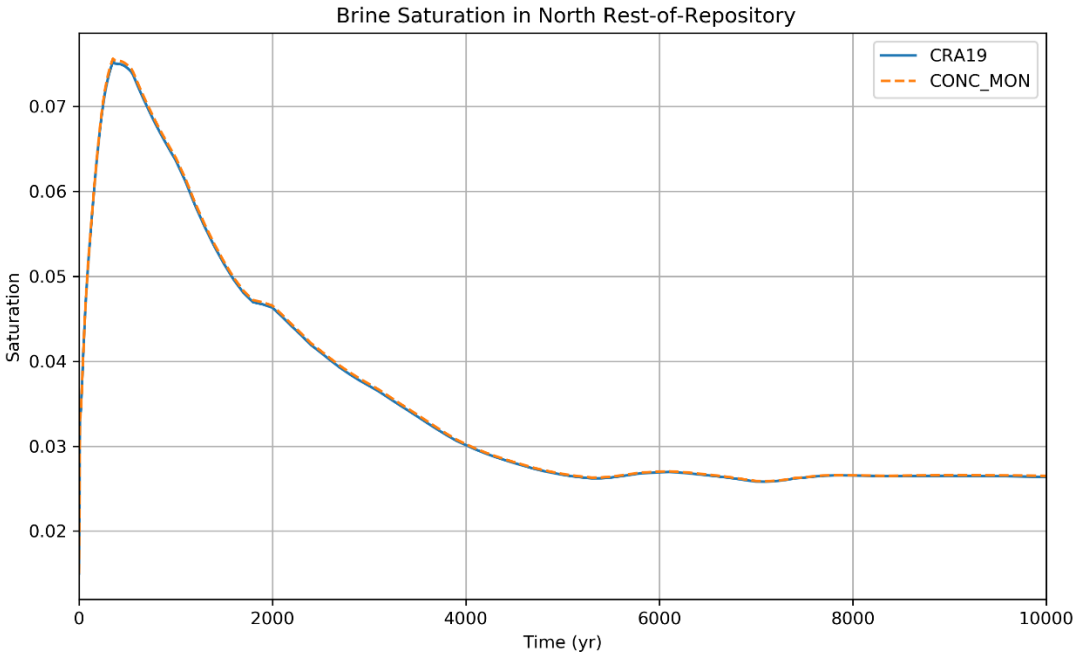

Figure 23 Mean North Rest-of-Repository Brine Saturations for scenario with E1 intrusion (S2-BF)

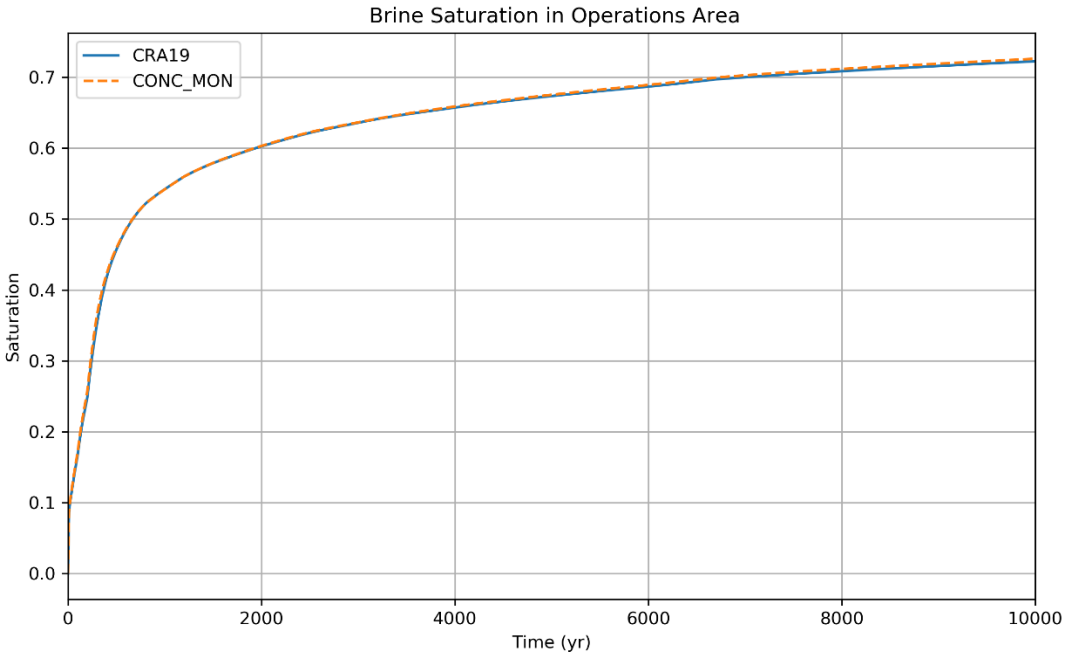

Figure 24 Mean Operations Area Brine Saturations for scenario with E1 intrusion (S2-BF)

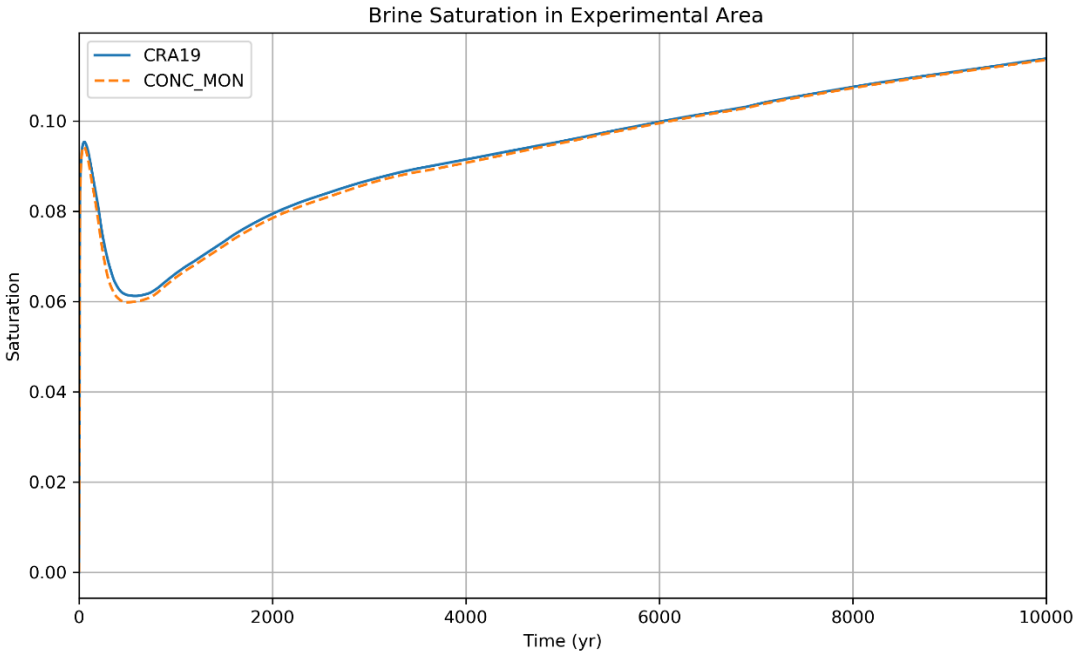

Figure 25 Mean Experimental Area Brine Saturations for scenario with E1 intrusion (S2-BF)

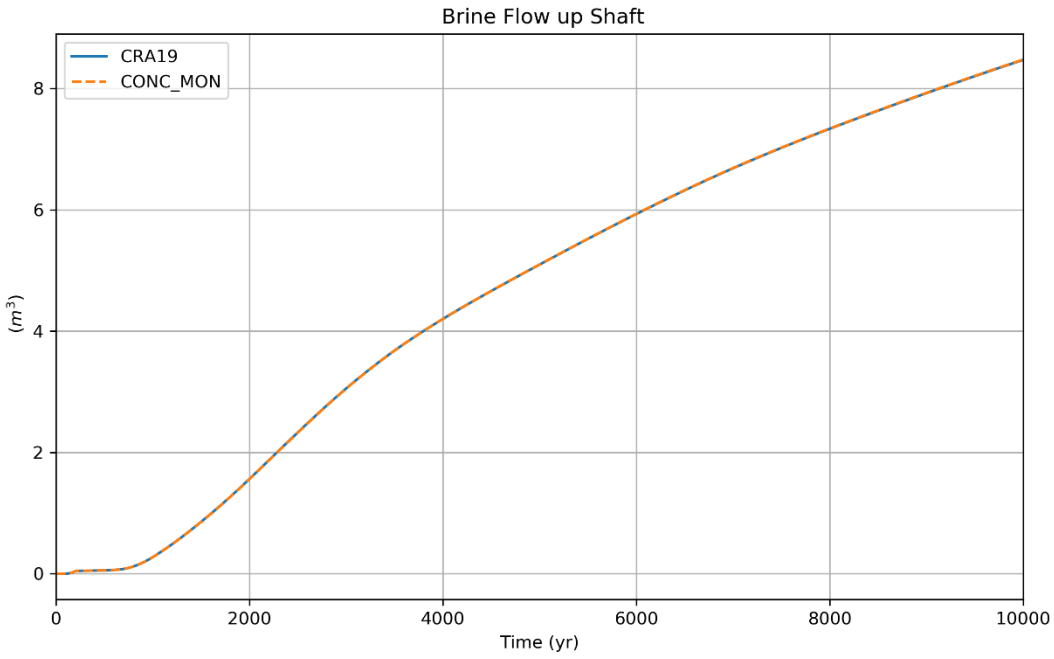

Figure 26 Mean Brine flow (m3) up the shaft for scenario with E1 intrusion (S2-BF)

The results for a scenario with an E2 intrusion are shown below. Scenario S4-BF is used to represent E2 intrusion scenarios, results from scenario S5-BF show similar behavior. Figure 25

through Figure 29 show mean brine pressures in the repository areas. No significant differences are seen in these results between the two analyses.

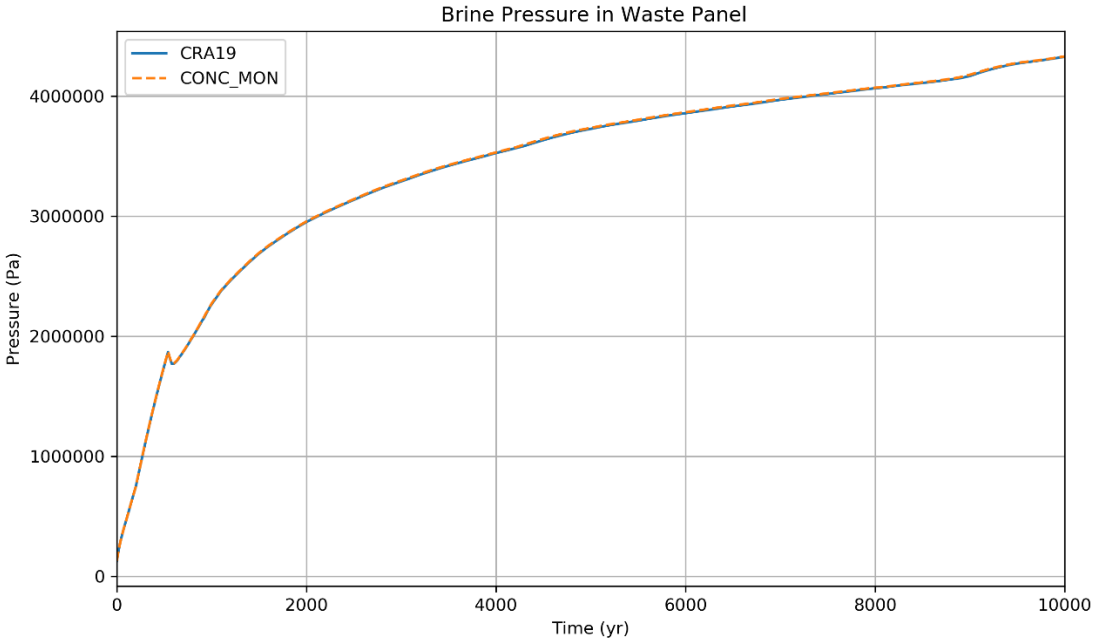

Figure 27 Mean Waste Panel Brine Pressure (Pa) for scenario with E2 intrusion (S4-BF)

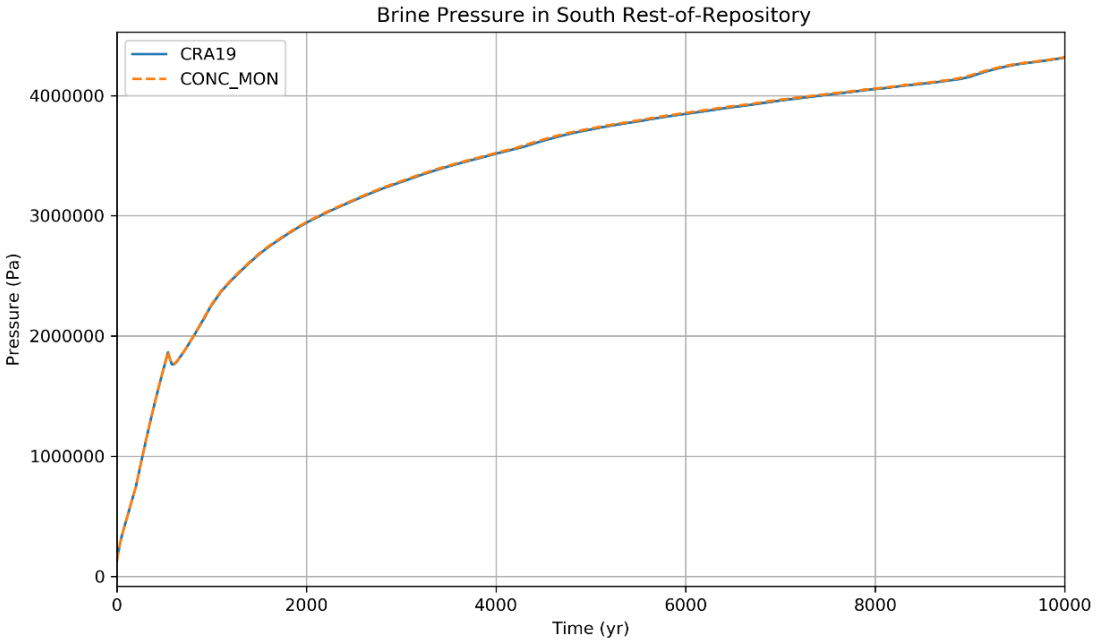

Figure 28 Mean South Rest-of-Repository Brine Pressure (Pa) for scenario with E2 intrusion (S4-BF)

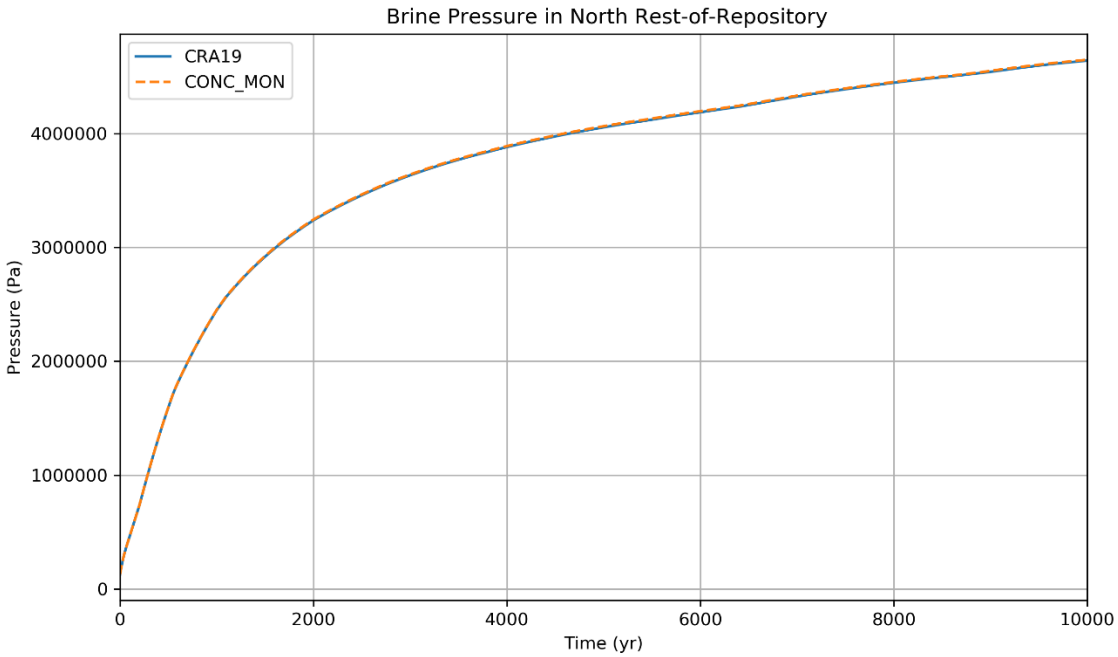

Figure 29 Mean North Rest-of-Repository Brine Pressure (Pa) for scenario with E2 intrusion (S4-BF)

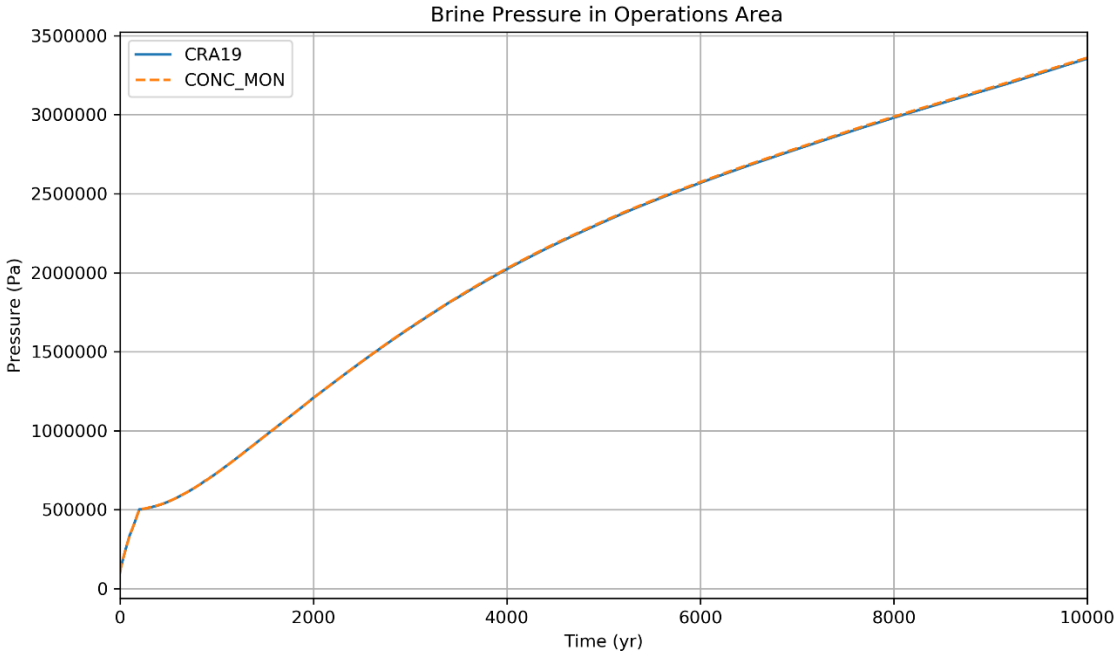

Figure 30 Mean Operations Area Brine Pressure (Pa) for scenario with E2 intrusion (S4-BF)

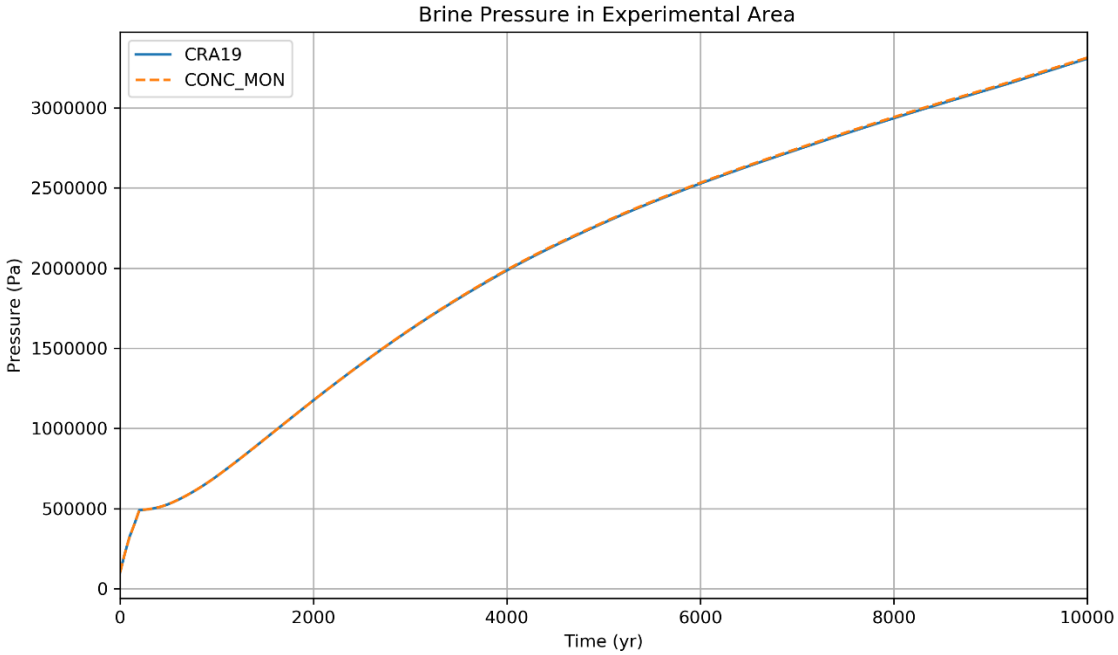

Figure 31 Mean Experimental Area Brine Pressure (Pa) for scenario with E2 intrusion (S4-BF)

Figure 30 through Figure 34 show mean brine saturations for the repository areas. Again, only slight differences are seen in the mean brine saturation values, which primary occur below the mean residual brine saturation (0.276) and are considered non-impactful. Figure 35 shows no impact to brine flow up the shaft due to lengthening the shaft.

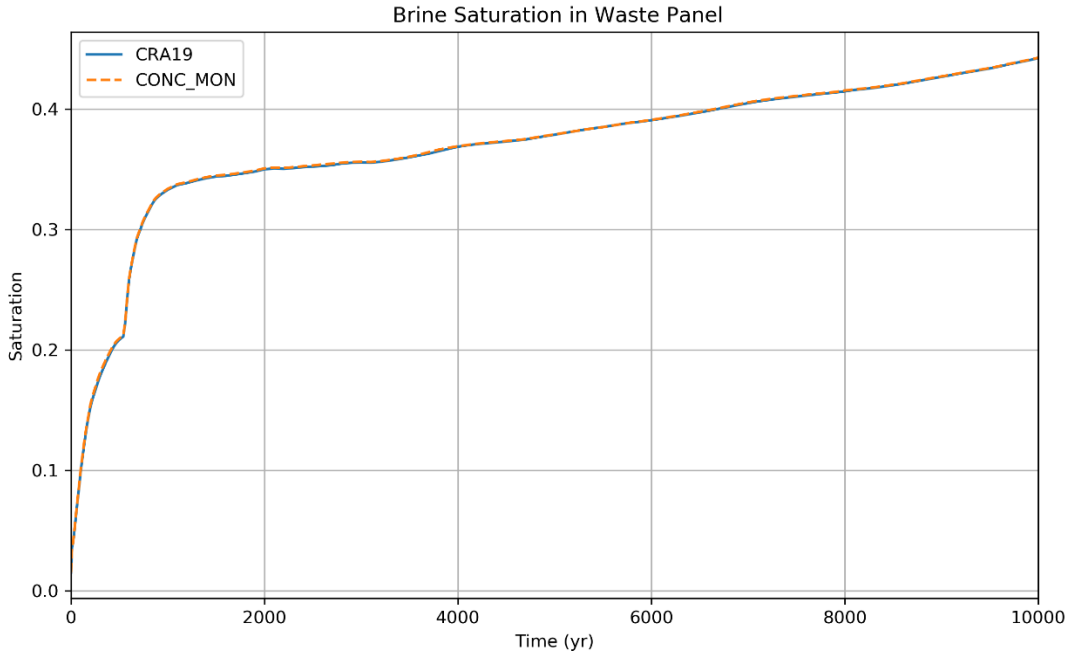

Figure 32 Mean Waste Panel Brine Saturations for scenario with E2 intrusion (S4-BF)

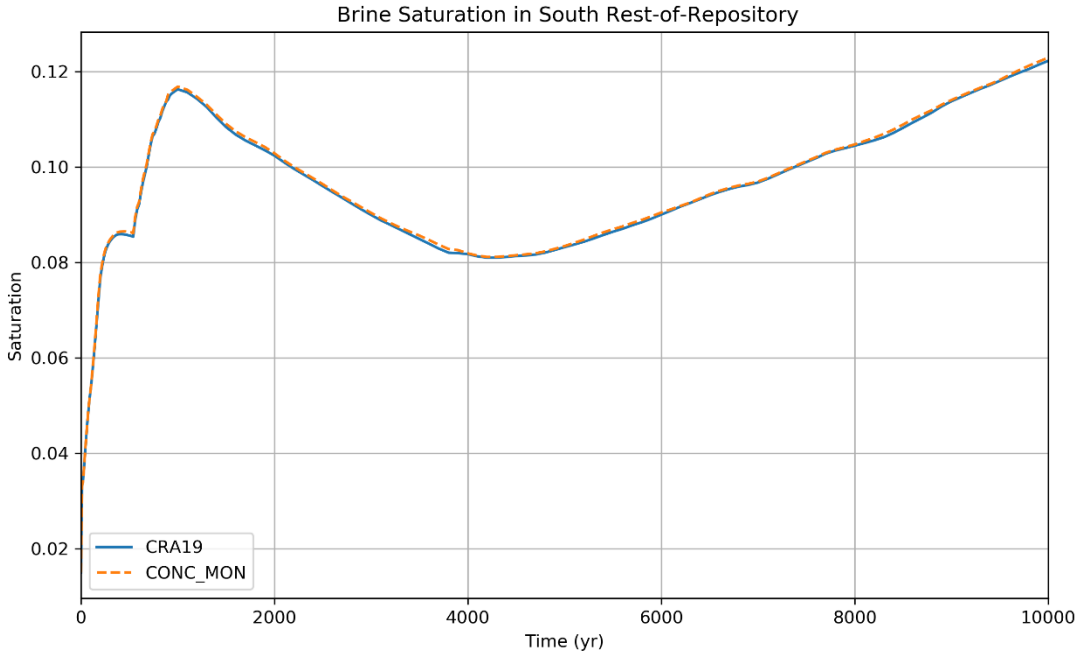

Figure 33 Mean South Rest-of-Repository Brine Saturations for scenario with E2 intrusion (S4-BF)

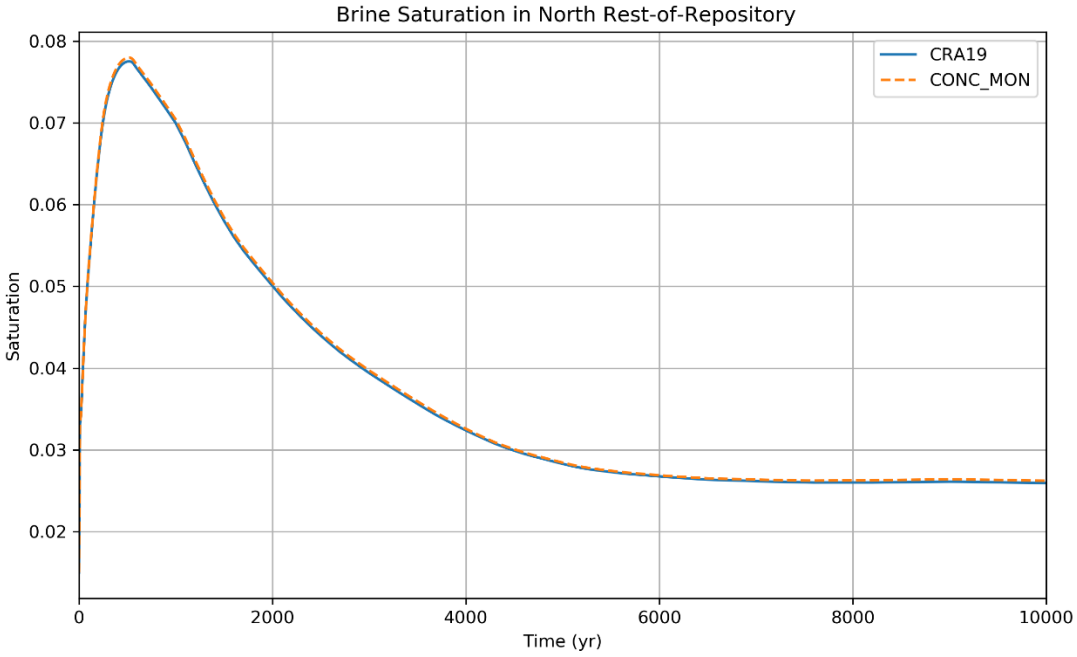

Figure 34 Mean North Rest-of-Repository Brine Saturations for scenario with E2 intrusion (S4-BF)

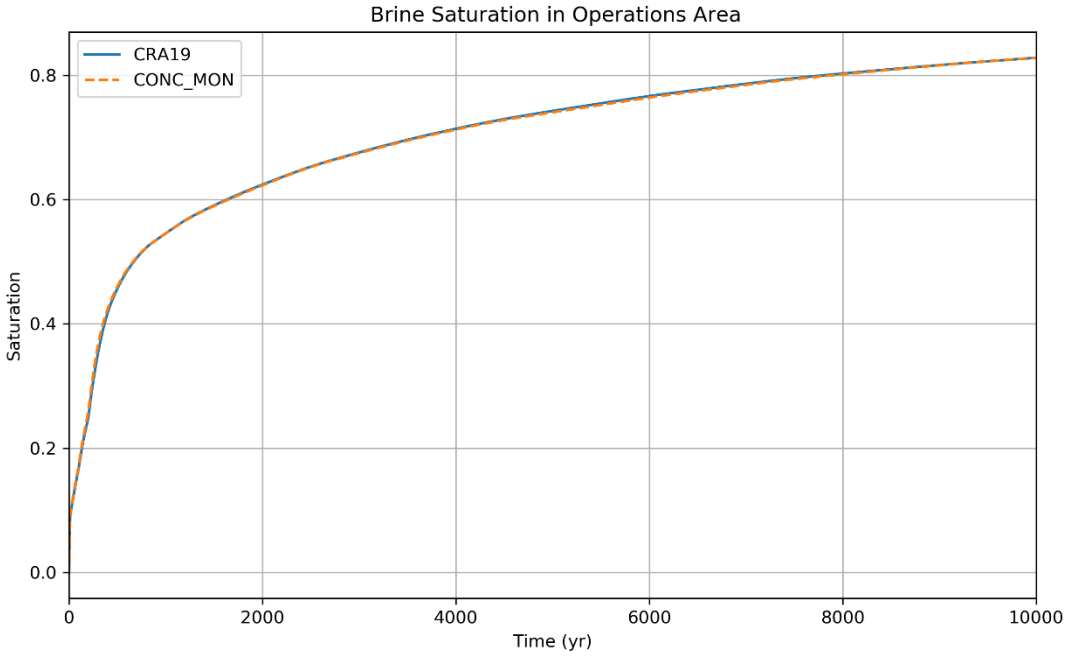

Figure 35 Mean Operations Area Brine Saturations for scenario with E2 intrusion (S4-BF)

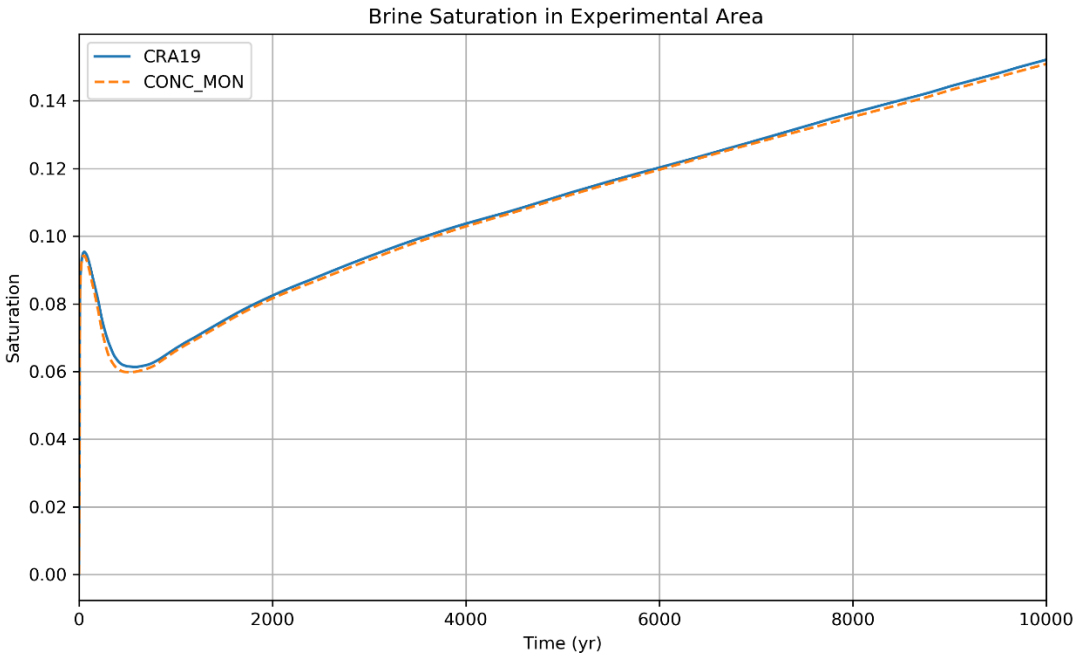

Figure 36 Mean Experimental Area Brine Saturations for scenario with E2 intrusion (S4-BF)

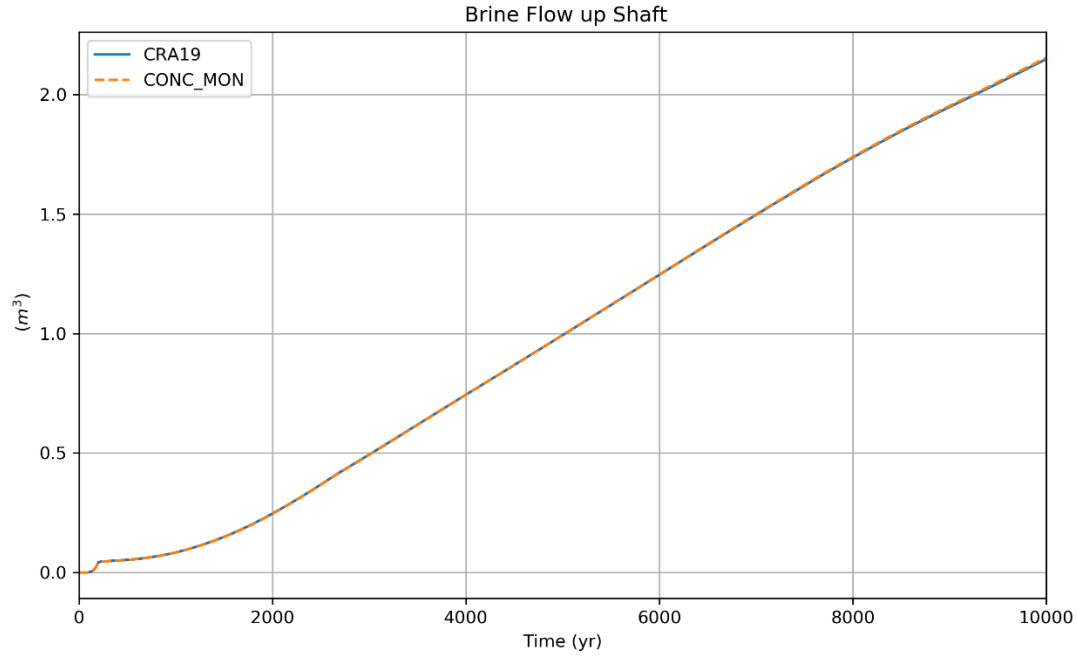

Figure 37 Mean Brine flow (m3) up the shaft for scenario with E2 intrusion (S4-BF)

Mean results have a potential to average out individual vector effects that could be impactful. To ensure the mean results have not averaged out effects that will have large impacts on releases, for each vector a time averaged value Figure 36 through Figure 46. A perfect agreement between the two analyses would be plotted along the line Y=X. The Operations area and Experimental area brine saturation results show the largest deviation, both positive and negative, from the perfect fit line.[1]

[1] Time-averaging is done by a trapezoidal integration of each value over time, divided by the 10,000 year simulation time.

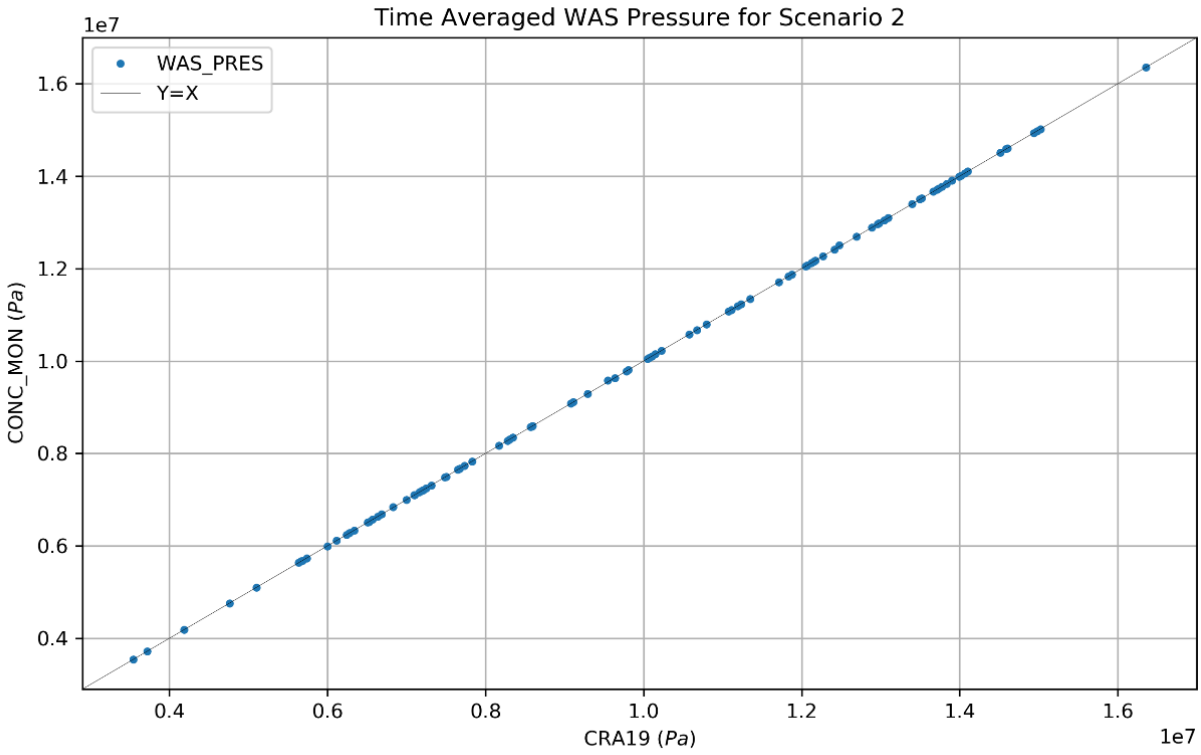

Figure 38 Time Averaged Waste Panel Pressures for a scenario with an E1 intrusion (S2-BF)

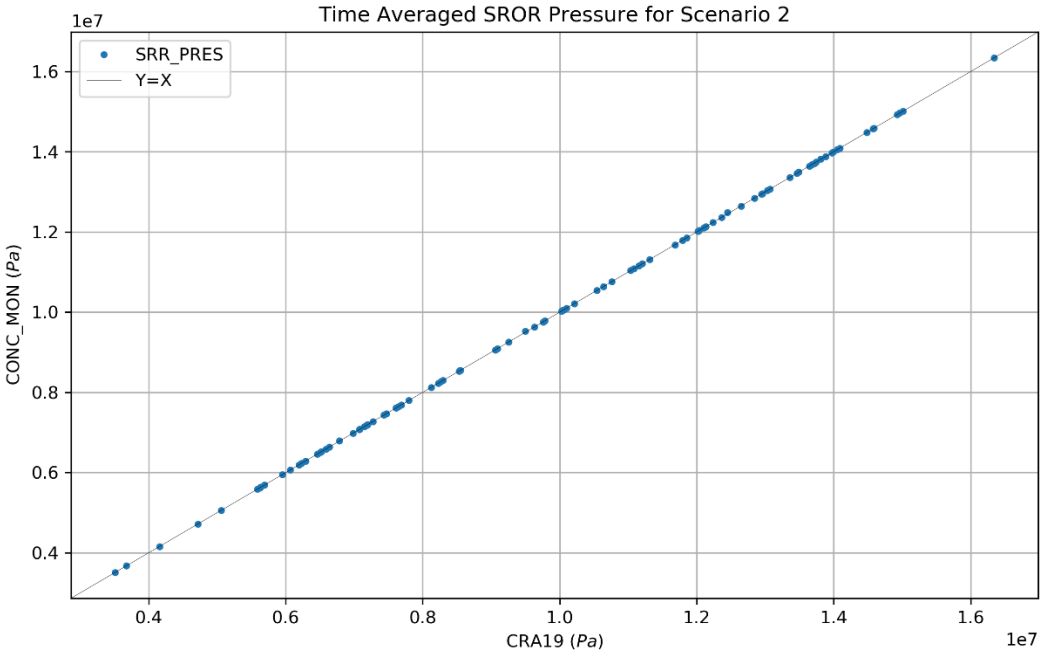

Figure 39 Time Averaged South Rest-of-Repository Pressures for a scenario with an E1 intrusion (S2-BF)

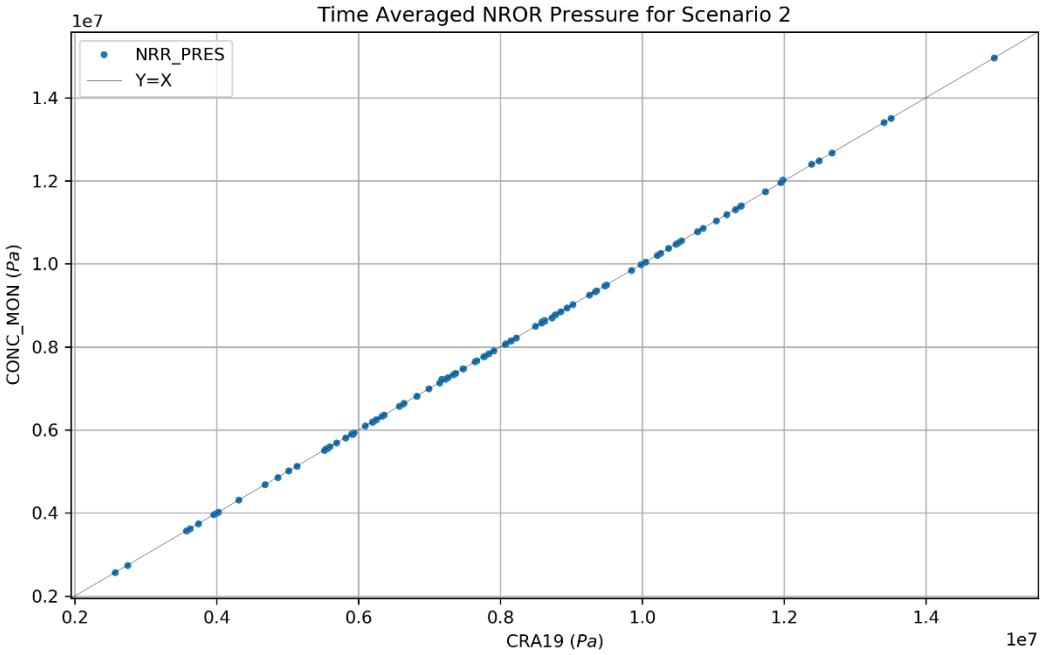

Figure 40 Time Averaged North Rest-of-Repository Pressures for a scenario with an E1 intrusion (S2-BF)

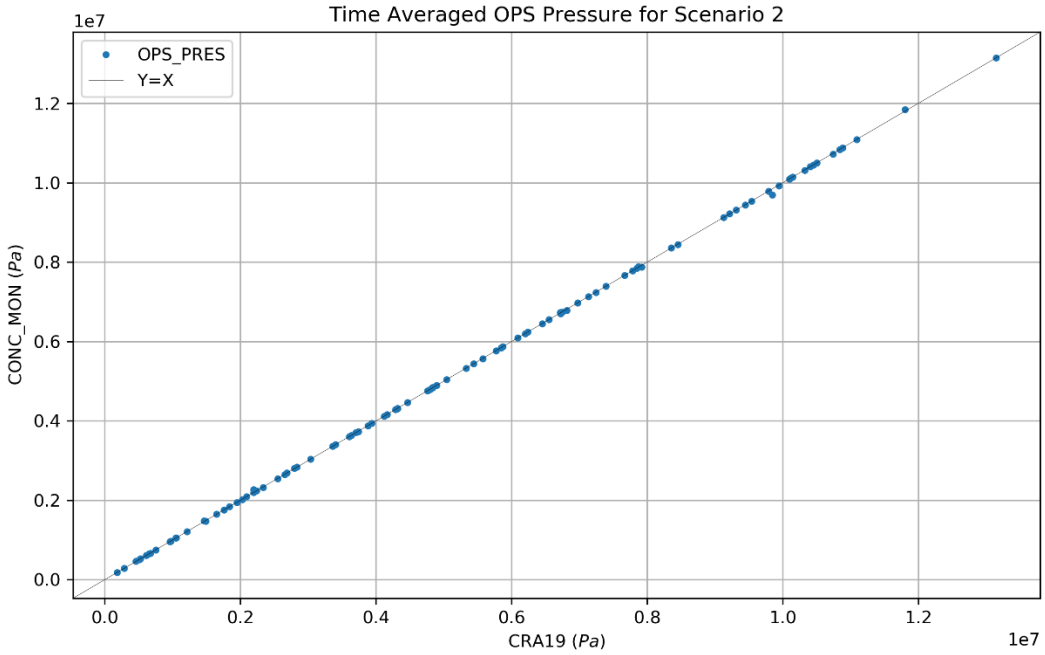

Figure 41 Time Averaged Operations Area Pressures for a scenario with an E1 intrusion (S2-BF)

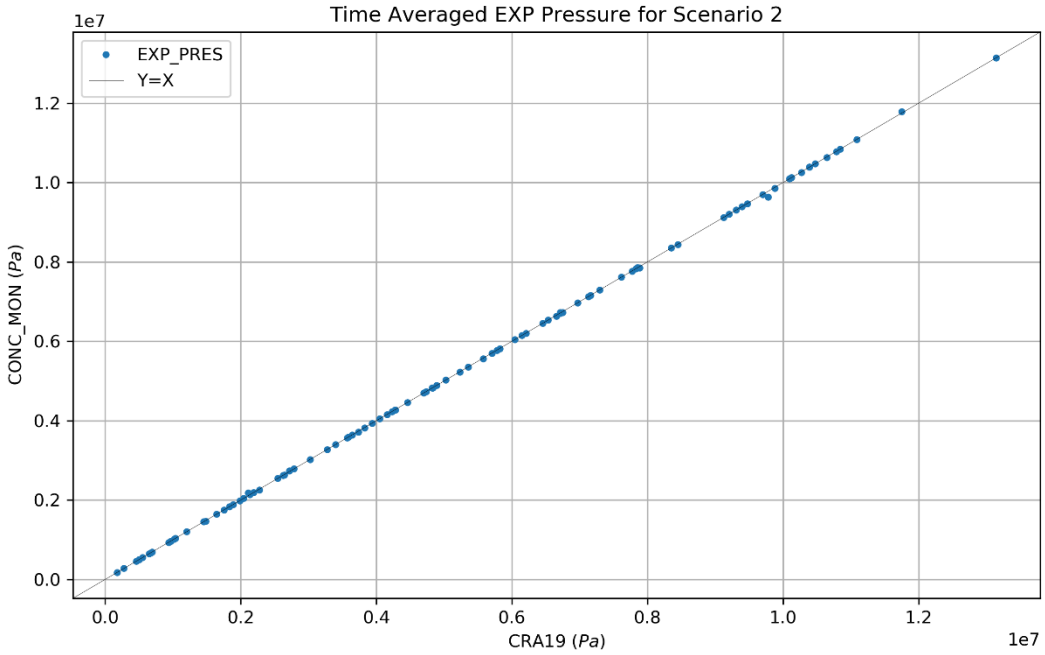

Figure 42 Time Averaged Experimental Area Pressures for a scenario with an E1 intrusion (S2-BF)

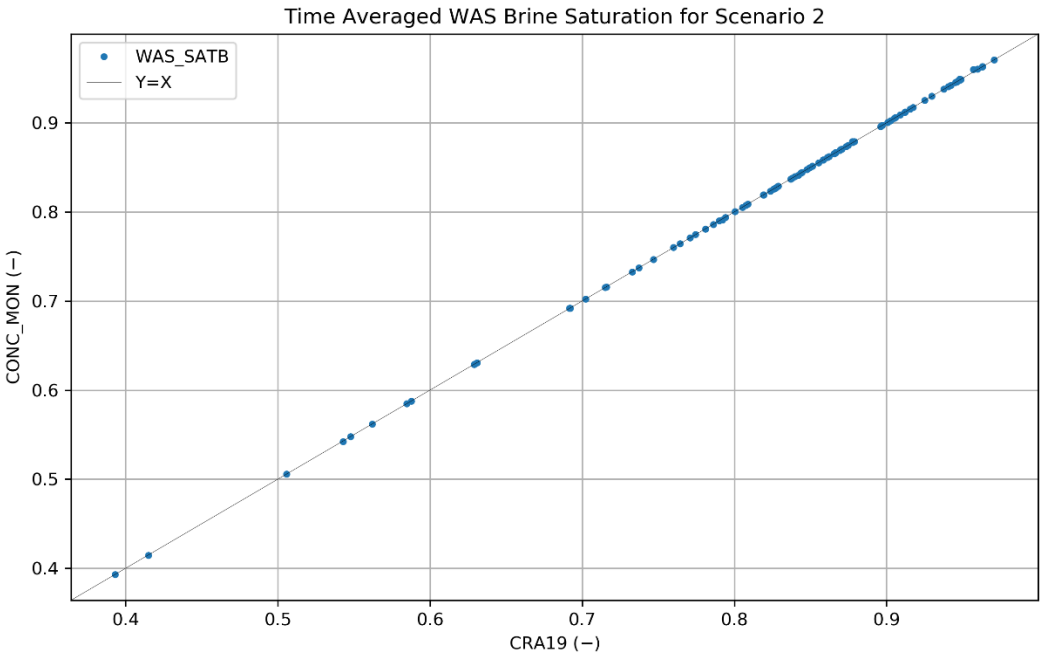

Figure 43 Time Averaged Waste Panel Brine Saturations for a scenario with an E1 intrusion (S2-BF)

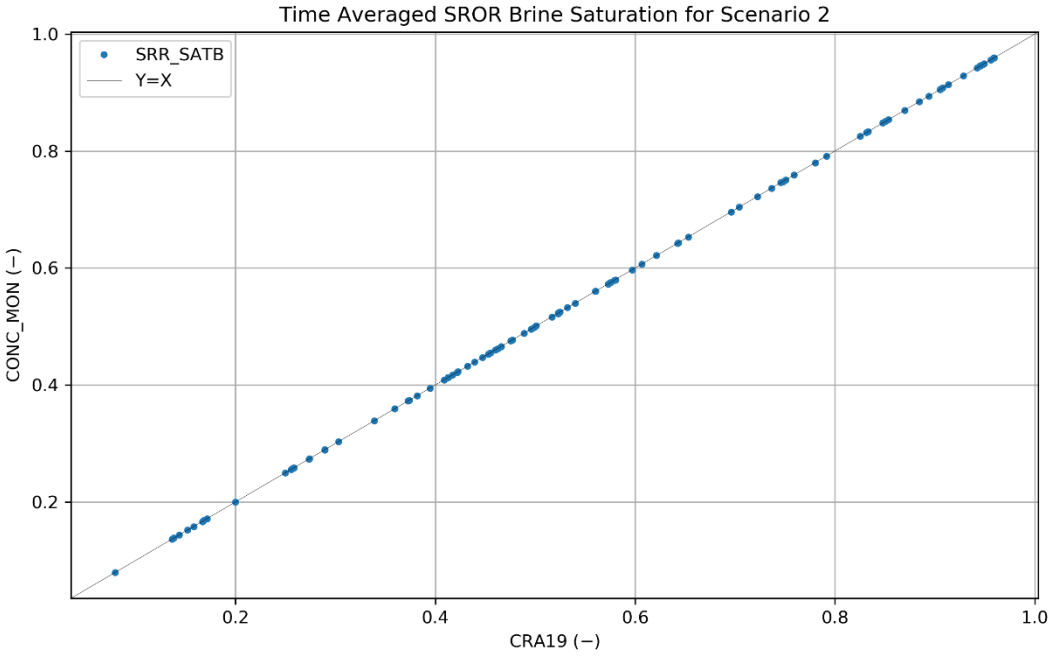

Figure 44 Time Averaged South Rest-of-Repository Brine Saturations for a scenario with an E1 intrusion (S2-BF)

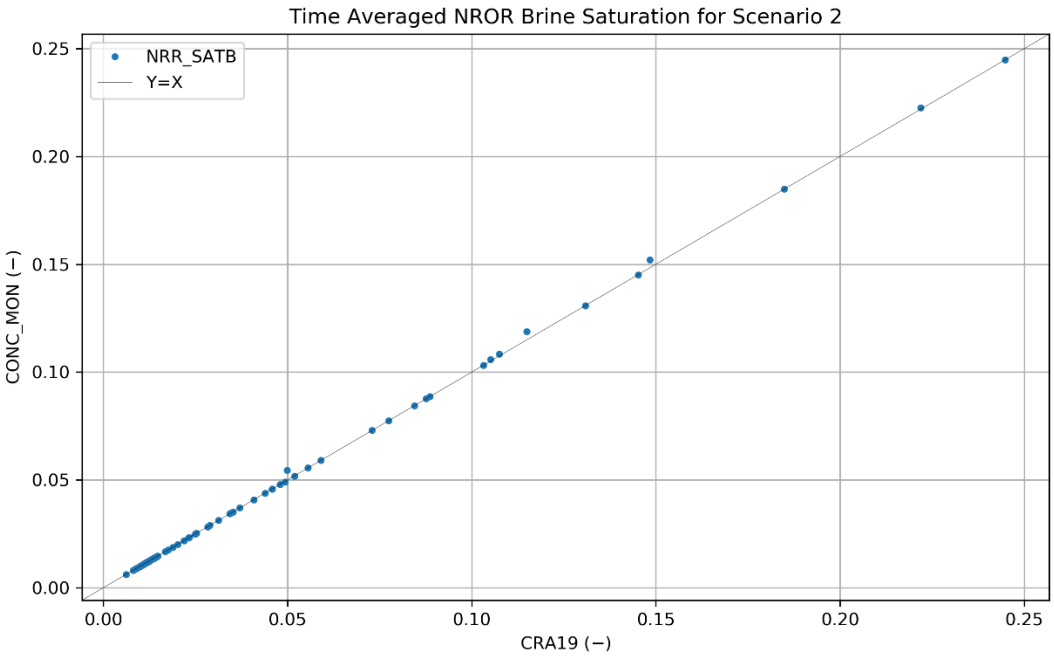

Figure 45 Time Averaged North Rest-of-Repository Brine Saturations for a scenario with an E1 intrusion (S2-BF)

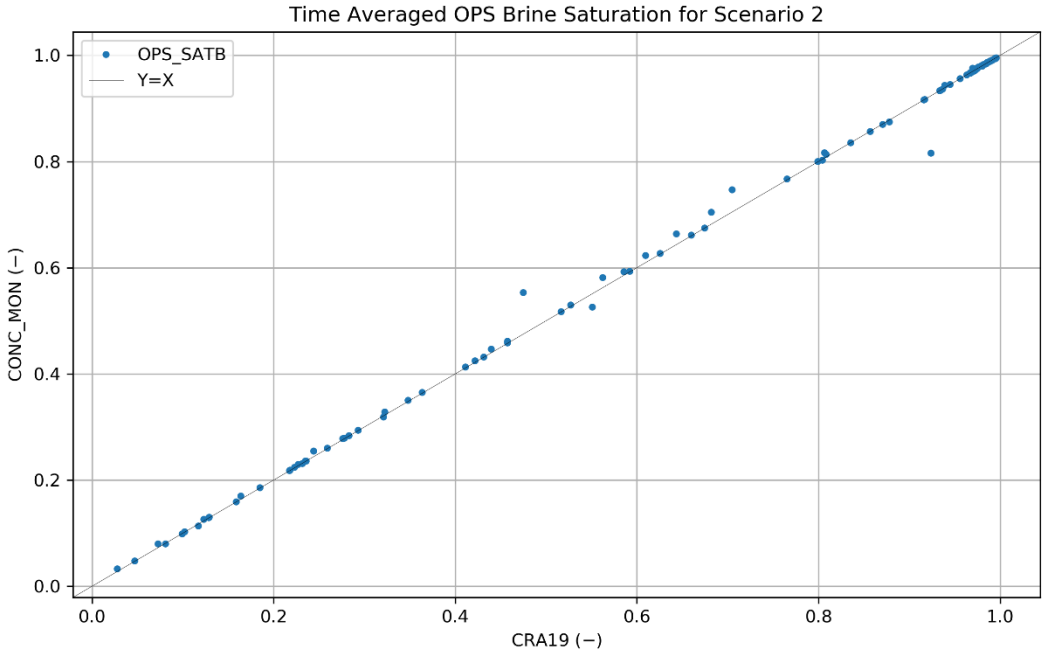

Figure 46 Time Averaged Operations Area Brine Saturations for a scenario with an E1 intrusion (S2-BF)

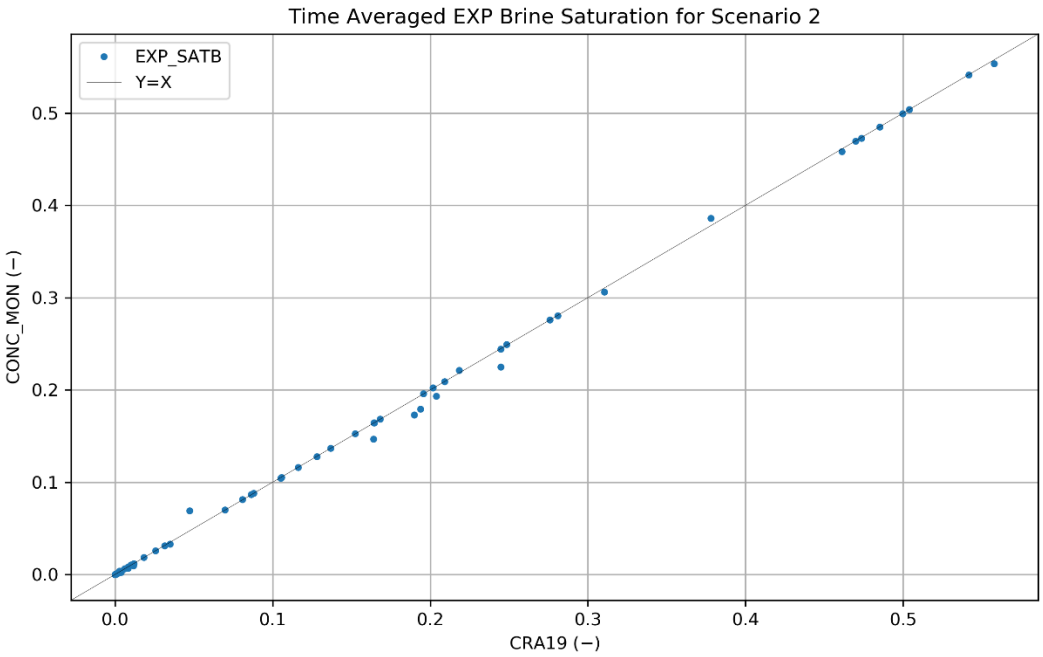

Figure 47 Time Averaged Experimental Area Brine Saturations for a scenario with an E1 intrusion (S2-BF)

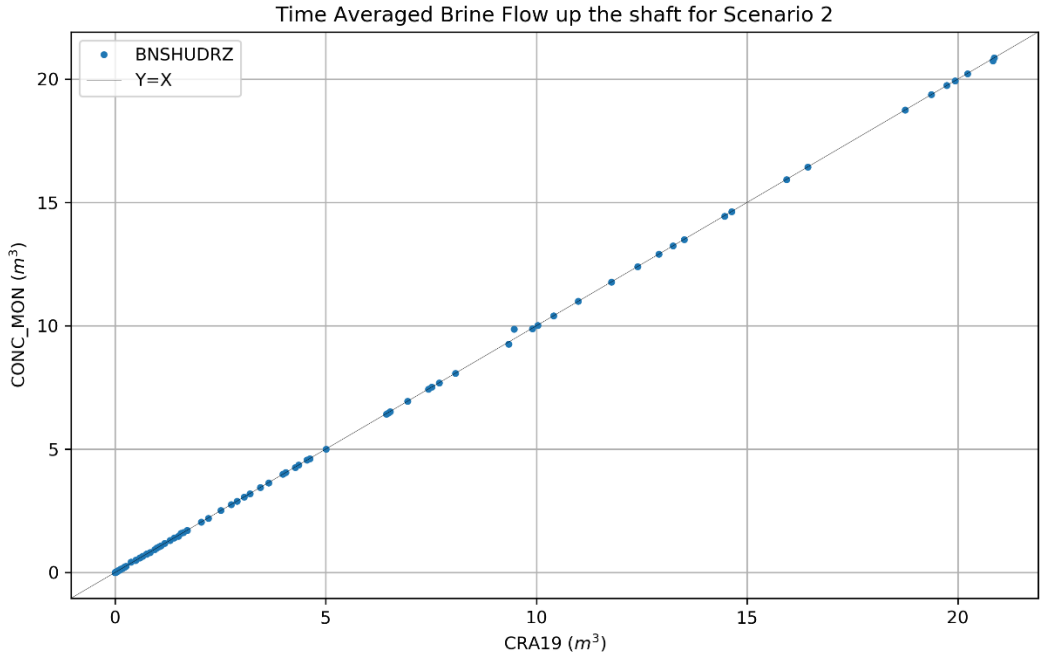

Figure 48 Time Averaged Brine Flow (m_3) up the shaft for a scenario with an E1 intrusion (S2-BF)

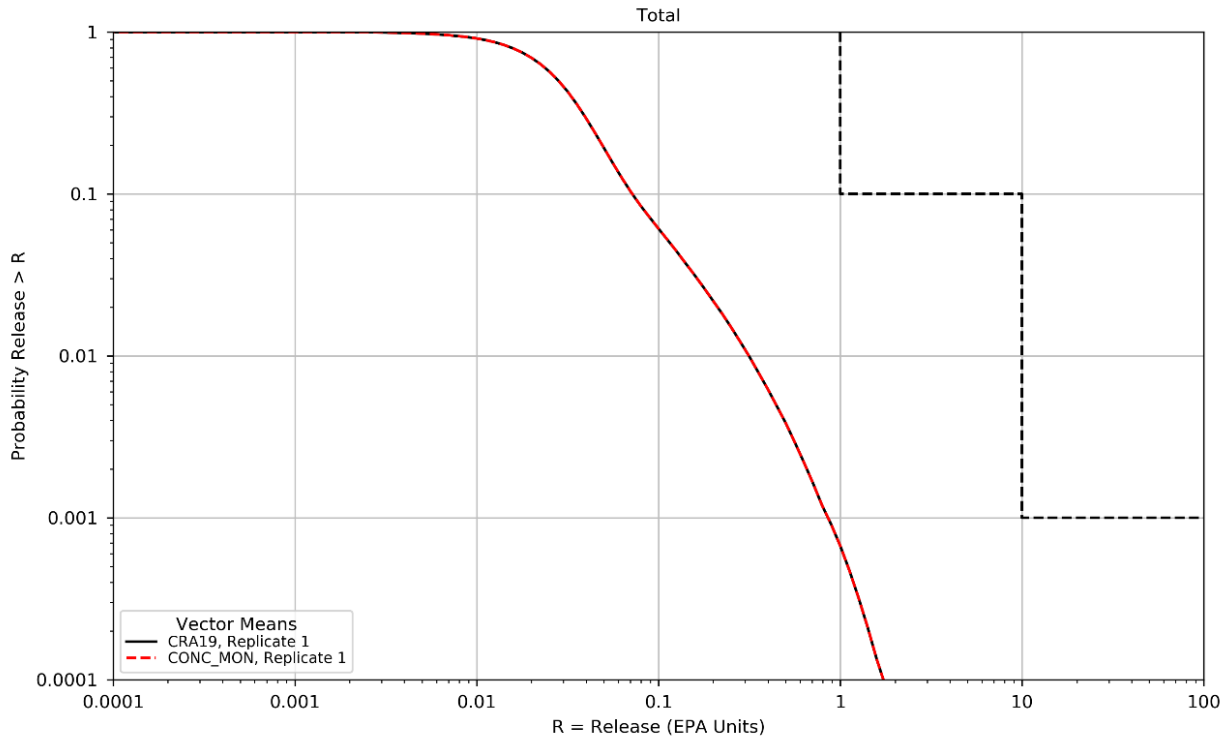

Figure 49 Mean Total Release CCDF curve

The results of the CONC_MON analysis are nearly identical to the results from CRA-2019 in all the primary outputs that drive releases (waste area pressures and saturations and brine flows up the shaft). There are slight differences in pressures and saturation in the operations and experimental areas, but these areas values do not directly drive later PA release calculations, so these differences are not considered impactful. The slight deviations in time-averaged results show no overall trend pushing the results one direction or another. These deviations being both positive and negative show that including an extended shaft does not alter any major flow paths.

Figure 47 shows the mean Complementary Cumulative Distribution Function (CCDF) curves for Total releases for replicate 1 of the CONC_MON and CRA19 analyses. There is no difference in the CCDF curves caused by the extension of the shaft. These results show that the PA results are not sensitive to the shaft extending through MB-139 into the lower intact Salado. This lack of sensitivity to extending shaft supports the concept of maintaining MB-139 above an intact Salado as representative of the 3-D flow pathways.

Reference

Day, B. 2019. Analysis Package for Salado Flow in the 2019 Compliance Recertification Application Performance Assessment (CRA-2019 PA). Sandia National Laboratories, Carlsbad, NM. ERMS 571368.

EPA Evaluation of Response

The DOE response was satisfactory. The response was thorough and adequately demonstrated that modeling the shaft as extending only to the top of MB-139 has a negligible impact on the results of the CRA19 PA.

Source Citation for DOE Completeness Question Response Package

DOE RP2 (U.S. Department of Energy) 2020. *Response 2 to U.S. Environmental Protection Agency's 2019 Compliance Recertification Application Completeness Comments Letter dated March 23, 2020 from Tom Peake to Mike Brown.* Letter from Gregory Sosson (DOE) to Lee Veal (EPA). CBFO:OEP:MRB:MC:20-0248:UFC 5486.00. Carlsbad, New Mexico. July 9, 2020. (Second Response Package). EPA-HQ-OAR-2019-0534-0013

Appendix B Correspondence

EPA/DOE and NMED Correspondence Regarding Modeling, Completeness, Disclosure, and Transparency of the New Shaft and Connecting Drifts

List of Correspondence

- EPA letter of January 22, 2018 acknowledging receipt of DOE New Shaft PCN and planned update
- EPA letter of May 4, 2020 transmitting questions and comments regarding DOE New Shaft PCN and update
- DOE letter of August 10, 2020 responding to EPA questions and comments regarding DOE New Shaft PCN and update
- EPA letter of September 28, 2020 transmitting the Agency's conclusion that the new shaft will not result in non-compliance with the terms of the certification and does not object to the shaft construction
- NMED Approval Letter of October 27, 2021 approving the Class 3 Modification Request for the excavation of a new shaft and associated connecting drifts

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JAN 22 2018

OFFICE OF
AIR AND RADIATION

Mr. Todd Shrader
Manager, Carlsbad Field Office
U.S. Department of Energy
P.O. Box 3090
Carlsbad, New Mexico 88221-3090

Dear Mr. Shrader:

I am writing to acknowledge receipt of your September 29, 2017 "Planned Change Notice Regarding the Excavation and Construction of a New Ventilation Shaft and Associated Access Drifts at the Waste Isolation Pilot Plant (WIPP)" and two associated documents: the "Impact Assessment of an Additional WIPP Shaft", Sandia National Laboratory, dated November 17, 2014 and the "New Shaft Conceptual Drawings" (undated). Thank you for providing this information.

Your letter describes the need for the new shaft and its benefit as part of the upgrade to the underground ventilation system. It also provides additional discussion relating to your view that the WIPP will continue to meet the regulatory requirements for long-term isolation of transuranic waste. Historical analyses (e.g., the original compliance certification application) have identified that the shafts are not pathways for releases, but the Impact Assessment enclosed with your letter is dated 2014 and does not address the data and analysis issues identified in EPA's 2017 recertification Federal Register Notice (82 FR 33106).

I understand that the DOE plans to conduct a more up-to-date analysis as part of the 2019 recertification process. The EPA will look forward to fully evaluating this planned change as part of its review of the DOE 2019 WIPP recertification application.

Please feel free to contact me at (202) 343-9448 or have your staff contact Kathleen Economy at (202) 343-9844 or economy.kathleen@epa.gov if you have any questions.

Sincerely,

Lee Ann B. Veal

Lee Ann B. Veal
Director
Radiation Protection Division

UNIQUE #	DOE UFC	DATE REC'VD	ADDRESSEES
1800176	$486.00	JAN 26 2018	T. Shrader S. Basabilvazo R. Patterson A. Ward

cc: Electronic Distribution
George Basabilvazo, DOE/CBFO
Russ Patterson, DOE/CBFO
Andrew Ward, DOE/CBFO
Betsy Forinash, DOE/HQ
Alton Harris, DOE/HQ
Ricardo Maestas, NMED
Nick Stone, EPA Region 6
EPA WIPP Team
EPA WIPP Docket

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OFFICE OF
AIR AND
RADIATION

May 4, 2020

Mr. Greg Sosson
Acting Manager
Carlsbad Field Office
U.S. Department of Energy
P.O. Box 3090
Carlsbad, New Mexico 88221-3090

Dear Mr. Sosson:

The U.S. Environmental Protection Agency (EPA) has been reviewing the September 29, 2017 Planned Change Notice for the excavation and construction of a new ventilation shaft (shaft #5) at the Waste Isolation Pilot Plant (WIPP), along with the updated information in the 2019 WIPP Compliance Recertification Application (CRA-2019) and the associated deferred performance assessment (DPA). In the Agency's initial response letter dated January 22, 2018 (L. Veal letter to T. Shrader), the EPA indicated that staff would evaluate the planned change in the wider context of the CRA-2019 review, which began in full in January 2020 upon receipt of the DPA.

The EPA recognizes the need for an additional shaft as part of the new Safety Significant Confinement Ventilation System for multiple purposes, including increasing air flow capacity for underground operations. Focusing primarily on the long-term performance of the repository, EPA staff have reviewed the relevant documentation provided in the DPA and other sources, including the original notice and the SHFT-14 analysis that used the CRA-2014 Performance Assessment modeling with the shaft #5 added. We have several outstanding questions and comments which are summarized below. These have been categorized as issues relating to representation of the shaft in the PA modeling, completeness, disclosure and transparency.

Identified issue with PA modeling:

- The representation of the concrete monolith filling the composite shaft in the two-dimensional BRAGFLO model does not extend below the repository level. This representation is inconsistent with the actual design of the largest shafts, which have sumps extending more than 125 feet below the repository level. This issue was identified in the first round of EPA comments for CRA-2019, sent to the U.S. Department of Energy (DOE) on March 20, 2020. See question CC1-34-8: BRAGFLO representation of the plugged shaft in the PA model.

Completeness of information related to implications of larger shaft:

- The planned shaft will be significantly larger than current shafts. What analysis was done that considered the larger dimensions on post-closure performance? How would the increased shaft diameter affect the installation of the closure seals in comparison to the smaller diameter shafts? What will DOE do to ensure that the vertical permeability of the large sealed shaft will be as effective in limiting radionuclide transport as with the smaller shafts?

Transparency/disclosure items:

- Documentation provided to the EPA indicates that the newly excavated shaft will be used solely as an air intake shaft, but only hints at possible future uses for other purposes, such as a hoist system. The large diameter of the planned shaft also suggests this as does other information we are aware of, such as the August 15th, 2019 Class 3 Permit Modification request to the New Mexico Environment Department (NMED) that states the new shaft is capable of supporting future uses such as a hoist for personnel, materials and salt. The DOE FY2019 Congressional Budget Justification stated that the shaft is expected to be utilized for airflow, salt hoists, waste emplacement, material handling, transporting personnel and emergency egress. Please describe, to the fullest extent possible, the full range of expected uses for the shaft.

- The new shaft is located to the west of the existing repository. Please provide the rationale and context that led to the selection of this location. Specifically, what long-term performance issues were considered? How were these issues weighed against other considerations, such as physical proximity to the anticipated new waste panels?

- Lastly, the EPA requests a current timeline for the excavation and construction of the shaft and associated drifts and facilities.

If you have any questions concerning these questions, please contact Tom Peake at peake.tom@epa.gov (202-343-9765).

Sincerely,

LEE ANN VEAL Digitally signed by LEE ANN VEAL
Date: 2020.05.04 14:19:30 -04'00'

Lee Ann B. Veal
Director
Radiation Protection Division

cc: Electronic Distribution
Kirk Lachman, DOE/CBFO
Mike Brown, DOE/CBFO
Russ Patterson, DOE/CBFO
Justin Marble, DOE/EM
Alton Harris, DOE/EM
Kevin Pierard, NMED
Ricardo Maestas, NMED
David Garcia, EPA Region VI
Ronnie Crossland, EPA Region VI
Tom Peake, EPA HQ
Ray Lee, EPA HQ
Jonathan Major, EPA HQ
Joseph Rustick, EPA HQ

Department of Energy
Carlsbad Field Office
P. O. Box 3090
Carlsbad, New Mexico 88221

AUG 10 2020

Ms. Lee Ann B. Veal, Director
Radiation Protection Division
U.S. Environmental Protection Agency
William Jefferson Clinton Building, West
1301 Constitution Ave. NW, Mail Code 6608T
Washington, DC 20004

Subject: Response to the Referenced Correspondence

Reference: Environmental Protection Agency Correspondence from Lee Veal, Director, Radiation Protection Division to Greg Sosson, Acting Manager, Carlsbad Field Office, dated May 4, 2020, Subject: Shaft PCN-CRA

Dear Ms. Veal:

Enclosed please find the response to the items in the above-referenced correspondence.

If you have any questions, please contact Mr. Michael R. Brown at (575) 706-0072.

Sincerely,

Reinhard Knerr
Manager
Carlsbad Field Office

Enclosures (3)

cc: w/enclosures
R. Crossland, EPA *ED
D. Gray, EPA ED
R. Lee, EPA ED
T. Peake, EPA ED
I. Rosencrantz, EPA ED
H. Shah, EPA ED
*ED denotes electronic distribution

CBFO:OEP:MRB:MC:20-0258:UFC 5486.00

Enclosure 1

Response to EPA Questions – S#5

Question 1:

- *The representation of the concrete monolith filling the composite shaft in the two-dimensional BRAGFLO model does not extend below the repository level. This representation is inconsistent with the actual design of the largest shafts, which have sumps extending more than 125 feet below the repository level. This issue was identified in the first round of EPA comments for CRA-2019, sent to the U.S. Department of Energy (DOE) on March 20, 2020. See question CC1-34-8: BRAGFLO representation of the plugged shaft in the PA model.*

Answer 1:

Reference: DOE response to EPA Question CC1-34-8: BRAGFLO representation of the plugged shaft in the PA model.

Question 2:

- *The planned shaft will be significantly larger than current shafts. What analysis was done that considered the larger dimensions on post-closure performance? How would the increased shaft diameter affect the installation of the closure seals in comparison to the smaller diameter shafts? What will DOE do to ensure that the vertical permeability of the large sealed shaft will be as effective in limiting radionuclide transport as with the smaller shafts?*

Answer 2:

For the post-closure performance aspect of this question, please see DOE response to question CC1-34-8: BRAGFLO representation of the plugged shaft in the PA model.

In relation to shaft seals, the DOE will treat Shaft #5 based on the same principles used for the other shafts at the time of closure:

> *It is recognized that actual placement of shaft seals is many years in the future, so design, planned construction method, and components will almost certainly change between now and the time that detailed construction specifications are prepared for the bidding process. Specifications provided here are likely to guide future work between now and the time of construction…* (CCA, Appendix SEAL-A, DOE, 1996).

Question 3:

- *Documentation provided to the EPA indicates that the newly excavated shaft will be used solely as an air intake shaft, but only hints at possible future uses for other purposes, such as a hoist system. The large diameter of the planned shaft also suggests this as does other information we are aware of, such as the August 15th, 2019 Class 3 Permit Modification request to the New Mexico Environment Department (NMED) that states the new shaft is capable of supporting future uses such as a hoist for personnel, materials, and salt. The DOE FY2019 Congressional Budget Justification stated that the shaft is expected to be utilized for airflow, salt hoists, waste emplacement, material handling, transporting personnel and emergency egress. Please describe, to the fullest extent possible, the full range of expected uses for the shaft.*

Answer 3:

The planned uses for S#5 described in the Class 3 Permit Modification Request (PMR) have not changed. The planned usage for the new shaft (S#5) is described in the PMR Overview and Item 1 as follows:

> *The S#5 design allows for increased ventilation airflow into the underground and an unfiltered exhaust path through the existing Air Intake Shaft for the Construction Circuit airflow. This design allows for concurrent mining (unfiltered ventilation), maintenance (either unfiltered or filtered ventilation, depending on location), and waste emplacement operations (filtered ventilation) to take place. This design also allows the salt particulate that is generated in the Construction Circuit (generated by mining) to be exhausted through an unfiltered exhaust path while the particulate that is generated in the North, Disposal, and Waste Shaft Station Circuits (generated by travel and maintenance operations) is exhausted through the Salt Reduction Building, then routed through the filters. This design will not only reduce the particulate build-up on the filters, it will reduce the amount of particulate from the Salt Reduction Building that must be disposed of.*
>
> *The Permanent Ventilations System restores the WIPP underground to its pre-2014 condition by providing significantly increased ventilation flow, unfiltered exhaust for the construction activities, and filtered exhaust for the disposal circuit.* (Overview p. 1)
>
> *Shaft #5 will be the primary source of intake air for the underground facility. The intake air from S#5 will be used to ventilate the North, Construction, and Disposal Circuits. The ventilation circuits are described in Permit Attachment A2, Section A-2a (3), Underground Facilities Ventilation System. The Salt Handling Shaft will downcast and will supplement the intake air from S#5 that is used to ventilate the north area of the underground. The Waste Shaft will continue to provide the intake air for the Waste Shaft Station Circuit.* (PMR Item 1, Page 7)

Underground ventilation is ubiquitous in that it affects the entire underground facility regardless of facility configuration. Therefore, the ventilation uses for S#5, as described in the PMR, will apply to both current and future facility configurations.

As described in the PMR air intake shaft, S#5, can support current needs and future uses (e.g., hoisting men, materials, and salt for the construction of additional disposal panels). DOE is evaluating the use of hoisting capabilities for S#5 for hoisting men, materials and salt. Adding hoisting capability is not expected to have any impact on repository performance.

Question 4:

- *The new shaft is located to the west of the existing repository. Please provide the rationale and context that led to the selection of this location. Specifically, what long-term performance issues were considered? How were these issues weighed against other considerations, such as physical proximity to the anticipated new waste panels?*

Answer 4:

Locations to the north, south, east, and west of the existing WIPP underground repository were originally analyzed to determine the location of the new shaft. General criteria for the shaft location included the following:

- Geologic, and hydrologic considerations,

- Physical plant configurations,
- Underground safety considerations, and
- Stability considerations around the new shaft.

It was determined that a shaft located to the west of the existing facility provides the fewest engineering challenges along with lower expected construction and long-term operational costs. A borehole confirmed the geological/hydrological adequacy of the location.

In addition, an Impact Assessment (Camphouse 2014) was run for an Additional WIPP Shaft in which the repository representation was modified to include the additional shaft and drifts. It was concluded that the WIPP repository continues to satisfy regulatory compliance limits with the addition of the new shaft and associated drifts. The design for new Panels is being developed. Once complete it will be evaluated for long term performance impacts.

Question 5:

- *Lastly, the EPA requests a current timeline for the excavation and construction of the shaft and associated drifts and facilities.*

Answer 5:

The construction of S#5 will be performed in stages with the respective approximate durations as shown in Table 1, Shaft Sinking Activities. The pre-sinking stage has begun. The connection to the existing repository will not be made until approximately 37 months after the start of shaft pre-sinking activities.

Table 1: Shaft Sinking Activities

Activity	Description	Approximate Duration (months)
Pre-sinking (0'-100')*	This includes surface preparation and installation of the Galloway shaft-sinking platform.	7
Shaft Excavation (100'-2,125')	Sink S#5 to 2,125' depth (depth of shaft station)	13
Underground Station Development	This includes mining cut-outs for electrical equipment and vehicle turnarounds.	2
Shaft Excavation (2,125' to 2,275')	Complete Shaft Sinking from 2,125' to 2,275'	2
Drift Mining	This includes excavating the two connecting drifts from S#5 to the existing repository.	8
Cold Testing	Testing of components such as fans and electrical gear prior to incorporation into the UVS.	5
Connection to Existing Repository	Ventilation isolation bulkheads will be installed between the new drifts and the existing repository prior to the connection so that there will be minimal impact on operations when the connection is made. The connection to the existing repository will be performed in accordance with a commissioning and start-up plan, which will be finalized in the future. This includes hot testing.	3

*Mobilization for sinking activities were started on April 27, 2020



Figure 1: Approximate Timeline for Shaft #5 Activities

References

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

Camphouse, R. 2014. Impact Assessment of an Additional WIPP Shaft. Carlsbad, NM: Sandia National Laboratories. ERMS 562973.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OFFICE OF AIR AND RADIATION

September 28, 2020

Mr. Reinhard Knerr
Manager
Carlsbad Field Office
U.S. Department of Energy
P.O. Box 3090
Carlsbad, New Mexico 88221-3090

Dear Mr. Knerr:

The U.S. Environmental Protection Agency has reviewed the planned change for the excavation and construction of a fifth shaft at the Waste Isolation Pilot Plant (WIPP) articulated in the U.S. Department of Energy's (DOE) Planned Change Notice (PCN) dated September 29, 2017. EPA staff have reviewed the PCN, DOE's August 10, 2020 response to the EPA's correspondence of May 4, and applicable sections from the 2019 WIPP Compliance Recertification Application (CRA) and finds that the new shaft is not expected to impact long-term releases of radionuclides. EPA's review concludes that the new shaft will not result in non-compliance with the terms of the certification. The EPA does not object to the shaft construction.

The EPA appreciates the advanced notice of the proposed change and the follow up information provided by DOE in these communications and as part of the CRA review. The Agency requests that DOE provide periodic updates on construction progress. We look forward to seeing the results of the concurrent shaft geologic characterization that DOE has committed to conduct.

If you have any questions concerning this letter, please contact Tom Peake at peake.tom@epa.gov (202-343-9765).

Sincerely,

LEE ANN VEAL Digitally signed by LEE ANN VEAL Date: 2020.09.28 17:02:46 -04'00'

Lee Ann B. Veal
Director, Radiation Protection Division

cc: Electronic Distribution
Mike Brown, DOE/CBFO
Russ Patterson, DOE/CBFO
Justin Marble, DOE/EM
Ricardo Maestas, NMED
Tom Peake, EPA/HQ
WIPP Team, EPA/HQ
Harry Shah, EPA/Region 6

October 27, 2021

Reinhard Knerr, Manager
Department of Energy - Carlsbad Field Office
P.O. Box 3090
Carlsbad, New Mexico 88221-3090

Sean Dunagan, President and Project Manager
Nuclear Waste Partnership, LLC
P.O. Box 2078
Carlsbad, New Mexico 88221-2078

Re: Final Determination on Class 3 Permit Modification Request and Incorporation of three Class 1 Permit Modification Notifications
Waste Isolation Pilot Plant
EPA I.D. Number NM4890139088

Dear Messrs. Knerr and Dunagan,

On October 27, 2021, the New Mexico Environment Department (NMED) Secretary signed a Final Order approving a draft Permit as a final Waste Isolation Pilot Plant Hazardous Waste Facility Permit (Permit), incorporating the following Class 3 Permit Modification Request (PMR): "*Excavation of a New Shaft and Associated Connecting Drifts*."

The Class 3 PMR, submitted August 15, 2019 by the Department of Energy and Nuclear Waste Partnership, LLC (collectively, the Permittees), was evaluated and processed in accordance with the requirements specified in 20.4.1.900 NMAC (incorporating 40 CFR §270.42.b). The current Permit as of August 2020 was the basis for the revised Permit.

In addition to the Class 3 changes, this revised Permit incorporates the following three Class 1 Permit Modification Notifications (PMNs):

- February 10, 2021 Class 1 PMN: *Revised List of Resource Conversation and Recovery Act Emergency Coordinators*
- May 19, 2021 Class 1 PMN: *Five Items*
  - *Reassign Emergency Response Team Duties to the Waste Isolation Pilot Plant (WIPP) Fire Department*
  - *Streamline and Add the Annual Inspection of the Surface Remote-Handled (RH) Transuranic (TRU) Mixed Waste Handling Area to Attachment E, Table E-1a*
  - *Revise Procedure Number in Attachment L, Table L-6*
  - *Update Property Protection Area Fence Line to Incorporate Temporary Fence Changes and Update WIPP Emergency Evacuation Figures and Text*
  - *Revise List of Resource Conservation and Recovery Act Emergency Coordinators*

- October 12, 2021 Class 1 PMN: *Four Items*
  - *Replacement of the Rescue Truck and Two Fire Trucks with Functionally Equivalent Fire/Rescue Vehicles in Permit Attachment D, Resource Conservation and Recovery Act (RCRA) Contingency Plan, and Attachment E, Inspection Schedule, Process and Forms*
  - *Updated List of Emergency Response Agreements in Permit Attachment D, RCRA Contingency Plan*
  - *Revise Permit Attachment F, Facility Personnel Permit Training Program, to Incorporate the Option of Computer and Web Based Training Examinations*
  - *Revise Permit Attachment A4, Traffic Patterns*

The New Mexico Hazardous Waste Management Regulations at 20.4.1.901.A.10 NMAC state, *"A final permit decision shall become effective thirty (30) days after the notice of the decision has been served on the applicant..."* Therefore, the effective date of the Permit shall be November 27, 2021. The Secretary's decision may be appealed under the provisions of HWMR, 20.4.1.901.H NMAC and Section 74-4-14 of the New Mexico Hazardous Waste Act.

Attached is a disc containing the revised Permit Parts and Attachments, with Class 3 changes in redline strikeout, as well as a clean final version of the Permit.

Further information on this administrative action, including the Final Order, NMED's response to comments, and the final Permit, may be found on the NMED WIPP News webpage at https://www.env.nm.gov/hazardous-waste/wipp/.

If you have any questions regarding this correspondence, please contact me at the Hazardous Waste Bureau at (505) 690-6148.

Sincerely,

Ricardo Maestas

Digitally signed by Ricardo Maestas
Date: 2021.10.28 11:19:25 -06'00'

Ricardo Maestas
Acting Chief
Hazardous Waste Bureau

cc: D. Biswell, NMED HWB
M. McLean, NMED HWB
N. Barka, NMED HWB
B. Masse, NMED DOE-OB
L. King, EPA Region 6
T. Peake, EPA ORIA
R. Chavez, RES
M. Brown, DOE-CBFO
File: WIPP '21