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SANDIA NATIONAL LABORATORIES
WASTE ISOLATION PILOT PLANT

Panel Closure System Sensitivity Study

Revision 0

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Executive Summary

The application of EPA-requested modified parameters in the panel closure areas and operations and experimental (non-waste) areas of the repository to simulate an accelerated (instantaneous) creep closure, the inclusion of capillary pressure effects on relative permeability, and an increase in initial/residual brine saturation and residual gas saturation is incorporated into a sensitivity analysis (CRA14_SEN3) and compared to the current model (CRA14) and previous sensitivity analysis focused on non-waste area changes only (CRA14_SEN2). The modifications to the repository model predominantly result in increased pressures and decreased brine saturations in waste areas, increased pressures and brine saturations in the operations and experimental areas, and decreased brine and gas flows across all panel closures. The pressure increases in repository waste regions yielded slightly decreased brine saturations (on average) in those areas. Brine flows in general are reduced and brine flows up the borehole during a hypothetical drilling intrusion are nearly identical to those found in the CRA14. Brine flows up the repository shaft are decreased as compared to CRA14 due to restricted flow within the operations and experimental areas. The modified panel closure, operations, and experimental area parameters decrease the flow of gas across the panel closures and halt the flow of gas to the repository north end. The combination of increased waste region pressure (on average) and slightly decreased brine saturations resulted in a modest increase in spallings and a small increase in (low probability) direct brine releases due to the pressure/saturation trade-off. Total from Culebra releases and cuttings and cavings releases are not affected. Overall, the effects on total high-probability ($P(R) > 0.1$) mean releases from the repository are entirely insignificant, with total low-probability ($P(R) > 0.001$) mean releases increased by about 15% and the associated 95% confidence level on the mean nearly unchanged. It is concluded that the modeling assumptions associated with the panel closures and north end areas of the repository have only a small effect on the prediction of total releases from the repository and/or adequacy of the current (CRA14) model to demonstrate compliance with the regulatory limits.

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1 Introduction

The Waste Isolation Pilot Plant (WIPP), located in southeastern New Mexico, has been developed by the U.S. Department of Energy (DOE) for the geologic (deep underground) disposal of transuranic (TRU) waste. Containment of TRU waste at the WIPP is regulated by the U.S. Environmental Protection Agency (EPA) according to the regulations set forth in Title 40 of the Code of Federal Regulations (CFR), Part 191. The DOE demonstrates compliance with the containment requirements according to the Certification Criteria in Title 40 CFR Part 194 by means of performance assessment (PA) calculations performed by Sandia National Laboratories (SNL). WIPP PA calculations estimate the probability and consequence of potential radionuclide releases from the repository to the accessible environment for a regulatory period of 10,000 years after facility closure. The models used in PA are maintained and updated with new information as part of an ongoing process. Improved information regarding important WIPP features, events, and processes typically results in refinements and modifications to PA models and the parameters used in them. Planned changes to the repository and/or the components therein also result in updates to WIPP PA models. WIPP PA models are used to support the repository recertification process that occurs at five-year intervals following the receipt of the first waste shipment at the site in 1999.

A sensitivity evaluation of the CRA-2014 PA (CRA14) to modified parameters and modeling assumptions for the panel closure system (PCS) and operations and experimental (OPS/EXP) areas of the repository has been requested by the U.S. Environmental Protection Agency for specific parameter values (Zeitler 2016). The objective of the sensitivity analysis was to evaluate the effect on pressures and saturations of gas/brine in waste and non-waste areas of the repository under the conditions where the panel closures and the operations and experimental areas undergo rapid closure and quickly reach material properties that are similar to intact halite. An understanding of the types and quantities of flow subject to the near-halite material properties and the modeling of two-phase flow with active capillary pressure effects on relative permeability was desired. Particularly, flows through the PCS and associated disturbed rock zone (DRZ) areas of the repository were of interest.

A prior sensitivity study (“CRA14_SEN2”) was completed (Day 2016), in which the effects on pressures and saturations of gas/brine in waste and non-waste areas of the repository were investigated under the conditions that the operations and experimental areas creep closed in short time duration to properties that are similar to intact Halite. The parameters for the north-end areas (including the OPS/EXP areas, as well as associated DRZ areas) that were evaluated in that sensitivity study were also implemented in the current study (“CRA14_SEN3”). The difference between the CRA14_SEN2 and CRA14_SEN3 sensitivity studies is that the CRA14_SEN3 study includes changes to the panel closure (and associated DRZ) parameters, plus one small change to the BRAGFLO grid (discussed below).

Modified PCS, OPS/EXP, and associated DRZ parameters implemented herein were used to satisfy an official request by the EPA for this sensitivity study. As such, the parameter values modified for this analysis should not be interpreted as being developed by Sandia National Laboratories. The CRA14_SEN3 sensitivity analysis was performed under AP-164, Analysis

Plan for the 2014 WIPP Compliance Recertification Application Performance Assessment (Camphouse 2013).

2 Approach

In the Compliance Certification Application (CCA), so-called "Option D" panel closures, which consisted of a concrete block explosion wall and concrete plug, were considered (DOE 1996). Option D panel closures were modeled in subsequent Compliance Recertification Applications (CRAs) through the current baseline established by a Performance Assessment Baseline Calculation (PABC-2009) (DOE 2009). As part of a planned change request (PCR) submitted to the EPA in 2011 (DOE 2011), the PCS-2012 PA was performed that investigated the impact of using run-of-mine (ROM) salt panel closures instead of Option D panel closures (Camphouse 2012). The CRA14_SEN3 sensitivity study also assumes that the panel closures will be made of ROM salt, but investigates new parameters for the panel closure areas and associated DRZ.

2.1 Modified BRAGFLO Material Map

The code BRAGFLO is the WIPP PA code used to model brine and gas flow in and around the repository. The current (CRA14) numerical grid and material map used to represent the WIPP in BRAGFLO are shown in Figure 2-1. As seen in that figure, the current disturbed rock zone (DRZ) above and below the operations and experimental (OPS/EXP) areas is modeled as the same material representing the DRZ above and below the waste areas. The EPA-requested parameter changes for DRZ properties above and below the OPS/EXP areas and the PCS require a change to the BRAGFLO material map in order to implement the requested parameter changes specific to those areas. The BRAGFLO grid and material map that incorporates the requested OPS/EXP area and PCS property changes is shown in Figure 2-2. The modified grid separates the material in the DRZ, located above and below the OPS/EXP area and the PCS, so that they may be treated separately from the DRZ above and below the waste areas of the repository. This modification to the grid is an extension of that made for the CRA14_SEN2 sensitivity study (Day 2016). The new material regions for the DRZ above and below the OPS/EXP and PCS areas as well as the pre-existing material regions for the PCS and OPS/EXP areas, themselves, are thus available for application of the requested parameter modifications.

2.2 Modified Length of Northern Panel Closure

The proposed repository panel closures are modeled in BRAGFLO as three separate panel closure areas. The "northernmost" panel closure area separates the operations area from the "north rest of repository" (NROR) waste area, the "middle" panel closure separates the NROR from the "south rest of repository" (SROR), and the "southernmost" panel closure separates the SROR from the waste panel. The CRA14_SEN3 sensitivity study request (Zeitler 2016) notes that the northernmost panel closure in the BRAGFLO grid should represent the length of two panel closures, 60.96 m. The CRA14 PA used a length of 30.48 m for the northernmost panel closure. The correction to the BRAGFLO grid has been made here and is denoted by the change in grid cell *x*-dimensions for columns 38 and 39 in Figure 2-2. As part of the EPA completeness determination for CRA-2014, the issue of the length of the northernmost panel closure was broached by the EPA (EPA 2015). A PA calculation was done to examine the impact of doubling the length of the northernmost panel closure and negligible changes to the pressures and saturations in the waste areas were found (Zeitler 2015, DOE 2015).

2.3 Baseline PA Analyses and BRAGFLO Scenarios

The application of the requested modified parameters to the repository model used in WIPP PA has the potential of altering calculated brine and gas flow behaviors. The PA code BRAGFLO is used to ascertain changes to repository performance due to the modified parameters. BRAGFLO provides flow results for the undisturbed repository as well as several disturbance scenarios used to represent inadvertent human intrusion after facility closure. The scenarios include one undisturbed scenario (S1-BF), four scenarios that include a single inadvertent future drilling intrusion into the repository during the 10,000 year regulatory period (S2-BF to S5-BF), and one scenario investigating the effect of two intrusions into a single waste panel (S6-BF). Two types of intrusions, denoted as E1 and E2, are considered. An E1 intrusion assumes the borehole passes through a waste-filled panel and into a region of pressurized brine that may exist under the repository in the Castile formation. An E2 intrusion assumes that the borehole passes through the repository but does not encounter pressurized brine. Scenarios S2-BF and S3-BF model the effect of an E1 intrusion occurring at 350 years and 1000 years, respectively, after the repository is closed. Scenarios S4-BF and S5-BF model the effect of an E2 intrusion at 350 and 1000 years. Scenario S6-BF models an E2 intrusion occurring at 1000 years, followed by an E1 intrusion into the same panel at 2000 years. The six scenarios modeled by BRAGFLO are summarized in Table 2-1.

The most recent PA done to demonstrate WIPP regulatory compliance is that performed for the CRA-2014 (DOE 2014). The CRA-2014 PA considered four distinct cases with detailed descriptions of the four cases considered in the CRA-2014 PA found in Camphouse (2013) and a summary of results given in Camphouse et al. (2013). The final of the four cases considered in the CRA-2014 PA, identified as CRA14-0, is referenced herein as CRA14 and utilized as the baseline analysis for comparison with the modified parameter sensitivity case called CRA14_SEN3 (in some cases, CRA14_SEN2 is also used for comparison). All three replicates evaluated under CRA14 are similarly run for CRA14_SEN3, over the six scenarios listed in Table 2-1.

2.4 Modified Parameters

Table 2-2 and Table 2-3 provide a summary of original parameters used for CRA14 and the modified parameters implemented for CRA14_SEN3 per the EPA request (Zeitler 2016).

2.4.1 Operations and Experimental Area (and Surrounding DRZ) Parameters

In the CRA14_SEN2 sensitivity study, material parameters and two-phase flow parameters were modified for the operations and experimental areas, as well as the surrounding DRZ (Day 2016). In general, the use of those modified parameters resulted in a reduced flow for brine and gas in and out of the operations and experimental areas. All parameters used for the operations and experimental areas in the CRA14_SEN2 analysis are identical to those used for the CRA14_SEN3 analysis (Table 2-2).

2.4.2 Panel Closure Area Parameters

For the CRA14_SEN3 sensitivity study, the EPA has requested the use of modified material parameters for the panel closure areas (Zeitler 2016). Although the modified parameters are constant for the entire simulation time (-5 to 10,000 years), for consistency with the other models of repository areas (i.e., the waste panels and operations and experimental areas), a separate material is used in the BRAGFLO model for the time frame -5 to 0 years.

The startup material used for the panel closure system in the -5 to 0 year time frame is a new material, CAVITY_5. For CRA14, the panel closure system was, along with the shaft area, part of CAVITY_4, but was separated from CAVITY_4 for the CRA14_SEN3 analysis. Although CRA14 used three materials (PCS_T1, PCS_T2, and PCS_T3) to describe the panel closures for the period 0 to 10,000 year time frame, the CRA14_SEN3 analysis uses only one material (PCS_T1). The parameters for POROSITY, PRMX_LOG, PRMY_LOG, PRMZ_LOG, COMP_RCK, CAP_MOD, PCT_A, PCT_EXP, SAT_IBRN, SAT_RBRN, and SAT_RGAS for CAVITY_5 differ from those for CAVITY_4 (Table 2-3). The panel closure area material (PCS_T1) in the time from 0 to 10,000 years has the same parameter values as those specified for CAVITY_5 under the CRA14_SEN3 analysis.

The modified POROSITY parameter implements a cavity porosity that is equal to the sampled value for S_HALITE. The log of intrinsic permeability in all directions (PRMX_LOG, PRMY_LOG, PRMZ_LOG) for the cavity is specified as the sampled S_HALITE value. Similarly, the rock compressibility parameter (COMP_RCK) for the cavity is set equal to the sampled S_HALITE value. As these are implemented over all times, the effect is to model the panel closure areas of the repository in a “closed” configuration with porosity, permeability, and rock compressibility set equal to the values sampled for intact Halite. The residual saturation (SAT_RBRN) is sampled via a uniform distribution of values. The residual gas saturation (SAT_RGAS) is calculated based on SAT_RBRN using the equation:

$$S_{gr} = 0.8 * (1 - S_{wr})$$

where S_{gr} and S_{wr} refer to residual gas and brine saturation, respectively. The residual brine saturation for PCS_T1 is not sampled explicitly, but is taken to be the same value as that for CAVITY_5.

2.4.3 Modified Parameters for DRZ Surrounding Panel Closures

For the disturbed rock zone surrounding the panel closure areas, parameter values are identical to those of the panel closures. The porosity, permeability, and rock compressibility parameters are also all set equal to the sampled values for S_HALITE, simulating a fully-healed disturbed rock zone for the entire simulation duration. The residual gas and brine saturations used for the panel closures are also used for the surrounding DRZ. The new materials DRZ_PC_0 and DRZ_PC_1 are introduced to represent the DRZ surrounding the panel closures over the time frames -5 to 0 years and 0 to 10,000 years, respectively, and have the same values for all material parameters.

2.4.4 Modified Two-Phase Flow Parameters for Panel Closures and Associated DRZ

In addition to the material parameter changes discussed above, modifications to parameters that control the application of the 2nd modified Brooks-Corey relative permeability model (specified by RELP_MOD = 4) are applied in the CRA14_SEN3 analysis for the panel closures and the associated disturbed rock zones. The pore size distribution parameter (PORE_DIS) remains at λ=0.7 for the panel closures, equal to the pore size distribution parameter for S_HALITE. In the 2nd modified Brooks-Corey relative permeability model, the capillary pressure is a function of the threshold capillary pressure that is determined as function of the permeability of the material (k) and the PCT_A (a) and PCT_EXP (ν) parameters using the following equation:

$$P_t = ak^{\nu}$$

To activate capillary pressure effects on relative permeability by utilizing a nonzero threshold capillary pressure in the panel closures and associated disturbed rock zones, the PCT_A and PCT_EXP parameters are specified as a = 0.56 and ν = -0.346, respectively, for CRA14_SEN3. Again, these values are equal to those utilized for the S_HALITE material. The initial brine (SAT_IBRN) saturations in the panel closures and associated disturbed rock zones are set to 0.95 for CRA14_SEN3, increasing the cavity saturations from 0 under CRA14 and slightly decreasing the disturbed rock zone saturations from 1 under CRA14. The residual brine (SAT_RBRN, S_{wr}) and residual gas (SAT_RGAS, S_{gr}) saturations for CRA14_SEN3 are modified from 0 values under CRA14. The sampled values of residual brine saturation have increased as the range has changed from [0.0-0.6] to [0.5-0.65] (mean value increased from 0.2 to 0.575). The values of residual gas saturations have increased as the range has changed from [0.0-0.4] to [0.28-0.4] (mean value increased from 0.2 to 0.34). The residual saturations S_{wr} and S_{gr} are utilized in the 2nd modified Brooks-Corey relative permeability model per the following equations for effective saturation (S_{e1}, S_{e2}), capillary pressure (P_c), relative brine permeability (k_{rw}), and relative gas permeability (k_{rg}):

$$S_{e_1} = \frac{S_w - S_{wr}}{1 - S_{wr}}$$

$$S_{e_2} = \frac{S_w - S_{wr}}{1 - S_{gr} - S_{wr}}$$

$$P_c = \begin{vmatrix} 0 & \text{if } S_w \le S_{wr} \\ \dfrac{P_t}{S_{e_2}^{1/\lambda}} & \text{if } S_g \le S_{gr} \\ \dfrac{P_t}{S_{e_2}^{1/\lambda}} & \text{otherwise} \end{vmatrix}$$

$$k_{rw} = \begin{vmatrix} 0 & \text{if } S_w \le S_{wr} \\ S_{e_1}^{(2+3\lambda)/\lambda} & \text{if } S_g \le S_{gr} \\ S_{e_1}^{(2+3\lambda)/\lambda} & \text{otherwise} \end{vmatrix}$$

$$k_{rg} = \begin{vmatrix} 1 & \text{if } S_w \le S_{wr} \\ 0 & \text{if } S_g \le S_{gr} \\ \left(1 - S_{e_2}\right)^2 \left(1 - S_{e_2}^{(2+\lambda)/\lambda}\right) & \text{otherwise} \end{vmatrix}$$

Finally, the capillary pressure is modified by the application of a CAP_MOD = 2 flag that limits the capillary pressure to a value of PC_MAX = 1E8 Pa for CRA14_SEN3. All modified parameters for CAVITY_5, PCS_T1, DRZ_PC_0, and DRZ_PC_1 that are defined in Table 2-3, as a function of the corresponding S_HALITE parameter, are established for each of the 300 vectors to correlate the sampled/calculated parameter values on a vector by vector basis.

2.4.5 Modified Post-processing Approach

Requested output variables (Zeitler 2016) require a modification to the post-processing of BRAGFLO output utilizing the ALGEBRACDB code. The new output measures obtained for CRA14_SEN3 were similarly obtained for CRA14 and CRA14_SEN2 by processing the official CRA14 and CRA14_SEN2 BRAGFLO results, respectively, with an equivalently modified ALGEBRACDB post-processing approach.

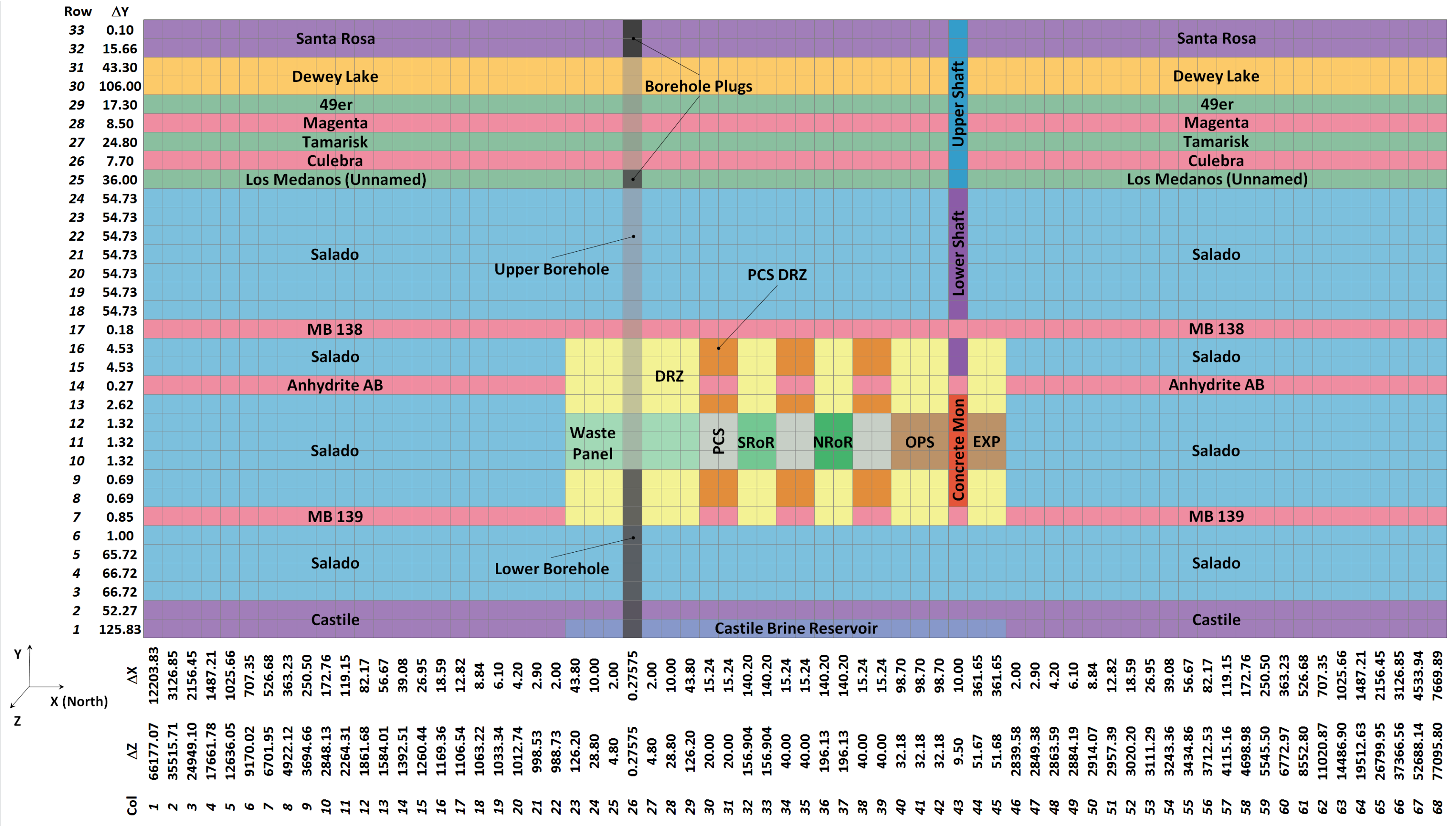

Figure 2-1: The CRA14 BRAGFLO Repository Representation

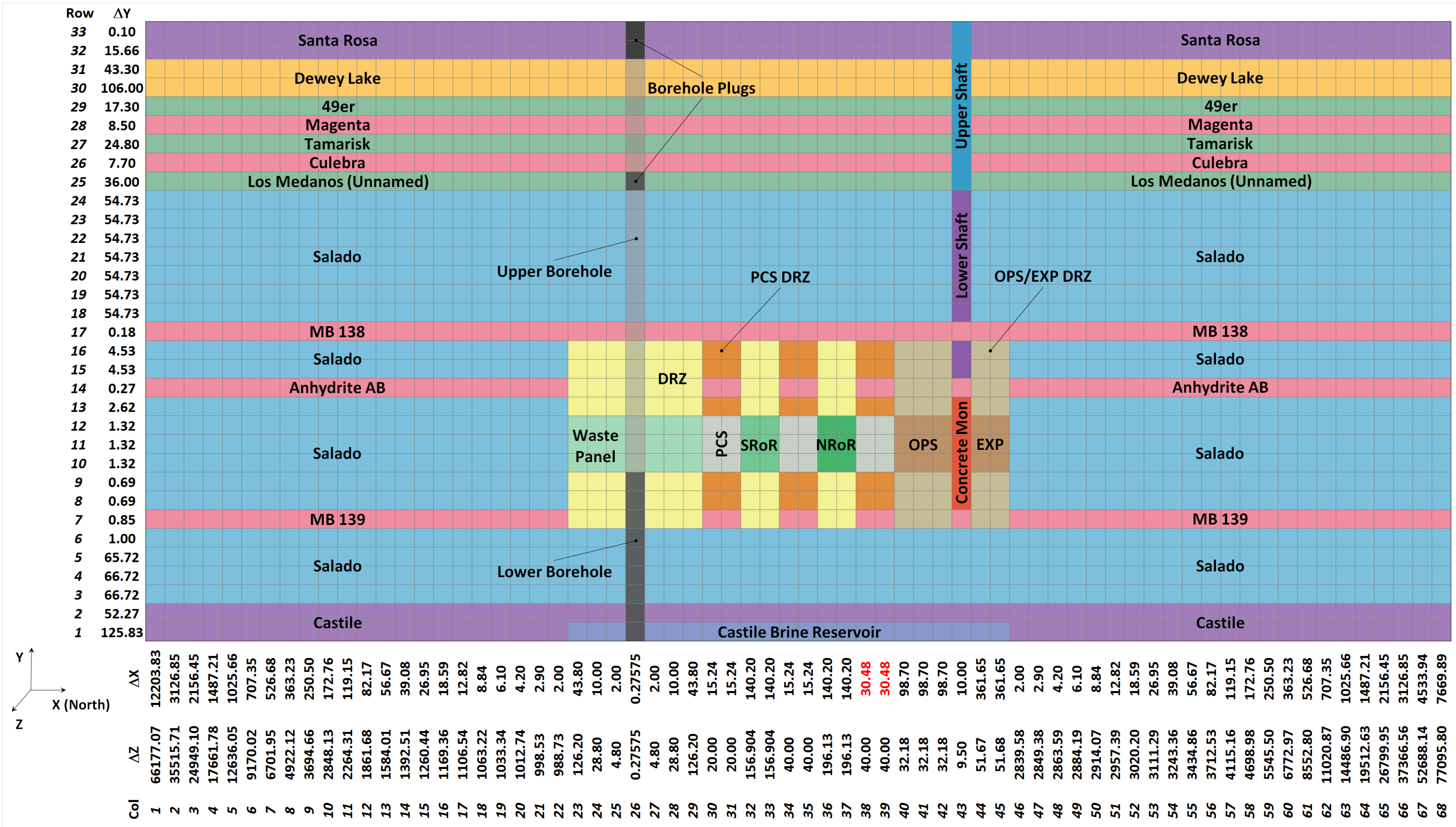

Figure 2-2: The CRA14_SEN3 BRAGFLO Repository Representation

Table 2-1: BRAGFLO 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.

Table 2-2: CRA14 and CRA14_SEN3 Modified Parameters for the Operations and Experimental Areas and Associated DRZ

Experimental and Operations Areas													
Material	**Time (yr)**	**POROSITY**	**PRMX_LOG PRMY_LOG PRMZ_LOG**	**COMP_RCK**	**PORE_DIS**	**CAP_MOD**	**PCT_A**	**PCT_EXP**	**RELP_MOD**	**SAT_IBRN**	**SAT_RBRN**	**SAT_RGAS**
CRA14 (Camphouse 2013)												
CAVITY_3	-5 - 0	1	-10	0	0.7	1	0	0	11	0	0	0
OPS_AREA	0 - 10,000	0.18	-11	0	0.7	1	0	0	11	0	0	0
EXP_AREA	0 - 10,000	0.18	-11	0	0.7	1	0	0	11	0	0	0
CRA14_SEN2 (EPA 2016) **and CRA14_SEN3** (Zeitler 2016)												
CAVITY_3	-5 - 0	S_HALITE + 1/2*STDEV	S_HALITE + 1	S_HALITE	0.7	2	0.56	-0.346	4	0.95	0.6	0.398
OPS_AREA	0 - 10,000	S_HALITE + 1/2*STDEV	S_HALITE + 1	S_HALITE	0.7	2	0.56	-0.346	4	0.95	0.6	0.398
EXP_AREA	0 - 10,000	S_HALITE + 1/2*STDEV	S_HALITE + 1	S_HALITE	0.7	2	0.56	-0.346	4	0.95	0.6	0.398

Disturbed Rock Zone Adjoining Experimental and Operations Areas												
Material	**Time (yr)**	**POROSITY**	**PRMX_LOG PRMY_LOG PRMZ_LOG**	**COMP_RCK**	**PORE_DIS**	**CAP_MOD**	**PCT_A**	**PCT_EXP**	**RELP_MOD**	**SAT_IBRN**	**SAT_RBRN**	**SAT_RGAS**
CRA14 (Camphouse 2013)												
DRZ_0	-5 - 0	S_HALITE + 0.0029	-17	7.41E-10	0.7	1	0	0	4	1	0	0
DRZ_1	0 - 10,000	S_HALITE + 0.0029	sampled	7.41E-10	0.7	1	0	0	4	N/A	0	0
CRA14_SEN2 (EPA 2016) **and CRA14_SEN3** (Zeitler 2016)												
DRZ_OE_0	-5 - 0	S_HALITE	S_HALITE	S_HALITE	0.7	2	0.56	-0.346	4	0.95	0.6	0.398
DRZ_OE_1	0 - 10,000	S_HALITE	S_HALITE	S_HALITE	0.7	2	0.56	-0.346	4	0.95	0.6	0.398

Legend:

(shaded) CRA14_SEN3 values that differ from CRA14

Table 2-3: CRA14 and CRA14_SEN3 Modified Parameters for the Panel Closure Areas and Associated DRZ

Panel Closures												
Material	**Time (yr)**	**POROSITY**	**PRMX_LOG PRMY_LOG PRMZ_LOG**	**COMP_RCK**	**PORE_DIS**	**CAP_MOD**	**PCT_A**	**PCT_EXP**	**RELP_MOD**	**SAT_IBRN**	**SAT_RBRN S_{ROMBR}**	**SAT_RGAS S_{ROMGR}**
CRA14 (Camphouse 2013) **and CRA14_SEN2** (EPA 2016)												
CAVITY_4	-5 - 0	1	-10	0	0.7	1	0	0	11	0	0	0
PCS_T1	0 - 100	Sampled [0.066 to 0.187] Uniform	Sampled [-20.84 to -12.00] Uniform	8E-11	Sampled [0.11 to 8.10] Cumulative	1	0	0	4	NA	Sampled [0.0 to 0.6] Cumulative	Sampled [0.0 to 0.4] Uniform
PCS_T2	100 - 200	Sampled [0.025 to 0.075] Uniform	-18.6	8E-11	Sampled [0.11 to 8.10] Cumulative	1	0	0	4	NA	Sampled [0.0 to 0.6] Cumulative	Sampled [0.0 to 0.4] Uniform
PCS_T3	200 - 10,000	Sampled [0.001 to 0.0519] Uniform	-19.1	8E-11	Sampled [0.11 to 8.10] Cumulative	1	0	0	4	NA	Sampled [0.0 to 0.6] Cumulative	Sampled [0.0 to 0.4] Uniform
CRA14_SEN3 (Zeitler 2016)												
CAVITY_5	-5 - 0	S_HALITE	S_HALITE	S_HALITE	0.7	2	0.56	-0.346	4	0.95	Sampled [0.5 to 0.65] Uniform	$(1-S_{ROMBR})*0.8$
PCS_T1	0 - 10,000	S_HALITE	S_HALITE	S_HALITE	0.7	2	0.56	-0.346	4	0.95	Sampled [0.5 to 0.65] Uniform	$(1-S_{ROMBR})*0.8$

Disturbed Rock Zone Adjoining Panel Closures												
Material	**Time (yr)**	**POROSITY**	**PRMX_LOG PRMY_LOG PRMZ_LOG**	**COMP_RCK**	**PORE_DIS**	**CAP_MOD**	**PCT_A**	**PCT_EXP**	**RELP_MOD**	**SAT_IBRN**	**SAT_RBRN S_{DRZBR}**	**SAT_RGAS S_{DRZBR}**
CRA14 (Camphouse 2013) **and CRA14_SEN2** (EPA 2016)												
DRZ_0	-5 - 0	S_HALITE + 0.0029	-17	7.41E-10	0.7	1	0	0	4	1	0	0
DRZ_1	0 - 200	S_HALITE + 0.0029	Sampled [-19.40 to -12.50] Uniform	7.41E-10	0.7	1	0	0	4	N/A	0	0
DRZ_PCS	200 - 10,000	S_HALITE + 0.0029	Sampled [-20.699 to -17.00] Triangular	7.41E-10	0.7	1	0	0	4	NA	0	0
CRA14_SEN3 (Zeitler 2016)												
DRZ_PC_0	-5 - 0	S_HALITE	S_HALITE	S_HALITE	0.7	2	0.56	-0.346	4	0.95	SROMBR	SROMGR
DRZ_PC_1	0 - 10,000	S_HALITE	S_HALITE	S_HALITE	0.7	2	0.56	-0.346	4	0.95	SROMBR	SROMGR

Legend:

[shaded] CRA14_SEN3 values that differ from CRA14

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3 Code Execution

Run control documentation of codes executed in the panel closure system sensitivity study is provided in Section 7.1 of this report. This documentation contains:

1. A description of the hardware platform and operating system used to perform the calculations.
2. A listing of the codes and versions used to perform the calculations.
3. A listing of the scripts used to run each calculation.
4. A listing of the input and output files for each calculation.
5. A listing of the library and class where each file is stored.
6. File naming conventions.

Results obtained in this analysis are compared to those acquired in the CRA-2014 PA and the CRA14_SEN2 sensitivity study, with the addition of a revised post processing step to obtain the requested output parameters for comparison with the sensitivity analysis results. Documentation of run control for results calculated in the CRA-2014 PA is provided in Long (2013), as supplemented by the reruns of ALGEBRACDB under BRAGFLO, defined in Section 7.2 of this report. Similarly, documentation of run control for results calculated in the CRA14_SEN2 sensitivity study is provided in Day (2016).

4 Results

Salado flow results obtained after inclusion of modified material parameters and two-phase flow properties in the operations and experimental areas and the panel closures in addition to associated disturbed rock zones are now presented, and compared to those obtained in the CRA-2014 PA (CRA14) and the CRA14_SEN2 sensitivity study. Results are discussed in terms of overall means. Overall means are obtained by forming the average of all realizations obtained for a given quantity and scenario. In WIPP PA, a replicate consists of 100 calculated realizations. Three replicates are used to generate results for CRA14, CRA14_SEN2, and CRA14_SEN3. Means and statistics presented for the analyses are also calculated over all three replicates.

Results are presented for undisturbed scenario S1-BF. Results associated with intrusions are presented for scenarios S2-BF and S4-BF, as these are representative of the intrusions considered in scenarios S3-BF and S5-BF, respectively, with the only differences being the timing of drilling intrusions. Results from BRAGFLO scenario S6-BF are also discussed. In the results that follow, summary statistics and plots were generated with Python, an open-source software package.

4.1 Pressure

The decrease in porosity and permeability, increase in initial and residual brine saturations, increase in residual gas saturations, and application of capillary-pressure effects on relative permeability in the operations and experimental areas, panel closures, and associated disturbed rock zones yields decreased pore volume and decreased brine and gas flow in these areas. An expected outcome of reduced volume and increased initial brine saturation is an increase in pressure. Plots of mean pressure for the experimental area are shown in Figure 4-1 to Figure 4-4. When compared to the CRA14, the modified operations and experimental area and panel closure parameters yield an increase in mean pressure in the experimental area for CRA14_SEN3 under all scenarios modeled in BRAGFLO. Similar trends are seen for the repository operations area. As seen in Figure 4-5 to Figure 4-8, mean pressures are increased for CRA14_SEN3 in comparison to CRA14. The pressures from CRA14_SEN3 are either the same or slightly reduced in comparison to CRA14_SEN2 within the operations and experimental areas.

The reduced flow of gas between waste areas and into the operations and experimental areas of the repository across panel closures results in increased pressures in waste areas for all scenarios not involving a Castile intrusion. For scenarios subject to a Castile intrusion (S2-BF and S6-BF), the reduced porosity and permeability of the panel closures and associated disturbed rock zones restricts brine flow from the intruded waste panel into the north and south rest-of-repository such that brine pressures in those regions for CRA14_SEN3 are less than CRA14 and CRA14_SEN2. Plots of mean pressure for the north rest-of-repository waste region are shown in Figure 4-9 to Figure 4-12. Similar trends are evident for the south rest-of-repository waste region as seen in Figure 4-13 to Figure 4-16. As seen in Figure 4-17 to Figure 4-20, mean pressures in the southernmost waste panel are increased due to restricted gas and brine flows out of the waste panel for CRA14_SEN3 in comparison to CRA14 and CRA14_SEN2 in all scenarios modeled with BRAGFLO.

Pressure statistics for CRA14 and CRA14_SEN3 are summarized in Table 4-1 and Table 4-2. Table 4-1 provides the 3-replicate mean (integrated over time) and 3-replicate maximum (over all time) pressure values. Table 4-2 provides the maximum pressure (over all time) for all individual vectors. The modified panel closure and north end parameters result in increased 3-replicate mean and maximum pressures as compared to the CRA14 for the operations and experimental areas and waste panel over all scenarios. The north and south rest-of-repository waste areas under scenarios without a Castile intrusion also experience mean and maximum pressures that are greater for CRA14_SEN3 than for CRA14, but comparison of scenarios with a Castile intrusion are inversely related. The individual vector maximum pressure values for CRA14_SEN3 are lower for the operations and experimental areas and southernmost waste panel and higher for the north and south rest-of-repository waste areas.

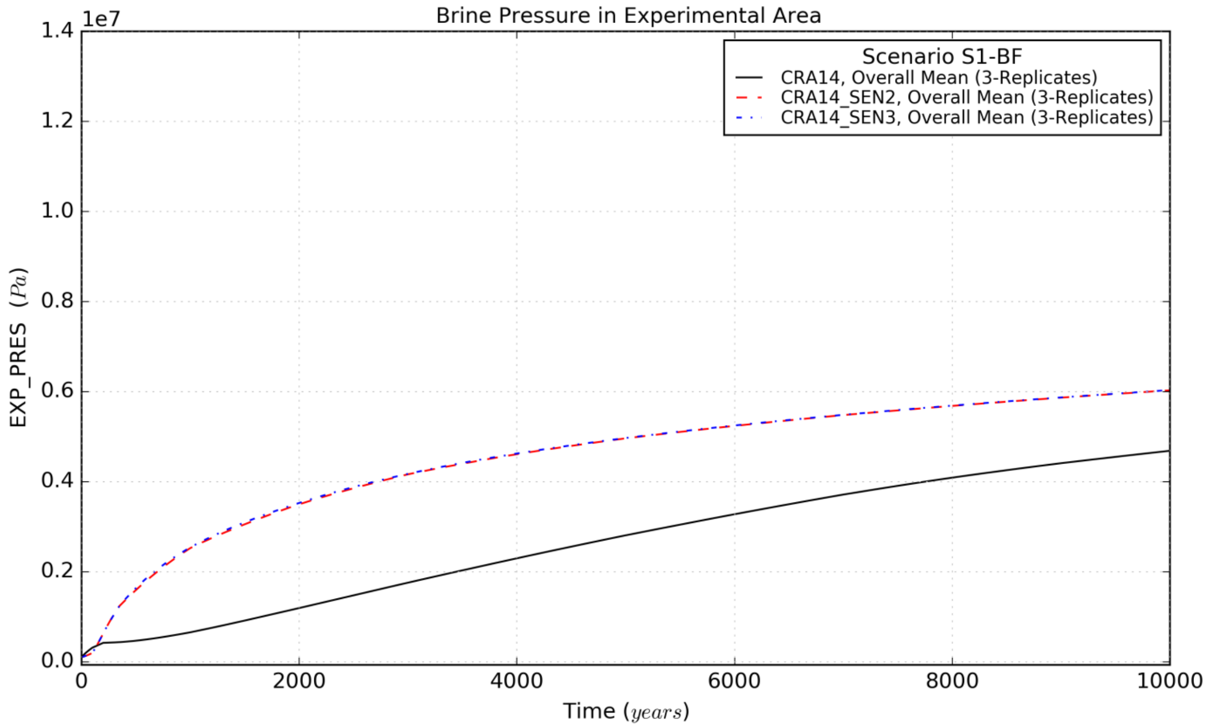

Figure 4-1: Pressure Means for the Experimental Area, Scenario S1-BF

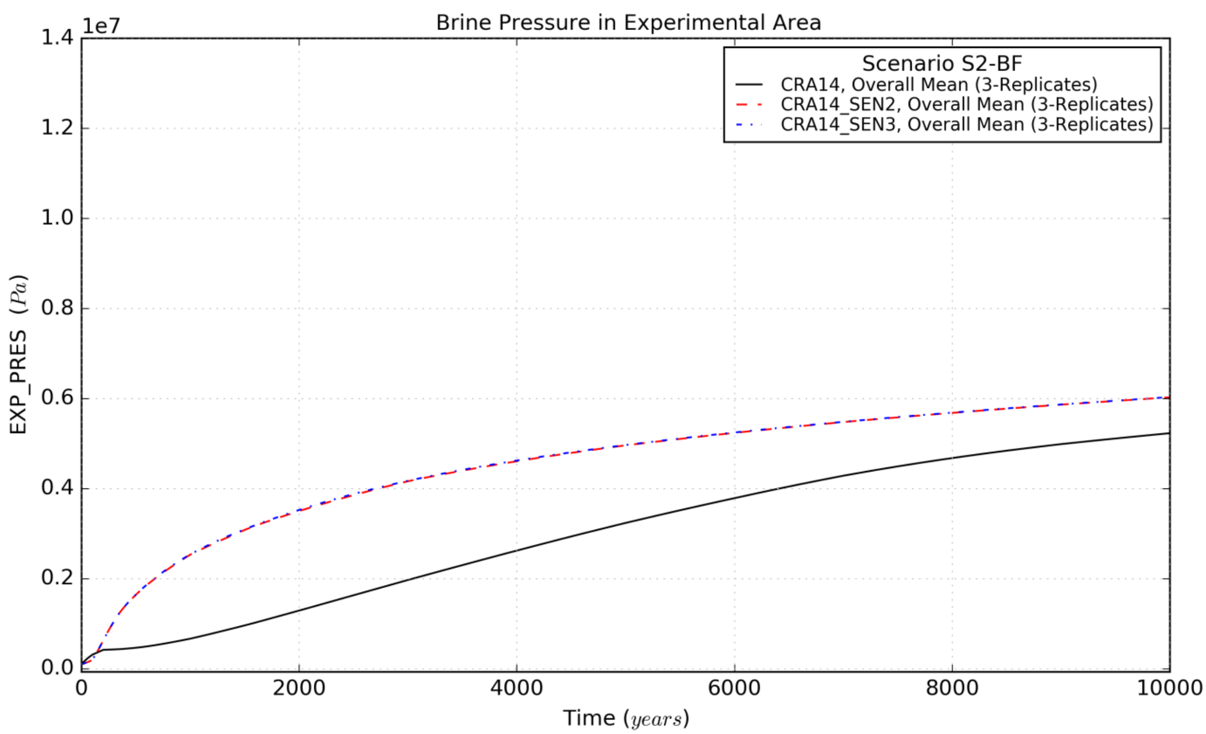

Figure 4-2: Pressure Means for the Experimental Area, Scenario S2-BF

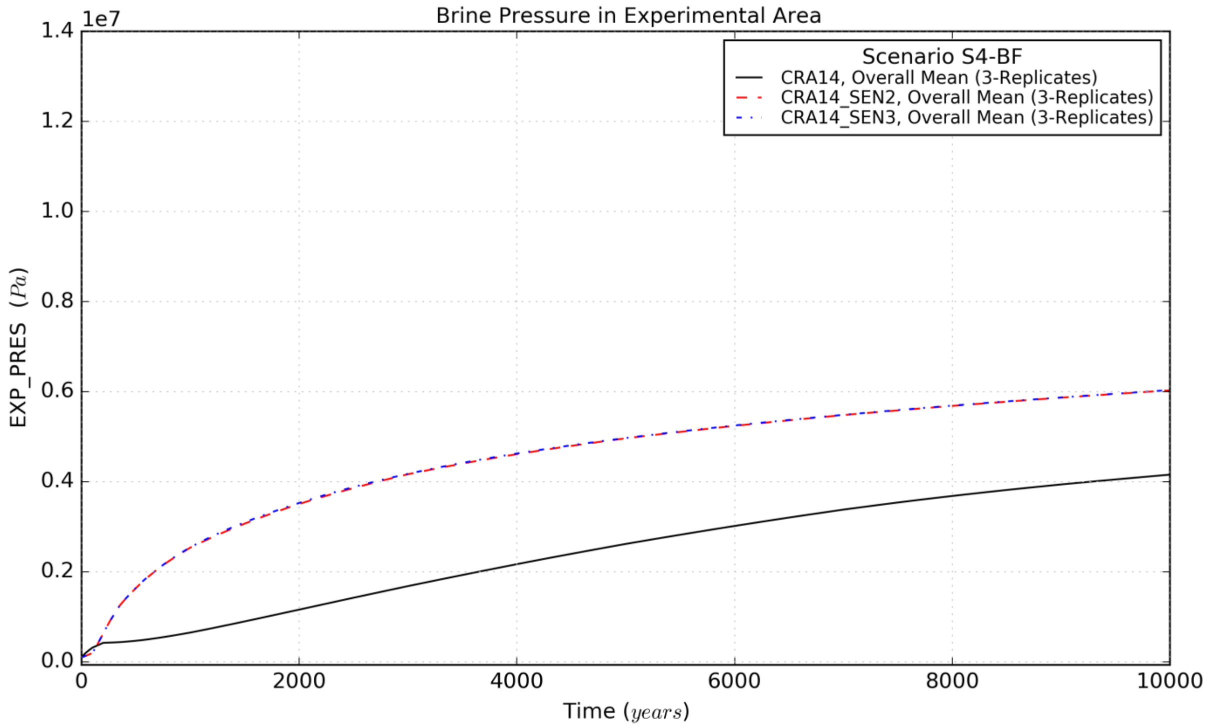

Figure 4-3: Pressure Means for the Experimental Area, Scenario S4-BF

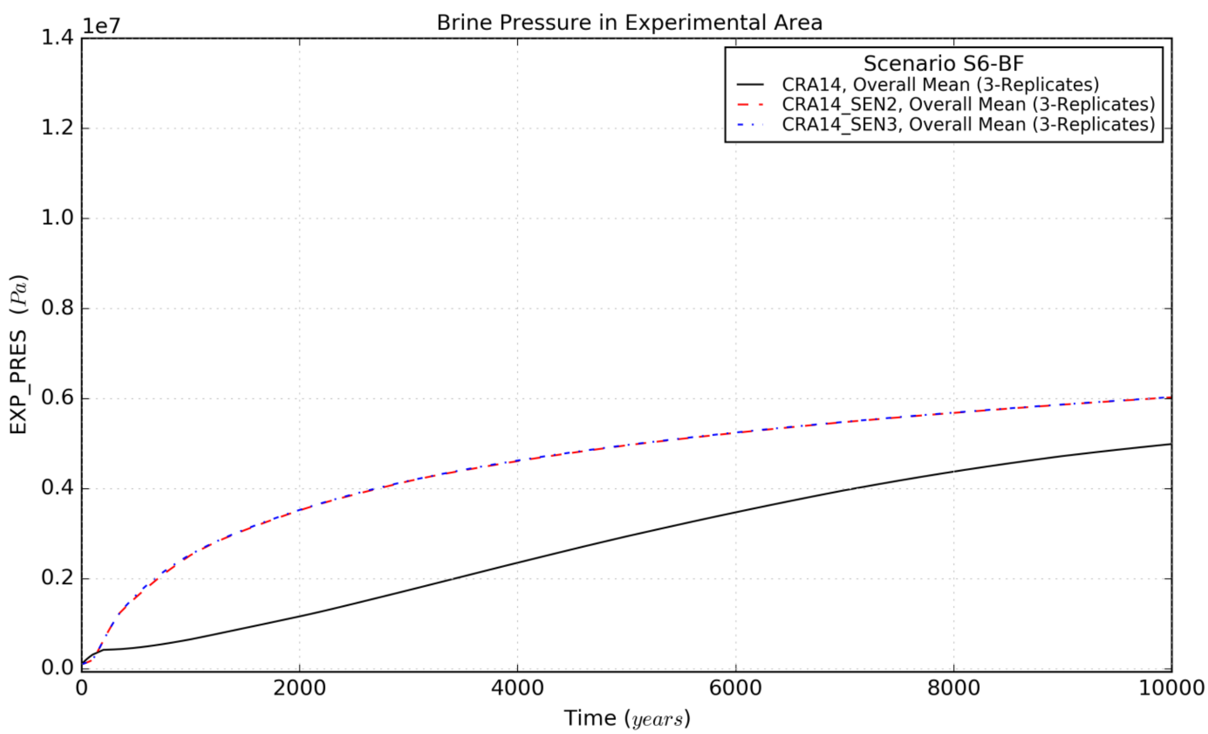

Figure 4-4: Pressure Means for the Experimental Area, Scenario S6-BF

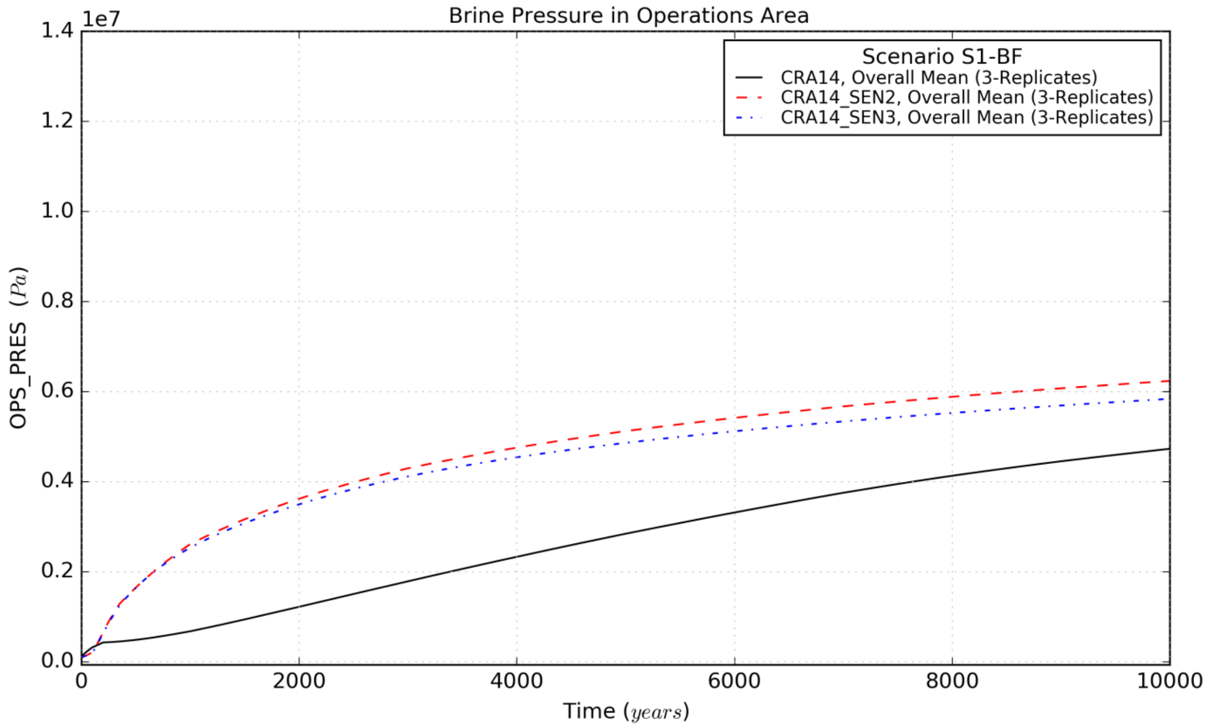

Figure 4-5: Pressure Means for the Operations Area, Scenario S1-BF

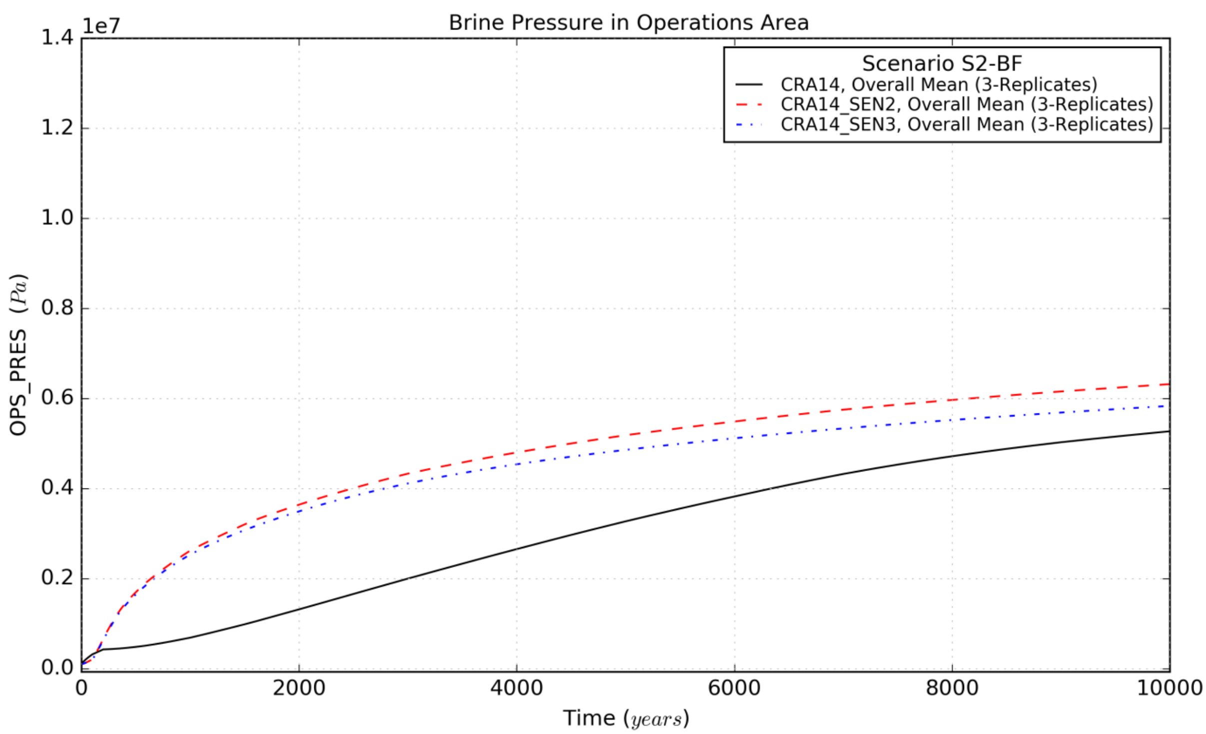

Figure 4-6: Pressure Means for the Operations Area, Scenario S2-BF

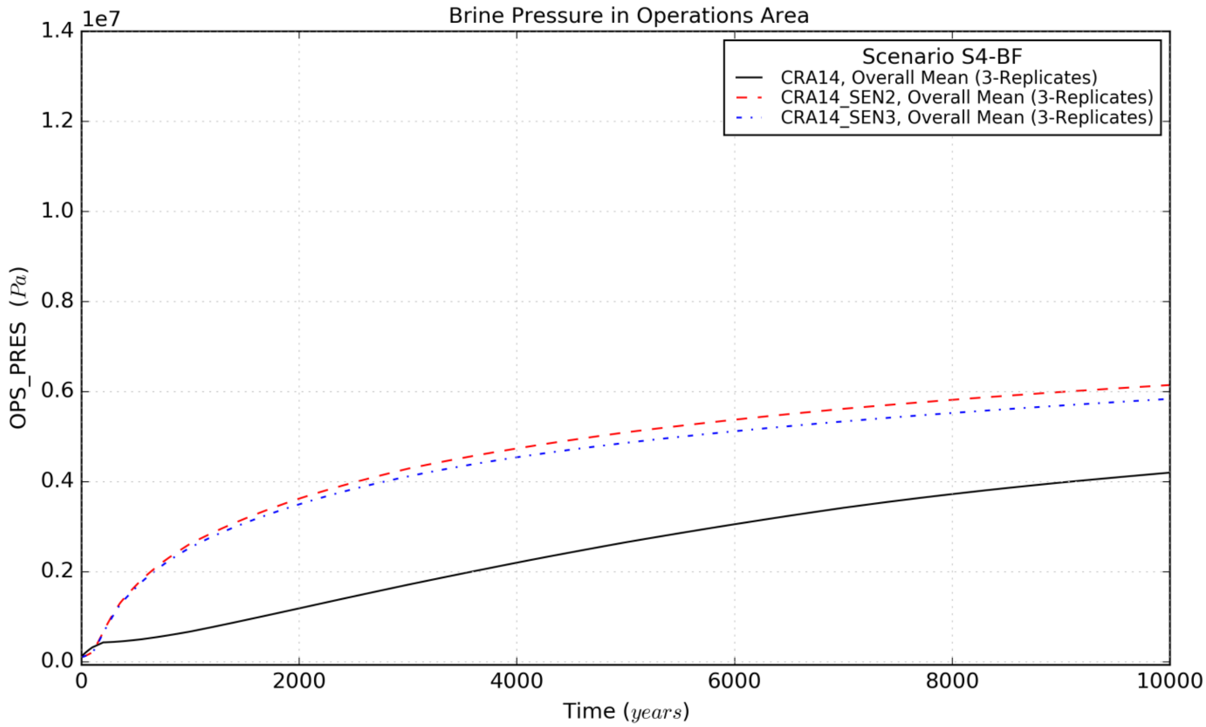

Figure 4-7: Pressure Means for the Operations Area, Scenario S4-BF

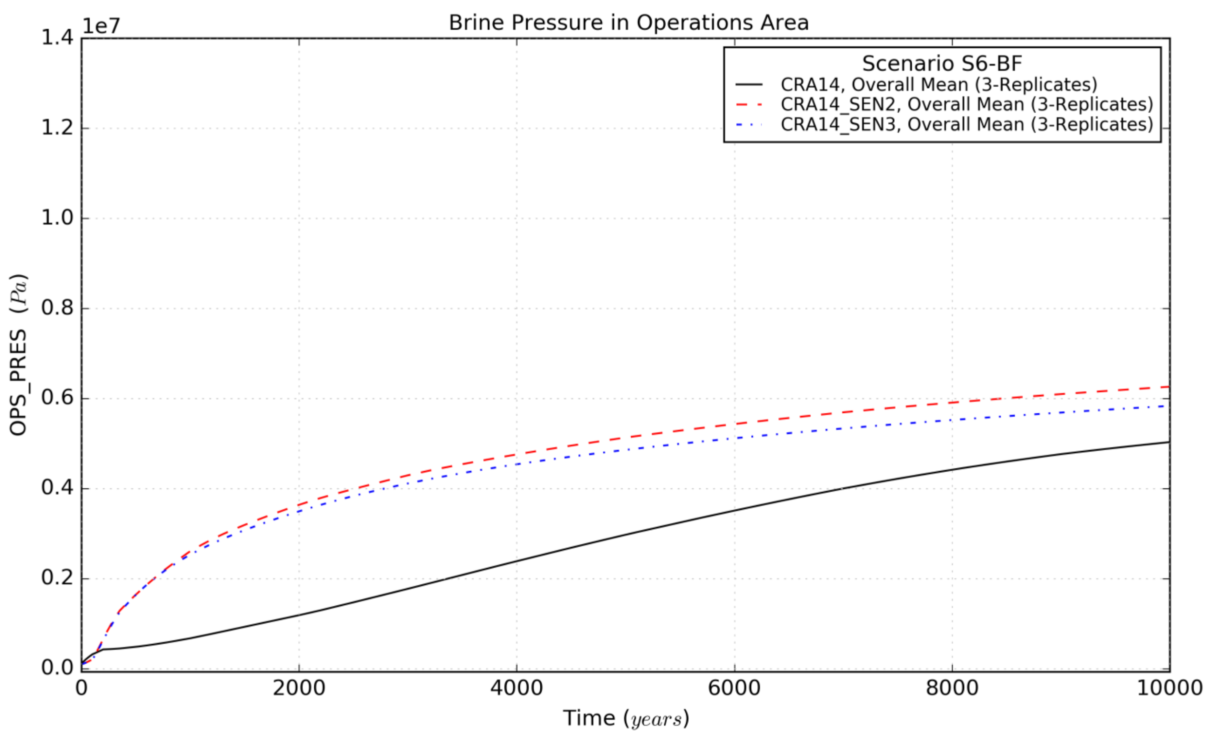

Figure 4-8: Pressure Means for the Operations Area, Scenario S6-BF

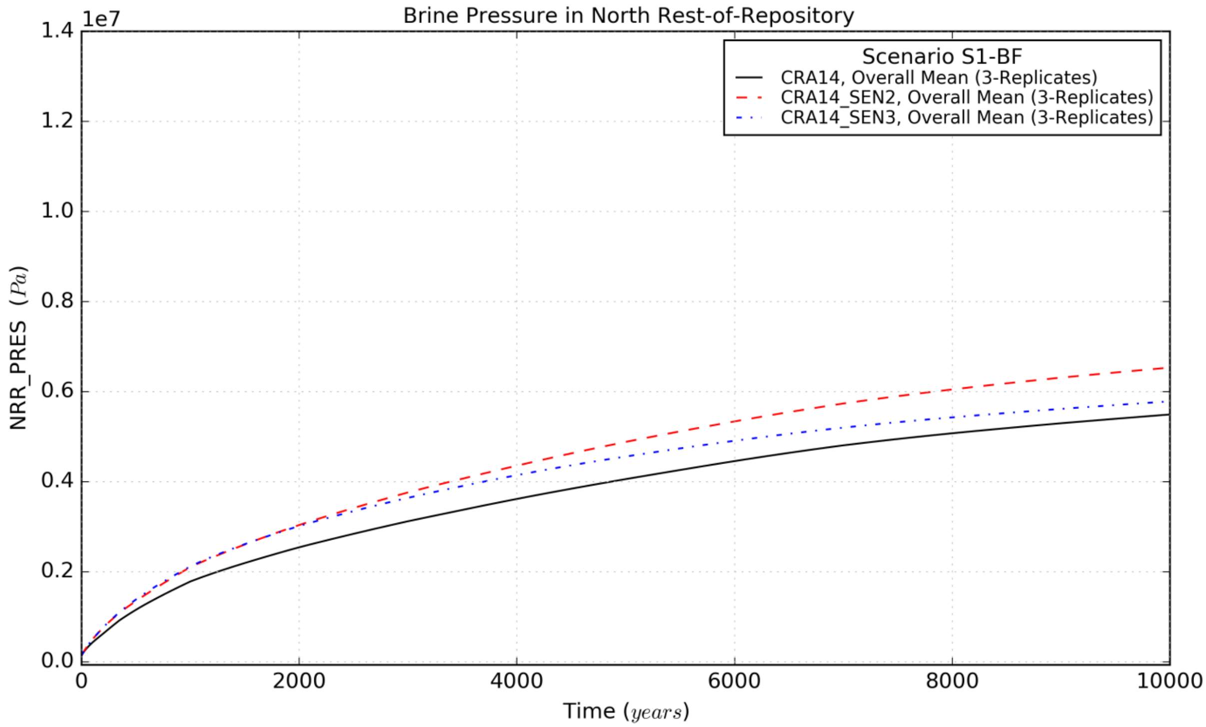

Figure 4-9: Pressure Means for the North Rest-of-Repository, Scenario S1-BF

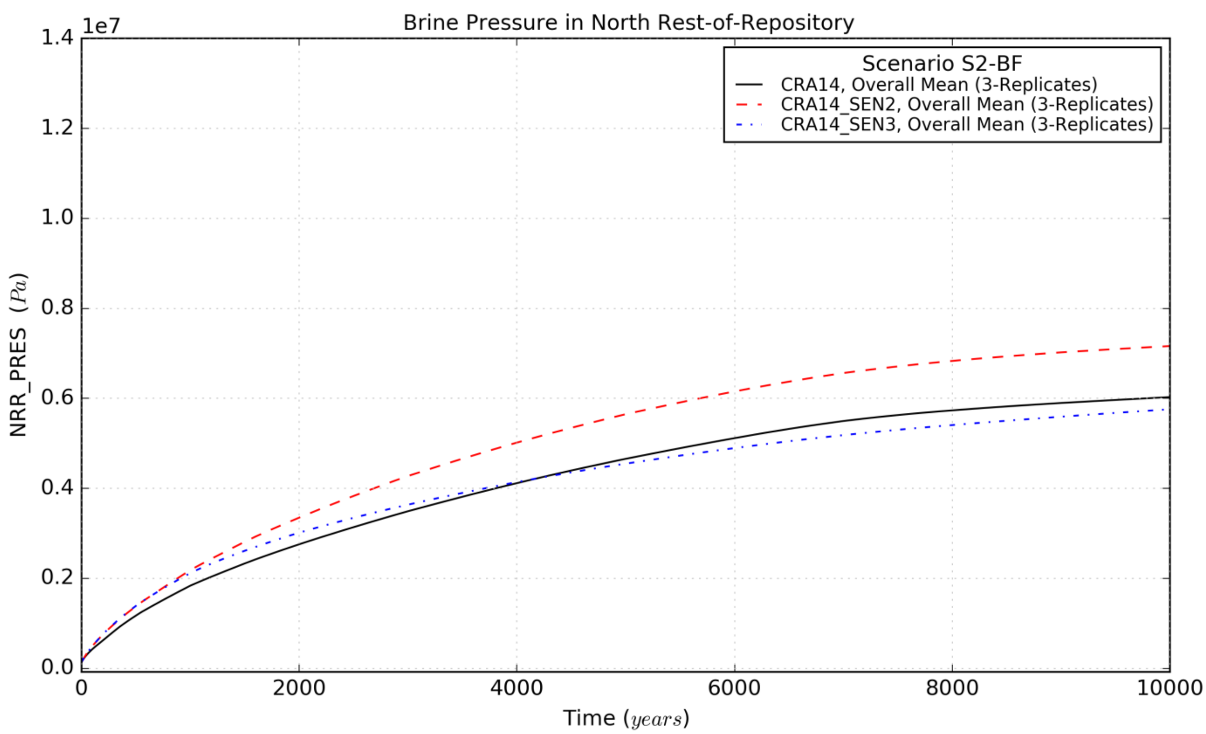

Figure 4-10: Pressure Means for the North Rest-of-Repository, Scenario S2-BF

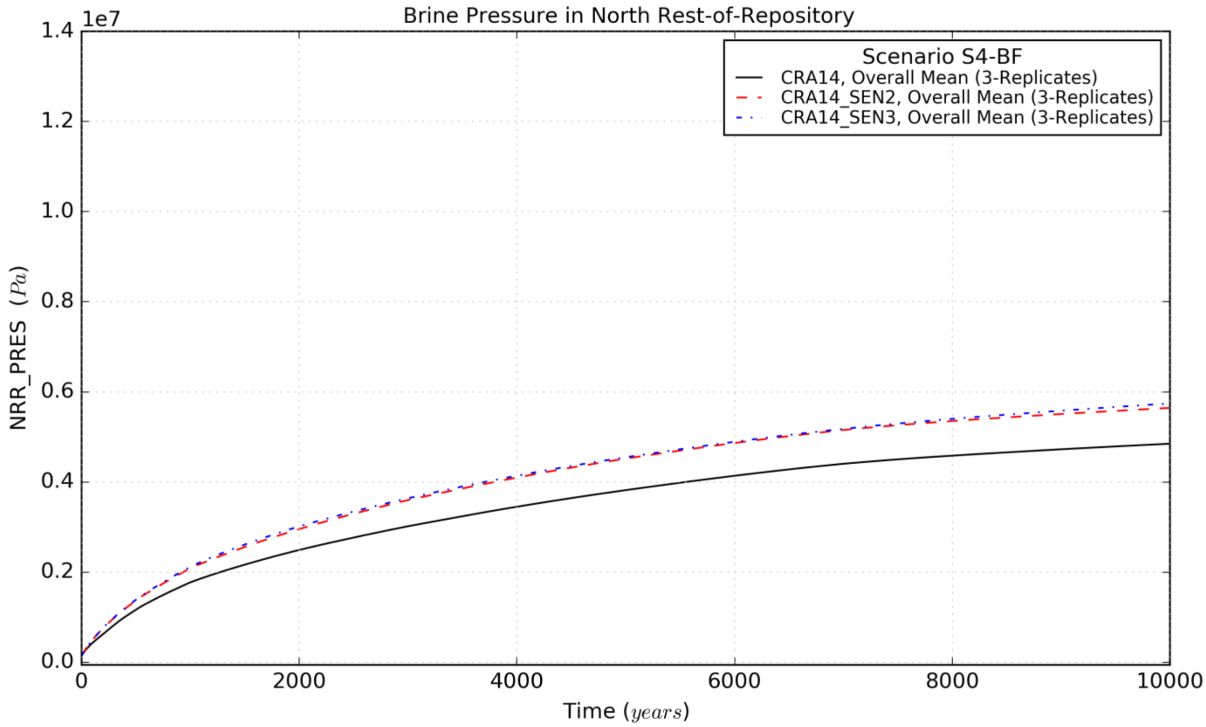

Figure 4-11: Pressure Means for the North Rest-of-Repository, Scenario S4-BF

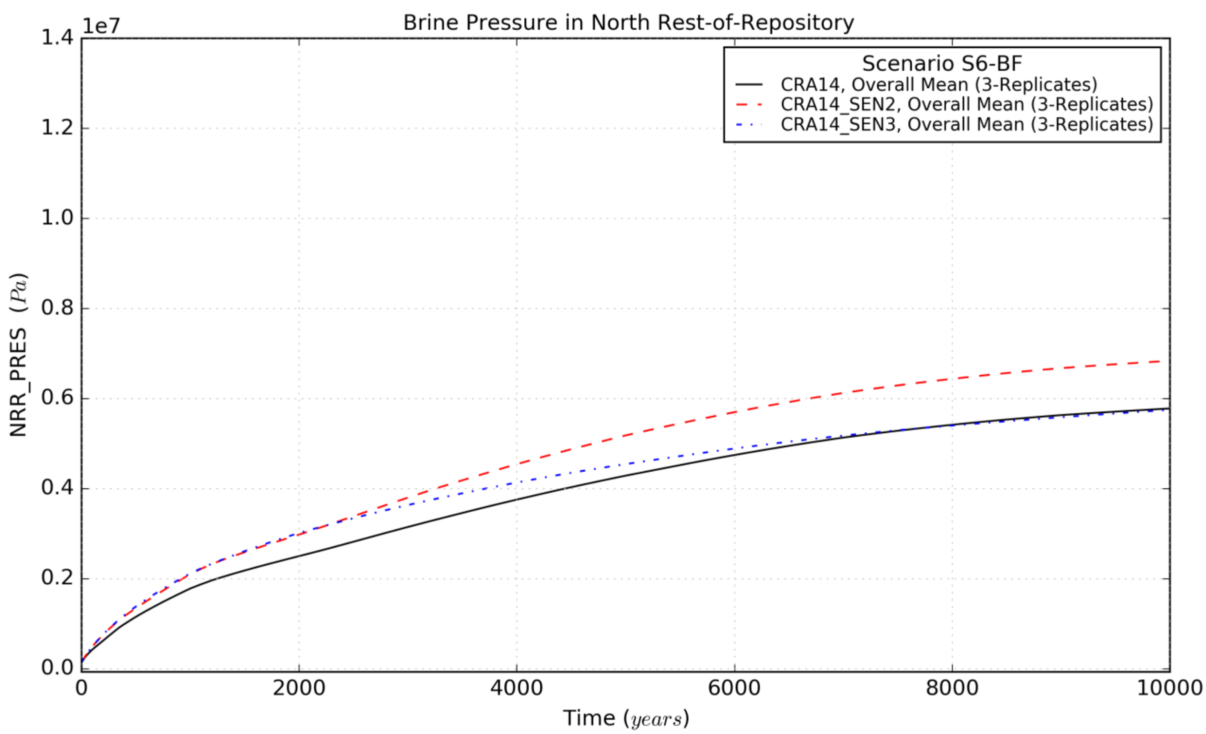

Figure 4-12: Pressure Means for the North Rest-of-Repository, Scenario S6-BF

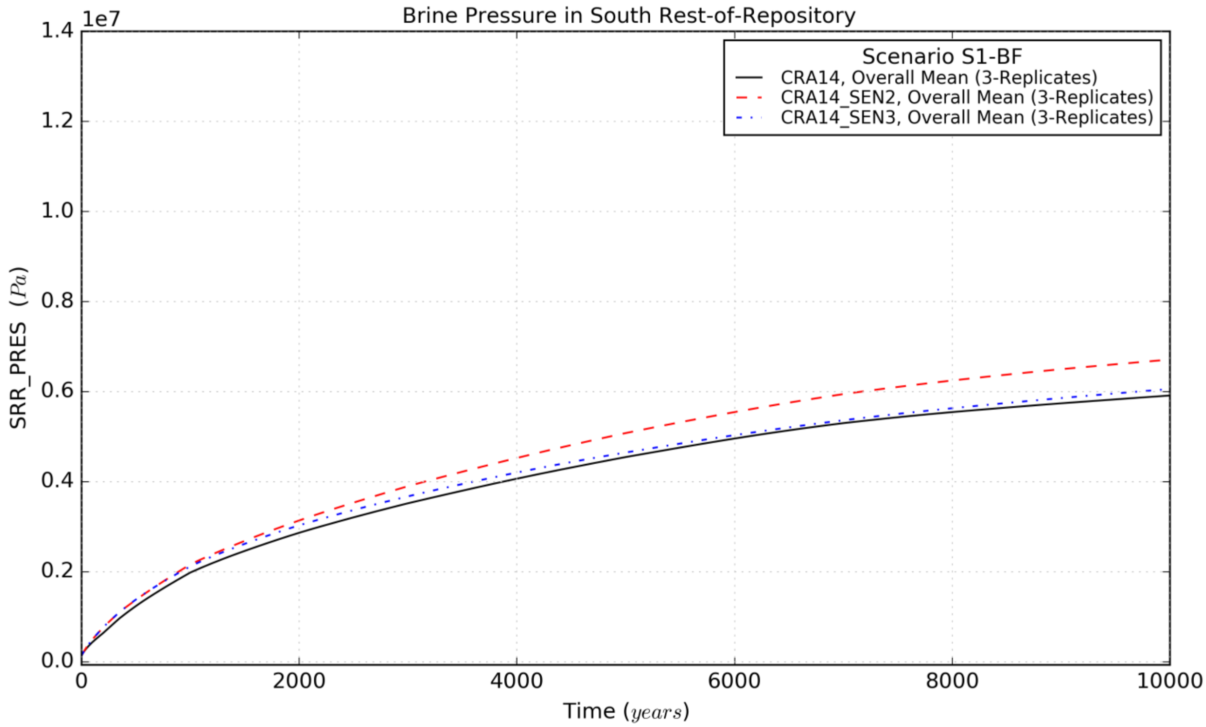

Figure 4-13: Pressure Means for the South Rest-of-Repository, Scenario S1-BF

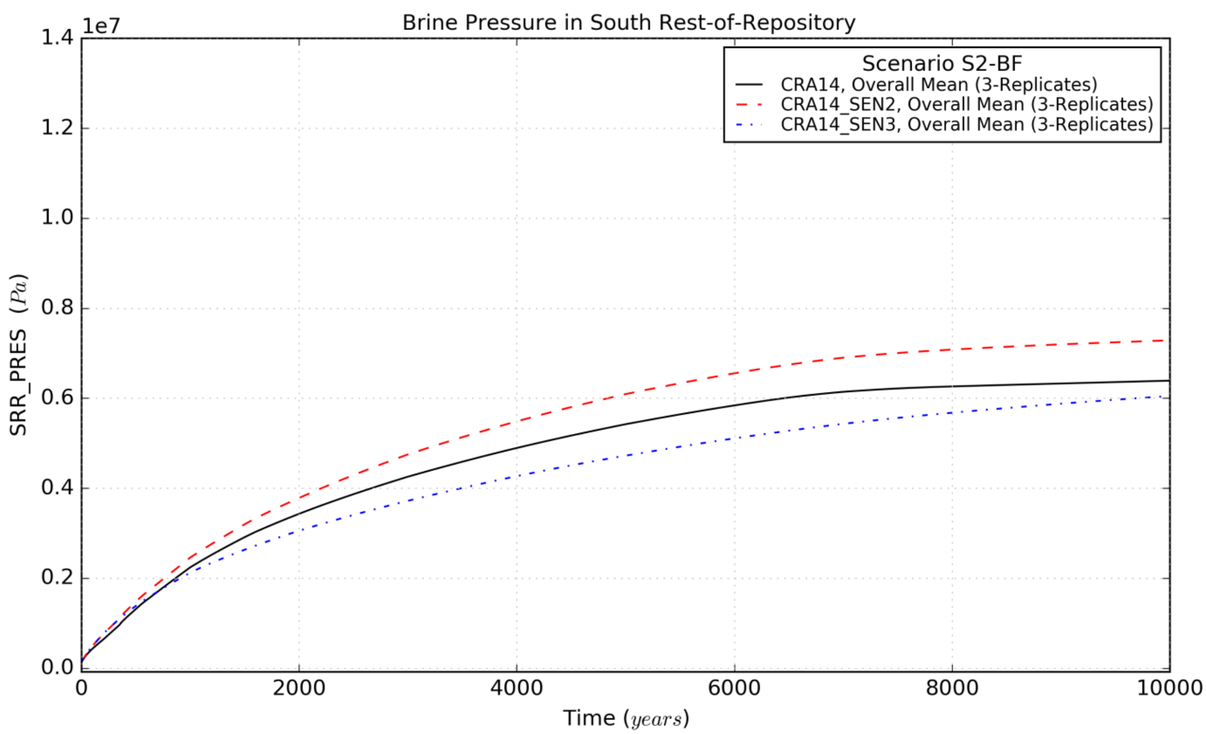

Figure 4-14: Pressure Means for the South Rest-of-Repository, Scenario S2-BF

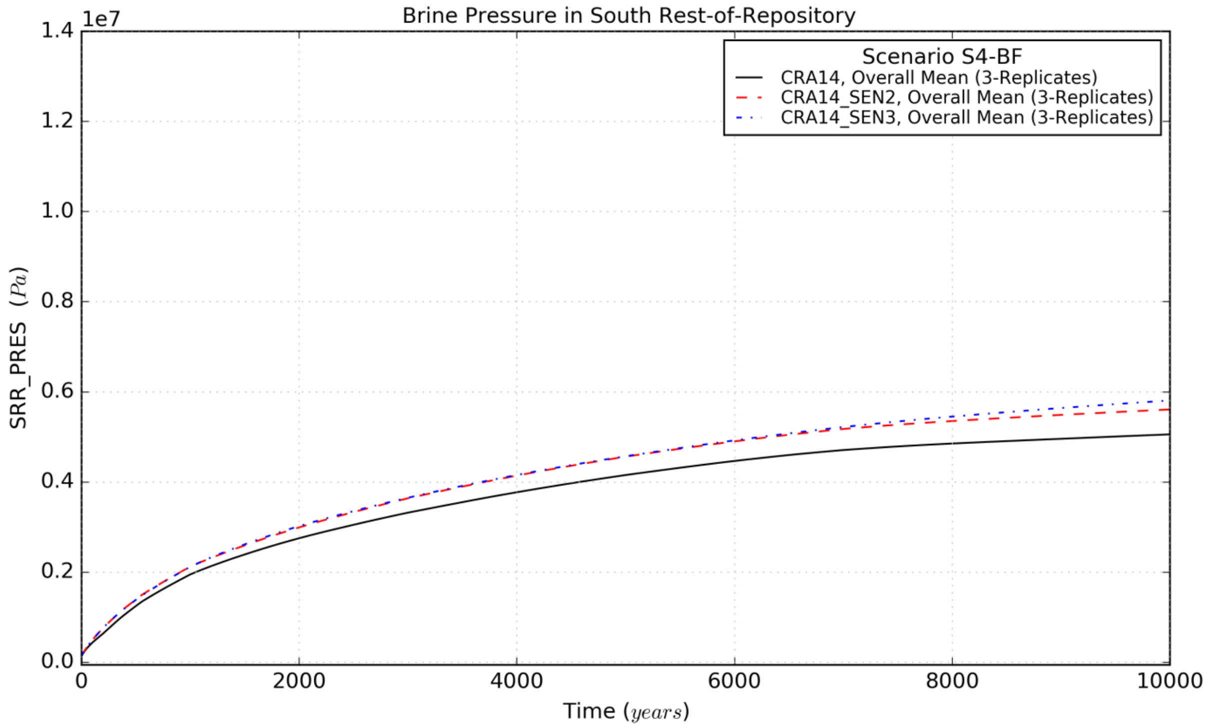

Figure 4-15: Pressure Means for the South Rest-of-Repository, Scenario S4-BF

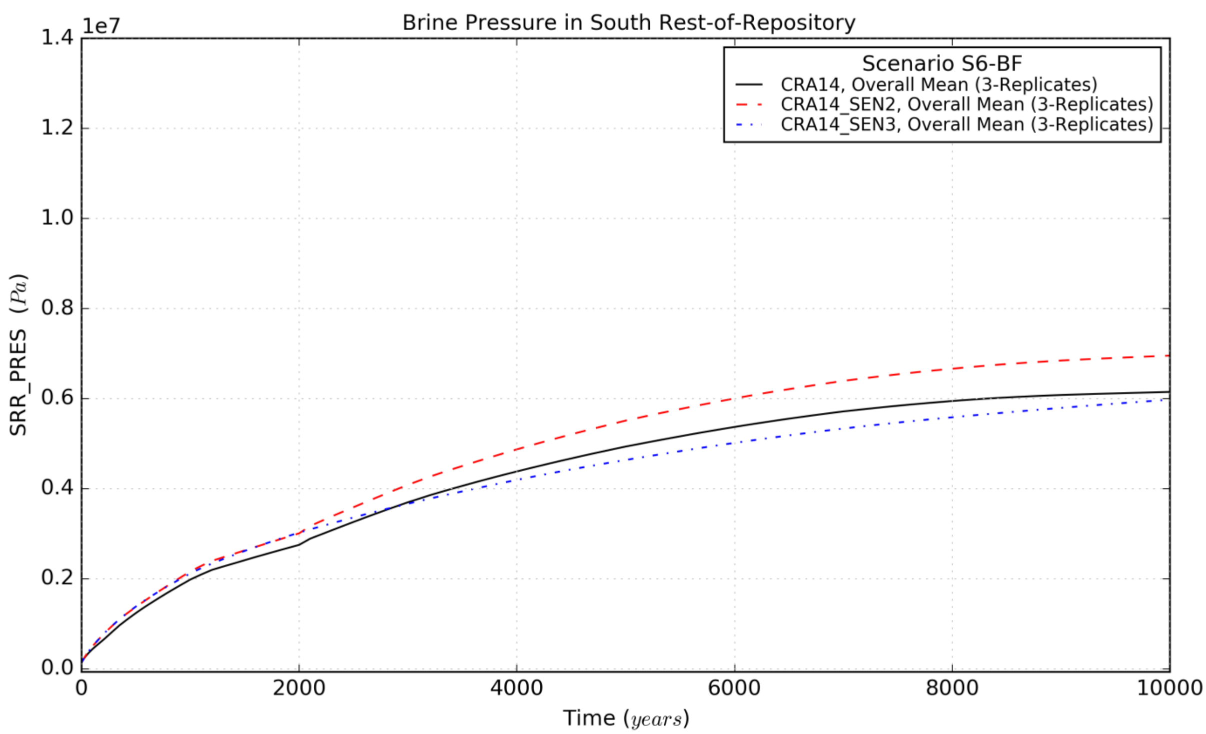

Figure 4-16: Pressure Means for the South Rest-of-Repository, Scenario S6-BF

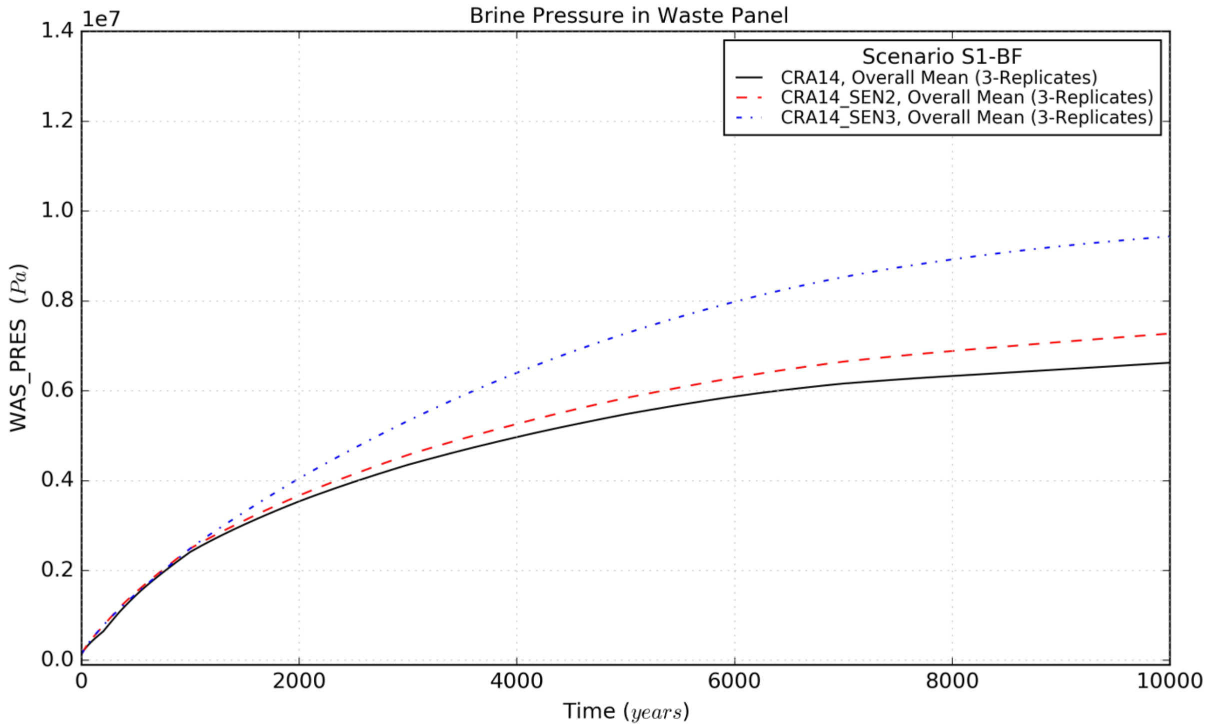

Figure 4-17: Pressure Means for the Waste Panel, Scenario S1-BF

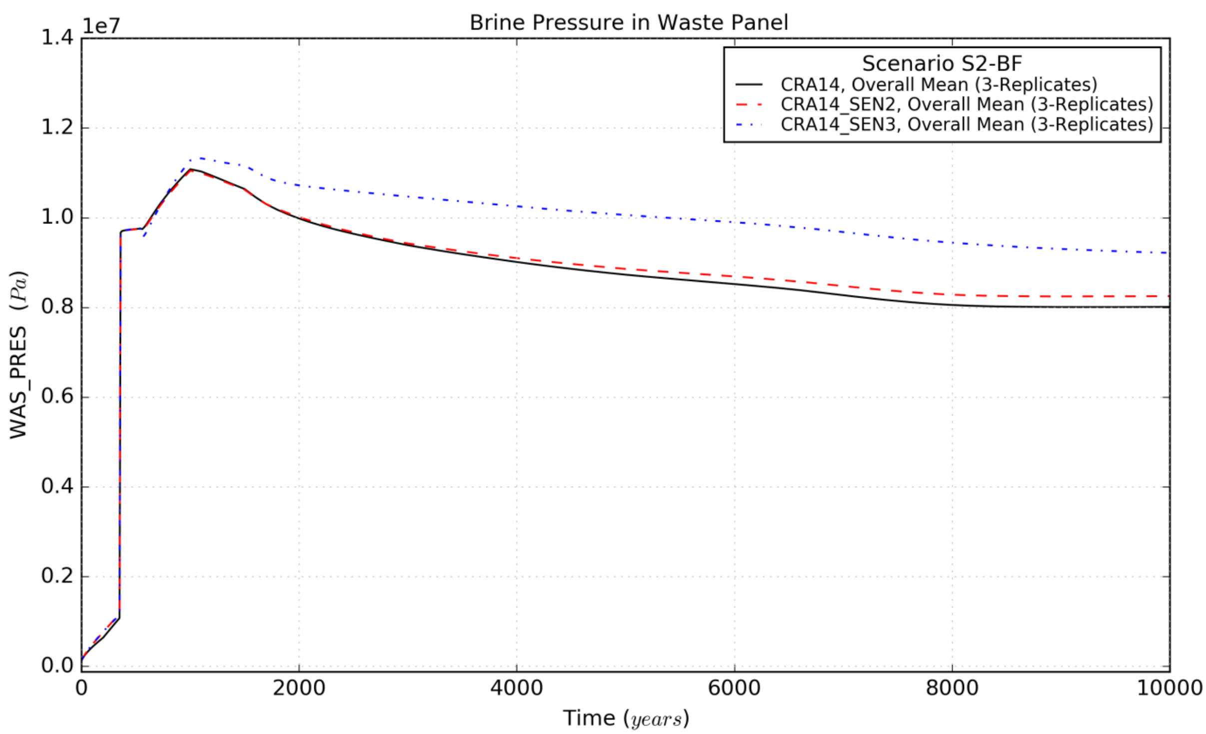

Figure 4-18: Pressure Means for the Waste Panel, Scenario S2-BF

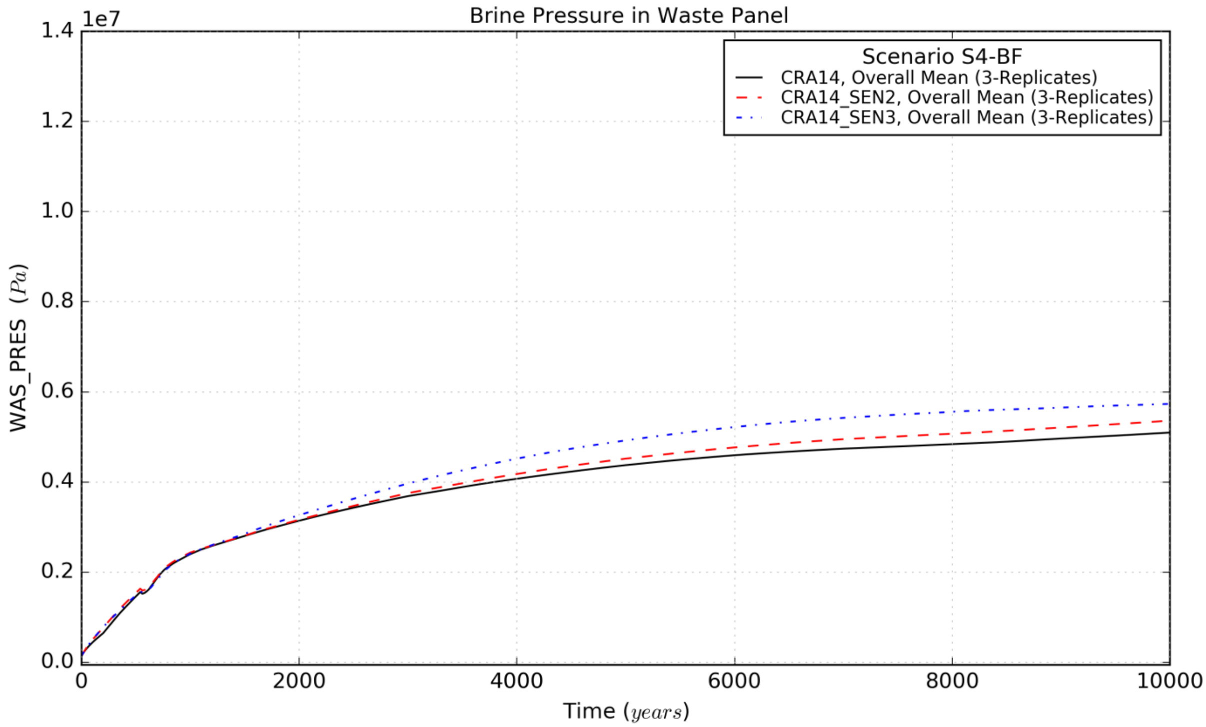

Figure 4-19: Pressure Means for the Waste Panel, Scenario S4-BF

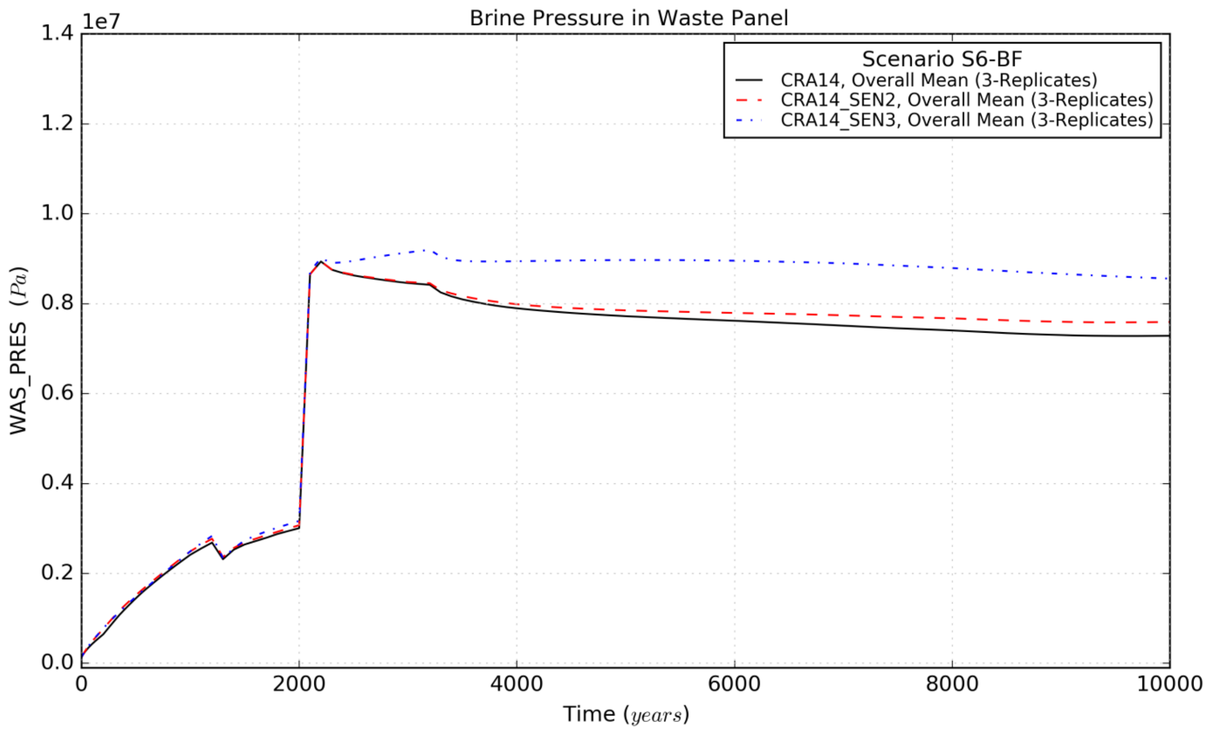

Figure 4-20: Pressure Means for the Waste Panel, Scenario S6-BF

Table 4-1: Pressure Statistics on Overall Means for CRA14 and CRA14_SEN3

Quantity (units)	Description	Scenario	Mean Value[1]		Maximum Value[2]	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
EXP_PRES (Pa)	Brine Pressure in Experimental Area	S1-BF	2.67E+06	4.54E+06	4.69E+06	6.03E+06
		S2-BF	3.03E+06	4.55E+06	5.23E+06	6.03E+06
		S4-BF	2.45E+06	4.55E+06	4.16E+06	6.03E+06
		S6-BF	2.81E+06	4.55E+06	4.99E+06	6.03E+06
OPS_PRES (Pa)	Brine Pressure in Operations Area	S1-BF	2.70E+06	4.45E+06	4.73E+06	5.84E+06
		S2-BF	3.07E+06	4.45E+06	5.28E+06	5.84E+06
		S4-BF	2.49E+06	4.45E+06	4.20E+06	5.84E+06
		S6-BF	2.84E+06	4.45E+06	5.04E+06	5.84E+06
NRR_PRES (Pa)	Brine Pressure in North Rest-of-Repository	S1-BF	3.78E+06	4.18E+06	5.49E+06	5.78E+06
		S2-BF	4.24E+06	4.17E+06	6.03E+06	5.76E+06
		S4-BF	3.51E+06	4.17E+06	4.85E+06	5.74E+06
		S6-BF	3.96E+06	4.17E+06	5.78E+06	5.75E+06
SRR_PRES (Pa)	Brine Pressure in South Rest-of-Repository	S1-BF	4.17E+06	4.29E+06	5.91E+06	6.06E+06
		S2-BF	4.83E+06	4.34E+06	6.39E+06	6.05E+06
		S4-BF	3.77E+06	4.20E+06	5.06E+06	5.81E+06
		S6-BF	4.42E+06	4.27E+06	6.15E+06	5.98E+06
WAS_PRES (Pa)	Brine Pressure in Waste Panel	S1-BF	4.92E+06	6.53E+06	6.63E+06	9.44E+06
		S2-BF	8.64E+06	9.70E+06	1.11E+07	1.13E+07
		S4-BF	3.96E+06	4.41E+06	5.10E+06	5.73E+06
		S6-BF	6.57E+06	7.50E+06	8.94E+06	9.20E+06

Notes:
1 Calculated as the function average (integrated) over the time interval (0-10,000 yr) for the overall means (3 replicates)
2 Calculated as the function maximum over the time interval (0-10,000 yr) for the overall means (3 replicates)

Table 4-2: Pressure Statistics on Individual Vectors for CRA14 and CRA14_SEN3

Quantity (units)	Description	Scenario	Maximum Value[3]	
			CRA14	CRA14_SEN3
EXP_PRES (Pa)	Brine Pressure in Experimental Area	S1-BF	1.43E+07	1.28E+07
		S2-BF	1.42E+07	1.28E+07
		S4-BF	1.38E+07	1.28E+07
		S6-BF	1.39E+07	1.28E+07
OPS_PRES (Pa)	Brine Pressure in Operations Area	S1-BF	1.43E+07	1.18E+07
		S2-BF	1.43E+07	1.18E+07
		S4-BF	1.39E+07	1.18E+07
		S6-BF	1.40E+07	1.18E+07
NRR_PRES (Pa)	Brine Pressure in North Rest-of-Repository	S1-BF	1.57E+07	1.61E+07
		S2-BF	1.57E+07	1.62E+07
		S4-BF	1.56E+07	1.62E+07
		S6-BF	1.56E+07	1.62E+07
SRR_PRES (Pa)	Brine Pressure in South Rest-of-Repository	S1-BF	1.58E+07	1.61E+07
		S2-BF	1.58E+07	1.62E+07
		S4-BF	1.58E+07	1.62E+07
		S6-BF	1.58E+07	1.62E+07
WAS_PRES (Pa)	Brine Pressure in Waste Panel	S1-BF	1.57E+07	1.61E+07
		S2-BF	1.62E+07	1.73E+07
		S4-BF	1.49E+07	1.53E+07
		S6-BF	1.50E+07	1.71E+07

Notes:
3 Calculated as the function maximum over the time interval (0-10,000 yr) for all replicates (300 vectors)

4.2 Brine Flow

The modified parameters in the operations and experimental areas, panel closures, and associated disturbed rock zones result in a significant reduction in cumulative brine inflow to the experimental area as shown in Figure 4-21 to Figure 4-24, and essentially eliminates any cumulative brine outflow from the experimental area as shown in Figure 4-25 to Figure 4-28. When compared to the CRA14, the modified operations and experimental area and panel closure parameters yield a significant decrease in mean brine flow to/from the experimental area for CRA14_SEN3 under all scenarios modeled in BRAGFLO. Similar trends are seen for the repository operations area. As seen in Figure 4-29 to Figure 4-32 and Figure 4-33 to Figure 4-36, mean brine flows to and from the operations area are significantly reduced for CRA14_SEN3 in comparison to CRA14 and effectively the same as CRA14_SEN2.

Pressure increases in repository waste areas typically result in decreased brine inflow to those areas or increased brine outflow from those areas. As seen in the pressure results already discussed, mean pressures are predominantly increased in repository waste regions as a result of the modified operations, experimental, and panel closure area parameters. The impact of the pressure increase on cumulative brine inflow to the north rest-of-repository waste area can be seen in Figure 4-37 to Figure 4-40. As seen in those figures, mean brine inflows to the northernmost repository waste region are slightly reduced for CRA14_SEN3 in comparison to CRA14 when the modified operations, experimental, and panel closure area parameters are included in the BRAGFLO repository representation. In comparison to CRA14_SEN2, the CRA14_SEN3 brine inflows to the northernmost repository waste region are increased. Moreover, brine inflow results for this region are nearly identical over all scenarios considered in BRAGFLO. Mean brine outflows from the north rest-of-repository are decreased initially and increased in later years for CRA14_SEN3 in comparison to CRA14, as shown in Figure 4-41 to Figure 4-44.

Brine inflow and outflow results for the south rest-of-repository waste region are shown in Figure 4-45 to Figure 4-48 and Figure 4-49 to Figure 4-52. The pressure increase in this region leads to reduced brine inflows for CRA14_SEN3 in comparison to CRA14, with the mean brine outflows also reduced. The reductions in brine inflow and outflow are more pronounced for CRA14_SEN3 than were for CRA14_SEN2.

Mean brine inflows to the southernmost waste panel modeled in BRAGFLO are similarly decreased when the modified operations, experimental, and panel closure area parameters are included in the repository representation. As seen in Figure 4-53 to Figure 4-56, the mean brine inflow to the waste panel obtained for CRA14_SEN3 is less than that found for CRA14 and CRA14_SEN2, over all BRAGFLO scenarios. The reduction in brine inflow to the waste panel is less pronounced for scenarios with Castile brine intrusions. Mean brine outflows from the waste panel are similarly affected as shown in Figure 4-57 to Figure 4-60.

Pressure increases in the operations and experimental areas, which would normally lead to an increase in the cumulative volume of brine flow up the shaft, are offset by the reduced permeability, increased residual brine saturation, and application of two-phase flow parameters within the operations and experimental areas. These modified parameters restrict the flow of brine into the shaft such that the mean brine flows up the repository shafts are even smaller for

CRA14_SEN3 than for CRA14 and CRA14_SEN2; each less than 3 m^3 over 10,000 years in all scenarios (see Figure 4-61 to Figure 4-64).

Mean brine flows up the intrusion borehole are only slightly impacted by the modified operations, experimental, and panel closure area parameters. As seen in Figure 4-65 to Figure 4-67, mean brine flows up the intrusion borehole are nearly identical to the CRA14 results.

Brine flow statistics for CRA14 and CRA14_SEN3 are summarized in Table 4-3 and Table 4-4. Table 4-3 provides the 3-replicate mean (integrated over time) and 3-replicate maximum (over all time) brine flow values. Table 4-4 provides the maximum brine flow (over all time) for all individual vectors. The modified north end and panel closure parameters result in slightly decreased 3-replicate mean and maximum brine inflows for waste areas and significantly decreased 3-replicate mean and maximum brine inflows for the operations and experimental areas as compared to the CRA14. The 3-replicate mean and maximum brine outflows from the operations and experimental areas indicate halting of brine flow from those areas with brine outflows from the waste areas reduced for CRA14_SEN3 in comparison to CRA14. The trend for individual vector maximum brine inflow and outflow values is generally similar, with the exception of the waste panel which has increased individual vector maximum brine flows for scenario S1-BF and S4-BF.

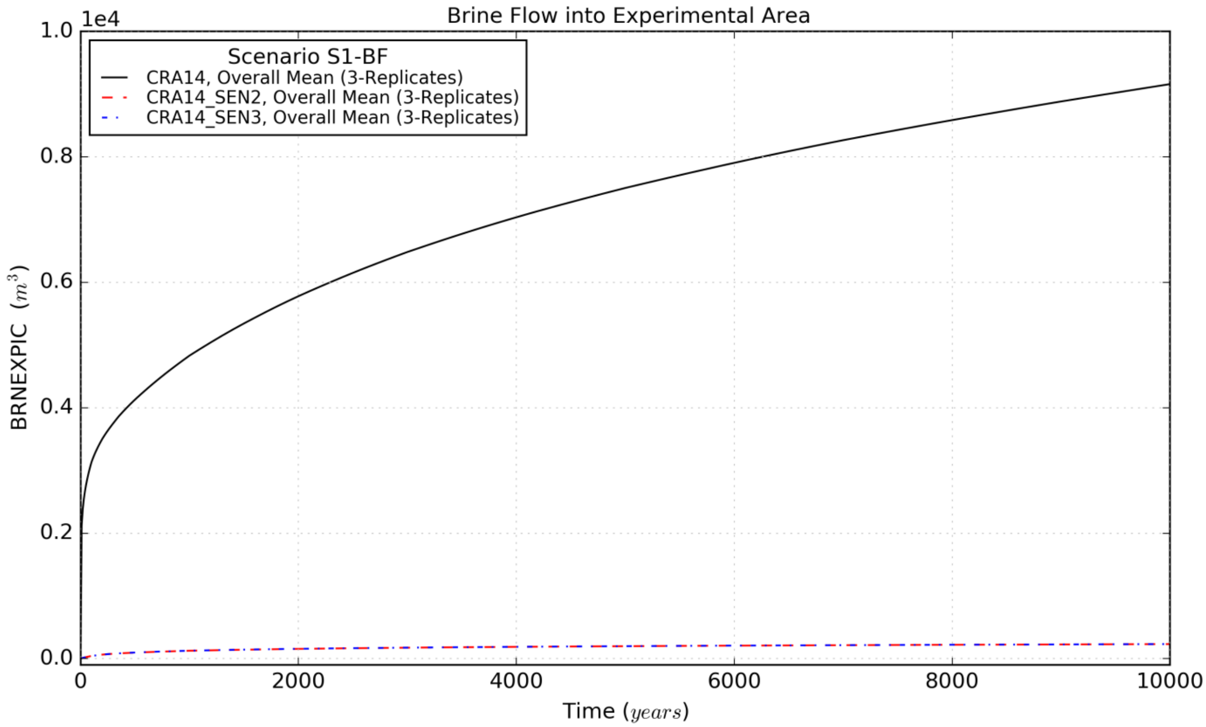

Figure 4-21: Brine Inflow Means to the Experimental Area, Scenario S1-BF

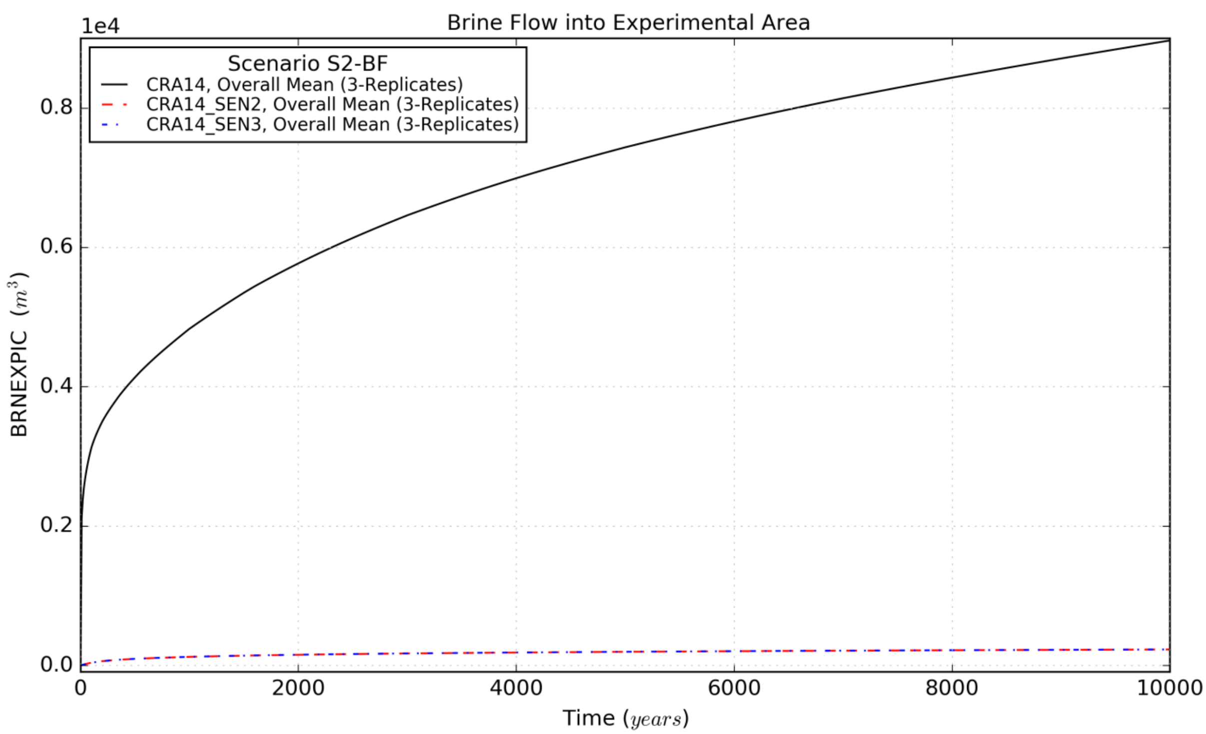

Figure 4-22: Brine Inflow Means to the Experimental Area, Scenario S2-BF

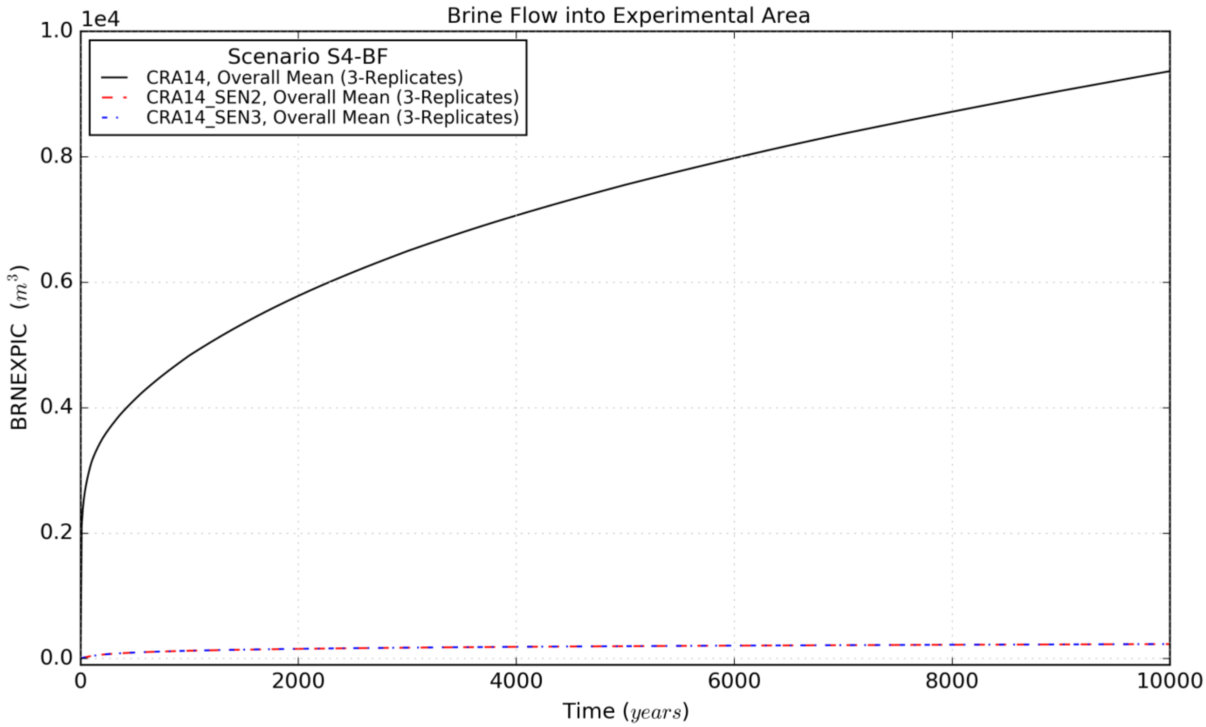

Figure 4-23: Brine Inflow Means to the Experimental Area, Scenario S4-BF

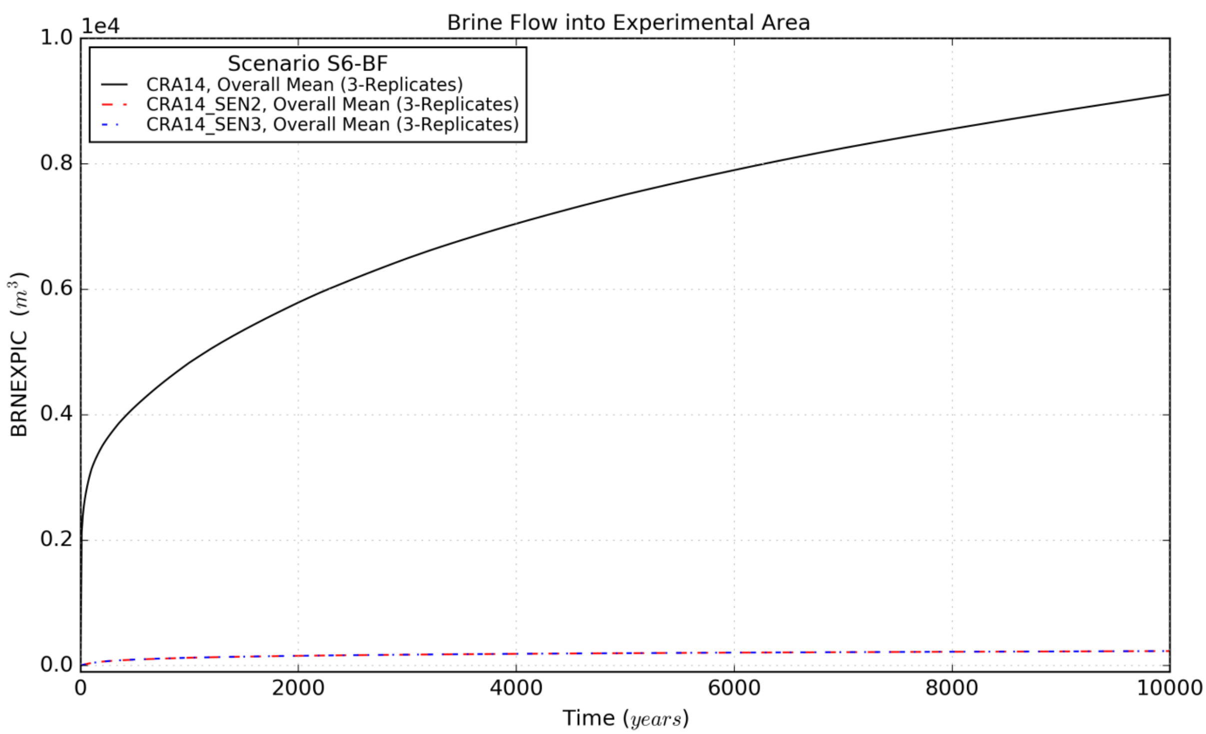

Figure 4-24: Brine Inflow Means to the Experimental Area, Scenario S6-BF

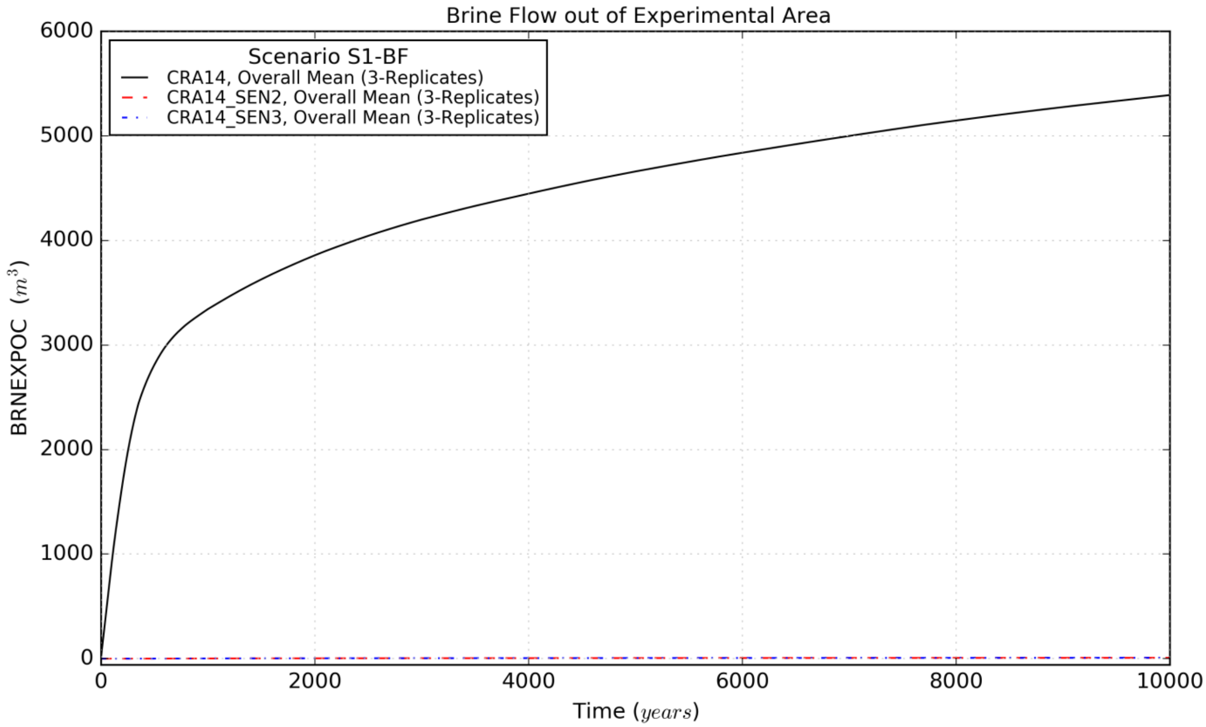

Figure 4-25: Brine Outflow Means from the Experimental Area, Scenario S1-BF

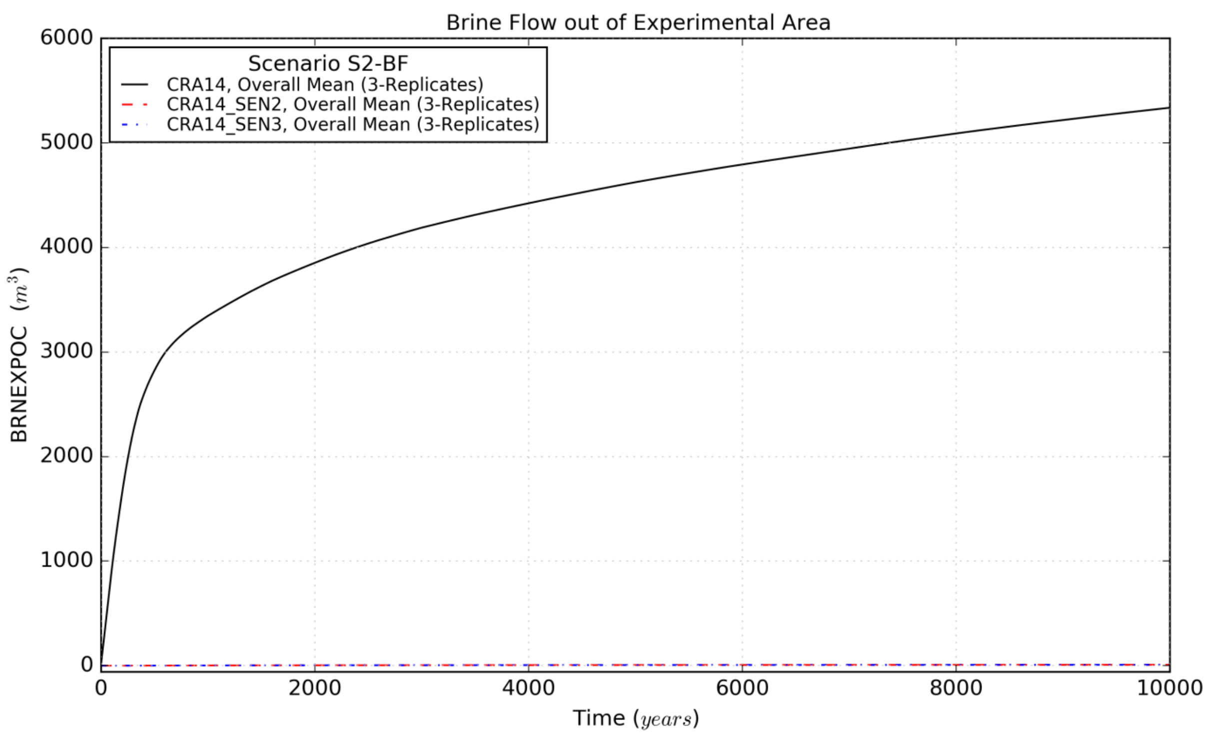

Figure 4-26: Brine Outflow Means from the Experimental Area, Scenario S2-BF

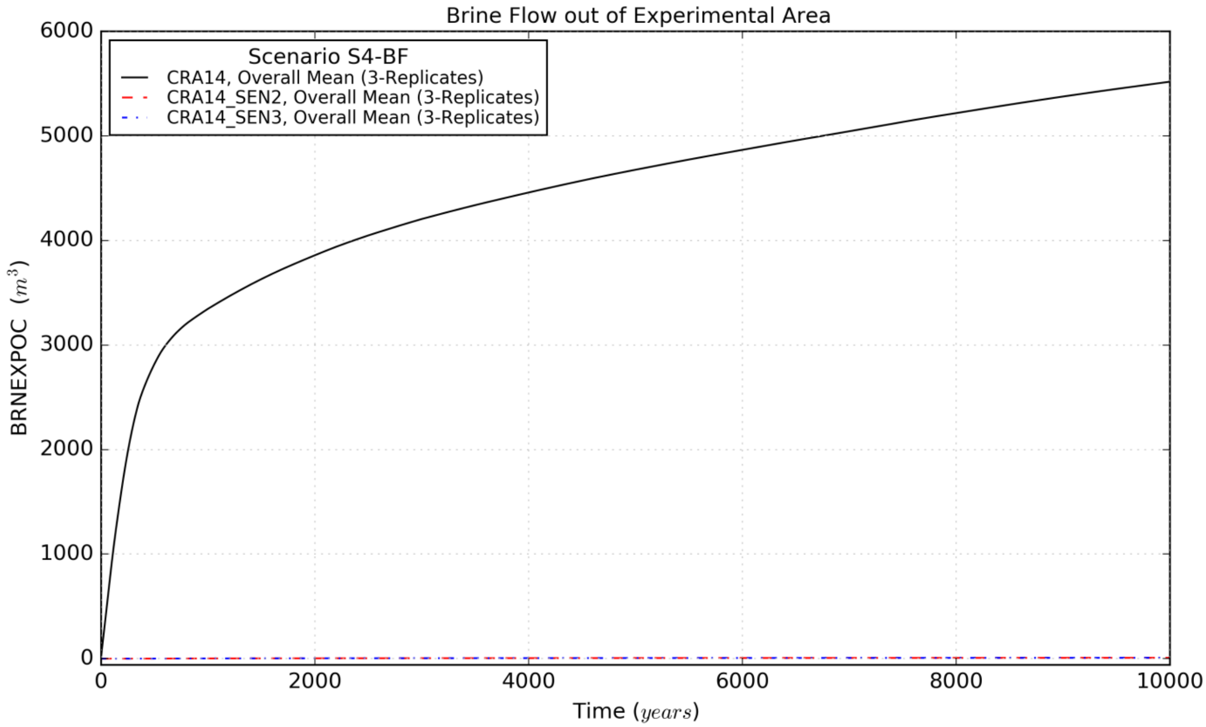

Figure 4-27: Brine Outflow Means from the Experimental Area, Scenario S4-BF

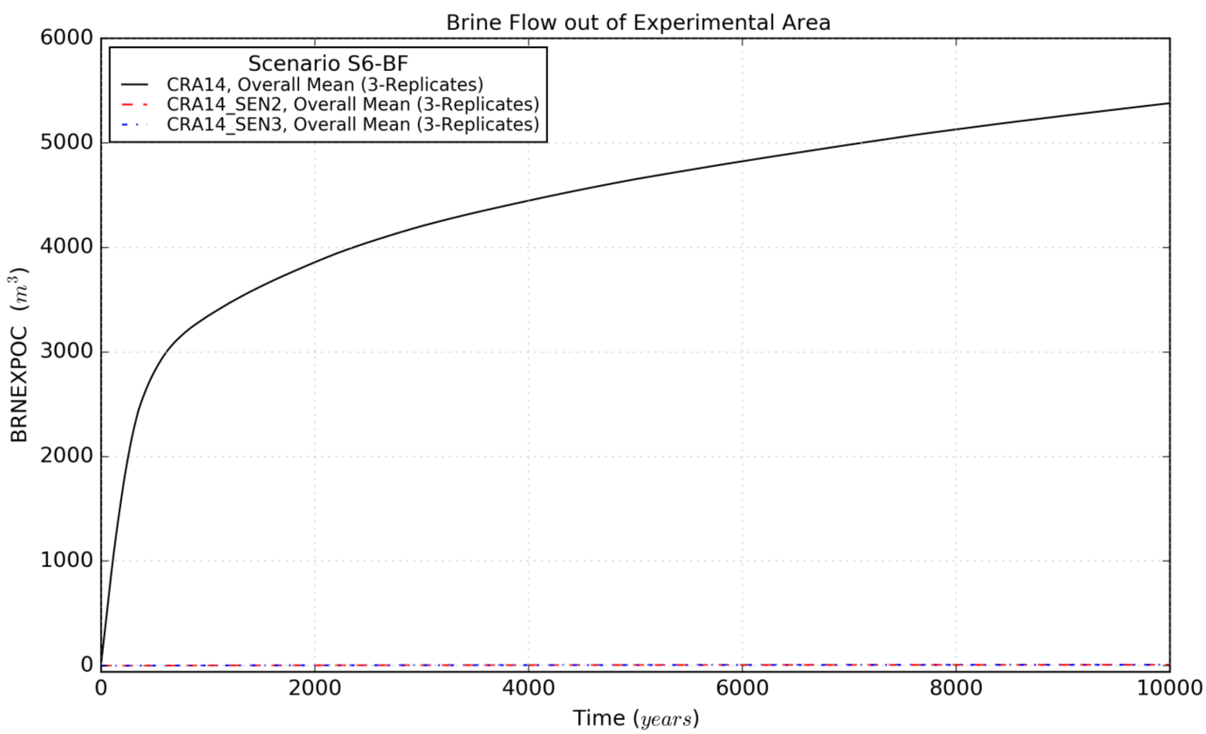

Figure 4-28: Brine Outflow Means from the Experimental Area, Scenario S6-BF

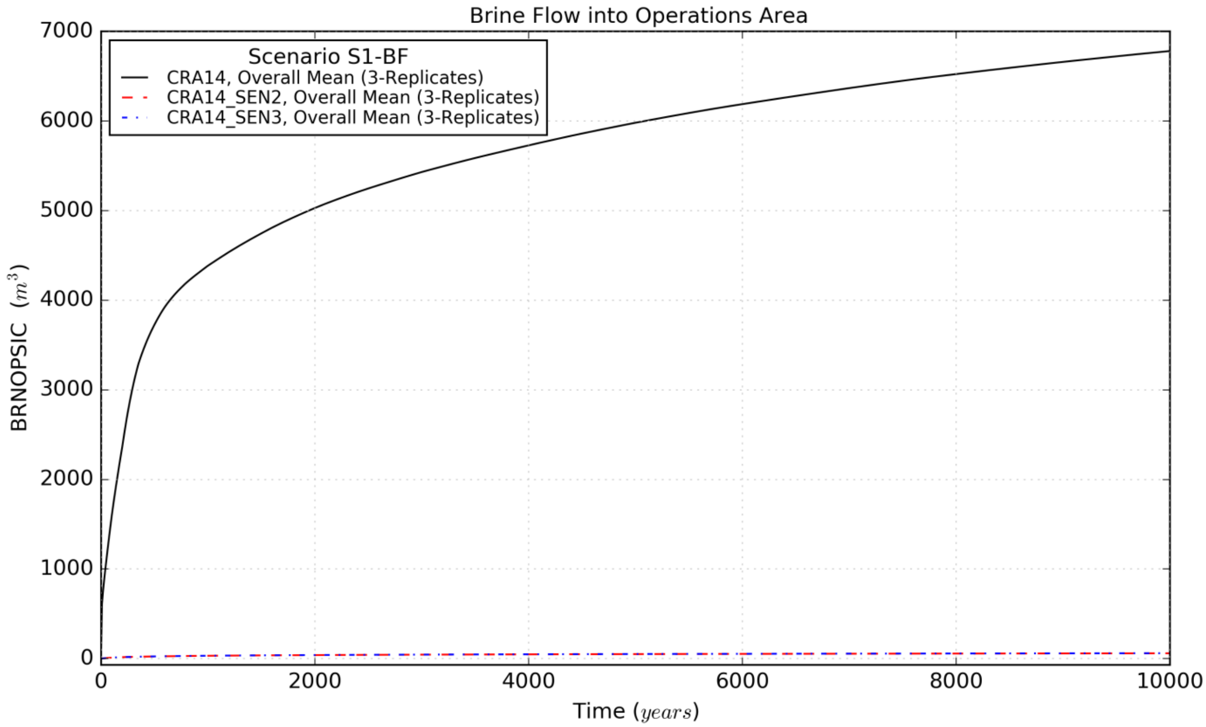

Figure 4-29: Brine Inflow Means to the Operations Area, Scenario S1-BF

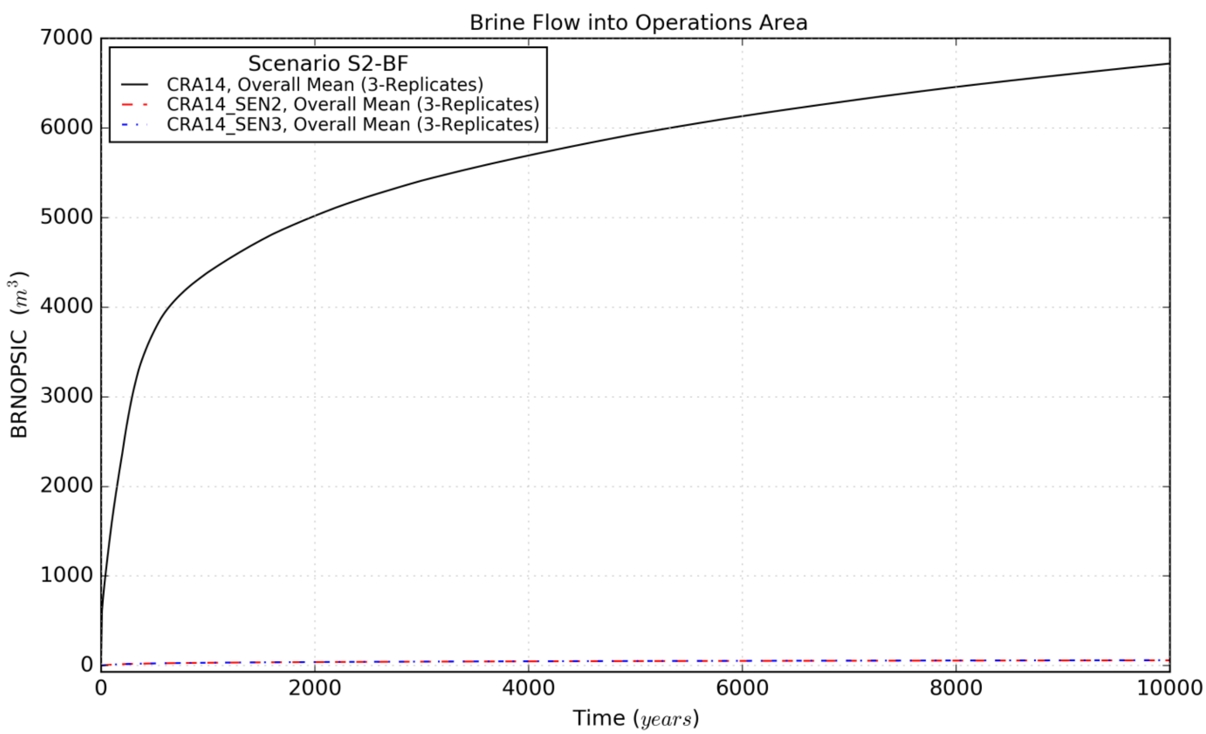

Figure 4-30: Brine Inflow Means to the Operations Area, Scenario S2-BF

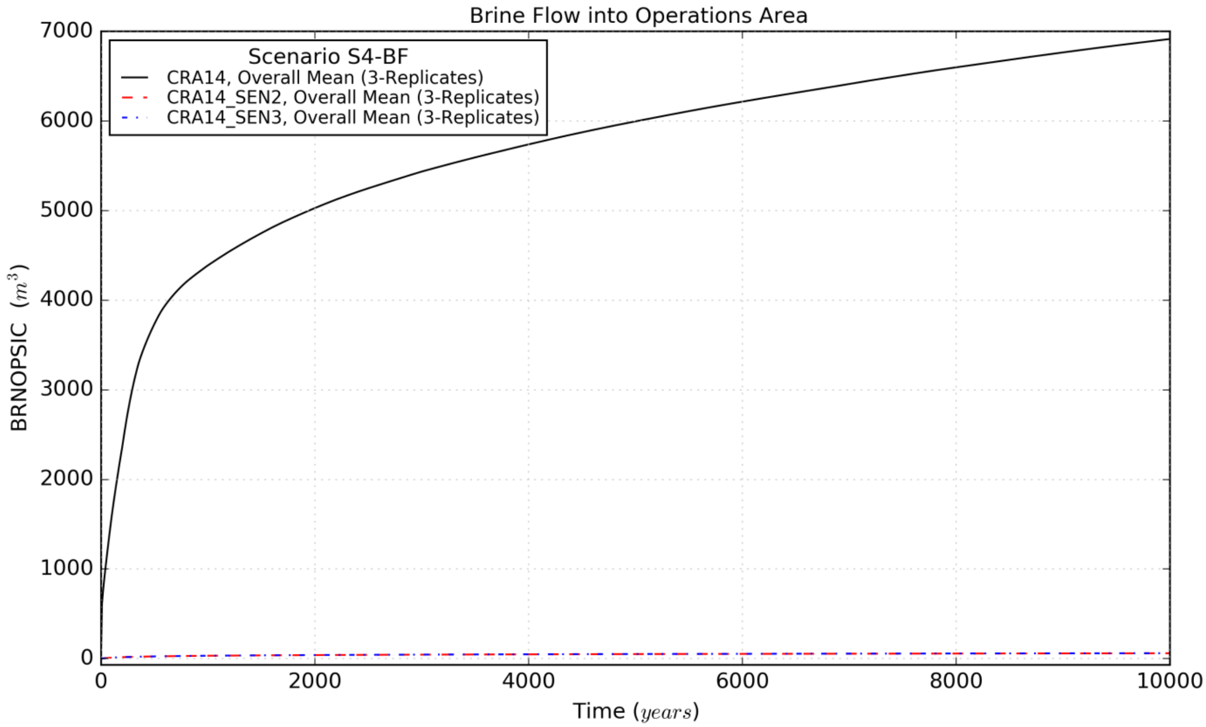

Figure 4-31: Brine Inflow Means to the Operations Area, Scenario S4-BF

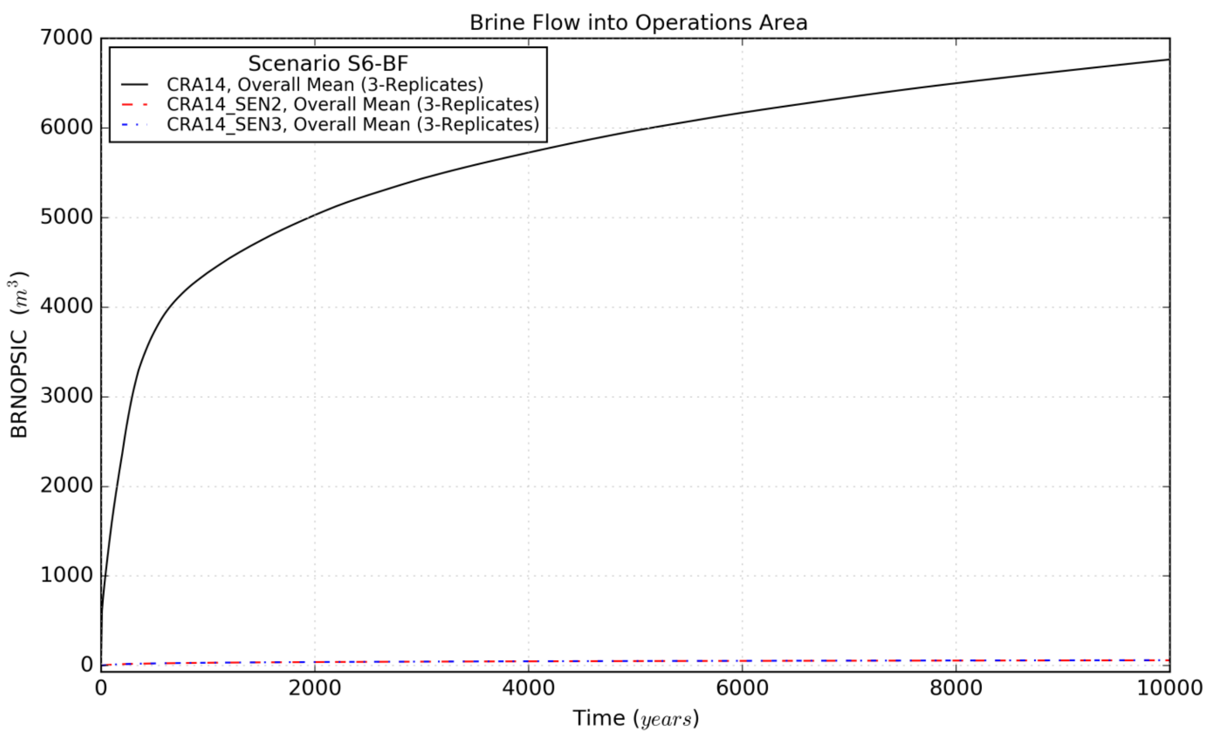

Figure 4-32: Brine Inflow Means to the Operations Area, Scenario S6-BF

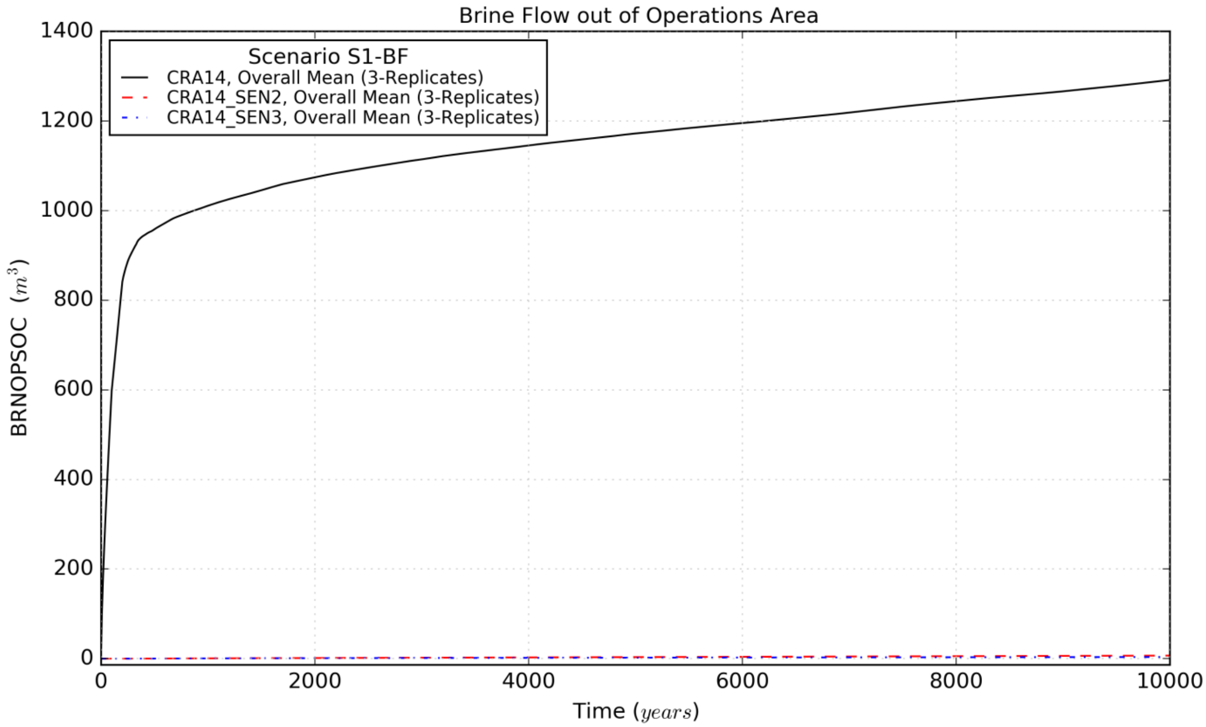

Figure 4-33: Brine Outflow Means from the Operations Area, Scenario S1-BF

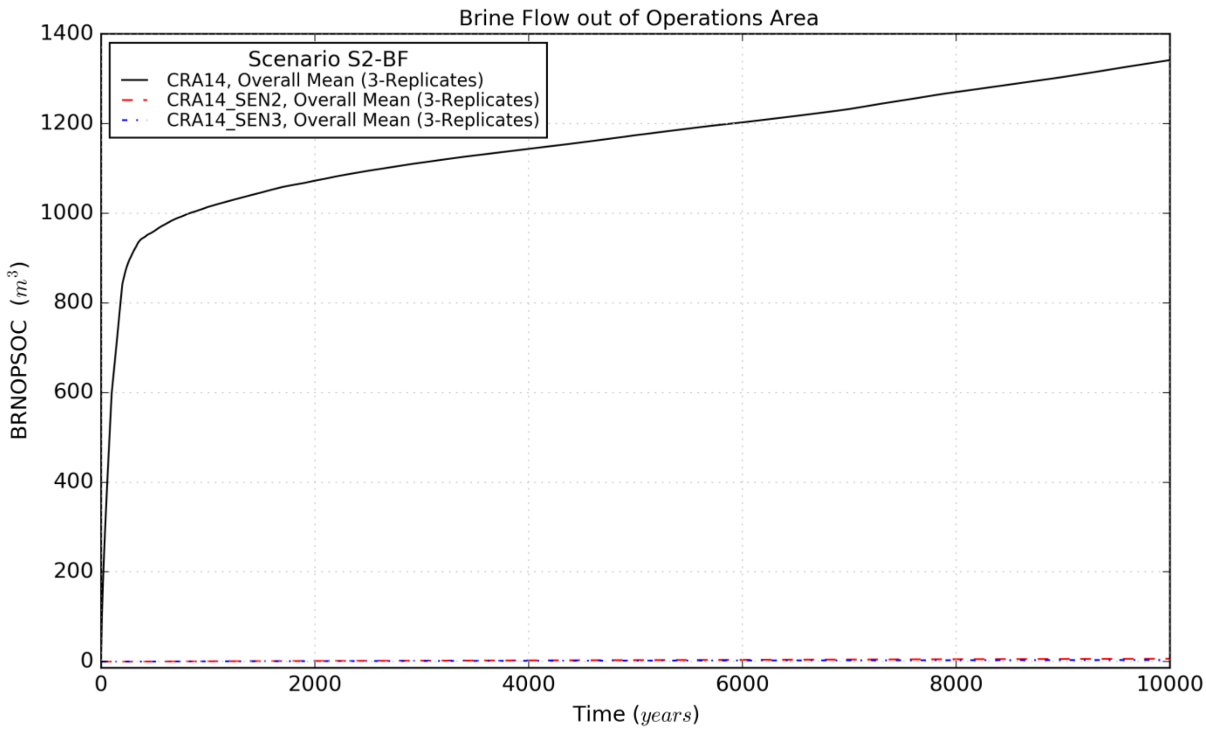

Figure 4-34: Brine Outflow Means from the Operations Area, Scenario S2-BF

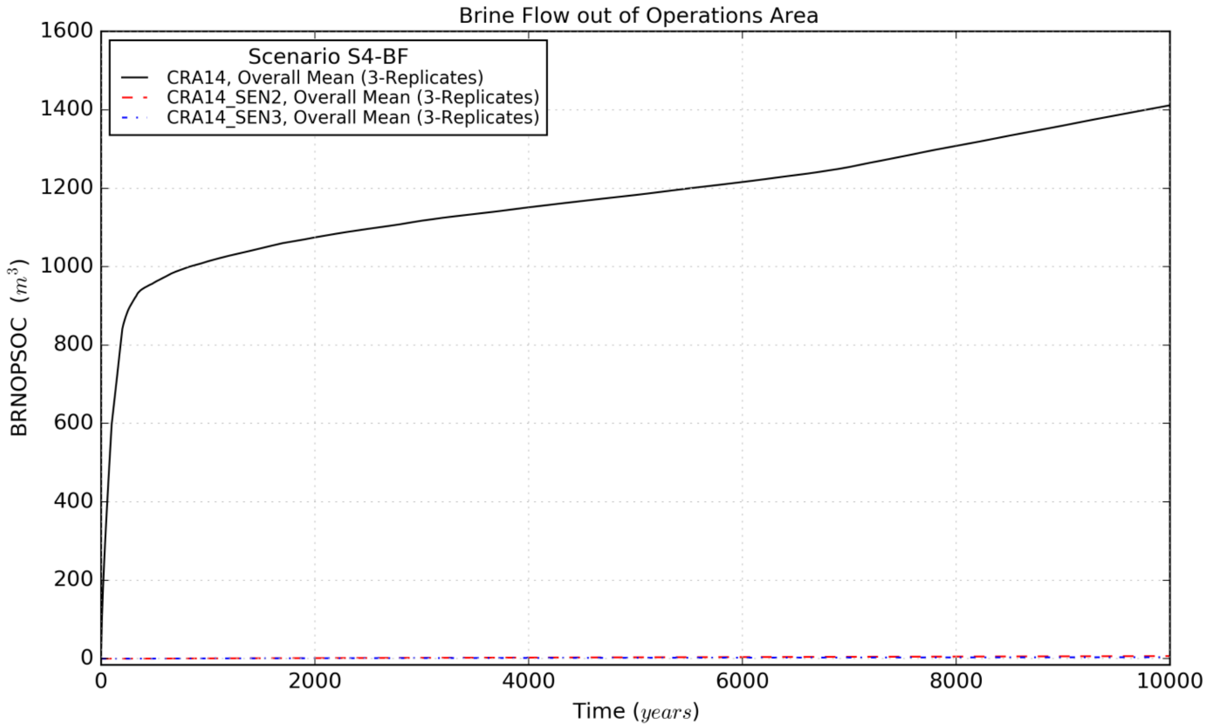

Figure 4-35: Brine Outflow Means from the Operations Area, Scenario S4-BF

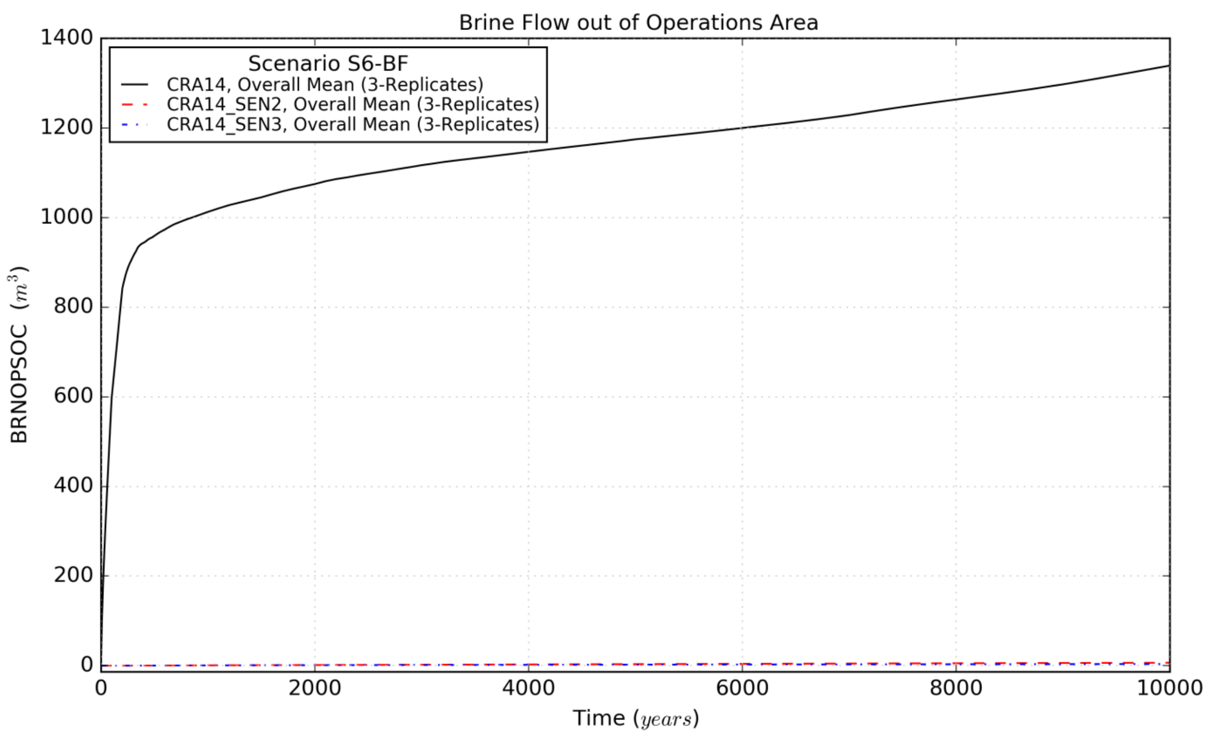

Figure 4-36: Brine Outflow Means from the Operations Area, Scenario S6-BF

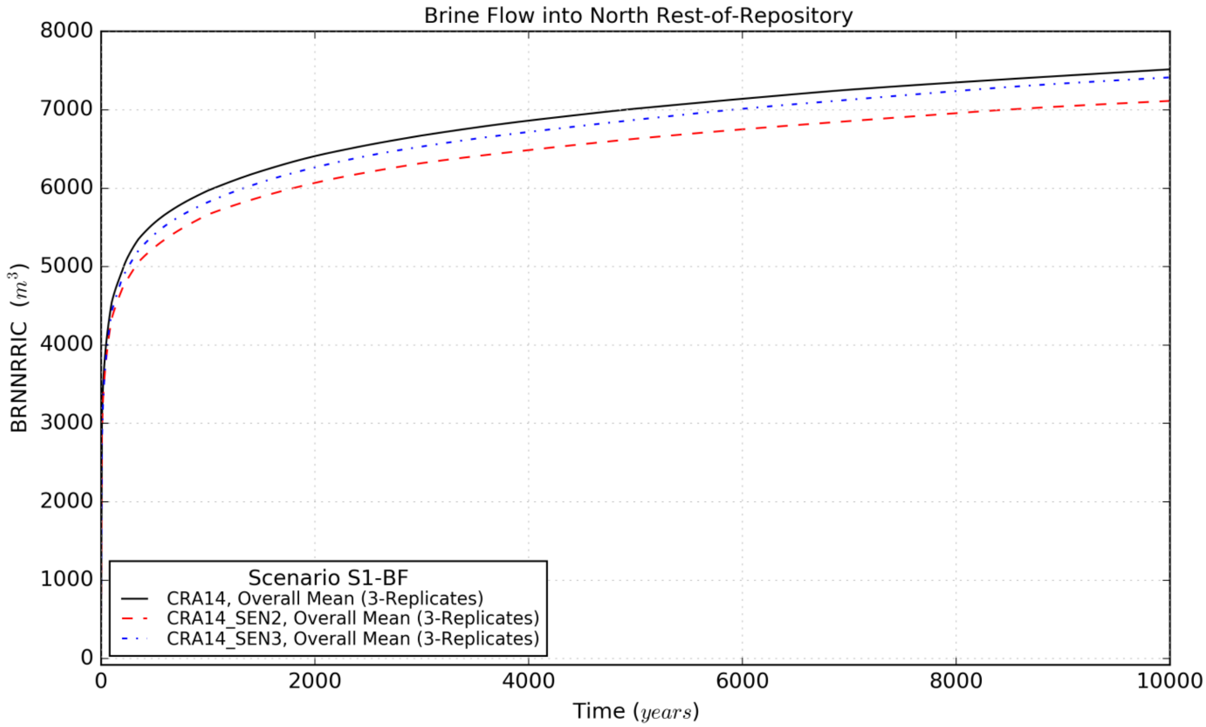

Figure 4-37: Brine Inflow Means to the North Rest-of-Repository, Scenario S1-BF

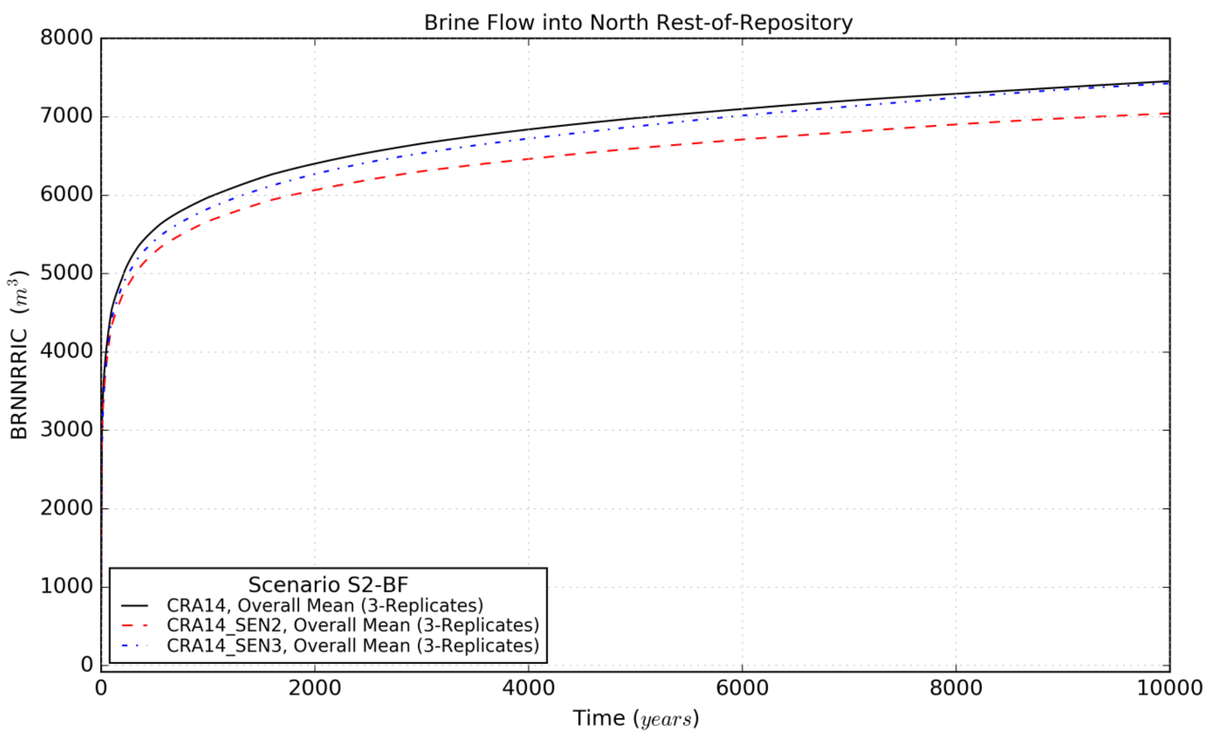

Figure 4-38: Brine Inflow Means to the North Rest-of-Repository, Scenario S2-BF

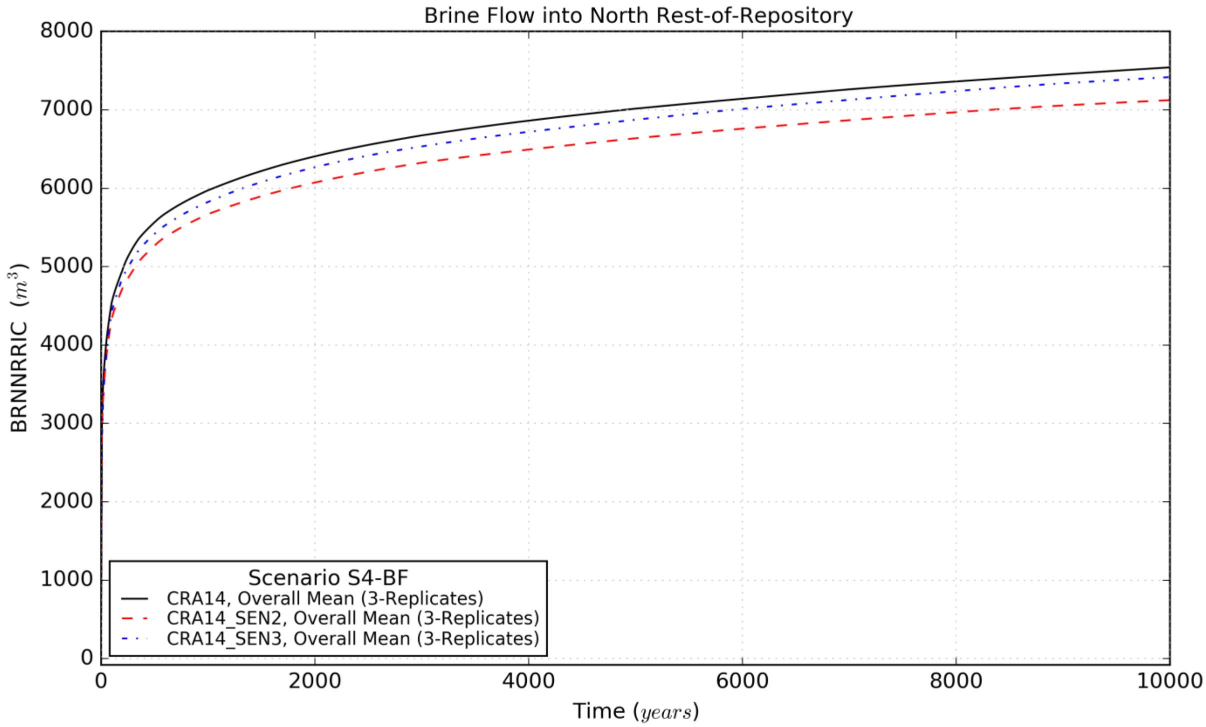

Figure 4-39: Brine Inflow Means to the North Rest-of-Repository, Scenario S4-BF

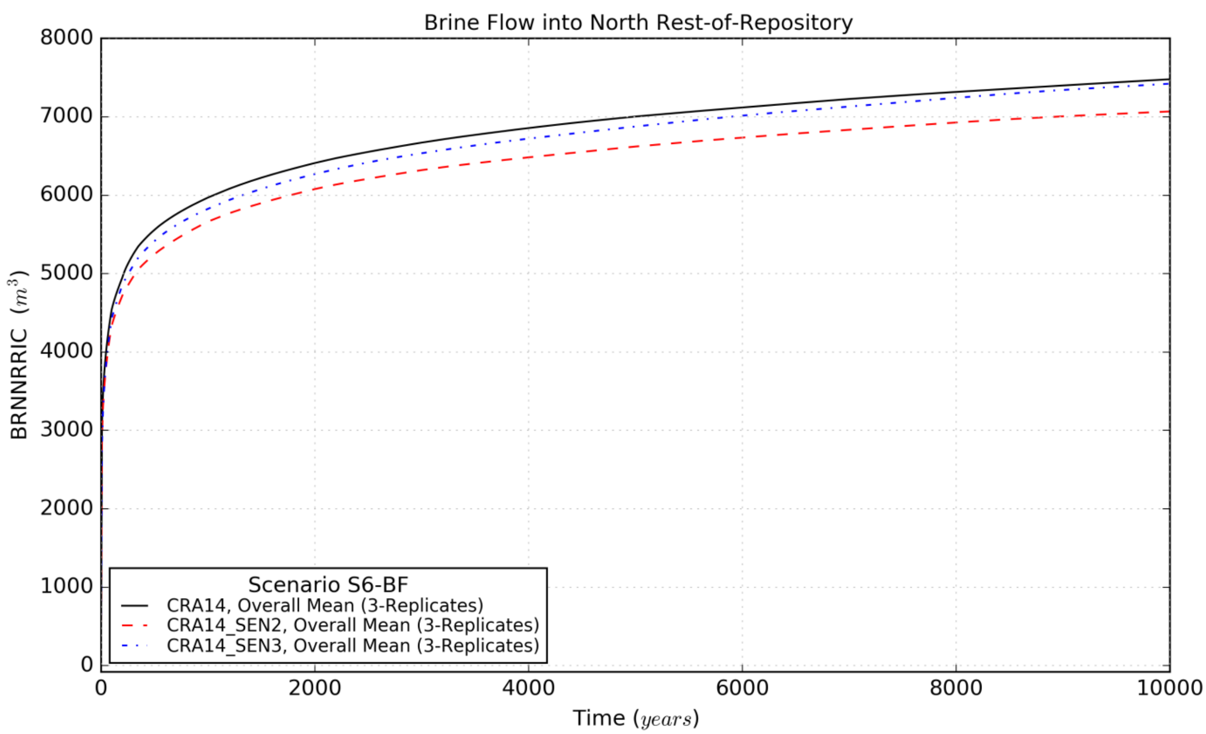

Figure 4-40: Brine Inflow Means to the North Rest-of-Repository, Scenario S6-BF

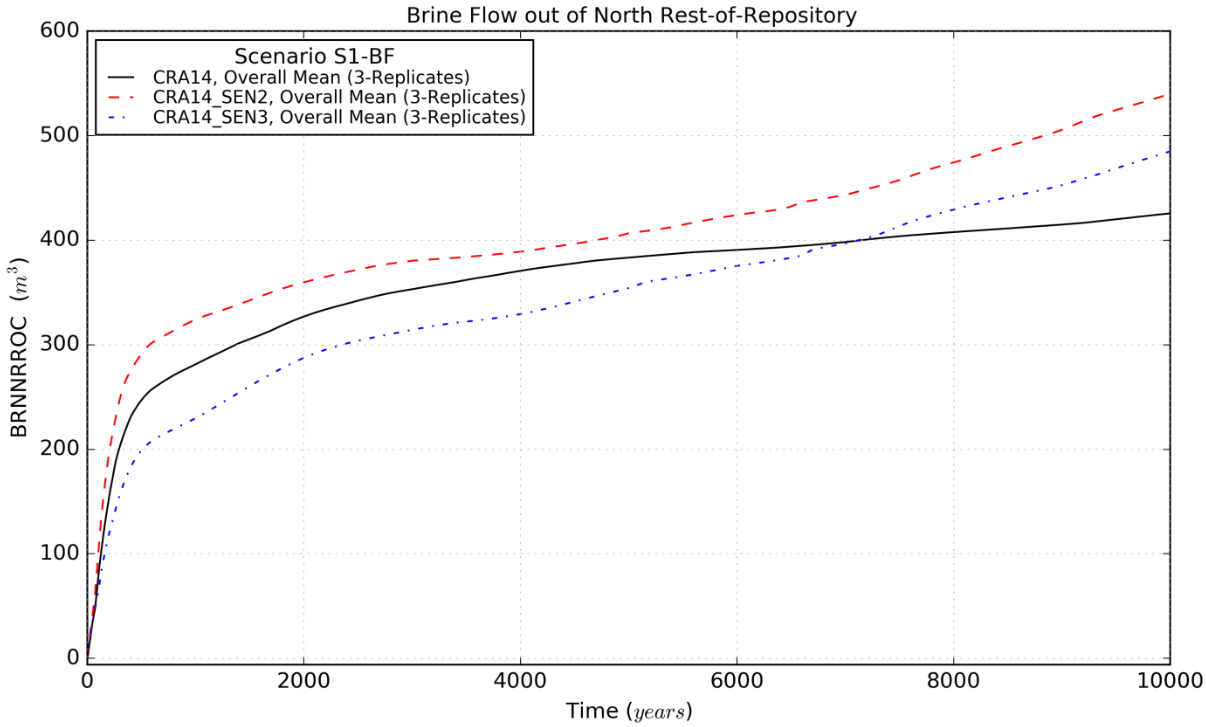

Figure 4-41: Brine Outflow Means from the North Rest-of-Repository, Scenario S1-BF

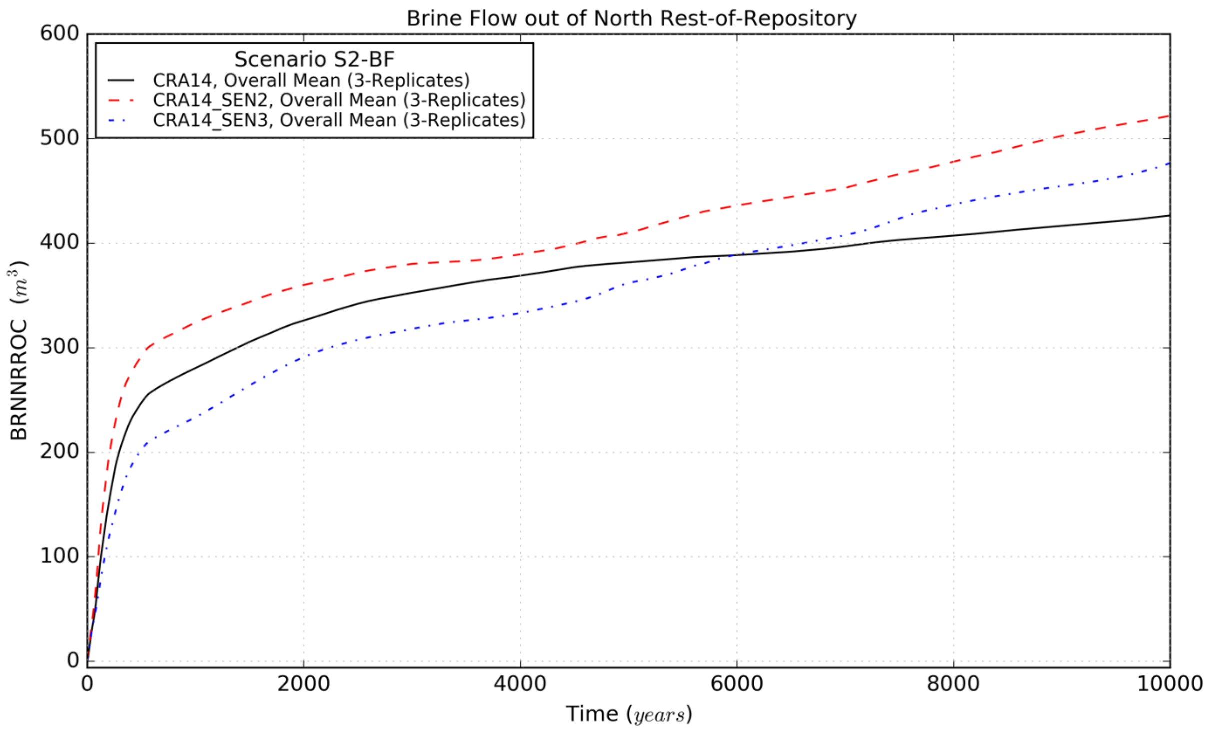

Figure 4-42: Brine Outflow Means from the North Rest-of-Repository, Scenario S2-BF

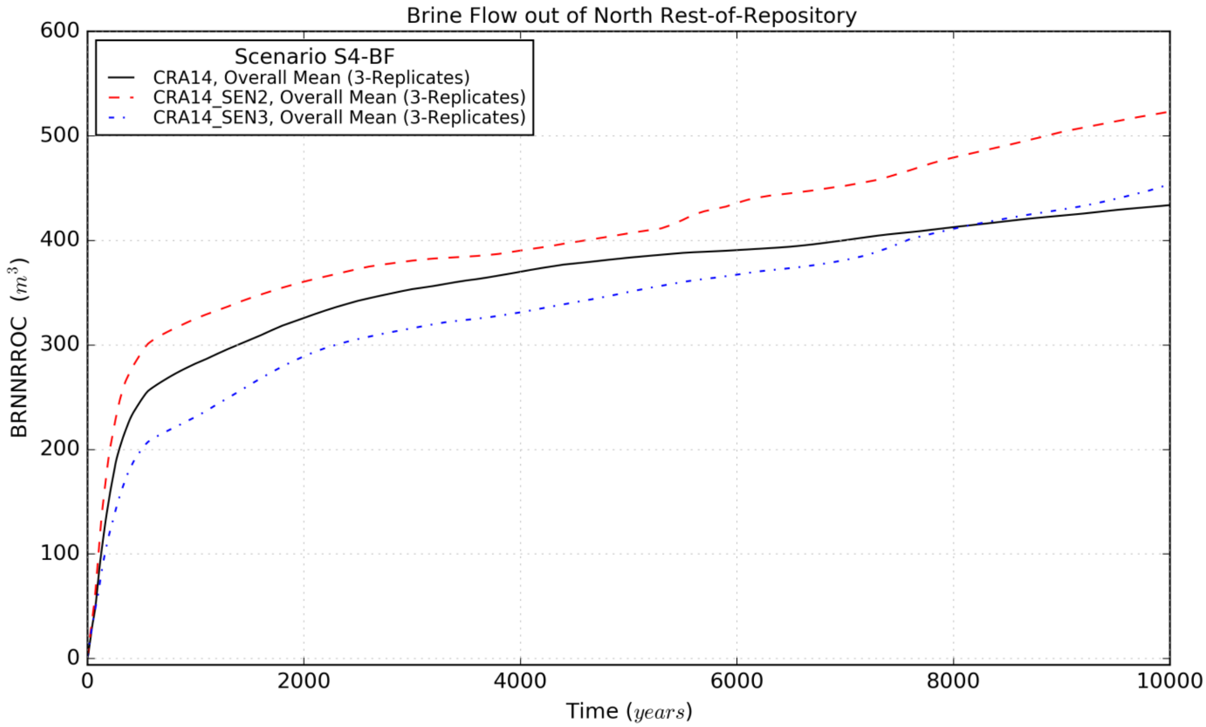

Figure 4-43: Brine Outflow Means from the North Rest-of-Repository, Scenario S4-BF

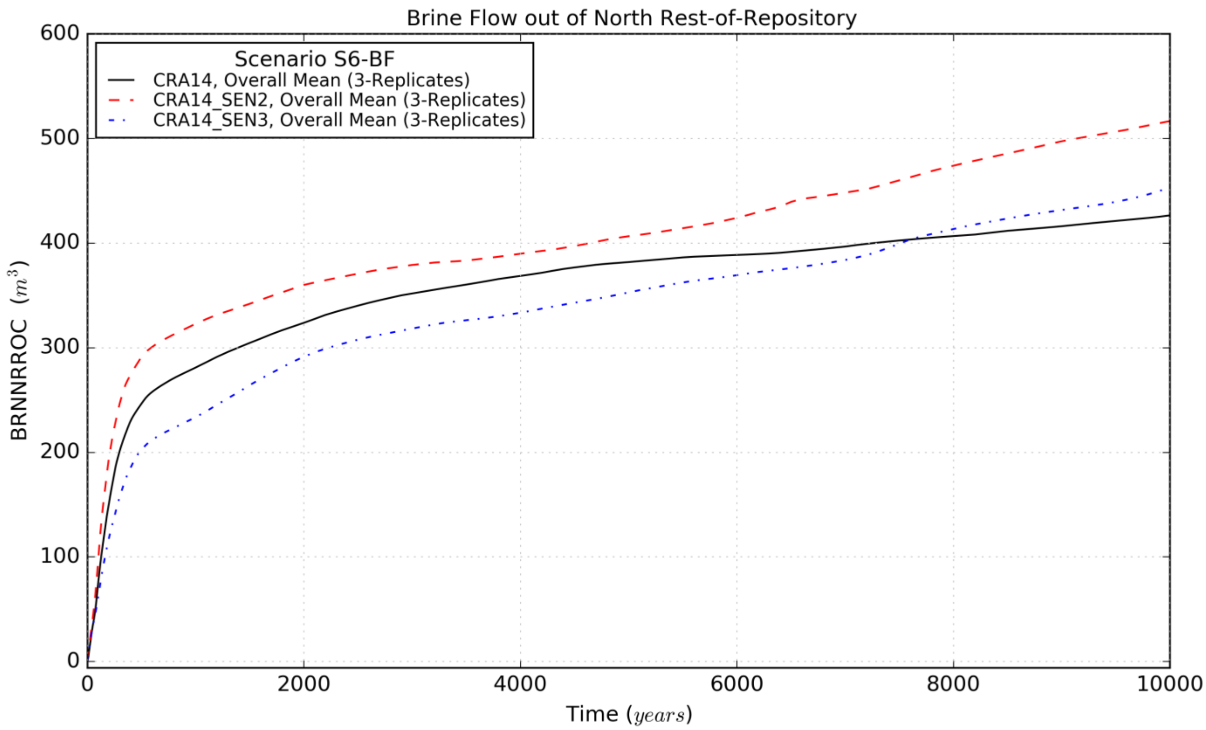

Figure 4-44: Brine Outflow Means from the North Rest-of-Repository, Scenario S6-BF

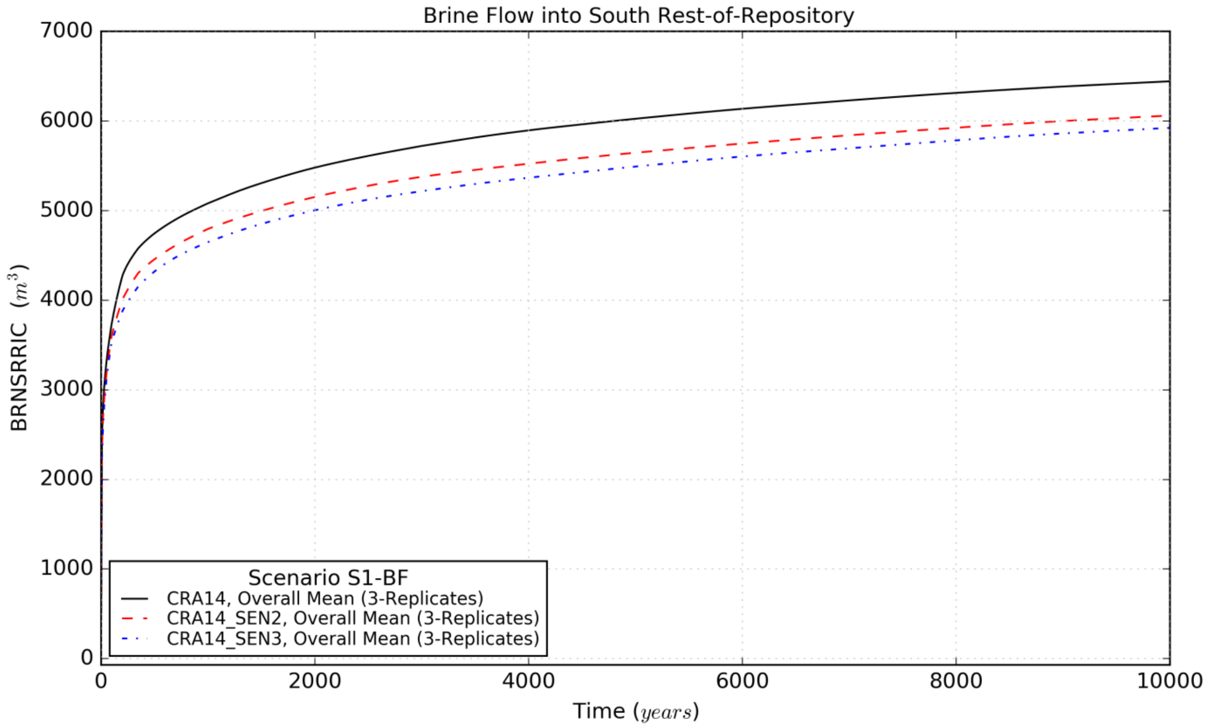

Figure 4-45: Brine Inflow Means to the South Rest-of-Repository, Scenario S1-BF

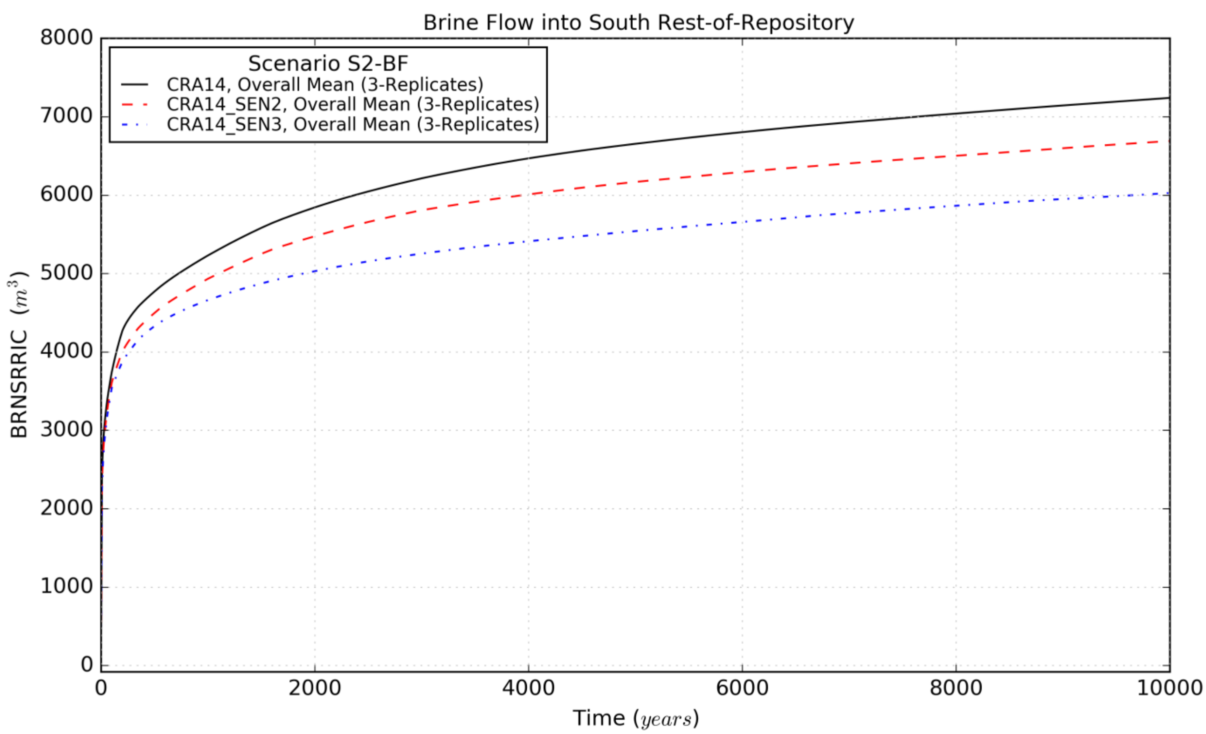

Figure 4-46: Brine Inflow Means to the South Rest-of-Repository, Scenario S2-BF

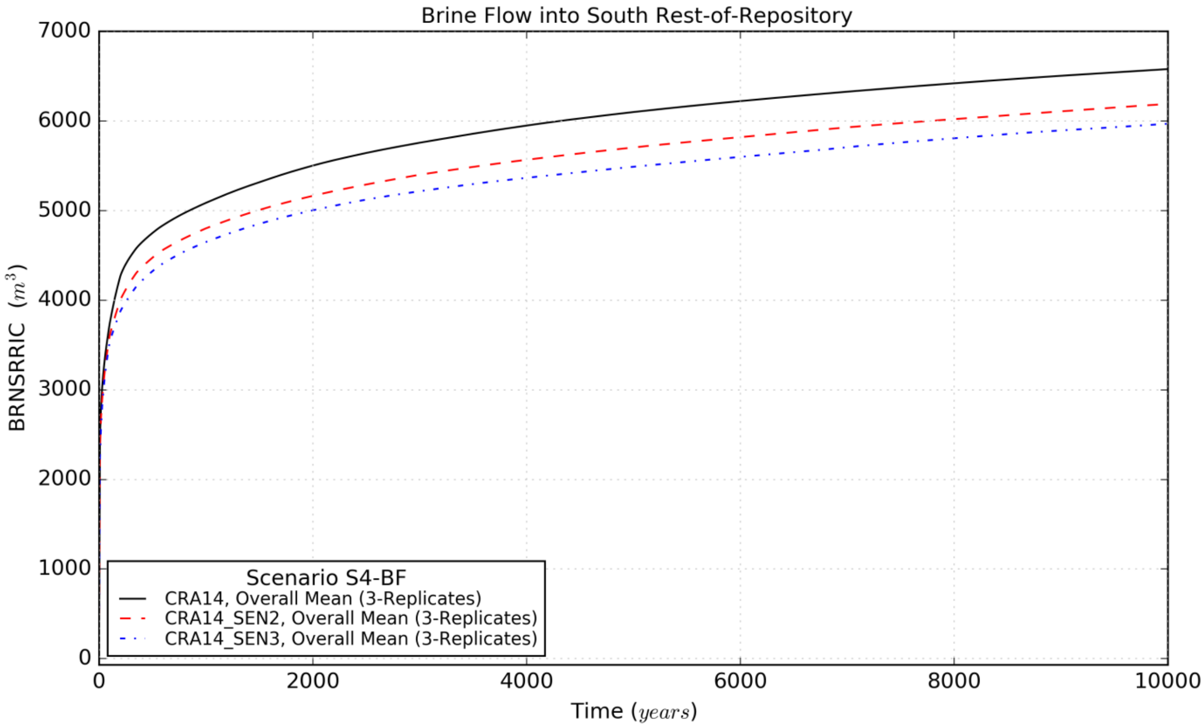

Figure 4-47: Brine Inflow Means to the South Rest-of-Repository, Scenario S4-BF

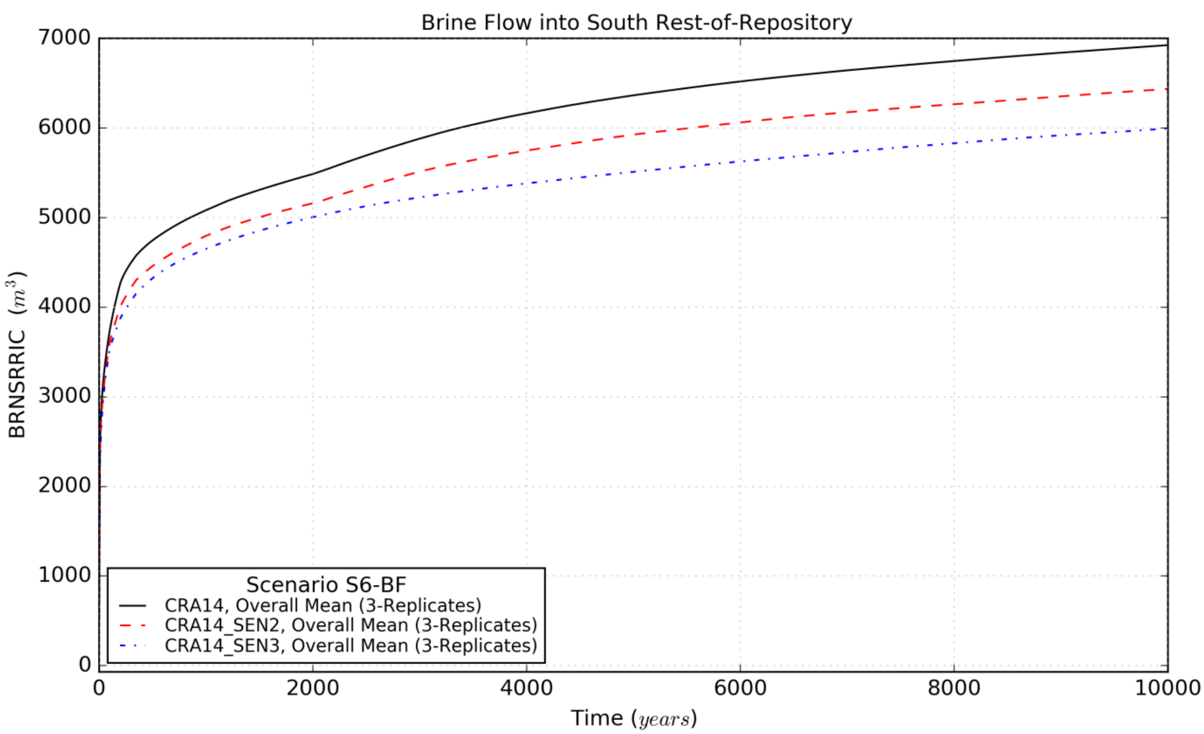

Figure 4-48: Brine Inflow Means to the South Rest-of-Repository, Scenario S6-BF

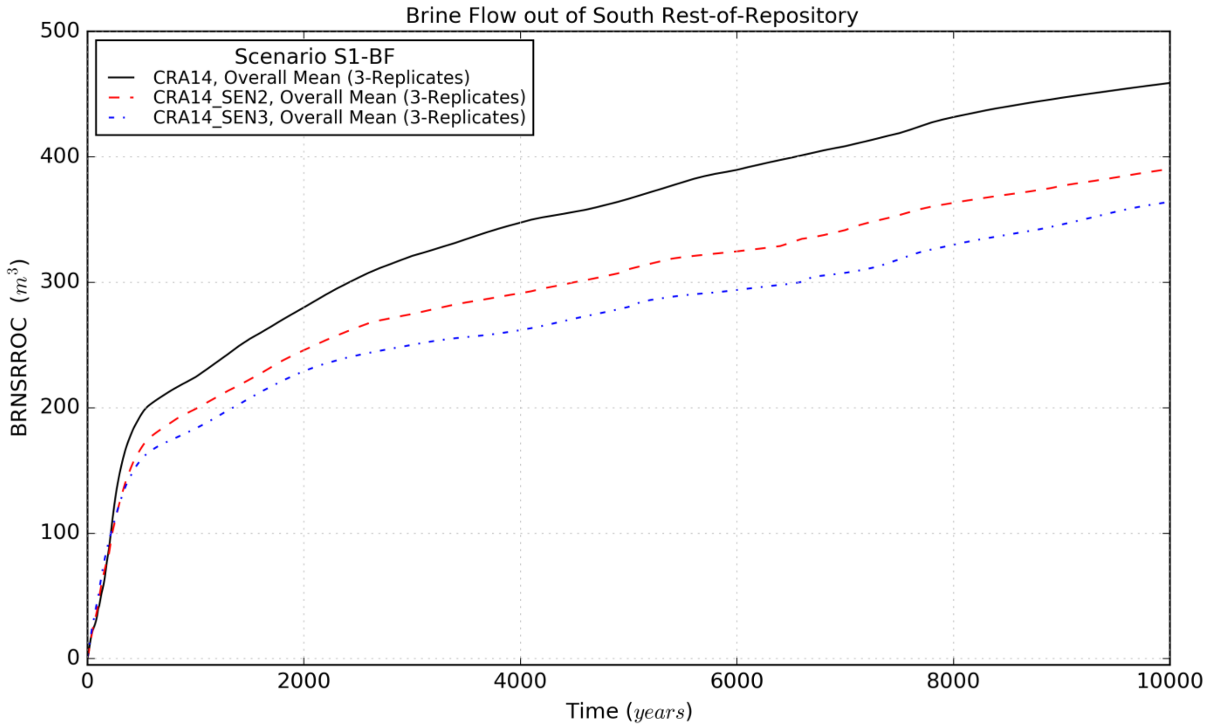

Figure 4-49: Brine Outflow Means from the South Rest-of-Repository, Scenario S1-BF

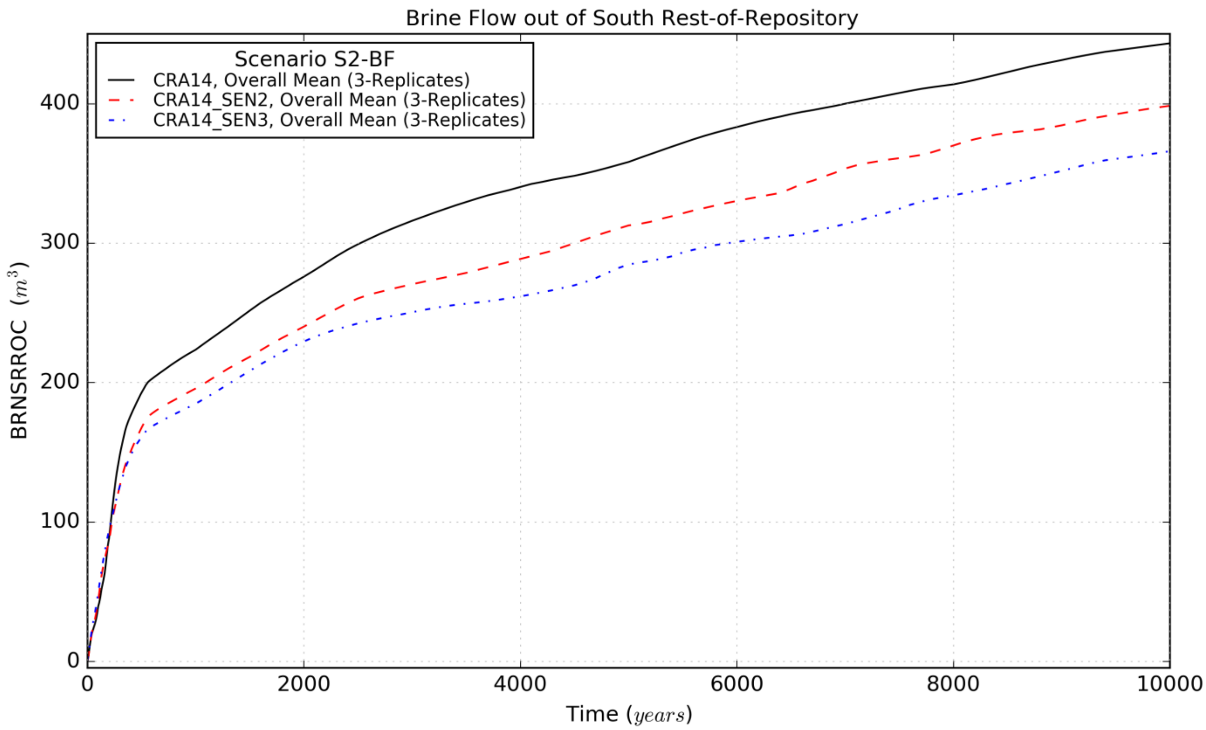

Figure 4-50: Brine Outflow Means from the South Rest-of-Repository, Scenario S2-BF

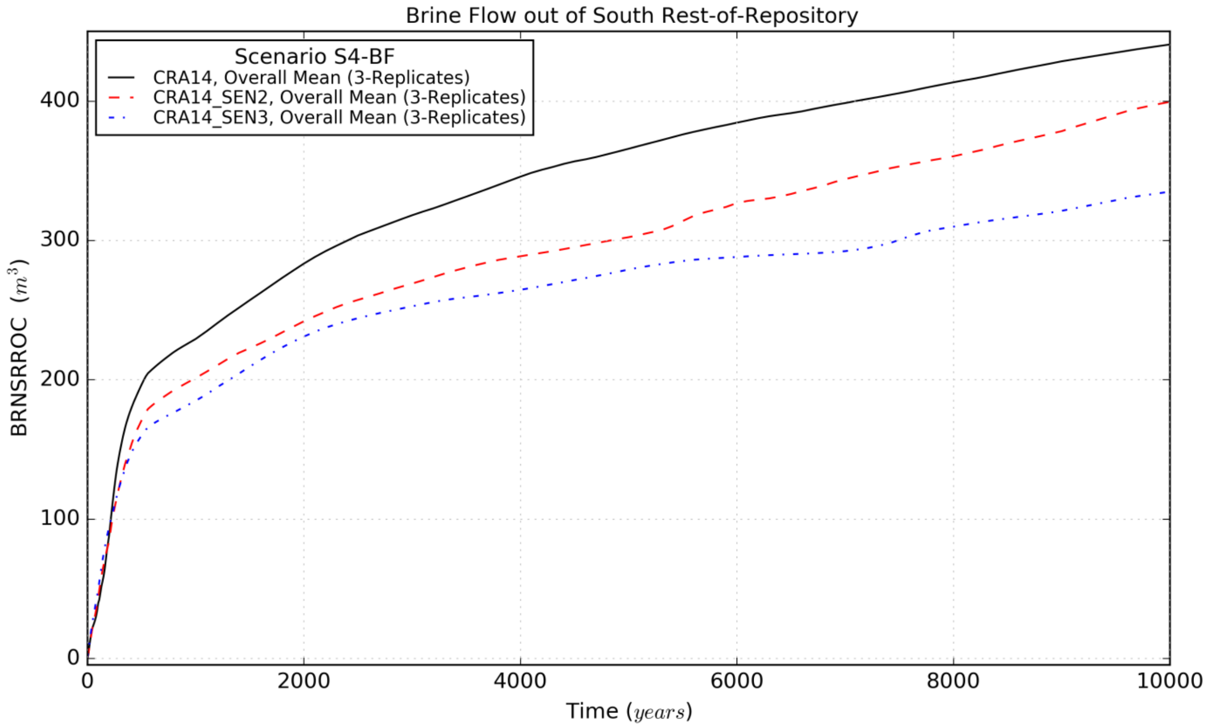

Figure 4-51: Brine Outflow Means from the South Rest-of-Repository, Scenario S4-BF

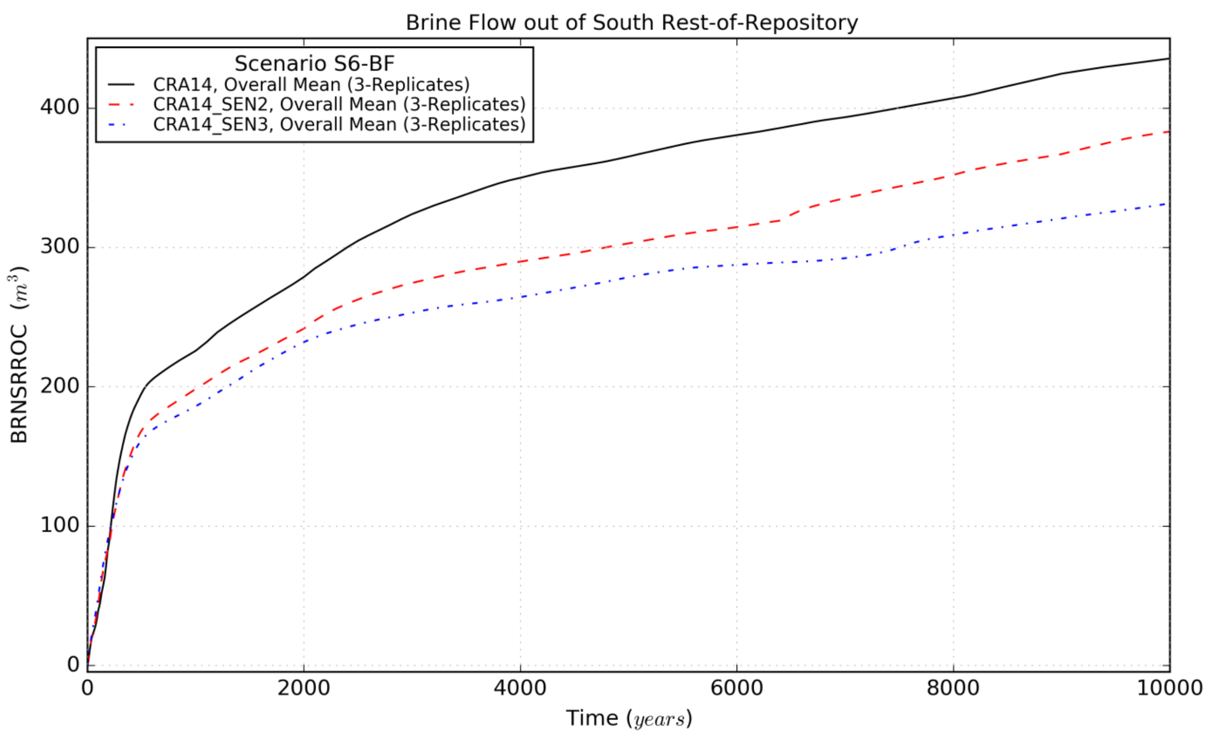

Figure 4-52: Brine Outflow Means from the South Rest-of-Repository, Scenario S6-BF

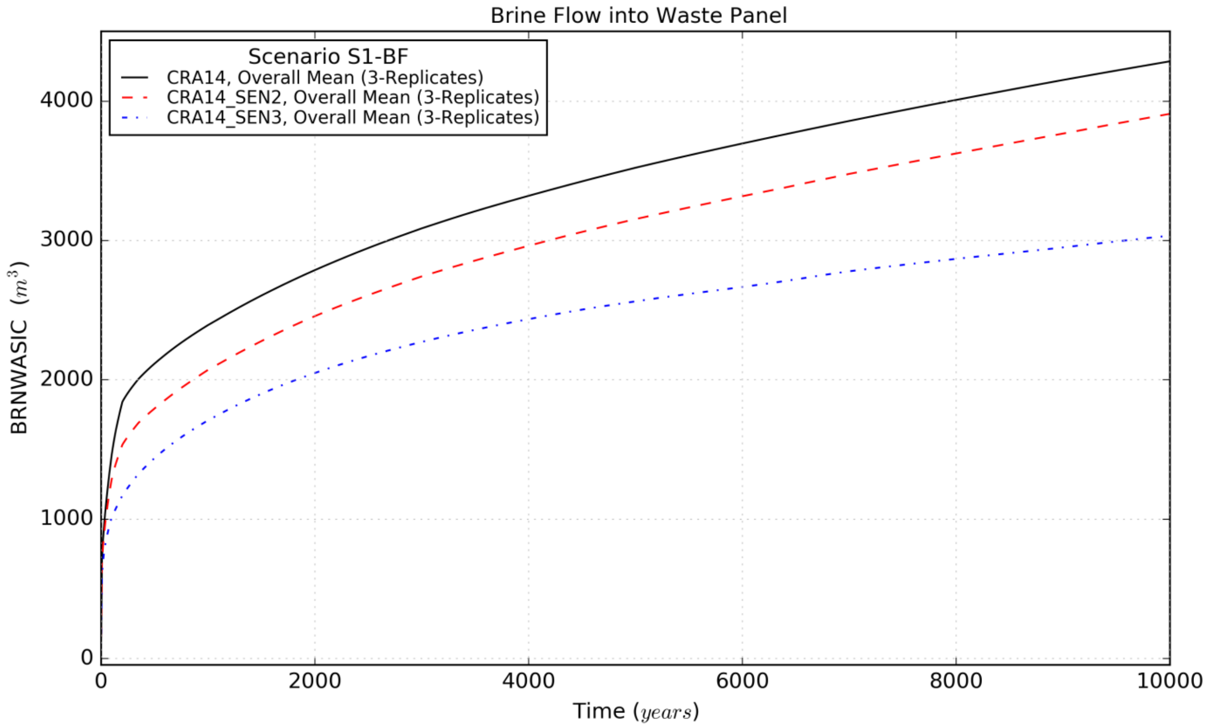

Figure 4-53: Brine Inflow Means to the Waste Panel, Scenario S1-BF

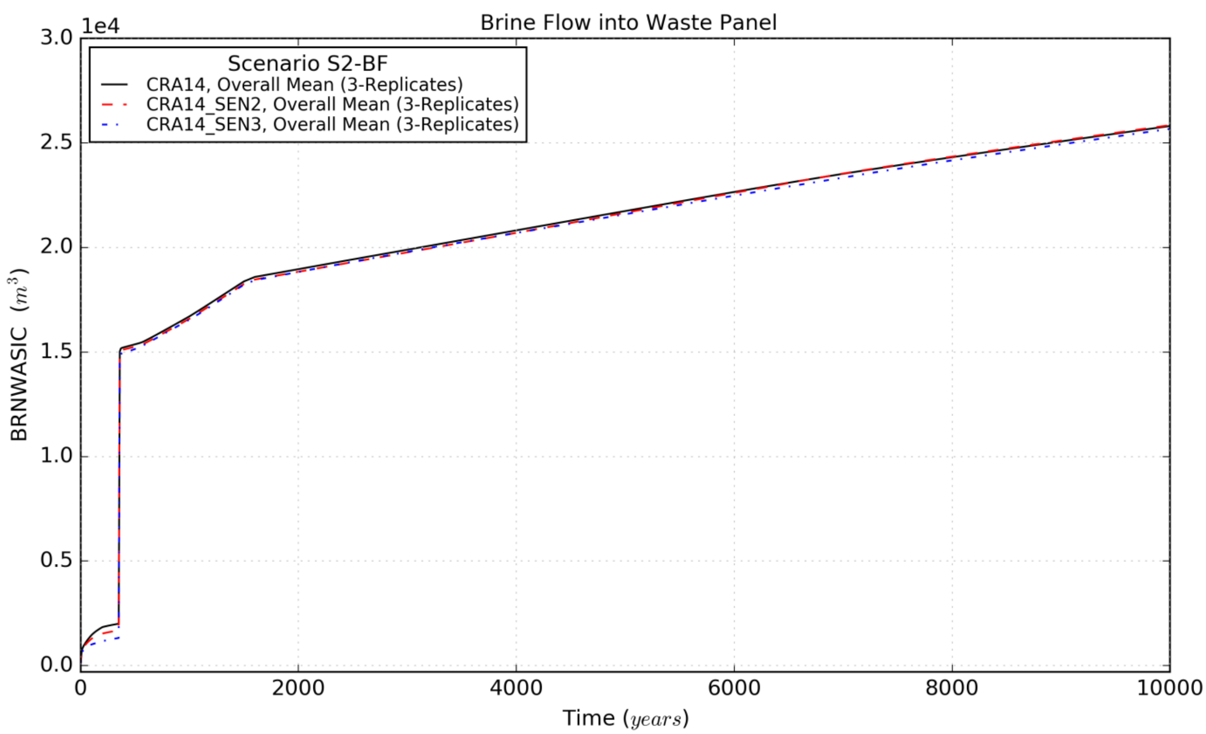

Figure 4-54: Brine Inflow Means to the Waste Panel, Scenario S2-BF

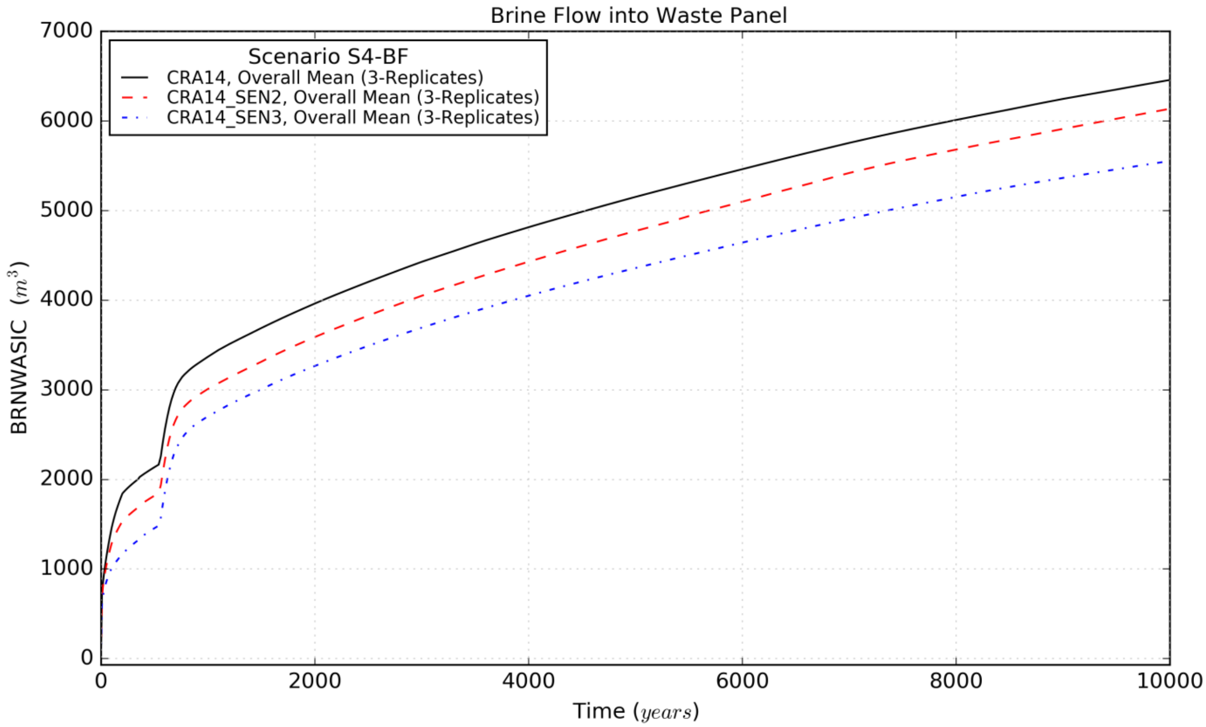

Figure 4-55: Brine Inflow Means to the Waste Panel, Scenario S4-BF

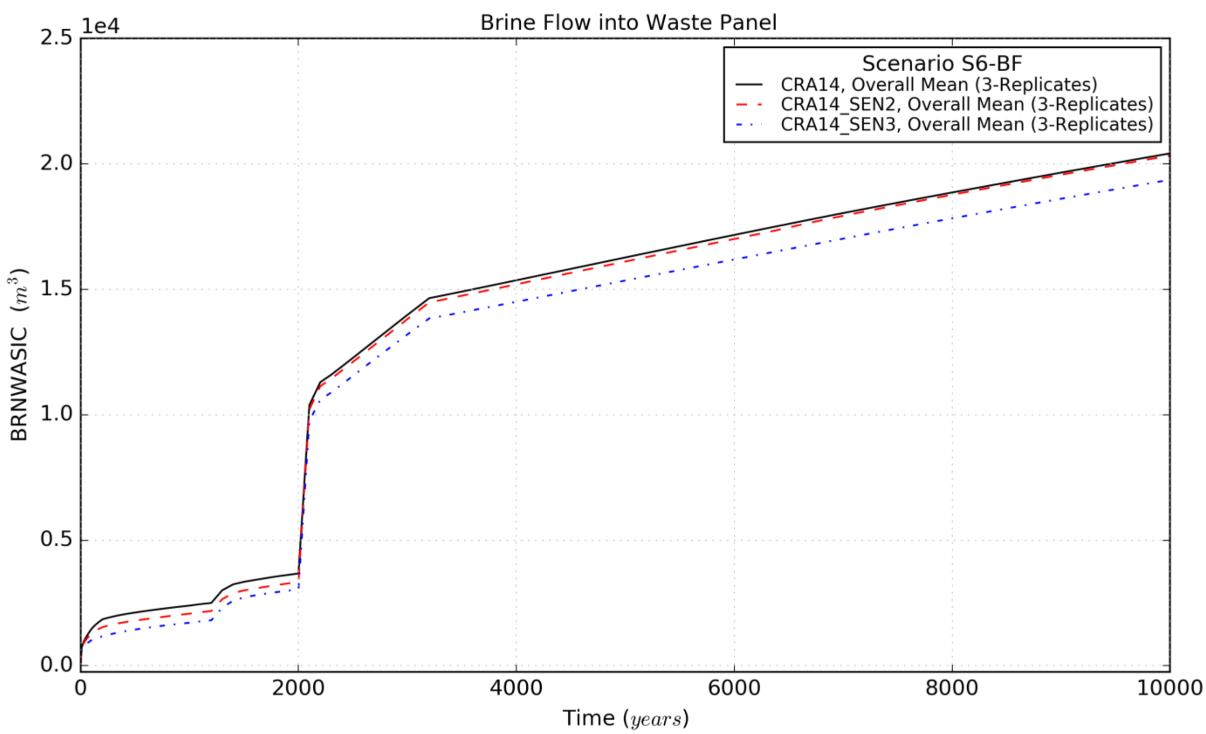

Figure 4-56: Brine Inflow Means to the Waste Panel, Scenario S6-BF

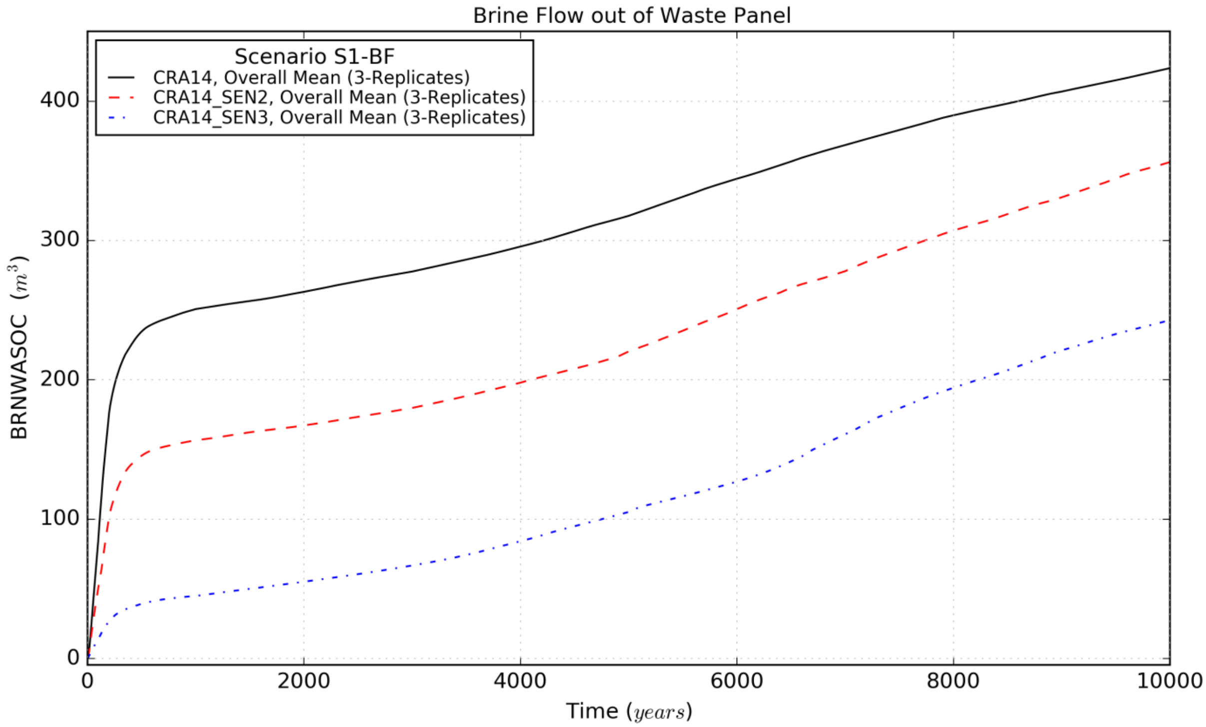

Figure 4-57: Brine Outflow Means from the Waste Panel, Scenario S1-BF

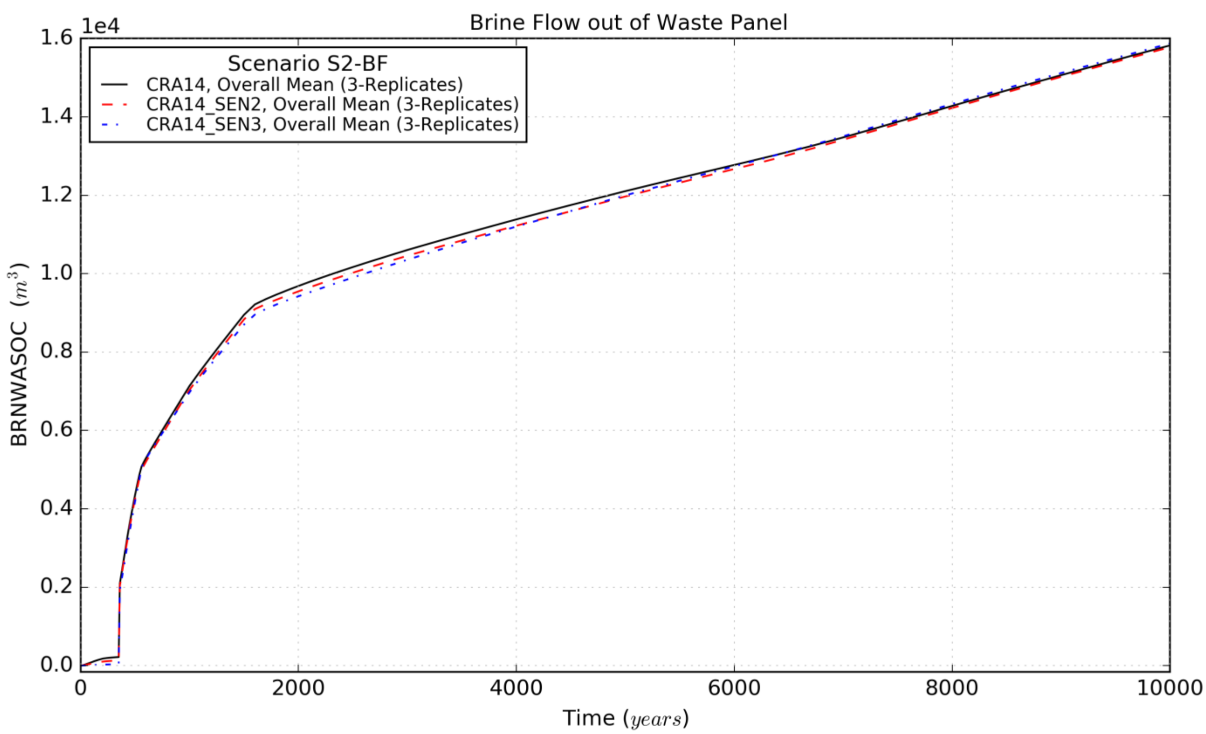

Figure 4-58: Brine Outflow Means from the Waste Panel, Scenario S2-BF

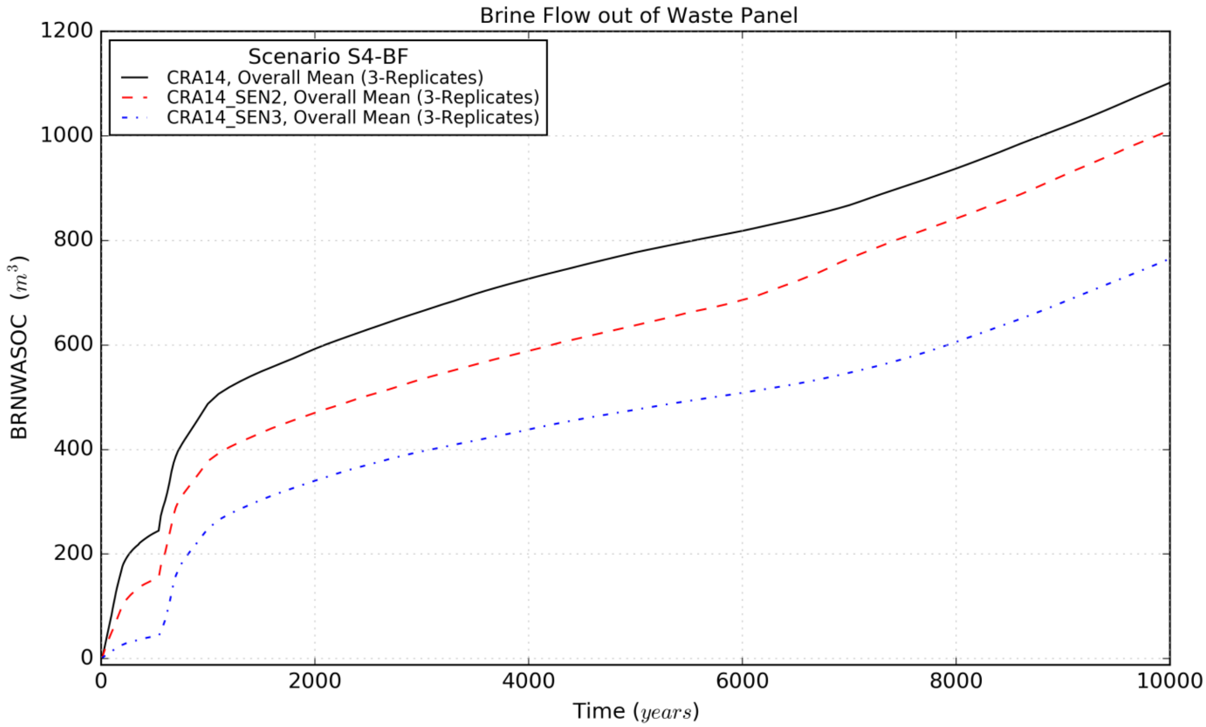

Figure 4-59: Brine Outflow Means from the Waste Panel, Scenario S4-BF

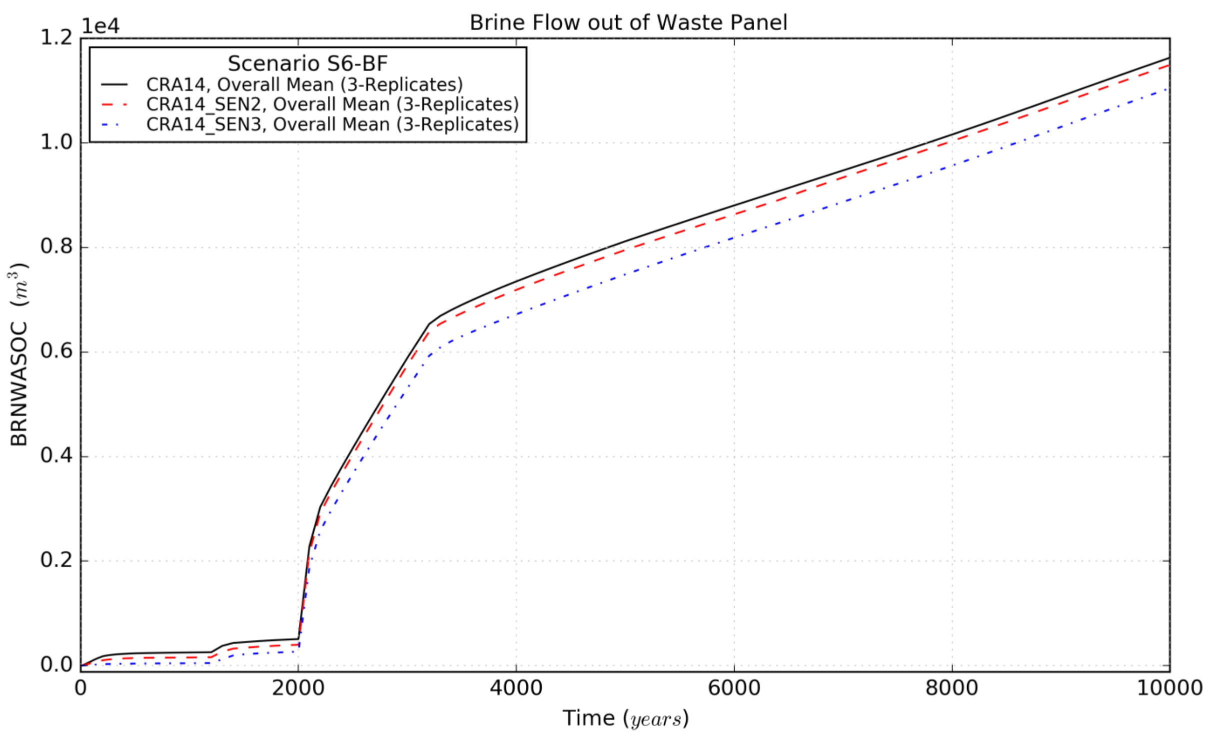

Figure 4-60: Brine Outflow Means from the Waste Panel, Scenario S6-BF

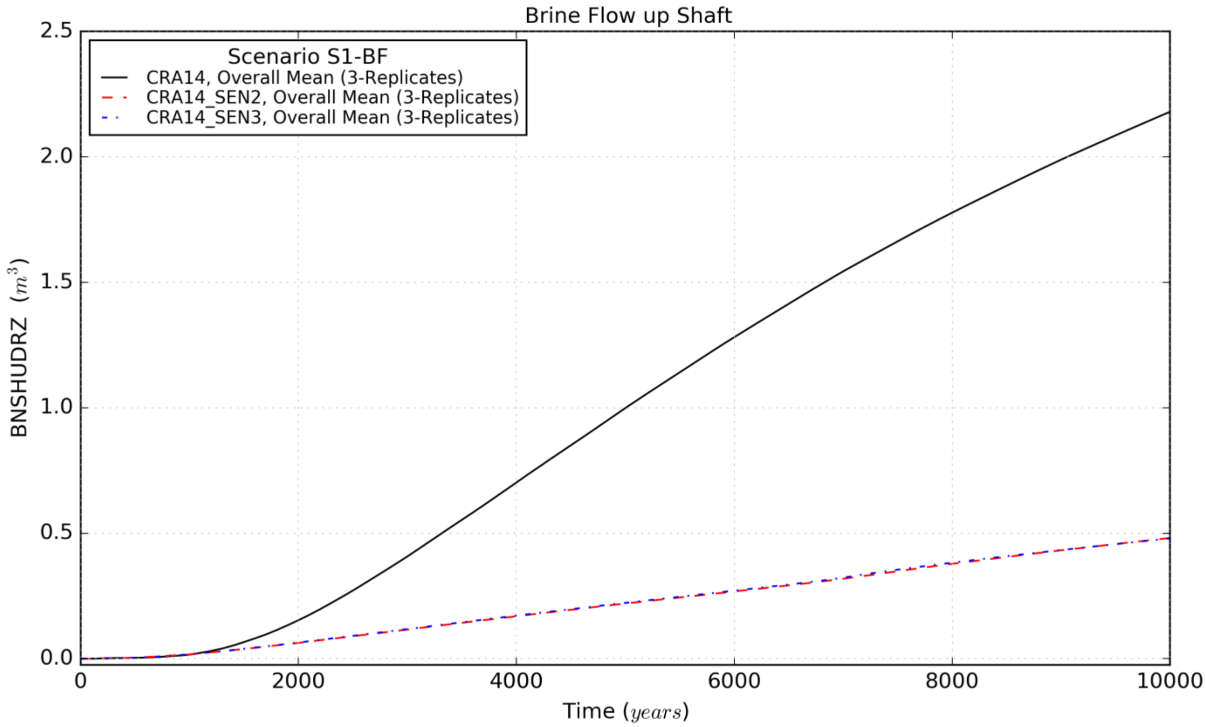

Figure 4-61: Brine Flow Means up the Shaft, Scenario S1-BF

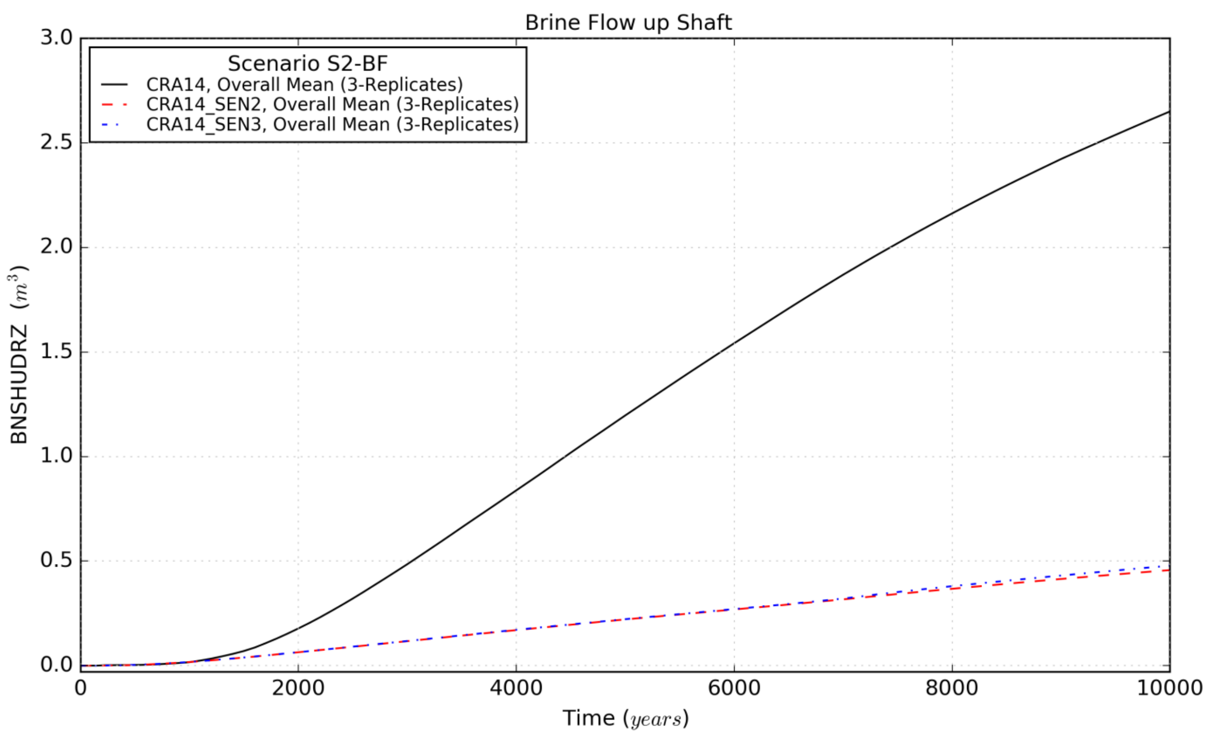

Figure 4-62: Brine Flow Means up the Shaft, Scenario S2-BF

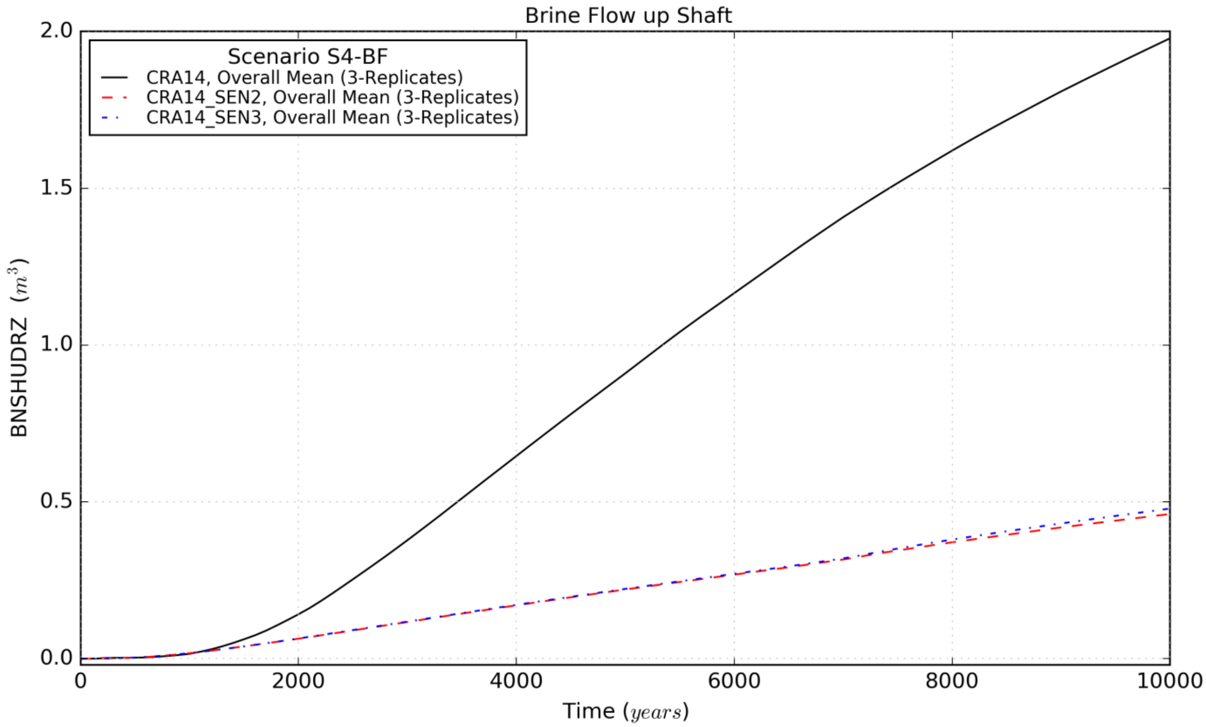

Figure 4-63: Brine Flow Means up the Shaft, Scenario S4-BF

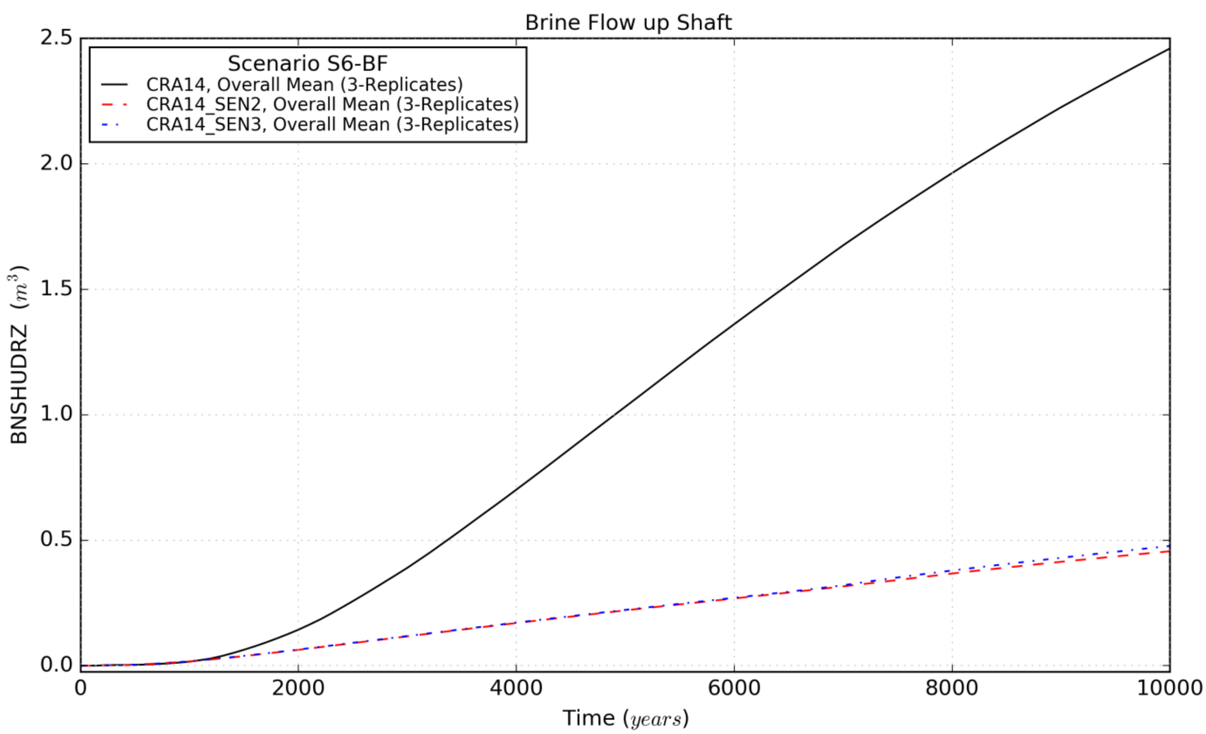

Figure 4-64: Brine Flow Means up the Shaft, Scenario S6-BF

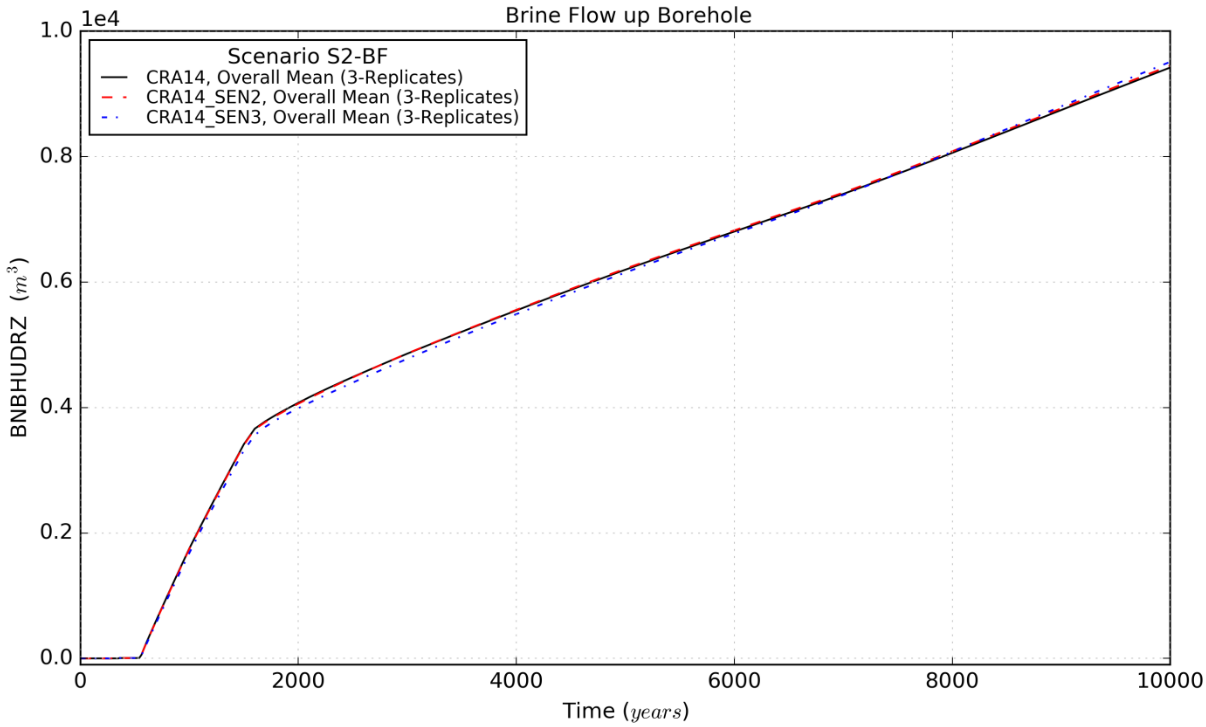

Figure 4-65: Brine Flow Means up the Borehole, Scenario S2-BF

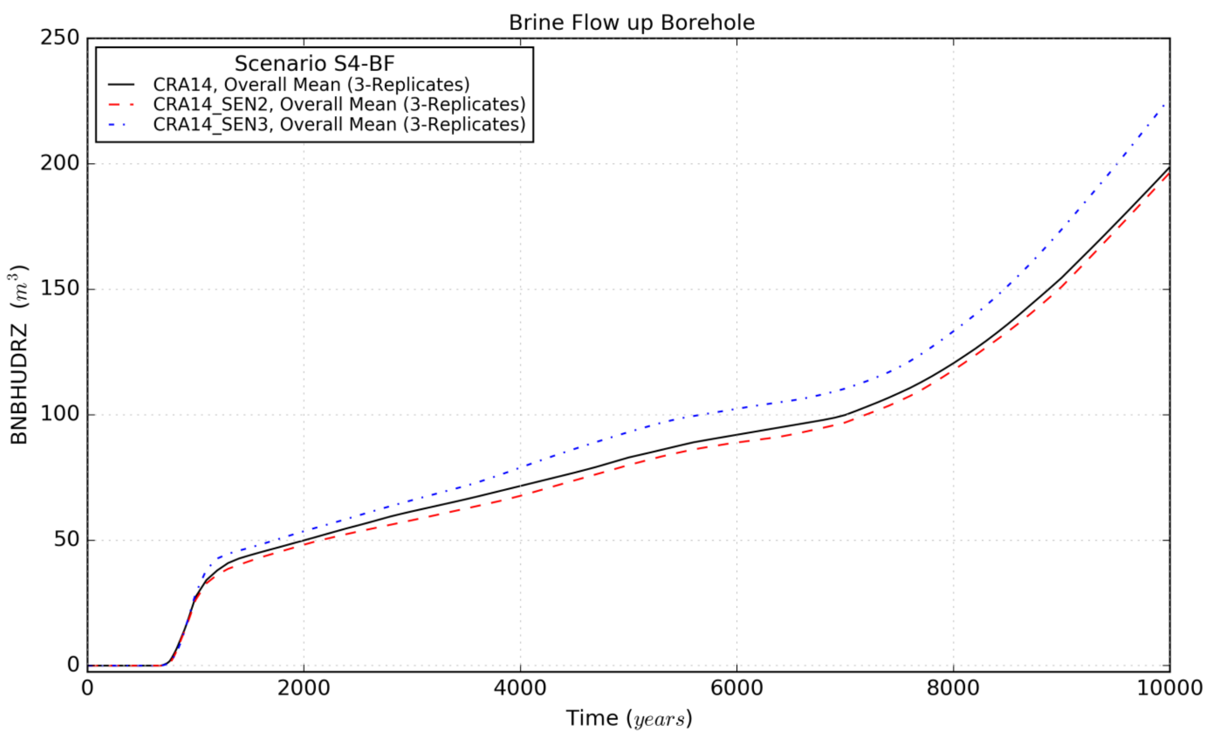

Figure 4-66: Brine Flow Means up the Borehole, Scenario S4-BF

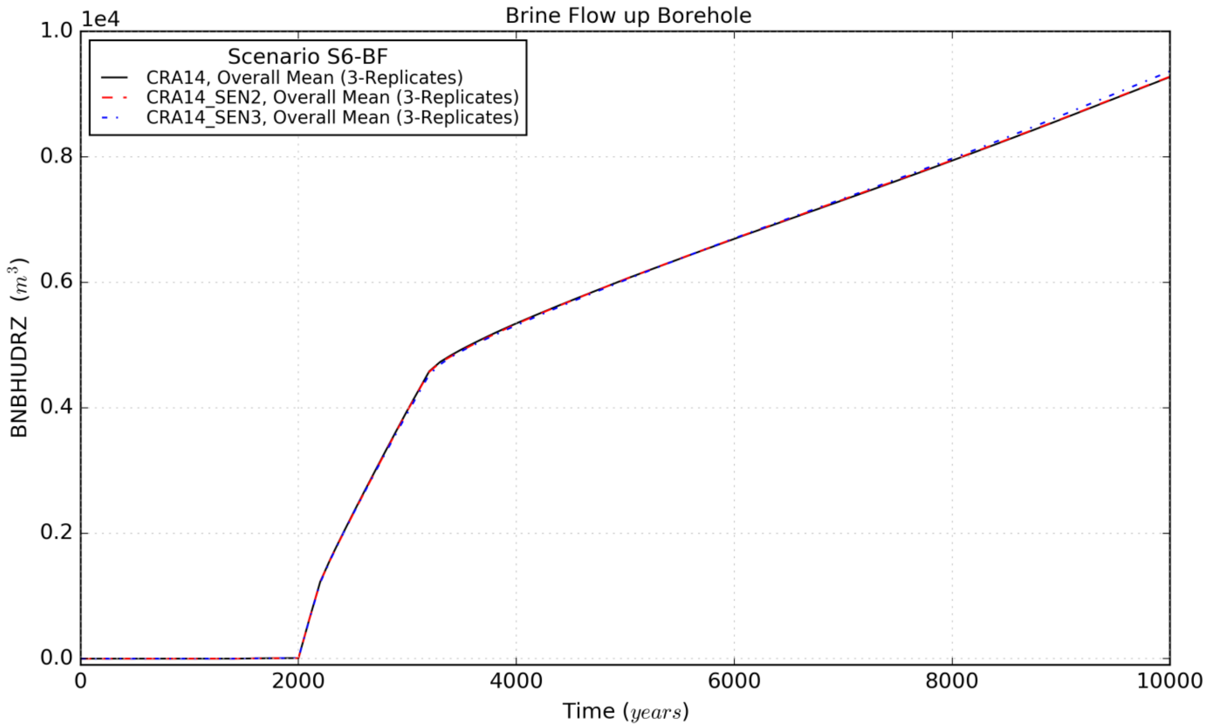

Figure 4-67: Brine Flow Means up the Borehole, Scenario S6-BF

Table 4-3: Brine Flow Statistics on Overall Means for CRA14 and CRA14_SEN3

Quantity (units)	Description	Scenario	Mean Value		Maximum Value	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
BRNEXPIC (m^3)	Brine Flow into Experimental Area	S1-BF	7.15E+03	1.86E+02	9.16E+03	2.32E+02
		S2-BF	7.07E+03	1.86E+02	8.97E+03	2.32E+02
		S4-BF	7.22E+03	1.86E+02	9.37E+03	2.32E+02
		S6-BF	7.14E+03	1.86E+02	9.11E+03	2.32E+02
BRNEXPOC (m^3)	Brine Flow out of Experimental Area	S1-BF	4.43E+03	5.17E+00	5.39E+03	7.96E+00
		S2-BF	4.40E+03	5.19E+00	5.34E+03	7.98E+00
		S4-BF	4.46E+03	5.18E+00	5.52E+03	7.97E+00
		S6-BF	4.42E+03	5.17E+00	5.38E+03	7.96E+00
BRNOPSIC (m^3)	Brine Flow into Operations Area	S1-BF	5.69E+03	4.82E+01	6.78E+03	6.07E+01
		S2-BF	5.65E+03	4.82E+01	6.72E+03	6.07E+01
		S4-BF	5.72E+03	4.82E+01	6.92E+03	6.07E+01
		S6-BF	5.68E+03	4.82E+01	6.77E+03	6.07E+01
BRNOPSOC (m^3)	Brine Flow out of Operations Area	S1-BF	1.15E+03	2.04E+00	1.29E+03	3.64E+00
		S2-BF	1.16E+03	2.05E+00	1.34E+03	3.65E+00
		S4-BF	1.18E+03	2.04E+00	1.41E+03	3.65E+00
		S6-BF	1.16E+03	2.04E+00	1.34E+03	3.65E+00
BRNNRRIC (m^3)	Brine Flow into North Rest-of-Repository	S1-BF	6.83E+03	6.70E+03	7.52E+03	7.41E+03
		S2-BF	6.80E+03	6.70E+03	7.46E+03	7.43E+03
		S4-BF	6.83E+03	6.70E+03	7.54E+03	7.42E+03
		S6-BF	6.81E+03	6.70E+03	7.48E+03	7.42E+03

Quantity (units)	Description	Scenario	Mean Value		Maximum Value	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
BRNNRROC (m^3)	Brine Flow out of North Rest-of-Repository	S1-BF	3.62E+02	3.47E+02	4.26E+02	4.85E+02
		S2-BF	3.61E+02	3.52E+02	4.27E+02	4.77E+02
		S4-BF	3.63E+02	3.39E+02	4.34E+02	4.54E+02
		S6-BF	3.61E+02	3.41E+02	4.27E+02	4.53E+02
BRNSRRIC (m^3)	Brine Flow into South Rest-of-Repository	S1-BF	5.85E+03	5.35E+03	6.44E+03	5.92E+03
		S2-BF	6.40E+03	5.40E+03	7.24E+03	6.03E+03
		S4-BF	5.92E+03	5.36E+03	6.58E+03	5.97E+03
		S6-BF	6.12E+03	5.37E+03	6.93E+03	6.00E+03
BRNSRROC (m^3)	Brine Flow out of South Rest-of-Repository	S1-BF	3.50E+02	2.71E+02	4.59E+02	3.64E+02
		S2-BF	3.42E+02	2.74E+02	4.43E+02	3.66E+02
		S4-BF	3.44E+02	2.64E+02	4.41E+02	3.35E+02
		S6-BF	3.42E+02	2.64E+02	4.36E+02	3.32E+02
BRNWASIC (m^3)	Brine Flow into Waste Panel	S1-BF	3.38E+03	2.44E+03	4.29E+03	3.04E+03
		S2-BF	2.09E+04	2.08E+04	2.58E+04	2.57E+04
		S4-BF	4.91E+03	4.13E+03	6.46E+03	5.55E+03
		S6-BF	1.40E+04	1.31E+04	2.04E+04	1.94E+04
BRNWASOC (m^3)	Brine Flow out of Waste Panel	S1-BF	3.20E+02	1.19E+02	4.24E+02	2.43E+02
		S2-BF	1.15E+04	1.14E+04	1.58E+04	1.59E+04
		S4-BF	7.48E+02	4.60E+02	1.10E+03	7.65E+02
		S6-BF	6.84E+03	6.33E+03	1.16E+04	1.11E+04

Quantity (units)	Description	Scenario	Mean Value		Maximum Value	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
BNSHUDRZ (m^3)	Brine Flow up Shaft	S1-BF	9.94E-01	2.24E-01	2.18E+00	4.79E-01
		S2-BF	1.20E+00	2.23E-01	2.65E+00	4.78E-01
		S4-BF	9.07E-01	2.23E-01	1.98E+00	4.79E-01
		S6-BF	1.07E+00	2.23E-01	2.46E+00	4.77E-01
BNBHUDRZ (m^3)	Brine Flow up Borehole	S1-BF	-	-	-	-
		S2-BF	5.80E+03	5.77E+03	9.42E+03	9.51E+03
		S4-BF	8.51E+01	9.44E+01	1.99E+02	2.26E+02
		S6-BF	5.10E+03	5.11E+03	9.28E+03	9.37E+03

Table 4-4: Brine Flow Statistics on Individual Vectors for CRA14 and CRA14_SEN3

Quantity (units)	**Description**	**Scenario**	**Maximum Value**	
			CRA14	**CRA14_SEN3**
BRNEXPIC (m^3)	Brine Flow into Experimental Area	S1-BF	3.68E+04	5.63E+02
		S2-BF	3.69E+04	5.63E+02
		S4-BF	3.70E+04	5.63E+02
		S6-BF	3.70E+04	5.62E+02
BRNEXPOC (m^3)	Brine Flow out of Experimental Area	S1-BF	1.94E+04	7.58E+01
		S2-BF	1.93E+04	7.50E+01
		S4-BF	1.93E+04	7.58E+01
		S6-BF	1.93E+04	7.50E+01
BRNOPSIC (m^3)	Brine Flow into Operations Area	S1-BF	2.20E+04	1.44E+02
		S2-BF	2.22E+04	1.44E+02
		S4-BF	2.20E+04	1.44E+02
		S6-BF	2.22E+04	1.44E+02
BRNOPSOC (m^3)	Brine Flow out of Operations Area	S1-BF	1.52E+04	2.77E+01
		S2-BF	1.53E+04	2.84E+01
		S4-BF	1.52E+04	2.82E+01
		S6-BF	1.54E+04	2.83E+01
BRNNRRIC (m^3)	Brine Flow into North Rest-of-Repository	S1-BF	3.95E+04	4.25E+04
		S2-BF	3.95E+04	4.34E+04
		S4-BF	3.94E+04	4.25E+04
		S6-BF	3.92E+04	4.33E+04

Quantity (units)	Description	Scenario	Maximum Value	
			CRA14	CRA14_SEN3
BRNNRROC (m^3)	Brine Flow out of North Rest-of-Repository	S1-BF	1.66E+04	1.49E+04
		S2-BF	1.65E+04	1.65E+04
		S4-BF	1.64E+04	1.50E+04
		S6-BF	1.62E+04	1.57E+04
BRNSRRIC (m^3)	Brine Flow into South Rest-of-Repository	S1-BF	4.89E+04	3.41E+04
		S2-BF	4.91E+04	3.46E+04
		S4-BF	4.93E+04	3.41E+04
		S6-BF	4.92E+04	3.45E+04
BRNSRROC (m^3)	Brine Flow out of South Rest-of-Repository	S1-BF	1.48E+04	1.20E+04
		S2-BF	1.48E+04	1.32E+04
		S4-BF	1.50E+04	1.21E+04
		S6-BF	1.49E+04	1.25E+04
BRNWASIC (m^3)	Brine Flow into Waste Panel	S1-BF	1.63E+04	1.41E+04
		S2-BF	1.89E+05	1.88E+05
		S4-BF	2.11E+04	1.89E+04
		S6-BF	1.86E+05	1.85E+05
BRNWASOC (m^3)	Brine Flow out of Waste Panel	S1-BF	7.23E+03	8.70E+03
		S2-BF	1.79E+05	1.78E+05
		S4-BF	8.94E+03	9.78E+03
		S6-BF	1.76E+05	1.75E+05

Quantity (units)	Description	Scenario	Maximum Value	
			CRA14	CRA14_SEN3
BNSHUDRZ (m^3)	Brine Flow up Shaft	S1-BF	2.47E+01	8.11E+00
		S2-BF	2.34E+01	8.11E+00
		S4-BF	2.21E+01	8.11E+00
		S6-BF	2.28E+01	8.11E+00
BNBHUDRZ (m^3)	Brine Flow up Borehole	S1-BF	-	-
		S2-BF	1.74E+05	1.74E+05
		S4-BF	5.53E+03	5.33E+03
		S6-BF	1.75E+05	1.74E+05

4.3 Brine Saturation

Increased initial brine saturations and modified parameters that restrict brine flow in the operations and experimental areas, combined with greatly reduced pore volumes therein, results in mean brine saturations being much higher for these regions in the CRA14_SEN3 as compared to CRA14 and equivalent to CRA14_SEN2. The significantly increased brine saturations in the experimental and operations areas are shown in Figure 4-68 to Figure 4-71 and Figure 4-72 to Figure 4-75, respectively. As seen in the results already discussed, predominantly increased pressures in the waste areas due to the modified operations and experimental area and panel closure area parameters result in a corresponding decrease in waste panel mean brine saturations for CRA14_SEN3 in comparison to CRA14 over all BRAGFLO scenarios. Figure 4-76 to Figure 4-79 show the slightly decreased brine saturations resulting from the increased pressures encountered under CRA14_SEN3 for the north rest-of-repository waste area. Similarly, Figure 4-80 to Figure 4-83 are provided for the south rest-of-repository and Figure 4-84 to Figure 4-87 are provided for the southernmost waste panel. All waste areas experience a similar reduction in mean brine saturation over all scenarios for CRA14_SEN3 in comparison to CRA14 with southernmost waste panel pressures being reduced by the greatest amount.

Although brine saturations in the operations and experimental areas for CRA14_SEN3 are increased over CRA14 due to the modified initial saturation conditions, the total brine volume in the experimental area is minimally changed at the end of the simulation duration due to the reduced pore volume for CRA14_SEN3 (see Figure 4-88 to Figure 4-91). Similarly, the brine volume in the operations area under CRA14_SEN3 is reduced in comparison to CRA14 due to the reduced pore volume and lack of brine inflow previously discussed (see Figure 4-92 to Figure 4-95).

Brine saturation statistics for CRA14 and CRA14_SEN3 are summarized in Table 4-5 and Table 4-6. Table 4-5 provides the 3-replicate mean (integrated over time) and 3-replicate maximum (over all time) pressure values. Table 4-6 provides the maximum brine saturation (over all time) for all individual vectors. The modified north end and panel closure parameters result in decreased 3-replicate mean and maximum brine saturations in waste areas as compared to the CRA14, with operations and experimental area values notably increased due to the higher initial saturations. The overall trend for individual vector maximum brine saturation values is similar with the exception of brine saturation within the north rest-of-repository waste area that experienced a slightly increased individual vector maximum over all scenarios.

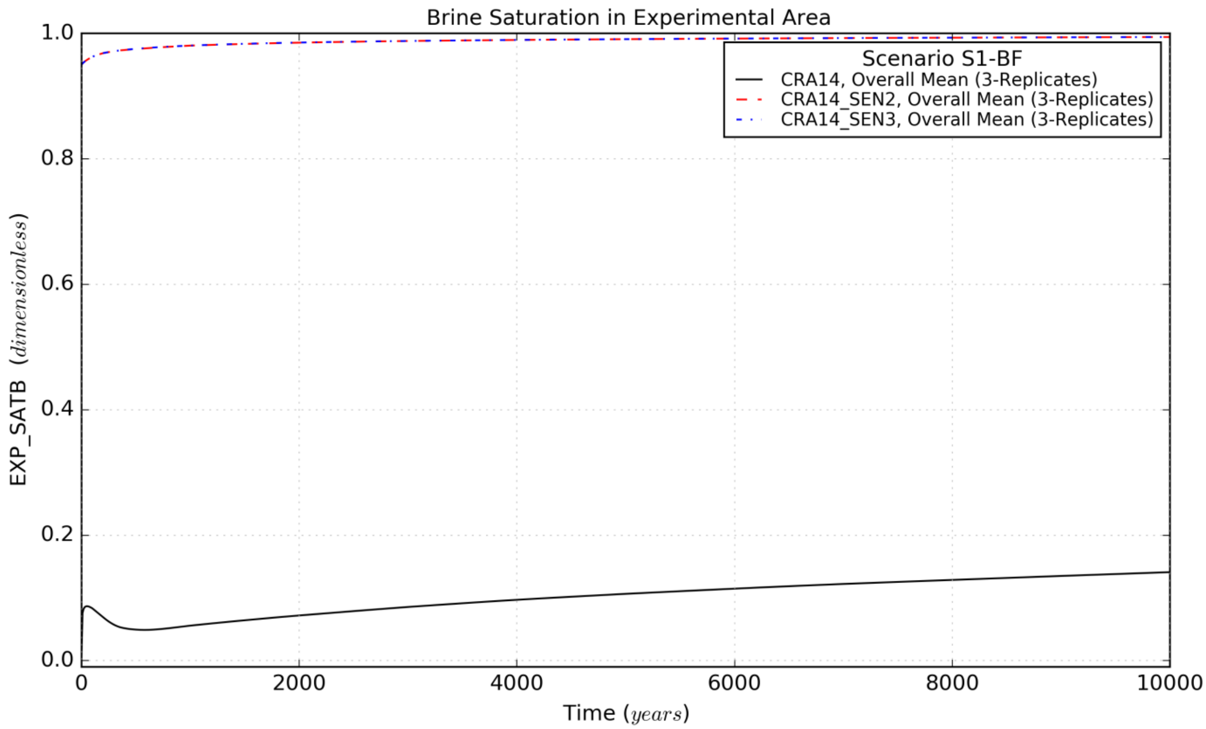

Figure 4-68: Brine Saturation Means for the Experimental Area, Scenario S1-BF

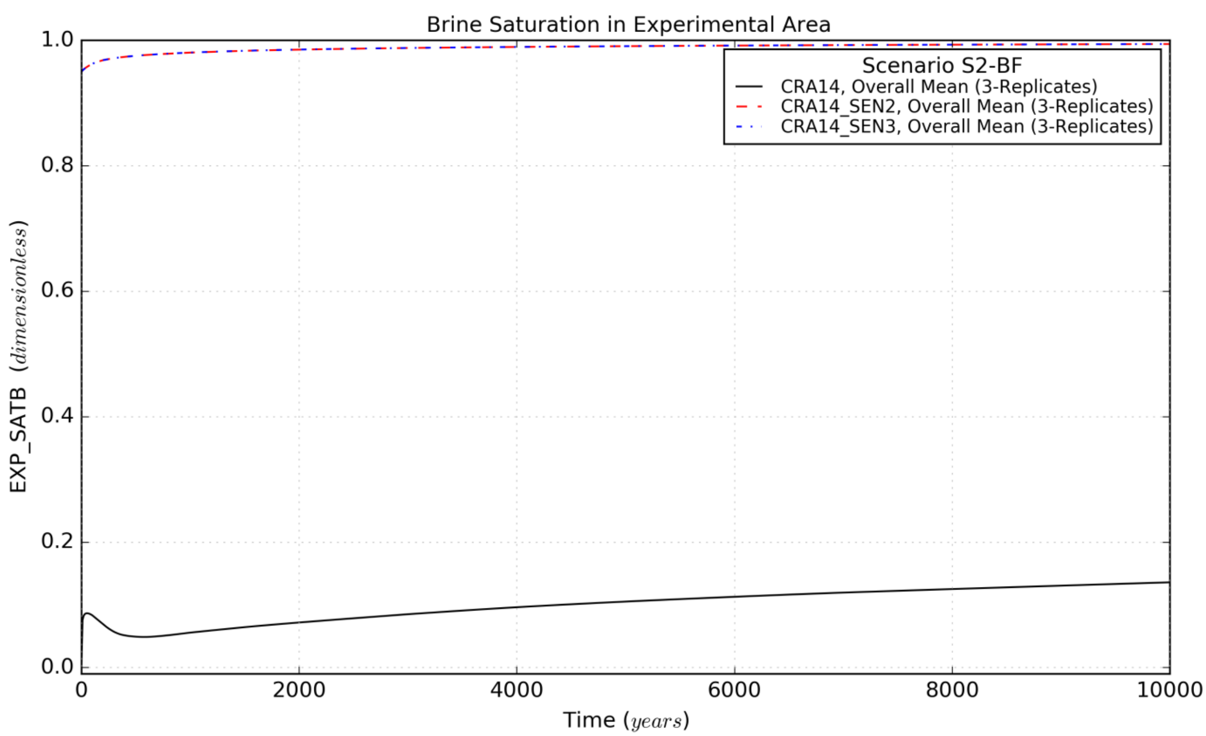

Figure 4-69: Brine Saturation Means for the Experimental Area, Scenario S2-BF

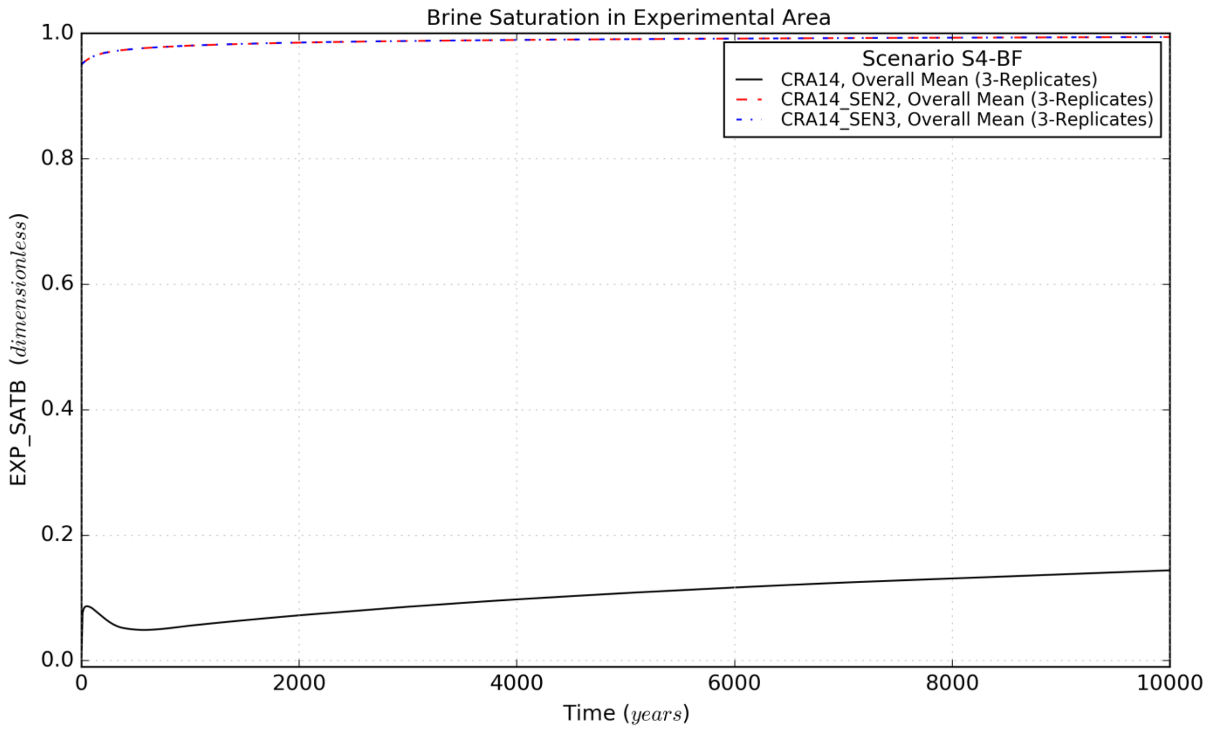

Figure 4-70: Brine Saturation Means for the Experimental Area, Scenario S4-BF

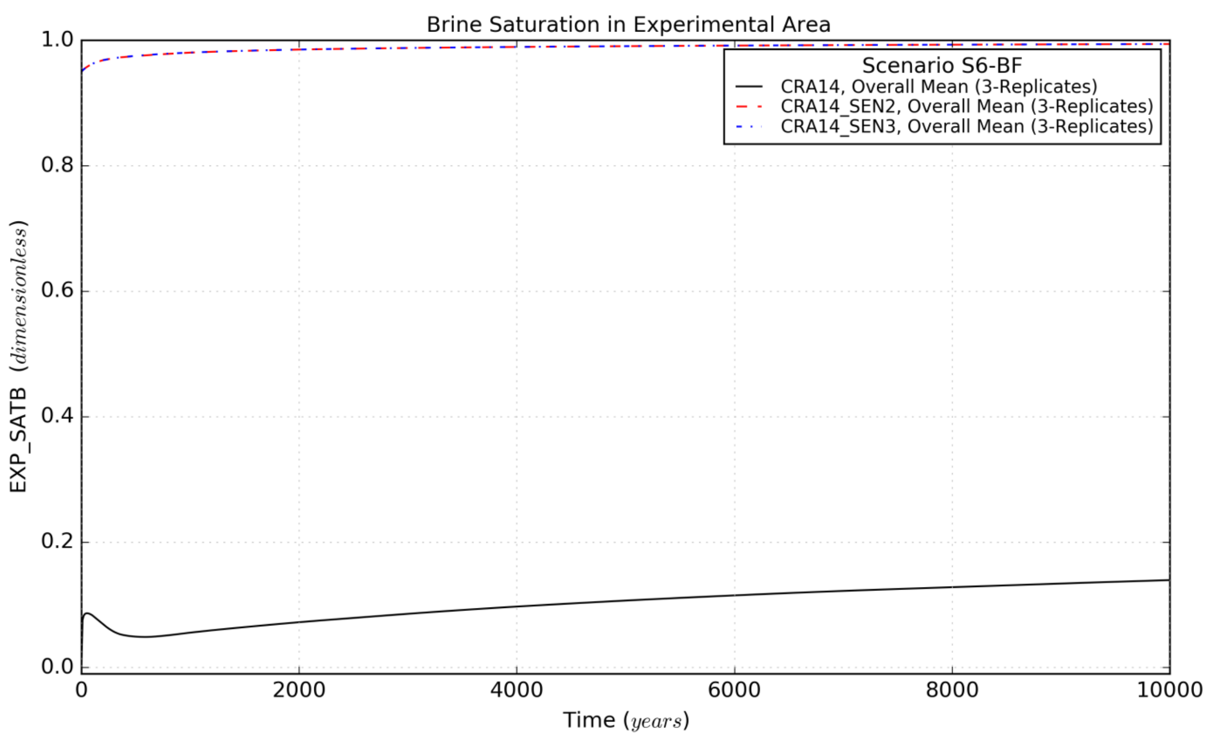

Figure 4-71: Brine Saturation Means for the Experimental Area, Scenario S6-BF

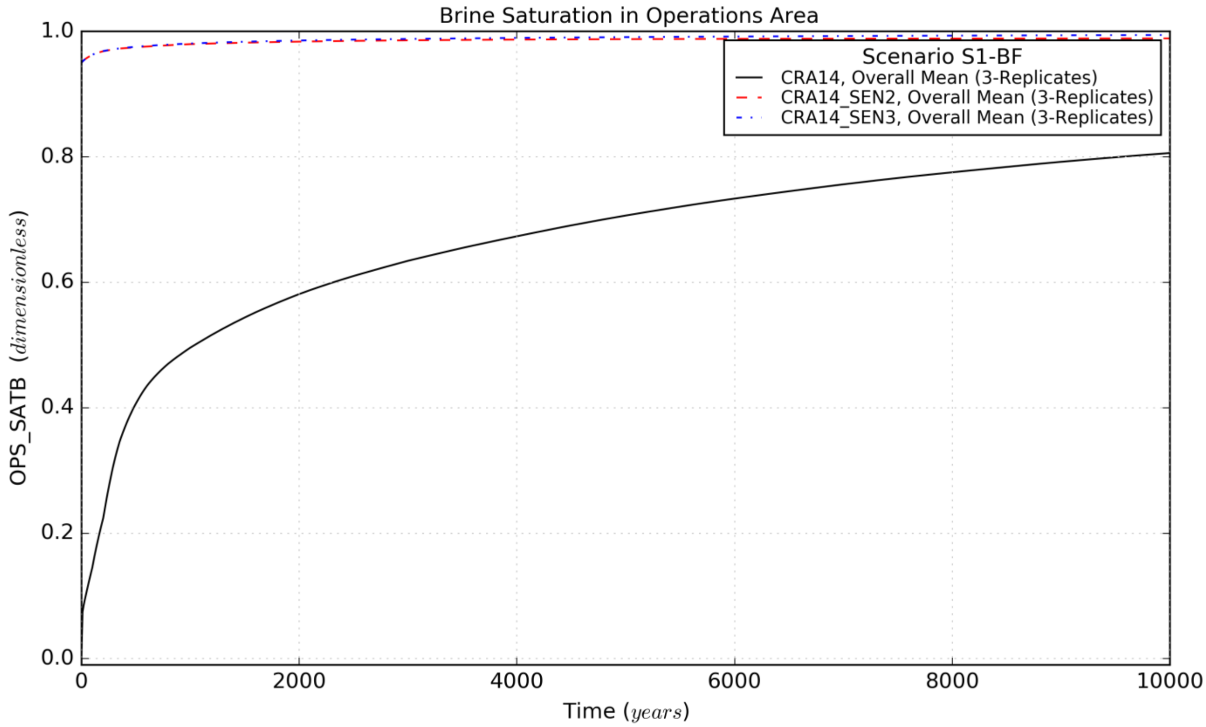

Figure 4-72: Brine Saturation Means for the Operations Area, Scenario S1-BF

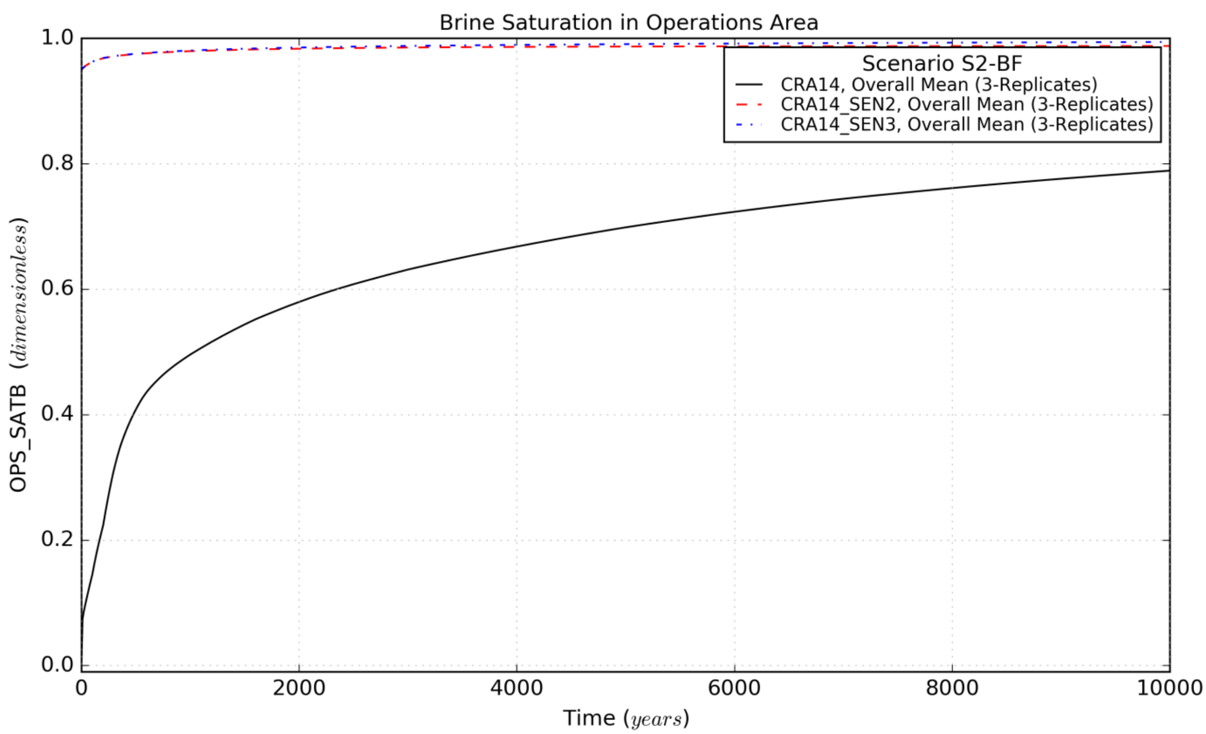

Figure 4-73: Brine Saturation Means for the Operations Area, Scenario S2-BF

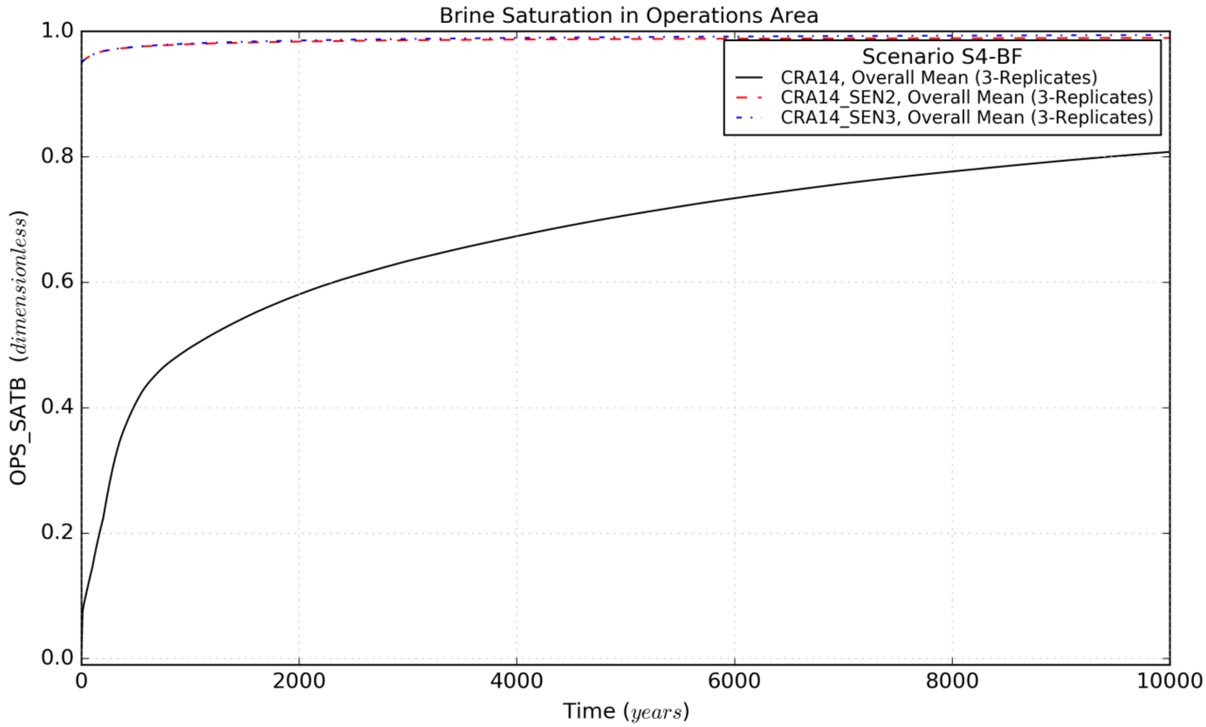

Figure 4-74: Brine Saturation Means for the Operations Area, Scenario S4-BF

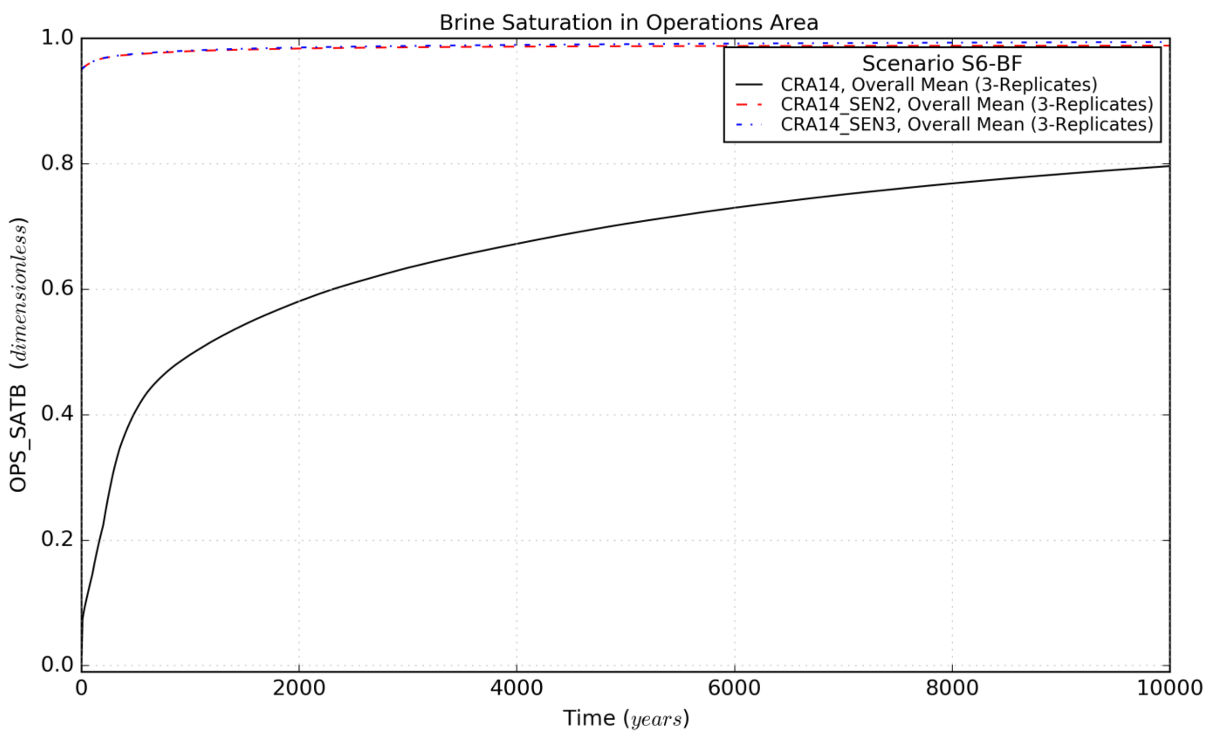

Figure 4-75: Brine Saturation Means for the Operations Area, Scenario S6-BF

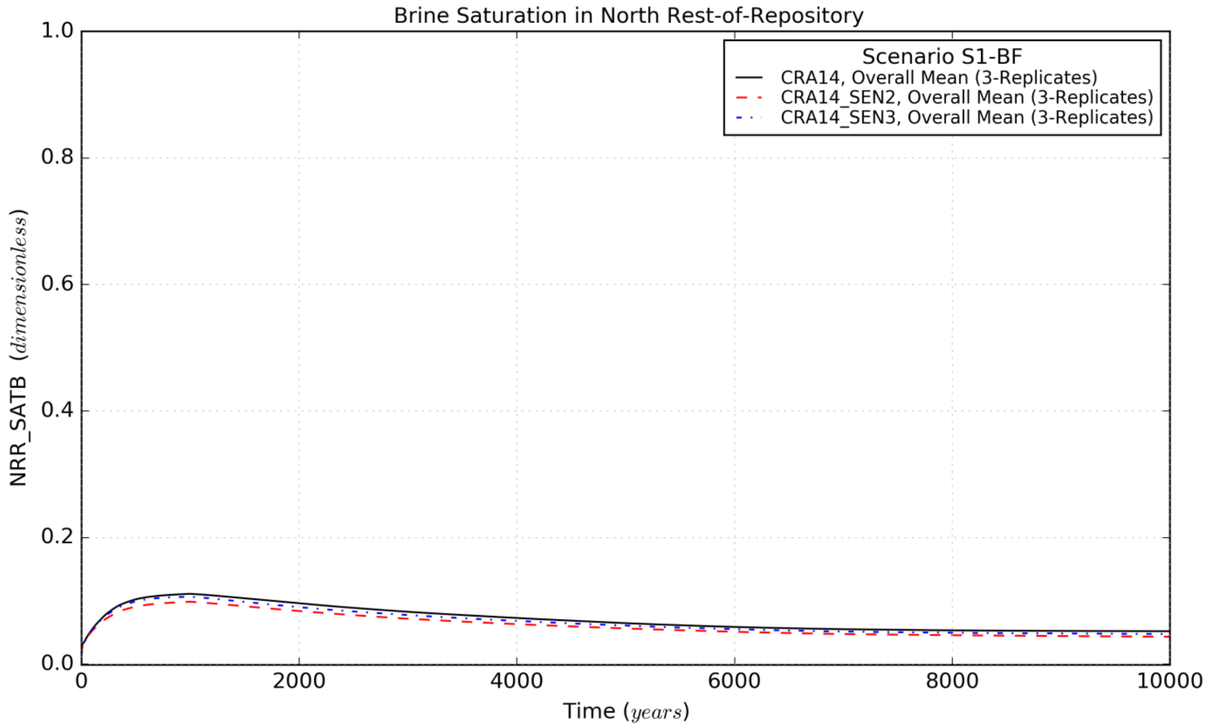

Figure 4-76: Brine Saturation Means for the North Rest-of-Repository, Scenario S1-BF

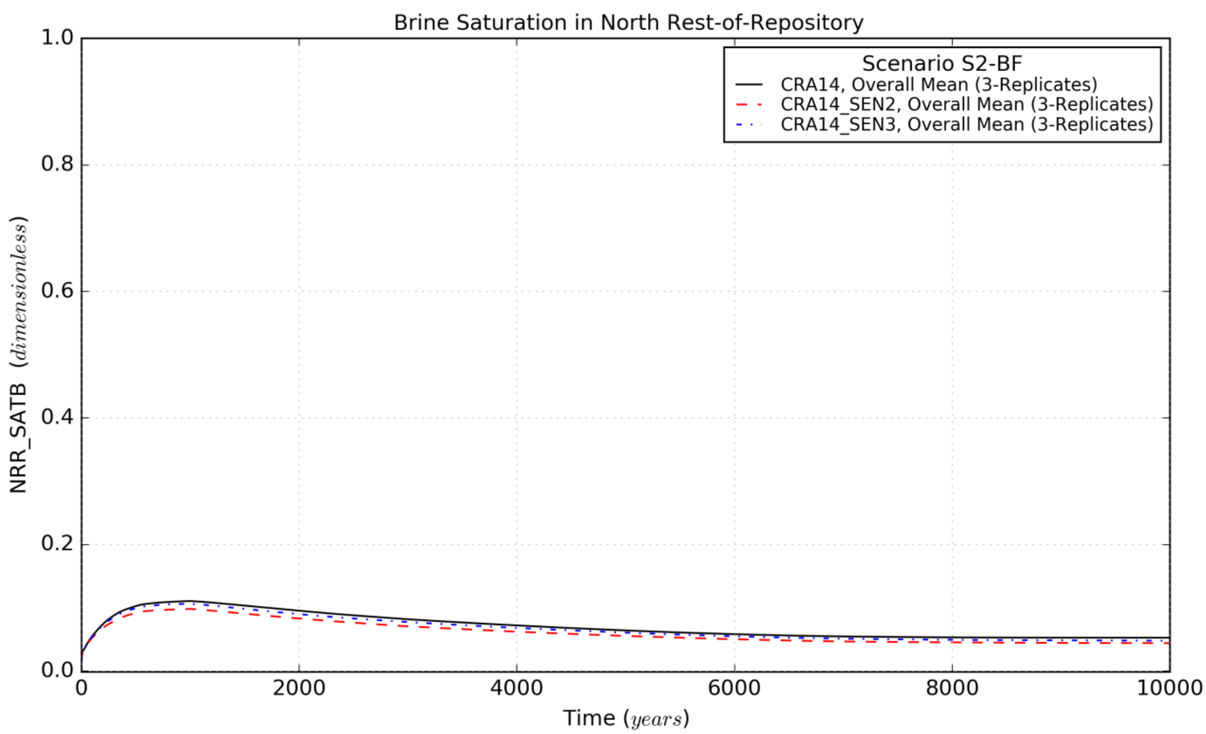

Figure 4-77: Brine Saturation Means for the North Rest-of-Repository, Scenario S2-BF

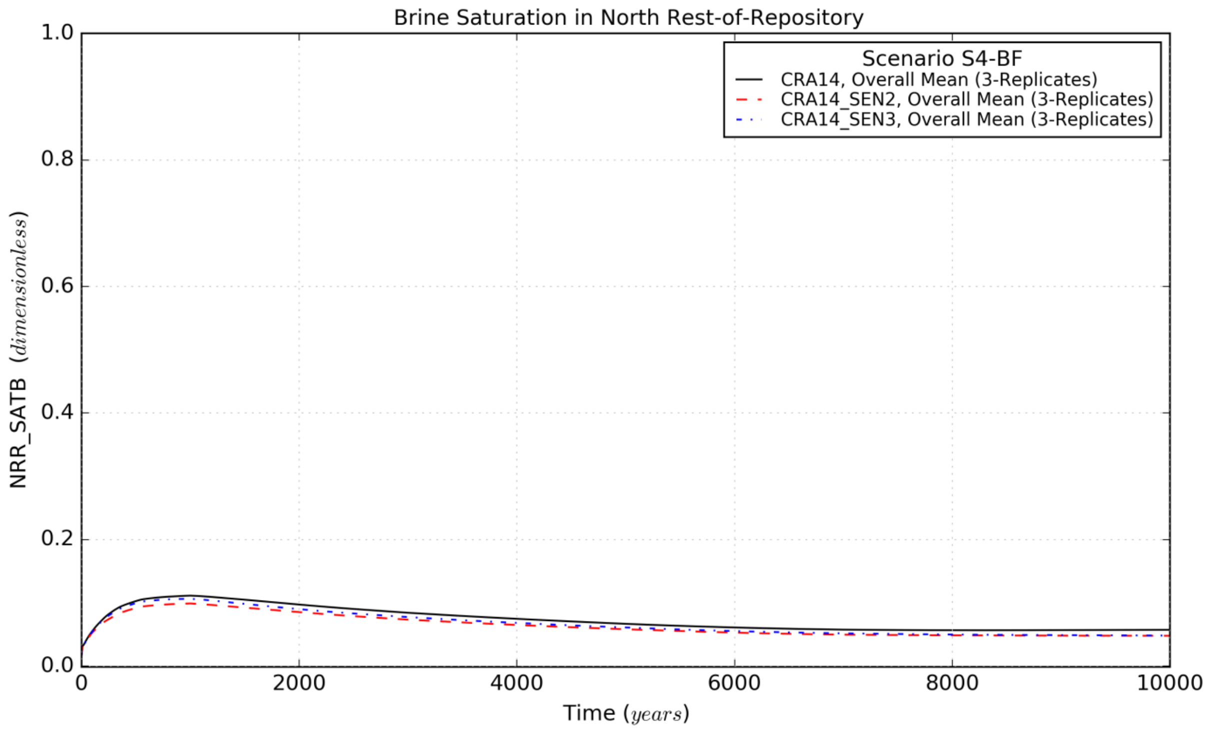

Figure 4-78: Brine Saturation Means for the North Rest-of-Repository, Scenario S4-BF

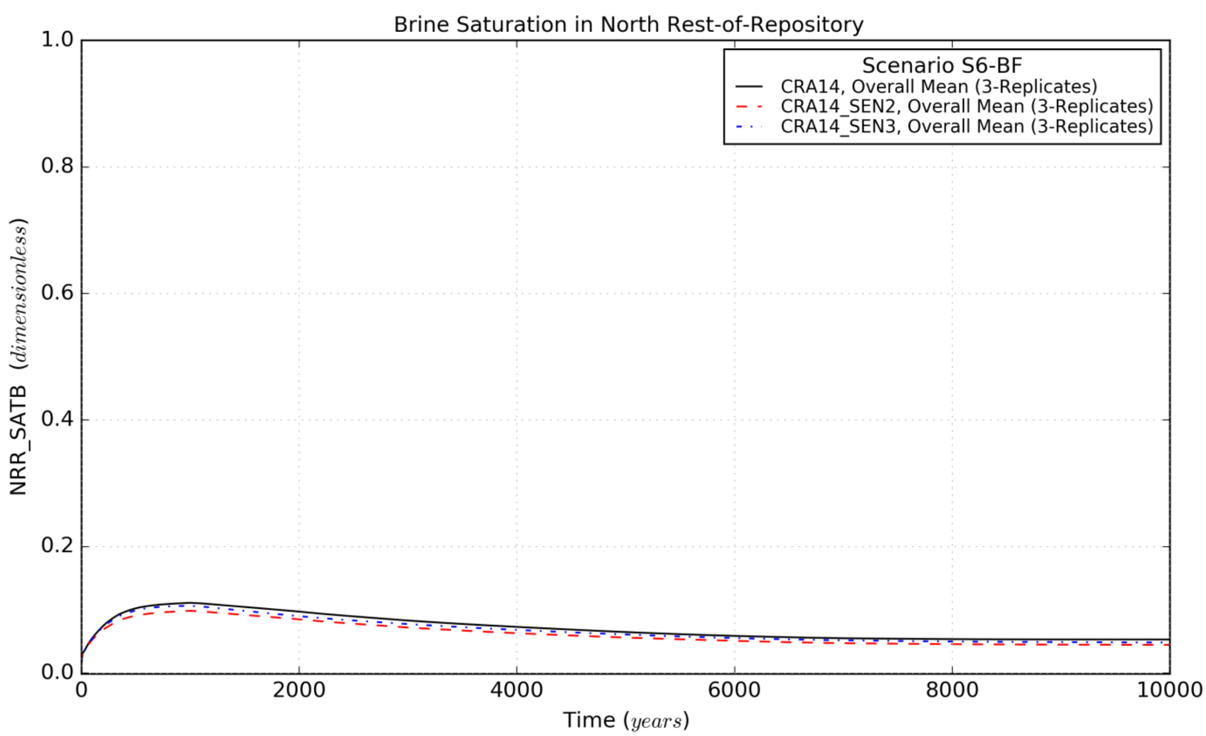

Figure 4-79: Brine Saturation Means for the North Rest-of-Repository, Scenario S6-BF

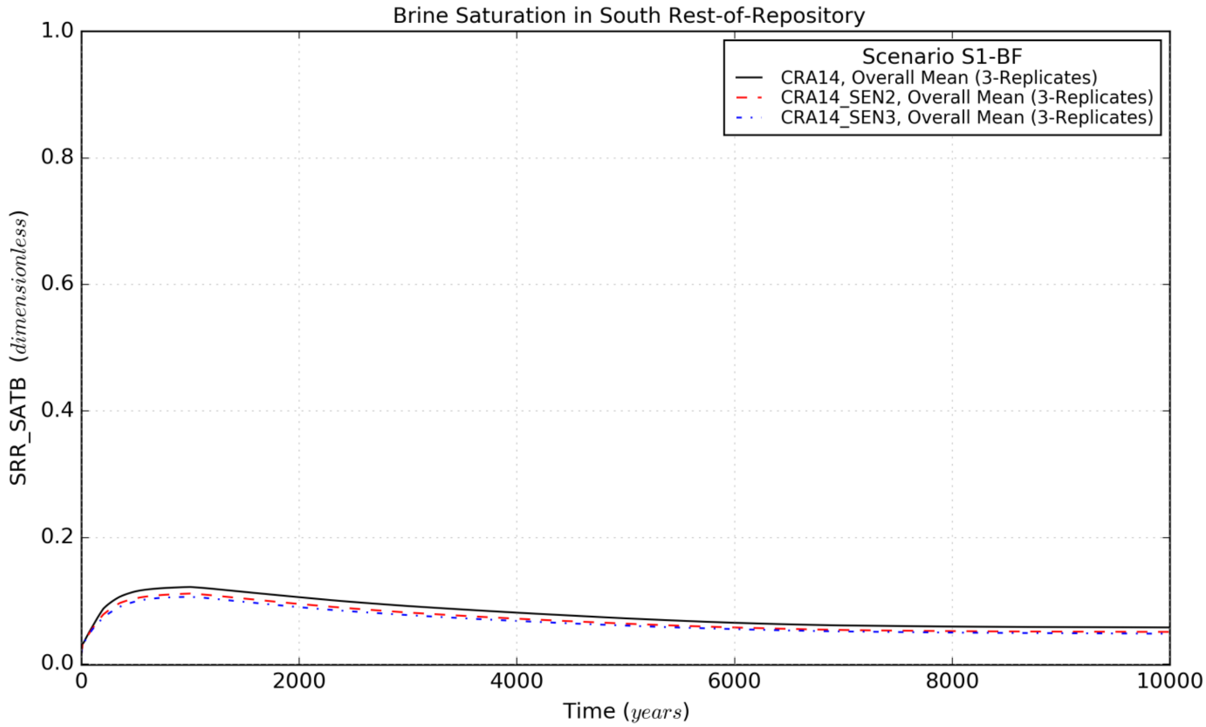

Figure 4-80: Brine Saturation Means for the South Rest-of-Repository, Scenario S1-BF

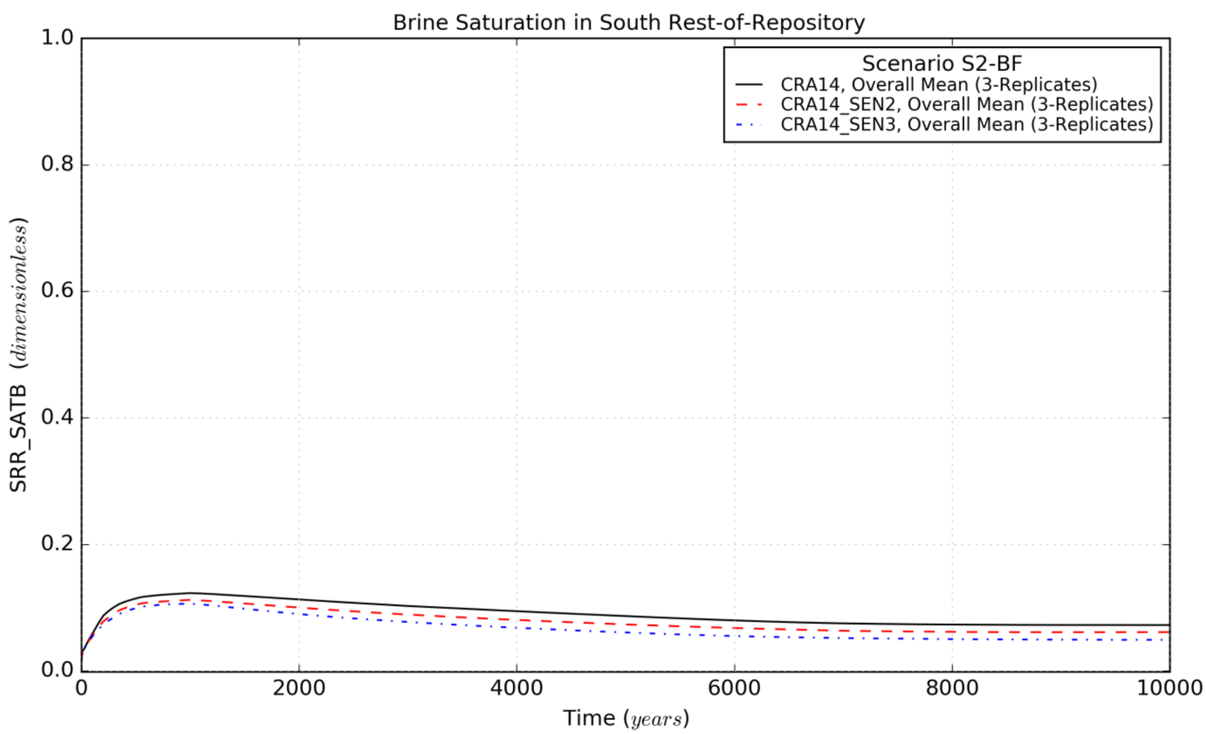

Figure 4-81: Brine Saturation Means for the South Rest-of-Repository, Scenario S2-BF

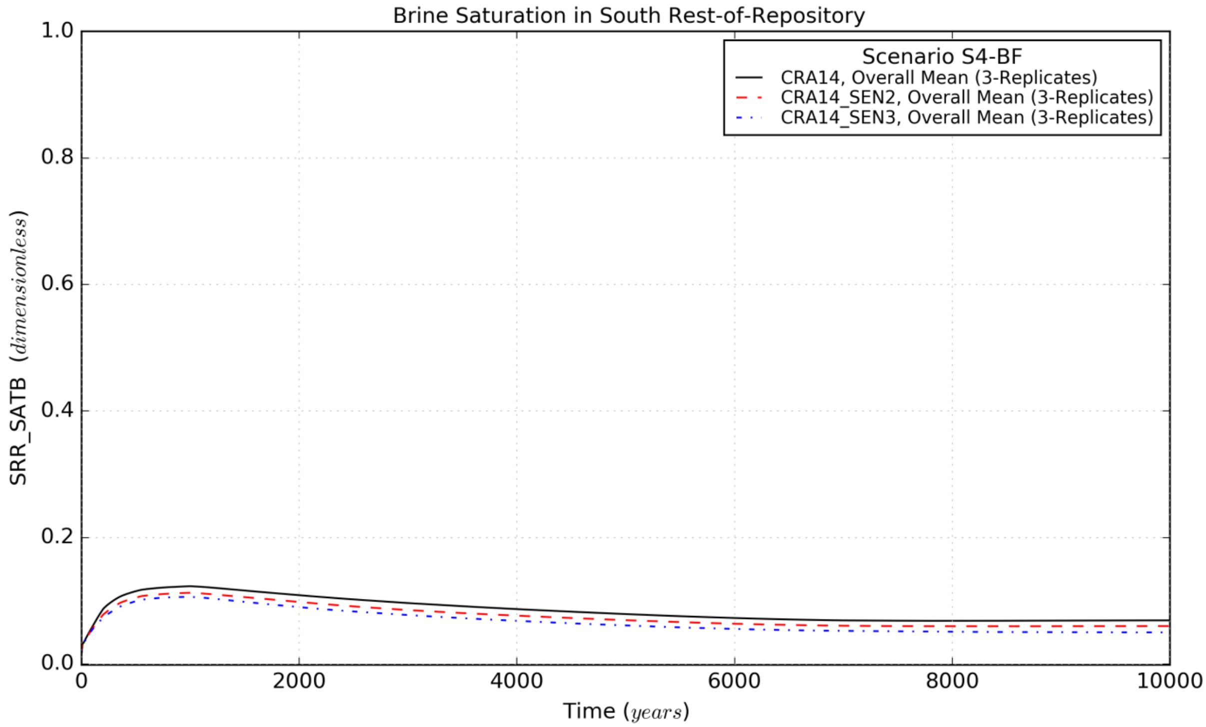

Figure 4-82: Brine Saturation Means for the South Rest-of-Repository, Scenario S4-BF

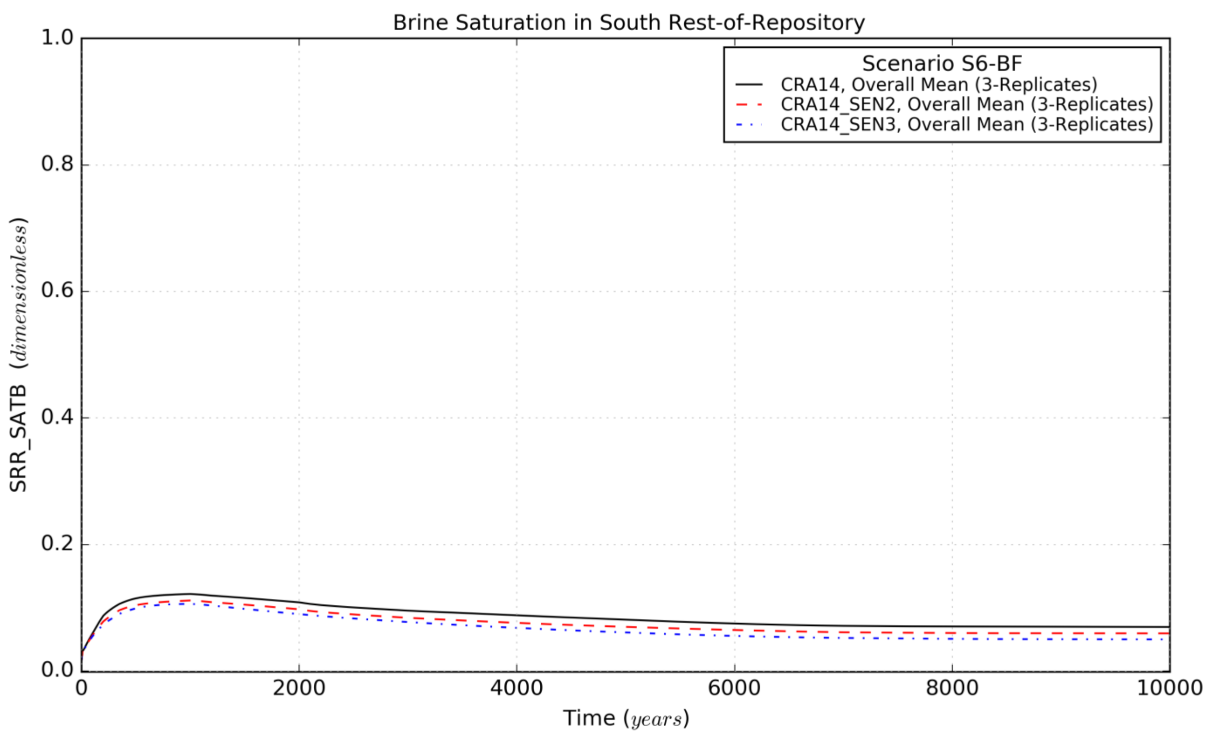

Figure 4-83: Brine Saturation Means for the South Rest-of-Repository, Scenario S6-BF

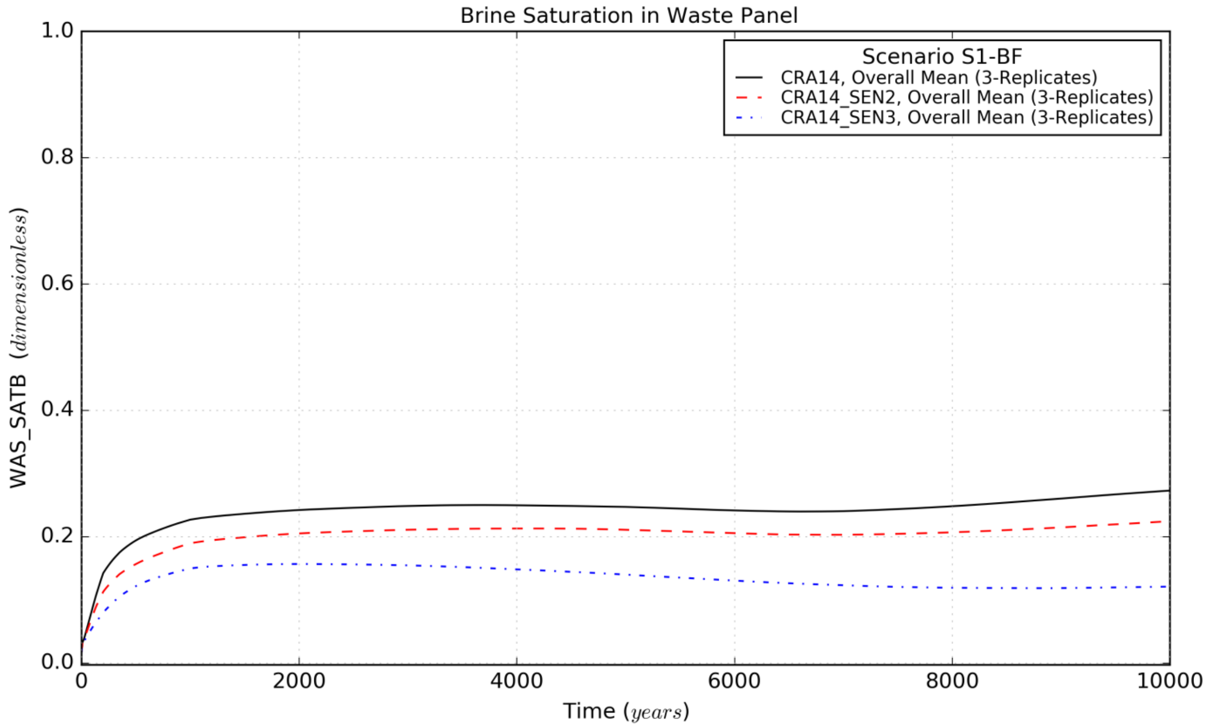

Figure 4-84: Brine Saturation Means for the Waste Panel, Scenario S1-BF

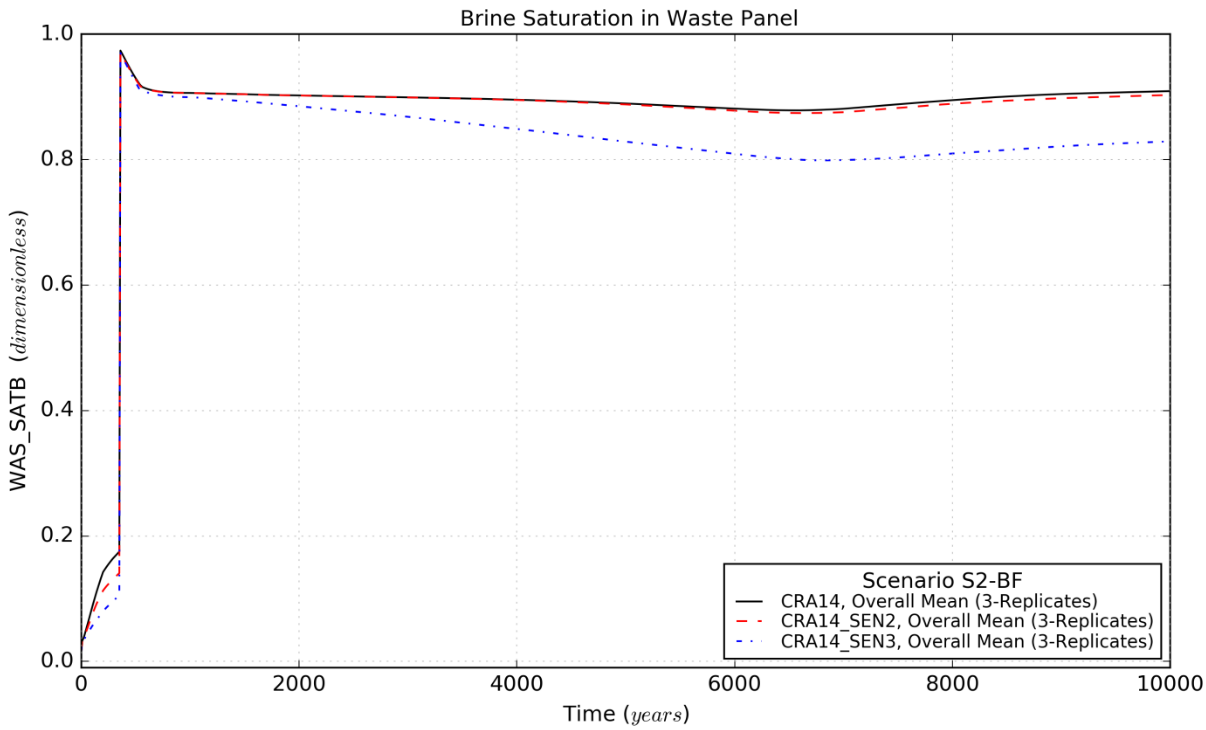

Figure 4-85: Brine Saturation Means for the Waste Panel, Scenario S2-BF

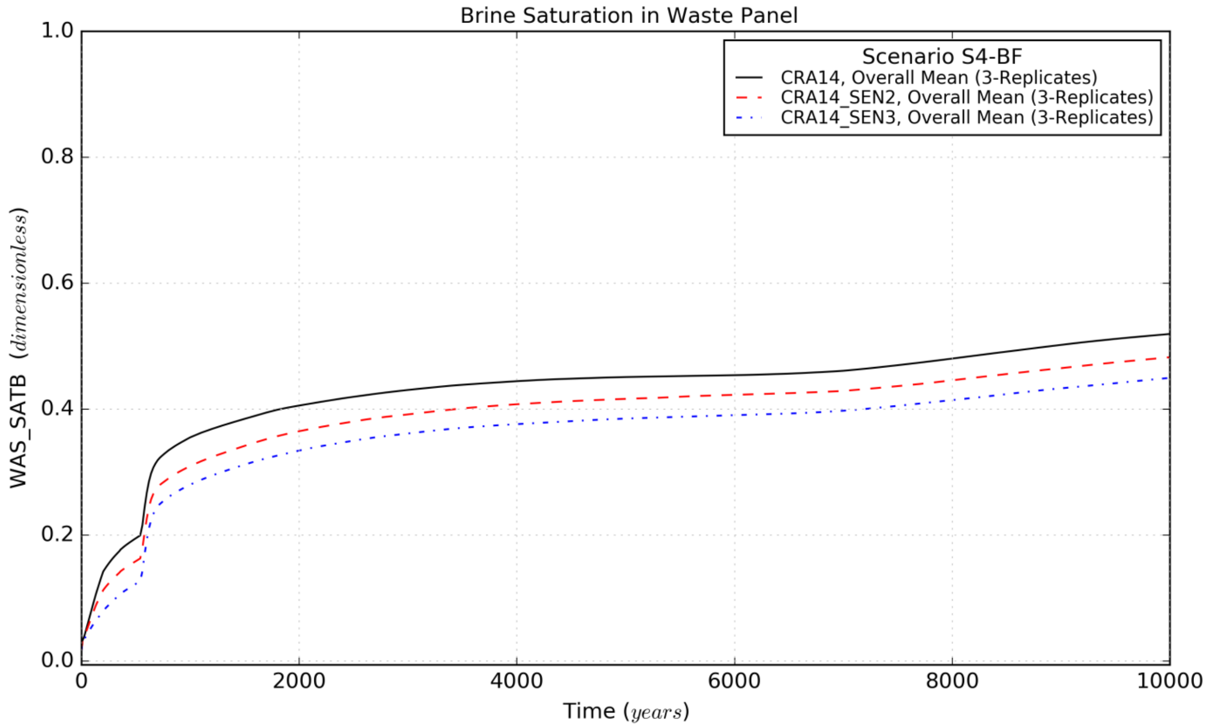

Figure 4-86: Brine Saturation Means for the Waste Panel, Scenario S4-BF

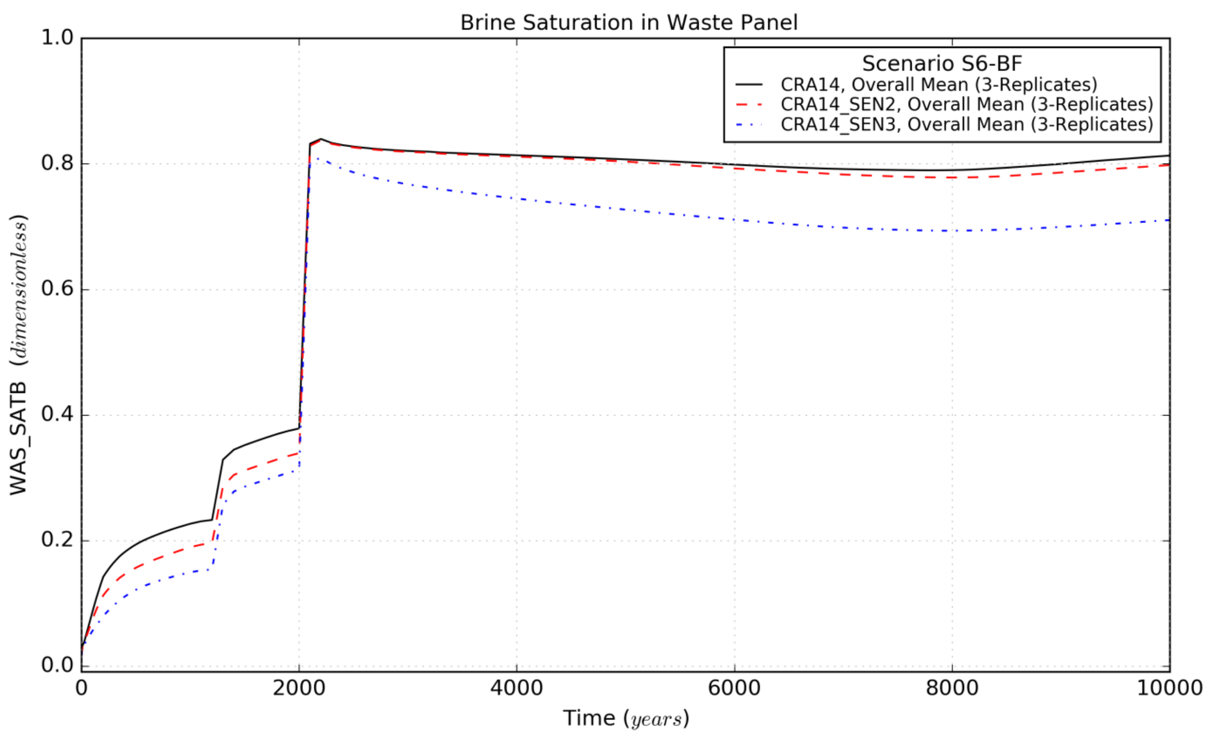

Figure 4-87: Brine Saturation Means for the Waste Panel, Scenario S6-BF

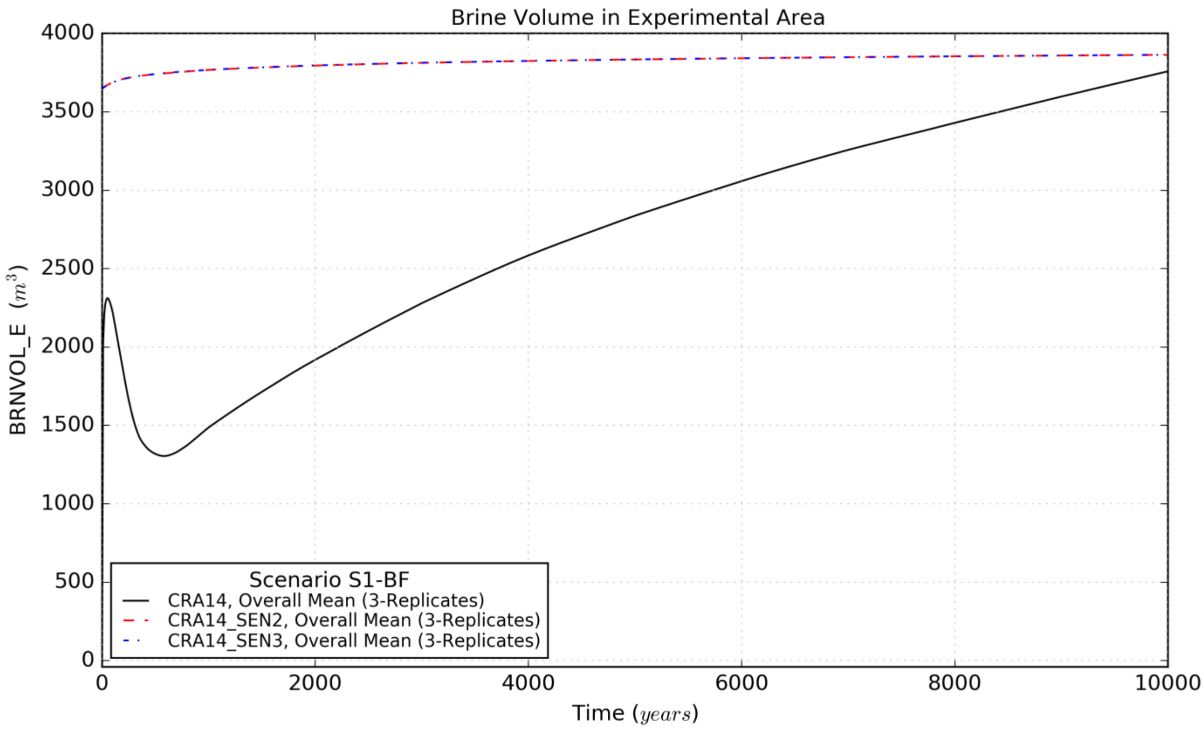

Figure 4-88: Brine Volume Means for the Experimental Area, Scenario S1-BF

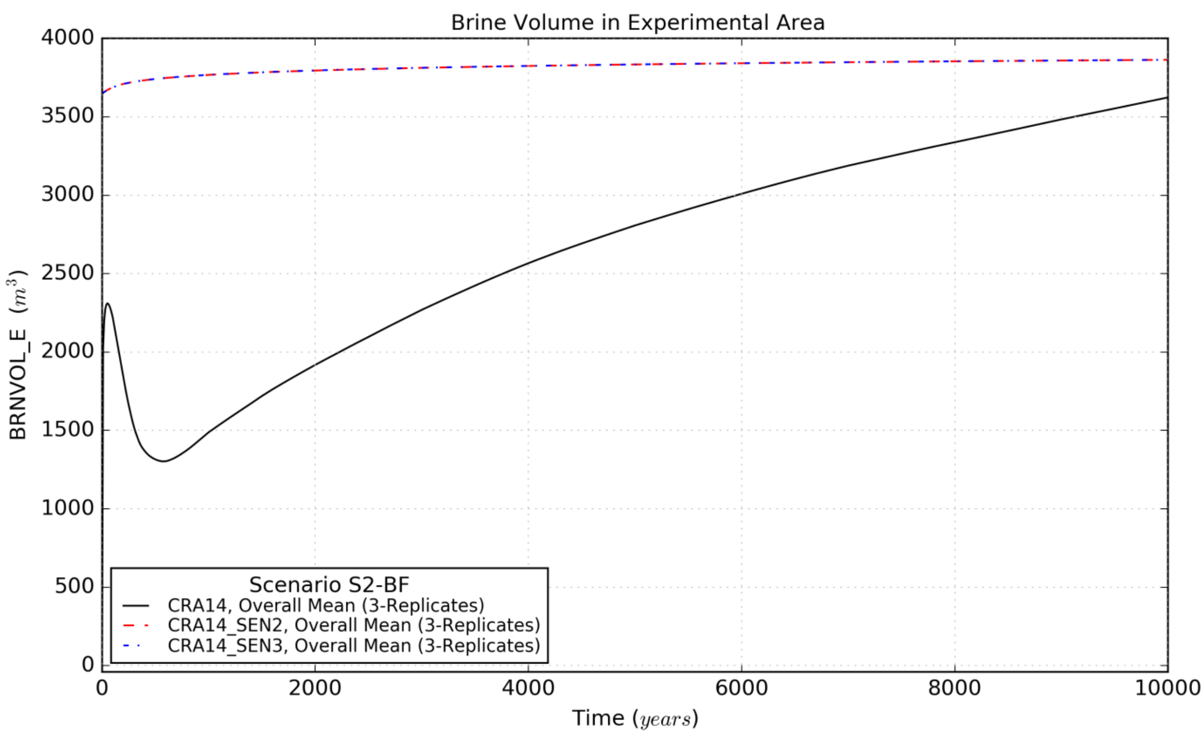

Figure 4-89: Brine Volume Means for the Experimental Area, Scenario S2-BF

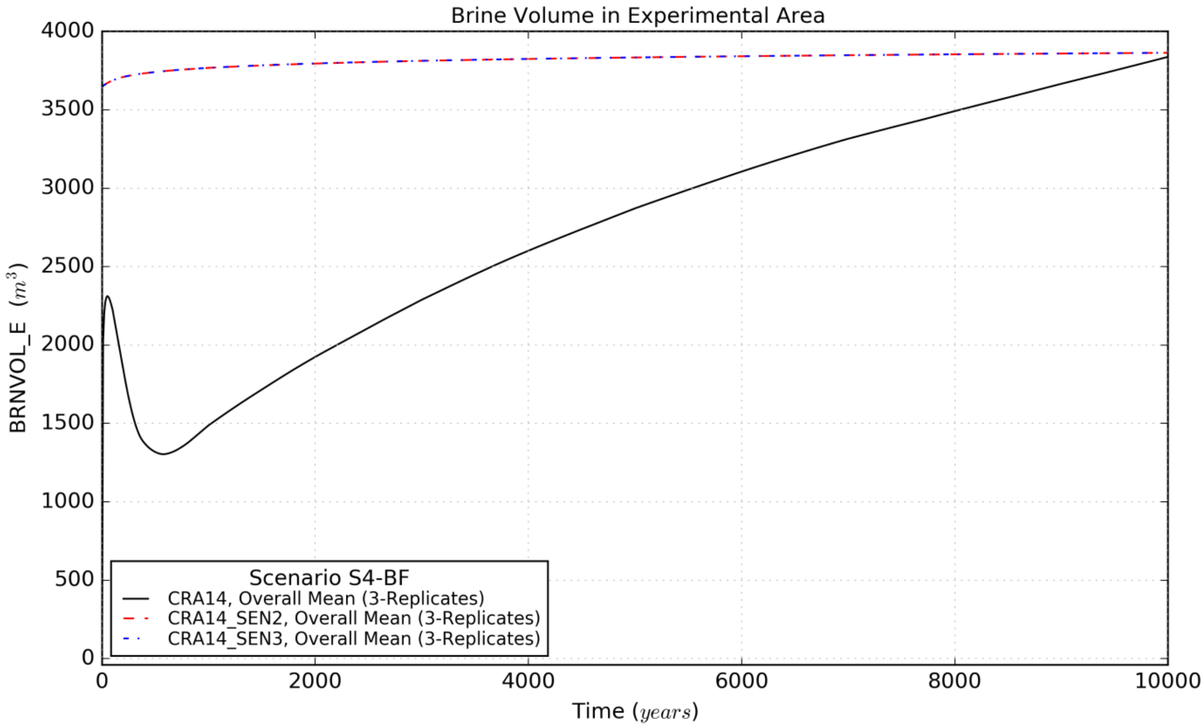

Figure 4-90: Brine Volume Means for the Experimental Area, Scenario S4-BF

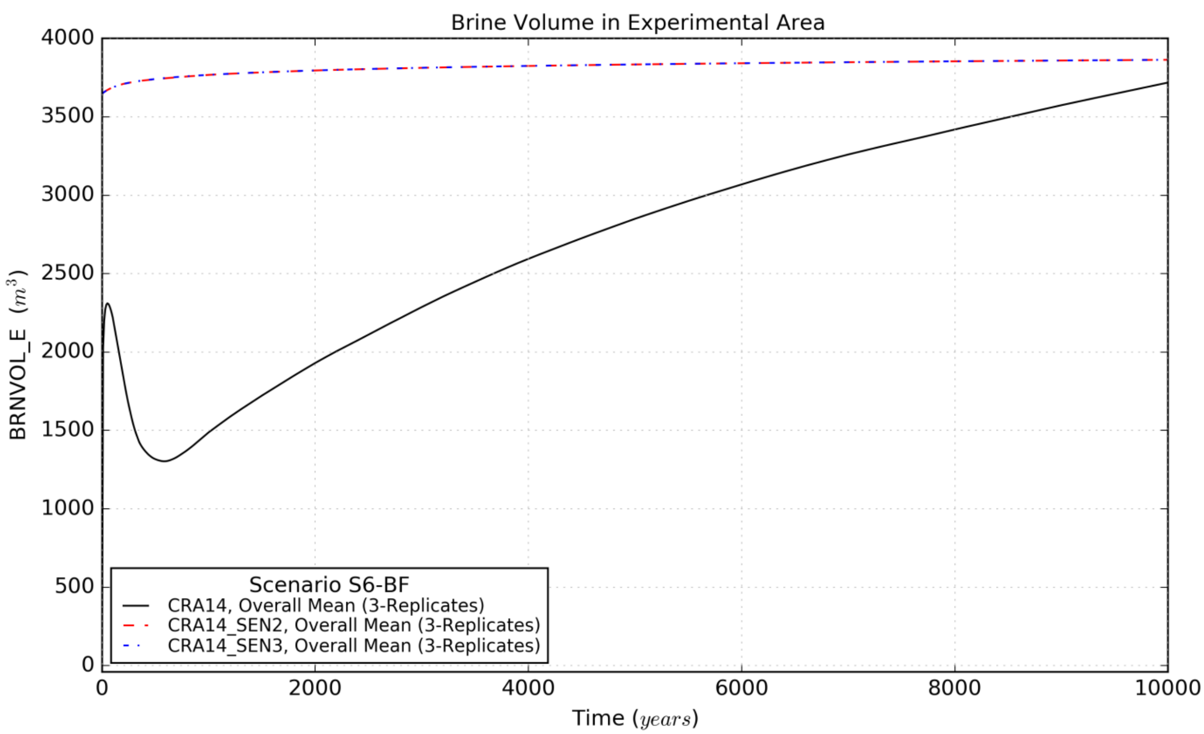

Figure 4-91: Brine Volume Means for the Experimental Area, Scenario S6-BF

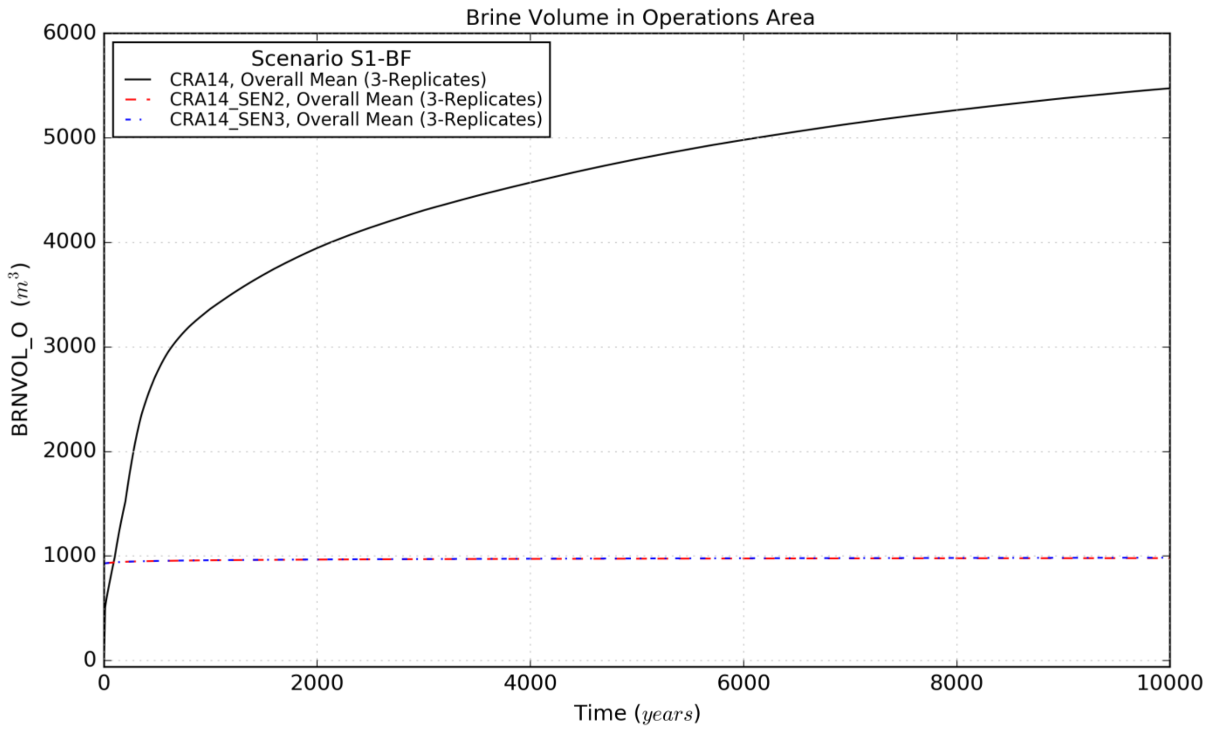

Figure 4-92: Brine Volume Means for the Operations Area, Scenario S1-BF

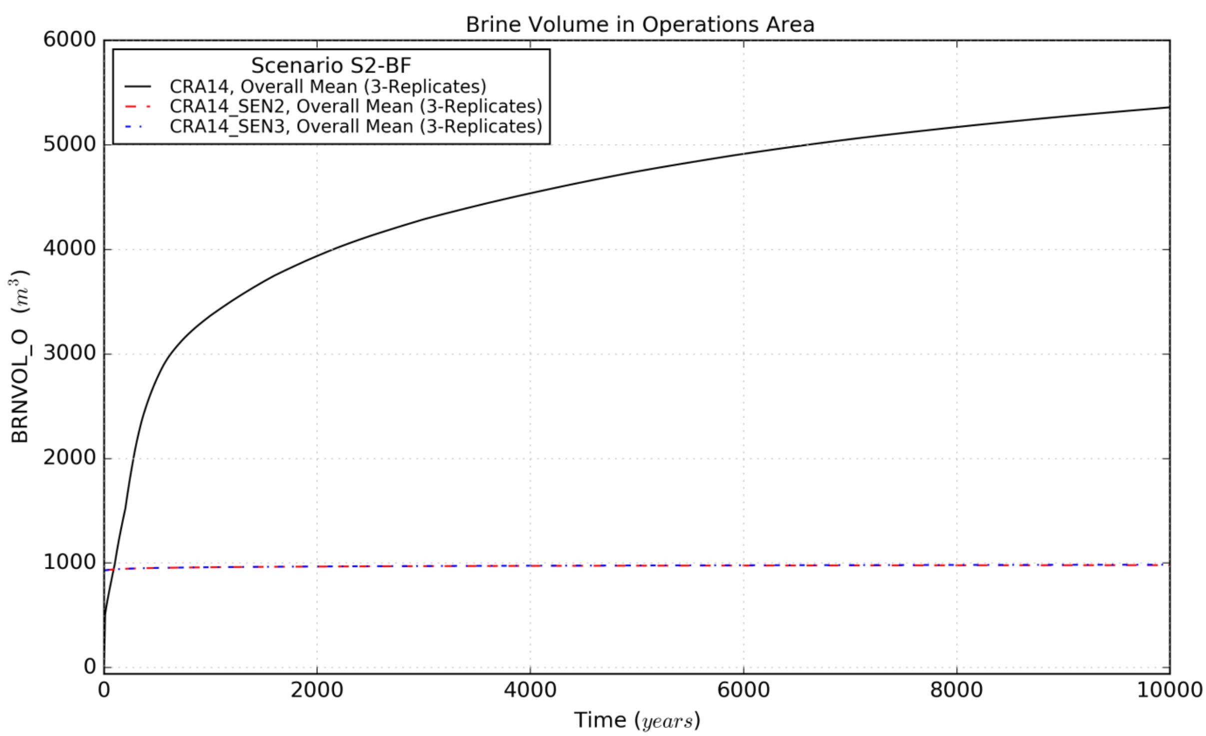

Figure 4-93: Brine Volume Means for the Operations Area, Scenario S2-BF

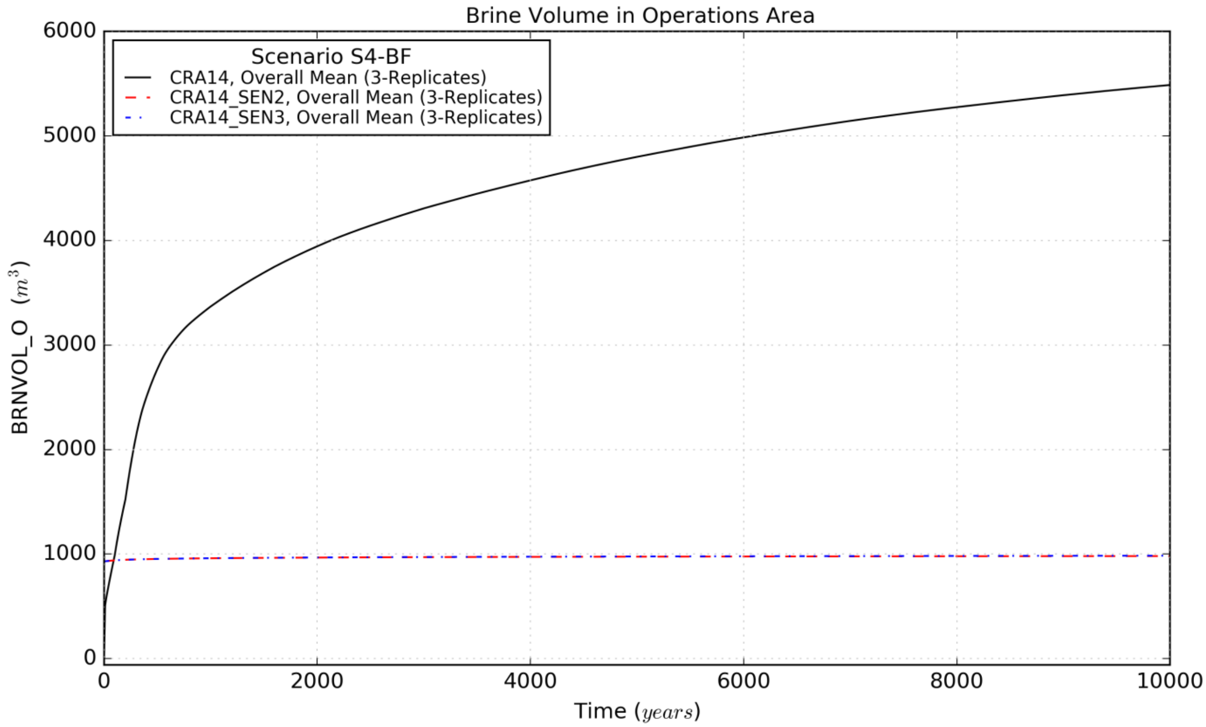

Figure 4-94: Brine Volume Means for the Operations Area, Scenario S4-BF

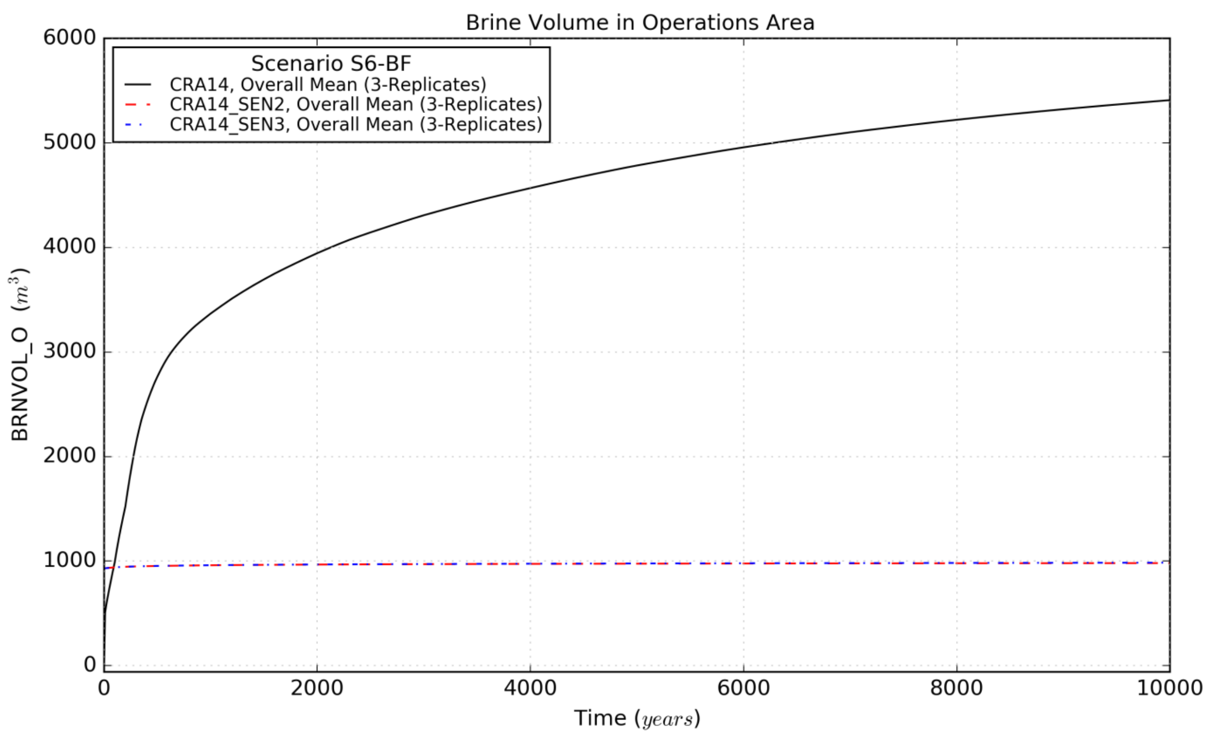

Figure 4-95: Brine Volume Means for the Operations Area, Scenario S6-BF

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Table 4-5: Brine Saturation Statistics on Overall Means for CRA14 and CRA14_SEN3

Quantity (units)	Description	Scenario	Mean Value		Maximum Value	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
EXP_SATB (dimensionless)	Brine Saturation in Experimental Area	S1-BF	1.02E-01	9.89E-01	1.41E-01	9.94E-01
		S2-BF	1.00E-01	9.89E-01	1.36E-01	9.94E-01
		S4-BF	1.03E-01	9.89E-01	1.44E-01	9.94E-01
		S6-BF	1.02E-01	9.89E-01	1.40E-01	9.94E-01
OPS_SATB (dimensionless)	Brine Saturation in Operations Area	S1-BF	6.67E-01	9.89E-01	8.06E-01	9.94E-01
		S2-BF	6.59E-01	9.89E-01	7.89E-01	9.94E-01
		S4-BF	6.68E-01	9.89E-01	8.08E-01	9.94E-01
		S6-BF	6.64E-01	9.89E-01	7.97E-01	9.94E-01
NRR_SATB (dimensionless)	Brine Saturation in North Rest-of-Repository	S1-BF	7.10E-02	6.67E-02	1.11E-01	1.06E-01
		S2-BF	7.07E-02	6.67E-02	1.11E-01	1.06E-01
		S4-BF	7.32E-02	6.69E-02	1.11E-01	1.06E-01
		S6-BF	7.13E-02	6.69E-02	1.11E-01	1.06E-01
SRR_SATB (dimensionless)	Brine Saturation in South Rest-of-Repository	S1-BF	7.86E-02	6.66E-02	1.22E-01	1.06E-01
		S2-BF	8.99E-02	6.70E-02	1.23E-01	1.06E-01
		S4-BF	8.48E-02	6.72E-02	1.23E-01	1.06E-01
		S6-BF	8.57E-02	6.71E-02	1.22E-01	1.06E-01
WAS_SATB (dimensionless)	Brine Saturation in Waste Panel	S1-BF	2.40E-01	1.34E-01	2.73E-01	1.57E-01
		S2-BF	8.69E-01	8.15E-01	9.74E-01	9.70E-01
		S4-BF	4.30E-01	3.62E-01	5.20E-01	4.50E-01
		S6-BF	6.93E-01	6.14E-01	8.40E-01	8.10E-01

Table 4-6: Brine Saturation Statistics on Individual Vectors for CRA14 and CRA14_SEN3

Quantity (units)	Description	Scenario	Maximum Value	
			CRA14	CRA14_SEN3
EXP_SATB (dimensionless)	Brine Saturation in Experimental Area	S1-BF	8.67E-01	1.00E+00
		S2-BF	9.05E-01	1.00E+00
		S4-BF	9.08E-01	1.00E+00
		S6-BF	9.06E-01	1.00E+00
OPS_SATB (dimensionless)	Brine Saturation in Operations Area	S1-BF	1.00E+00	1.00E+00
		S2-BF	1.00E+00	1.00E+00
		S4-BF	1.00E+00	1.00E+00
		S6-BF	1.00E+00	1.00E+00
NRR_SATB (dimensionless)	Brine Saturation in North Rest-of-Repository	S1-BF	7.21E-01	7.42E-01
		S2-BF	7.20E-01	7.37E-01
		S4-BF	7.22E-01	7.42E-01
		S6-BF	7.21E-01	7.37E-01
SRR_SATB (dimensionless)	Brine Saturation in South Rest-of-Repository	S1-BF	9.36E-01	7.37E-01
		S2-BF	9.36E-01	7.39E-01
		S4-BF	9.36E-01	7.37E-01
		S6-BF	9.36E-01	7.39E-01
WAS_SATB (dimensionless)	Brine Saturation in Waste Panel	S1-BF	9.91E-01	9.74E-01
		S2-BF	9.99E-01	9.99E-01
		S4-BF	9.96E-01	9.97E-01
		S6-BF	9.99E-01	9.99E-01

4.4 Gas Flow

The modified parameters in the operations and experimental areas, panel closures, and associated disturbed rock zones result in an elimination of cumulative gas inflow to the experimental area as shown in Figure 4-96 to Figure 4-99, and similarly eliminates any cumulative gas outflow from the experimental area as shown in Figure 4-100 to Figure 4-103. Similar trends are seen for the repository operations area. As seen in Figure 4-104 to Figure 4-107 and Figure 4-108 to Figure 4-111, mean gas flows to and from the operations area are significantly reduced for CRA14_SEN3 in comparison to CRA14. Comparison of inflow and outflow between CRA14_SEN2 and CRA14_SEN3 indicates no significant change for gas inflow or outflow from these areas.

The impact of the modified operations, experimental, and panel closure area parameters on cumulative gas inflow to the north rest-of-repository waste area can be seen in Figure 4-112 to Figure 4-115. As seen in those figures, mean gas inflows to the northernmost repository waste region are reduced by about a factor of four or more in all scenarios when the modified operations, experimental, and panel closure area parameters are included in the BRAGFLO repository representation. Mean gas outflows from the north rest-of-repository are similarly reduced for CRA14_SEN3 in comparison to CRA14, as shown in Figure 4-116 to Figure 4-119, apparently due to a significant reduction of gas flows into the operations area or adjacent waste areas under CRA14_SEN3.

Gas inflow and outflow results for the south rest-of-repository waste region are shown in Figure 4-120 to Figure 4-123 and Figure 4-124 to Figure 4-127. The flow of gas into the south rest-of-repository is significantly decreased for CRA14_SEN3 in comparison to CRA14 under all scenarios. Gas outflows for CRA14_SEN3 from the south rest-of-repository are reduced from those in CRA14 and are correspondingly reduced in comparison to CRA14_SEN2.

Mean gas inflows to the southernmost waste panel modeled in BRAGFLO are both increased and decreased (dependent upon the scenario) when the modified operations, experimental, and panel closure area parameters are included in the repository representation. As seen in Figure 4-128 to Figure 4-131, the mean gas inflow to the waste panel determined at the end of the simulation duration for CRA14_SEN3 is less than that found for CRA14 for all scenarios except for the undisturbed scenario, S1-BF. Mean gas outflows from the waste panel are reduced for CRA14_SEN3 in comparison to CRA14 as shown in Figure 4-132 to Figure 4-135.

Pressure increases in the operations and experimental areas, which would normally lead to an increase in the cumulative volume of gas flowing up the shaft, are offset by the reduced permeability, increased residual gas saturation, and application of two-phase flow parameters within the operations and experimental areas. These modified parameters restrict the flow of gas into the shaft such that the mean gas flows up the repository shafts are essentially nonexistent for CRA14_SEN3 (see Figure 4-136 to Figure 4-139).

Mean gas flows up the intrusion borehole are increased as a result of the gas flow into the southernmost waste panel under S1-BF, S2-BF, and S6-BF, but reduced under S4-BF due to reduced gas flow into the waste panel. As seen in Figure 4-140 to Figure 4-142, mean gas flows up the intrusion borehole for CRA14_SEN3 are greater than the CRA14 results, with the exception of scenario S4-BF.

Gas flow statistics for CRA14 and CRA14_SEN3 are summarized in Table 4-7 and Table 4-8. Table 4-7 provides the 3-replicate mean (integrated over time) and 3-replicate maximum (over all time) gas flow values. Table 4-8 provides the maximum gas flow (over all time) for all individual vectors. The modified north end and panel closure parameters result in changes in gas inflows for waste areas that are more pronounced with gas inflow essentially halted for the northern non-waste areas of the repository as compared to the CRA14. The 3-replicate mean and maximum gas outflows from the operations and experimental areas indicate halting of gas flow from those areas with gas outflows from the waste areas reduced for CRA14_SEN3 in comparison to CRA14 over all scenarios. Individual vector maximum gas inflow and outflow values are reduced for CRA14_SEN3 in comparison to CRA14 except for flow into the south rest-of-repository and southernmost waste panel under scenario S1-BF.

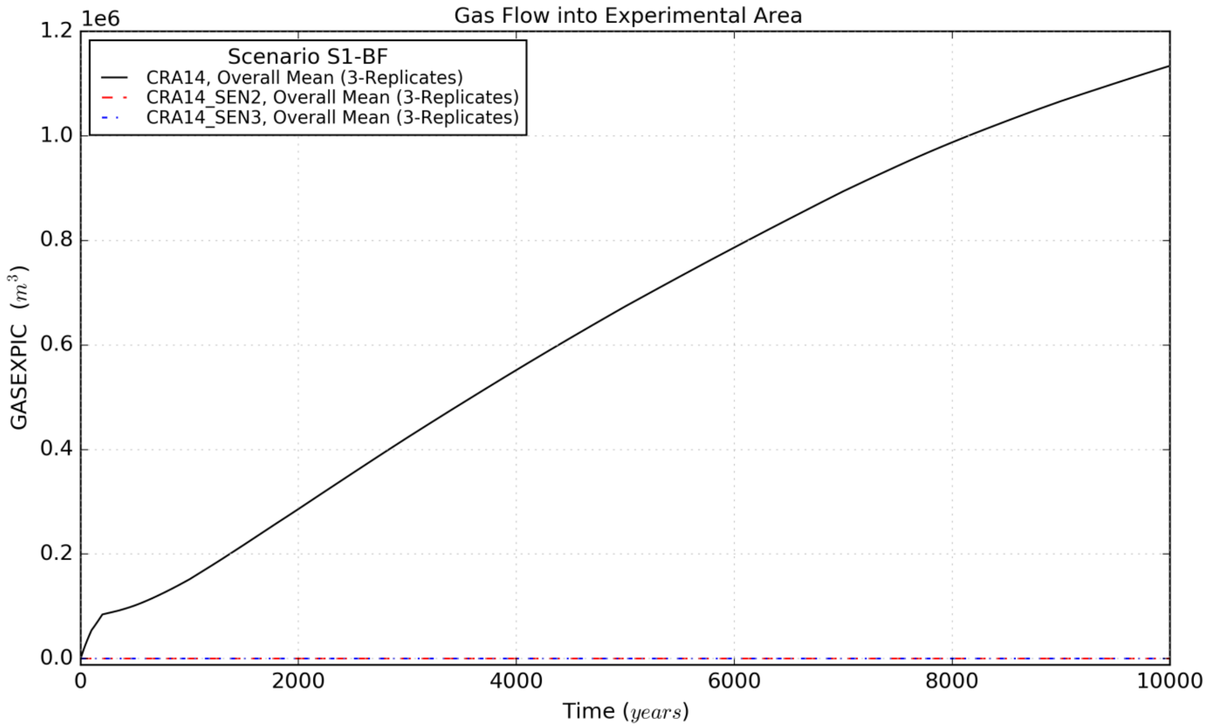

Figure 4-96: Gas Inflow Means to the Experimental Area, Scenario S1-BF

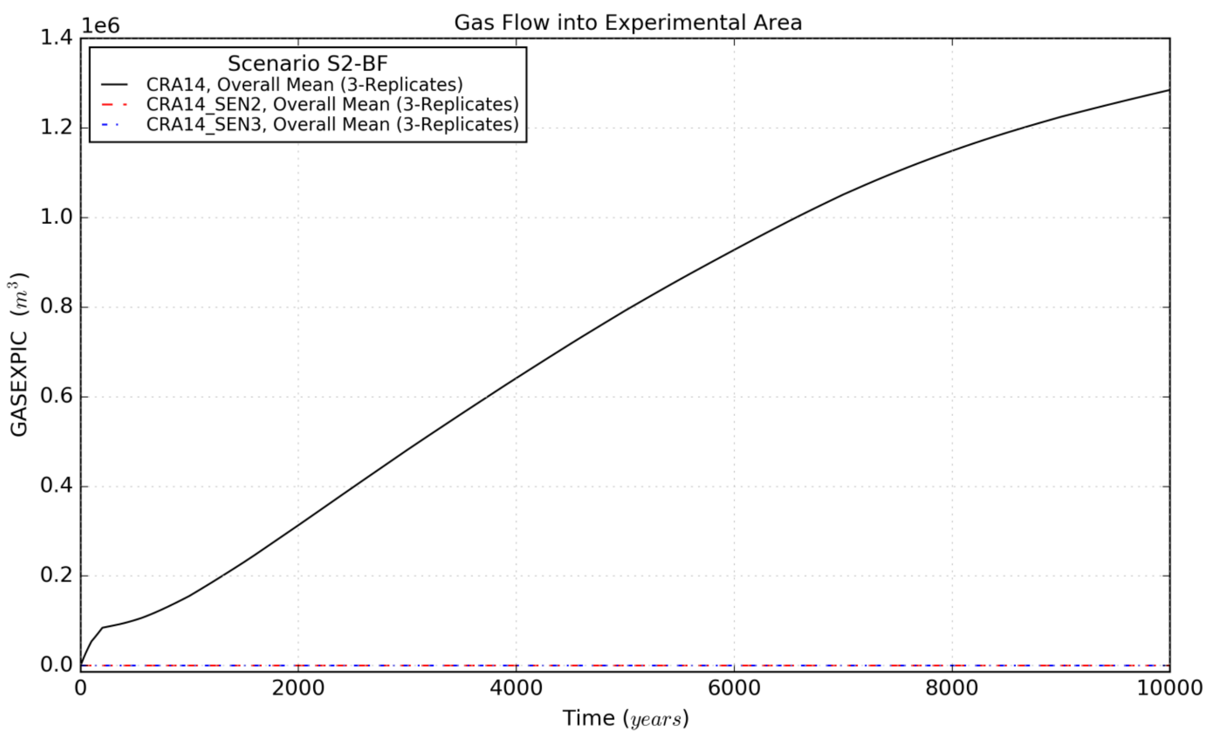

Figure 4-97: Gas Inflow Means to the Experimental Area, Scenario S2-BF

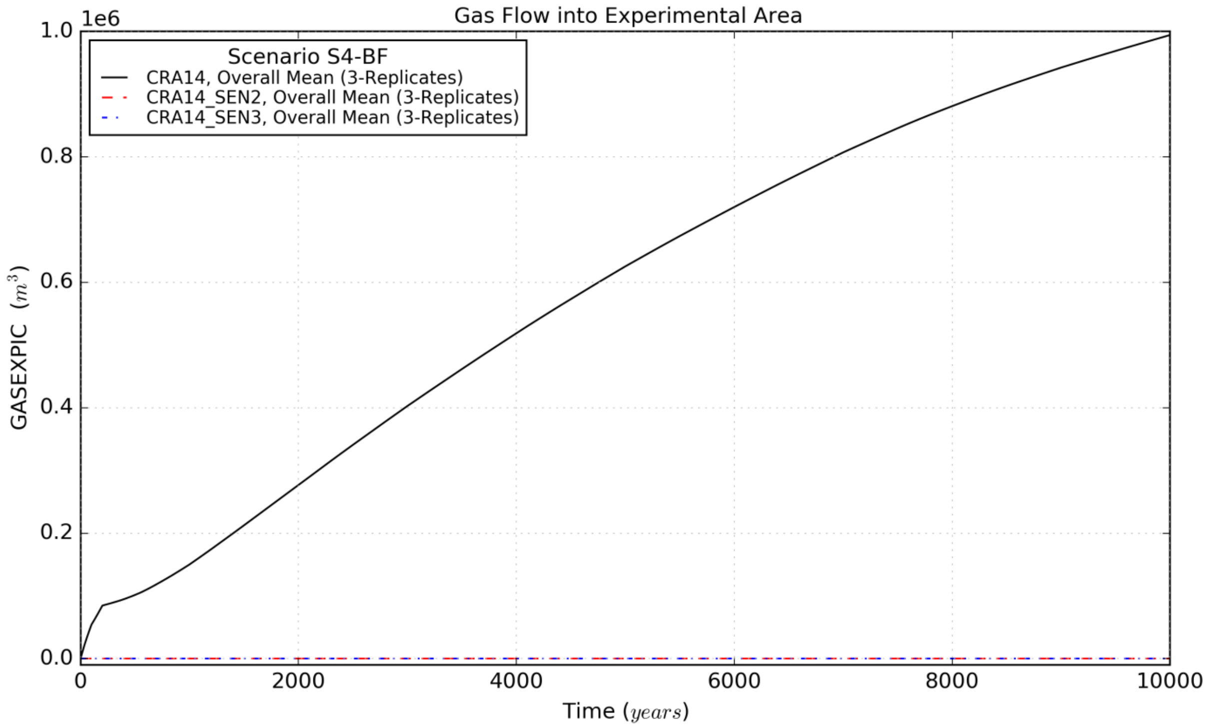

Figure 4-98: Gas Inflow Means to the Experimental Area, Scenario S4-BF

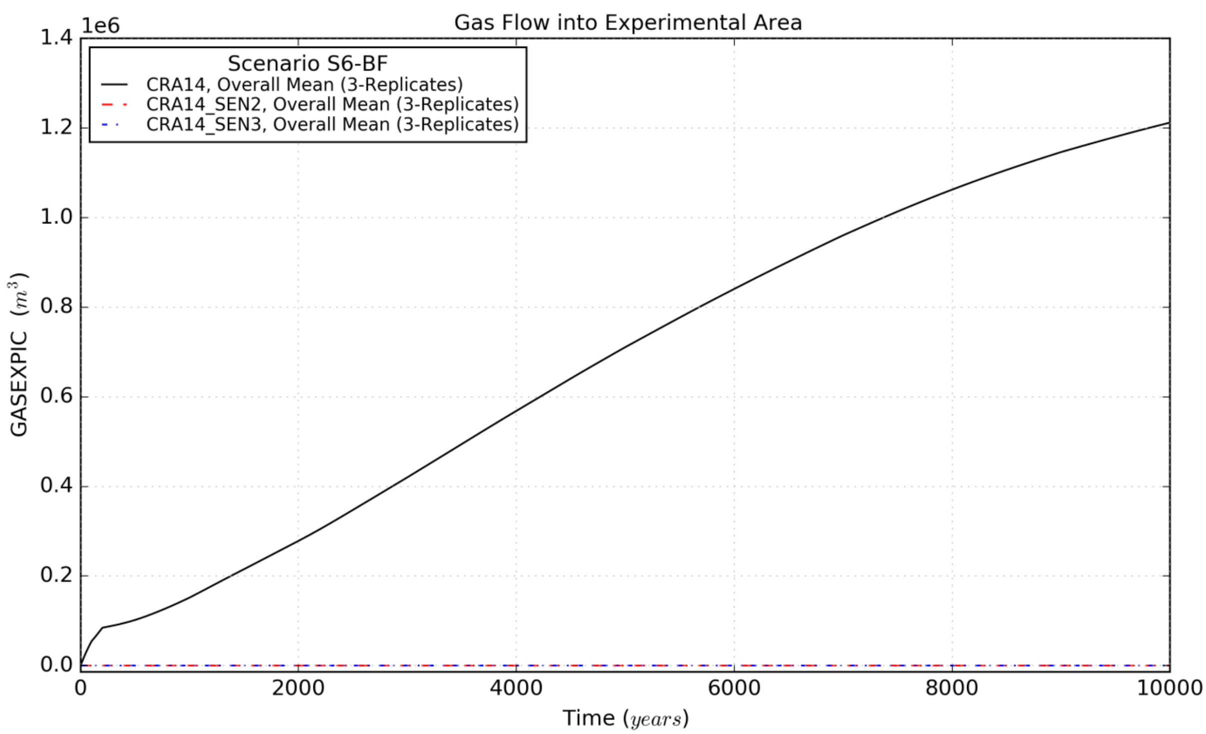

Figure 4-99: Gas Inflow Means to the Experimental Area, Scenario S6-BF

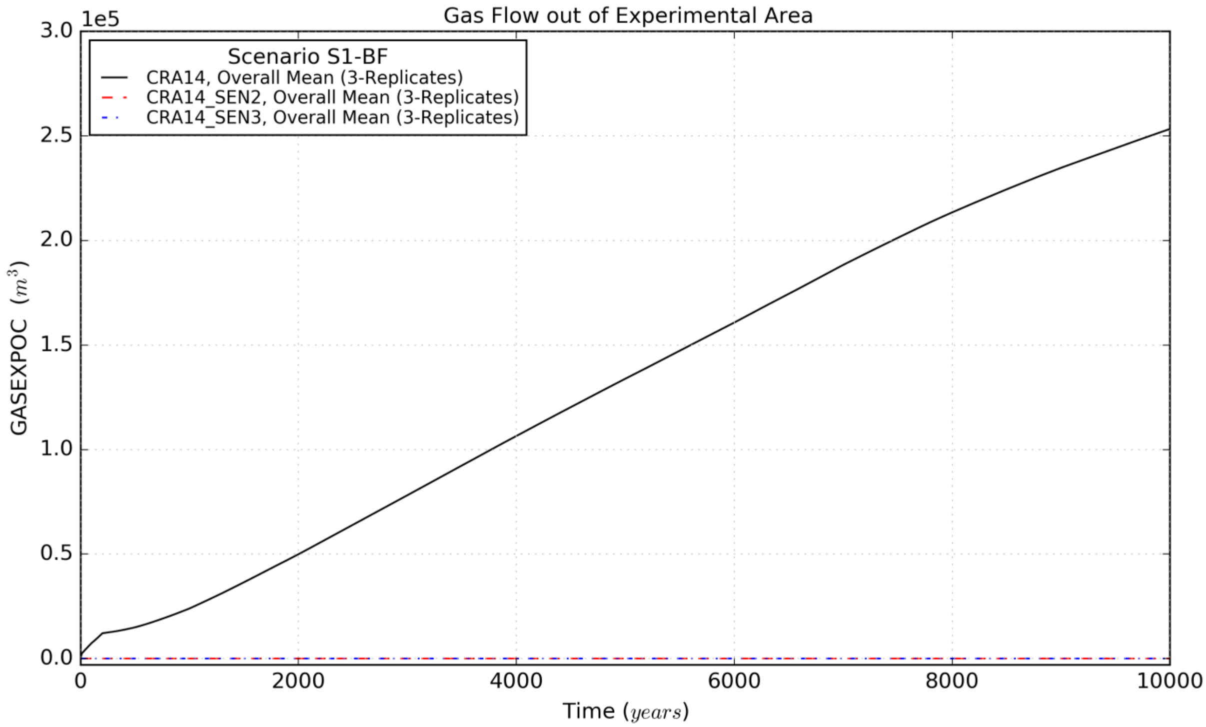

Figure 4-100: Gas Outflow Means from the Experimental Area, Scenario S1-BF

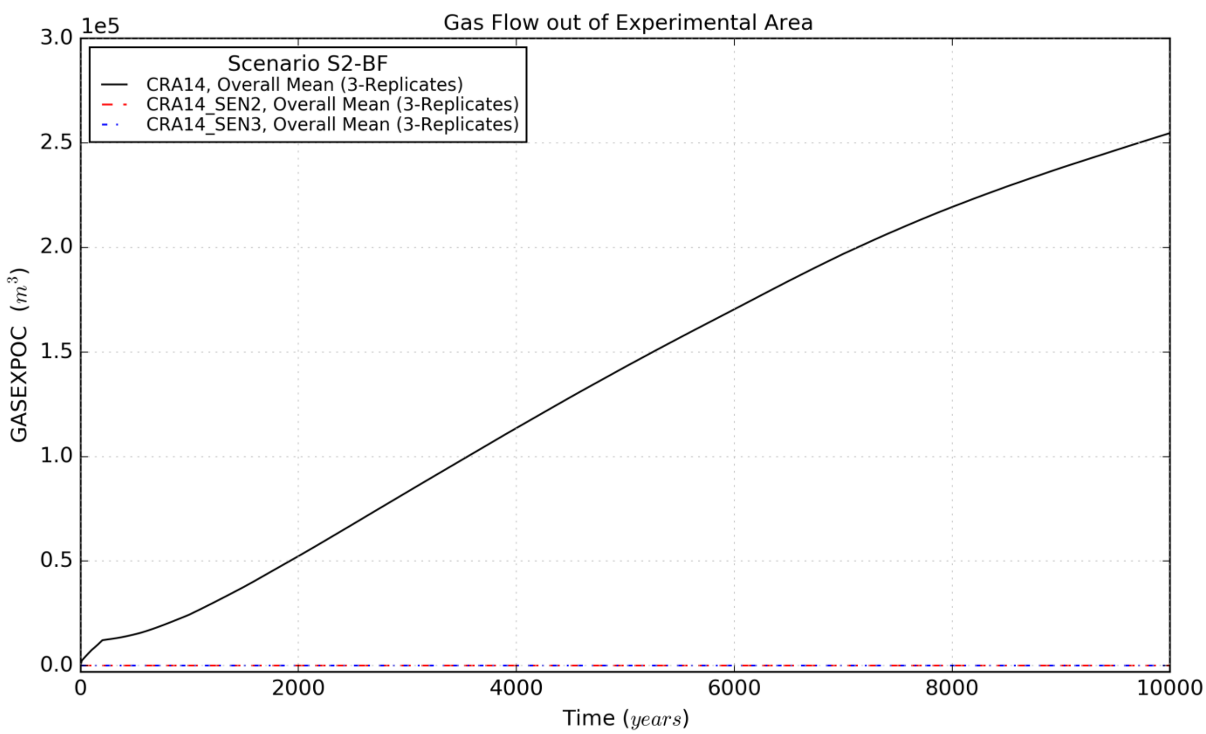

Figure 4-101: Gas Outflow Means from the Experimental Area, Scenario S2-BF

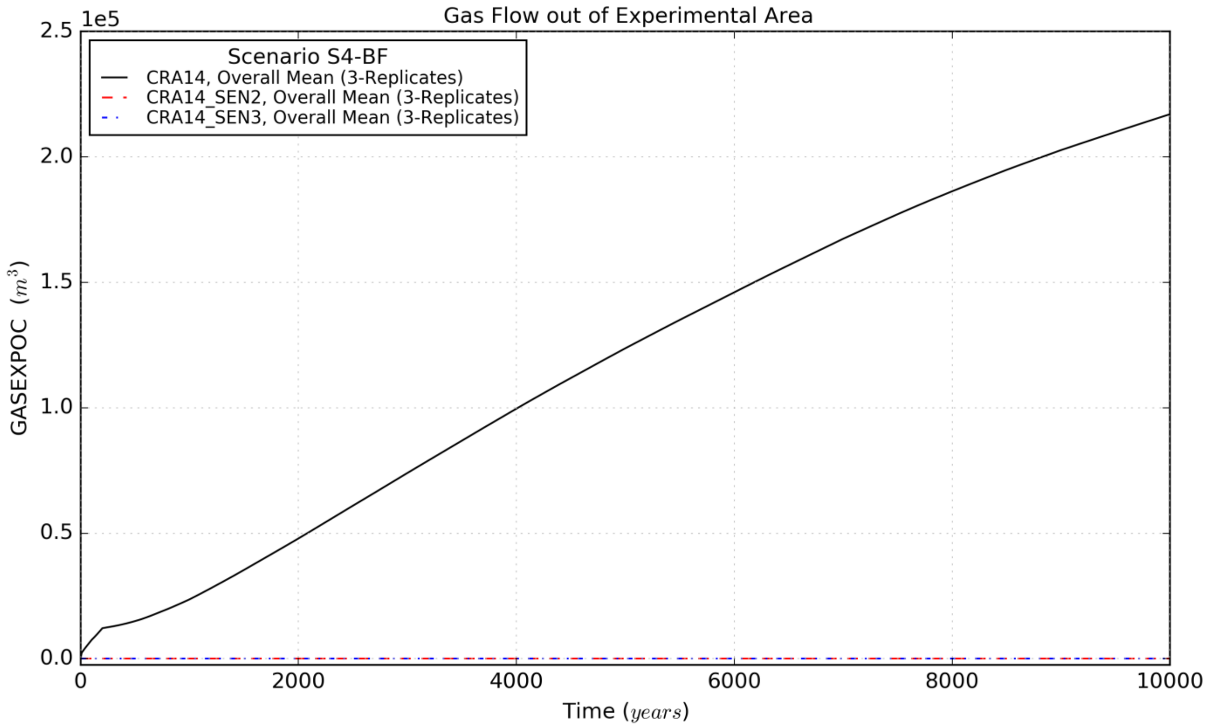

Figure 4-102: Gas Outflow Means from the Experimental Area, Scenario S4-BF

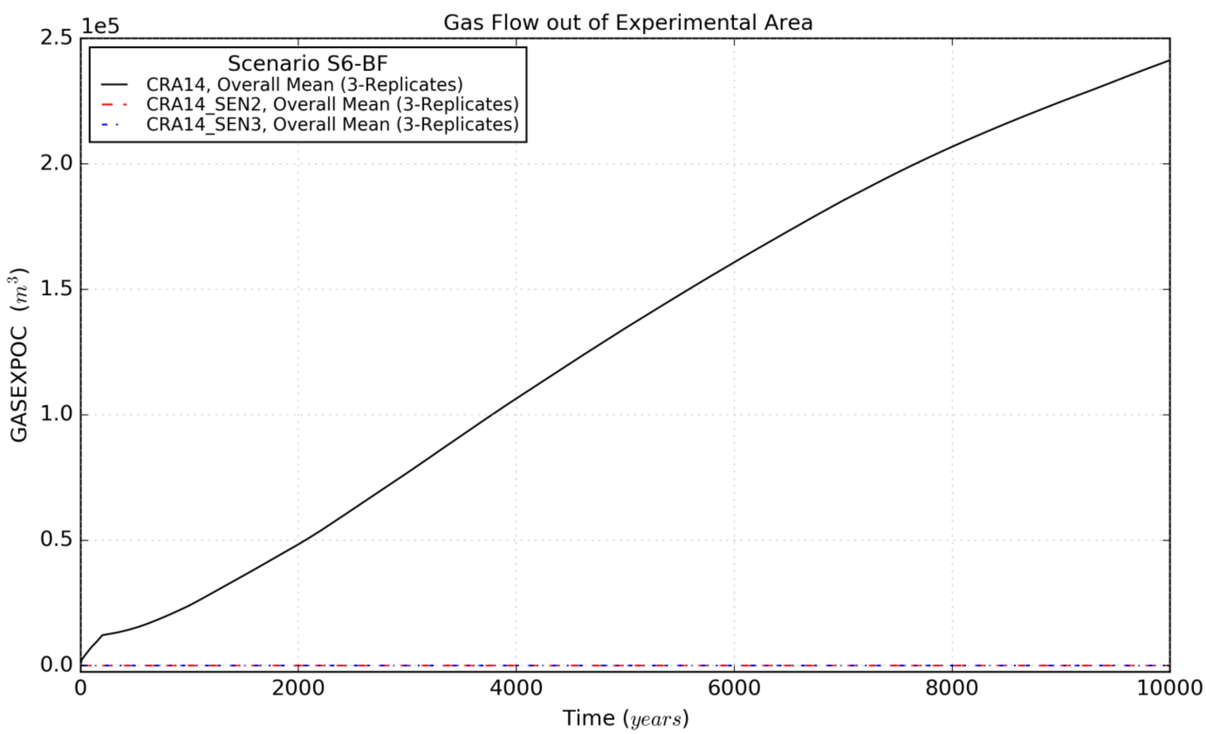

Figure 4-103: Gas Outflow Means from the Experimental Area, Scenario S6-BF

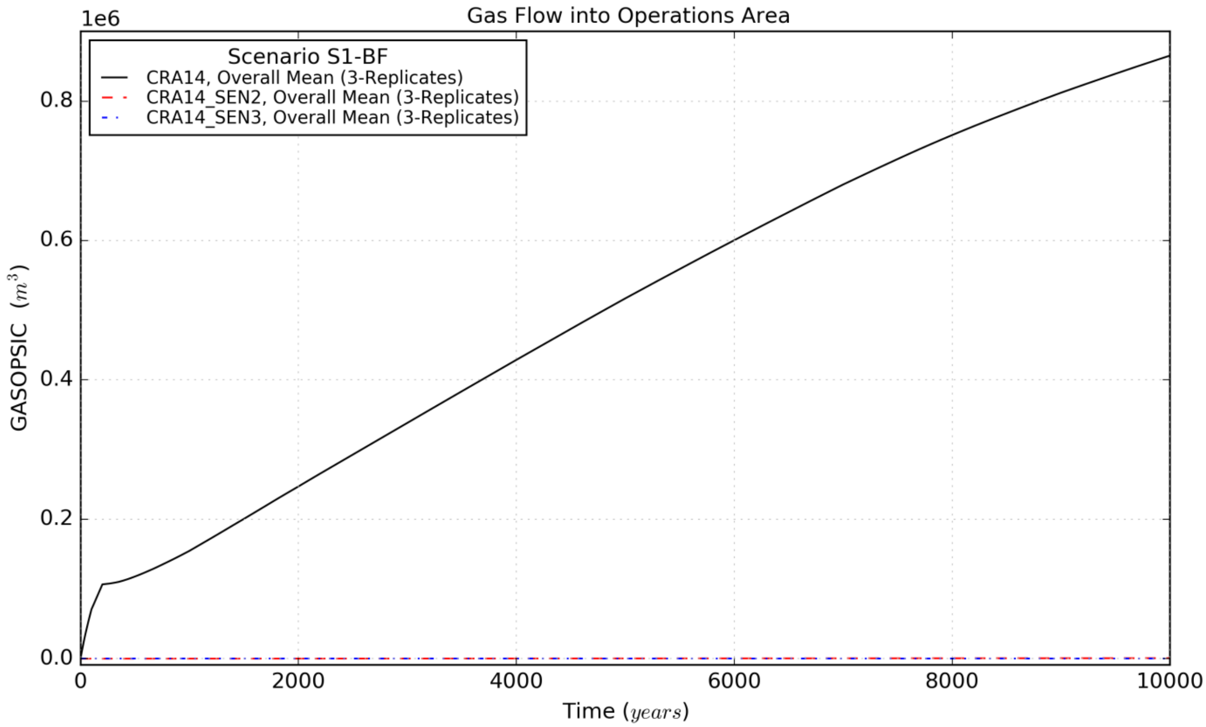

Figure 4-104: Gas Inflow Means to the Operations Area, Scenario S1-BF

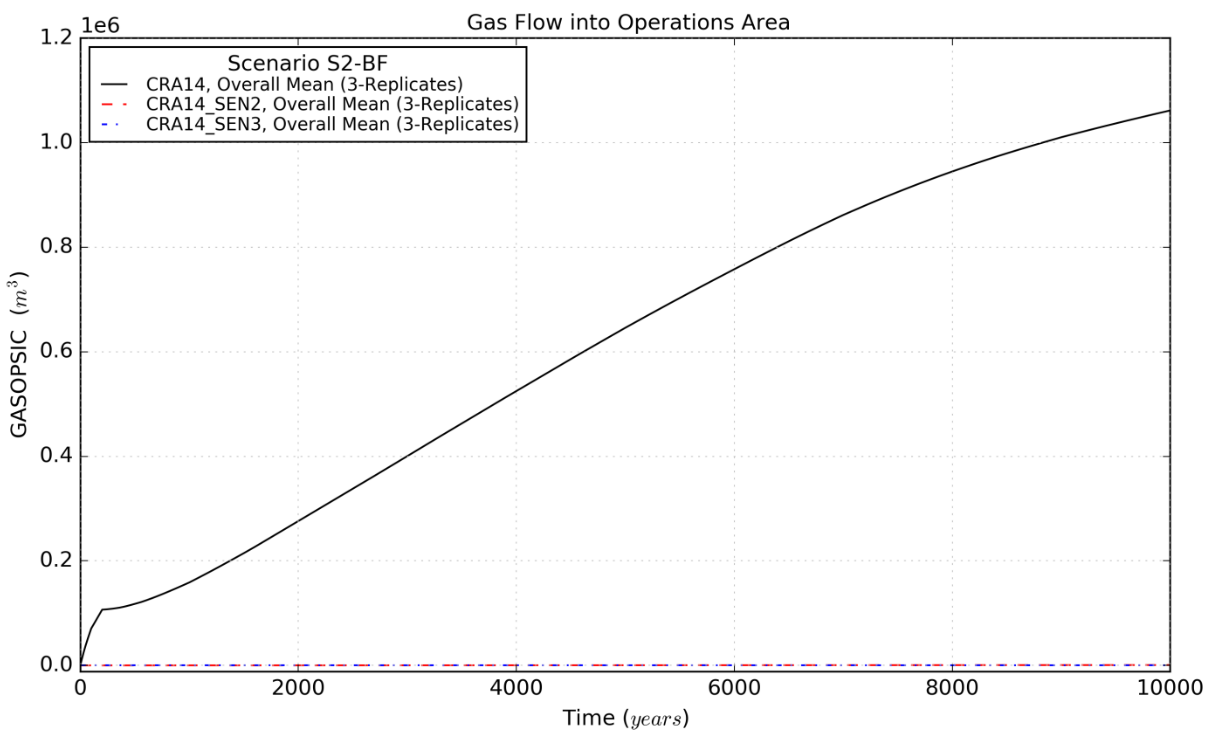

Figure 4-105: Gas Inflow Means to the Operations Area, Scenario S2-BF

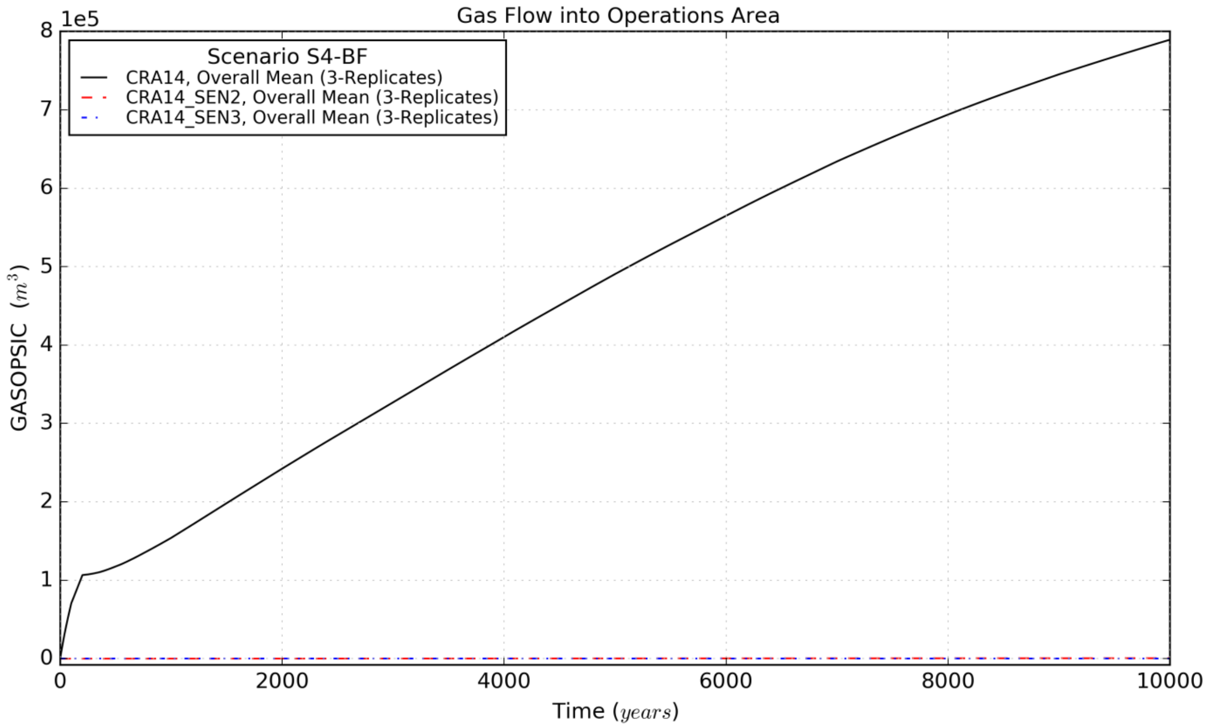

Figure 4-106: Gas Inflow Means to the Operations Area, Scenario S4-BF

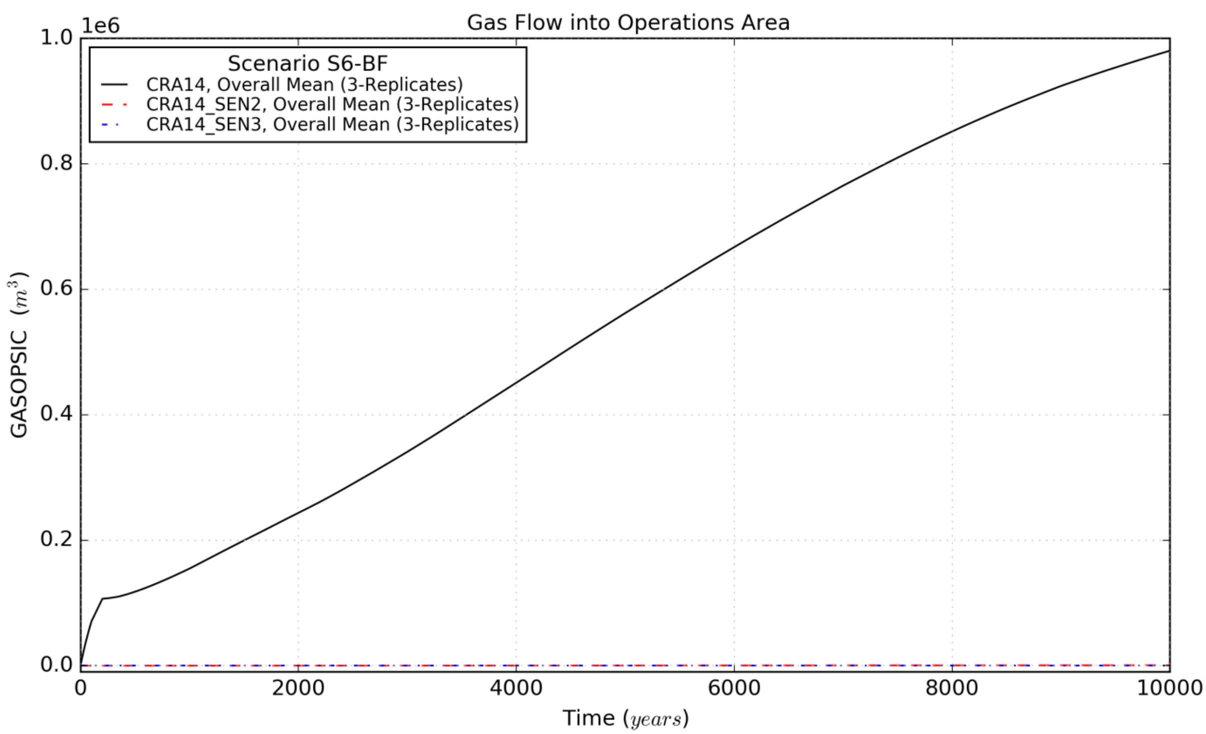

Figure 4-107: Gas Inflow Means to the Operations Area, Scenario S6-BF

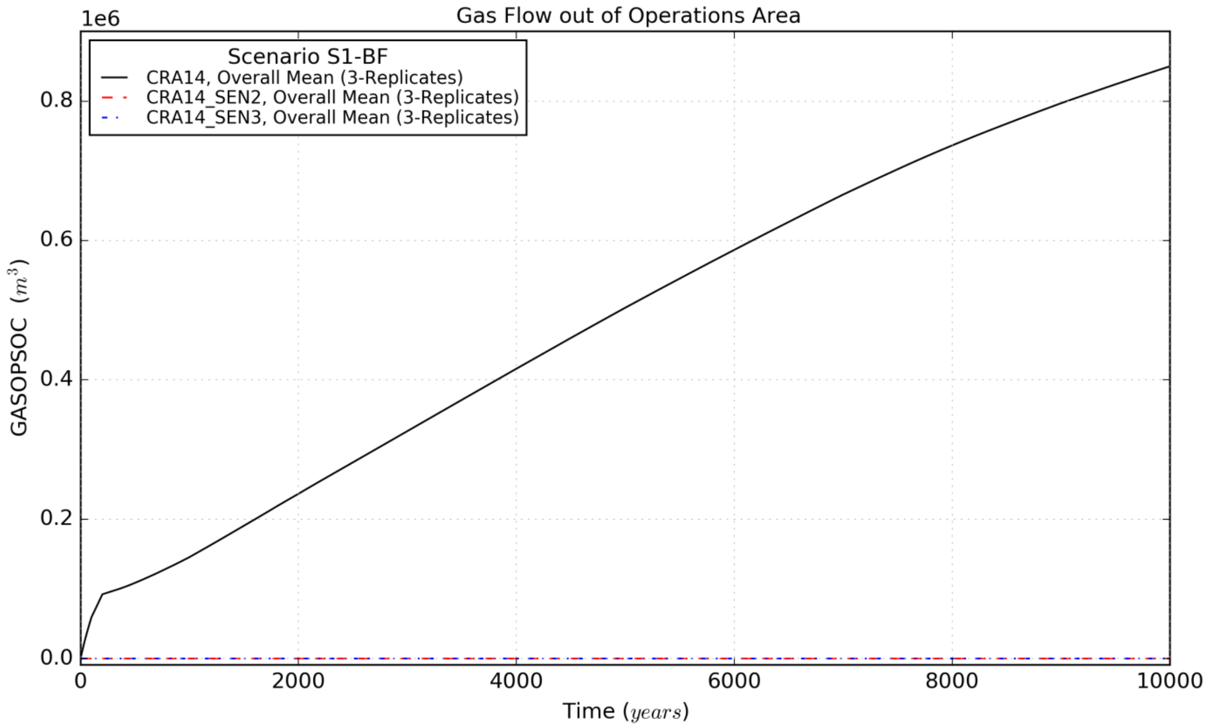

Figure 4-108: Gas Outflow Means from the Operations Area, Scenario S1-BF

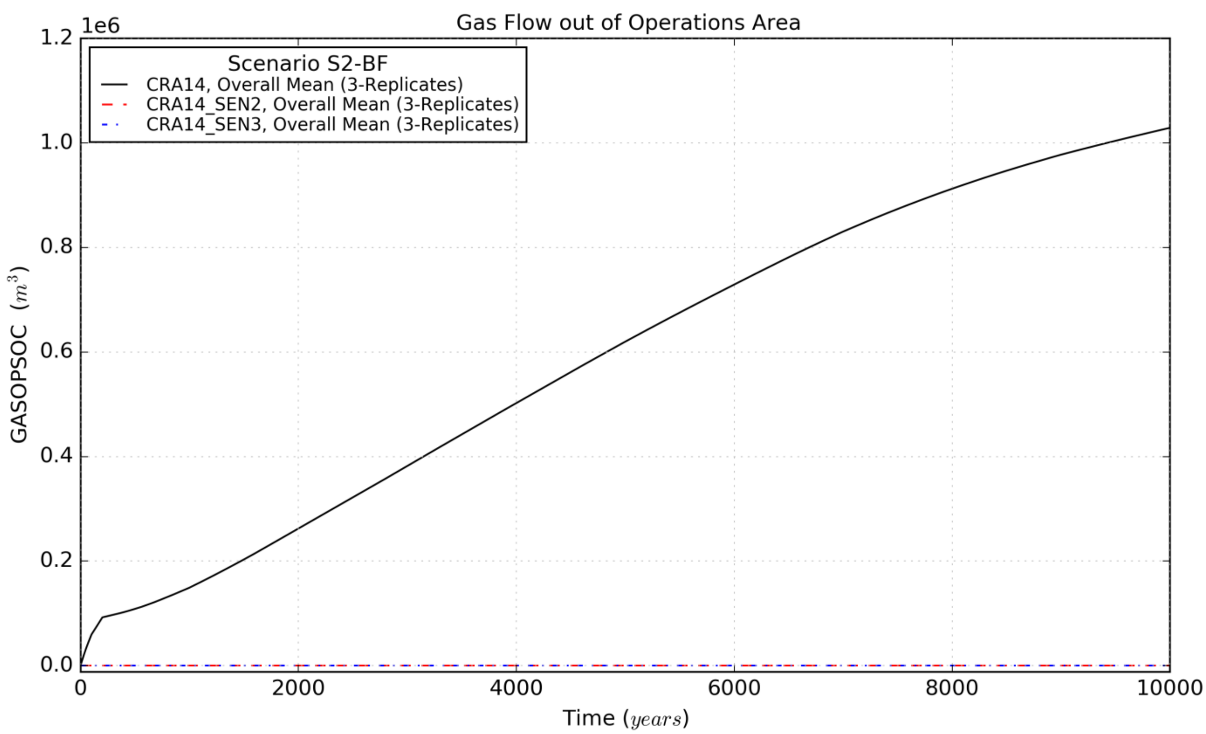

Figure 4-109: Gas Outflow Means from the Operations Area, Scenario S2-BF

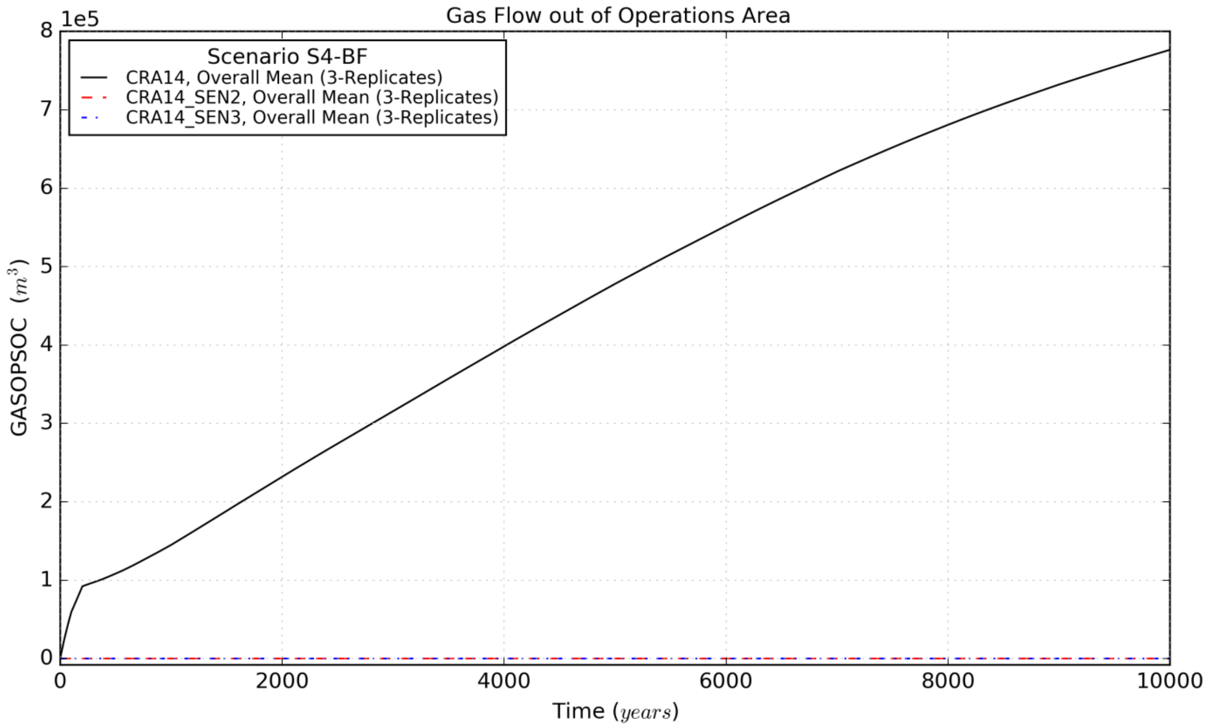

Figure 4-110: Gas Outflow Means from the Operations Area, Scenario S4-BF

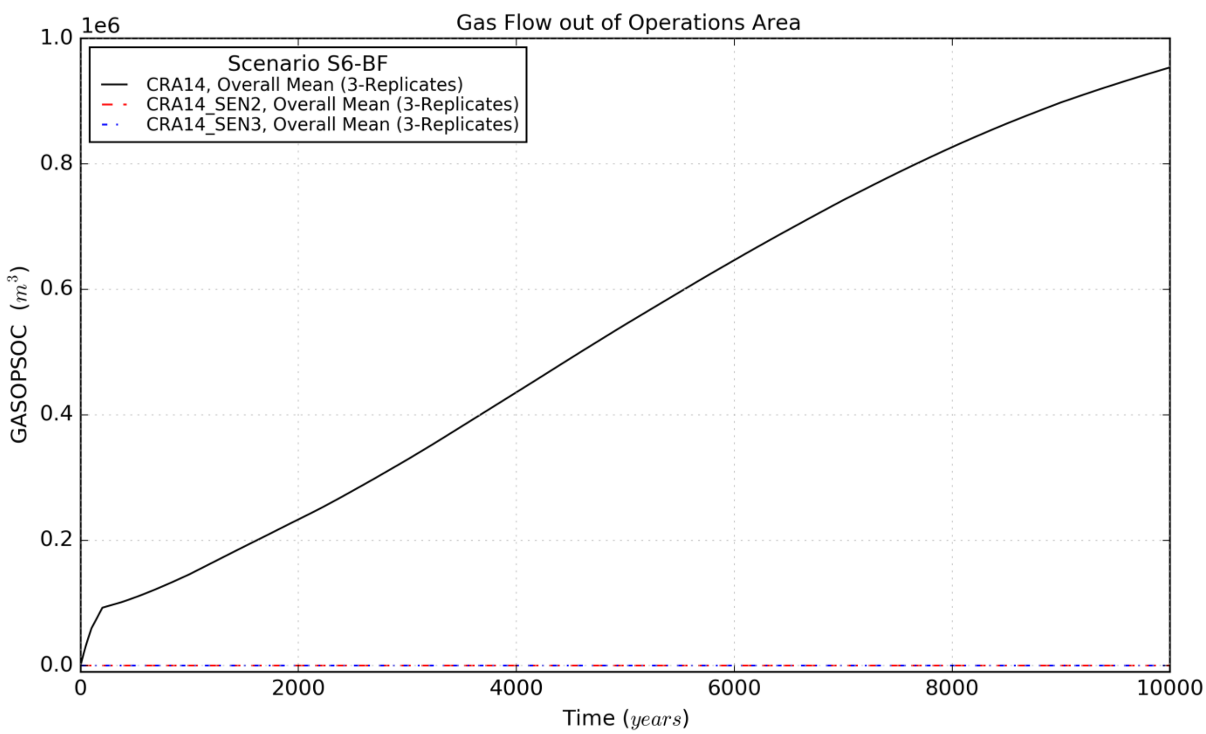

Figure 4-111: Gas Outflow Means from the Operations Area, Scenario S6-BF

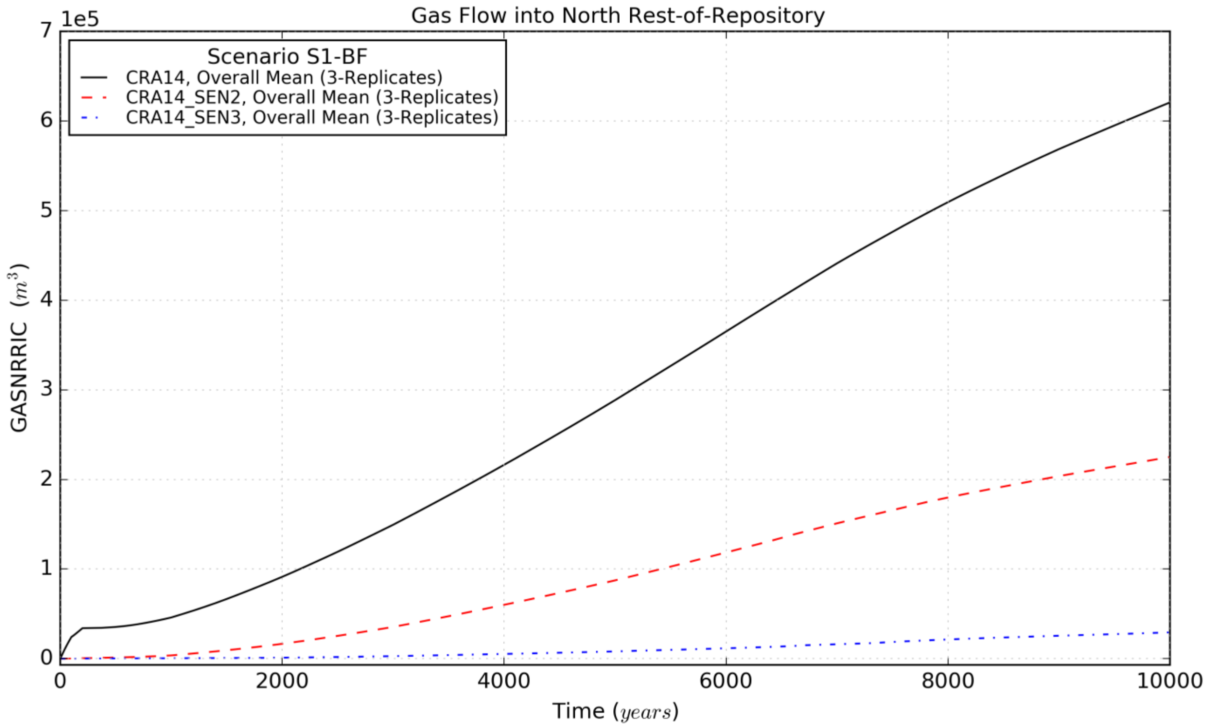

Figure 4-112: Gas Inflow Means to the North Rest-of-Repository, Scenario S1-BF

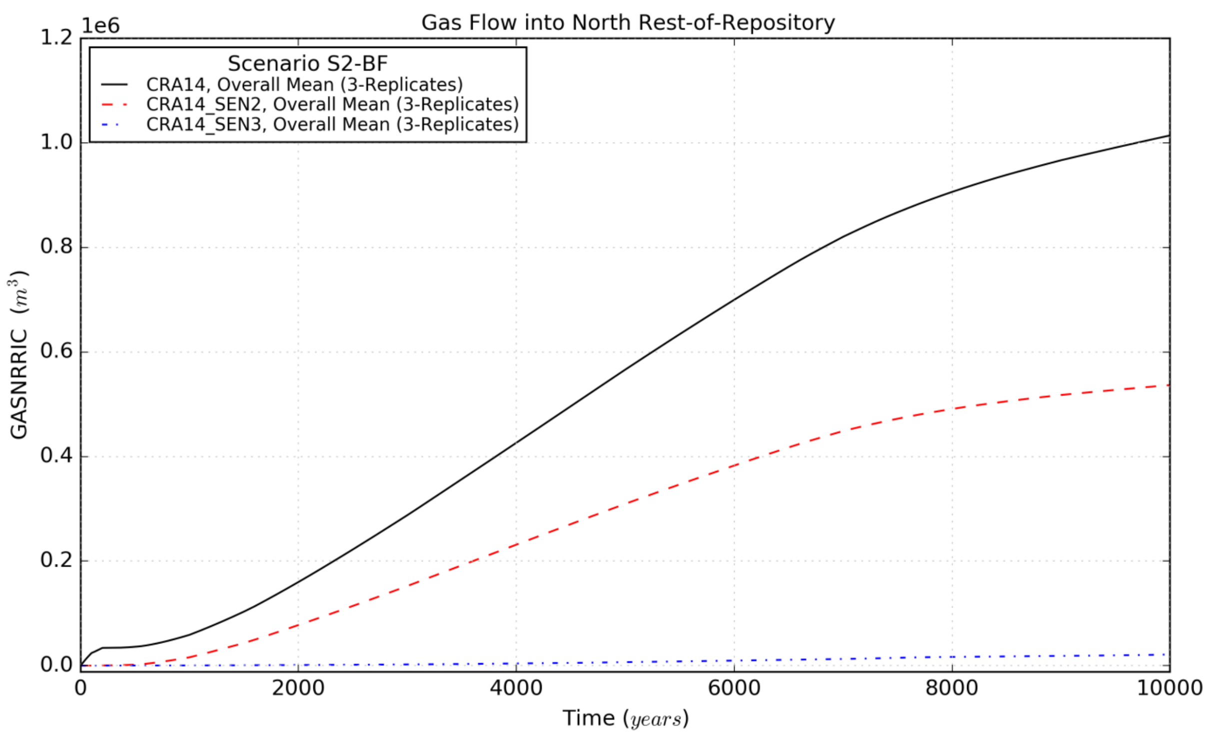

Figure 4-113: Gas Inflow Means to the North Rest-of-Repository, Scenario S2-BF

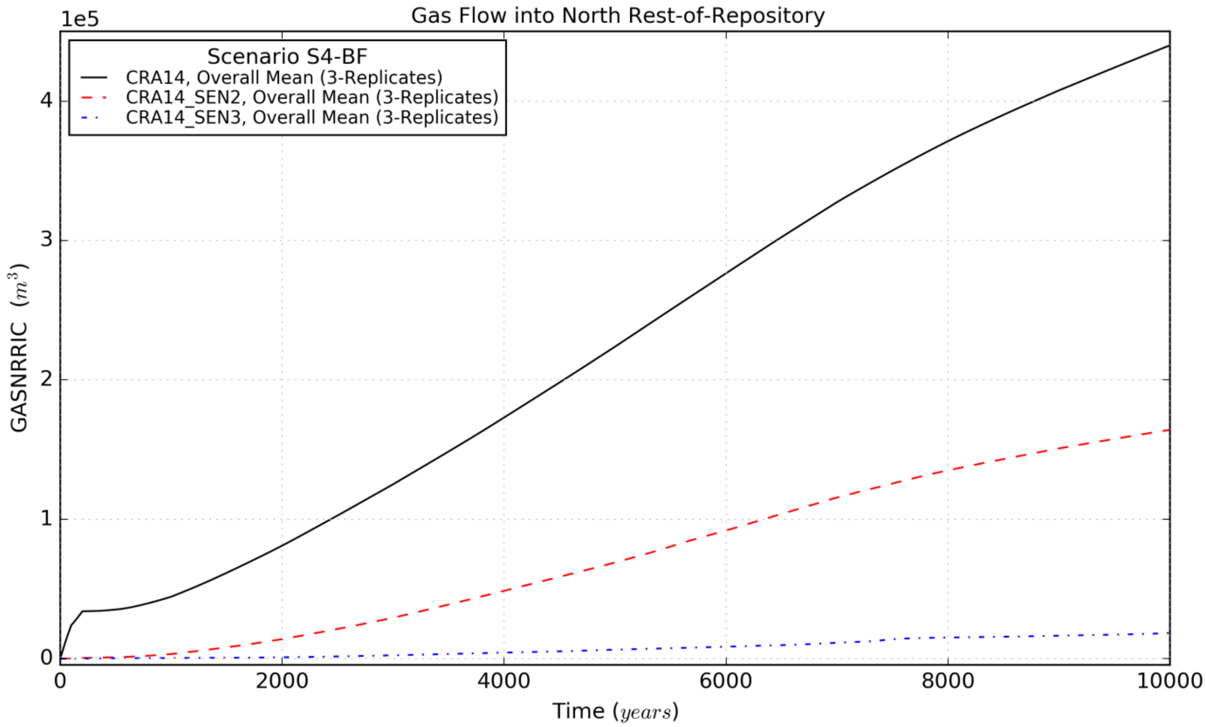

Figure 4-114: Gas Inflow Means to the North Rest-of-Repository, Scenario S4-BF

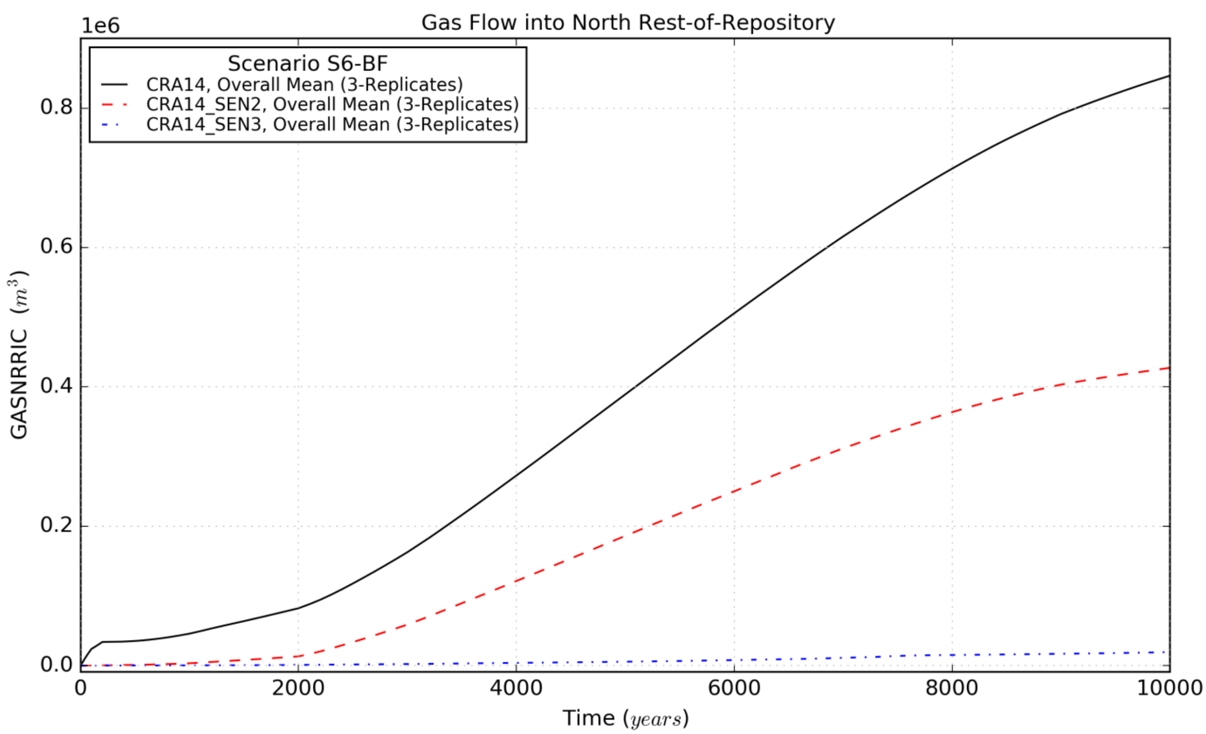

Figure 4-115: Gas Inflow Means to the North Rest-of-Repository, Scenario S6-BF

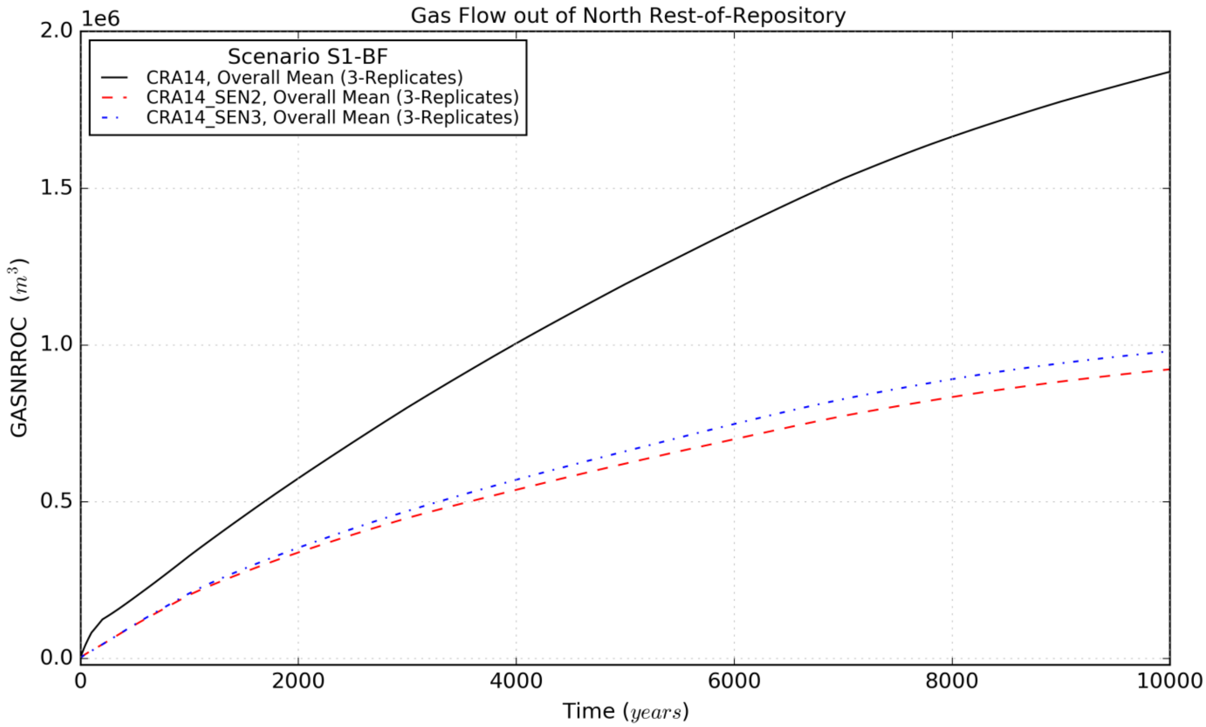

Figure 4-116: Gas Outflow Means from the North Rest-of-Repository, Scenario S1-BF

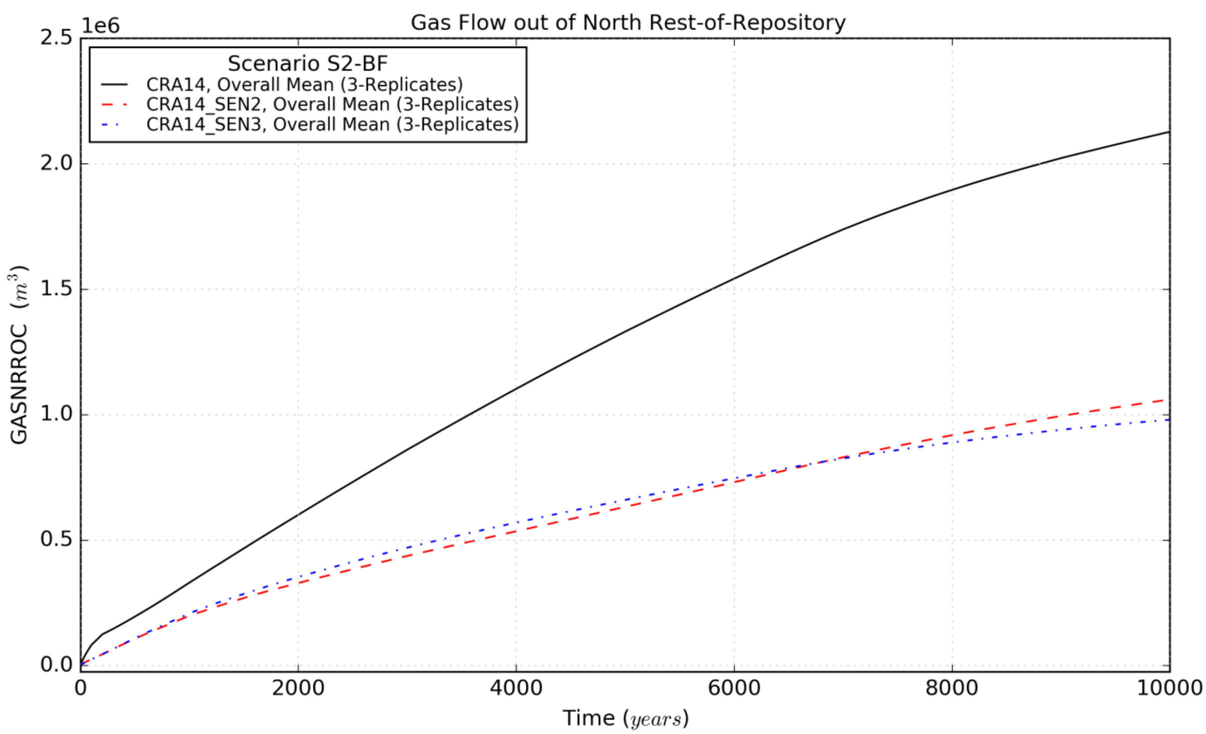

Figure 4-117: Gas Outflow Means from the North Rest-of-Repository, Scenario S2-BF

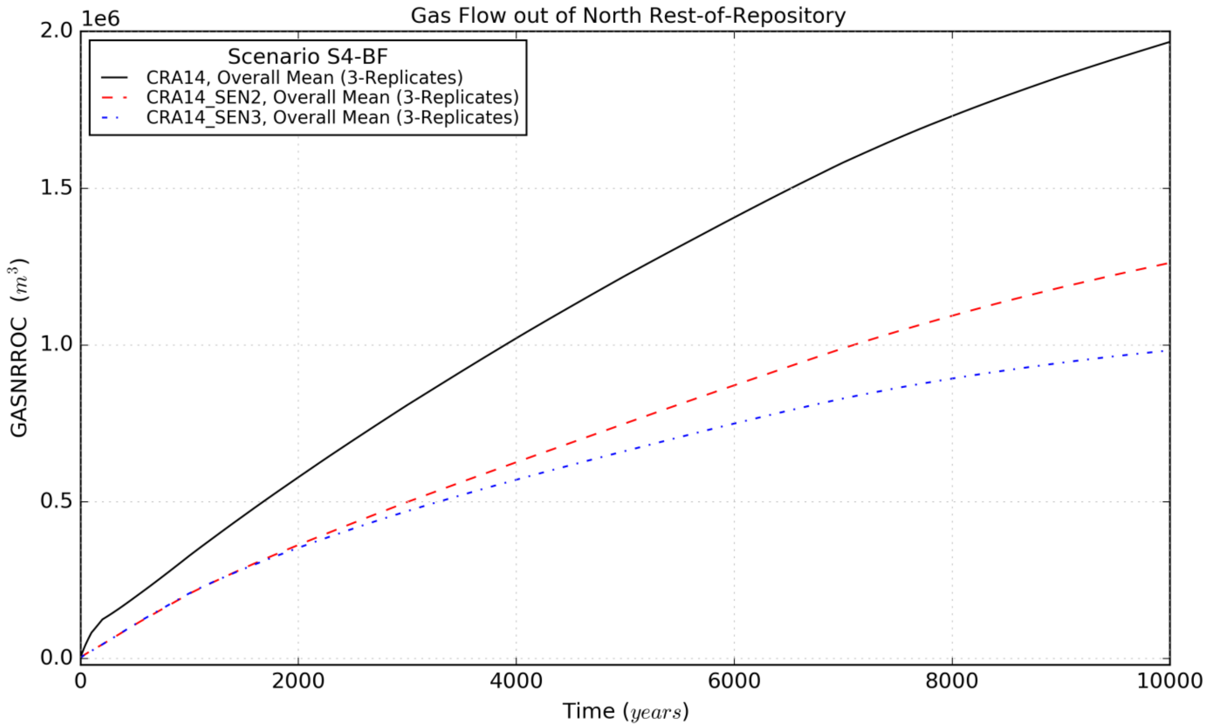

Figure 4-118: Gas Outflow Means from the North Rest-of-Repository, Scenario S4-BF

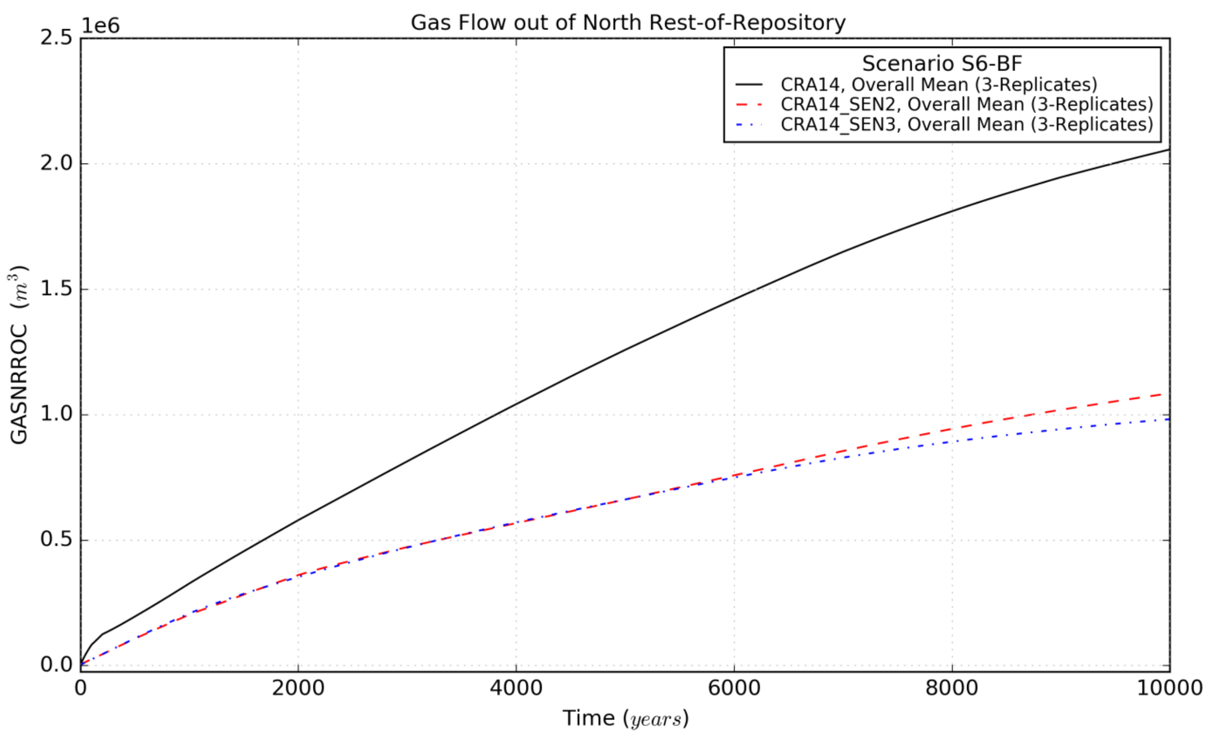

Figure 4-119: Gas Outflow Means from the North Rest-of-Repository, Scenario S6-BF

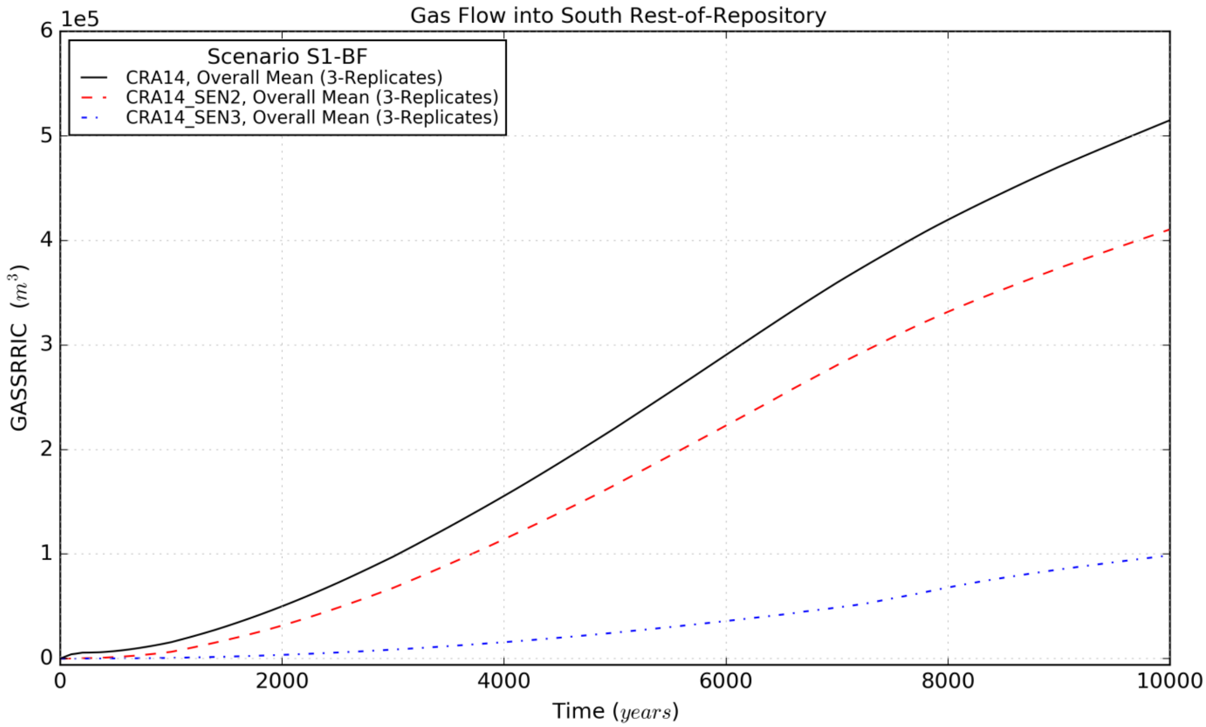

Figure 4-120: Gas Inflow Means to the South Rest-of-Repository, Scenario S1-BF

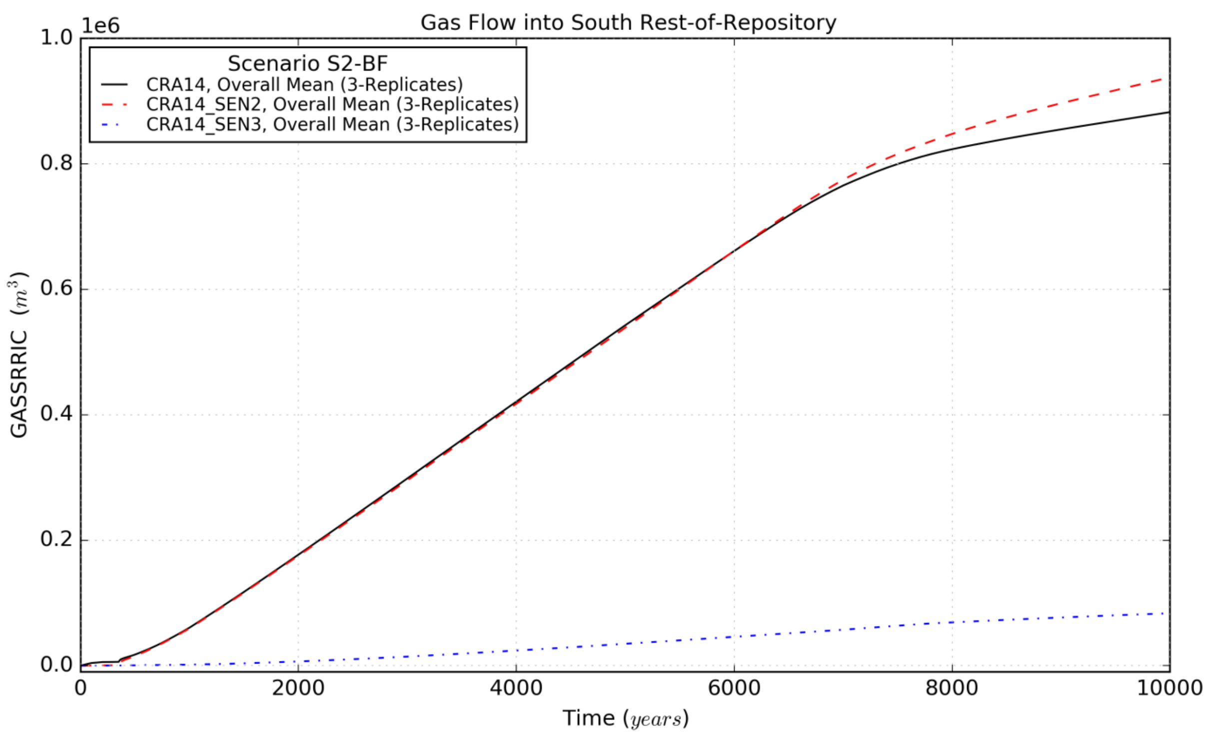

Figure 4-121: Gas Inflow Means to the South Rest-of-Repository, Scenario S2-BF

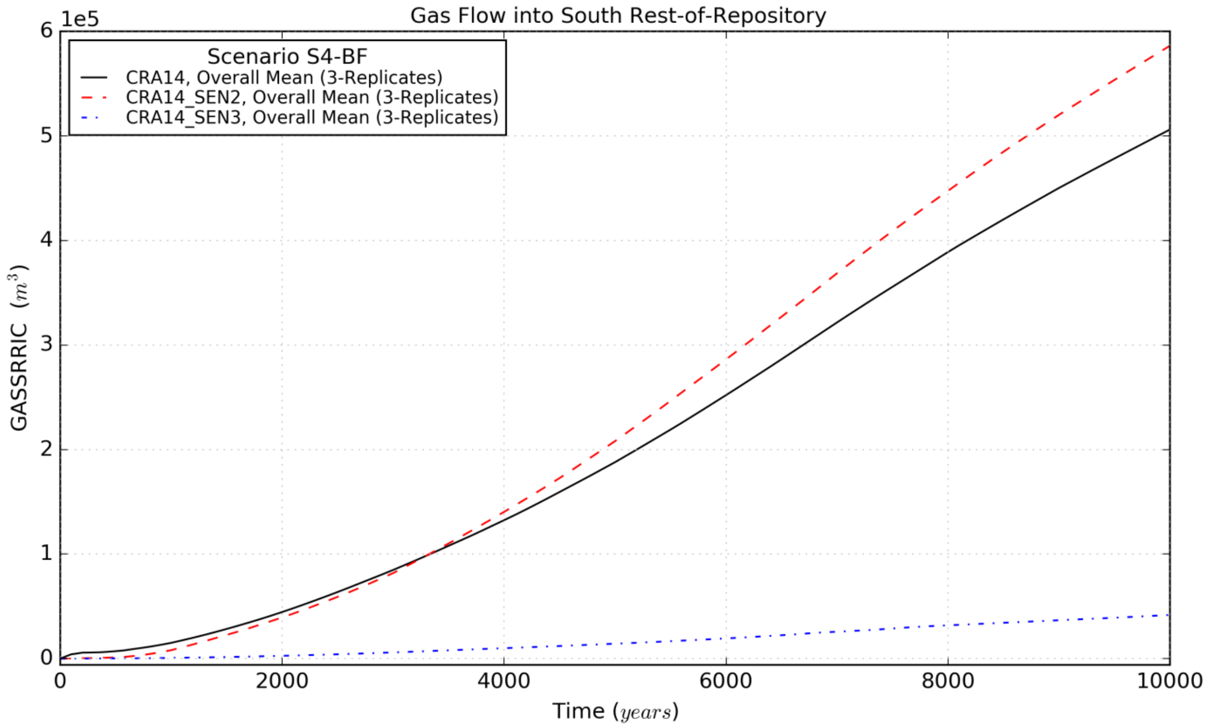

Figure 4-122: Gas Inflow Means to the South Rest-of-Repository, Scenario S4-BF

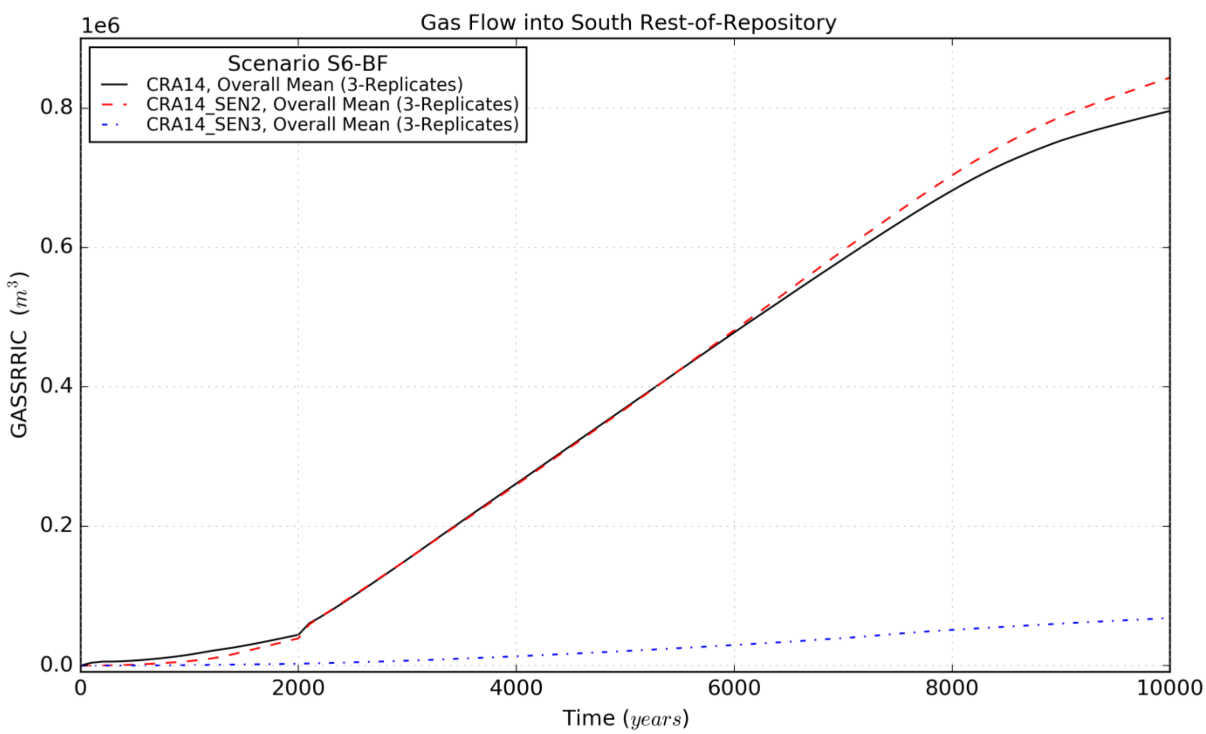

Figure 4-123: Gas Inflow Means to the South Rest-of-Repository, Scenario S6-BF

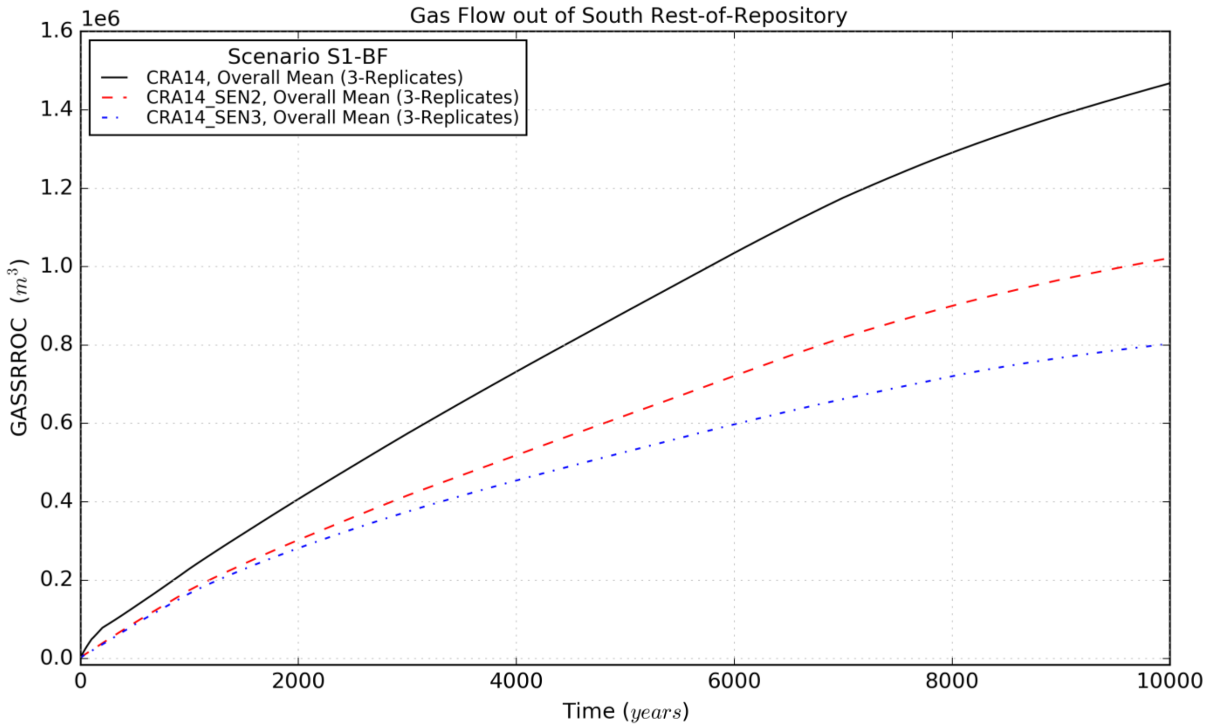

Figure 4-124: Gas Outflow Means from the South Rest-of-Repository, Scenario S1-BF

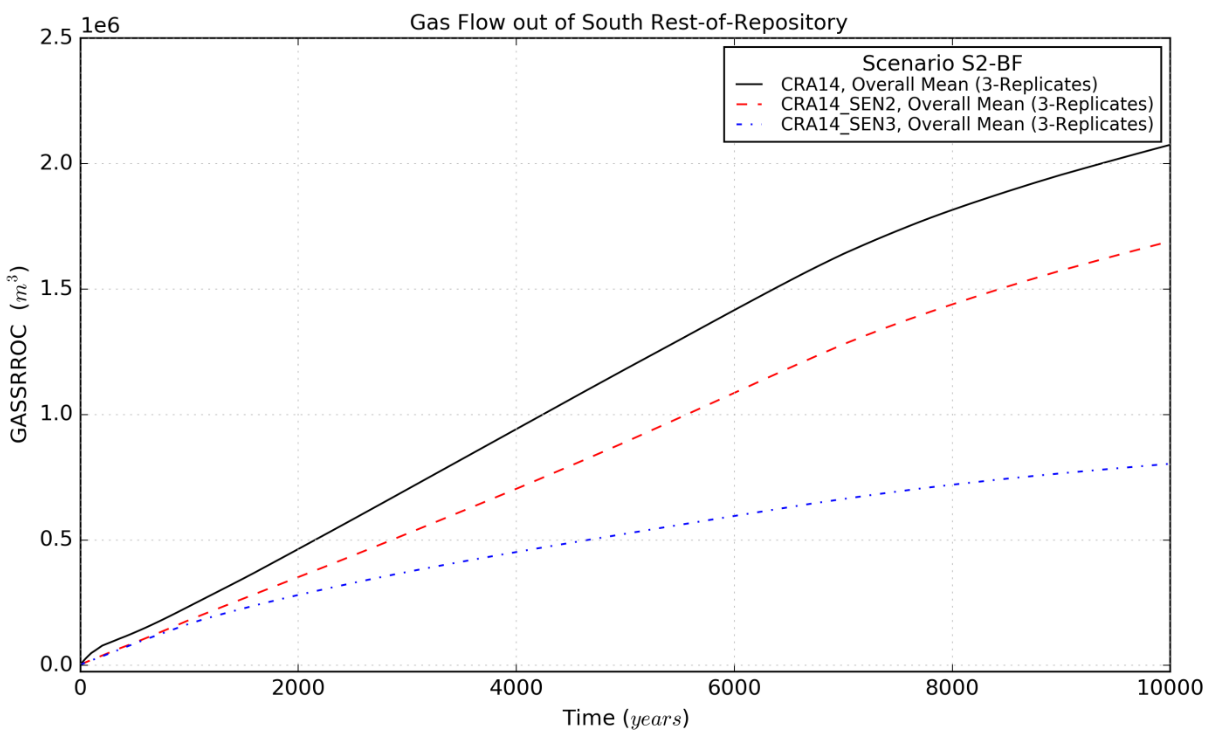

Figure 4-125: Gas Outflow Means from the South Rest-of-Repository, Scenario S2-BF

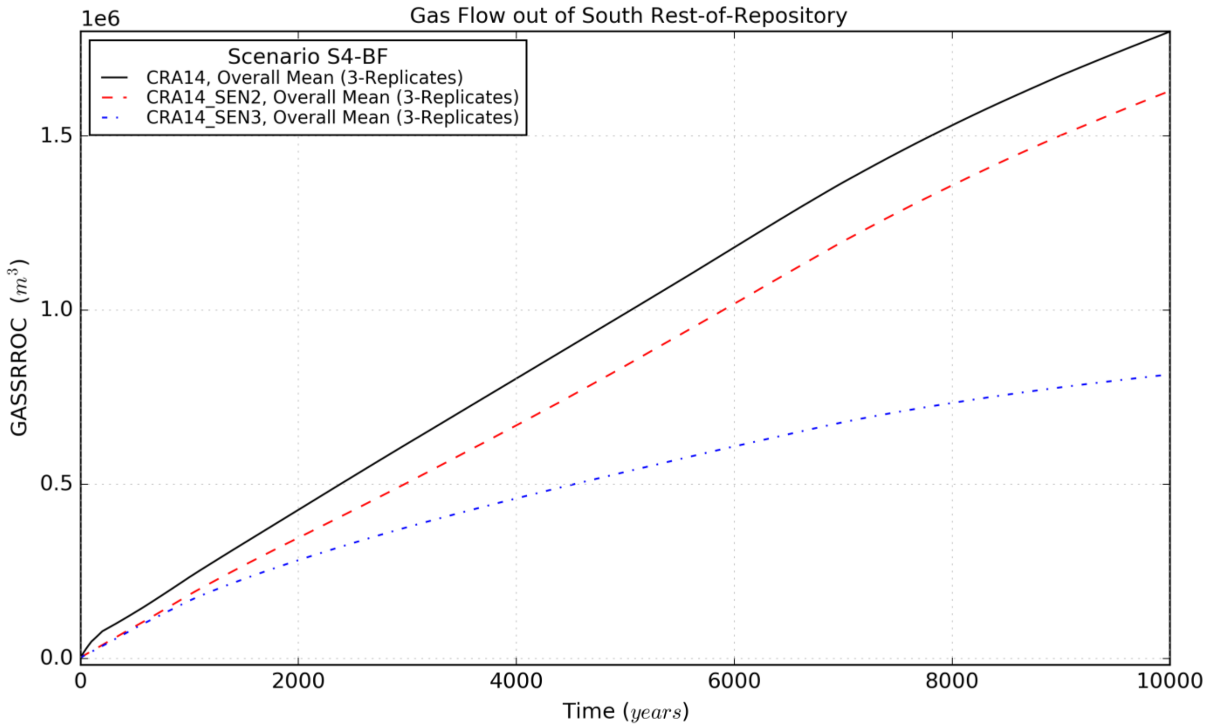

Figure 4-126: Gas Outflow Means from the South Rest-of-Repository, Scenario S4-BF

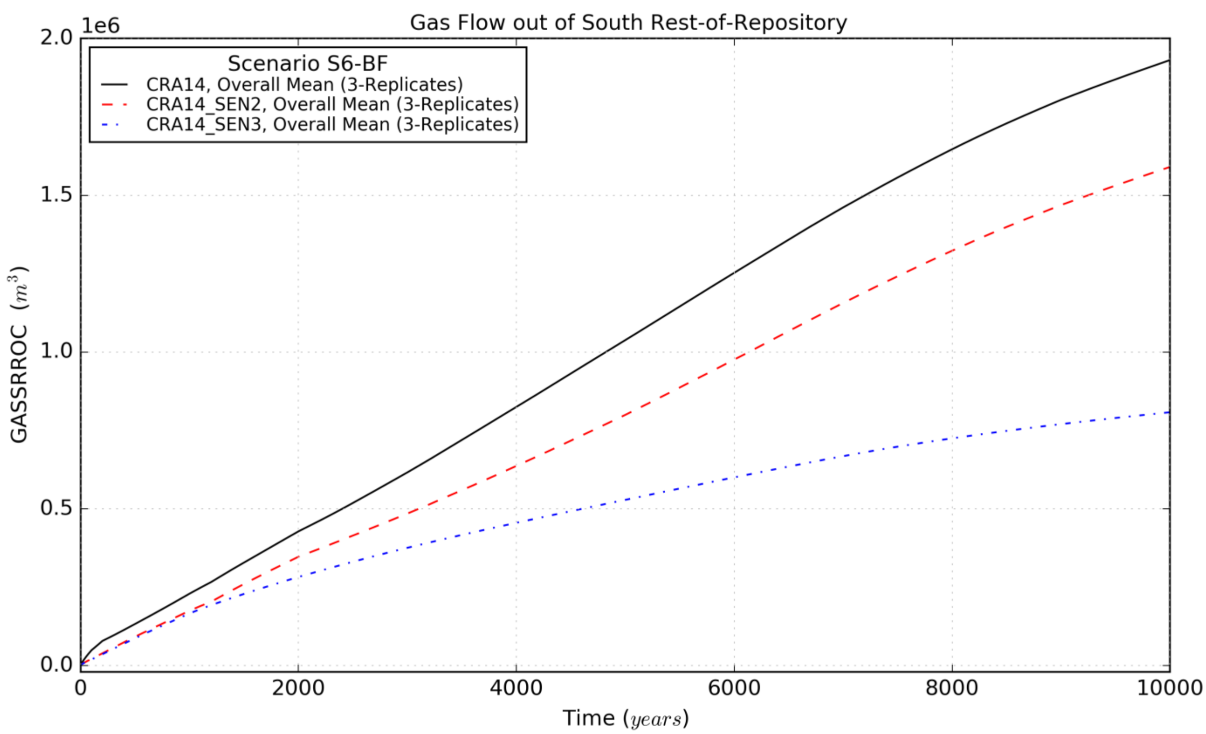

Figure 4-127: Gas Outflow Means from the South Rest-of-Repository, Scenario S6-BF

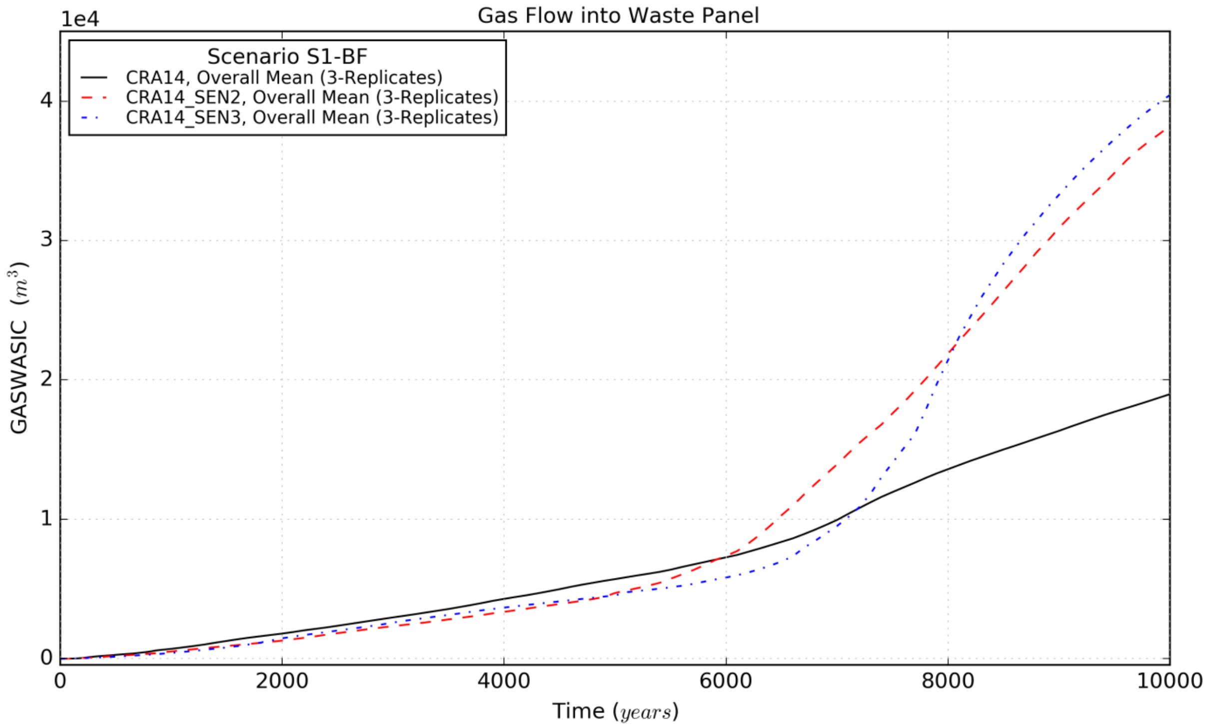

Figure 4-128: Gas Inflow Means to the Waste Panel, Scenario S1-BF

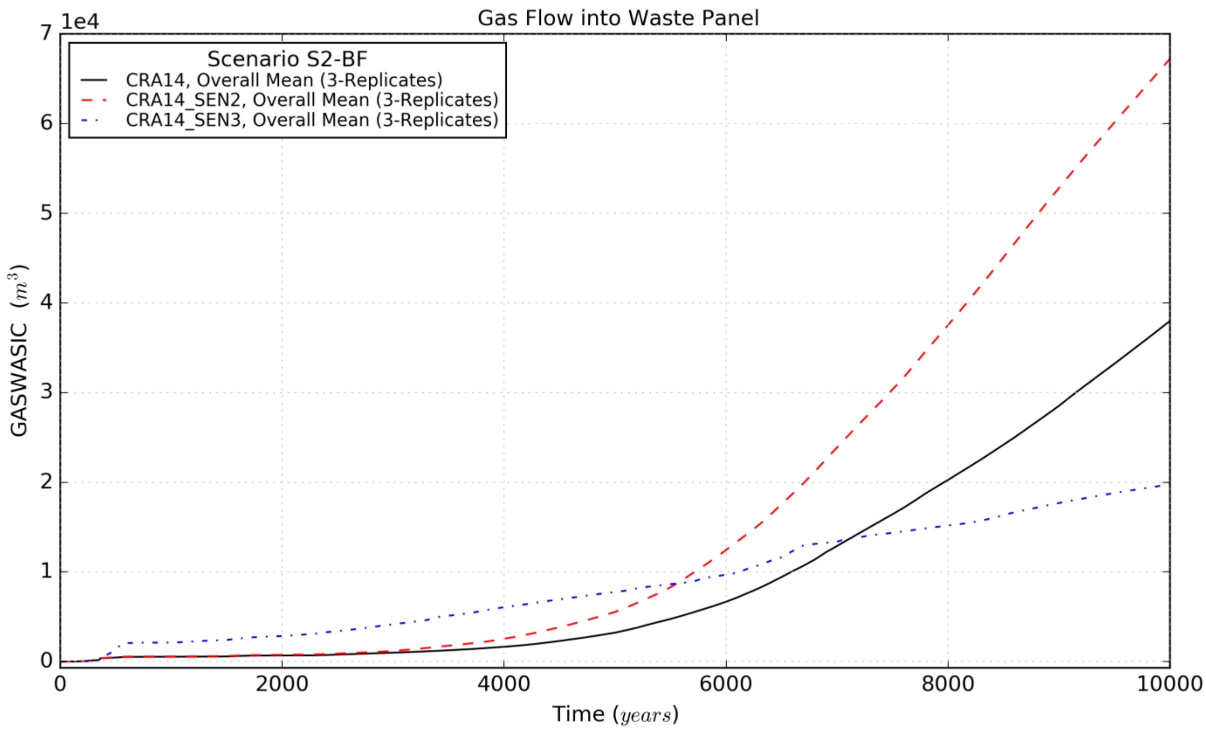

Figure 4-129: Gas Inflow Means to the Waste Panel, Scenario S2-BF

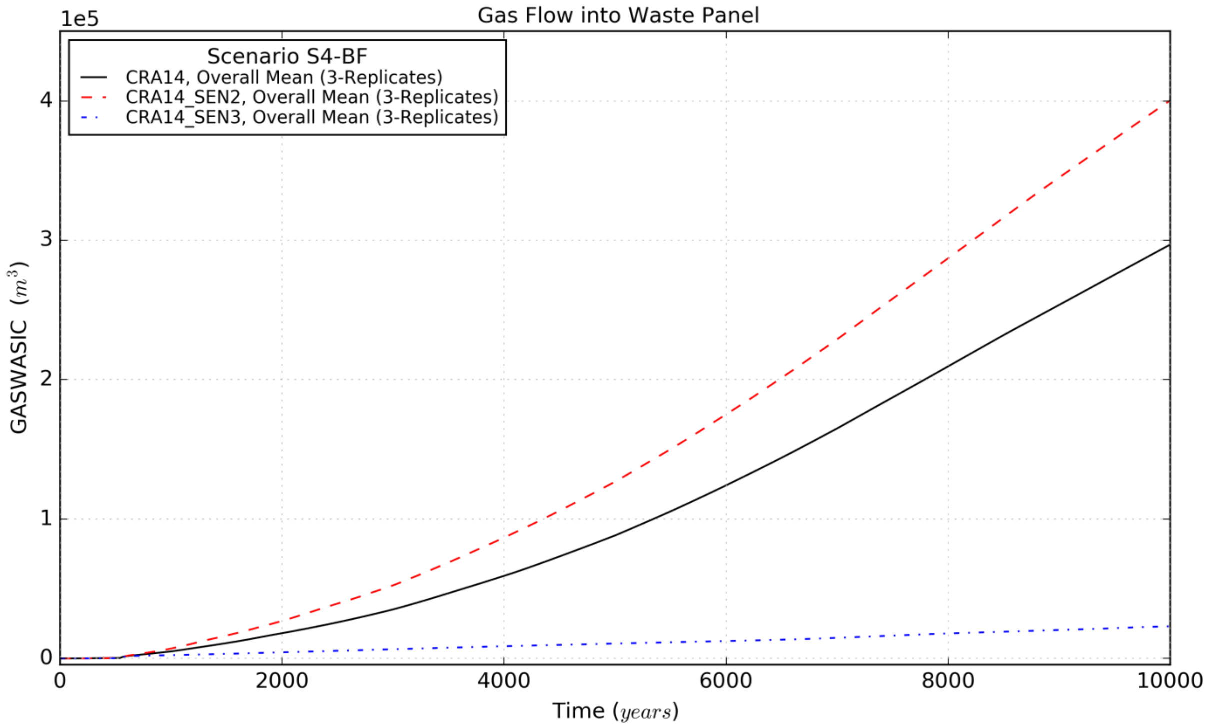

Figure 4-130: Gas Inflow Means to the Waste Panel, Scenario S4-BF

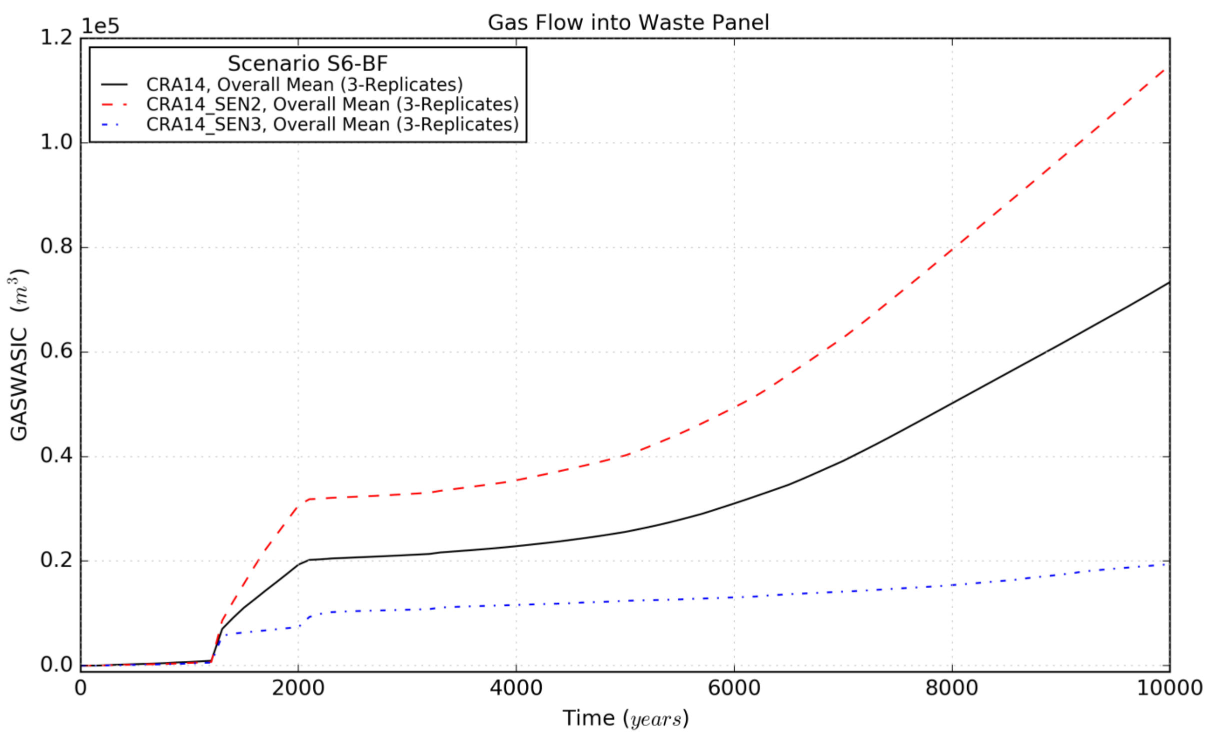

Figure 4-131: Gas Inflow Means to the Waste Panel, Scenario S6-BF

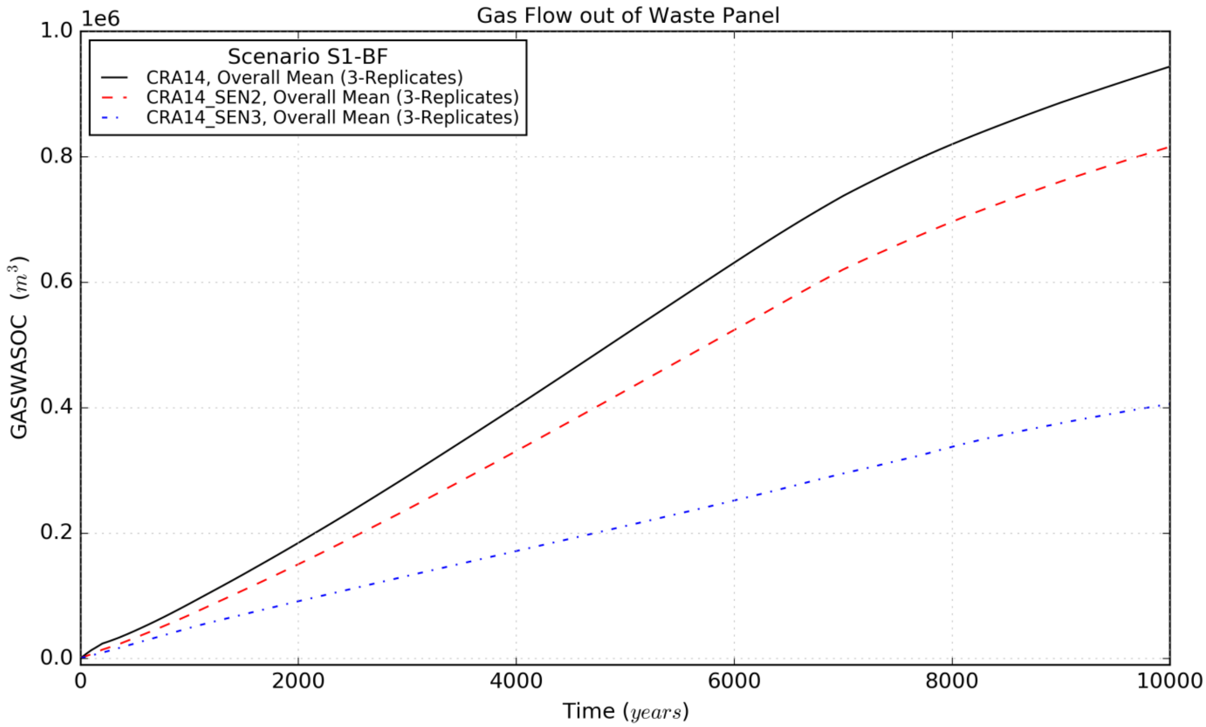

Figure 4-132: Gas Outflow Means from the Waste Panel, Scenario S1-BF

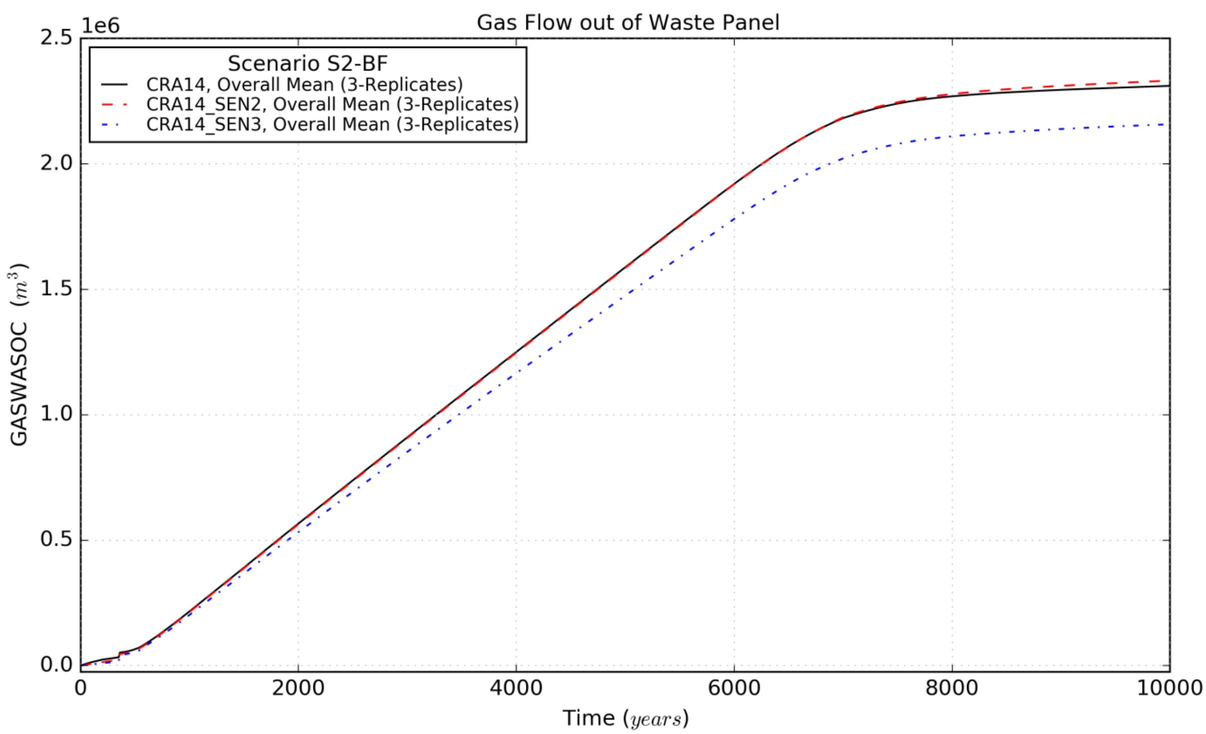

Figure 4-133: Gas Outflow Means from the Waste Panel, Scenario S2-BF

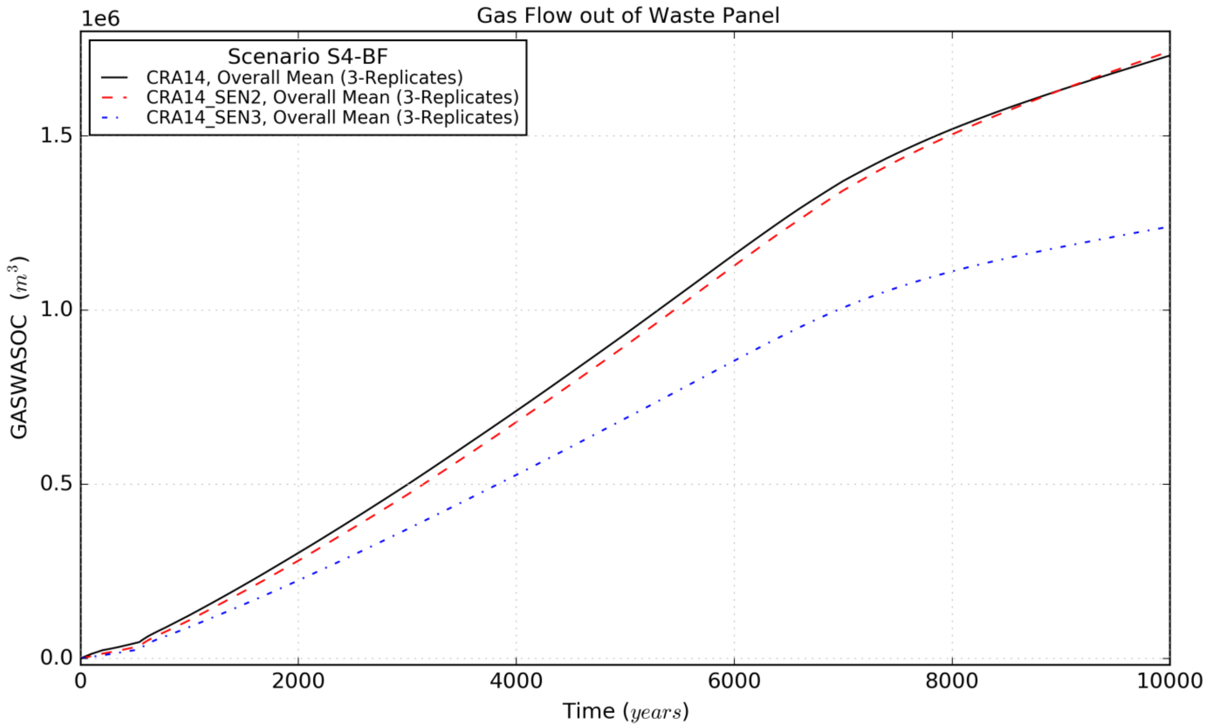

Figure 4-134: Gas Outflow Means from the Waste Panel, Scenario S4-BF

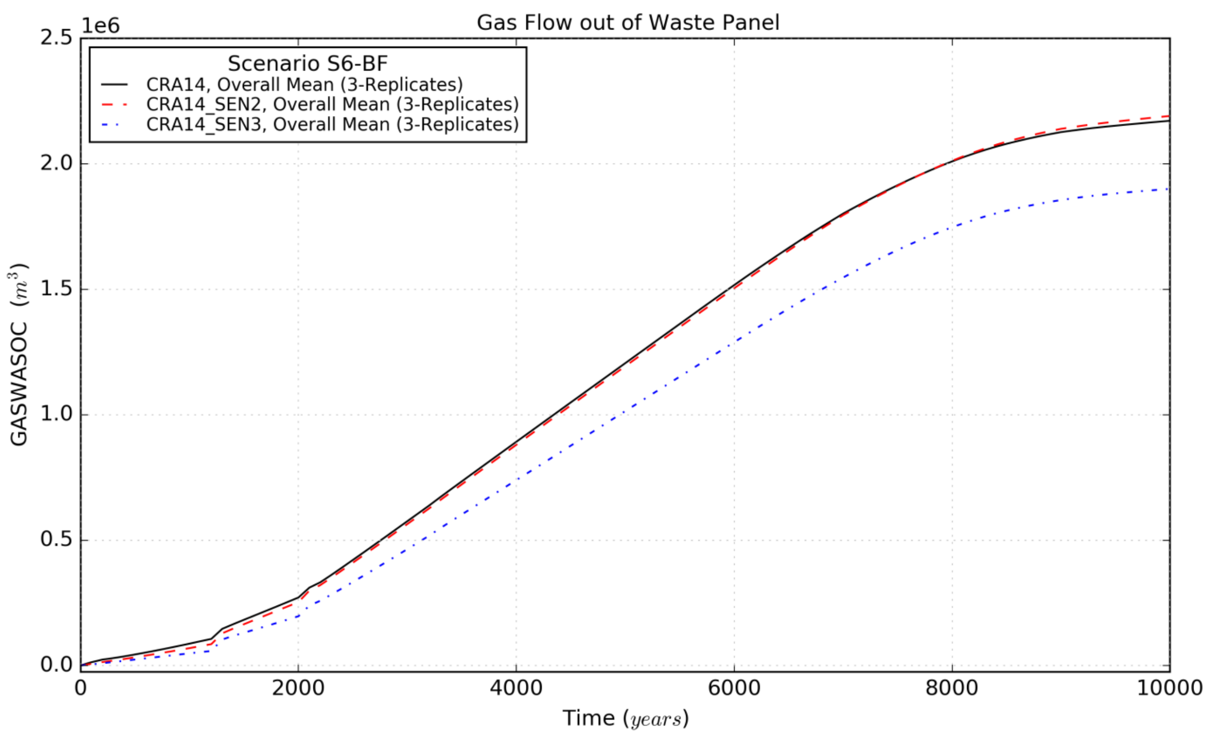

Figure 4-135: Gas Outflow Means from the Waste Panel, Scenario S6-BF

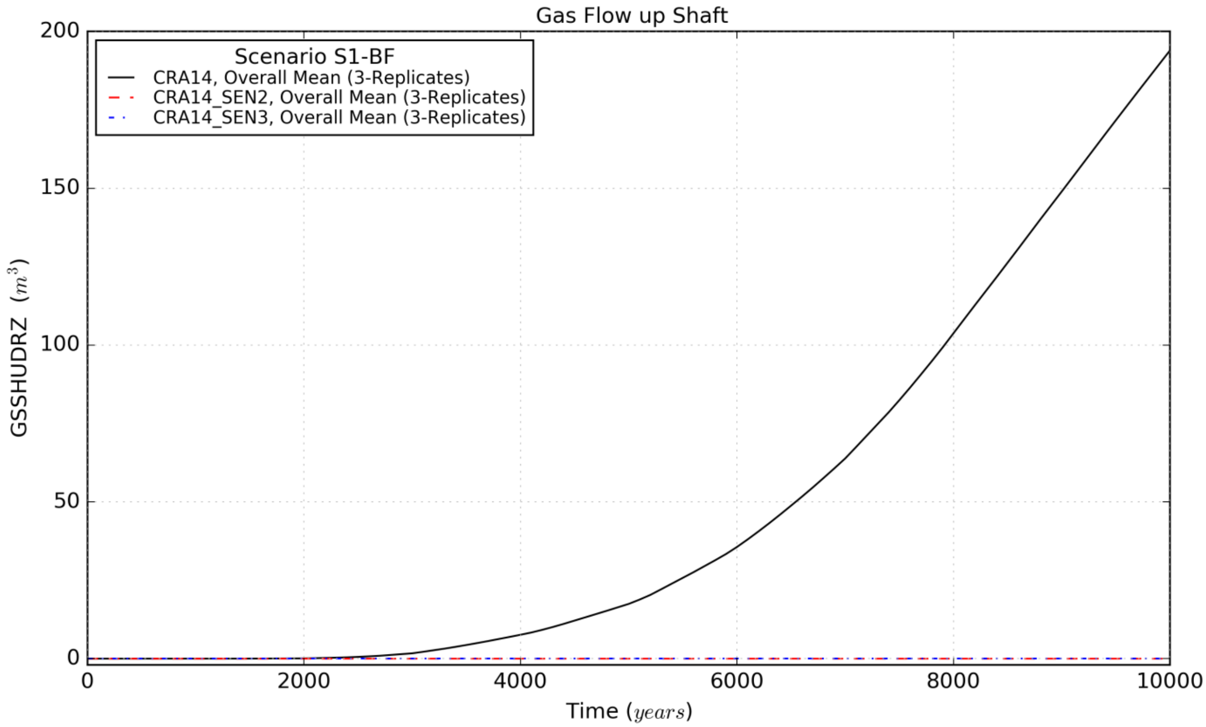

Figure 4-136: Gas Flow Means up the Shaft, Scenario S1-BF

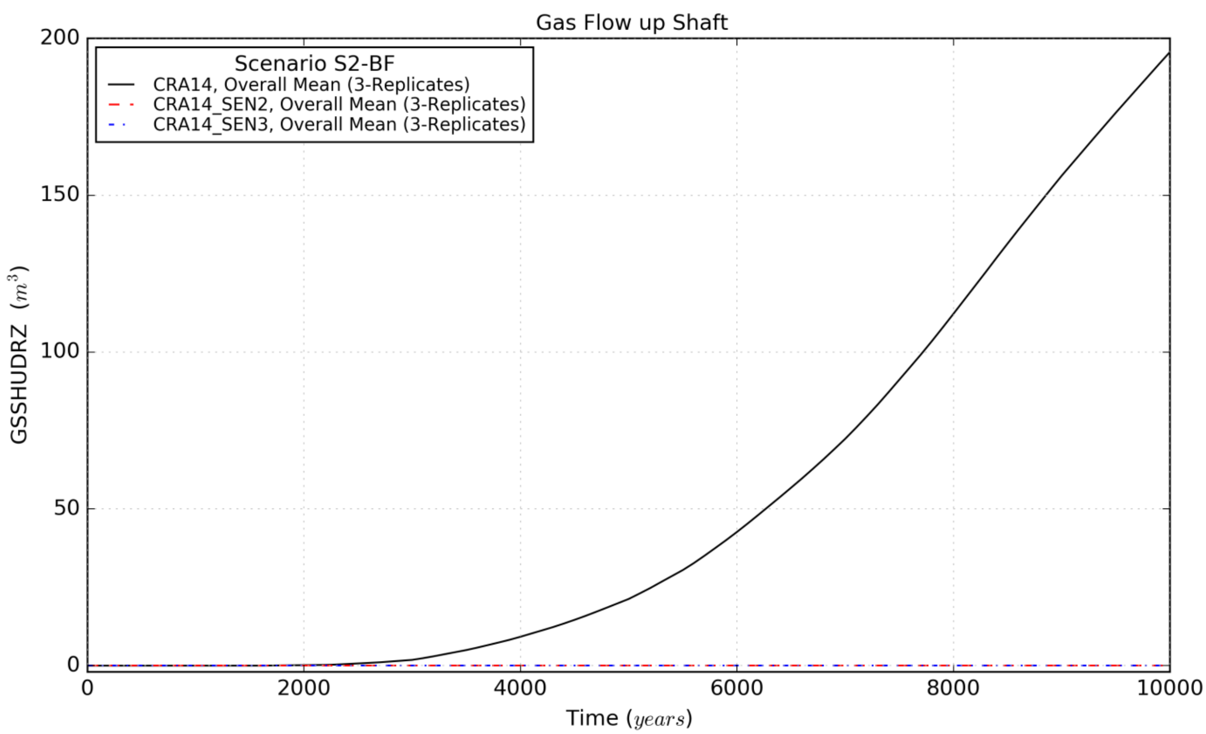

Figure 4-137: Gas Flow Means up the Shaft, Scenario S2-BF

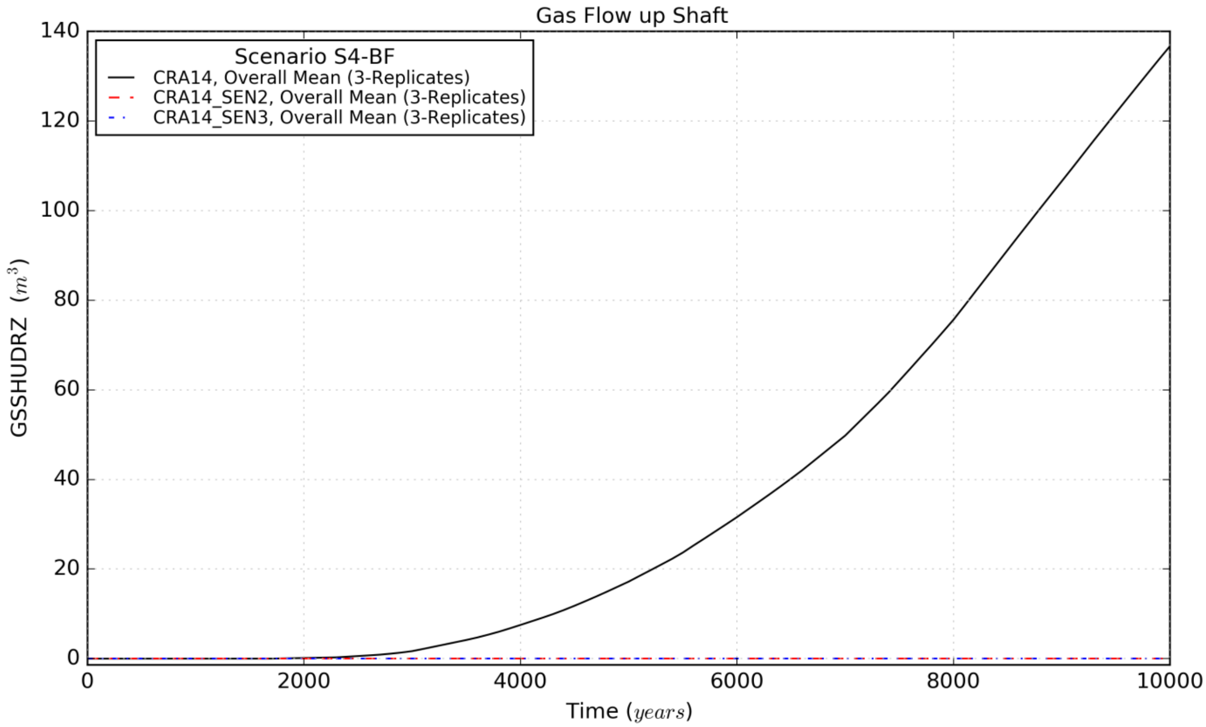

Figure 4-138: Gas Flow Means up the Shaft, Scenario S4-BF

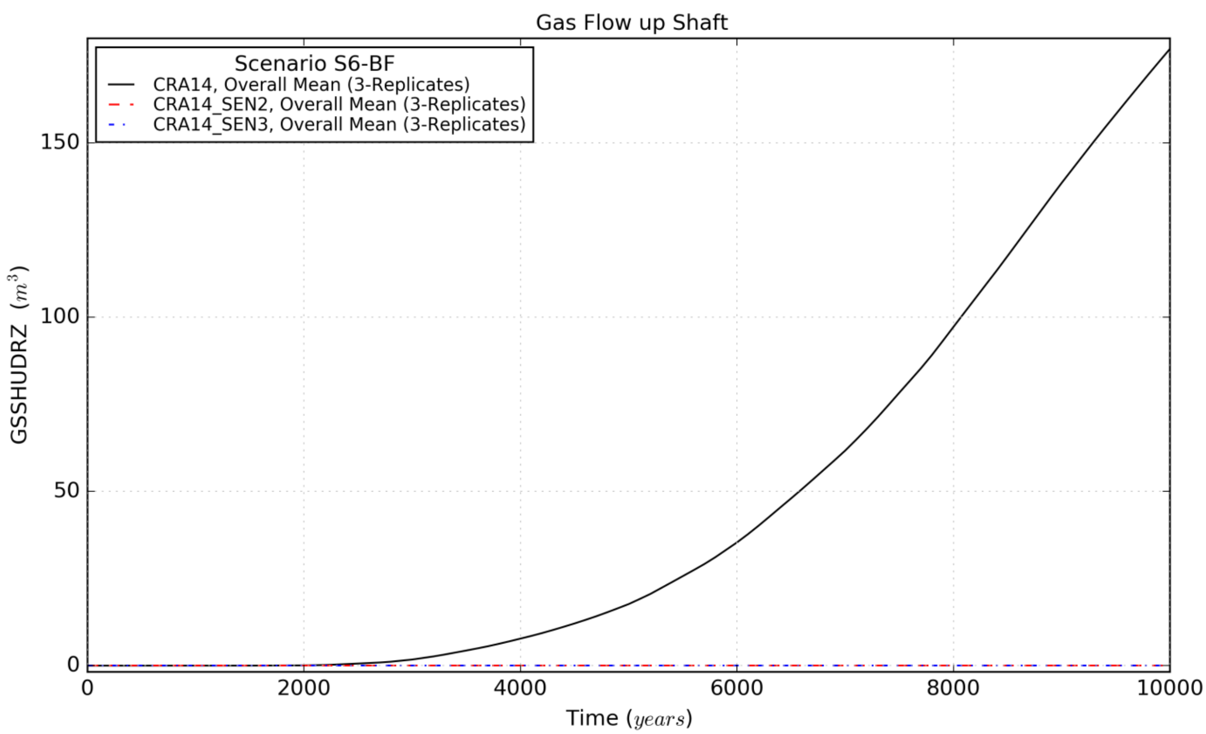

Figure 4-139: Gas Flow Means up the Shaft, Scenario S6-BF

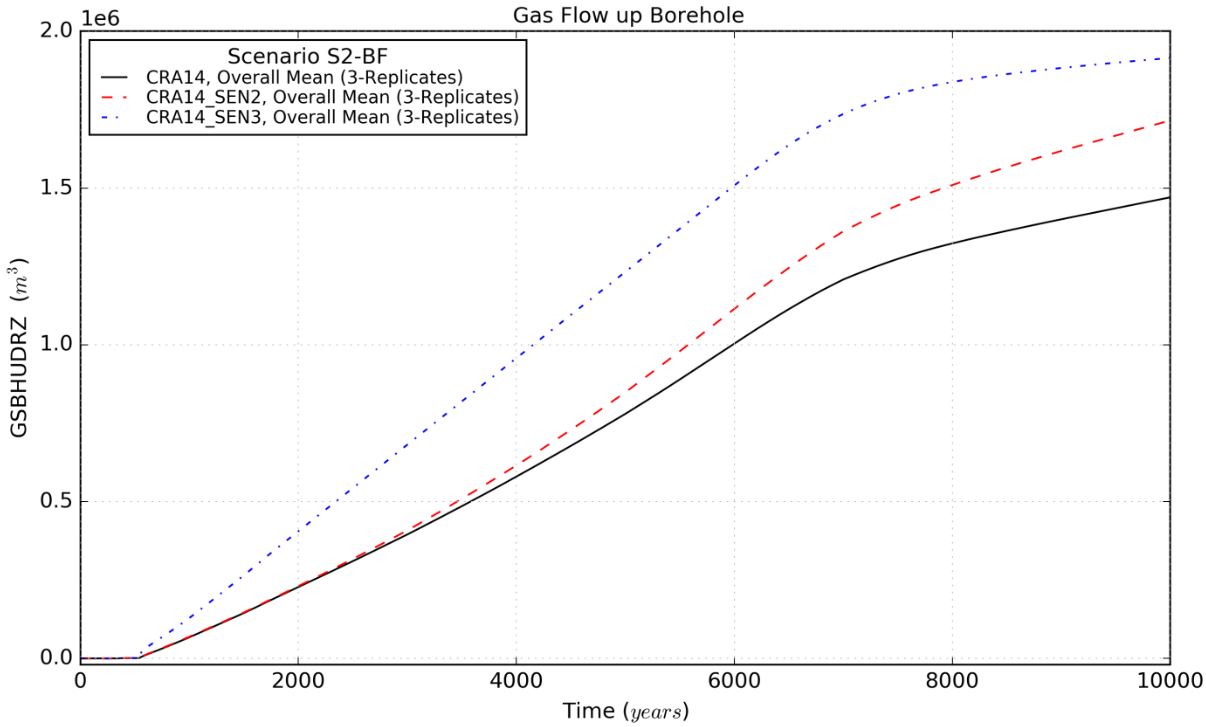

Figure 4-140: Gas Flow Means up the Borehole, Scenario S2-BF

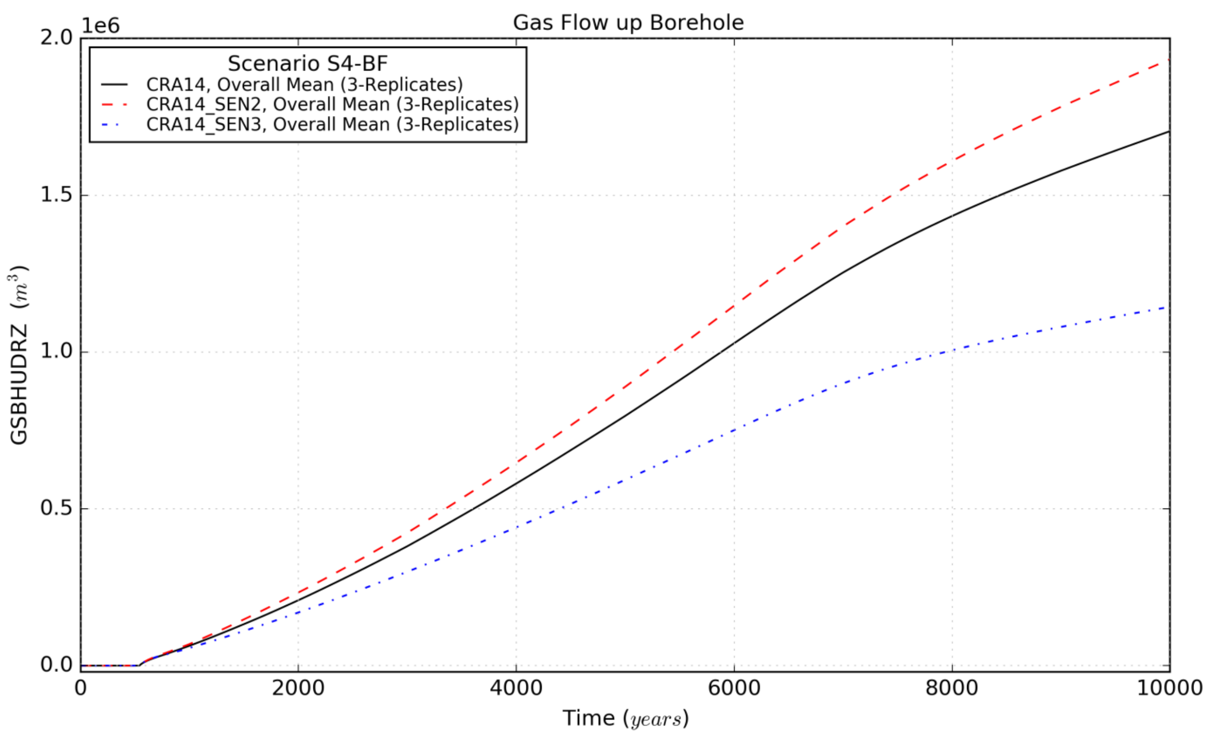

Figure 4-141: Gas Flow Means up the Borehole, Scenario S4-BF

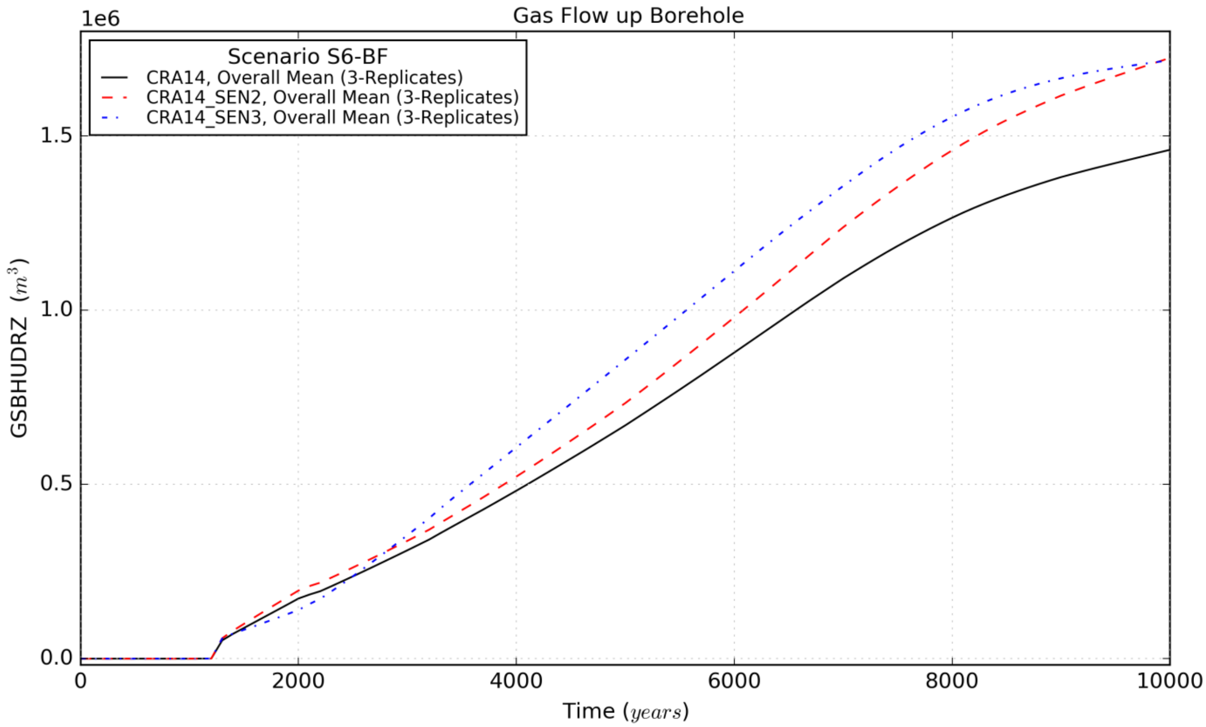

Figure 4-142: Gas Flow Means up the Borehole, Scenario S6-BF

Table 4-7: Gas Flow Statistics on Overall Means for CRA14 and CRA14_SEN3

Quantity (units)	Description	Scenario	Mean Value		Maximum Value	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
GASEXPIC (m^3)	Gas Flow into Experimental Area	S1-BF	6.42E+05	0	1.13E+06	0
		S2-BF	7.41E+05	0	1.29E+06	0
		S4-BF	5.85E+05	0	9.94E+05	0
		S6-BF	6.78E+05	0	1.21E+06	0
GASEXPOC (m^3)	Gas Flow out of Experimental Area	S1-BF	1.32E+05	0	2.53E+05	0
		S2-BF	1.37E+05	0	2.55E+05	0
		S4-BF	1.18E+05	0	2.17E+05	0
		S6-BF	1.29E+05	0	2.41E+05	0
GASOPSIC (m^3)	Gas Flow into Operations Area	S1-BF	5.00E+05	0	8.65E+05	0
		S2-BF	6.15E+05	0	1.06E+06	0
		S4-BF	4.70E+05	0	7.90E+05	0
		S6-BF	5.49E+05	0	9.81E+05	0
GASOPSOC (m^3)	Gas Flow out of Operations Area	S1-BF	4.87E+05	0	8.50E+05	0
		S2-BF	5.91E+05	0	1.03E+06	0
		S4-BF	4.58E+05	0	7.77E+05	0
		S6-BF	5.31E+05	0	9.54E+05	0
GASNRRIC (m^3)	Gas Flow into North Rest-of-Repository	S1-BF	3.00E+05	1.06E+04	6.21E+05	2.93E+04
		S2-BF	5.41E+05	8.27E+03	1.01E+06	2.14E+04
		S4-BF	2.26E+05	7.50E+03	4.40E+05	1.84E+04
		S6-BF	4.01E+05	7.42E+03	8.47E+05	1.95E+04

Quantity (units)	Description	Scenario	Mean Value		Maximum Value	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
GASNRROC (m^3)	Gas Flow out of North Rest-of-Repository	S1-BF	1.12E+06	6.18E+05	1.87E+06	9.80E+05
		S2-BF	1.25E+06	6.17E+05	2.13E+06	9.80E+05
		S4-BF	1.16E+06	6.19E+05	1.97E+06	9.83E+05
		S6-BF	1.20E+06	6.19E+05	2.06E+06	9.82E+05
GASSRRIC (m^3)	Gas Flow into South Rest-of-Repository	S1-BF	2.34E+05	3.40E+04	5.15E+05	9.89E+04
		S2-BF	5.04E+05	3.72E+04	8.83E+05	8.35E+04
		S4-BF	2.13E+05	1.68E+04	5.06E+05	4.18E+04
		S6-BF	3.75E+05	2.60E+04	7.96E+05	6.83E+04
GASSRROC (m^3)	Gas Flow out of South Rest-of-Repository	S1-BF	8.47E+05	4.97E+05	1.47E+06	8.03E+05
		S2-BF	1.14E+06	4.95E+05	2.08E+06	8.04E+05
		S4-BF	9.75E+05	5.04E+05	1.80E+06	8.16E+05
		S6-BF	1.03E+06	4.99E+05	1.93E+06	8.08E+05
GASWASIC (m^3)	Gas Flow into Waste Panel	S1-BF	7.20E+03	1.02E+04	1.90E+04	4.05E+04
		S2-BF	9.38E+03	8.90E+03	3.80E+04	1.98E+04
		S4-BF	1.10E+05	1.09E+04	2.97E+05	2.30E+04
		S6-BF	3.08E+04	1.14E+04	7.34E+04	1.94E+04
GASWASOC (m^3)	Gas Flow out of Waste Panel	S1-BF	5.03E+05	2.12E+05	9.44E+05	4.06E+05
		S2-BF	1.44E+06	1.34E+06	2.31E+06	2.16E+06
		S4-BF	9.12E+05	6.68E+05	1.73E+06	1.24E+06
		S6-BF	1.16E+06	9.88E+05	2.17E+06	1.90E+06

Quantity (units)	Description	Scenario	Mean Value		Maximum Value	
			CRA14	CRA14_SEN3	CRA14	CRA14_SEN3
GSSHUDRZ (m^3)	Gas Flow up Shaft	S1-BF	4.73E+01	0	1.94E+02	0
		S2-BF	5.11E+01	5.98E-08	1.96E+02	2.74E-07
		S4-BF	3.57E+01	2.78E-07	1.37E+02	1.28E-06
		S6-BF	4.46E+01	0	1.77E+02	0
GSBHUDRZ (m^3)	Gas Flow up Borehole	S1-BF	-	-	-	-
		S2-BF	7.71E+05	1.13E+06	1.47E+06	1.91E+06
		S4-BF	8.16E+05	5.86E+05	1.70E+06	1.14E+06
		S6-BF	6.98E+05	8.52E+05	1.46E+06	1.72E+06

Table 4-8: Gas Flow Statistics on Individual Vectors for CRA14 and CRA14_SEN3

Quantity (units)	Description	Scenario	Maximum Value	
			CRA14	CRA14_SEN3
GASEXPIC (m^3)	Gas Flow into Experimental Area	S1-BF	6.63E+06	0
		S2-BF	4.48E+06	0
		S4-BF	4.35E+06	0
		S6-BF	4.41E+06	0
GASEXPOC (m^3)	Gas Flow out of Experimental Area	S1-BF	4.06E+06	0
		S2-BF	2.31E+06	0
		S4-BF	1.64E+06	0
		S6-BF	1.98E+06	0
GASOPSIC (m^3)	Gas Flow into Operations Area	S1-BF	4.84E+06	0
		S2-BF	4.50E+06	0
		S4-BF	4.33E+06	0
		S6-BF	4.41E+06	0
GASOPSOC (m^3)	Gas Flow out of Operations Area	S1-BF	4.84E+06	0
		S2-BF	4.43E+06	0
		S4-BF	4.14E+06	0
		S6-BF	4.28E+06	0
GASNRRIC (m^3)	Gas Flow into North Rest-of-Repository	S1-BF	2.98E+06	1.23E+06
		S2-BF	4.69E+06	1.26E+06
		S4-BF	3.00E+06	1.16E+06
		S6-BF	4.07E+06	1.18E+06

Quantity (units)	Description	Scenario	Maximum Value	
			CRA14	CRA14_SEN3
GASNRROC (m^3)	Gas Flow out of North Rest-of-Repository	S1-BF	8.92E+06	7.95E+06
		S2-BF	1.08E+07	7.23E+06
		S4-BF	1.06E+07	7.40E+06
		S6-BF	1.07E+07	7.42E+06
GASSRRIC (m^3)	Gas Flow into South Rest-of-Repository	S1-BF	2.22E+06	3.44E+06
		S2-BF	4.27E+06	1.77E+06
		S4-BF	4.95E+06	2.03E+06
		S6-BF	3.84E+06	1.84E+06
GASSRROC (m^3)	Gas Flow out of South Rest-of-Repository	S1-BF	6.62E+06	9.17E+06
		S2-BF	1.00E+07	7.43E+06
		S4-BF	1.29E+07	6.49E+06
		S6-BF	1.01E+07	7.32E+06
GASWASIC (m^3)	Gas Flow into Waste Panel	S1-BF	1.52E+06	4.42E+06
		S2-BF	1.93E+06	9.15E+05
		S4-BF	1.17E+07	9.15E+05
		S6-BF	2.45E+06	8.79E+05
GASWASOC (m^3)	Gas Flow out of Waste Panel	S1-BF	3.08E+06	6.04E+06
		S2-BF	4.25E+06	2.37E+06
		S4-BF	1.41E+07	2.65E+06
		S6-BF	4.65E+06	2.64E+06

Quantity (units)	Description	Scenario	Maximum Value	
			CRA14	CRA14_SEN3
GSSHUDRZ (m^3)	Gas Flow up Shaft	S1-BF	6.44E+03	0
		S2-BF	6.30E+03	8.23E-05
		S4-BF	5.90E+03	3.84E-04
		S6-BF	6.12E+03	0
GSBHUDRZ (m^3)	Gas Flow up Borehole	S1-BF	-	-
		S2-BF	1.59E+07	6.36E+06
		S4-BF	1.62E+07	4.91E+06
		S6-BF	1.58E+07	6.20E+06

4.5 Gas Saturation

Gas saturation results are not explicitly provided herein, but are inferred from the brine saturation results presented in Section 4.3, with gas saturation equal to one minus the brine saturation.

4.6 Brine and Gas Flows across the Northernmost Panel Closure

Referring to Figure 2-1 and Figure 2-2, two planes have been established to measure the quantities of gas and brine flowing across the boundary between the north rest-of-repository waste area of the repository and the northern operational and experimental areas. The first plane is located in the BRAGFLO grid between columns 37 and 38 from rows 7 to 17 and is used to measure gas and brine flowing to the south through the panel closure system and the associated disturbed rock zone that includes the marker beds and the anhydrite layer. The second plane is located in the BRAGFLO grid between columns 39 and 40 from rows 7 to 17 and is used to measure gas and brine flowing to the north through the panel closure system and the associated disturbed rock zone that includes the marker beds and the anhydrite layer. Further sub-planes have been established as subsets of the flow planes to differentiate the north and south flows through the upper disturbed rock zone, panel closure system, and lower disturbed rock zone.

To facilitate understanding of the relative quantities of gas and brine flow for the CRA14 and CRA14_SEN3 repository representations, the measured 3-replicate mean cumulative flow for each fluid has been individually normalized by the maximum gas and brine flow quantity observed in either direction across the full planes for both analyses. As such, the total normalized gas flow and total normalized brine flow for the governing direction and analysis are each equal to unity for total flow across either of the panel closure planes. Therefore, the quantities of gas and brine flowing north and south through the northernmost panel closure system can be identified and compared.

For Scenario S1-BF, the normalized gas and brine flows across the northernmost panel closure in both directions are illustrated in Figure 4-143 for flows across the panel closure plane, panel closure, disturbed rock zone (DRZ, summation of upper and lower disturbed rock zone), upper disturbed rock zone (UDRZ), and lower disturbed rock zone (LDRZ). The normalization indicates that gas flow is primarily to the north for CRA14 with approximately 75% of the total flow passing through the upper disturbed rock zone. Gas flow for CRA14_SEN3 is essentially zero. For brine, the normalization indicates that flow is primarily to the south for CRA14 with approximately 80% of the total flow passing through the lower disturbed rock zone. Brine flow for CRA14_SEN3 is less than 3% of the CRA14 flow and also southward and primarily within the disturbed rock zone.

Scenario S2-BF, S4-BF, and S6-BF brine and gas flows are consistent with those observed for S1-BF as shown in Figure 4-144, Figure 4-145, and Figure 4-146, respectively.

The 3-replicate mean gas and brine flows values that were subsequently normalized for the figures discussed above are presented in Table 4-9, Table 4-10, Table 4-11, and Table 4-12 for Scenarios S1-BF, S2-BF, S4-BF, and S6-BF, respectively.

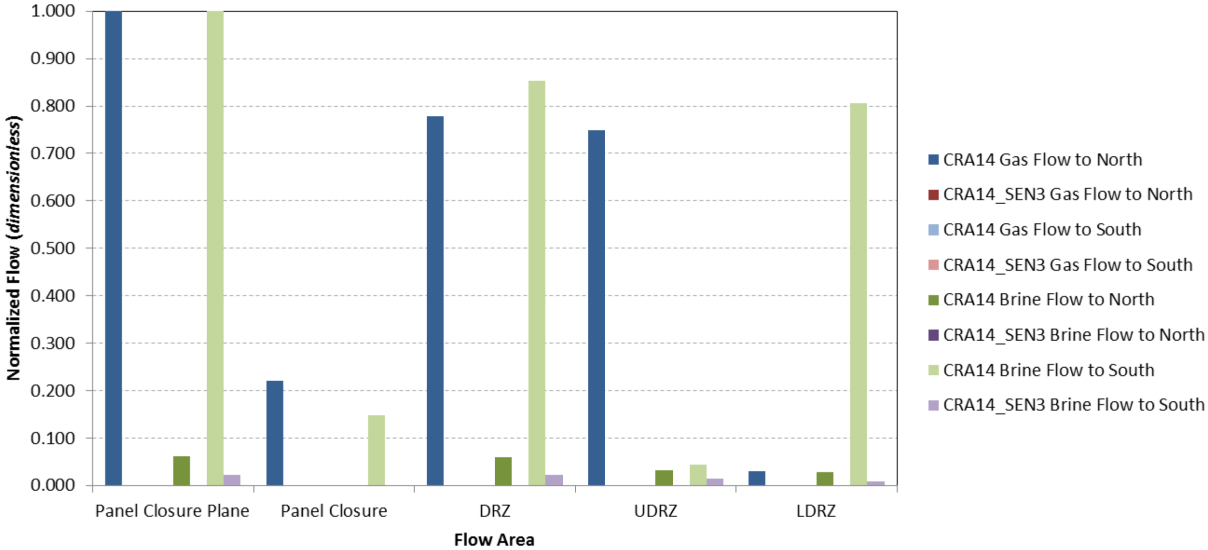

Figure 4-143: Normalized Gas and Brine Flow Across Northernmost Panel Closure, Scenario S1-BF

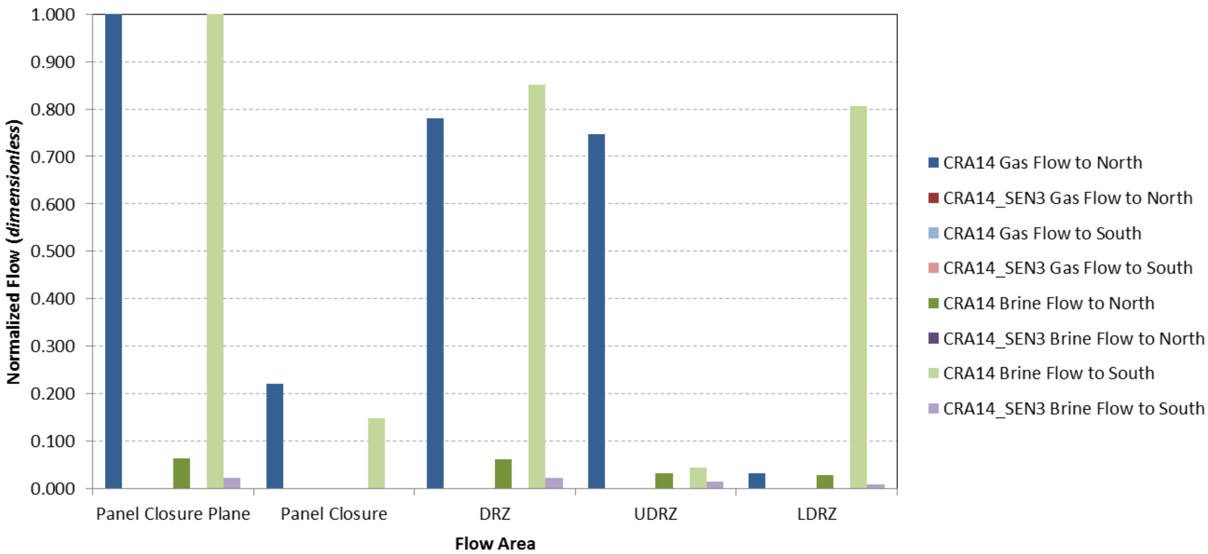

Figure 4-144: Normalized Gas and Brine Flow Across Northernmost Panel Closure, Scenario S2-BF

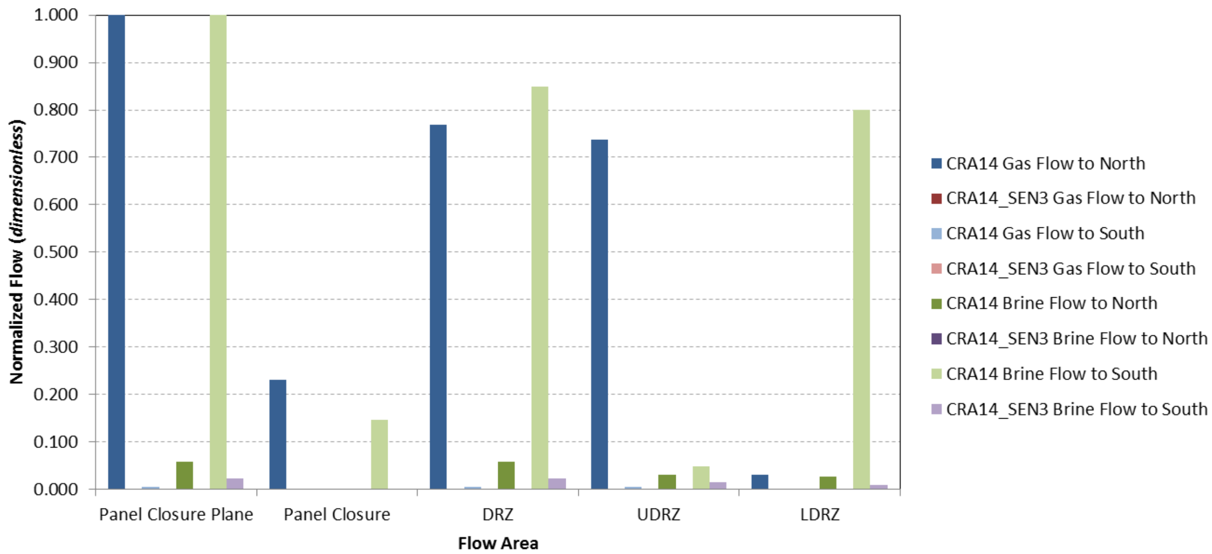

Figure 4-145: Normalized Gas and Brine Flow Across Northernmost Panel Closure, Scenario S4-BF

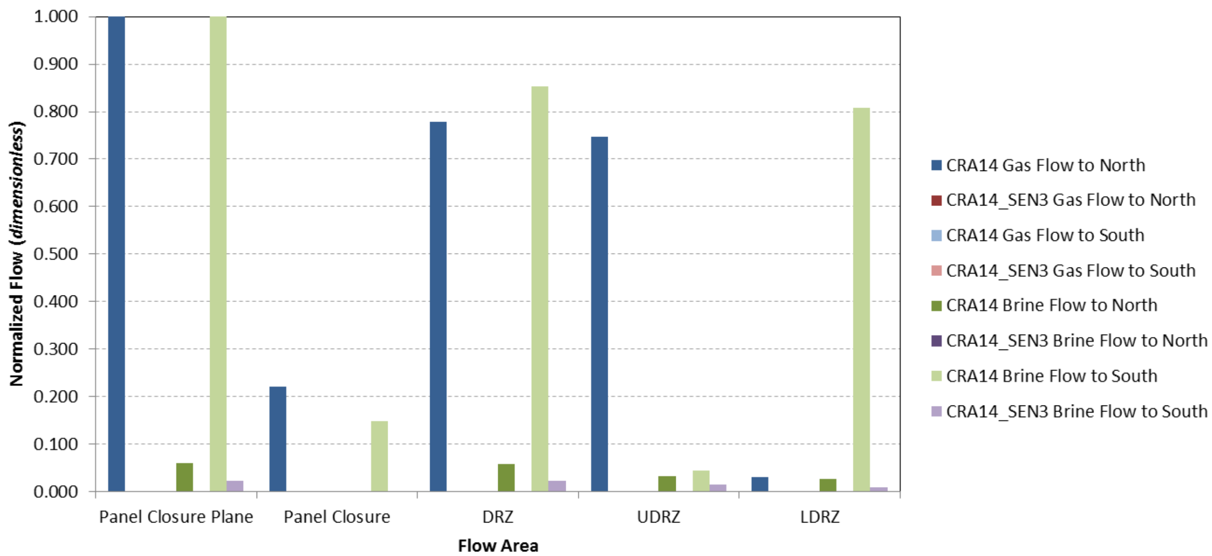

Figure 4-146: Normalized Gas and Brine Flow Across Northernmost Panel Closure, Scenario S6-BF

Table 4-9: Gas and Brine Flow Means Across Northernmost Panel Closure, Scenario S1-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	8.26E+05	6.45E+01	6.35E+01	1.03E+03	1.11E+03	5.08E-01	1.13E-01	2.35E+01
Panel Closure	1.83E+05	9.33E+00	1.78E+00	1.52E+02	0.00E+00	2.69E-05	1.57E-02	1.12E-01
DRZ	6.43E+05	5.52E+01	6.18E+01	8.78E+02	1.11E+03	5.08E-01	9.78E-02	2.33E+01
UDRZ	6.18E+05	5.20E+01	3.28E+01	4.62E+01	1.11E+03	3.41E-01	9.69E-02	1.46E+01
LDRZ	2.51E+04	3.20E+00	2.90E+01	8.31E+02	5.31E-01	1.67E-01	8.47E-04	8.70E+00

Table 4-10: Gas and Brine Flow Means Across Northernmost Panel Closure, Scenario S2-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	9.36E+05	1.45E+03	6.51E+01	1.03E+03	9.44E+02	5.11E-01	1.11E-01	2.35E+01
Panel Closure	2.06E+05	3.33E+01	1.90E+00	1.52E+02	0.00E+00	3.34E-05	1.57E-02	1.12E-01
DRZ	7.30E+05	1.41E+03	6.32E+01	8.77E+02	9.44E+02	5.11E-01	9.51E-02	2.34E+01
UDRZ	7.00E+05	1.40E+03	3.32E+01	4.62E+01	9.44E+02	4.04E-01	9.43E-02	1.47E+01
LDRZ	2.98E+04	8.90E+00	3.00E+01	8.31E+02	5.42E-01	1.07E-01	8.46E-04	8.72E+00

Table 4-11: Gas and Brine Flow Means Across Northernmost Panel Closure, Scenario S4-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	7.47E+05	3.36E+03	6.12E+01	1.04E+03	9.43E+02	2.71E-01	1.50E-01	2.35E+01
Panel Closure	1.73E+05	9.51E+01	1.77E+00	1.52E+02	0.00E+00	1.77E-05	1.57E-02	1.12E-01
DRZ	5.74E+05	3.27E+03	5.95E+01	8.83E+02	9.43E+02	2.71E-01	1.34E-01	2.33E+01
UDRZ	5.51E+05	3.26E+03	3.27E+01	5.06E+01	9.42E+02	2.42E-01	1.33E-01	1.47E+01
LDRZ	2.29E+04	1.40E+01	2.68E+01	8.33E+02	5.42E-01	2.95E-02	8.48E-04	8.69E+00

Table 4-12: Gas and Brine Flow Means Across Northernmost Panel Closure, Scenario S6-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	8.61E+05	1.10E+03	6.26E+01	1.03E+03	9.23E+02	3.45E-01	1.18E-01	2.35E+01
Panel Closure	1.90E+05	2.91E+01	1.85E+00	1.52E+02	0.00E+00	1.41E-05	1.57E-02	1.12E-01
DRZ	6.70E+05	1.07E+03	6.07E+01	8.78E+02	9.23E+02	3.45E-01	1.03E-01	2.34E+01
UDRZ	6.44E+05	1.06E+03	3.30E+01	4.64E+01	9.23E+02	2.66E-01	1.02E-01	1.47E+01
LDRZ	2.68E+04	7.78E+00	2.78E+01	8.32E+02	5.40E-01	7.94E-02	8.48E-04	8.70E+00

4.7 Brine and Gas Flows across the Middle Panel Closure

Referring again to Figure 2-1 and Figure 2-2, two planes have been established to measure the quantities of gas and brine flowing across the boundary between the south rest-of-repository waste area and the north rest-of-repository waste area of the repository. The first plane is located in the BRAGFLO grid between columns 33 and 34 from rows 7 to 17 and is used to measure gas and brine flowing to the south through the panel closure system and the associated disturbed rock zone that includes the marker beds and the anhydrite layer. The second plane is located in the BRAGFLO grid between columns 35 and 36 from rows 7 to 17 and is used to measure gas and brine flowing to the north through the panel closure system and the associated disturbed rock zone that includes the marker beds and the anhydrite layer. Further sub-planes were also established as subsets of the flow planes to differentiate the north and south flows through the upper disturbed rock zone, panel closure system, and lower disturbed rock zone.

As described in Section 4.6, the measured 3-replicate mean cumulative flow for each fluid was similarly normalized. For Scenario S1-BF, the normalized gas and brine flows across the middle panel closure in both directions are illustrated in Figure 4-147 for flows across the panel closure plane, panel closure, DRZ, UDRZ, and LDRZ. The normalization indicates that gas flow is primarily to the north for CRA14 with approximately 76% of the total flow passing through the upper disturbed rock zone. Gas flow for CRA14_SEN3 is less than 2% of the CRA14 flow and also northward and primarily within the disturbed rock zone. For brine, the normalization indicates that flow is primarily to the south for CRA14 with approximately 95% of the total flow passing through the lower disturbed rock zone. Brine flow for CRA14_SEN3 is less than 5% of the CRA14 flow and also southward and primarily within the disturbed rock zone. Scenario S2-BF, S4-BF, and S6-BF brine and gas flows are shown in Figure 4-148, Figure 4-149, and Figure 4-150, respectively.

The 3-replicate mean gas and brine flows values that were subsequently normalized for the figures discussed above are presented in Table 4-13, Table 4-14, Table 4-15, and Table 4-16 for Scenarios S1-BF, S2-BF, S4-BF, and S6-BF, respectively.

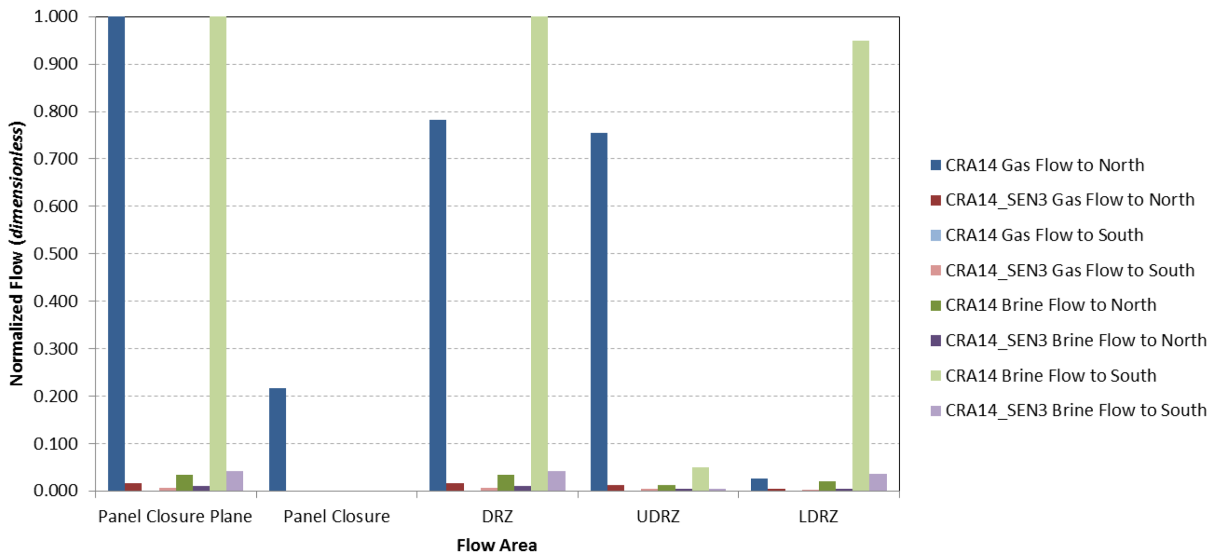

Figure 4-147: Normalized Gas and Brine Flow Across Middle Panel Closure, Scenario S1-BF

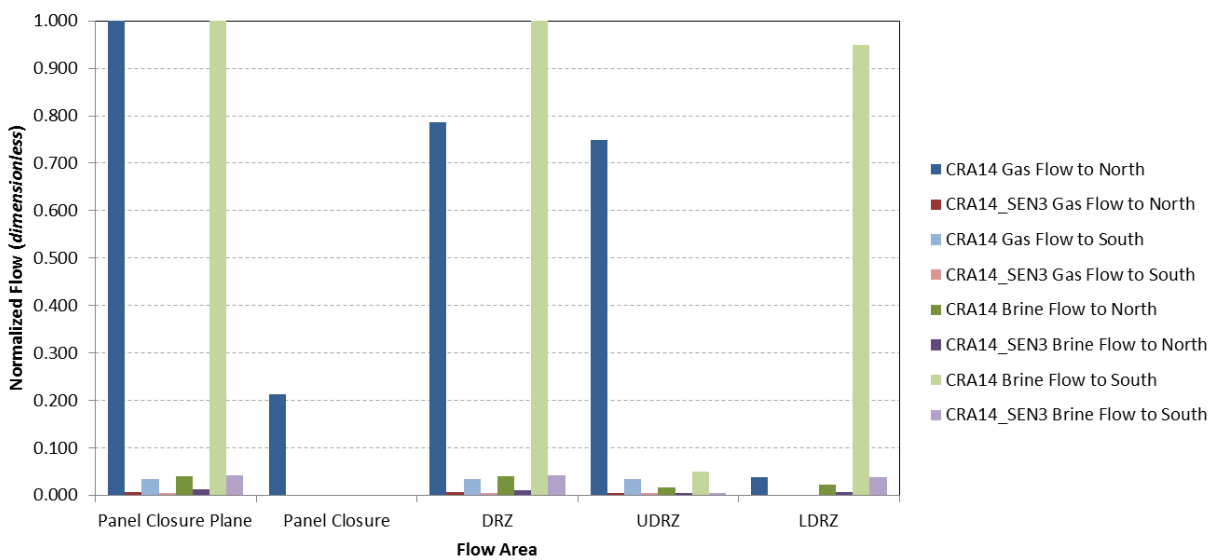

Figure 4-148: Normalized Gas and Brine Flow Across Middle Panel Closure, Scenario S2-BF

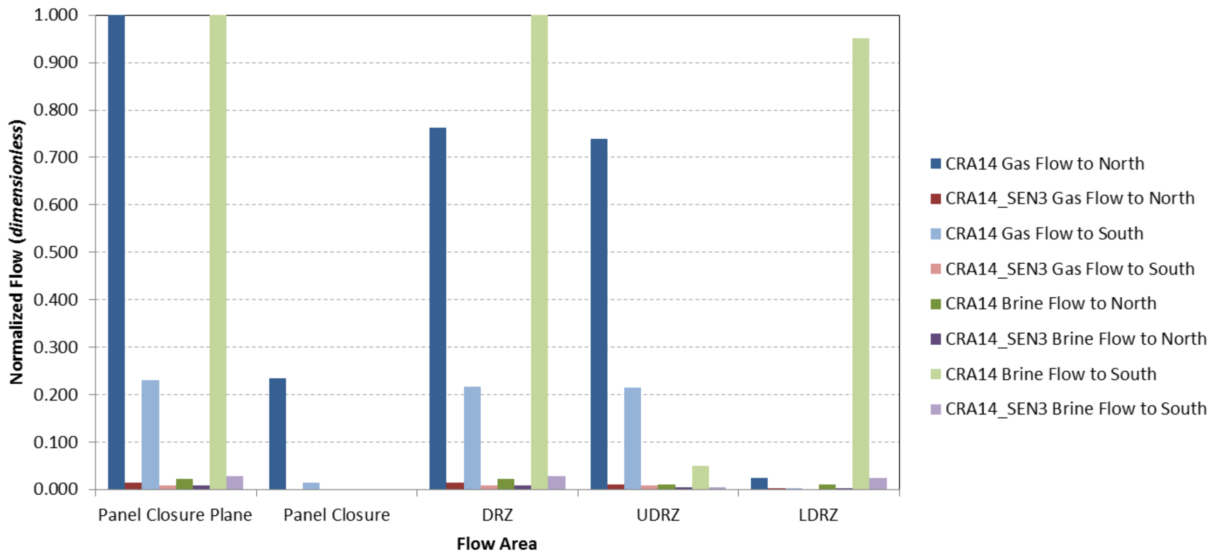

Figure 4-149: Normalized Gas and Brine Flow Across Middle Panel Closure, Scenario S4-BF

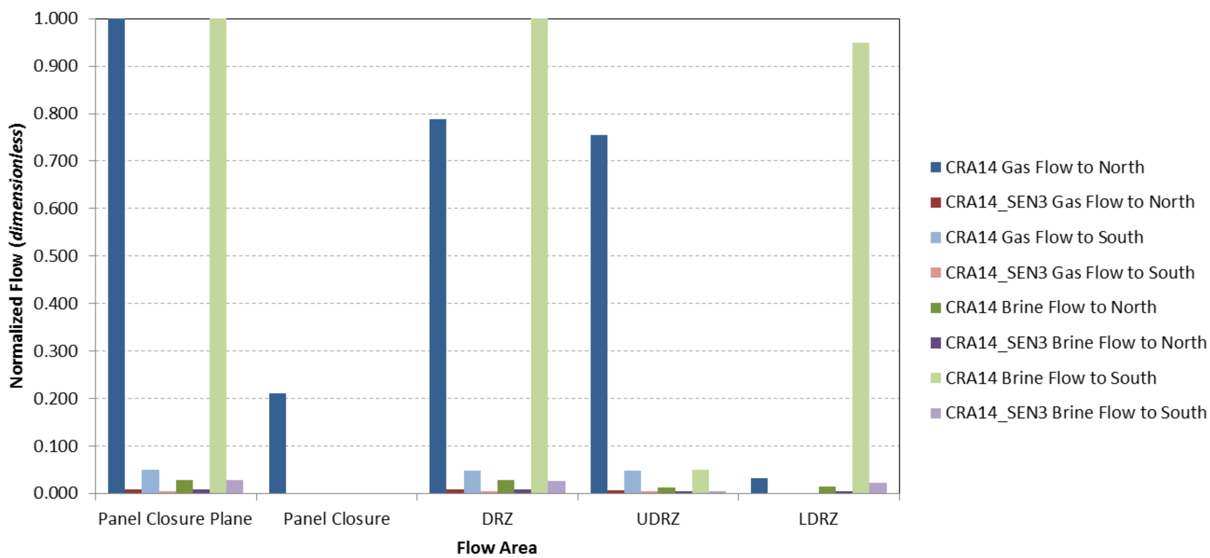

Figure 4-150: Normalized Gas and Brine Flow Across Middle Panel Closure, Scenario S6-BF

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Table 4-13: Gas and Brine Flow Means Across Middle Panel Closure, Scenario S1-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	5.24E+05	6.60E+01	3.43E+01	1.00E+03	8.85E+03	4.09E+03	1.06E+01	4.15E+01
Panel Closure	1.14E+05	6.51E+00	5.80E-01	1.42E+00	7.96E-06	1.43E-05	6.32E-02	6.33E-02
DRZ	4.10E+05	5.95E+01	3.37E+01	1.00E+03	8.85E+03	4.09E+03	1.05E+01	4.15E+01
UDRZ	3.96E+05	5.89E+01	1.26E+01	4.98E+01	6.68E+03	3.01E+03	5.03E+00	5.49E+00
LDRZ	1.43E+04	5.56E-01	2.11E+01	9.50E+02	2.18E+03	1.08E+03	5.48E+00	3.60E+01

Table 4-14: Gas and Brine Flow Means Across Middle Panel Closure, Scenario S2-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	7.82E+05	2.76E+04	4.11E+01	1.00E+03	5.91E+03	4.02E+03	1.19E+01	4.29E+01
Panel Closure	1.67E+05	8.50E+02	6.15E-01	1.53E+00	2.22E-05	3.22E-05	6.37E-02	6.23E-02
DRZ	6.15E+05	2.67E+04	4.05E+01	1.00E+03	5.91E+03	4.02E+03	1.18E+01	4.28E+01
UDRZ	5.86E+05	2.65E+04	1.71E+01	4.96E+01	4.52E+03	3.41E+03	5.52E+00	5.27E+00
LDRZ	2.95E+04	2.35E+02	2.34E+01	9.50E+02	1.39E+03	6.05E+02	6.30E+00	3.75E+01

Table 4-15: Gas and Brine Flow Means Across Middle Panel Closure, Scenario S4-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	3.72E+05	8.61E+04	2.33E+01	1.00E+03	5.21E+03	3.34E+03	8.60E+00	2.91E+01
Panel Closure	8.76E+04	5.42E+03	4.82E-01	1.53E+00	1.39E-05	9.85E-06	6.26E-02	6.38E-02
DRZ	2.84E+05	8.06E+04	2.29E+01	1.00E+03	5.21E+03	3.34E+03	8.54E+00	2.91E+01
UDRZ	2.75E+05	7.99E+04	1.14E+01	5.03E+01	4.13E+03	3.21E+03	4.83E+00	5.36E+00
LDRZ	9.01E+03	7.78E+02	1.15E+01	9.52E+02	1.08E+03	1.28E+02	3.71E+00	2.37E+01

Table 4-16: Gas and Brine Flow Means Across Middle Panel Closure, Scenario S6-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	6.07E+05	3.00E+04	2.85E+01	1.00E+03	5.16E+03	3.35E+03	9.33E+00	2.76E+01
Panel Closure	1.28E+05	9.17E+02	6.18E-01	1.54E+00	2.12E-05	1.08E-05	6.29E-02	6.33E-02
DRZ	4.78E+05	2.91E+04	2.79E+01	1.00E+03	5.16E+03	3.35E+03	9.26E+00	2.75E+01
UDRZ	4.58E+05	2.88E+04	1.35E+01	4.98E+01	4.14E+03	2.82E+03	4.97E+00	5.25E+00
LDRZ	2.02E+04	2.74E+02	1.44E+01	9.50E+02	1.02E+03	5.36E+02	4.29E+00	2.23E+01

4.8 Brine and Gas Flows across the Southernmost Panel Closure

Referring again to Figure 2-1 and Figure 2-2, two planes have been established to measure the quantities of gas and brine flowing across the boundary between the southernmost waste panel and the south rest-of-repository waste area of the repository. The first plane is located in the BRAGFLO grid between columns 29 and 30 from rows 7 to 17 and is used to measure gas and brine flowing to the south through the panel closure system and the associated disturbed rock zone that includes the marker beds and the anhydrite layer. The second plane is located in the BRAGFLO grid between columns 31 and 32 from rows 7 to 17 and is used to measure gas and brine flowing to the north through the panel closure system and the associated disturbed rock zone that includes the marker beds and the anhydrite layer. Further sub-planes were also established as subsets of the flow planes to differentiate the north and south flows through the upper disturbed rock zone, panel closure system, and lower disturbed rock zone.

As described in Section 4.6, the measured 3-replicate mean cumulative flow for each fluid was similarly normalized. For Scenario S1-BF, the normalized gas and brine flows across the southernmost panel closure in both directions are illustrated in Figure 4-151 for flows across the panel closure plane, panel closure, DRZ, UDRZ, and LDRZ. The normalization indicates that gas flow is primarily to the north for CRA14 with approximately 78% of the total flow passing through the upper disturbed rock zone. Gas flow for CRA14_SEN3 is less than 12% of the CRA14 flow and also northward and primarily within the disturbed rock zone. For brine, the normalization indicates that flow is primarily to the south for CRA14 with approximately 94% of the total flow passing through the lower disturbed rock zone. Brine flow for CRA14_SEN3 is less than 10% of the CRA14 flow and also southward and primarily within the disturbed rock zone. Scenario S2-BF, S4-BF, and S6-BF brine and gas flows are shown in Figure 4-152, Figure 4-153, and Figure 4-154, respectively.

The 3-replicate mean gas and brine flows values that were subsequently normalized for the figures discussed above are presented in Table 4-17, Table 4-18, Table 4-19, and Table 4-20 for Scenarios S1-BF, S2-BF, S4-BF, and S6-BF, respectively.

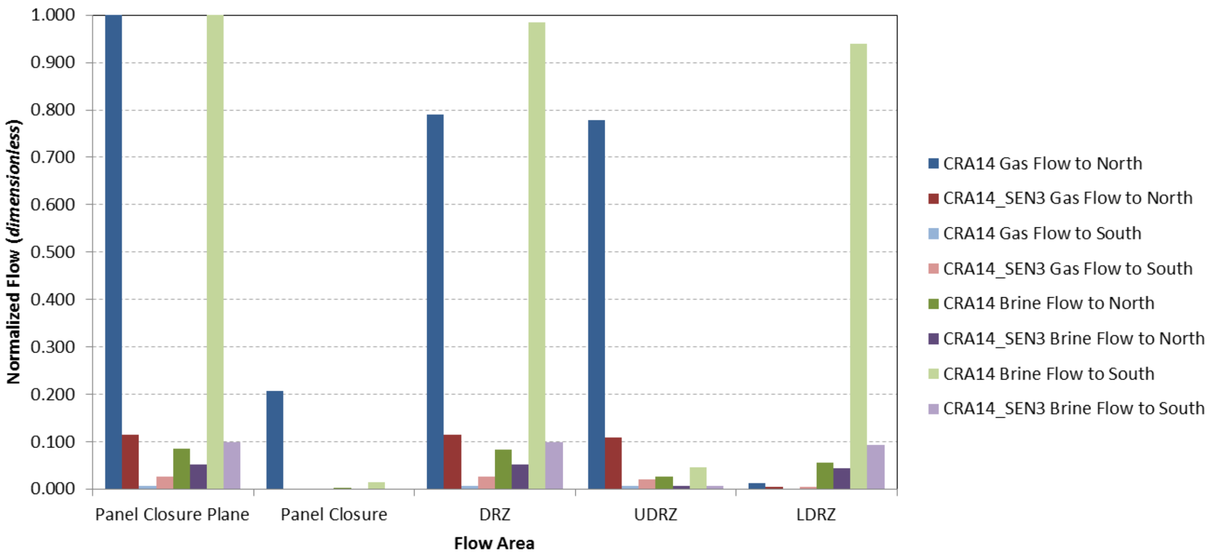

Figure 4-151: Normalized Gas and Brine Flow Across Southernmost Panel Closure, Scenario S1-BF

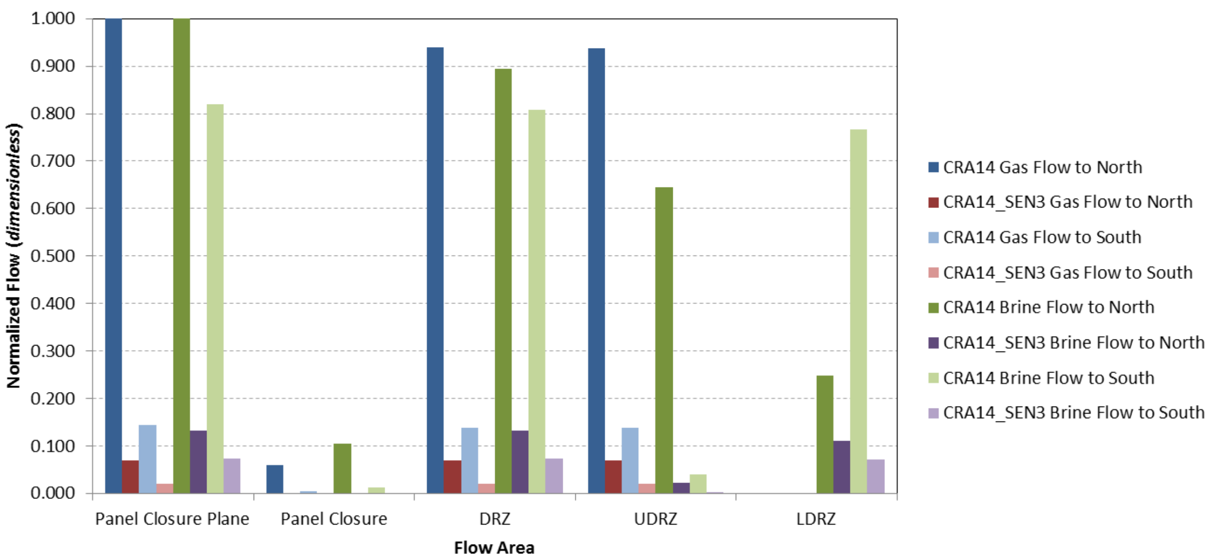

Figure 4-152: Normalized Gas and Brine Flow Across Southernmost Panel Closure, Scenario S2-BF

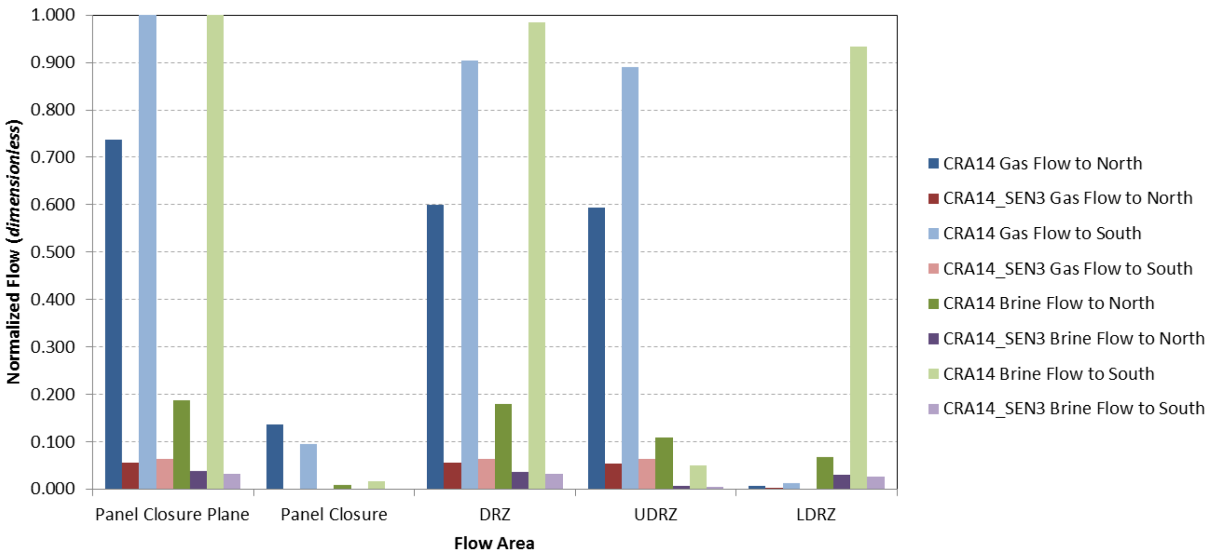

Figure 4-153: Normalized Gas and Brine Flow Across Southernmost Panel Closure, Scenario S4-BF

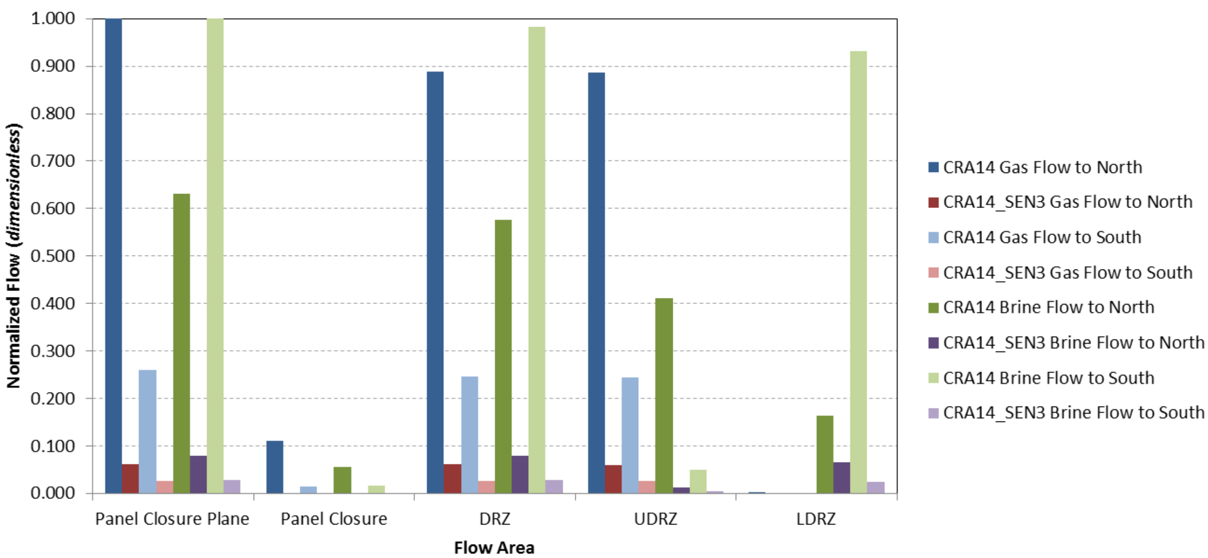

Figure 4-154: Normalized Gas and Brine Flow Across Southernmost Panel Closure, Scenario S6-BF

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Table 4-17: Gas and Brine Flow Means Across Southernmost Panel Closure, Scenario S1-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	3.67E+05	2.70E+03	4.92E+01	5.70E+02	4.22E+04	9.73E+03	2.92E+01	5.69E+01
Panel Closure	7.60E+04	2.51E+01	1.75E+00	8.98E+00	1.44E-05	1.99E-05	5.31E-02	1.98E-02
DRZ	2.90E+05	2.67E+03	4.74E+01	5.61E+02	4.22E+04	9.73E+03	2.92E+01	5.69E+01
UDRZ	2.86E+05	2.67E+03	1.54E+01	2.60E+01	4.01E+04	7.78E+03	4.44E+00	3.55E+00
LDRZ	4.83E+03	5.92E-01	3.21E+01	5.35E+02	2.09E+03	1.94E+03	2.47E+01	5.33E+01

Table 4-18: Gas and Brine Flow Means Across Southernmost Panel Closure, Scenario S2-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	6.80E+05	9.75E+04	7.02E+02	5.76E+02	4.77E+04	1.44E+04	9.37E+01	5.18E+01
Panel Closure	4.07E+04	3.42E+03	7.36E+01	9.67E+00	1.15E-05	5.68E-05	1.68E-01	9.98E-03
DRZ	6.39E+05	9.41E+04	6.28E+02	5.67E+02	4.77E+04	1.44E+04	9.36E+01	5.18E+01
UDRZ	6.38E+05	9.35E+04	4.53E+02	2.87E+01	4.77E+04	1.44E+04	1.54E+01	1.94E+00
LDRZ	6.66E+02	5.98E+02	1.75E+02	5.38E+02	0.00E+00	3.70E-08	7.82E+01	4.98E+01

Table 4-19: Gas and Brine Flow Means Across Southernmost Panel Closure, Scenario S4-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	2.30E+05	3.12E+05	1.09E+02	5.80E+02	1.77E+04	1.99E+04	2.17E+01	1.84E+01
Panel Closure	4.28E+04	2.98E+04	5.47E+00	9.82E+00	7.36E-06	1.81E-05	4.85E-02	3.28E-02
DRZ	1.87E+05	2.82E+05	1.04E+02	5.71E+02	1.77E+04	1.99E+04	2.16E+01	1.84E+01
UDRZ	1.85E+05	2.78E+05	6.38E+01	2.95E+01	1.68E+04	1.99E+04	4.13E+00	3.16E+00
LDRZ	2.09E+03	3.81E+03	3.98E+01	5.41E+02	9.15E+02	1.15E-09	1.75E+01	1.53E+01

Table 4-20: Gas and Brine Flow Means Across Southernmost Panel Closure, Scenario S6-BF

	CRA14				CRA14_SEN3			
	Gas Flow (m^3)		Brine Flow (m^3)		Gas Flow (m^3)		Brine Flow (m^3)	
Area / Direction	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**	**to North**	**to South**
Panel Closure Plane	4.92E+05	1.28E+05	3.63E+02	5.75E+02	3.00E+04	1.30E+04	4.58E+01	1.68E+01
Panel Closure	5.42E+04	7.21E+03	3.19E+01	9.53E+00	7.14E-06	1.21E-04	8.40E-02	2.33E-02
DRZ	4.37E+05	1.21E+05	3.31E+02	5.65E+02	3.00E+04	1.30E+04	4.57E+01	1.68E+01
UDRZ	4.36E+05	1.20E+05	2.37E+02	2.88E+01	2.94E+04	1.30E+04	7.68E+00	2.45E+00
LDRZ	1.80E+03	9.92E+02	9.43E+01	5.36E+02	6.35E+02	4.94E-01	3.80E+01	1.43E+01

4.9 Impacts to Regulatory Compliance

The impacts of the modified operations and experimental area and panel closure (and associated disturbed rock zone) parameters to CRA14 results predominantly are a pressure increase in repository waste regions accompanied by a decrease to brine saturation (on average). The tightening of the northern non-waste and panel closure areas, application of capillary pressure effects on relative permeability, and the use of associated two-phase flow parameters with increased residual gas and brine saturation effectively halt flow of brine and gas to/from these areas. The resulting pressure increases and brine saturation decreases in the waste areas of the repository result from an enhanced buildup of gas within these areas due to being more isolated from one another and less able to vent gas to the non-waste areas of the repository.

For the release mechanisms considered in WIPP PA, cuttings and cavings are not dependent on repository pressures or brine saturations, and so are not impacted at all by the modified northern non-waste and panel closure area parameters as shown in Figure 4-155.

Spallings releases are a function of repository pressure and the waste inventory. Increases in pressure necessarily translate to increased spallings release volumes. As a result, spallings releases are increased with the application of two-phase flow parameters in the operations, experimental, and panel closure areas that are modeled as crept-closed over the full simulation duration, as compared to CRA14 and CRA14_SEN2 results (see Figure 4-156).

Brine flows up the intrusion borehole obtained in CRA14_SEN3 are nearly identical to those obtained in CRA14 and CRA14_SEN2. Consequently, volumes of brine flowing up the borehole to the Culebra are primarily unaffected by the sensitivity analysis parameter modifications. Thus, transport releases through the Culebra and across the land withdrawal boundary are negligibly different from results calculated for CRA14 and CRA14_SEN2 as shown in Figure 4-157.

Direct brine releases (DBRs) require sufficient waste panel pressure and brine saturation in order to occur. The repository pressure near the drilling location must exceed the hydrostatic pressure of the drilling fluid, which is specified to be 8 MPa in WIPP PA. The brine saturation in the intruded panel must exceed the residual brine saturation of the waste, a sampled parameter in WIPP PA. As seen, the CRA14_SEN3 sensitivity analysis parameters tend to slightly increase waste region pressure while very slightly decreasing waste region brine saturation as compared to CRA14 and CRA14_SEN2. The net result of this pressure and saturation trade-off is a slight increase in DBRs at low probabilities (see Figure 4-158).

Total releases are calculated by totaling the releases from each release pathway: cuttings and cavings releases, spallings releases, DBRs, and transport releases (there were no undisturbed releases to contribute to total release). CRA14_SEN3 CCDFs for total releases obtained in replicates 1, 2, and 3 are plotted together in Figure 4-159. The overall mean CCDF is computed as the arithmetic mean of the mean CCDFs from each replicate. A confidence interval is computed about the overall mean CCDF using the Student's t-distribution and the mean CCDFs from each replicate. Figure 4-160 shows 95% confidence intervals about the overall mean for CRA14_SEN3.

Mean CCDFs of the individual release mechanisms that comprise total normalized releases are plotted together in Figure 4-161, as well as the CRA14_SEN3 total release overall mean. As seen in that figure, total normalized releases obtained for CRA14_SEN3 are dominated by cuttings and cavings releases and DBRs. Contributions to total releases from spallings and Culebra transport are much less significant, although spallings have been increased in comparison to CRA14.

Overall means for total normalized releases obtained for CRA14, CRA14_SEN2, and CRA14_SEN3 are plotted together in Figure 4-162. Overall, total normalized releases insignificantly increase from CRA14 to CRA14_SEN3 due to an insignificant change to all contributing release components (with the exception of spallings which is a non-dominant release mechanism). Total normalized releases increase at low probabilities from CRA14 to CRA14_SEN3 due to increased DBRs. A comparison of the statistics on the overall mean for total normalized releases obtained for CRA14, CRA14_SEN2, and CRA14_SEN3 can be seen in Table 4-21. At a probability of 0.1, values obtained for the mean total release and upper 95% confidence interval for CRA14_SEN3 are very slightly increased in comparison to CRA14. At a probability of 0.001, the mean total release is very slightly higher for CRA14_SEN3 (~14%) in comparison to CRA14 with the upper 95% confidence level almost identical.

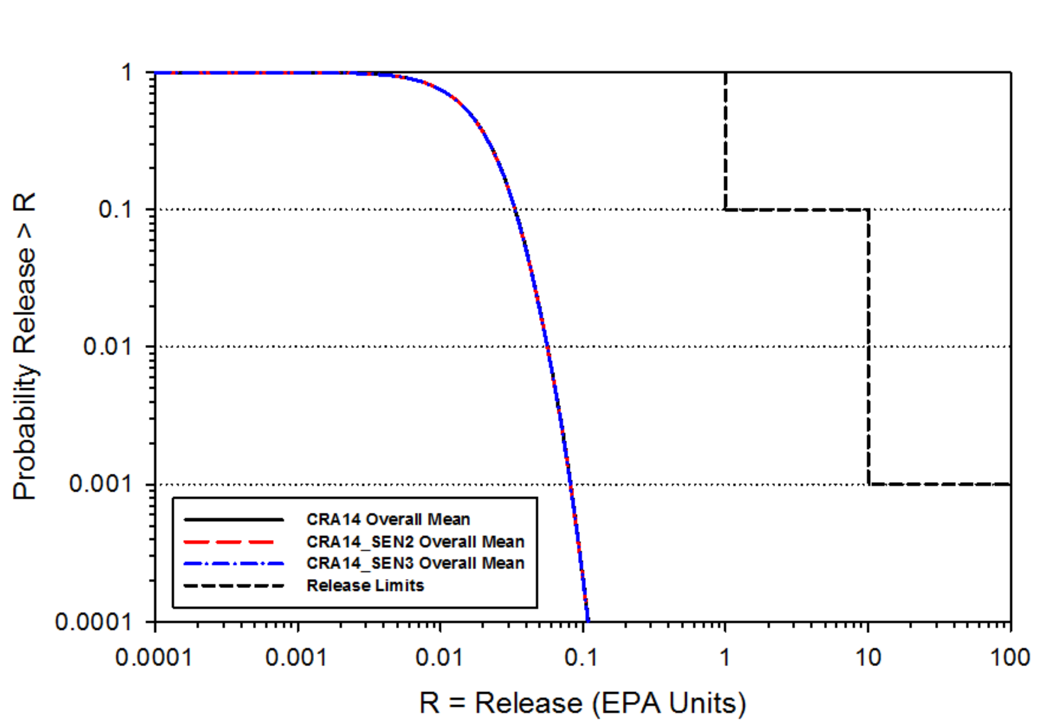

Figure 4-155: Overall Mean CCDFs for Cuttings and Cavings Releases: CRA14, CRA14_SEN2, and CRA14_SEN3

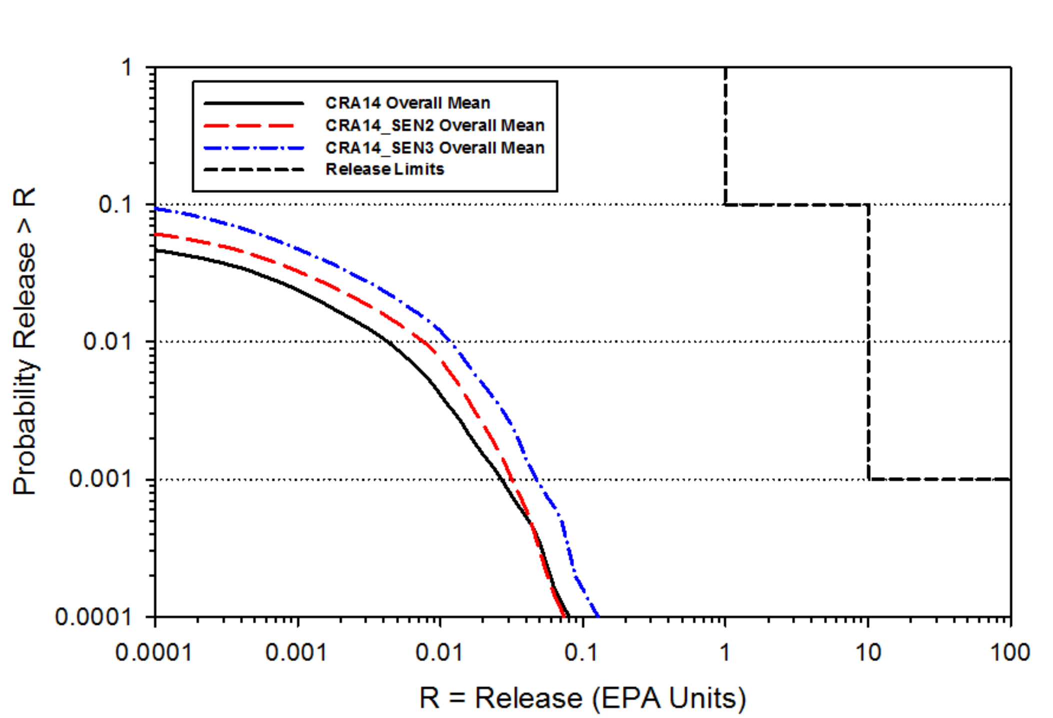

Figure 4-156: Overall Mean CCDFs for Spallings Releases: CRA14, CRA14_SEN2, and CRA14_SEN3

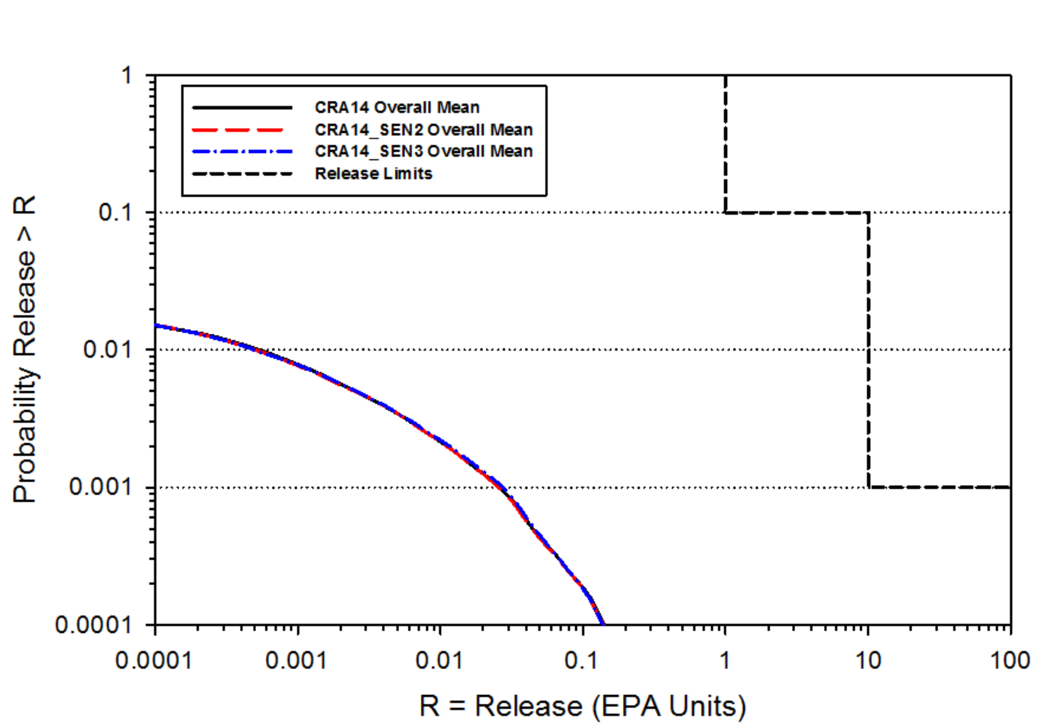

Figure 4-157: Overall Mean CCDFs for Releases from the Culebra: CRA14, CRA14_SEN2, and CRA14_SEN3

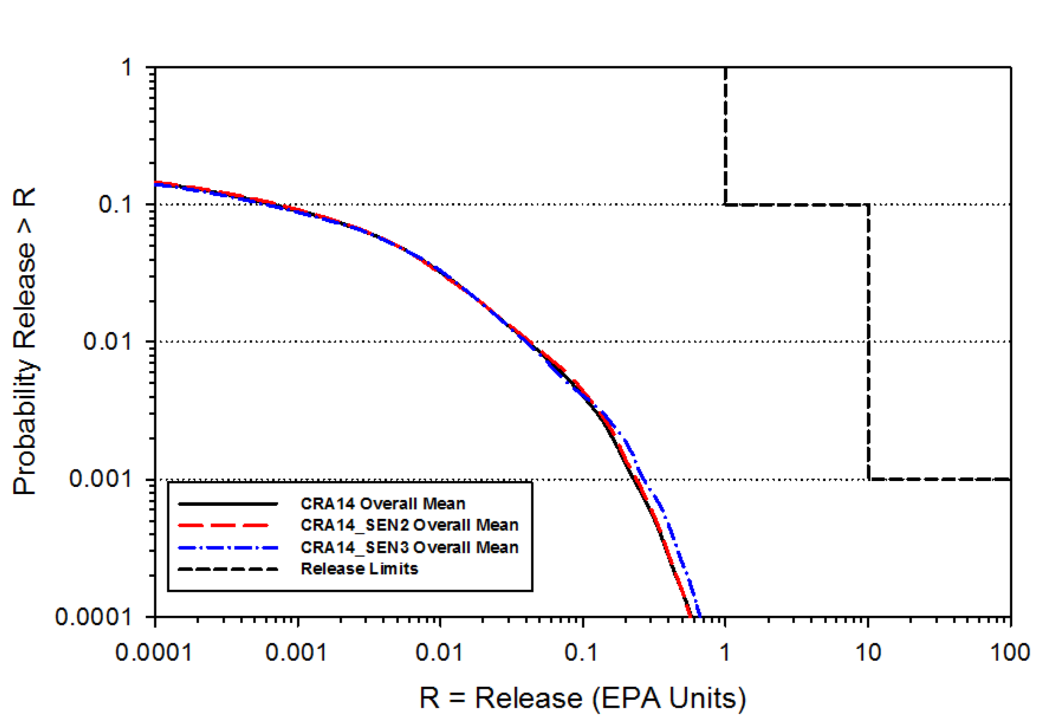

Figure 4-158: Overall Mean CCDFs for Direct Brine Releases: CRA14, CRA14_SEN2, and CRA14_SEN3

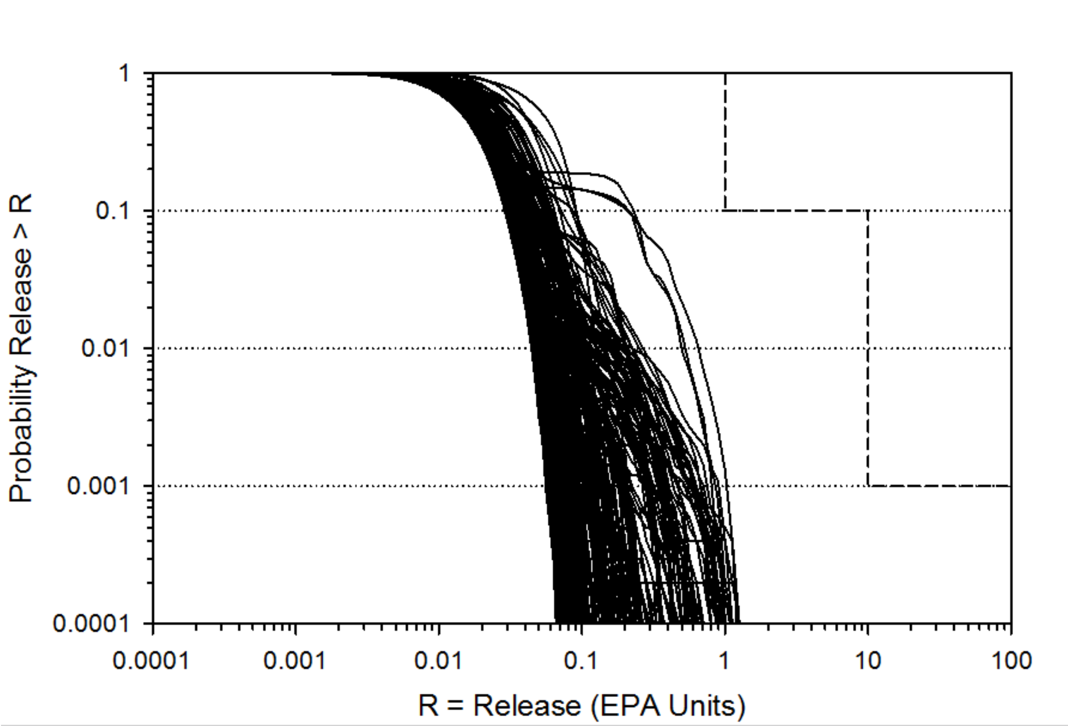

Figure 4-159: Total Normalized Releases, Replicates R1, R2, and R3, CRA14_SEN3

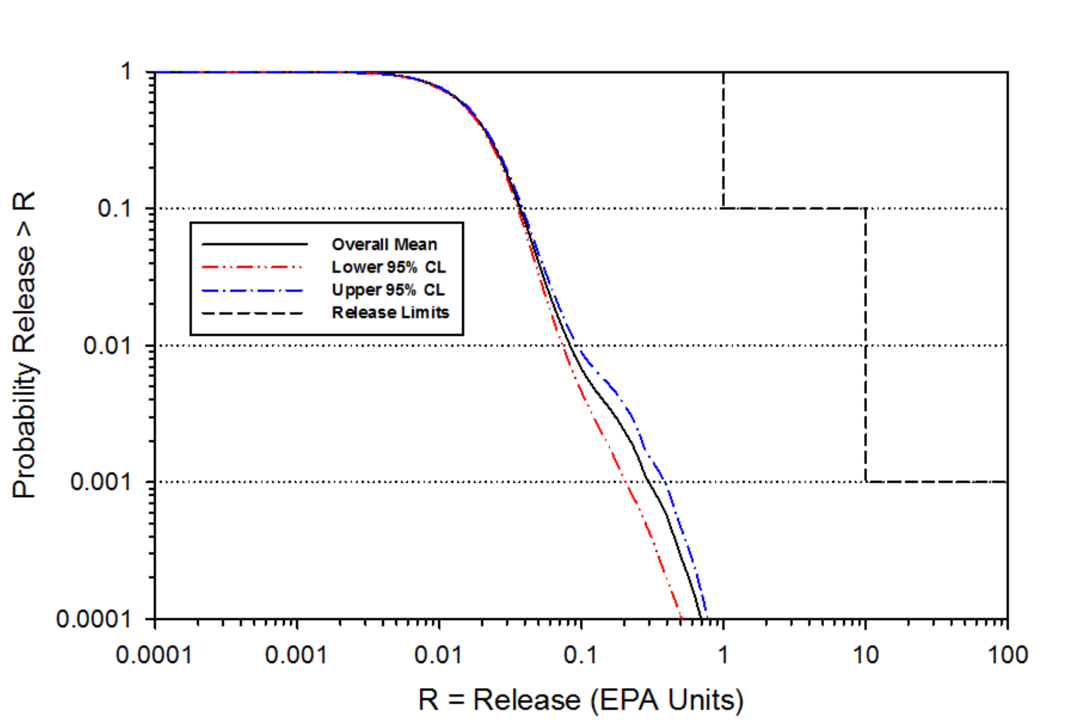

Figure 4-160: Confidence Interval on Overall Mean CCDF for Total Normalized Releases, CRA14_SEN3

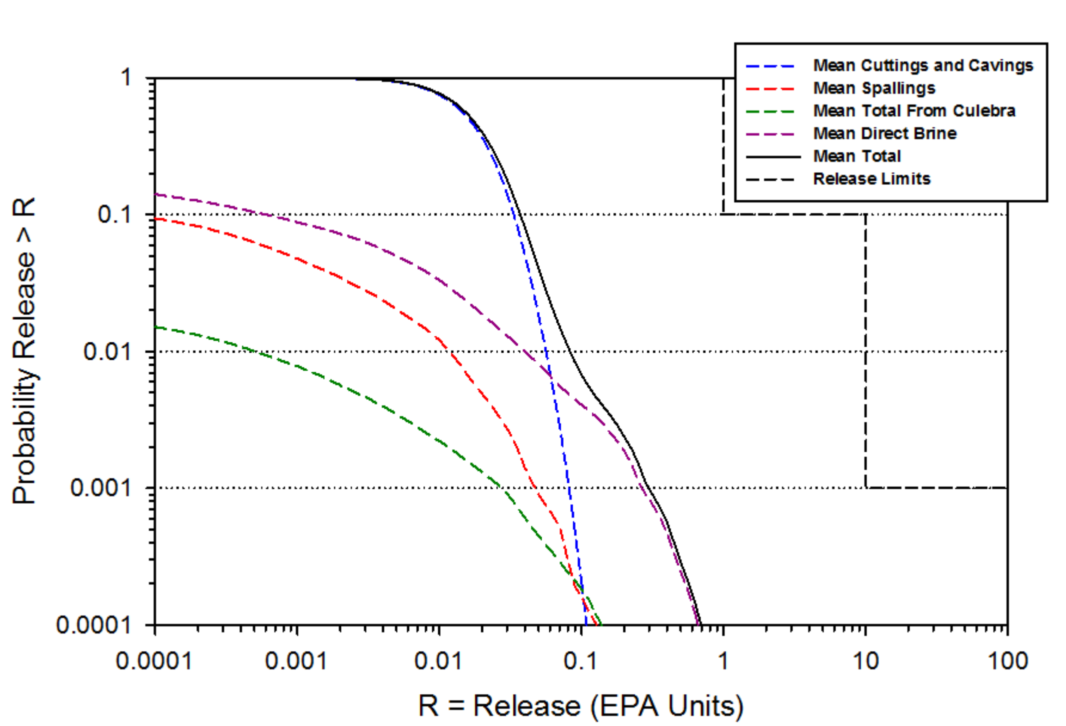

Figure 4-161: Comparison of Overall Means for Release Components of CRA14_SEN3

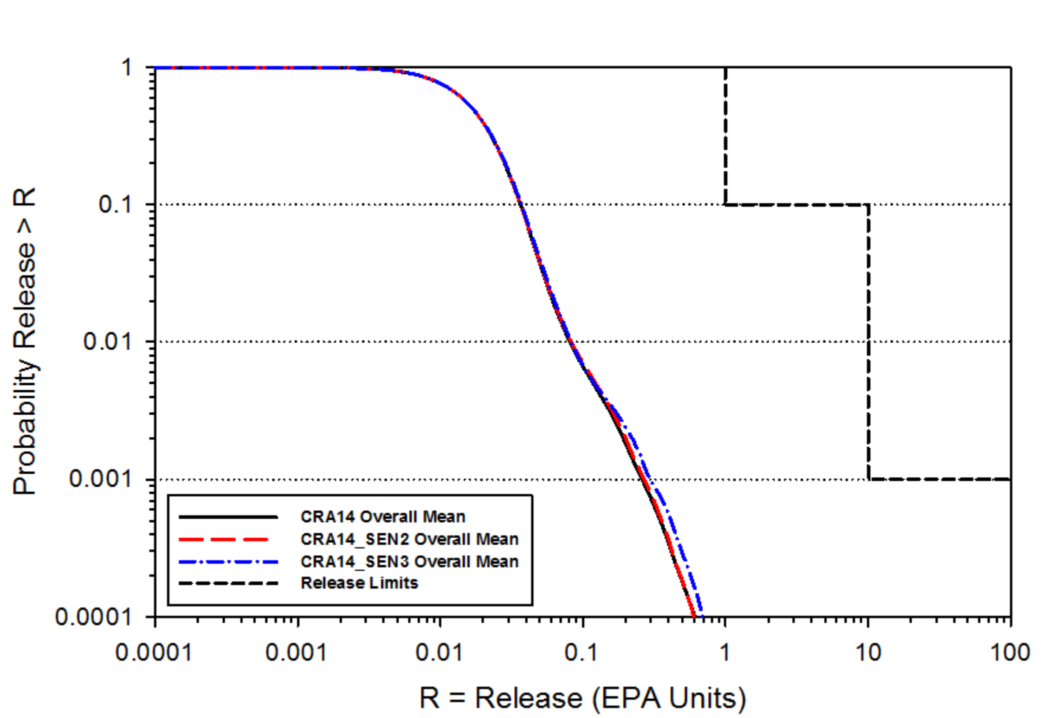

Figure 4-162: CRA14, CRA14_SEN2, and CRA14_SEN3 Overall Mean CCDFs for Total Normalized Releases

Table 4-21: CRA14, CRA14_SEN2, and CRA14_SEN3 Statistics on the Overall Mean for Total Normalized Releases in EPA Units at Probabilities of 0.1 and 0.001

Probability	Analysis	Mean Total Release	Lower 95% CL	Upper 95% CL	Release Limit
0.1	CRA14	0.0367	0.0352	0.0384	1
	CRA14_SEN2	0.0369	0.0354	0.0383	
	CRA14_SEN3	0.0374	0.0359	0.0387	
0.001	CRA14	0.261	0.109	0.384	10
	CRA14_SEN2	0.271	0.201	0.319	
	CRA14_SEN3	0.299	0.207	0.387	

5 Summary

The application of EPA-requested modified parameters in the panel closure areas and operations and experimental (non-waste) areas of the repository to simulate an accelerated (instantaneous) creep closure, the inclusion of capillary pressure effects on relative permeability, and an increase in initial/residual brine saturation and residual gas saturation have been incorporated into a sensitivity analysis (CRA14_SEN3) and compared to the current model (CRA14) and previous sensitivity analysis focused on non-waste area changes only (CRA14_SEN2). The modifications to the repository model predominantly resulted in increased pressures and decreased brine saturations in waste areas, increased pressures and brine saturations in the operations and experimental areas, and decreased brine and gas flows across all panel closures. The pressure increases in repository waste regions yielded slightly decreased brine saturations (on average) in those areas. Brine flows in general were reduced and brine flows up the borehole during a hypothetical drilling intrusion were nearly identical to those found in the CRA14. Brine flows up the repository shaft were decreased as compared to CRA14 due to restricted flow within the operations and experimental areas. The modified panel closure, operations, and experimental area parameters decrease the flow of gas across the panel closures and halt the flow of gas to the repository north end. The combination of increased waste region pressure (on average) and slightly decreased brine saturations resulted in a modest increase in spallings and a small increase in (low probability) direct brine releases due to the pressure/saturation trade-off. Total from Culebra releases and cuttings and cavings releases were not affected. Overall, the effects on total high-probability $(P(R) > 0.1)$ mean releases from the repository were entirely insignificant, with total low-probability $(P(R) > 0.001)$ mean releases increased by about 15% and the associated 95% confidence level on the mean nearly unchanged. It is concluded that the modeling assumptions associated with the panel closure and north end areas of the repository have only a small effect on the prediction of total releases from the repository and/or adequacy of the current (CRA14) model to demonstrate compliance with the regulatory limits.

6 References

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7 Run Control

7.1 CRA14_SEN3

7.1.1 LHS

Table 7-1: CRA14_SEN3 LHS Run Script Files

File	Repository	Comment
RunControl/LHS.py	$REP/CRA14_SEN3/LHS	Python run control script
RunControl/LHSlib.py	$REP/CRA14_SEN3/LHS	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/LHS	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/LHS	Main control script

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-2: CRA14_SEN3 LHS Input Files

File	Repository	Comment
Input/lhs1_CRA14_SEN3_r*i*_con.inp	$REP/CRA14_SEN3/PRELHS	PRELHS input file

Where:

i is 1-3
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-3: CRA14_SEN3 LHS CVS Repositories

CVS Repositories
$CODE/LHS
$CODE/PRELHS
$REP/CRA14_SEN3/LHS
$REP/CRA14_SEN3/PRELHS

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-4: CRA14_SEN3 LHS Log Files

File	Repository	Comment
RunControl/LHS.log	$REP/CRA14_SEN3/LHS	log file
RunControl/LHS.rtf	$REP/CRA14_SEN3/LHS	Formatted log file (Word file)

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-5: CRA14_SEN3 LHS Output Files

File	Repository	Comment
Output/lhs1_CRA14_SEN3_r*i*_con.dbg	$REP/CRA14_SEN3/PRELHS	PRELHS debug file
Output/lhs1_CRA14_SEN3_r*i*_con.trn	$REP/CRA14_SEN3/PRELHS	PRELHS transfer file
Output/lhs2_CRA14_SEN3_r*i*_con.dbg	$REP/CRA14_SEN3/LHS	LHS debug file
Output/lhs2_CRA14_SEN3_r*i*_con.trn	$REP/CRA14_SEN3/LHS	LHS transfer file

Where:
i is 1-3
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-6: CRA14_SEN3 LHS Executable Files

File	Repository	Comment
Build/Solaris/lhs (Ver:2.44)	$CODE/LHS	Code to sample uncertain parameters
Build/Solaris/prelhs (Ver:2.43)	$CODE/PRELHS	Pre-processes data for lhs

Where:
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.1.2 EPAUNI

Table 7-7: CRA14_SEN3 EPAUNI Run Script Files

File	Repository	Comment
RunControl/EPAUNI.py	$REP/CRA14_SEN3/EPAUNI	Python run control script
RunControl/EPAUNIlib.py	$REP/CRA14_SEN3/EPAUNI	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/EPAUNI	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/EPAUNI	Main control script

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-8: CRA14_SEN3 EPAUNI Input Files

File	Repository	Comment
Input/epu_CRA14_SEN3_ch.inp	$REP/CRA14_SEN3/EPAUNI	
Input/epu_CRA14_SEN3_ch_misc.inp	$REP/CRA14_SEN3/EPAUNI	
Input/epu_CRA14_SEN3_rh.inp	$REP/CRA14_SEN3/EPAUNI	
Input/epu_CRA14_SEN3_rh_misc.inp	$REP/CRA14_SEN3/EPAUNI	

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-9: CRA14_SEN3 EPAUNI CVS Repositories

CVS Repositories
$CODE/EPAUNI
$REP/CRA14_SEN3/EPAUNI

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-10: CRA14_SEN3 EPAUNI Log Files

File	Repository	Comment
RunControl/EPAUNI.log	$REP/CRA14_SEN3/EPAUNI	log file
RunControl/EPAUNI.rtf	$REP/CRA14_SEN3/EPAUNI	Formatted log file (Word file)

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-11: CRA14_SEN3 EPAUNI Output Files

File	Repository	Comment
Output/epu_CRA14_SEN3_ch.dat	$REP/CRA14_SEN3/EPAUNI	Radionuclide inventory
Output/epu_CRA14_SEN3_ch.dia	$REP/CRA14_SEN3/EPAUNI	Diagnostic file
Output/epu_CRA14_SEN3_ch.out	$REP/CRA14_SEN3/EPAUNI	supplementl output file
Output/epu_CRA14_SEN3_ch.out2	$REP/CRA14_SEN3/EPAUNI	supplemental output file
Output/epu_CRA14_SEN3_ch_activity.dia	$REP/CRA14_SEN3/EPAUNI	diagnostic file
Output/epu_CRA14_SEN3_rh.dat	$REP/CRA14_SEN3/EPAUNI	Radionuclide inventory
Output/epu_CRA14_SEN3_rh.dia	$REP/CRA14_SEN3/EPAUNI	Diagnostic file
Output/epu_CRA14_SEN3_rh.out	$REP/CRA14_SEN3/EPAUNI	supplementl output file
Output/epu_CRA14_SEN3_rh.out2	$REP/CRA14_SEN3/EPAUNI	supplemental output file
Output/epu_CRA14_SEN3_rh_activity.dia	$REP/CRA14_SEN3/EPAUNI	diagnostic file

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-12: CRA14_SEN3 EPAUNI Executable Files

File	Repository	Comment
Build/Solaris/epauni (Ver:1.18)	$CODE/EPAUNI	Computes decay of radionuclide components in inventory

Where:

$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.1.3 BRAGFLO

Table 7-13: CRA14_SEN3 BRAGFLO Run Script Files

File	Repository	Comment
RunControl/BRAGFLO.py	$REP/CRA14_SEN3/BRAGFLO	Python run control script
RunControl/BRAGFLOlib.py	$REP/CRA14_SEN3/BRAGFLO	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/BRAGFLO	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/BRAGFLO	Main control script

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-14: CRA14_SEN3 BRAGFLO Input Files

File	Repository	Comment
Input/alg1_bf_CRA14_SEN3.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg2_bf_CRA14_SEN3.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/bf1_CRA14_SEN3_s*n*.inp	$REP/CRA14_SEN3/PREBRAG	Input file
Input/bf1_CRA14_SEN3_s*n*_mod1.inp	$REP/CRA14_SEN3/PREBRAG	Input file
Input/bf1_CRA14_SEN3_s*n*_mod2.inp	$REP/CRA14_SEN3/PREBRAG	Input file
Input/bf2_CRA14_SEN3_closure.dat	$REP/CRA14_SEN3/BRAGFLO	Input file
Input/gm_bf_CRA14_SEN3.inp	$REP/CRA14_SEN3/GENMESH	Input file
Input/ic_bf_CRA14_SEN3.inp	$REP/CRA14_SEN3/ICSET	Input file
Input/ms_bf_CRA14_SEN3.inp	$REP/CRA14_SEN3/MATSET	Input file

Where:

n is 1-6
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-15: CRA14_SEN3 BRAGFLO CVS Repositories

CVS Repositories
$CODE/ALGEBRACDB
$CODE/BRAGFLO
$CODE/GENMESH
$CODE/ICSET
$CODE/MATSET
$CODE/POSTBRAG
$CODE/POSTLHS
$CODE/PREBRAG
$REP/CRA14_SEN3/ALGEBRACDB
$REP/CRA14_SEN3/BRAGFLO
$REP/CRA14_SEN3/GENMESH
$REP/CRA14_SEN3/ICSET
$REP/CRA14_SEN3/MATSET
$REP/CRA14_SEN3/PREBRAG

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-16: CRA14_SEN3 BRAGFLO Log Files

File	Repository	Comment
RunControl/BRAGFLO.log	$REP/CRA14_SEN3/BRAGFLO	log file
RunControl/BRAGFLO.rtf	$REP/CRA14_SEN3/BRAGFLO	Formatted log file (Word file)

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-17: CRA14_SEN3 BRAGFLO Output Files

File	Repository	Comment
Output/alg1_bf_CRA14_SEN3_r*i*_*vvvv*.cdb		NOT SAVED:CDB transfer file
Output/alg2_bf_CRA14_SEN3_r*i*_s*n*_*vvvv*.cdb		NOT SAVED:CDB transfer file
Output/bf2_CRA14_SEN3_r*i*_s*n*_*vvvv*.inp	$REP/CRA14_SEN3/PREBRAG	BRAGFLO input file
Output/bf2_CRA14_SEN3_r*i*_s*n*_*vvvv*.log	$REP/CRA14_SEN3/BRAGFLO	Logfile
Output/bf2_CRA14_SEN3_r*i*_s*n*_*vvvv*.sum	$REP/CRA14_SEN3/BRAGFLO	Summary file
Output/bf3_CRA14_SEN3_r*i*_s*n*_*vvvv*.cdb		NOT SAVED:CDB transfer file
Output/gm_bf_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file
Output/ic_bf_CRA14_SEN3_r*i*_*vvvv*.cdb		NOT SAVED:CDB transfer file
Output/lhs3_bf_CRA14_SEN3_r*i*_*vvvv*.cdb		NOT SAVED:CDB transfer file
Output/ms_bf_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file

Where:
i is 1-3
n is 1-6
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-18: CRA14_SEN3 BRAGFLO Executable Files

File	Repository	Comment
Build/Solaris/algebracdb (Ver:2.36)	$CODE/ALGEBRACDB	Manipulates CAMDAT data by evaluating algebraic expressions
Build/Solaris/bragflo (Ver:6.03)	$CODE/BRAGFLO	Computes brine and gas flow in the repository
Build/Solaris/genmesh (Ver:6.10)	$CODE/GENMESH	Generates the CAMDAT computational grid
Build/Solaris/icset (Ver:2.23)	$CODE/ICSET	Assigns initial conditions to the CAMDAT grid elements
Build/Solaris/matset (Ver:9.23)	$CODE/MATSET	Assigns material properties to CAMDAT grid blocks
Build/Solaris/postbrag (Ver:4.02)	$CODE/POSTBRAG	Post-processes data for bragflo
Build/Solaris/postlhs (Ver:4.11)	$CODE/POSTLHS	Assigns sampled parameters to the grid blocks and elements
Build/Solaris/prebrag (Ver:8.03)	$CODE/PREBRAG	Pre-processes data for bragflo

Where:
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.1.4 PANEL

Table 7-19: CRA14_SEN3 PANEL Run Script Files

File	Repository	Comment
RunControl/PANEL.py	$REP/CRA14_SEN3/PANEL	Python run control script
RunControl/PANELlib.py	$REP/CRA14_SEN3/PANEL	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/PANEL	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/PANEL	Main control script

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-20: CRA14_SEN3 PANEL Input Files

File	Repository	Comment
Input/alg1_panel_CRA14_SEN3.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Output/alg2_bf_CRA14_SEN3_r*i*_s*n*_v*vvv*.cdb	$REP/CRA14_SEN3/ALGEBRACDB	CDB transfer file
Input/alg2_panel_CRA14_SEN3_b1.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg2_panel_CRA14_SEN3_b2.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg2_panel_CRA14_SEN3_b3.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg2_panel_CRA14_SEN3_b4.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg2_panel_CRA14_SEN3_b5.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg3_panel_CRA14_SEN3_b1.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg3_panel_CRA14_SEN3_b2.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg3_panel_CRA14_SEN3_b3.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg3_panel_CRA14_SEN3_b4.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg3_panel_CRA14_SEN3_b5.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/gm_panel_CRA14_SEN3.inp	$REP/CRA14_SEN3/GENMESH	Input file
Input/ms_panel_CRA14_SEN3.inp	$REP/CRA14_SEN3/MATSET	Input file
Input/sum_panel_con.inp	$REP/CRA14_SEN3/SUMMARIZE	Input file
Input/sum_panel_int.inp	$REP/CRA14_SEN3/SUMMARIZE	Input file
Input/sum_panel_st.inp	$REP/CRA14_SEN3/SUMMARIZE	Input file

Where:

i is 1-3
n is 1-6
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-21: CRA14_SEN3 PANEL CVS Repositories

CVS Repositories
$CODE/ALGEBRACDB
$CODE/GENMESH
$CODE/MATSET
$CODE/PANEL
$CODE/POSTLHS
$CODE/SUMMARIZE
$REP/CRA14_SEN3/ALGEBRACDB
$REP/CRA14_SEN3/GENMESH
$REP/CRA14_SEN3/MATSET
$REP/CRA14_SEN3/PANEL
$REP/CRA14_SEN3/SUMMARIZE

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-22: CRA14_SEN3 PANEL Log Files

File	Repository	Comment
RunControl/PANEL.log	$REP/CRA14_SEN3/PANEL	log file
RunControl/PANEL.rtf	$REP/CRA14_SEN3/PANEL	Formatted log file (Word file)

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-23: CRA14_SEN3 PANEL Output Files

File	Repository	Comment
Output/alg1_panel_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file
Output/alg2_panel_CRA14_SEN3_b1.cdb		NOT SAVED:CDB transfer file
Output/alg2_panel_CRA14_SEN3_b2.cdb		NOT SAVED:CDB transfer file
Output/alg2_panel_CRA14_SEN3_b3.cdb		NOT SAVED:CDB transfer file
Output/alg2_panel_CRA14_SEN3_b4.cdb		NOT SAVED:CDB transfer file
Output/alg2_panel_CRA14_SEN3_b5.cdb		NOT SAVED:CDB transfer file
Output/alg3_panel_CRA14_SEN3_b1_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/alg3_panel_CRA14_SEN3_b2_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/alg3_panel_CRA14_SEN3_b3_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/alg3_panel_CRA14_SEN3_b4_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/alg3_panel_CRA14_SEN3_b5_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/gm_panel_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file
Output/lhs3_panel_CRA14_SEN3_b1_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/lhs3_panel_CRA14_SEN3_b2_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/lhs3_panel_CRA14_SEN3_b3_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/lhs3_panel_CRA14_SEN3_b4_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/lhs3_panel_CRA14_SEN3_b5_r*j*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/ms_panel_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file
Output/panel_con_CRA14_SEN3_b1_r*j*_s*q*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_con_CRA14_SEN3_b2_r*j*_s*q*_v*www*.cdb		NOT SAVED:CDB transfer file

File	Repository	Comment
Output/panel_con_CRA14_SEN3_b3_r*j*_s*q*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_con_CRA14_SEN3_b4_r*j*_s*q*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_con_CRA14_SEN3_b5_r*j*_s*q*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_decay_CRA14_SEN3_r*i*_s*n*_v*vvv*.cdb		NOT SAVED:CDB transfer file
Output/panel_int_CRA14_SEN3_b1_r*j*_s*o*_t*tttt*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_int_CRA14_SEN3_b2_r*j*_s*o*_t*tttt*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_int_CRA14_SEN3_b3_r*j*_s*o*_t*tttt*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_int_CRA14_SEN3_b4_r*j*_s*o*_t*tttt*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/panel_int_CRA14_SEN3_b5_r*j*_s*o*_t*tttt*_v*www*.cdb		NOT SAVED:CDB transfer file
Output/sum_panel_con_CRA14_SEN3_b1_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_con_CRA14_SEN3_b2_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_con_CRA14_SEN3_b3_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_con_CRA14_SEN3_b4_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_con_CRA14_SEN3_b5_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_int_CRA14_SEN3_b1_r*j*_s*o*_t*tttt*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_int_CRA14_SEN3_b2_r*j*_s*o*_t*tttt*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_int_CRA14_SEN3_b3_r*j*_s*o*_t*tttt*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_int_CRA14_SEN3_b4_r*j*_s*o*_t*tttt*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_int_CRA14_SEN3_b5_r*j*_s*o*_t*tttt*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_st_CRA14_SEN3_b1_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_st_CRA14_SEN3_b2_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_st_CRA14_SEN3_b3_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_st_CRA14_SEN3_b4_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_panel_st_CRA14_SEN3_b5_r*j*_s*p*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file

Where:

i is 1
j is 1-3
n is 1
o is 6
p is 1-2
q is 1-6
tttt is 00100, 00350, 01000, 02000, 04000, 06000, 09000
vvv is 001
www is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-24: CRA14_SEN3 PANEL Executable Files

File	Repository	Comment
Build/Solaris/algebracdb (Ver:2.36)	$CODE/ALGEBRACDB	Manipulates CAMDAT data by evaluating algebraic expressions
Build/Solaris/genmesh (Ver:6.10)	$CODE/GENMESH	Generates the CAMDAT computational grid
Build/Solaris/matset (Ver:9.23)	$CODE/MATSET	Assigns material properties to CAMDAT grid blocks
Build/Solaris/panel (Ver:4.04)	$CODE/PANEL	Computes release concentrations of nuclides from repository
Build/Solaris/postlhs (Ver:4.11)	$CODE/POSTLHS	Assigns sampled parameters to the grid blocks and elements
Build/Solaris/summarize (Ver:3.02)	$CODE/SUMMARIZE	Writes tables of data from many CAMDAT files

Where:

$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.1.5 NUTS

Table 7-25: CRA14_SEN3 NUTS Run Script Files

File	Repository	Comment
RunControl/NUTS.py	$REP/CRA14_SEN3/NUTS	Python run control script
RunControl/NUTSlib.py	$REP/CRA14_SEN3/NUTS	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/NUTS	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/NUTS	Main control script

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-26: CRA14_SEN3 NUTS Input Files

File	Repository	Comment
Input/alg_nut_iso_CRA14_SEN3.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Input/alg_nut_scn_CRA14_SEN3.inp	$REP/CRA14_SEN3/ALGEBRACDB	Input file
Output/bf2_CRA14_SEN3_r*i*_s*n*_v*vvv*.inp	$REP/CRA14_SEN3/PREBRAG	Input file
Output/bf3_CRA14_SEN3_r*i*_s*n*_v*vvv*.cdb	$REP/CRA14_SEN3/BRAGFLO	CDB transfer file
Input/ms_nut_CRA14_SEN3.inp	$REP/CRA14_SEN3/MATSET	Input file
Input/nut_int_CRA14_SEN3_s*o*_t*tttt*.inp	$REP/CRA14_SEN3/NUTS	Input file
Input/nut_iso_CRA14_SEN3_s*n*.inp	$REP/CRA14_SEN3/NUTS	Input file
Input/nut_scn_CRA14_SEN3_s*n*.inp	$REP/CRA14_SEN3/NUTS	Input file
Output/panel_con_CRA14_SEN3_b1_r*i*_s*n*_v*vvv*.cdb	$REP/CRA14_SEN3/PANEL	CDB transfer file

Where:

i is 1-3
n is 1-5
o is 2-5
tttt is 0100 for S2, S4
03000, 05000, 07000, 09000 for S3, S5
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-27: CRA14_SEN3 NUTS CVS Repositories

CVS Repositories
$CODE/ALGEBRACDB
$CODE/MATSET
$CODE/NUTS
$CODE/SCREEN_NUTS
$CODE/SUMMARIZE
$REP/CRA14_SEN3/ALGEBRACDB
$REP/CRA14_SEN3/BRAGFLO
$REP/CRA14_SEN3/MATSET
$REP/CRA14_SEN3/NUTS
$REP/CRA14_SEN3/PANEL
$REP/CRA14_SEN3/PREBRAG
$REP/CRA14_SEN3/SCREEN_NUTS
$REP/CRA14_SEN3/SUMMARIZE

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-28: CRA14_SEN3 NUTS Log Files

File	Repository	Comment
RunControl/NUTS.log	$REP/CRA14_SEN3/NUTS	log file
RunControl/NUTS.rtf	$REP/CRA14_SEN3/NUTS	Formatted log file (Word file)

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-29: CRA14_SEN3 NUTS Output Files

File	Repository	Comment
Output/alg_nut_int_CRA14_SEN3_r*i*_s*o*_*ttttt*_V*VVV*.cdb		NOT SAVED:CDB transfer file
Output/alg_nut_iso_CRA14_SEN3_r*i*_s*n*_V*VVV*.cdb		NOT SAVED:CDB transfer file
Output/alg_nut_scn_CRA14_SEN3_r*i*_s*n*_*vvvv*.cdb		NOT SAVED:CDB transfer file
Output/ms_nut_CRA14_SEN3_r*i*_s*n*_V*VVV*.cdb		NOT SAVED:CDB transfer file
Output/nut_int_CRA14_SEN3_r*i*_s*o*_*ttttt*_V*VVV*.cdb		NOT SAVED:CDB transfer file
Output/nut_iso_CRA14_SEN3_r*i*_s*n*_V*VVV*.cdb		NOT SAVED:CDB transfer file
Output/nut_scn_CRA14_SEN3_r*i*_s*n*_*vvvv*.cdb		NOT SAVED:CDB transfer file
Output/screen_nut_scn_CRA14_SEN3_r*i*_EDIT.inp	$REP/CRA14_SEN3/SCREEN_NUTS	Input file
Output/screen_nut_scn_CRA14_SEN3_r*i*_s*n*.out	$REP/CRA14_SEN3/SCREEN_NUTS	Output file
Output/sum_nut_CRA14_SEN3_r*i*_s*n*_t*uuuuu*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file
Output/sum_nut_scn_CRA14_SEN3_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Table file

Where:

i is 1-3
n is 1-5
o is 2-5
ttttt is 0100 for S2, S4
03000, 05000, 07000, 09000 for S3, S5
uuuuu is 0100 for s1
00100, 00350 for S2,S4
01000, 03000, 05000, 07000, 09000 for S3, S5
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
VVV are the screened-in vectors listed in Table 7-30.

Table 7-30: CRA14_SEN3 NUTS Screened-in Vectors

Replicate	Scenario	Vectors
1	1	1,2,3,5,6,7,8,9,11,12,13,14,16,17,19,20,22,23,24,25,26,27,28,29,30,34,35,36,37,38,39,41,43,44,45,46,47,50,51,52,53,54,55,58,59,60,61,62,63,64,66,67,68,69,70,71,72,74,76,77,78,79,80,82,83,84,85,86,87,88,89,90,91,92,93,94,96,97,98
1	2	1,2,3,5,6,7,8,9,11,12,13,14,16,17,19,20,22,23,24,25,26,27,28,29,30,34,35,36,37,38,39,41,43,44,45,46,47,50,51,52,53,54,55,58,59,60,61,62,63,64,66,67,68,69,70,71,72,74,76,77,78,79,80,82,83,84,85,86,87,88,89,90,91,92,93,94,96,97,98
1	3	1,2,3,5,6,7,8,9,12,13,14,16,17,19,20,22,23,24,25,26,27,28,29,30,34,35,36,38,39,41,43,44,45,46,47,50,51,52,53,54,55,58,59,60,61,62,63,64,66,67,69,70,71,76,78,79,80,82,83,84,86,88,89,90,93,97,98
1	4	2,3,7,9,12,16,17,22,27,28,30,36,45,50,53,58,63,66,67,76,78,79,82,98
1	5	2,3,7,9,12,16,17,22,27,28,30,36,45,50,53,58,63,66,67,76,78,79,82,98
2	1	1,2,3,4,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21,22,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,43,44,45,46,48,49,50,51,52,53,54,55,56,59,62,63,65,66,67,68,70,71,72,74,75,77,79,80,81,83,84,86,87,88,89,90,92,94,95,96,98,100
2	2	1,2,3,4,6,7,8,9,10,11,12,13,14,16,17,18,19,20,21,22,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,43,44,45,46,48,49,50,51,52,53,54,55,56,59,62,63,65,66,67,68,70,71,72,74,75,77,79,80,81,83,84,86,87,88,89,90,92,94,95,96,98,100
2	3	3,4,6,8,9,10,12,14,16,17,18,19,20,21,22,24,25,26,27,28,29,30,31,33,34,35,36,37,38,39,40,41,43,44,45,46,48,49,50,51,52,53,54,55,56,59,63,65,66,67,68,71,72,74,75,77,79,80,81,84,87,89,90,92,94,95,96,98,100
2	4	4,17,21,24,25,28,30,33,34,36,40,53,55,63,67,68,79,90,92,95,96,98
2	5	4,17,21,24,25,28,30,34,36,40,53,55,63,67,68,79,90,92,95,96,98
3	1	2,3,5,7,8,9,10,11,13,14,17,18,20,21,22,24,25,26,27,28,30,32,33,34,35,37,38,39,40,41,42,43,44,45,46,47,49,50,52,53,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,77,78,79,81,83,84,85,86,88,89,90,91,93,94,95,96,97,98,99,100
3	2	2,3,5,7,8,9,10,11,13,14,17,18,20,21,22,24,25,26,27,28,30,32,33,34,35,37,38,39,40,41,42,43,44,45,46,47,49,50,52,53,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,77,78,79,81,83,84,85,86,88,89,90,91,93,94,95,96,97,98,99,100
3	3	2,3,5,7,10,11,14,18,21,22,24,25,26,27,28,30,32,33,34,35,37,38,39,40,42,43,44,45,46,47,49,50,52,53,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,73,74,75,77,78,79,84,85,86,88,89,90,91,93,94,95,96,97,99,100
3	4	14,30,35,37,40,42,44,47,49,53,59,61,66,69,77,86,91,93,96,97
3	5	14,30,35,37,40,42,44,47,49,53,59,66,69,77,86,91,93,96,97

Table 7-31: CRA14_SEN3 NUTS Executable Files

File	Repository	Comment
Build/Solaris/algebracdb (Ver:2.36)	$CODE/ALGEBRACDB	Manipulates CAMDAT data by evaluating algebraic expressions
Build/Solaris/matset (Ver:9.23)	$CODE/MATSET	Assigns material properties to CAMDAT grid blocks
Build/Solaris/nuts (Ver:2.06)	$CODE/NUTS	Nuclide Transport system model
Build/Solaris/screen_nuts (Ver:1.01)	$CODE/SCREEN_NUTS	Executable file
Build/Solaris/summarize (Ver:3.02)	$CODE/SUMMARIZE	Writes tables of data from many CAMDAT files

Where:

$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.1.6 CUTTINGS_S

Table 7-32: CRA14_SEN3 CUTTINGS_S Run Script Files

File	Repository	Comment
RunControl/CUTTINGS_S.py	$REP/CRA14_SEN3/CUTTINGS_S	Python run control script
RunControl/CUTTINGS_Slib.py	$REP/CRA14_SEN3/CUTTINGS_S	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/CUTTINGS_S	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/CUTTINGS_S	Main control script

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-33: CRA14_SEN3 CUTTINGS_S Input Files

File	Repository	Comment
Output/bf3_CRA14_SEN3_r*i*_s*n*_v*vvv*.cdb	$REP/CRA14_SEN3/BRAGFLO	
Input/cusp_CRA14_SEN3.inp	$REP/CRA14_SEN3/CUTTINGS_S	
Input/gm_cusp_CRA14_SEN3.inp	$REP/CRA14_SEN3/GENMESH	
Input/ms_cusp_CRA14_SEN3.inp	$REP/CRA14_SEN3/MATSET	
Output/mspall_drs_PABC09_r*i*.out	$REP/PABC09/DRSPALL	

Where:

i is 1-3
n is 1-5
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-34: CRA14_SEN3 CUTTINGS_S CVS Repositories

CVS Repositories
$CODE/CUTTINGS_S
$CODE/GENMESH
$CODE/MATSET
$CODE/POSTLHS
$REP/CRA14_SEN3/BRAGFLO
$REP/CRA14_SEN3/CUTTINGS_S
$REP/CRA14_SEN3/GENMESH
$REP/CRA14_SEN3/MATSET
$REP/PABC09/DRSPALL

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-35: CRA14_SEN3 CUTTINGS_S Log Files

File	Repository	Comment
RunControl/CUTTINGS_S.log	$REP/CRA14_SEN3/CUTTINGS_S	log file
RunControl/CUTTINGS_S.rtf	$REP/CRA14_SEN3/CUTTINGS_S	Formatted log file (Word file)

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-36: CRA14_SEN3 CUTTINGS_S Output Files

File	Repository	Comment
Output/cusp_CRA14_SEN3_master_r*i*.inp	$REP/CRA14_SEN3/CUTTINGS_S	
Output/cusp_CRA14_SEN3_r*i*.tbl	$REP/CRA14_SEN3/CUTTINGS_S	
Output/cusp_CRA14_SEN3_r*i*_s*n*_t*tttt*_L_*vvvv*.cdb		NOT SAVED:
Output/cusp_CRA14_SEN3_r*i*_s*n*_t*tttt*_M_*vvvv*.cdb		NOT SAVED:
Output/cusp_CRA14_SEN3_r*i*_s*n*_t*tttt*_U_*vvvv*.cdb		NOT SAVED:
Output/gm_cusp_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file
Output/lhs3_cusp_CRA14_SEN3_r*i*_*vvvv*.cdb		NOT SAVED:
Output/ms_cusp_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file

Where:

i is 1-3
n is 1-5
tttt is 00100, 00350, 01000, 03000, 05000, 10000 for S1
00550, 00750, 02000, 04000, 10000 for S2, S4
01200, 01400, 03000, 05000, 10000 for S3, S5
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-37: CRA14_SEN3 CUTTINGS_S Executable Files

File	Repository	Comment
Build/Solaris/cuttings_s (Ver:6.03)	$CODE/CUTTINGS_S	Computes cuttings/spall generated by drilling
Build/Solaris/genmesh (Ver:6.10)	$CODE/GENMESH	Generates the CAMDAT computational grid
Build/Solaris/matset (Ver:9.23)	$CODE/MATSET	Assigns material properties to CAMDAT grid blocks
Build/Solaris/postlhs (Ver:4.11)	$CODE/POSTLHS	Assigns sampled parameters to the grid blocks and elements

Where:
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.1.7 BRAGFLO_DBR

Table 7-38: CRA14_SEN3 BRAGFLO_DBR Run Script Files

File	Repository	Comment
RunControl/BRAGFLO_DBR.py	$REP/CRA14_SEN3/BRAGFLO_DBR	Python run control script
RunControl/BRAGFLO_DBRlib.py	$REP/CRA14_SEN3/BRAGFLO_DBR	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/BRAGFLO_DBR	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/BRAGFLO_DBR	Main control script

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-39: CRA14_SEN3 BRAGFLO_DBR Input Files

File	Repository	Comment
Input/alg1_dbr_CRA14_SEN3.inp	$REP/CRA14_SEN3/ALGEBRACDB	
Input/alg2_dbr_CRA14_SEN3_s*o*.inp	$REP/CRA14_SEN3/ALGEBRACDB	
Input/alg3_dbr_CRA14_SEN3_L.inp	$REP/CRA14_SEN3/ALGEBRACDB	
Input/alg3_dbr_CRA14_SEN3_M.inp	$REP/CRA14_SEN3/ALGEBRACDB	
Input/alg3_dbr_CRA14_SEN3_U.inp	$REP/CRA14_SEN3/ALGEBRACDB	
Input/bf1_dbr_CRA14_SEN3_L.inp	$REP/CRA14_SEN3/PREBRAG	
Input/bf1_dbr_CRA14_SEN3_M.inp	$REP/CRA14_SEN3/PREBRAG	
Input/bf1_dbr_CRA14_SEN3_s*n*_100_L.inp	$REP/CRA14_SEN3/PREBRAG	
Input/bf1_dbr_CRA14_SEN3_s*n*_100_M.inp	$REP/CRA14_SEN3/PREBRAG	
Input/bf1_dbr_CRA14_SEN3_s*n*_100_U.inp	$REP/CRA14_SEN3/PREBRAG	
Input/bf1_dbr_CRA14_SEN3_U.inp	$REP/CRA14_SEN3/PREBRAG	
Output/bf3_CRA14_SEN3_r*i*_s*o*_*vvvv*.cdb	$REP/CRA14_SEN3/BRAGFLO	
Output/cusp_CRA14_SEN3_r*i*_s*o*_*ttttt*_L_*vvvv*.cdb	$REP/CRA14_SEN3/CUTTINGS_S	
Output/cusp_CRA14_SEN3_r*i*_s*o*_*ttttt*_M_*vvvv*.cdb	$REP/CRA14_SEN3/CUTTINGS_S	
Output/cusp_CRA14_SEN3_r*i*_s*o*_*ttttt*_U_*vvvv*.cdb	$REP/CRA14_SEN3/CUTTINGS_S	
Input/gm_dbr_CRA14_SEN3.inp	$REP/CRA14_SEN3/GENMESH	
Input/ic_dbr_CRA14_SEN3_s*o*.inp	$REP/CRA14_SEN3/ICSET	
Input/ms_dbr_CRA14_SEN3.inp	$REP/CRA14_SEN3/MATSET	
Input/rel1_dbr_CRA14_SEN3.inp	$REP/CRA14_SEN3/RELATE	
Input/rel2_dbr_CRA14_SEN3_s*o*.inp	$REP/CRA14_SEN3/RELATE	
Input/sum_dbr.inp	$REP/CRA14_SEN3/SUMMARIZE	

Where:

i is 1-3
n is 1
o is 1-5
ttttt is 00100, 00350, 01000, 03000, 05000, 10000 for S1
00550, 00750, 02000, 04000, 10000 for S2, S4
01200, 01400, 03000, 05000, 10000 for S3, S5
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-40: CRA14_SEN3 BRAGFLO_DBR CVS Repositories

CVS Repositories
$CODE/ALGEBRACDB
$CODE/BRAGFLO
$CODE/GENMESH
$CODE/ICSET
$CODE/MATSET
$CODE/POSTBRAG
$CODE/POSTLHS
$CODE/PREBRAG
$CODE/RELATE
$CODE/SUMMARIZE
$REP/CRA14_SEN3/ALGEBRACDB
$REP/CRA14_SEN3/BRAGFLO
$REP/CRA14_SEN3/BRAGFLO_DBR
$REP/CRA14_SEN3/CUTTINGS_S
$REP/CRA14_SEN3/GENMESH
$REP/CRA14_SEN3/ICSET
$REP/CRA14_SEN3/MATSET
$REP/CRA14_SEN3/PREBRAG
$REP/CRA14_SEN3/RELATE
$REP/CRA14_SEN3/SUMMARIZE

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-41: CRA14_SEN3 BRAGFLO_DBR Log Files

File	Repository	Comment
RunControl/BRAGFLO_DBR.log	$REP/CRA14_SEN3/BRAGFLO_DBR	log file
RunControl/BRAGFLO_DBR.rtf	$REP/CRA14_SEN3/BRAGFLO_DBR	Formatted log file (Word file)

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-42: CRA14_SEN3 BRAGFLO_DBR Output Files

File	Repository	Comment
Output/alg1_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_v*vvv*.cdb		NOT SAVED:
Output/alg2_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_v*vvv*.cdb		NOT SAVED:
Output/alg3_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_L_v*vvv*.cdb		NOT SAVED:
Output/alg3_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_M_v*vvv*.cdb		NOT SAVED:
Output/alg3_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_U_v*vvv*.cdb		NOT SAVED:
Output/bf2_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_L_v*vvv*.inp	$REP/CRA14_SEN3/BRAGFLO_DBR	
Output/bf2_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_M_v*vvv*.inp	$REP/CRA14_SEN3/BRAGFLO_DBR	
Output/bf2_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_U_v*vvv*.inp	$REP/CRA14_SEN3/BRAGFLO_DBR	
Output/bf3_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_L_v*vvv*.cdb		NOT SAVED:
Output/bf3_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_M_v*vvv*.cdb		NOT SAVED:
Output/bf3_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_U_v*vvv*.cdb		NOT SAVED:
Output/gm_dbr_CRA14_SEN3.cdb		NOT SAVED:
Output/ic_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_v*vvv*.cdb		NOT SAVED:
Output/ms_dbr_CRA14_SEN3.cdb		NOT SAVED:
Output/rel1_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_v*vvv*.cdb		NOT SAVED:
Output/rel2_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_v*vvv*.cdb		NOT SAVED:
Output/sum_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_L.tbl	$REP/CRA14_SEN3/SUMMARIZE	
Output/sum_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_M.tbl	$REP/CRA14_SEN3/SUMMARIZE	
Output/sum_dbr_CRA14_SEN3_r*i*_s*n*_t*tttt*_U.tbl	$REP/CRA14_SEN3/SUMMARIZE	

Where:

i is 1-3
n is 1-5
tttt is 00100, 00350, 01000, 03000, 05000, 10000 for S1
00550, 00750, 02000, 04000, 10000 for S2, S4
01200, 01400, 03000, 05000, 10000 for S3, S5
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-43: CRA14_SEN3 BRAGFLO_DBR Executable Files

File	Repository	Comment
Build/Solaris/algebracdb (Ver:2.36)	$CODE/ALGEBRACDB	Manipulates CAMDAT data by evaluating algebraic expressions
Build/Solaris/bragflo (Ver:6.03)	$CODE/BRAGFLO	Computes brine and gas flow in the repository
Build/Solaris/genmesh (Ver:6.10)	$CODE/GENMESH	Generates the CAMDAT computational grid
Build/Solaris/icset (Ver:2.23)	$CODE/ICSET	Assigns initial conditions to the CAMDAT grid elements
Build/Solaris/matset (Ver:9.23)	$CODE/MATSET	Assigns material properties to CAMDAT grid blocks
Build/Solaris/postbrag (Ver:4.02)	$CODE/POSTBRAG	Post-processes data for bragflo
Build/Solaris/postlhs (Ver:4.11)	$CODE/POSTLHS	Assigns sampled parameters to the grid blocks and elements
Build/Solaris/prebrag (Ver:8.03)	$CODE/PREBRAG	Pre-processes data for bragflo
Build/Solaris/relate (Ver:1.45)	$CODE/RELATE	Transfers CAMDAT data to another CAMDAT file
Build/Solaris/summarize (Ver:3.02)	$CODE/SUMMARIZE	Writes tables of data from many CAMDAT files

Where:
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.1.8 CCDFGF

Table 7-44: CRA14_SEN3 CCDFGF Run Script Files

File	Repository	Comment
RunControl/CCDFGF.py	$REP/CRA14_SEN3/CCDFGF	Python run control script
RunControl/CCDFGFlib.py	$REP/CRA14_SEN3/CCDFGF	Python run control script class modules
RunControl/rc.py	$REP/CRA14_SEN3/CCDFGF	Run control module
RunControl/Run.py	$REP/CRA14_SEN3/CCDFGF	Main control script

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-45: CRA14_SEN3 CCDFGF Input Files

File	Repository	Comment
Input/ccgf_CRA14_SEN3_control_r*i*.inp	$REP/CRA14_SEN3/CCDFGF	Input file
Output/cusp_CRA14_SEN3_r*i*.tbl	$REP/CRA14_SEN3/CUTTINGS_S	Release table file
Output/epu_CRA14_SEN3_ch.dat	$REP/CRA14_SEN3/EPAUNI	Release table file
Output/epu_CRA14_SEN3_rh.dat	$REP/CRA14_SEN3/EPAUNI	Release table file
Input/gm_ccgf_CRA14_SEN3.inp	$REP/CRA14_SEN3/GENMESH	Input file
Input/intrusiontimes.in	$REP/CRA14_SEN3/PRECCDFGF	Input file
Input/ms_ccgf_CRA14_SEN3.inp	$REP/CRA14_SEN3/MATSET	Input file
Output/sum_dbr_CRA14_SEN3_r*i*_s*o*_t*vvvvv*_L.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_dbr_CRA14_SEN3_r*i*_s*o*_t*vvvvv*_M.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_dbr_CRA14_SEN3_r*i*_s*o*_t*vvvvv*_U.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_nut_CRA14_SEN3_r*i*_s*o*_t*uuuuu*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_con_CRA14_SEN3_b1_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_con_CRA14_SEN3_b2_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_con_CRA14_SEN3_b3_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_con_CRA14_SEN3_b4_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_con_CRA14_SEN3_b5_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_int_CRA14_SEN3_b1_r*i*_s*p*_t*ttttt*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_st_CRA14_SEN3_b1_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_st_CRA14_SEN3_b2_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_st_CRA14_SEN3_b3_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_st_CRA14_SEN3_b4_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_panel_st_CRA14_SEN3_b5_r*i*_s*n*.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_st2d_PABC09_r*i*_mf.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file
Output/sum_st2d_PABC09_r*i*_mp.tbl	$REP/CRA14_SEN3/SUMMARIZE	Release table file

Where:

i is 1-3
n is 1-2
o is 1-5
p is 6
ttttt is 00100, 00350, 01000, 02000, 04000, 06000, 09000
uuuuu is 0100 for s1
00100, 00350 for S2,S4
01000, 03000, 05000, 07000, 09000 for S3, S5
vvvvv is 00100, 00350, 01000, 03000, 05000, 10000 for S1
00550, 00750, 02000, 04000, 10000 for S2, S4
01200, 01400, 03000, 05000, 10000 for S3, S5
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-46: CRA14_SEN3 CCDFGF CVS Repositories

CVS Repositories
$CODE/CCDFGF
$CODE/CCDFVECTORSTATS
$CODE/GENMESH
$CODE/MATSET
$CODE/POSTLHS
$CODE/PRECCDFGF
$REP/CRA14_SEN3/CCDFGF
$REP/CRA14_SEN3/CUTTINGS_S
$REP/CRA14_SEN3/EPAUNI
$REP/CRA14_SEN3/GENMESH
$REP/CRA14_SEN3/MATSET
$REP/CRA14_SEN3/PRECCDFGF
$REP/CRA14_SEN3/SUMMARIZE

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-47: CRA14_SEN3 CCDFGF Log Files

File	Repository	Comment
RunControl/CCDFGF.log	$REP/CRA14_SEN3/CCDFGF	log file
RunControl/CCDFGF.rtf	$REP/CRA14_SEN3/CCDFGF	Formatted log file (Word file)

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-48: CRA14_SEN3 CCDFGF Output Files

File	Repository	Comment
Output/ccgf_CRA14_SEN3_reltab_r*i*.dat	$REP/CRA14_SEN3/PRECCDFGF	CCDFGF Reults
Output/ccgf_CRA14_SEN3_r*i*.out	$REP/CRA14_SEN3/CCDFGF	CCDFGF Reults
Output/gm_ccgf_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file
Output/lhs3_ccgf_CRA14_SEN3_r*i*_v*vvv*.cdb		NOT SAVED:LHS file
Output/ms_ccgf_CRA14_SEN3.cdb		NOT SAVED:CDB transfer file

Where:
i is 1-3
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-49: CRA14_SEN3 CCDFGF Executable Files

File	Repository	Comment
Build/Solaris/ccdfgf (Ver:6.02)	$CODE/CCDFGF	Constructs complimentary cumulative distribution functions for radionuclide releases
Build/Solaris/ccdfvectorstats	$CODE/CCDFVECTORSTATS	Executable file
Build/Solaris/genmesh (Ver:6.10)	$CODE/GENMESH	Generates the CAMDAT computational grid
Build/Solaris/matset (Ver:9.23)	$CODE/MATSET	Assigns material properties to CAMDAT grid blocks
Build/Solaris/postlhs (Ver:4.11)	$CODE/POSTLHS	Assigns sampled parameters to the grid blocks and elements
Build/Solaris/preccdfgf (Ver:2.01)	$CODE/PRECCDFGF	Pre-processes data for ccdfgf

Where:
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.2 CRA14

7.2.1 BRAGFLO ALGEBRACDB RERUN

Table 7-50: CRA14 BRAGFLO Run Script Files

File	Repository	Comment
RunControl/runalg.sh	$REP/CRA14_SEN3/CRA14	Algebracdb run script

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-51: CRA14 BRAGFLO Input Files

File	Repository	Comment
Input/alg2_bf_CRA14.inp	$REP/CRA14_SEN3/CRA14	Input file

Where:
n is 1-6
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-52: CRA14 BRAGFLO CVS Repositories

CVS Repositories
$CODE/ALGEBRACDB

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-53: CRA14 BRAGFLO Log Files

File	Repository	Comment
RunControl/rerunCRA14algebra2.log	$REP/CRA14_SEN3/CRA14	log file

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-54: CRA14 BRAGFLO Output Files

File	Repository	Comment
Output/alg2_bf_CRA14 _r*i*_s*n*_*vvvv*.cdb		NOT SAVED:CDB transfer file

Where:
i is 1-3
n is 1-6
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-55: CRA14 BRAGFLO Executable Files

File	Repository	Comment
Build/Solaris/algebracdb (Ver:2.36)	$CODE/ALGEBRACDB	Manipulates CAMDAT data by evaluating algebraic expressions

Where:
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

7.3 CRA14_SEN2

7.3.1 BRAGFLO ALGEBRACDB RERUN

Table 7-56: CRA14_SEN2 BRAGFLO Run Script Files

File	Repository	Comment
RunControl/runalg.sh	$REP/CRA14_SEN3/CRA14_SEN2	Algebracdb run script

Where:
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-57: CRA14_SEN2 BRAGFLO Input Files

File	Repository	Comment
Input/alg2_bf_CRA14_SEN2.inp	$REP/CRA14_SEN3/CRA14_SEN2	Input file

Where:
n is 1-6
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-58: CRA14_SEN2 BRAGFLO CVS Repositories

CVS Repositories
$CODE/ALGEBRACDB

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES
$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

Table 7-59: CRA14_SEN2 BRAGFLO Log Files

File	Repository	Comment
RunControl/rerunCRA14_SEN2algebra2.log	$REP/CRA14_SEN3/CRA14_SEN2	log file

Where:

$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-60: CRA14_SEN2 BRAGFLO Output Files

File	Repository	Comment
Output/alg2_bf_CRA14_SEN2_r*i*_s*n*_v*vvv*.cdb		NOT SAVED:CDB transfer file

Where:

i is 1-3
n is 1-6
vvv is 001-100
$REP = /nfs/data/CVSLIB/WIPP_ANALYSES

Table 7-61: CRA14_SEN2 BRAGFLO Executable Files

File	Repository	Comment
Build/Solaris/algebracdb (Ver:2.36)	$CODE/ALGEBRACDB	Manipulates CAMDAT data by evaluating algebraic expressions

Where:

$CODE = /nfs/data/CVSLIB/WIPP_CODES/PA_CODES

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