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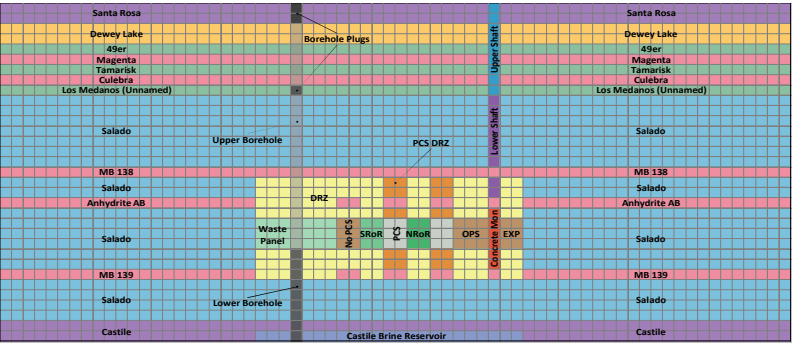

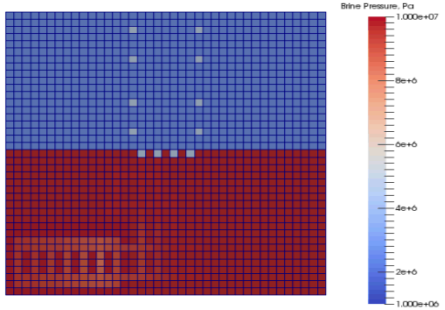

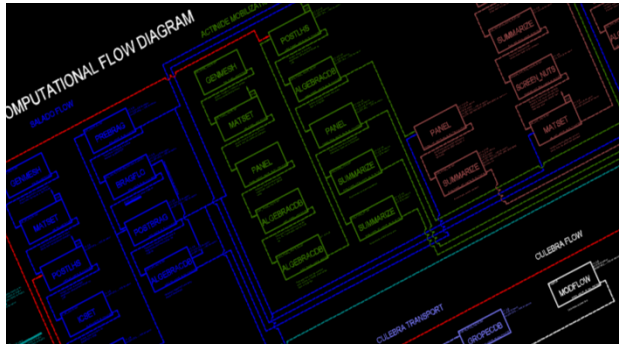

December 2017 Technical Exchange Action Items and APCS_NT Sensitivity Study

DOE EPA Technical Exchange on WIPP Recertification

Presented by Brad Day on February 13, 2018

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SAND 2018-99999PE

Outline

- Action Items from December 2017 Technical Exchange
  - Status Overview
  - Summary of Technical Responses
    - Realizations that cross WIPP compliance limit for APCS Analysis
    - Saturation vs pressure in North Rest-of-Repository for APCS Analysis
    - Timing and presence of borehole intrusions for BRAGFLO_DBR
- APCS_NT Sensitivity Study
  - Objective
  - Methodology
  - Release Results
  - Summary/Conclusions

Action Item Status

Item	Status
Analysis of two realizations that cross WIPP compliance boundary	Complete: 01/16/18 memo
Provide copies of SNL's rock mechanics test and analysis plans	Complete: 12/18/17 email
Analysis of saturation vs pressure in North Rest-of-Repository	Complete: 01/16/18 memo
Analysis of timing and presence of borehole intrusions for BRAGFLO_DBR	Complete: 01/16/18 memo
Update of FEP screening for 5th shaft	Planned for CRA-2019
Briefing on PFLOTRAN	TBD
Provide expanded discussion of APCS approach	Complete: 12/20/17 email

Action Item Status (cont.)

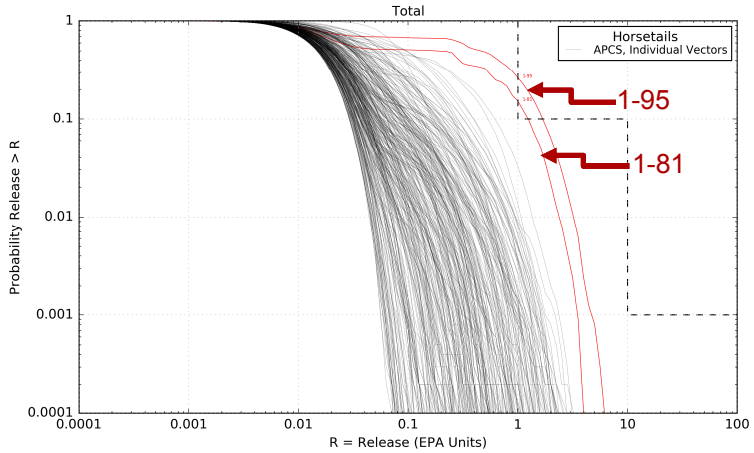
Item	Status
EPA to send DOE letter with comments on PCN for new shaft	Complete: 01/22/18 letter
Date and agenda for February technical exchange	Complete

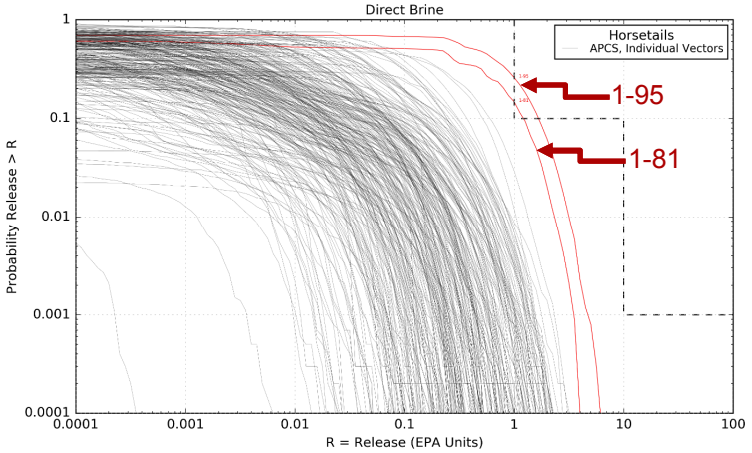
Item	Status
Analysis of two realizations that cross WIPP compliance boundary	Complete: 01/16/18 memo

- Realizations are for vectors 81 and 95 of replicate 1
- STEPWISE analysis indicates CASTILER:PRESSURE, GLOBAL:PBRINE, and SOLMOD3:SOLVAR as most important epistemic variables

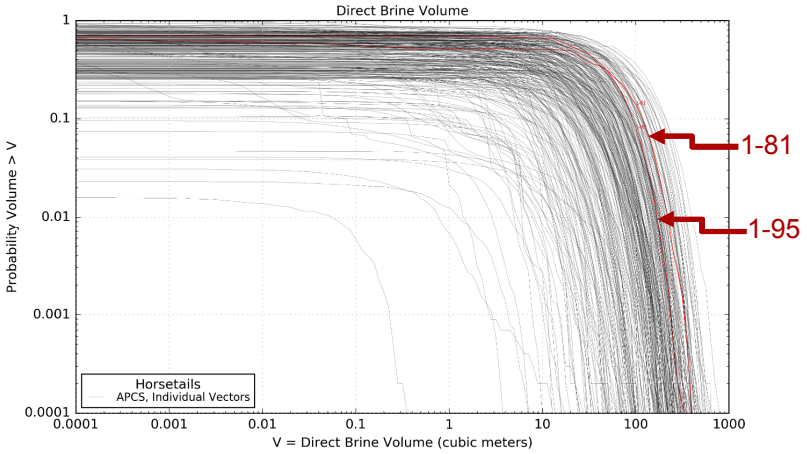
CASTILER:PRESSURE	Replicate	Vector	Value (Pa)	High-to-Low Order
Maximum	-	-	1.68E+07	1
Minimum	-	-	1.12E+07	300
	1	81	1.17E+07	290
	1	95	1.49E+07	50
SOLMOD3:SOLVAR	Replicate	Vector	Value	High-to-Low Order
Maximum	-	-	2.92	1
Minimum	-	-	-1.12	300
	1	81	2.35	10
	1	95	2.65	4
GLOBAL:PBRINE	Replicate	Vector	Value	High-to-Low Order
Maximum	-	-	0.55	1
Minimum	-	-	0.06	300
	1	81	0.25	146
	1	95	0.39	67

Item	Status
Analysis of two realizations that cross WIPP compliance boundary	Complete: 01/16/18 memo

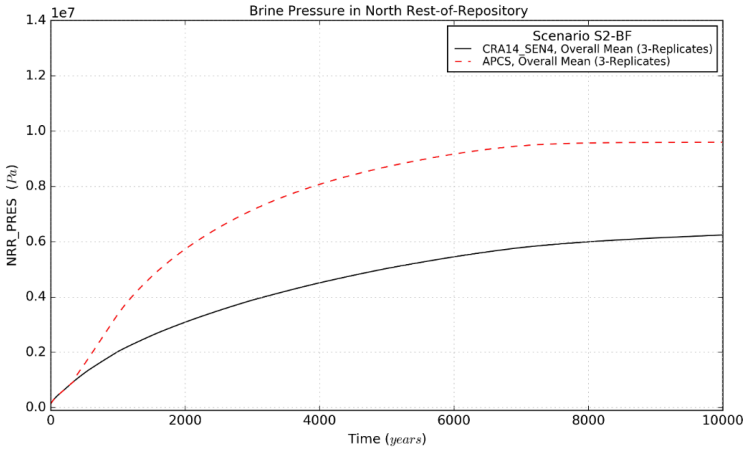


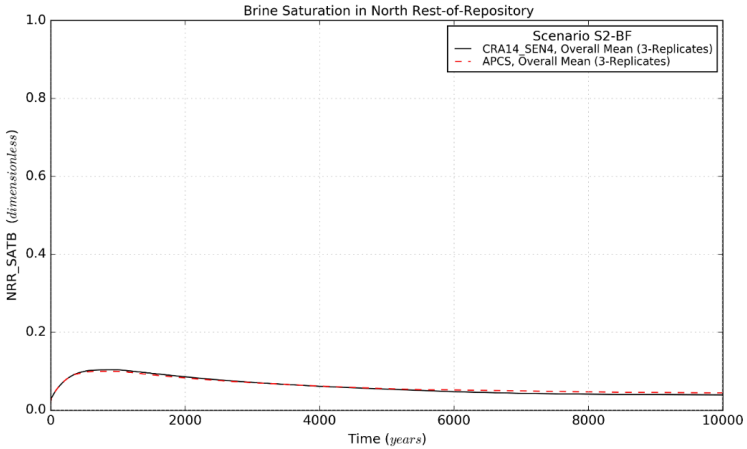


- R1V95 has lower DBR volume than R1V81
- R1V95 has higher solubility uncertainty multiplier than R1V81
- R1V95 has highest release



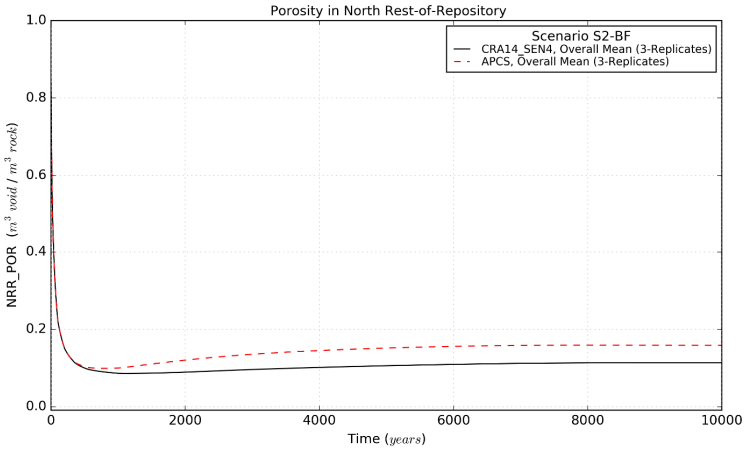
Item	Status
Analysis of saturation vs pressure in North Rest-of-Repository	Complete: 01/16/18 memo

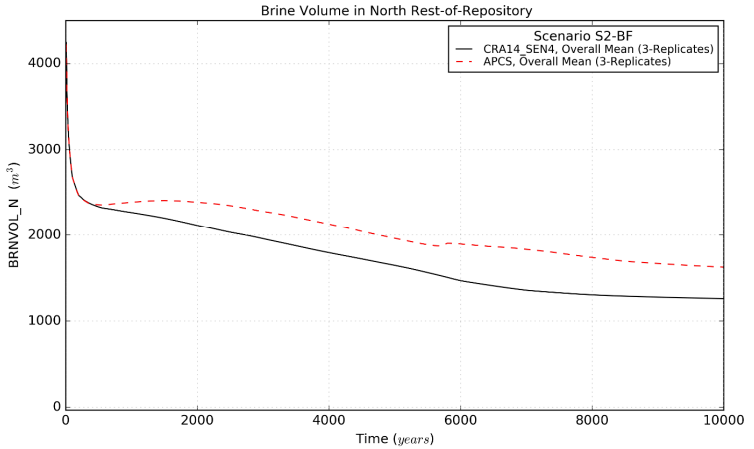




- Why is brine saturation not decreasing under the influence of increased gas flow to the north and an associated increase in brine pressure?
- Answer is due to the effect of gas/brine pressure that results in an increase in porosity due to reversal of creep-closure

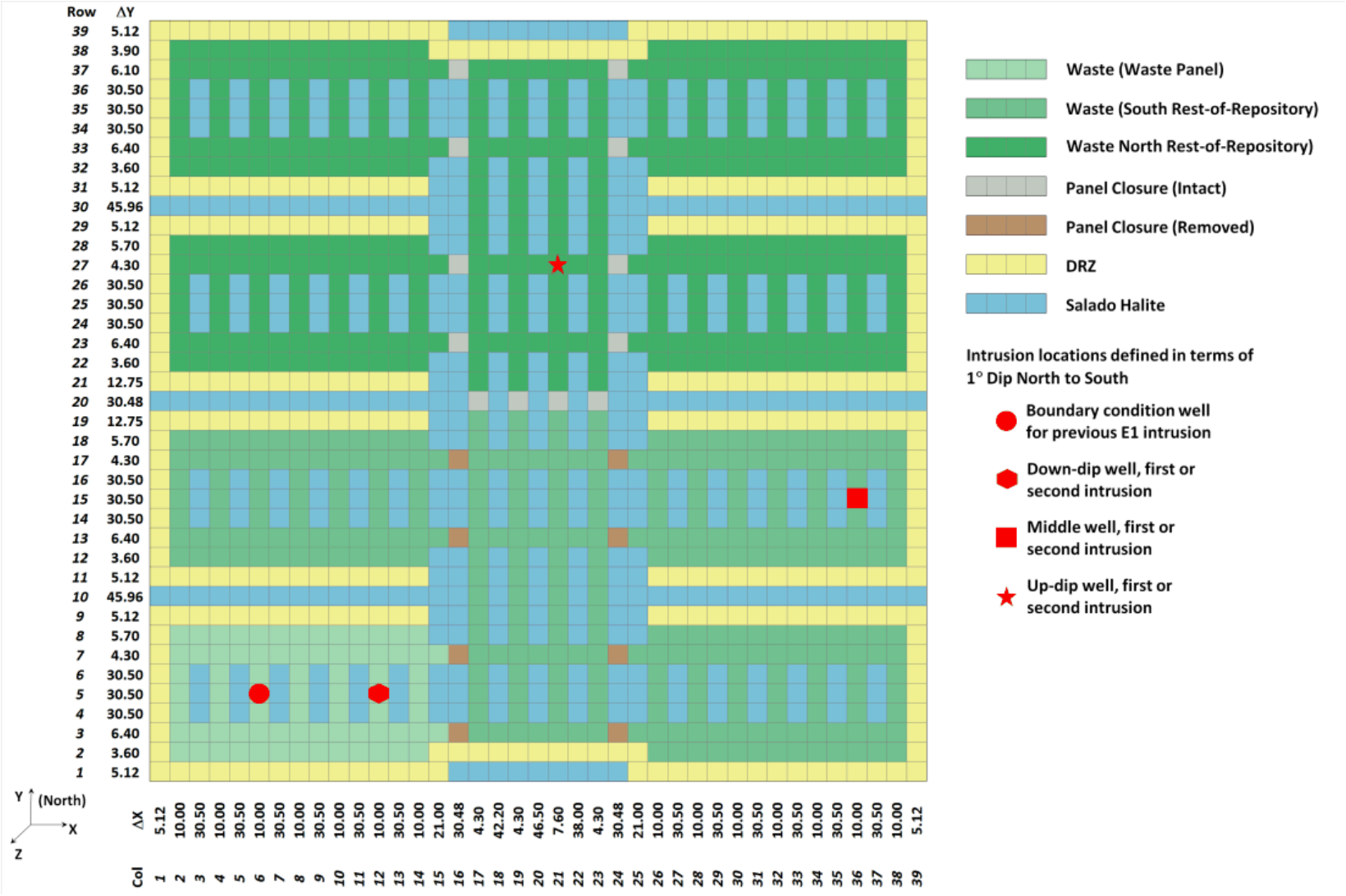
Item	Status
Analysis of saturation vs pressure in North Rest-of-Repository	Complete: 01/16/18 memo



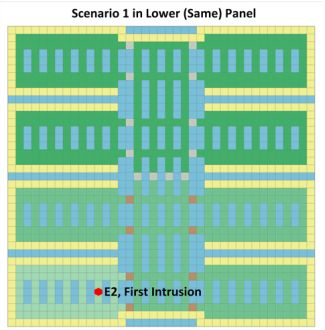


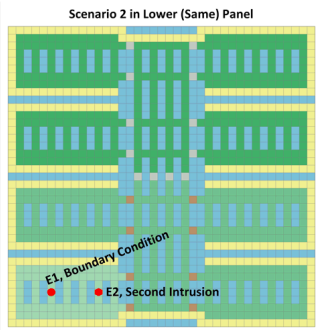
- Gas flow into the NRoR does not necessitate a reduction in brine saturation because there is additional pore space made available by the pressure-induced reversal of creep closure within the NRoR under APCS to accommodate additional brine and gas

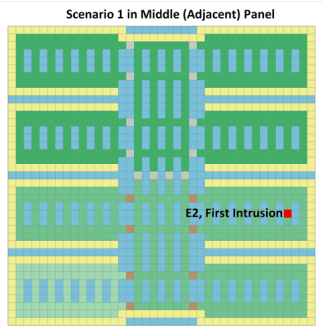
Item	Status
Analysis of timing and presence of borehole intrusions for BRAGFLO_DBR	Complete: 01/16/18 memo

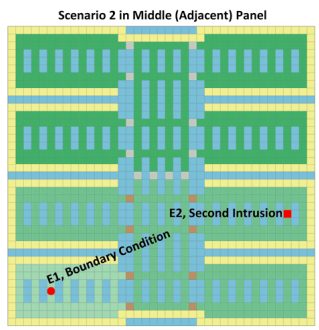


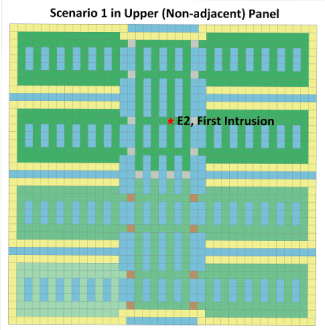
Item	Status
Analysis of timing and presence of borehole intrusions for BRAGFLO_DBR	Complete: 01/16/18 memo

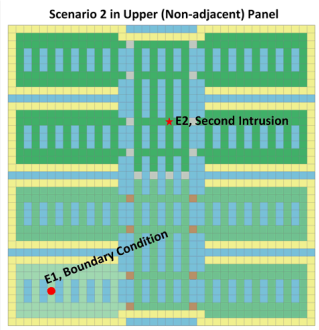












- Initial conditions for the DBR simulation are taken from the corresponding BRAGFLO Salado flow solution at the time of the latest intrusion
- Total number of DBR analyses for a full PA is equal to 26 scenario/time combinations x 3 locations x 300 realizations = 23,400
- Pressure-based boundary condition well simulates continued communication with Castile for Scenarios 2/3

Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
E0 followed by E2 at t_1 = 100 yr E2 at t_1 = 350 yr E2 at t_1 = 1000 yr E2 at t_1 = 3000 yr E2 at t_1 = 5000 yr E2 at t_1 = 10000 yr	E1 at t_1 = 350 yr followed by E2 at t_2 = 550 yr E2 at t_2 = 750 yr E2 at t_2 = 2000 yr E2 at t_2 = 4000 yr E2 at t_2 = 10000 yr	E1 at t_1 = 1000 yr followed by E2 at t_2 = 1200 yr E2 at t_2 = 1400 yr E2 at t_2 = 3000 yr E2 at t_2 = 5000 yr E2 at t_2 = 10000 yr	E2 at t_1 = 350 yr followed by E2 at t_2 = 550 yr E2 at t_2 = 750 yr E2 at t_2 = 2000 yr E2 at t_2 = 4000 yr E2 at t_2 = 10000 yr	E2 at t_1 = 1000 yr followed by E2 at t_2 = 1200 yr E2 at t_2 = 1400 yr E2 at t_2 = 3000 yr E2 at t_2 = 5000 yr E2 at t_2 = 10000 yr

APCS_NT Objective

- Quantitatively assess the SNL assertion that radionuclide releases from WIPP are bounded by the APCS treatment of abandoned panel closure and operations and experimental areas as "open" by alternatively assessing the postulate that these areas are "healed" to essentially intact Halite at time = 0 yr
  - "open"
    - permeability = 1×10^{-11} m^2
    - porosity = 18%
  - "healed" operations and experimental areas
    - permeability = 9.9×10^{-21} to 1.0×10^{-23}
    - porosity = 0.88 to 5.93%
  - "healed" abandoned panel closure areas
    - permeability = 9.9×10^{-22} to 1.0×10^{-24}
    - porosity = 0.11 to 5.16%
- Non-QA'd calculation based on previously QA'd input decks/parameters for CRA14_SEN3 and CRA14_SEN4/APCS

APCS_NT Methodology

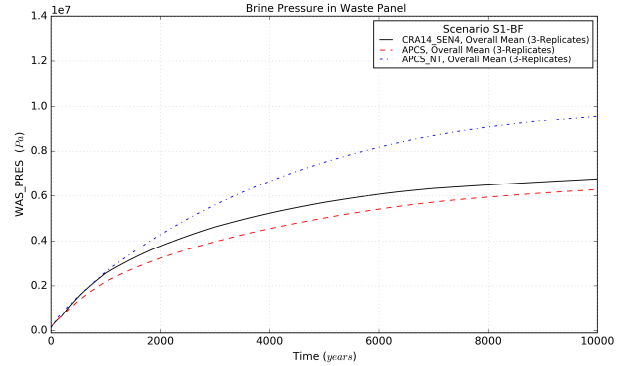
- Input Parameters
  - Flow material parameters from CRA14_SEN3
  - Release-enhancing parameters from CRA14_SEN4 (same as APCS)
    - GLOBAL:PBRINE, SOLMOD3:SOLVAR, SOLMOD4:SOLVAR, BOREHOLE:TAUFAIL, REFCON:STCO_3*, REFCON:STCO_4*
- BRAGFLO/BRAGFLO_DBR
  - ROMPCS modeled the same as for CRA14_SEN3 (near intact Halite from time=0 yr)
  - Operations and Experimental areas modeled the same as for CRA14_SEN3 (near intact Halite from time=0yr)
  - Abandoned panel closure areas modeled with flow material parameters equal to ROMPCS
- CCDFGF
  - Use updated neighbor relationships to associate panels separated by either installed ROMPCS or healed panel closure areas

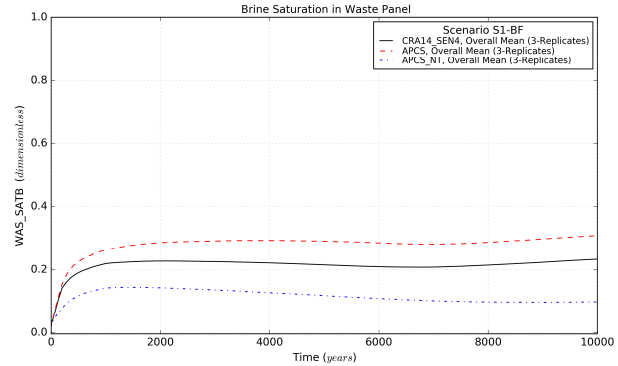
Pressure/Saturation for S1-BF

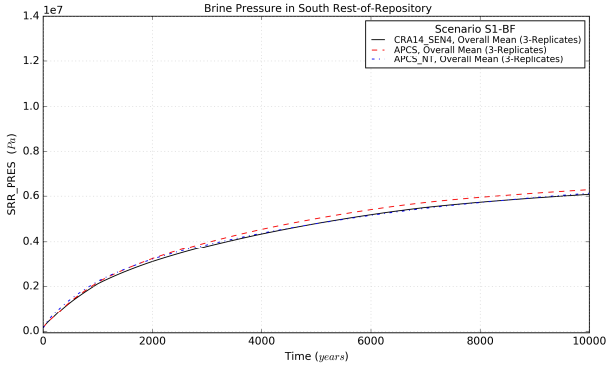
WP
(Panel 5)

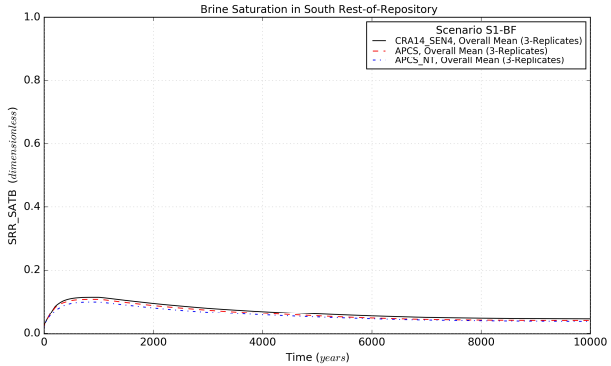
SROR
(Panels 3, 4, 6, 9)

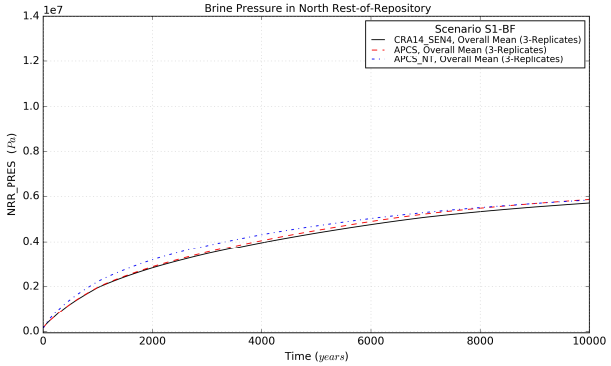
NROR
(Panels 1, 2, 7, 8, 10)

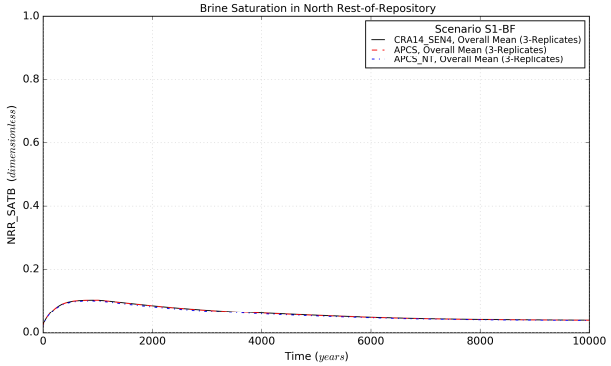










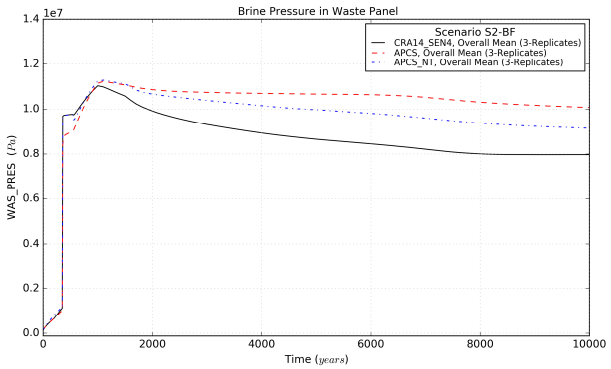


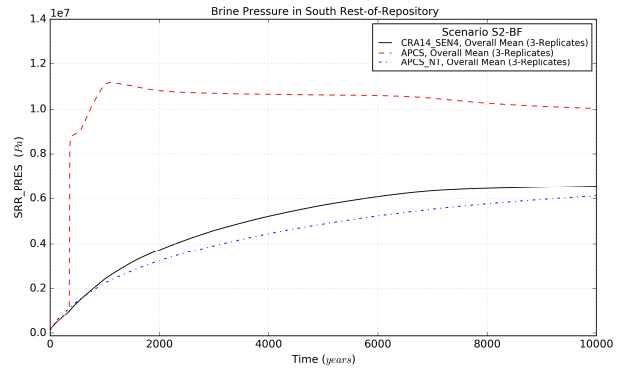
Pressure/Saturation for S2-BF

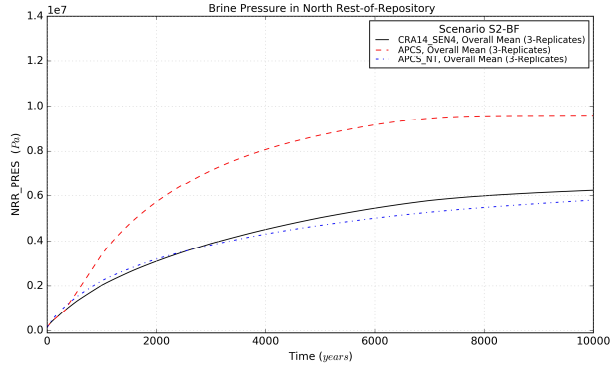
WP
(Panel 5)

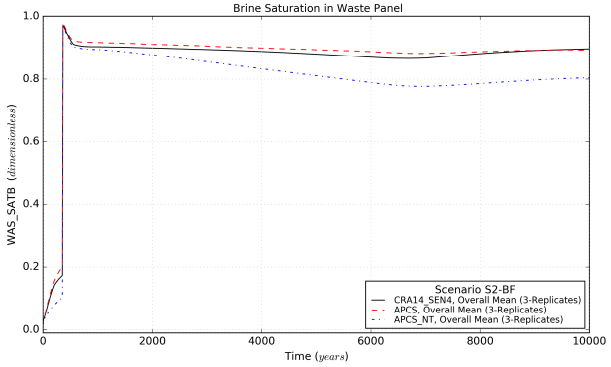
SROR
(Panels 3, 4, 6, 9)

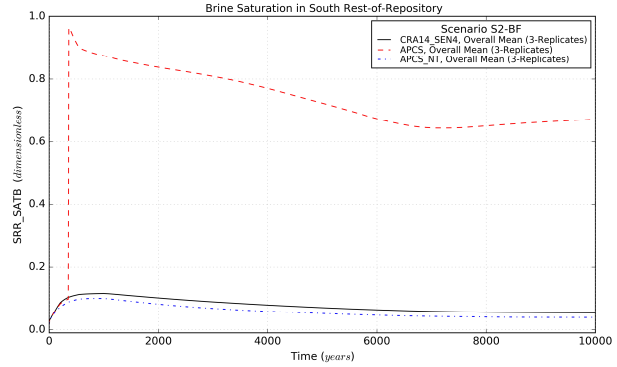
NROR
(Panels 1, 2, 7, 8, 10)

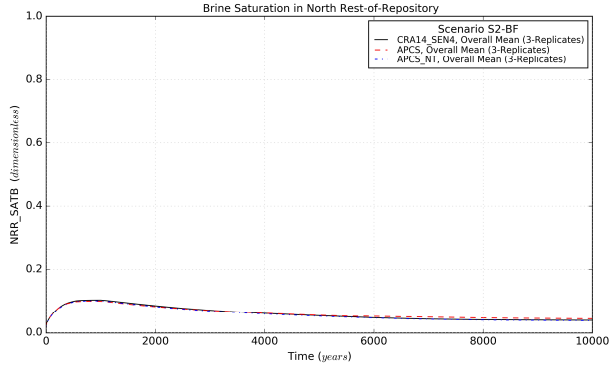




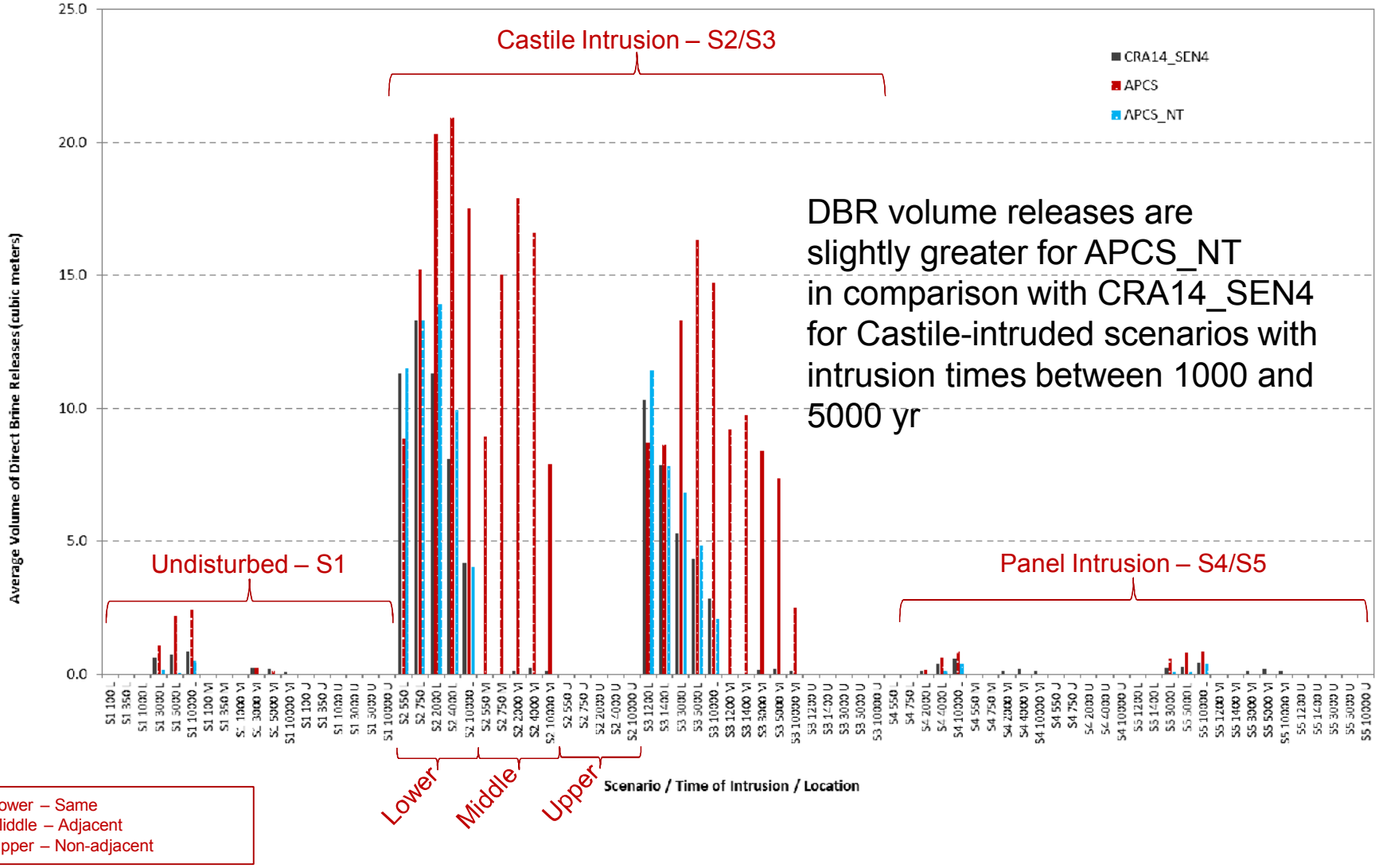






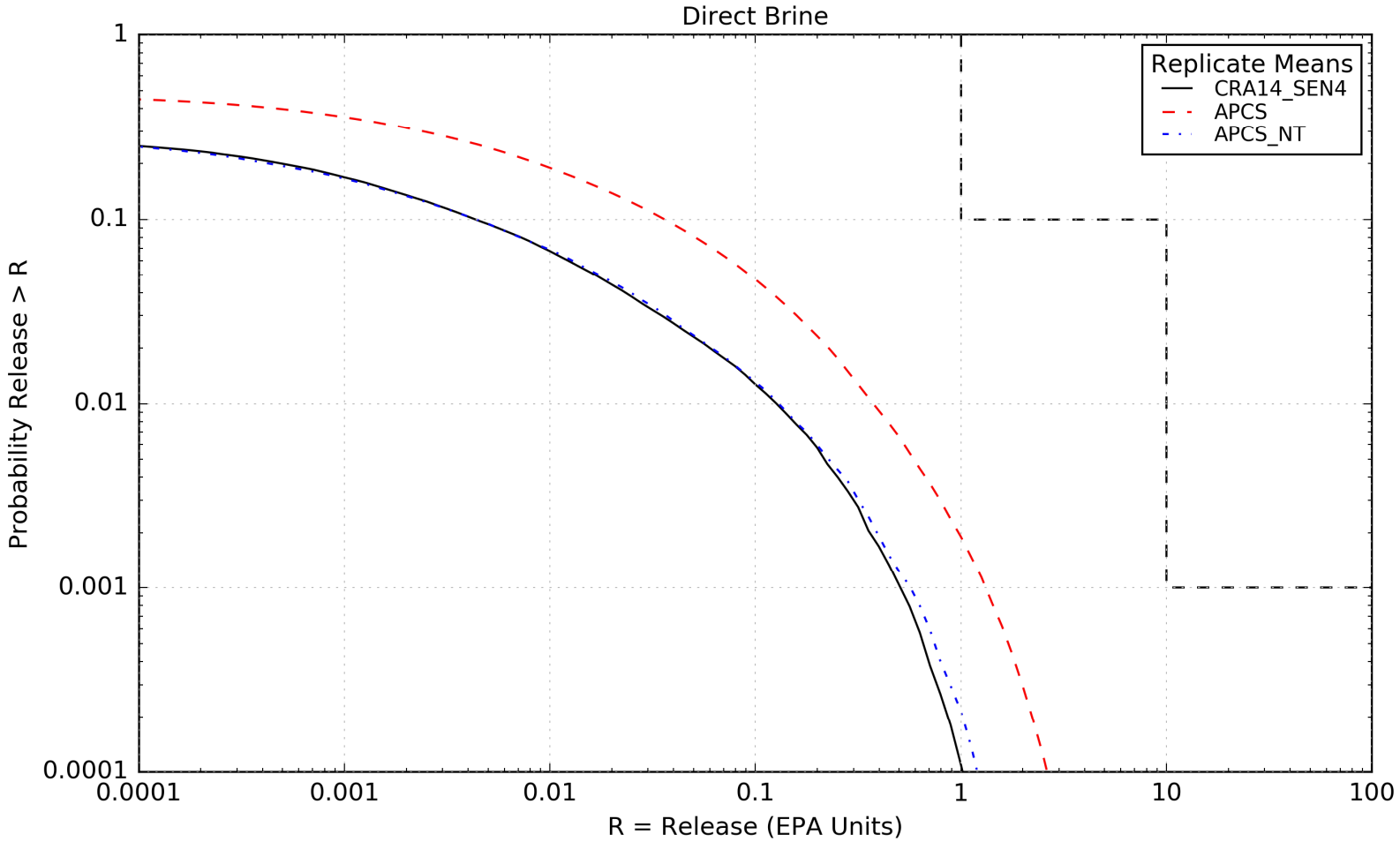


Volume of DBR by Scn, Tim, Loc



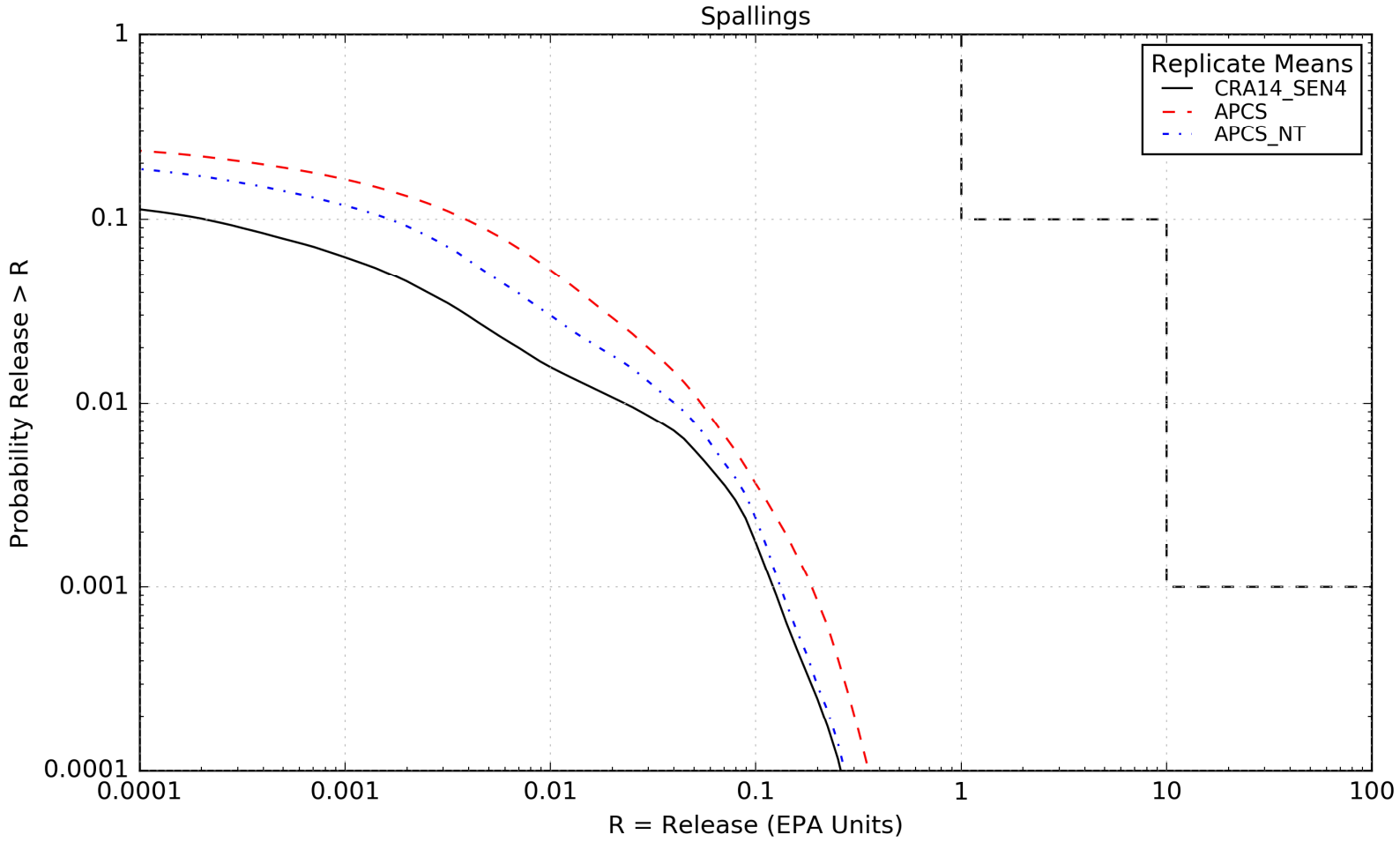
Lower – Same
Middle – Adjacent
Upper – Non-adjacent

Direct Brine Releases



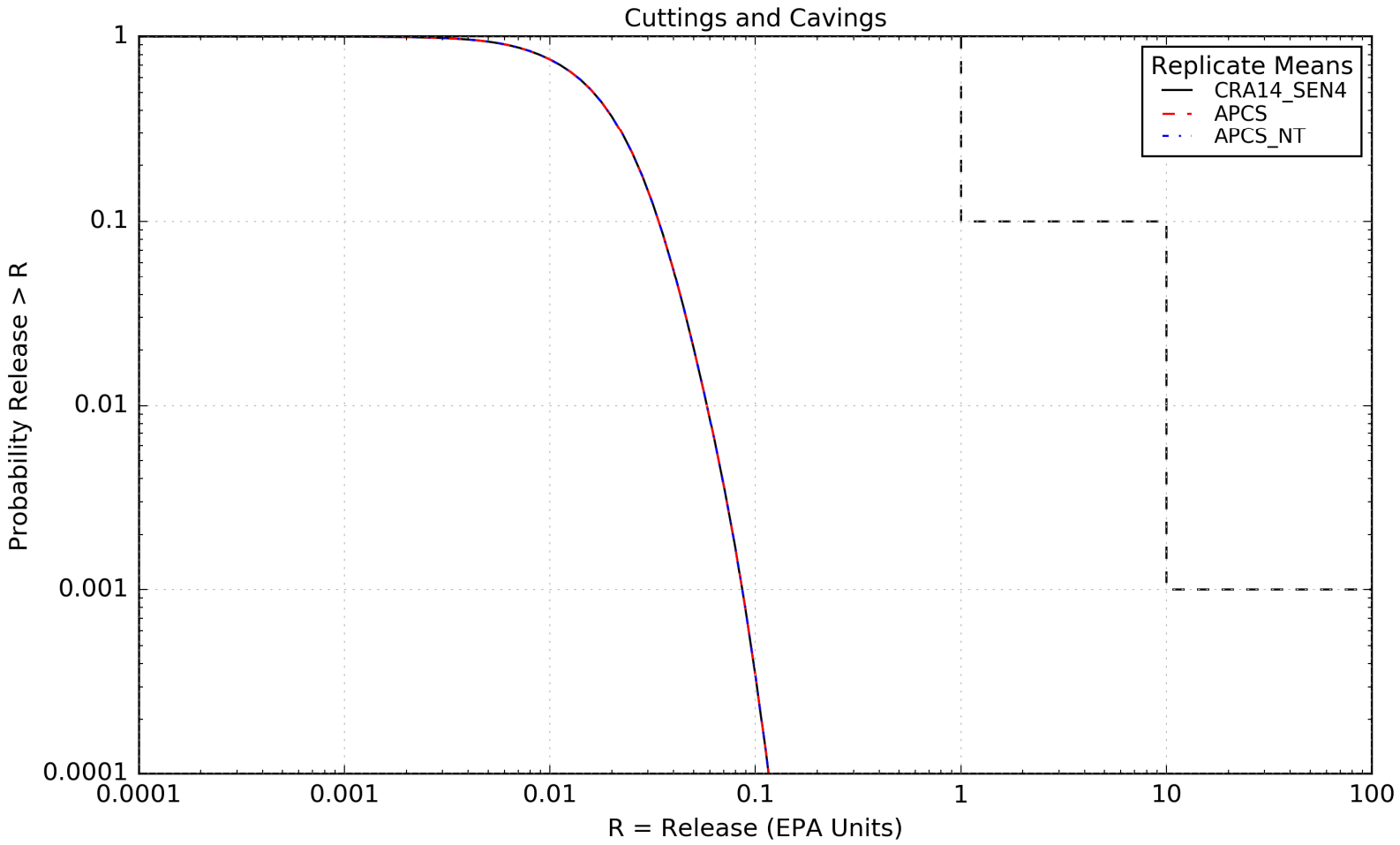
APCS_NT essentially equivalent to CRA14_SEN4 due to increased brine pressure impacts on DBR being attenuated by decreased brine saturation

Spallings Releases



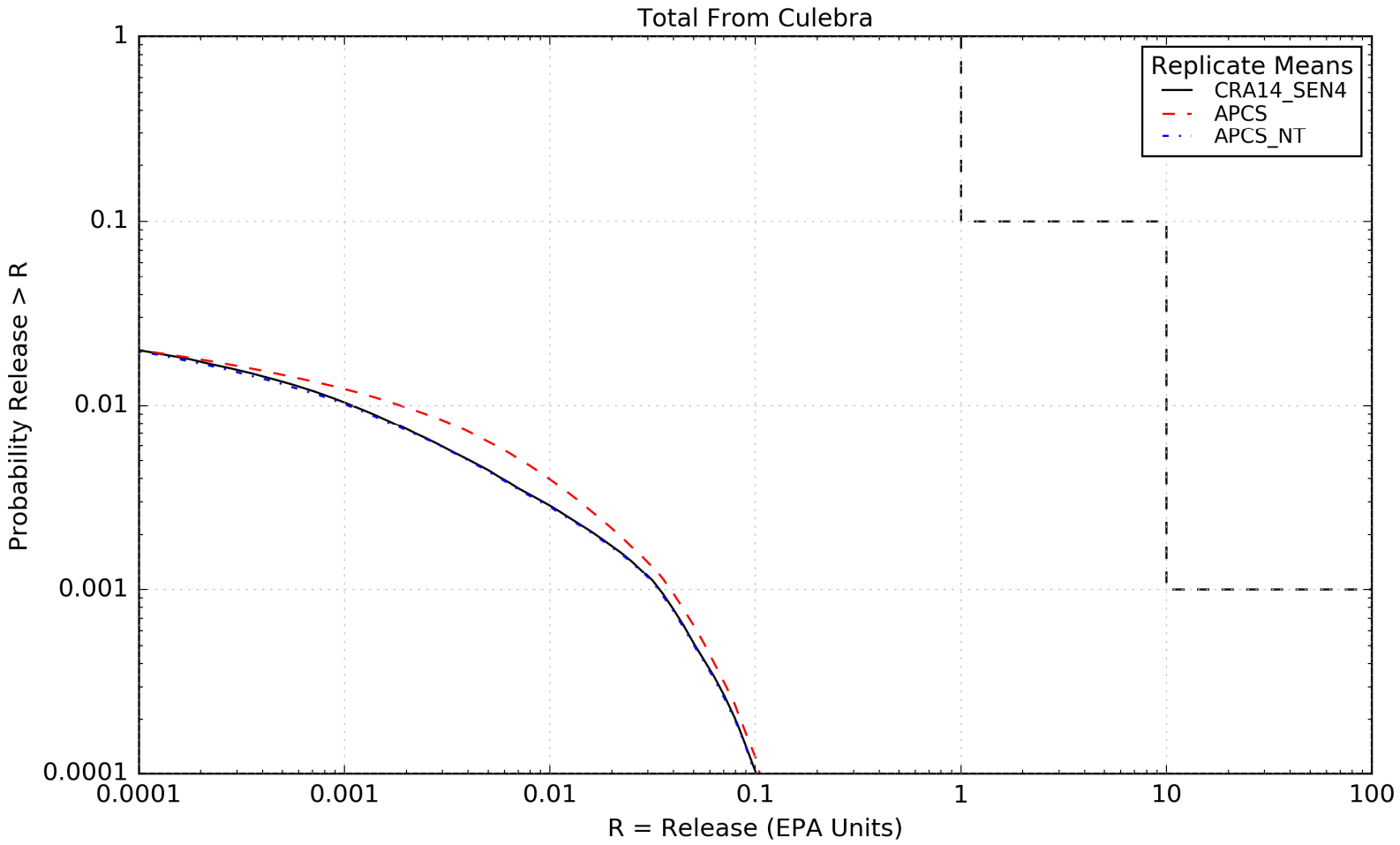
APCS_NT slightly increased over CRA14_SEN4 due to isolation of WP and decrease in void space in the OPS/EXP that increases pressure in WP

Cuttings and Cavings Releases



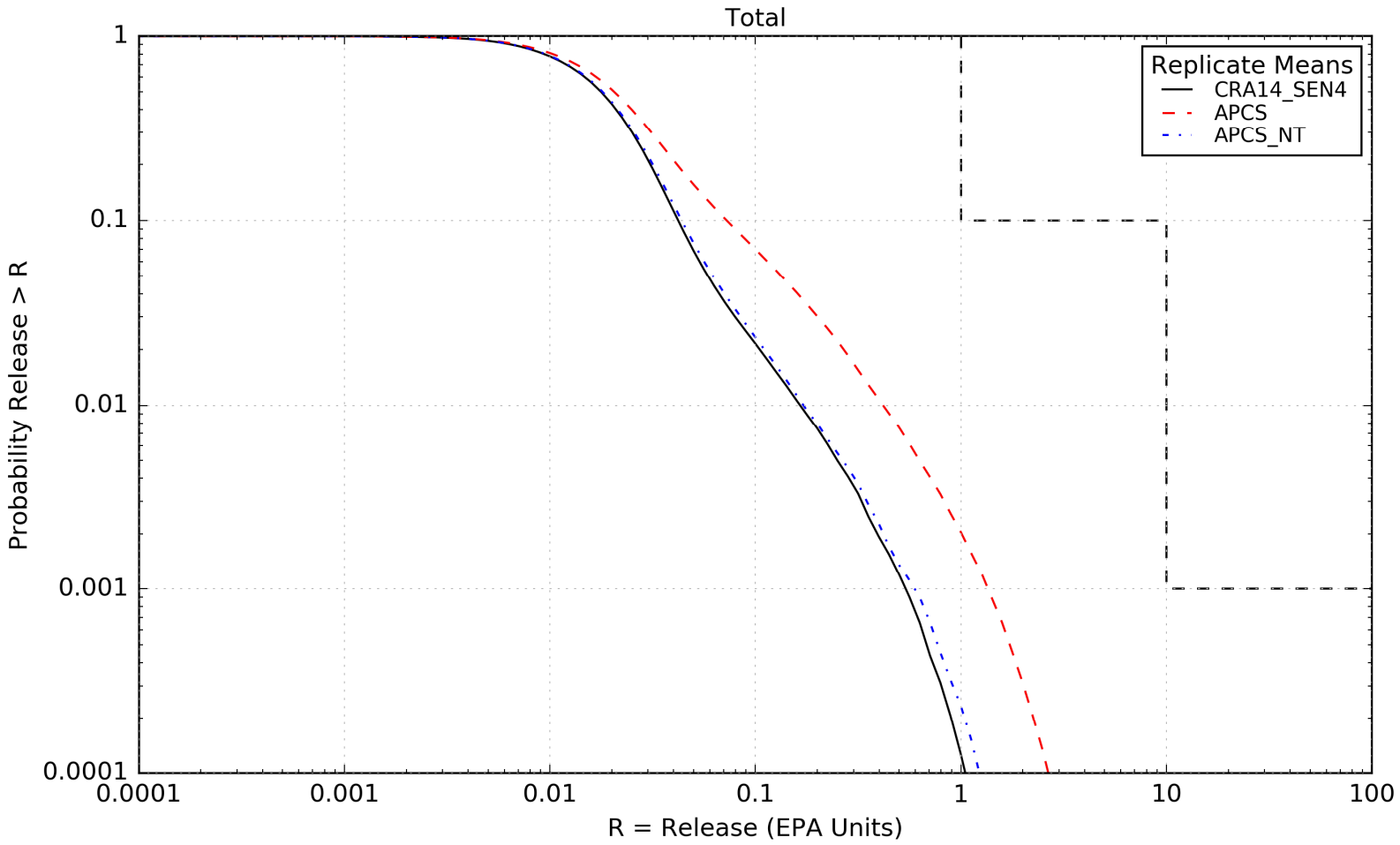
No change – independent of Salado flow solution

Total from Culebra Releases



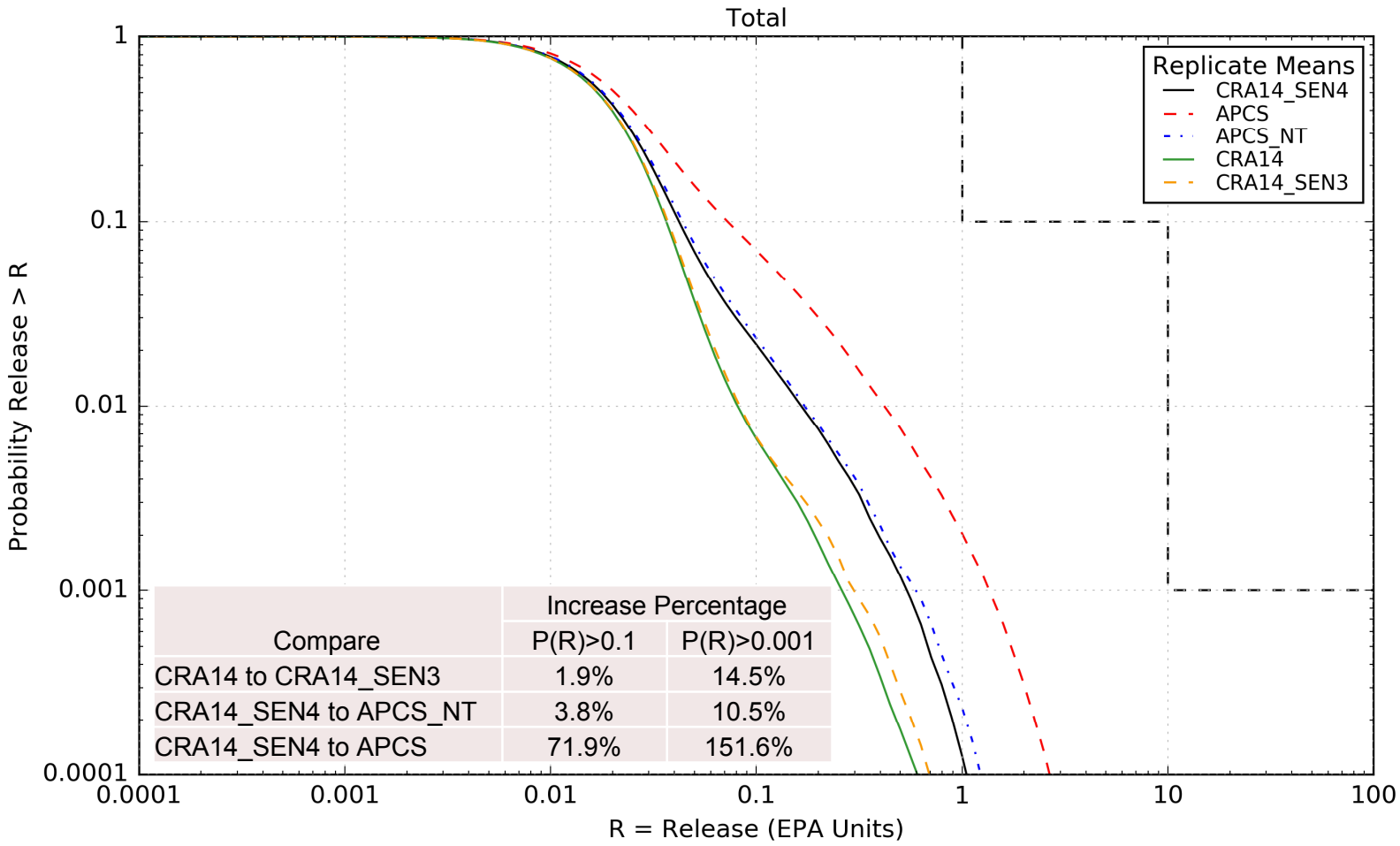
APCS_NT effectively the same as CRA14_SEN4 due to no change to flow up the borehole

Total Release Comparisons



Modeling APCS with “tight” open areas (i.e, APCS_NT) predicts releases essentially equivalent to CRA14_SEN4

Overall Total Release Comparisons



Compare	Increase Percentage	
	P(R)>0.1	P(R)>0.001
CRA14 to CRA14_SEN3	1.9%	14.5%
CRA14_SEN4 to APCS_NT	3.8%	10.5%
CRA14_SEN4 to APCS	71.9%	151.6%

Effect of modeling open areas as “tight” is not bounding of releases and increase from CRA14 to CRA14_SEN3 is very similar to CRA14_SEN4 to APCS_NT

APCS_NT Summary/Conclusions

- The marginal impact on releases from using essentially intact Halite properties for healed open areas was previously understood from comparisons between CRA14 and CRA14_SEN3
  - Slight increases (<15%) were observed due to associated increases in Spallings and DBR releases due to higher waste panel brine pressures and lower waste panel brine saturations
- The APCS_NT analysis reaffirms the trend against CRA14_SEN4 and further validates the assertion that the APCS methodology is an appropriately bounding representation of the repository that addresses no panel closures in Panels 3, 4, 5, and 6 and no waste in Panel 9 (that could be located in a new panel to the north)
- Modeling abandoned panel closures and operations/experimental areas of the repository as “open” should be maintained for CRA-2019