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Changes, Approach, and Results for the CRA-2014 PA

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Recap from November 2012

The CRA-2014 PA was the focus of an EPA tech exchange on November 14-15, 2012.

<u>Highlights of that exchange:</u>

- A number of changes/refinements are included in the CRA-2014 PA (e.g. incorporate new data and experimental results).
- Changes are made with the aim of increasing credibility, defensibility, and accuracy of WIPP PA.

"Standard" Updates Included in the CRA-2014 PA

- Drilling Rate
- Plugging Pattern Probabilities
- Inventory
  - Radionuclides
  - Waste Materials
  - Organics
- Radionuclide Solubilities and their Uncertainty

Planned Changes Included

ROMPCS (PCR)

- Option D PCS replaced with the ROMPCS Design

SDI (PCN)

- Additional Excavated Volume in WIPP North End

Parameter and Implementation Refinements Included in the CRA-2014 PA

- Steel Corrosion Rate
- Waste Shear Strength
- Probability of Brine Pocket Encounter during Drilling
- Radionuclide Concentration/Brine Volume Dependence
- Expanded Water Balance
- Colloid Enhancement Parameters (added since Nov. 2012)

ROMPCS

The ROMPCS is included in the CRA-2014 PA. Its implementation is slightly changed from that of the PCS-2012 PA.

- The minimum of PCS_T1:PRMX_LOG is increased from -21.0 log(m^2) to -20.84 log(m^2) so that the permeability of PCS_T1 is never lower than the minimum calculated for PCS_T2.

- The permeability of DRZ_PCS is not allowed to be greater than the permeability of DRZ_1.

Additional Excavation

The CRA-2014 PA includes additional mined volume in the repository north end.

- The added volume is included in the same fashion as was done in the SDI PCN impact assessment.

Drilling Rate

Parameter GLOBAL:LAMBDAD is used to represent the drilling rate in WIPP PA.

GLOBAL:LAMBDAD
($km^{-2}\ yr^{-1}$)

CRA-2009 PABC	CRA-2014 PA
5.98×10^{-3}	6.73×10^{-3}

Drilling rates and plugging patterns updated to reflect most recent Delaware Basin monitoring data (ERMS 559198).

Probability of Brine Pocket Encounter

Parameter GLOBAL:PBRINE is used to represent the probability of encountering pressurized brine during drilling.

GLOBAL:PBRINE

(none)

CRA-2009 PABC	CRA-2014 PA
Uniform Distribution	Normal Distribution
Minimum: 0.01	Minimum: 0.06
Mean: 0.305	Mean: 0.127
Maximum: 0.6	Maximum: 0.19

Parameter updated via a re-examination of TDEM data integrated with 20 years of brine pocket intrusion observations (ERMS 558724).

Steel Corrosion Rate

Parameter STEEL:CORRMCO2 represents the anoxic steel corrosion rate for brine-inundated steel in the absence of CO_2.

STEEL:CORRMCO2
(m/s)

CRA-2009 PABC	CRA-2014 PA
Uniform Distribution	Student Distribution
Minimum: 0.0	Minimum: 3.29×10^{-16}
Mean: 1.59×10^{-14}	Mean: 6.06×10^{-15}
Maximum: 3.17×10^{-14}	Maximum: 1.84×10^{-14}

Parameter updated using experimental data for steel corrosion rates obtained under WIPP-relevant conditions(ERMS 559077).

Waste Shear Strength

Parameter BOREHOLE:TAUFAIL represents the effective shear strength for erosion of WIPP waste.

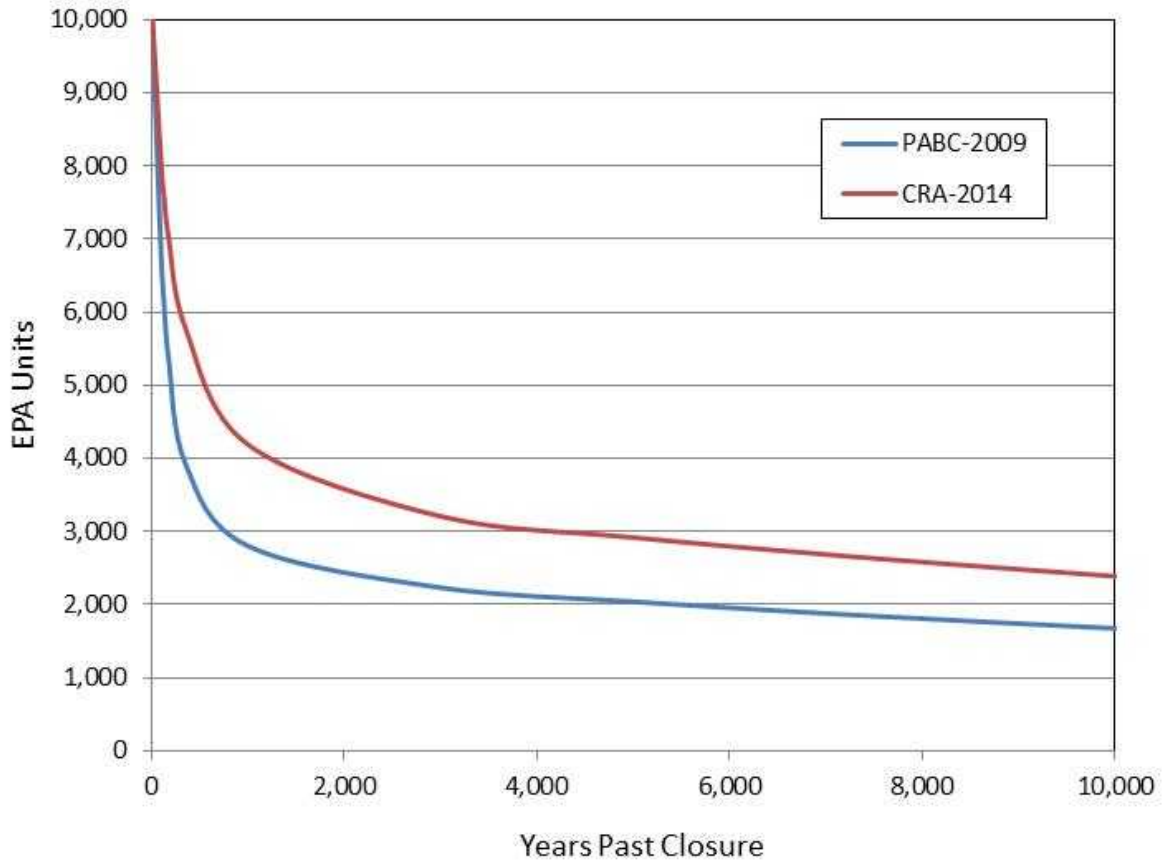
BOREHOLE:TAUFAIL
(Pa)

CRA-2009 PABC	CRA-2014 PA
Log-uniform Distribution	Uniform Distribution
Minimum: 0.05	Minimum: 2.22
Mean: 10.5	Mean: 39.61
Maximum: 77.0	Maximum: 77.0

Parameter updated using vertical flume experimental data for surrogate WIPP waste (ERMS 558479, 559081).

Waste Inventory

Inventory parameters in the CRA-2014 PA are updated to reflect information collected through December 31, 2011. (ERMS 559257)



Difference primarily due to increased ^{239}Pu in the CRA-2014 PA (ERMS 560065)

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Radionuclide Solubilities and their Uncertainty

Radionuclide baseline solubilities and their uncertainty are updated to reflect the CRA-2014 PA waste inventory.

- Organic ligand concentrations are calculated over a range of brine volumes (rather than a single volume) (ERMS 559005).
- Oxidation state III, IV, and V baseline actinide solubilities are calculated using the range of organic ligand concentrations
- (ERMS 559138).
- Solubility uncertainties are updated based on results in published literature (ERMS 559712).

Colloid Enhancement Parameters

Colloid parameters are updated in the CRA-2014 PA to incorporate recently available data.

- Colloid enhancement parameters were re-assessed and updated to reflect recent literature and more extensive WIPP-specific data (LCO-ACP-18, also in SNL WIPP records under ERMS 559200, 559205).

Water Budget Refinement

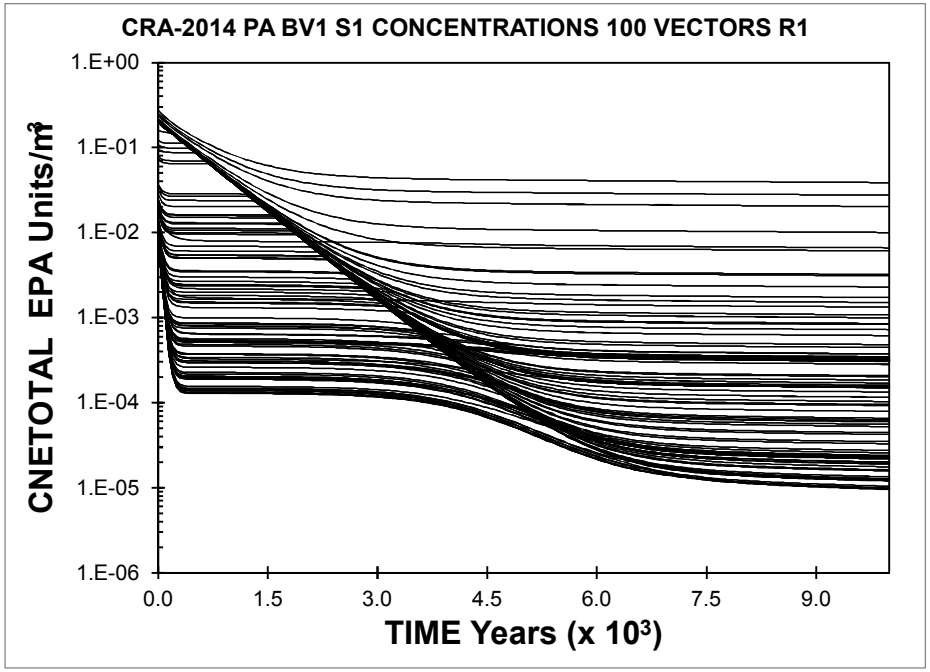
The repository water balance is refined to include MgO hydration.

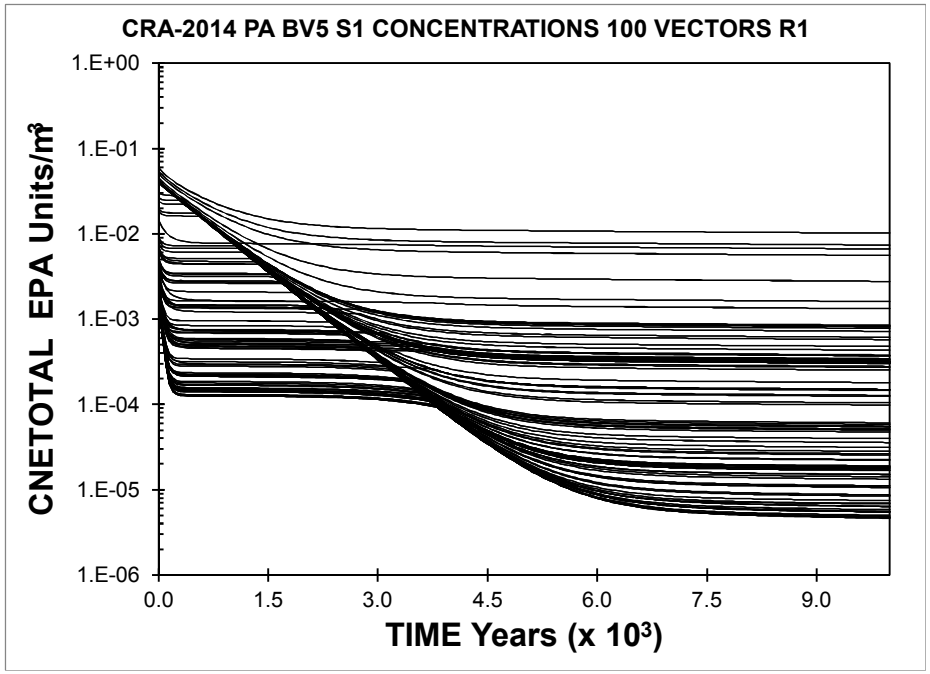
- MgO hydration consumes water and produces brucite.
- The carbonation of brucite forms hydromagnesite.
- Hydromagnesite dehydrates to form magnesite.

Repository water balance is refined to include the major gas and brine producing and consuming reactions in the existing conceptual model (ERMS 559466).

Radionuclide Concentration Dependence on Repository Brine Volume

Radionuclide concentrations in brine are dependent on the repository brine volume.





Radionuclide concentrations decrease as brine volumes increase.

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CRA-2014 PA Approach

CRA-2014 PA changes are included sequentially so that compliance impacts can be reasonably isolated.

The CRA-2014 PA is comprised of 4 cases:

Case CRA14-BL
(1 Replicate: R1)
Includes:
- ROMPCS
- SDI Volume
- Updated Inventory
- Updated Solubilities (Single Brine Volume)
- Updated Drilling Parameters
- Revised Colloid Factors

Case CRA14-TP
(1 Replicate: R1)
Includes CRA14-BL changes plus:
- TAUFAIL Update
- PBRINE Revision

Case CRA14-BV
(1 Replicate: R1)
Includes CRA14-TP changes plus:
- Brine Volume Dependence

Case CRA14-0
(3 Replicates)
Includes CRA14-BV changes plus:
- Steel Corrosion Update
- Water Budget

Case CRA14-0 includes all changes in the CRA-2014 PA, and is the "formal" compliance calculation.

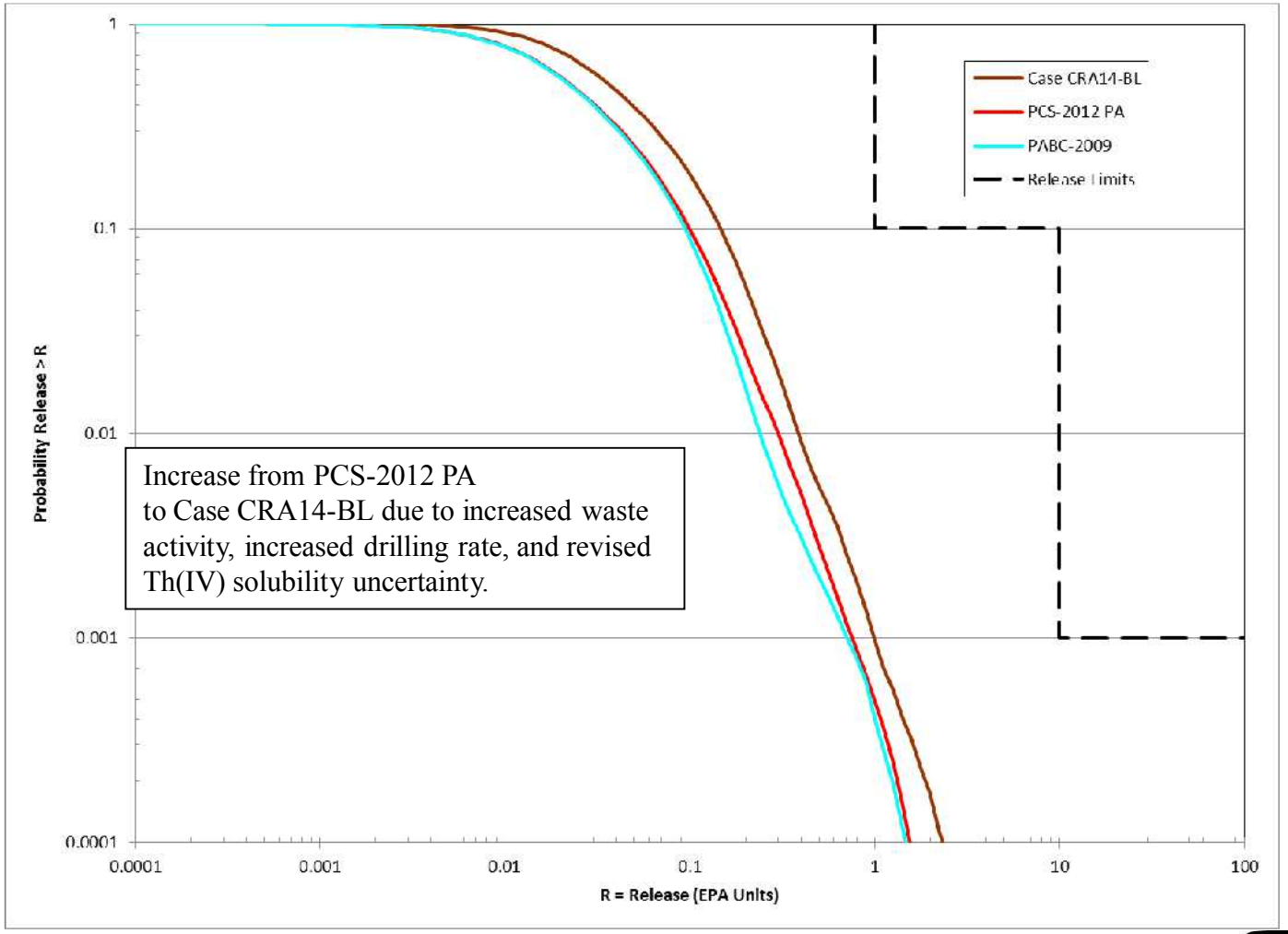
CRA-2014 PA Status

- Calculations are complete.
- Documentation of the PA is complete.
- Appendix PA is in the DOE review process.

PA Documentation Approach

- Results of the 4 CRA-2014 PA cases are discussed (as appropriate) in the individual analysis packages.
- The CRA-2014 PA summary report discusses results obtained when all changes are included in the PA.

Case CRA14-BL Results



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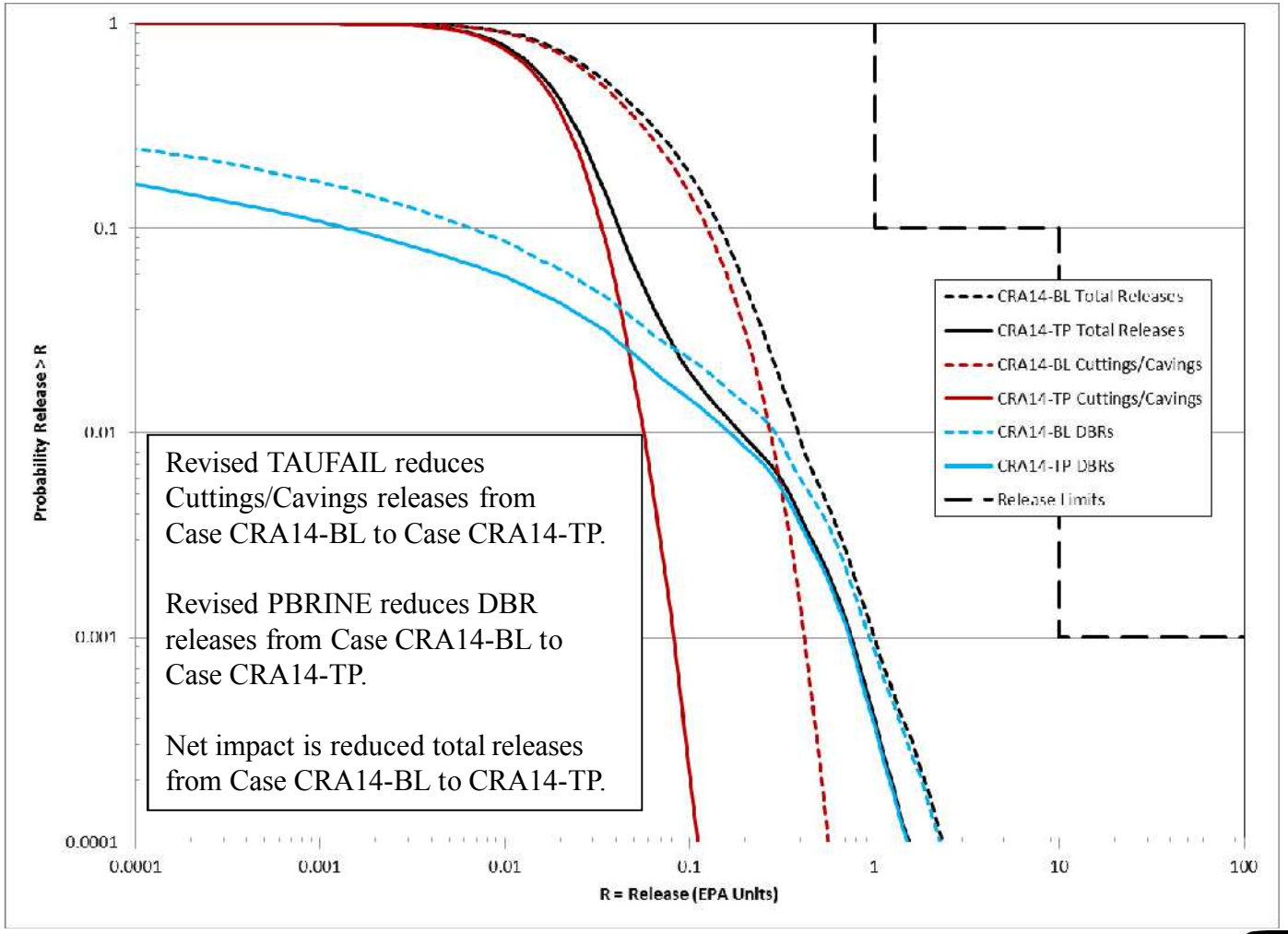
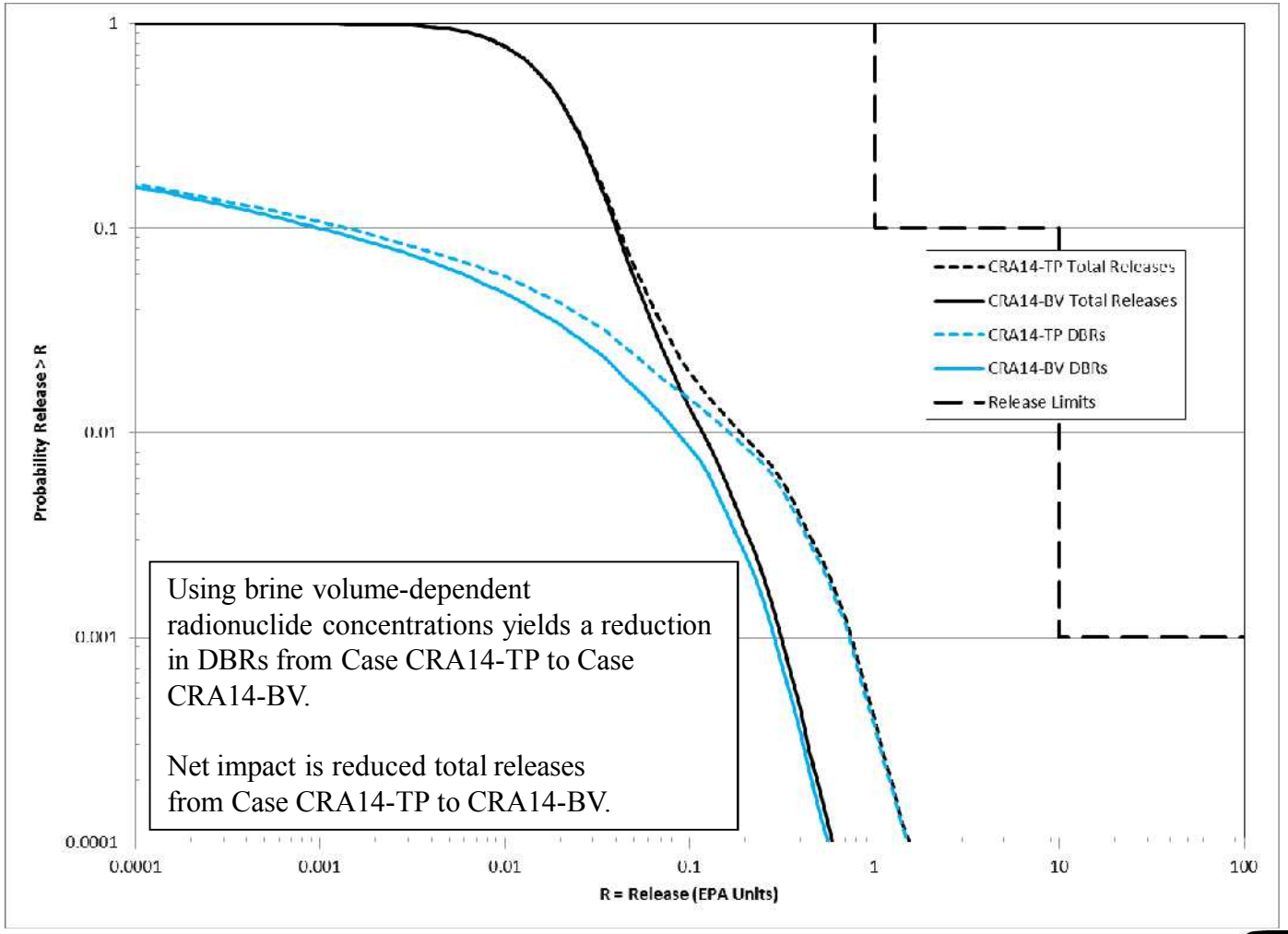
Case CRA14-TP Results



Case CRA14-BV Results



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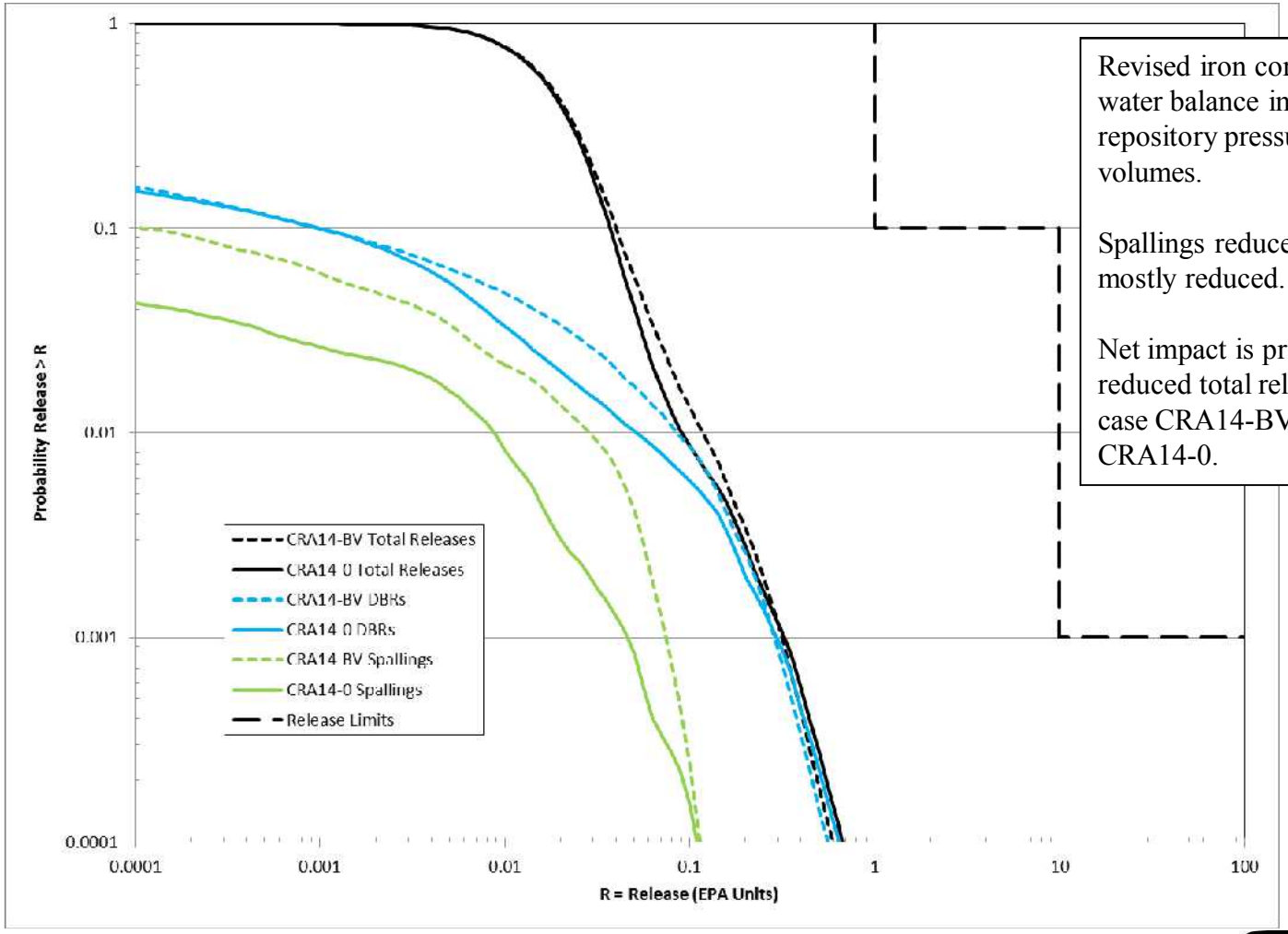
CRA14-0 Results



Revised iron corrosion and water balance impact repository pressures and brine volumes.

Spallings reduced, DBRs mostly reduced.

Net impact is primarily reduced total releases from case CRA14-BV to Case CRA14-0.

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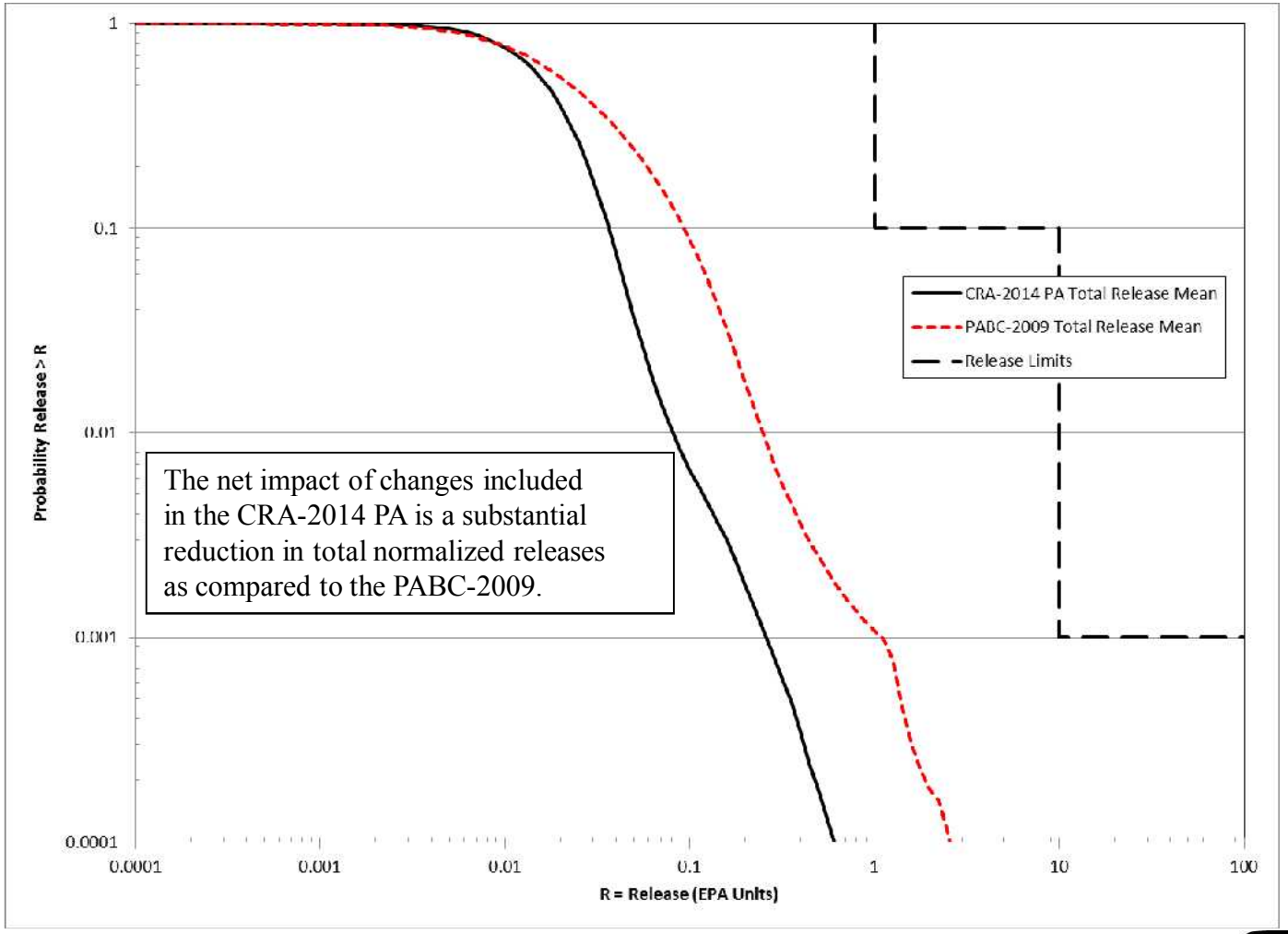
CRA-2014 PA Main Result



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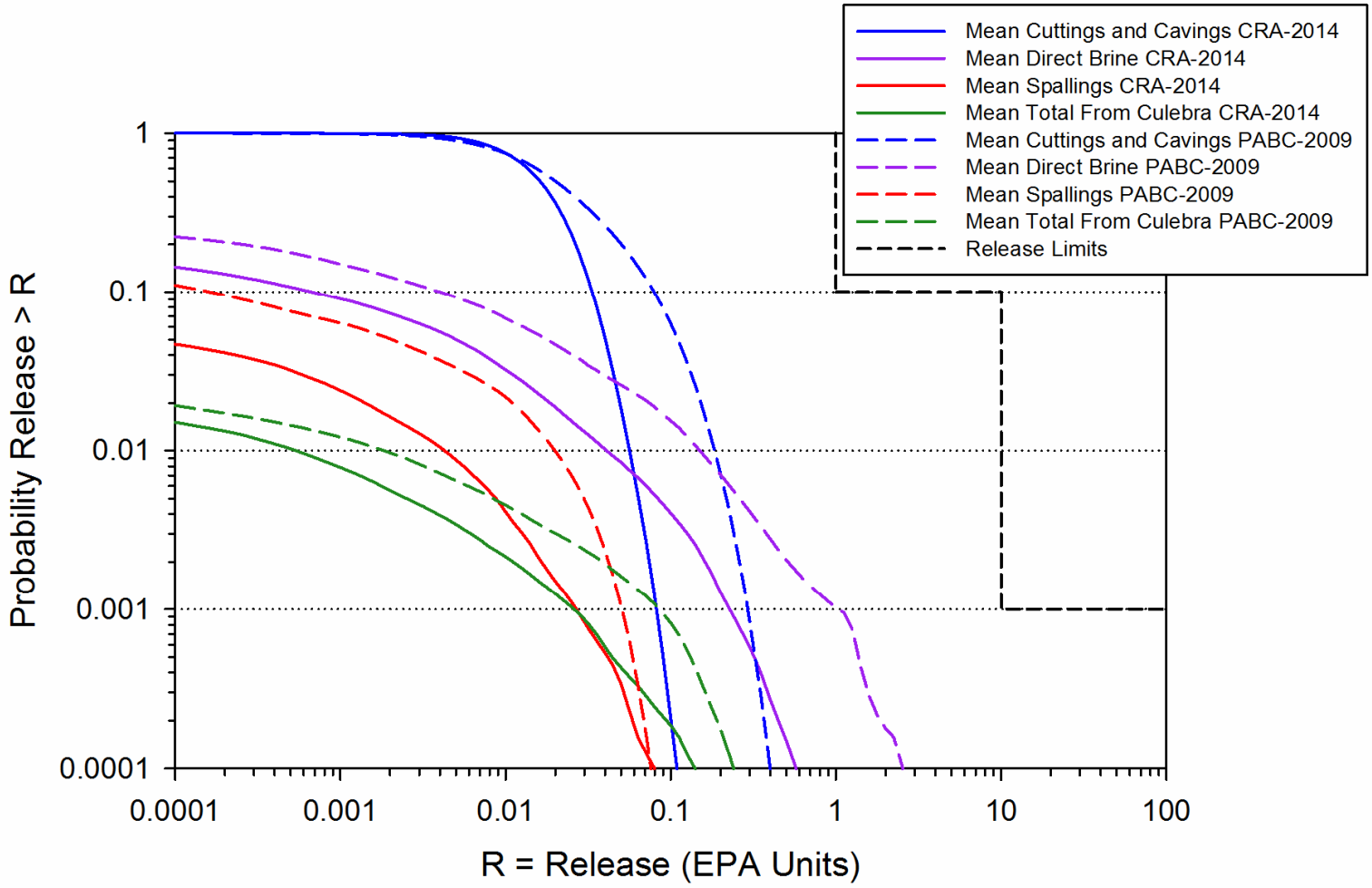
CRA-2014 PA Release Components



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Summary

- The CRA-2014 PA includes planned changes and numerous refinements/updates.
- Refinements were developed with the goal of increasing credibility, defensibility, and accuracy of WIPP PA.
- Changes are included sequentially so that compliance impacts can be reasonably isolated.
- Total normalized releases obtained in the CRA-2014 PA are less than those found in the PABC-2009.