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**Sandia National Laboratories**

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To: Sean Dunagan (6211)

From: Gregory Roselle (6212)

A handwritten signature in black ink, appearing to read 'Greg Roselle'.

*Technical Review:* Chris Camphouse

*QA Review:* Steve Davis

Subject: Summary of colloid parameters to be implemented in the CRA-2014 PA

The DOE/CBFO Recertification Project Manager, Russ Patterson, has directed the Sandia National Laboratories Carlsbad Office to implement colloid parameter changes based on data presented in Los Alamos National Laboratory Report LCO-ACP-18 "Intrinsic, Mineral and Microbial Colloid Enhancement Parameters for the WIPP Actinide Source Term" (Reed et al., 2013). A copy of that direction and the LANL report is available in the SNL WIPP Records Center under ERMS 559200.

A summary of the recommended parameter updates for the properties CONCINT, PROPMIC and CAPMIC are provided below in Tables 1, 2, and 3, respectively. The parameter values to be utilized in the CRA-2014 PA are contained in Tables 1 and 3 of Reed et al. (2013). Copies of these tables from Reed et al. (2013) are included as an attachment to this memo.

It should be noted that Reed et al. (2013) suggested microbial parameter values (CAPMIC and PROPMIC) for both archaea and bacteria. They state that the archaea are expected to predominate in the WIPP near-field (Salado) and the bacteria in the far-field (Culebra). However, the WIPP PA model only allows for a single set of microbial colloid parameters. Thus, for the CRA-2014 PA Sandia National Laboratories has opted to use the more conservative bacteria values from Table 3 in Reed et al. (2013).

WIPP:1.2.5:PA:QA-L:559199

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**Table 1: Recommended Parameter Updates for the Property CONCINT to be used in the CRA-2014 PA**

Material	Units	Description	Distribution Type	Value	Source
AM	moles/liter	Americium	Constant	$4 \times 10^{-9}$	Reed et al. Table 1
NP	moles/liter	Neptunium	Constant	$2 \times 10^{-8}$	Reed et al. Table 1
PU	moles/liter	Plutonium	Constant	$2 \times 10^{-8}$	Reed et al. Table 1
TH	moles/liter	Thorium	Constant	$2 \times 10^{-8}$	Reed et al. Table 1
U	moles/liter	Uranium	Constant	$3 \times 10^{-8}$	Reed et al. Table 1

**Table 2: Recommended Parameter Updates for the Property PROPMIC to be used in the CRA-2014 PA**

Material	Units	Description	Distribution Type	Value	Source
AM	none	Americium	Constant	0.32	Reed et al. Table 3
NP	none	Neptunium	Constant	1.76	Reed et al. Table 3
PU	none	Plutonium	Constant	1.76	Reed et al. Table 3
TH	none	Thorium	Constant	1.76	Reed et al. Table 3
U	none	Uranium	Constant	1.76	Reed et al. Table 3

**Table 3: Recommended Parameter Updates for the Property CAPMIC to be used in the CRA-2014 PA**

Material	Units	Description	Distribution Type	Value	Source
AM	moles/liter	Americium	Constant	$3.1 \times 10^{-8}$	Reed et al. Table 3
NP	moles/liter	Neptunium	Constant	$2.3 \times 10^{-6}$	Reed et al. Table 3
PU	moles/liter	Plutonium	Constant	$2.3 \times 10^{-6}$	Reed et al. Table 3
TH	moles/liter	Thorium	Constant	$2.3 \times 10^{-6}$	Reed et al. Table 3
U	moles/liter	Uranium	Constant	$2.3 \times 10^{-6}$	Reed et al. Table 3

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## **References**

Reed, D.J., J. Swanson, J.-F. Lucchini and M. Richman. 2013. Intrinsic, Mineral and Microbial Colloid Enhancement Parameters for the WIPP Actinide Source Term. LCO-ACP-18. Los Alamos Laboratory. Carlsbad, NM. ERMS 559200.

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Attachment:

Tables 1 and 3 from Reed et al. (2013)

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CCA. These experiments build on the more extensive understanding that we now have about the microbial ecology in the WIPP. Microbial colloid enhancement parameters based on these new data are recommended and these are, in general, more realistic and lead to a lower overall contribution of microorganisms on the actinide source term.

As a whole, the WIPP-specific data summarized in this report address the oft-stated concern by the regulator that there was a significant lack of WIPP-specific data on colloids at the time of the CCA. These data, although not complete, provide significant improvement in our understanding of the potential contribution of colloidal species to the actinide source term. Additionally, some inconsistencies between the known solution chemistry and literature observation are addressed. A summary of the updated parameters recommend are given in the following three Tables and are discussed more extensively within this report.

<b>Table 1 Summary of CRA-2009 and recommended/updated enhancement parameters for mineral and intrinsic colloids</b>					
<b>Actinide Oxidation State</b>	<b>Mineral Colloid Enhancement Parameter</b>		<b>Intrinsic Colloid Enhancement Parameter</b>		
	CRA-2009	Proposed	<sup>1</sup> CRA-2009	Proposed Oxidation-State Specific	<sup>2</sup> Proposed Element-Specific
Th(IV)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	0	2 x 10 <sup>-8</sup> M	2 x 10 <sup>-8</sup> M
U(IV)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	0	2 x 10 <sup>-8</sup> M	3 x 10 <sup>-8</sup> M
U(VI)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	0	3 x 10 <sup>-8</sup> M	
Np(IV)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	0	2 x 10 <sup>-8</sup> M	2 x 10 <sup>-8</sup> M
Np(V)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	0	ND	
Pu(III)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	1 x 10 <sup>-9</sup> M	4 x 10 <sup>-9</sup> M	2 x 10 <sup>-8</sup> M
Pu(IV)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	1 x 10 <sup>-9</sup> M	2 x 10 <sup>-8</sup> M	
Am(III)	2.6 x 10 <sup>-8</sup> M	2.6 x 10 <sup>-8</sup> M	0	4 x 10 <sup>-9</sup> M	4 x 10 <sup>-9</sup> M
1 - for CRA-2009, only plutonium intrinsic colloids are considered 2 - for the element-specific case, the highest value is proposed ND - not determined					

**Table 2 Summary of CRA-2009 and recommended/updated oxidation-state specific enhancement parameters for microbial colloids**

Actinide Oxidation State	PROPMIC			CAPMIC (M)		
	CRA-2009 (M)	Proposed (M)		CRA-2009	Proposed	
		Archaea	Bacteria		Archaea	Bacteria
Th(IV)	3.1	0.21	1.76	0.0019	3.8 E-8	2.3 E-6
U(IV)	0.0021	0.21	1.76	0.0021	3.8 E-8	2.3 E-6
U(VI)	0.0021	ND	ND	0.0021	ND	ND
Np(IV)	12	0.21	1.76	0.0027	3.8 E-8	2.3 E-6
Np(V)	12	ND	1.4	0.0027	ND	4 E-6
Pu(III)	0.3	0.05	0.32	6.8E-5	3.9 E-10	3.1 E-8
Pu(IV)	0.3	0.21	1.76	6.8E-5	3.8 E-8	2.3 E-6
Am(III)	3.6	0.05	0.32	1.0	3.9 E-10	3.1 E-8

ND – not determined, no new recommendation

**Table 3 Summary of CRA-2009 and recommended/updated element-specific enhancement parameters for microbial colloids**

Actinide Oxidation State	<sup>1</sup> PROPMIC			<sup>1</sup> CAPMIC (M)		
	CRA-2009 (M)	Proposed (M)		CRA-2009	Proposed (M)	
		Archaea	Bacteria		Archaea	Bacteria
Th(IV)	3.1	0.21	1.76	0.0019	3.8 E-8	2.3 E-6
U(IV)	0.0021	0.21	1.76	0.0021	3.8 E-8	2.3 E-6
U(VI)	0.0021			0.0021		
Np(IV)	12	0.21	1.76	0.0027	3.8 E-8	2.3 E-6
Np(V)	12			0.0027		
Pu(III)	0.3	0.21	1.76	6.8E-5	3.8 E-8	2.3 E-6
Pu(IV)	0.3			6.8E-5		
Am(III)	3.6	0.05	0.32	1.0	3.9 E-10	3.1 E-8

ND – not determined, no new recommendation

1 – highest value for a particular element is recommended for the element, this is extended to all oxidation states even if they are “ND”

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