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from: David Lord DL
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subject: Justification for particle diameter and shape factor used in DRSPALL

The purpose of this memo is to justify the definition of a constant value for the particle shape factor in the DRSPALL model in the Compliance Recertification Application (CRA) calculations. This represents a change from the Parameter Justification Report for DRSPALL (Hansen et al., 2003). Hansen et al. (2003) suggested the following:

Table 1. Shape factor and particle size suggested in Hansen et al (2003).

	Particle shape factor	Particle diameter
Units	none	m
Minimum	0.1	1.00E-03
Maximum	1.0	1.00E-01
Distribution	UNIFORM	LOGUNIFORM

The sensitivity study conducted for the spallings conceptual model peer review and documented in Lord and Rudeen (2003) reduced the sampling range for particle size as shown in Table 2. This was done because the problem geometry specified in Hansen et al (2003) defined a wellbore annulus that is only 0.05 m wide. As such, particles larger than 0.05m cannot transport up the wellbore. Constraining the particle size to a maximum of 0.01 m is not only physically reasonable, but also conservative with respect to releases because 0.01 m particles are easier to fluidize and spall than 0.05 m particles.

Table 2. Shape factor and particle size used in Lord and Rudeen (2003).

	Particle shape factor	Particle diameter
Units	none	m
Minimum	0.1	1.00E-03
Maximum	1.0	1.00E-02
Distribution	UNIFORM	UNIFORM

The shape factor and particle diameter appear in DRPSPALL exclusively as the product of both variables in the Ergun fluidization equation (WIPP PA, 2003). Therefore, the individual value of one is not as important as the product of the two. For simplicity in sampling for WIPP PA, we propose to hold one value constant, and vary the other in such a way that the product honors the original range of uncertainty explored during the peer review analysis, and remains conservative for releases relative to ranges specified in the Hansen et al (2003) report.

We intend to fix the shape factor at 0.1, and vary the particle diameter from 0.001 to 0.1m in a loguniform. distribution Using this approach, the product will range between 1.0E-4 and 1.0E-2m as it did in the peer review analysis (Lord and Rudeen, 2003), though it will require sampling of only one variable.

Table 3. Particle diameter and shape factor distributions for use in CRA.

	Particle shape factor	Particle diameter
Material Name	SPALLMOD	SPALLMOD
Variable Name	SHAPFAC	PARTDIAM
Units	none	m
Median	0.1	1.00E-02
Mean	N/A	1.00E-02
Minimum	N/A	1.00E-03
Maximum	N/A	1.00E-01
Distribution	CONSTANT	LOGUNIFORM

This work supports the objectives outlined in AP-096, Analysis Plan for Completion of the Spallings Model for WIPP Recertification.

References

Hansen, F.D., Pfeifle, T.W., Lord, D.L. 2003. *Parameter Justification Report for DRSPALL.* ERMS#531057. Carlsbad, NM: Sandia National Laboratories.

Lord, D.L., Rudeen, D.K. 2003. *Sensitivity Analysis Report - Parts I & II, DRSPALL version 1.00.* Report for Conceptual Model Peer Review Panel Convening July 7-11, 2003. Carlsbad, NM: Sandia National Laboratories.

WIPP PA, 2003. *Design Document for DRSPALL Version 1.00, document version 1.10.* ERMS# 529878. Carlsbad, NM: Sandia National Laboratories