the drift walls. Six quasi-static calculations of drift degradation with increased tessellated domain were carried out for different average block sizes (0.2 and 0.3 m) and block geometry realizations. The geometry used in one of the simulations (0.2-m average block size), indicating the size of the original tessellated domain, is shown in Figure 7.

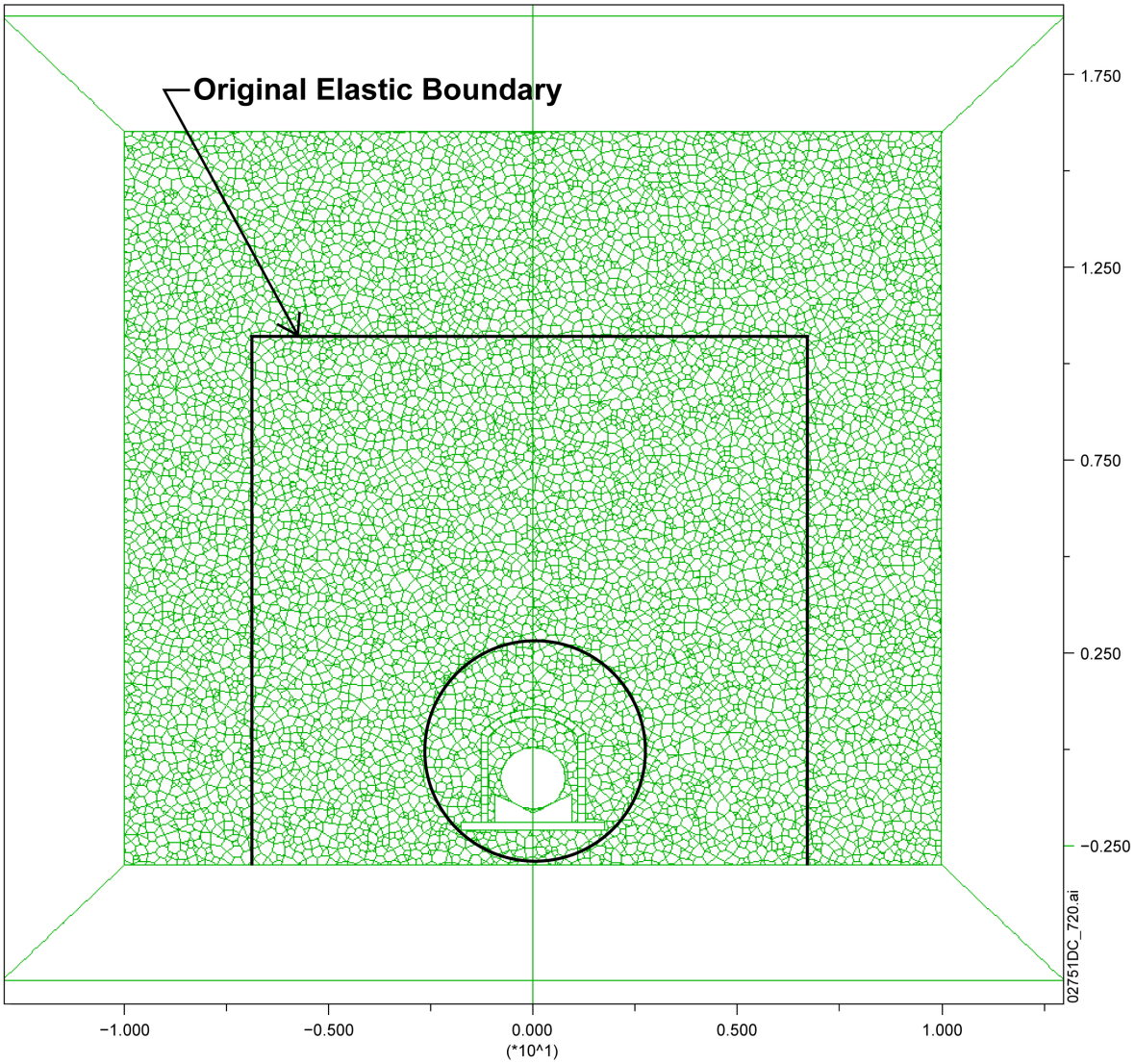
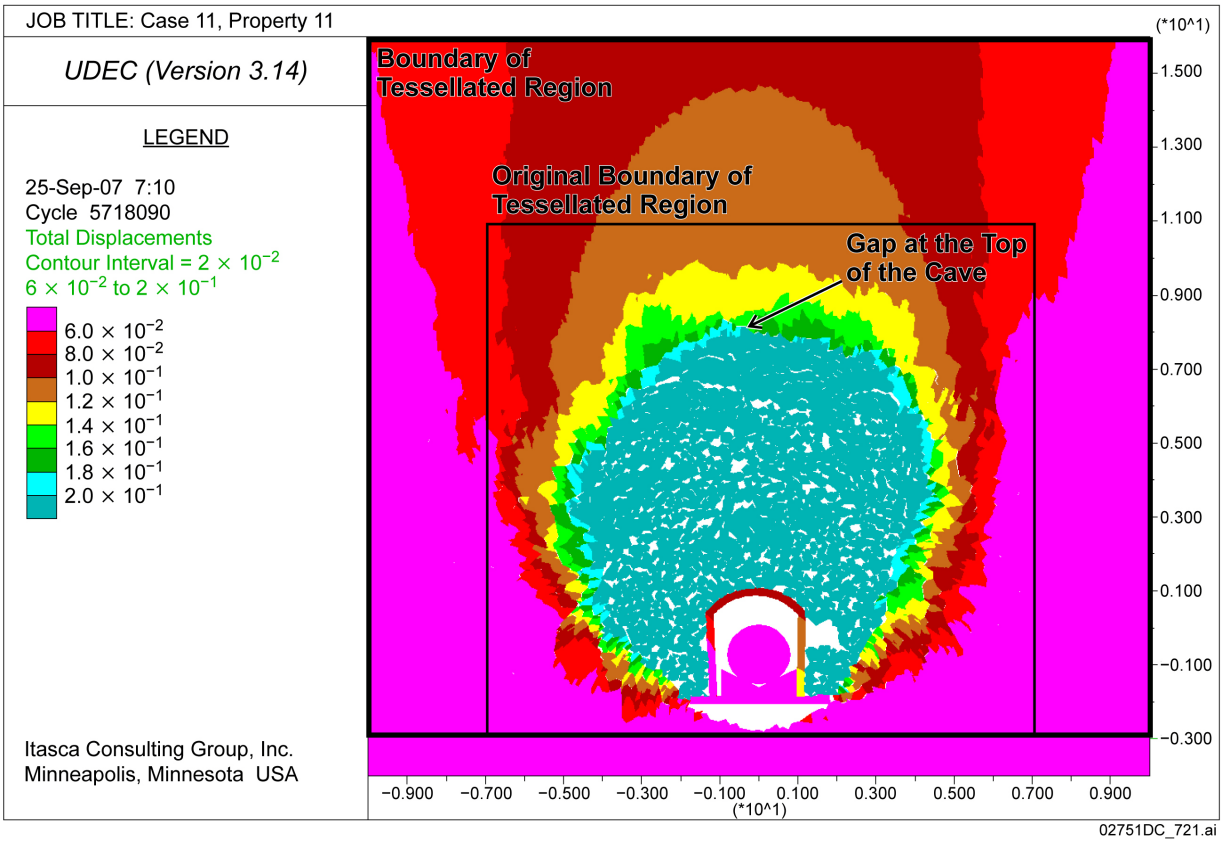


Figure 7. Initial Geometry of the Model with Extension of the Tessellated Domain

The results of one simulation, which are typical for all simulations with increased tessellated domain, are shown in Figures 8 and 9. Figure 8 shows contours of displacement magnitudes. The stress tensors colored by the value of the major principal stress are shown in Figure 9. In both figures, showing the same model domain, the lateral and top boundaries of the view window coincide with the boundaries of the tessellated domain. Also, the outline of the tessellated domain with the boundary 8.25 m above the initial drift roof, as used in the quasi-static analysis of drift degradation, is indicated in both figures.

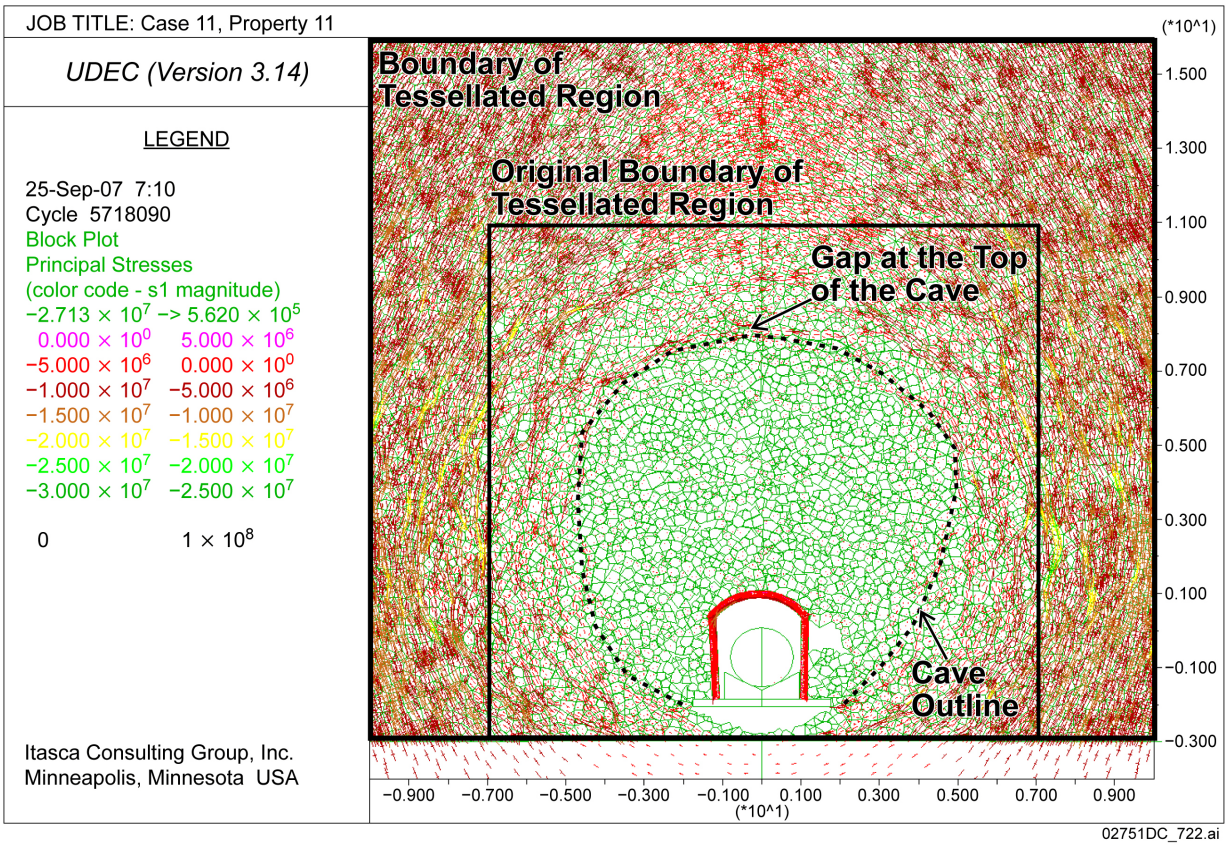
The displacement contour plot shown in Figure 8 is similar to those with a smaller tessellated domain shown in Section 1.1. The location of the top of the caved region is approximately 8 m above the drift center (or 5.25 m above the initial drift roof), irrespective of the size of the tessellated domain (as used in original analyses discussed in Section 1.1 or in these sensitivity analyses).

The stress tensor plot in Figure 9 provides another method for assessment of the size of the rockfall volume and potential effect of the size of the tessellated domain on that volume. The caved region or the rockfall volume is essentially the de-stressed region relative to the stress-bearing region in the stable rock mass. As shown in Figure 9, the distressed region is completely contained within the original (smaller) tessellated domain.



NOTE: The y-coordinate of the top of the tessellated domain is 16 m; horizontally, the tessellated domain extends between −10 m and 10 m. Displacement contours in this figure quantify the displacement between the particle initial and final position during the simulation.

Figure 8. Displacement Contours (m) for Quasi-Static Drift Degradation, 0.2-m Average Block Size, and Extension of the Tessellated Domain



NOTE: The y-coordinate of the top of the tessellated domain is 16 m; horizontally, the tessellated domain extends between −10 and 10 m. The range $-2.713 \times 10^7 > 5.620 \times 10^5$ shown in the legend indicates the range of the major principal stress magnitudes in the plot.

Figure 9. Stress Tensor Field (Pa) Colored by Value of the Major Principal Stress for Quasi-Static Drift Degradation, 0.2-m Average Block Size, and Extension of the Tessellated Domain

1.4 CONCLUSION

The potential effect of the size of the tessellated domain on the estimated rockfall volumes is checked by back-analysis of the model results. As described in Section 1.2 of this response, in all but two of the simulations (Figure 6, realizations 4 and 6), the contour plots of displacement show continuity across the boundaries of the tessellated domain, and the voids and the gaps, which result from bulking of the rock mass as unraveling blocks displace and rotate, are contained within the tessellated domain. The two exceptions are for the weakest rock (Category 1) and PGV values of 2.44 m/s, and for those combinations of rock strength and PGV, the analysis overpredicts the rockfall volume. Sensitivity analyses, conducted with an extended tessellated domain, result in the same estimates of the size of the caved region and rockfall volume as for the original, smaller tessellated domain used in the drift degradation analysis and assessment of the rubble load on the drip shield. Thus, the dimensions of the tessellated domain do not affect the calculations of rock fall volumes from seismic events or during quasi-static drift degradation.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2004. *Drift Degradation Analysis.* ANL-EBS-MD-000027 REV 03. Las Vegas, Nevada: Bechtel SAIC Company. ACC: DOC.20040915.0010; DOC.20050419.0001; DOC.20051130.0002; DOC.20060731.0005; LLR.20080311.0066.

SNL (Sandia National Laboratories) 2007a. *Mechanical Assessment of Degraded Waste Packages and Drip Shields Subject to Vibratory Ground Motion.* MDL-WIS-AC-000001 REV 00. Las Vegas, Nevada: Sandia National Laboratories. ACC: DOC.20070917.0006; DOC.20080623.0002; DOC.20081021.0001.

SNL 2007b. *Seismic Consequence Abstraction.* MDL-WIS-PA-000003 REV 03. Las Vegas, Nevada: Sandia National Laboratories. ACC: DOC.20070928.0011, LLR.20080414.0012