DR-3: DYNAMIC CLOSURE OF THE NORTH-END AND HALLWAYS

Summary Memo of Record

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Subject: FEP Screening Issue DR-3

STATEMENT OF SCREENING DECISION

FEP Screening Issue DR-3 need not be included in future system-level performance assessment calculations.

STATEMENT OF SCREENING ISSUE

This screening effort evaluates the need for including dynamic closure of the north-end and hallways in future system-level performance assessment calculations. In past calculations, the dynamic effect of halite creep and room consolidation on room porosity was modeled only in the waste disposal regions. Other portions of the repository, such as the experimental region in the north end and the hallways, were modeled assuming fixed (invariant with time) properties. In these regions, the permeability was held at a fixed high value representative of nearly unconsolidated or modestly consolidated material. The porosity in these regions was maintained at relatively low values associated with highly consolidated material. It was assumed that this combination of low porosity and high permeability would conservatively overestimate flow through these regions and minimize the capacity of this material to store fluids. An associated screening issue is uncontrolled fluid flow to the surface (blowout) during an intrusion into the repository. The volume of uncontrolled releases to the surface due to cuttings, spalling, and blowout during drilling is influenced by the prevailing pressure, permeability, and saturation conditions in the disposal room at the time of intrusion.

APPROACH

Consolidation of the north-end and hallways was implemented in BRAGFLO by relating pressure and time to porosity via a "porosity surface" method. The porosity surface is a look-up table within BRAGFLO that relates cavity closure (void volume) to time and pressure for different gas generation histories (see Butcher et al. 1991). The porosity surface for the north-end and hallways is different than the one used for consolidation of the disposal room and is based on an empty excavation; it is described in detail in a memo from Stone and Arquello to Butcher entitled 'Porosity Surface Generation for a Disposal Room Without Crushed Salt Backfill' and dated 2/2/95.

A series of BRAGFLO simulations were performed to determine if dynamic consolidation of the north-end and hallways has the potential to enhance contaminant migration to the accessible environment. Effects of all other FEP issues were turned off in the simulations. Two basic scenarios were considered in the screening analysis, undisturbed performance and disturbed performance. Both scenarios included a 1.0 degree formation dip downward to the south. Intrusion event E1 is considered in the disturbed scenario and consists of a borehole that penetrates the repository and pressurized brine in the underlying Castile Formation. Two variations of intrusion event E1 are examined, E1 Up-Dip and E1 Down-Dip. In the E1 Up-Dip event the intruded panel region is located on the up-dip (north) end of the repository, whereas in the E1 Down-Dip event the intruded panel region is located on the down-dip (south) end of the repository. These two E1 events permit evaluation of the possiblity of increased brine flow into the panel region due to higher brine saturations down-dip of the borehole and the potential for subsequent impacts on contaminant migration. To incorporate the effects of uncertainty in each case (E1 Up-Dip, E1 Down-Dip, and undisturbed), a Latin hypercube sample size of 20 was used resulting in a total of sixty simulations. To assess the sensitivity of system performance to north-end and hallway consolidation, conditional complementary cumulative distribution functions (CCDFs) of normalized contaminated brine releases to the Culebra via human intrusion and shaft system, as well as releases to the subsurface boundary of the accessible environment, were constructed and compared to the corresponding baseline model CCDFs. In the baseline model calculations, the effects of all FEP issues are turned off. These comparisons provide direct information about how the inclusion of north-end and hallway consolidation may influence repository performance. In addition, blowout, cuttings, and spalling performance measures are examined. Drivers for potential releases to the surface by these mechanisms are brine pressures, brine saturations, and permeability in the waste disposal area.

RESULTS AND DISCUSSION

CCDFs for releases to the Culebra and lateral land withdrawal boundary for E1 Up-Dip, E1 Down-Dip, and undisturbed cases are provided in Figure 5 of Appendix 1 in the records package entitled "FEPs Screening Analysis for FEPs DR2, DR3, DR6, DR7, and S6". Each figure compares CCDFs of normalized releases predicted by the baseline model and normalized releases predicted with north-end and hallway consolidation. Note that releases to the Culebra via the shaft and intrusion borehole are shown on the left side of the figure whereas releases to the lateral land withdrawal boundary are presented on the right side of the figure. In the E01_Down and E01-Up cases, the dynamic consolidation curves for releases to the Culebra via shaft and borehole are very close to the baseline curves for most of their lengths. In the undisturbed case, the dynamic consolidation CCDF is above the baseline curve for only very small releases via the shaft to the Culebra. However, CCDFs for releases to the subsurface boundary of the accessible environment via the marker beds show only minor differences between the dynamic closure and baseline results with the baseline curve consistently above and to the right of the dynamic consolidation CCDF. These results can be explained in part by the fact that time-varying porosities of the north-end and hallways exceed the conservative cavity porosity (0.075) used in the baseline model for most of the 10000 yrs. The time-varying porosities are initially set to 1.0 and during the course of simulation they gradually decrease. For a short duration (500 to 1000 yrs), starting at around 500 yrs, cavity porosities drop slightly below 0.075 and then experience a gradual increase to values well above the value of 0.075.

Blowout, spalling, and cuttings metrics including maximum, mean, medium, and minimum values of volume averaged brine pressures, brine saturations, porosity, and permeability in the waste region for undisturbed conditions at 100, 1000, and 10000 years are given in Table 4 of Appendix 1. Comparison of these table values with the baseline values given in Table 2 indicate that brine pressures tend to be higher in the baseline case. Also, the maximum, median, and mean brine saturations for dynamic closure at 100 yrs are slightly higher than the corresponding baseline values, however, the actual volumes of brine (the product of porosity and saturation) are nearly equal in the two cases. It is also important to note that these slightly higher saturations fall below the minimum saturation (approximately 0.6) needed for uncontrolled releases due to blowout (see Summary Memo of Record for FEP Issue DR-4). In summary, dynamic closure of the north-end and hallways has a negligible effect on waste room conditions relevant to releases due to blowout, cuttings, and spalling.

BASIS FOR RECOMMENDED SCREENING DECISION

Based on the CCDFs, the inclusion of consolidation of the north-end and hallways in BRAGFLO results in overall lower computed releases to the accessible environment than the baseline case. In addition, dynamic consolidation has an insignificant effect on waste room conditions relevant to blowout, spallings, and cuttings. As a result, the baseline model is conservative in its treatment of closure and consolidation of the north-end and can be eliminated from consideration in the baseline PA model.