WPO 30794

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 material or modestly consolidated. 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 conservativly overestimate flow through these regions and minimize the capacity of this material to store fluids.

The impact of dynamic closure of the north-end and hallways on direct releases to the surface during a drilling intrusion into the repository is also considered. Direct releases to the surface may occur during drilling due to cuttings and spallings in the drilling fluid and brine circulation from the repository to the surface in the wellbore. These releases are controlled by the prevailing pressure, permeability, and saturation conditions in the disposal room at the time of intrusion. The effect of dynamic closure of the north-end and hallways on these conditions may be important and needs to be evaluated.

APPROACH

Consolidation of the north-end and hallways was implemented in BRAGFLO by relating pressure and time to porosity via the "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. This porosity surface is calculated independently of BRAGFLO by the computer code SANTOS (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 disabled 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 were disabled. These comparisons provide direct information about how the inclusion of north-end and hallway consolidation may influence repository performance. In addition, performance measures are examined for direct releases during drilling due to cuttings and spallings and brine circulation from the repository to the surface. Potential releases to the surface during drilling are strongly influenced by three drivers: brine pressures, brine saturations, and permeability in the waste disposal area. Spallings, cuttings, and brine releases tend to increase with an increase in each of these drivers. The exception to this trend is that at high brine saturations (or low gas saturations) brine releases tend to decrease because gas volumes become to small to maintain an appreciable gas drive (gas expansion).

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 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 closure 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. This results in greater storage volume capacity and lower repository pressure. Lower pressures result in a lower driving force for release. 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.

Performance measures for direct release during drilling, which include 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 differences in brine saturations between the baseline and closure model are insignificant, except possibly the maximum medium, and mean brine saturation at 100 years. At these low saturations, however, the brine is relatively immobile and releases to the intruding wellbore will be small, both in the baseline and dynamic closure cases. This condition is further compounded by the fact that, besides pressures being less than the baseline case, the brine pressures are well below hydrostatic pressure in the wellbore (approximately 7.8 MPa). Pressures must exceed hydrostatic pressure before direct releases up the borehole during drilling can occur (based on a hydrostatic column of drilling mud). In summary, dynamic closure of the north-end and hallways has a negligible effect on waste room conditions relevant to releases during a drilling intrusion.

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 direct releases during a drilling intrusion. As a result, the baseline model is conservative (over predicts potential releases) in its treatment of closure and consolidation of the north-end and can be eliminated from consideration in the baseline PA model.