Summary of the Resolution of the Key Technical Issue on Evolution of the Near-Field Environment

Subissue #	Subissue Title	Status	NRC/DOE Agreements
1	Effects of coupled thermal-hydrologic-chemical processes on seepage and flow	Closed-Pending	1) Provide updated FEPs AMRs with additional technical bases for those FEPs previously identified by the NRC in Rev. 03 of the ENFE IRSR as inadequately screened. In Rev 03 of the ENFE IRSR, the NRC identified 17 FEPs associated with Subissue 1 for which no screening arguments were identified in the FEPs data base, screening arguments were inconsistent with other project documents, or inadequate exclusion arguments were provided. The lack of screening arguments has been addressed in Rev 00 of the FEPs data base and Rev 00 of the supporting AMRs. Current revisions (or ICNs) of the FEPs AMRs, scheduled for completion in January 2001, will partially address the remaining NRC comments. Consideration of the remaining NRC comments will be provided in subsequent FEPs AMR revisions, expected to be available as periodic revisions, the entirety of which will be available prior to license application. 2) Provide the FEPs database. The DOE will provide the FEPs data base to the NRC during March 2001.

1	Effects of coupled thermal-hydrologic-chemical processes on seepage and flow - cont.		3) Provide the Drift-Scale Coupled Processes (DST and THC Seepage) Models AMR, Rev. 01 and 02, including (1) information on the quantity of unreacted solute mass that is trapped in dry-out zone in TOUGHREACT simulations, as well as how this would affect precipitation and the resulting change in hydrologic properties and (2) documentation of model validation consistent with the DOE QA requirements. The DOE will provide documentation of model validation, consistent with the DOE QA requirements, in the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR (MDL-NBS-HS-000001) Rev 01, expected to be available to the NRC in March 2001. The DOE will provide information on the quantity of unreacted solute mass that is trapped in the dryout zone in TOUGHREACT simulations in the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR Rev 02, expected to be available to the NRC in FY 02. 4) Provide additional technical bases for the DOE's treatment of the effects of cementitious materials on hydrologic properties. The DOE will provide additional information on the effects of cementitious materials in an update to the *Unsaturated Zone Flow and Transport* PMR (TDR-NBS-HS-000002), available in FY 02. Information provided will include results of evaluation of the magnitude of potential effects on hydrologic properties and radionuclide transport characteristics of the unsaturated zone. 5) Address the various sources of uncertainty (e.g., model implementation, conceptual model, and data uncertainty (hydrologic, thermal, and geochemical)) in the THC model. The DOE will evaluate the various sources of uncertainty in the THC process model, including details as to how the propagation of various sources of uncertainty are calculated in a systematic uncertainty analysis. The DOE will document that uncertainty evaluation in the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR (MDL-NBS-HS-000001) Rev 02 (or in another future document), expected to be available in FY 02.

1	Effects of coupled thermal-hydrologic-chemical processes on seepage and flow - cont.		6) Provide the technical basis for excluding entrained colloids in the analysis of FEP 2.2.10.06.00 (Thermo-Chemical Alteration) or an alternative FEP. The DOE will provide the technical basis for screening entrained colloids in the analysis of FEP 2.2.10.06.00 in a future revision of the *Features, Events, and Processes in UZ Flow and Transport* AMR (ANL-NBS-MD-000001), expected to be available in FY 02. 7) Provide physical evidence that supports the model of matrix fracture interaction precipitation effects (e.g., coring). The DOE will provide the following evidence that supports the model of matrix/fracture interaction precipitation effects: (1) Existing data from the Single Heater Test (SHT) of post-test overcoring Mineralogy-Petrology (Min-Pet) analysis (SHT final report [MOL.20000103.0634] and DTN LASL831151.AQ98.001) is expected to be provided to the NRC in March 2001. (2) Results of ongoing side-wall sampling Min-Pet analyses of DST samples are expected to be provided to the NRC in FY 02. (3) The DOE expects to provide the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR (MDL-NBS-HS-000001) Rev 01 to the NRC as evidence of matrix-fracture interaction in March 2001.

2	Effects of coupled thermal-hydrologic-chemical processes on waste package chemical environment	Closed-Pending	1) Provide updated FEPs AMRs with additional technical bases for those FEPs previously identified by the NRC in Rev. 03 of the ENFE IRSR as inadequately screened. In Rev 03 of the ENFE IRSR, the NRC identified 24 FEPs associated with Subissue 2 for which no screening arguments were identified in the FEPs data base, screening arguments were inconsistent with other project documents, or inadequate exclusion arguments were provided. The lack of screening arguments has been addressed in Rev 00 of the FEPs data base and Rev 00 of the supporting AMRs. Current revisions (or ICNs) of the FEPs AMRs, scheduled for completion in January 2001, will partially address the remaining NRC comments. Consideration of the remaining NRC comments will be provided in subsequent FEPs AMR revisions, expected to be available as periodic revisions, the entirety of which will be available prior to license application. 2) Provide the FEPs database. The DOE will provide the FEPs data base to the NRC during March 2001.

2	Effects of coupled thermal-hydrologic-chemical processes on waste package chemical environment - cont.		3) Provide the technical basis for FEP 1.2.06.00 (Hydrothermal Activity), addressing points (a) through (e) of NRC Subissue 2 slide handed out at the January 2001 ENFE technical exchange. The DOE will provide additional technical bases for the screening of FEP 1.2.06.00 (Hydrothermal Activity), in a future revision of the *Features, Events, and Processes in UZ Flow and Transport* AMR (ANL-NBS-MD-000001), expected to be available in FY 02. Within these technical bases, the DOE will address NRC comments [points (a) through (e)] presented on the NRC Subissue 2 slide handed out at the January 2001 ENFE technical exchange or provide justification that it is not needed. 4) Provide the technical basis for bounding the trace elements and fluoride for the geochemical environment affecting the drip shield and waste package, including the impact of engineered materials. The DOE will document the concentrations of trace elements and fluoride in waters that could contact the drip shield and waste package in a revision to the *Environment on the Surfaces of the Drip Shield and Waste Package Outer Barrier* AMR (ANL-EBS-MD-000001), which will be available in FY02. In addition, trace elements and fluoride concentrations in introduced materials in the EBS (including cement grout, structural steels, and other materials as appropriate) will be addressed in a revision to the *Engineered Barrier System: Physical and Chemical Environment Model AMR* (ANL-EBS-MD-000033), expected to be available in FY 02. 5) Evaluate data and model uncertainties for specific in-drift geochemical environment submodels used in TSPA calculations and propagate those uncertainties following the approach described in Agreement #5, Subissue 1. The DOE will evaluate data and model uncertainties for specific in-drift geochemical environment submodels used in TSPA calculations and propagate those uncertainties following the approach described in Subissue 1, Agreement #5. The DOE will document the evaluation in an update to the *Engineered Barrier System: Physical and Chemical Environment Model* AMR (ANL-EBS-MD-000033) (or in another future document), expected to be available in FY 02.

2	Effects of coupled thermal-hydrologic-chemical processes on waste package chemical environment - cont.		6) Evaluate the impact of the range of local chemistry (e.g., dripping of equilibrated evaporated cement leachate and corrosion products) conditions at the drip shield and waste package considering the chemical divide phenomena that may propagate small uncertainties into large effects. The DOE will evaluate the range of local chemical conditions at the drip shield and waste package (e.g. local variations in water composition associated with cement leaching or the presence of corrosion products), considering potential evaporative concentration and the chemical divide effect whereby small differences in initial composition could cause large differences in brine characteristics. This evaluation will be documented in a revision to the *Engineered Barrier System: Physical and Chemical Environment Model* AMR (ANL-EBS-MD-000033), expected to be available in FY 02. 7) Identify specific coupling relationships that are included and excluded from TSPA, including Onsager couples, and give technical bases for their inclusion or exclusion. The DOE will identify specific coupling relationships that are included and excluded from TSPA, including Onsager couples, and give the technical basis for inclusion and exclusion. This information will be documented in a revision to the *Engineered Barrier System Degradation, Flow, and Transport* PMR (TDR-EBS-MD-000006), expected to be available by September 2001. 8) Provide stronger technical basis for the suppression of individual minerals predicted by equilibrium models. The DOE will provide additional technical basis for suppression of individual minerals predicted by equilibrium models, in a revision to the *Engineered Barrier System: Physical and Chemical Environment Model* AMR (ANL-EBS-MD-000033), expected to be available in FY02.

2	Effects of coupled thermal-hydrologic-chemical processes on waste package chemical environment - cont.		9) Provide the In-Drift Precipitates/Salts Analysis AMR, Rev. 00, ICN 02, including (1) the major anionic (e.g., fluoride or chloride) and cationic species, and (2) additional technical basis for the low relative humidity model. The DOE will provide the *In-Drift Precipitates/Salts Analysis* AMR (ANL-EBS-MD-000045), Rev. 00, ICN 02, including the major anionic (e.g., fluoride or chloride) and cationic species, in January 2001. The DOE will provide to the NRC an update to the *In-Drift Precipitates/Salts Analysis* AMR (ANL-EBS-MD-000045) that will provide additional technical bases for the low relative humidity model, expected to be available in FY 02. 10) Provide additional information about the range of composition of waters that could contact the drip shield or waste package, including whether such waters are of the bicarbonate or chloride-sulfate type. The DOE will describe the range of bulk composition for waters that could affect corrosion of the drip shield or waste package outer barrier, in a revision to the *Environment on the Surfaces of the Drip Shield and Waste Package Outer Barrier* AMR (ANL-EBS-MD-000001), expected to be available in FY02. 11) Provide the technical basis for the current treatment of the kinetics of chemical processes in the in-drift geochemical models. This basis should address data in the figure on page 16 of the G.Gdowski Subissue 2 presentation with appropriate treatment of time as related to abstractions used in TSPA. The DOE will provide additional technical basis for the treatment of precipitation-dissolution kinetics by the in-drift geochemical models, in a revision to the *Engineered Barrier System: Physical and Chemical Environment Model* AMR (ANL-EBS-MD-000033), expected to be available in FY02. The technical basis will include reaction progress simulation for laboratory evaporative concentration tests, and will include appropriate treatment of time as related to the residence times associated with the abstractions used to represent in-drift processes in TSPA.

2	Effects of coupled thermal-hydrologic-chemical processes on waste package chemical environment - cont.		12) Provide the documentation and analysis of the column crush tuff experiments. The DOE will provide documentation of the results obtained from the crushed tuff hydrothermal column experiment, and of post-test analysis, in new reports specific to the column test, expected to be available by September 2001. 13) Provide documentation regarding the deposition of dust and its impact on the salt analysis. The DOE will provide documentation of dust sampling in the Exploratory Studies Facility, and analysis of the dust and evaluation of its impact on the chemical environment on the surface of the drip shield and waste package, in a revision to the *Engineered Barrier System: Physical and Chemical Environment Model* AMR (ANL-EBS-MD-000033), expected to be available in FY02. 14) Provide the analysis of laboratory solutions that have interacted with introduced materials. The DOE will provide additional information about laboratory solutions that have interacted with introduced materials, in a revision to the *Environment on the Surfaces of the Drip Shield and Waste Package Outer Barrier* AMR (ANL-EBS-MD-000001), expected to be available in FY02. 15) Provide the additional data to constrain the interpolative low relative humidity salts model. The data should provide the technical basis as to why the assumption of the presence of sodium nitrate is conservative, when modeling and experimental results indicate the presence of other mineral phases for which the deliquesence point is unknown. The DOE will provide additional information to constrain the low-relative humidity salts model. The information will include the deliquescence behavior of mineral assemblages derived from alternative starting water compositions (including bulk water compositions, and local variations associated with cement leaching or the presence of corrosion products) representing the range of potential water compositions in the emplacement drifts. This information will be documented in a revision to the *In-Drift Precipitates/Salts Analysis* AMR (ANL-EBS-MD-000045), expected to be available in FY02.

2	Effects of coupled thermal-hydrologic-chemical processes on waste package chemical environment - cont.		16) Provide the Drift-Scale Coupled Processes (DST and THC Seepage) Models, Rev. 01, including information supporting both the limited suite mineral model and the more complete extended model. The DOE will provide the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR (MDL-NBS-HS-000001) Rev 01, including information supporting both the limited suite mineral model and the more complete extended model, in March 2001. 17) Provide documentation of data used to calibrate models and data to support model predictions, and an assessment of data uncertainty (e.g., sampling and analytical), that includes critical analyses of variables that affect the data measurements and their interpretations (e.g., drift-scale thermal test and evaporation tests). The DOE will provide documentation of data used to calibrate models and data to support model predictions, and an assessment of data uncertainty (e.g., sampling and analytical) in the area of water and gas chemistry from the drift-scale thermal tests and evaporation tests. This documentation will be provided in revisions to the following AMRs: *Environment on the Surfaces of the Drip Shield and Waste Package Outer Barrier* (ANL-EBS-MD-000001), *Engineered Barrier System: Physical and Chemical Environment Model* (ANL-EBS-MD-000033), and *Drift-Scale Coupled Processes (DST and THC Seepage) Models* (MDL-NBS-HS-000001), or other documents as appropriate. All documents or revisions are expected to be available in FY 02. 18) Provide the following documents: EBS: Physical and Chemical Environment Model, Rev. 01; Multiscale Thermohydrologic Model, Rev. 00, ICN 01; Abstraction of Drift-Scale Coupled Processes, Rev 01; Environments on the Surfaces of the Drip Shield and the Waste Package Outer Barrier, Rev. 00, ICN 01; Waste Package Degradation PMR, Rev. 00, ICN 01; EBS Degradation, Flow, and Transport PMR, Rev. 01; Near Field Environment PMR, Rev. 00, ICN 02 and Rev. 01; Hydrogen Induced Cracking of Drip Shield, Rev. 00, ICN 01; Drift Degradation Analysis, Rev. 01; Design Analysis for the Ex-Container Components, Rev. 00; Longevity of Emplacement Drift Ground Support Materials, Rev. 01; Stress Corrosion Cracking AMR, Rev.

			00, ICN 01; In-Drift Microbial Communities, Rev. 00, ICN 01; Physical and Chemical Environment Abstraction Model, Rev. 00, ICN 01; UZ Flow and Transport Model PMR, Rev. 01; General Corrosion and Localized Corrosion of the Drip Shield, Rev. 00; Water Distribution and Removal Model, Rev. 01. The DOE will provide the documents requested by the dates indicated: *Engineered Barrier System: Physical and Chemical Environment Model* (ANL-EBS-MD-000033) Rev. 01: FY 02; *Multiscale Thermohydrologic Model* (ANL-EBS-MD-000049) Rev. 00, ICN 01: January 2001; *Abstraction of Drift-Scale Coupled Processes* (ANL-NBS-HS-000029) Rev 01: September 2001; *Environment on the Surfaces of the Drip Shield and the Waste Package Outer Barrier* (ANL-EBS-MD-000001) Rev. 00, ICN 01: January 2001; *Waste Package Degradation* PMR (TDR-WIS-MD-000002) Rev. 00, ICN 01: January 2001; *Engineered Barrier System Degradation, Flow, and Transport* PMR (TDR-EBS-MD-000006) Rev. 01: September 2001; *Near Field Environment* PMR (TDR-NBS-MD-000001) Rev. 00, ICN 02: January 2001 and Rev. 01: September 2001; *Hydrogen Induced Cracking of Drip Shield* (ANL-EBS-MD-000006) Rev. 00, ICN 01: January 2001; *Drift Degradation Analysis* (ANL-EBS-MD-000027) Rev. 01: January 2001; *Design Analysis for the Ex-Container Components*, ANL-XCS-ME-000001 Rev. 00: January 2001; *Longevity of Emplacement Drift Ground Support Materials* (ANL-EBS-GE-000003) Rev. 01: January 2001; *Stress Corrosion Cracking* of the Drip Shield, the Waste Package Outer Barrier, and the Stainless Steel Structural Material AMR (ANL-EBS-MD-000005) Rev. 00, ICN 01: January 2001; *In-Drift Microbial Communities* (ANL-EBS-MD-000038) Rev. 00, ICN 01: January 2001; *Physical and Chemical Environmental Abstraction Model* (ANL-EBS-MD-000046) Rev. 00, ICN 01: January 2001; *Unsaturated Zone Flow and Transport Model* PMR (TDR-NBS-HS-000002) Rev. 01: September 2001; *General Corrosion and Localized Corrosion of the Drip Shield* (ANL-EBS-MD-000004) Rev. 00: January 2001; *Water Distribution and Removal Model* (ANL-EBS-MD-000032) Rev. 01: January 2001.

3	Effects of coupled thermal-hydrologic-chemical processes on chemical environment for radionuclide release	Closed-Pending	1) Provide the following documents: WAPDEG Analysis of Waste Package and Drip Shield Degradation AMR, Rev. 00, ICN 01; Near-Field Environment PMR, Rev. 00, ICN 03; In-Package Chemistry AMR, Rev. 01; CAL-EBS-PA-000002, Rev. 01; ANL-EBS-PA-000005, Rev. 00; In-Package Chemistry Abstraction AMR, Rev. 01; TSPA-SR, Rev. 00; Waste Form Colloid-Associated Concentration Limits: Abstraction and Summary AMR. The DOE will provide the following documents to the NRC by February 2001: *WAPDEG Analysis of Waste Package and Drip Shield Degradation* AMR (ANL-EBS-PA-000001) Rev 00 ICN 01; *Near Field Environment* PMR (TDR-NBS-MD-000001) Rev 00 ICN 03; *Summary of In-Package Chemistry for Waste Forms* AMR (ANL-EBS-MD-000050) Rev 01; *Calculation of General Corrosion Rate of Drip Shield and Waste Package Outer Barrier to Support WAPDEG Analysis* (CAL-EBS-PA-000002) Rev 01; *Abstraction of Models for Stainless Steel Structural Material Degradation* (ANL-EBS-PA-000005) Rev 00; *In-Package Chemistry Abstraction* AMR (ANL-EBS-MD-000037) Rev 01; *Total System Performance Assessment for the Site Recommendation* (TDR-WIS-PA-000001) Rev 00; *Waste Form Colloid-Associated Concentrations Limits: Abstraction and Summary* AMR (ANL-WIS-MD-000012) Rev 00 ICN 01 2) Provide the thermodynamic database and the report associated with the database. The DOE will provide the thermodynamic data base [Input Transmittal for Thermodynamic Data Input Files for Geochemical Calculations (MO0009THRMODYN.001)] and *Data Qualification Report for the Thermodynamic Data File, DATA0.ympR0 for Geochemical Code EQ 3/6* (TDR-EBS-MD-000012) to the NRC in February 2001. 3) Provide analyses to verify that bulk-scale chemical processes dominate the in-package chemical environment. The DOE will provide analyses justifying the use of bulk chemistry as opposed to local chemistry for solubility and waste form degradation models. These analyses will be documented in an update to the *Miscellaneous Waste-Form FEPs* AMR (ANL-WIS-MD-000009) or in an update to the *Summary of In-Package Chemistry for Waste Forms* AMR (ANL-EBS-MD-000050), expected to be available in FY 02.

3	Effects of coupled thermal-hydrologic-chemical processes on chemical environment for radionuclide release - cont.		4) Complete validation of in-package chemistry models. Agreement #5 for CLST subissue 3 addresses testing plans. Model validation based on this testing and further analysis will be documented in an update to the *Summary of In-Package Chemistry for Waste Forms* AMR (ANL-EBS-MD-000050), expected to be available in FY 02. 5) Provide the technical basis for selection of radionuclides that are released via reversible and irreversible attachment to colloids for different waste forms in the TSPA. The technical bases for the selection of radionuclides released via reversible and irreversible attachments to colloids for different waste forms is provided in section 3.5.6.1 of the *Total System Performance Assessment (TSPA) Model for Site Recommendation* (MDL-WIS-PA-000002) Rev 00. This document will be provided to the NRC in January 2001.
4	Effects of coupled thermal-hydrologic-chemical processes on radionuclide transport through engineered and natural barriers	Closed-Pending	1) Provide the executable version of the most recently qualified version of TOUGHREACT. The DOE will provide the executable TOUGHREACT Rev 2.2 to the NRC by February 2001, subject to the NRC obtaining any applicable agreement for usage of the software. 2) Provide the Drift-Scale Coupled Processes (DST and THC Seepage) Models AMR, Rev. 01 and 02. The DOE will provide the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR (MDL-NBS-HS-000001) Rev 01 to the NRC in March 2001. The DOE will provide the *Drift-Scale Coupled Processes (DST and THC Seepage) Models* AMR Rev 02 to the NRC in FY 02. 3) Provide the technical bases for screening out coupled THC effects on radionuclide transport properties and colloids. The DOE will provide the technical bases for screening out coupled THC effects on radionuclide transport properties and colloids in a new AMR or in a revision to an existing AMR, expected to be available in FY 02.

4	Effects of coupled thermal-hydrologic-chemical processes on radionuclide transport through engineered and natural barriers - cont		4) Provide the technical basis for excluding entrained colloids in the analysis of FEP 2.2.10.06.00 (Thermo-Chemical Alteration) or an alternative FEP. The DOE will provide the technical basis for screening entrained colloids in the analysis of FEP 2.2.10.06.00 in a future revision of the *Features, Events, and Processes in UZ Flow and Transport* AMR (ANL-NBS-MD-000001), expected to be available in FY 02. 5) Provide the screening criteria for the radionuclides selected for PA. Provide the technical basis for selection of radionuclides that are transported via colloids in the TSPA. The screening criteria for radionuclides selected for TSPA are contained in the AMR *Inventory Abstraction* (ANL-WIS-MD-000006) Rev 00, ICN 01. The DOE is documenting identification of radionuclides transported via colloids for TSPA in the AMR *Colloid-Associated Concentration Limits: Abstraction and Summary* (ANL-WIS-MD-000012) Rev 0, in the Total System Performance Assessment for the Site Recommendation (TDR-WIS-PA-000001) Rev 00 ICN 01, and in the *Total System Performance Assessment (TSPA) Model for Site Recommendation* (MDL-WIS-PA-000002) Rev 00. These documents will be available to the NRC in January 2001. 6) Provide documentation to demonstrate suitability of the bounding values used for colloid transport through the perturbed near-field environment. For example, consider sensitivity analyses to investigate the effects of varying colloid sorption parameters (K_c) on repository performance. The DOE will evaluate the suitability of the colloid transport model under perturbed conditions as discussed in agreement #3 for this subissue. As part of this work, the DOE will consider sensitivity analyses to investigate the effects of varying colloid sorption parameters (K_c) on repository performance. The DOE will also provide the TSPA-SR (TDR-WIS-PA-000001) Rev 00 ICN 01 in January 2001. The TSPA-SR includes sensitivity studies in the form of barrier degradation and parameter sensitivity analyses that investigate the effect of sorption and colloid parameters on repository performance.

4	Effects of coupled thermal-hydrologic-chemical processes on radionuclide transport through engineered and natural barriers - cont.		7) Provide updated FEPs AMRs with additional technical bases for those FEPs previously identified by the NRC in Rev. 03 of the ENFE IRSR as inadequately screened. In Rev 03 of the ENFE IRSR, the NRC identified 17 FEPs associated with Subissue 1 for which no screening arguments were identified in the FEPs data base, screening arguments were inconsistent with other project documents, or inadequate exclusion arguments were provided. The lack of screening arguments has been addressed in Rev 00 of the FEPs data base and Rev 00 of the supporting AMRs. Current revisions (or ICNs) of the FEPs AMRs, scheduled for completion in January 2001, will partially address the remaining NRC comments. Consideration of the remaining NRC comments will be provided in subsequent FEPs AMR revisions, expected to be available as periodic revisions, the entirety of which will be available prior to license application. 8) Provide the FEPs database. The DOE will provide the FEPs data base to the NRC during March 2001.