



U.S. Department of Energy  
Office of Civilian Radioactive Waste Management

# Model Abstraction Acceptance Criteria

Presented to:

**DOE/NRC Technical Exchange on Total System Performance  
Assessment (TSPA) for Yucca Mountain  
San Antonio, TX**

Presented by:

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YUCCA  
MOUNTAIN  
PROJECT

<b>TSPA I IRSR REV. 2 ACCEPTANCE CRITERIA</b>	<b>PRESENTATION/ DOCUMENTATION</b>	<b>SELF-ASSESSMENT</b>	<b>PATH FORWARD TO CLOSURE</b>
SUBISSUE 1 - System Description and Demonstration of Multiple Barriers			
Transparency and Traceability of the Analysis			
Abstraction Methodology	Robert Andrews		
T1) The levels and method(s) of abstraction are described starting from assumptions defining the scope of the assessment down to assumptions concerning specific processes and the validity of given data.	All PMRs, TSPA-SR Section 3	Largely Resolved	For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC. These documents provide detailed descriptions of the levels and methods of abstraction.
T2) A mapping (e.g., a road map diagram, a traceability matrix, a cross-reference matrix) is provided to show what conceptual features (e.g., patterns of volcanic events) and processes are represented in the abstracted models, and by what algorithms.	TSPA-SR Section 3	Partially Resolved	The TSPA-SR is currently being performed. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T3) An explicit discussion of uncertainty is provided to identify which issues and factors are of most concern or are key sources of disagreement among experts.	All PMRs, TSPA-SR Section 3, TSPA-SR Section 5	Largely Resolved	The TSPA-SR is currently being performed. This document provides descriptions of the treatment of uncertainty for each component model and describes uncertainty importance analysis results. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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SUBISSUE 3 - Model Abstraction			
Generic Acceptance Criteria	Robert Andrews		
T1) Data and Model Justification - Sufficient data (field, laboratory, or natural analog data) are available to adequately support the conceptual models, assumptions, and boundary conditions and to define all relevant parameters implemented in the TSPA. Where adequate data do not exist, other information sources such as expert elicitation have been appropriately incorporated into the TSPA.	All PMRs	This will be discussed at the PMR Technical Exchanges	
T2) Data Uncertainty - Parameter values, assumed ranges, probability distributions, and bounding assumptions used in the TSPA are technically defensible and reasonably account for uncertainties and variability.	All PMRs	This will be discussed at the PMR Technical Exchanges	
T3) Model Uncertainty - Alternative modeling approaches consistent with available data and current scientific understanding are investigated and results and limitations appropriately considered in the abstractions.	All PMRs	This will be discussed at the PMR Technical Exchanges	
T4) Model Support - Models implemented in the TSPA provide results consistent with output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	All PMRs	See Criterion T4 of the integrated subissue acceptance criterion	
T5) Integration – TSPA adequately incorporates important design features, physical phenomena, and couplings and uses consistent and appropriate assumptions throughout the abstraction process.	All PMRs	See Criterion T5 of the integrated subissue acceptance criterion	

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Engineered Barrier Degradation	Joon Lee		
T4) WP corrosion abstraction output is justified through comparison to output of detailed process models or empirical observations (laboratory testings, natural analogs, or both).	WP PMR, TSPA-SR Section 3.4	Partially Resolved	Waste package and drip shield degradation will be described in Section 3.4 of the TSPA-SR Technical Report and in the Waste Package Degradation PMR and supporting AMRs. The TSPA-SR is currently being performed. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the WP corrosion abstraction.	WP PMR, TSPA-SR Section 3.4	Partially Resolved	The waste package corrosion abstraction will be described in Section 3.4 of the TSPA-SR Technical Report. This report will also provide a description of the development of the integrated TSPA-SR model and development of the components of the model. The TSPA-SR is currently being performed. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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<b>Mechanical Disruption of Engineered Barriers</b>	<b>Michael Sauer</b>		
T4) Mechanical disruption of the engineered barriers abstraction output is justified through comparison to output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	DE PMR, TSPA-SR Section 4.2	Partially Resolved	The TSPA-SR is currently being performed. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the mechanical disruption of the engineered barriers abstraction.	DE PMR, TSPA-SR Section 4.2	Partially Resolved	The TSPA-SR is currently being performed. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
<b>Volcanic Disruption of Waste Packages</b>	<b>Michael Sauer</b>		
T4) Outputs of the volcanic disruption of WPs abstraction are justified through comparison to outputs of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	DE PMR, TSPA-SR Section 3.10	Partially Resolved	Section 3.10 of the TSPA-SR Technical Report and the Disruptive Events PMR provide descriptions of the conceptual model developed for volcanism. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important site and design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the volcanic disruption of WPs abstraction and the technical bases are provided.	DE PMR, TSPA-SR Section 3.10	Partially Resolved	Section 3.10 of the TSPA-SR Technical Report and the Disruptive Events PMR provide descriptions of the conceptual model developed for volcanism including the important design features and assumptions made during model development. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
<b>Airborne Transport of Radionuclides</b>	<b>Michael Sauer</b>		
T4) Airborne transport of RNs abstraction output is justified through comparison to output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	DE PMR, TSPA-SR Section 3.10	Partially Resolved	Section 3.10 of the TSPA-SR Technical Report and the Disruptive Events PMR provide descriptions of the conceptual model developed for volcanism. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important site features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the airborne transport of RNs abstraction.	DE PMR, TSPA-SR Section 3.10	Partially Resolved	Section 3.10 of the TSPA-SR Technical Report and the Disruptive Events PMR provide descriptions of the conceptual model developed for volcanism including the important design features and assumptions made during model development. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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<b>Redistribution of Radionuclides in Soil</b>			
T4) Redistribution of RNs in soil output is justified through comparison to output of detailed process models or empirical observations (laboratory testings, natural analogs, or both).	Biosphere PMR, TSPA-SR Section 3.10	Largely Resolved	Section 3.9 of the TSPA-SR Technical Report describes the Biosphere component of the TSPA-SR model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important site features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the redistribution of RNs in soil abstraction.	Biosphere PMR, TSPA-SR Section 3.10	Largely Resolved	Section 3.9 of the TSPA-SR Technical Report describes the Biosphere component of the TSPA-SR model. This section includes a description of the integration of the biosphere into the TSPA-SR model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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<b>Quantity and Chemistry of Water Contacting WPs and WFs</b>	<b>Jim Nowak/Nick Francis/</b>		
T4) Output of quantity and chemistry of water contacting WPs and waste forms abstraction are supported by comparison to output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	WF PMR, TSPA-SR Section 3.2	Partially Resolved	For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the quantity and chemistry of water contacting WPs and waste forms abstraction.	WF PMR, TSPA-SR Section 3.2	Partially Resolved	For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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<b>Radionuclide Release Rates and Solubility Limits</b>	<b>Rob Rechard</b>		
T4) RN release rates and solubility limits abstraction output is supported by comparison to outputs of detailed process models or empirical observations (field, laboratory, or natural analog data).	WF PMR, TSPA-SR Section 3.5	Largely Resolved	Section 3.5 of the TSPA-SR Technical Report will describe waste form degradation including radioelement solubility limits. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the RN release rates and solubility limits abstraction	WF PMR, TSPA-SR Section 3.5	Largely Resolved	Section 3.5 of the TSPA-SR Technical Report will describe waste form degradation including radioelement solubility limits. This section also provides discussion of the implementation of the models into the TSPA-SR model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.



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<b>Spatial and Temporal Distribution of Flow</b>	<b>Mike Wilson</b>		
T4) Spatial and temporal distribution of flow abstraction output is justified through comparison to output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	UZFT PMR, TSPA-SR Section 3.2	Largely Resolved	Section 3.2 of the TSPA-SR Technical Report and the Unsaturated Zone Flow and Transport PMR will provide descriptions of the unsaturated zone flow. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the spatial and temporal distribution of flow abstraction.	UZFT PMR, TSPA-SR Section 3.2	Largely Resolved	Section 3.2 of the TSPA-SR Technical Report and the Unsaturated Zone Flow and Transport PMR will provide descriptions of the unsaturated zone flow including integration of this component into the TSPA model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
<b>Flow Paths in the Unsaturated Zone</b>	<b>Mike Wilson</b>		
T4) Flow paths in the UZ abstraction output are justified through comparison to output of detailed flow process models or empirical observations (laboratory testings, natural analogs, or both).	UZFT PMR, TSPA-SR Section 3.2	Largely Resolved	Section 3.2 of the TSPA-SR Technical Report and the Unsaturated Zone Flow and Transport PMR will provide descriptions of the unsaturated zone flow. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the flow paths in the UZ abstraction.	UZFT PMR, TSPA-SR Section 3.2	Largely Resolved	Section 3.2 of the TSPA-SR Technical Report and the Unsaturated Zone Flow and Transport PMR will provide descriptions of the unsaturated zone flow including integration of this component into the TSPA model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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<b>Radionuclide Transport in the Unsaturated Zone</b>	<b>Mike Wilson</b>		
T4) RT in the UZ abstraction output is justified through comparison to output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	UZFT PMR, TSPA-SR Section 3.7	Largely Resolved	Section 3.7 of the TSPA-SR Technical Report and the Unsaturated Zone Flow and Transport PMR will provide descriptions of the unsaturated zone transport. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important design features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the consideration of RT in the UZ abstraction.	UZFT PMR, TSPA-SR Section 3.7	Largely Resolved	Section 3.7 of the TSPA-SR Technical Report and the Unsaturated Zone Flow and Transport PMR will provide descriptions of the unsaturated zone transport including integration of this component into the TSPA model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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<b>Flow Paths in the Saturated Zone</b>	<b>Bill Arnold</b>		
T4) Flow paths in the SZ abstraction output are justified through comparison to output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	SZFT PMR, TSPA-SR Section 3.8	Partially Resolved	Section 3.8 of the TSPA-SR Technical Report and the Saturated Zone Flow and Transport PMR will provide descriptions of the saturated zone flow. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important site (geologic and hydraulic) features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the flow paths in the SZ abstraction.	SZFT PMR, TSPA-SR Section 3.8	Partially Resolved	Section 3.8 of the TSPA-SR Technical Report and the Saturated Zone Flow and Transport PMR will provide descriptions of the saturated zone flow including integration of this component into the TSPA model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
<b>Radionuclide Transport in the Saturated Zone</b>	<b>Bill Arnold</b>		
T4) RT in the SZ abstraction output is justified through comparison to output of detailed process models or empirical observations (laboratory testing, natural analogs, or both).	SZFT PMR, TSPA-SR Section 3.8	Partially Resolved	Section 3.8 of the TSPA-SR Technical Report and the Saturated Zone Flow and Transport PMR will provide descriptions of the saturated zone flow. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important physical phenomena and couplings and consistent and appropriate assumptions are incorporated into the consideration of RT in the SZ abstraction.	SZFT PMR, TSPA-SR Section 3.8	Partially Resolved	Section 3.8 of the TSPA-SR Technical Report and the Saturated Zone Flow and Transport PMR will provide descriptions of the saturated zone flow including integration of this component into the TSPA model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
<b>Dilution of Radionuclides Due to Well Pumping</b>	<b>Bill Arnold</b>		
T4) Dilution of RNs due to well pumping abstraction output is justified through comparison to outputs of detailed process models or empirical observations (laboratory test).	SZFT PMR, Biosphere PMR, TSPA-SR Section 3.9	Largely Resolved	For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) PA analyses incorporate important hydrogeologic features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the dilution of RNs due to well pumping abstraction.	SZFT PMR, Biosphere PMR, TSPA-SR Section 3.9	Largely Resolved	For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.

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<b>Lifestyle of the Critical Group</b>	<b>Bill Arnold</b>		
T4) Dose calculation output pertaining to lifestyle of the critical group is justified through comparison to output of detailed process models, and/or empirical observations (field data, laboratory data, or natural analogs).	Biosphere PMR, TSPA-SR Section 3.9	Largely Resolved	Section 3.9 of the TSPA-SR Technical Report and the Biosphere PMR describe the Biosphere Model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.
T5) Important site features, physical phenomena and couplings, and consistent and appropriate assumptions are incorporated into the lifestyle of the critical group abstraction.	Biosphere PMR, TSPA-SR Section 3.9	Largely Resolved	Section 3.9 of the TSPA-SR Technical Report and the Biosphere PMR describe the Biosphere Model including integration of the biosphere into the TSPA-SR model. For this acceptance criteria to be closed, the TSPA-SR Technical Report and supporting PMRs and AMRs will need to be reviewed by the NRC.