

August 2, 2002

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Office of Licensing and Regulatory Compliance  
U.S. Department of Energy  
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P.O. Box 364629  
North Las Vegas, NV 89036-8629

SUBJECT: TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION  
AGREEMENT 2.05 and 2.06

Dear Mr. Ziegler:

During a Technical Exchange and Management Meeting held on August 6-10, 2001, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) reached agreement on a number of issues within the Total System Performance Assessment and Integration (TSPAI) Key Technical Issue (KTI). By letter dated April 5, 2002, DOE provided information pertaining to TSPAI Agreement 2.05. Subsequently, during a Technical Exchange and Management Meeting held on April 15-16, 2002, DOE requested that NRC review the information provided on April 5, 2002, as it pertains to TSPAI Agreement 2.06. The NRC staff has reviewed this information as it relates to the two agreements and the results of the staff's review are enclosed.

In summary, with respect to TSPAI Agreement 2.05, the NRC staff has determined that the Enhanced Plan for Features, Events, and Processes (FEPs) at Yucca Mountain (TDR-WIS-PA-000005 REV 00) (the Enhanced FEP Plan) does not fully satisfy the intent of the TSPAI Agreement 2.05. The Enhanced FEP Plan does address, at some level, each of the thirteen items listed in the agreement. However, the Enhanced FEP Plan does not clarify a number of unclear aspects of DOE's approach, nor does it provide, in some areas, the information and detail that would give the NRC staff confidence that DOE's approach would result in the information necessary to allow a detailed review of this part of a potential license application. Therefore, based on the staff needing additional information for this agreement, TSPAI Agreement 2.05 is listed as open - "need additional information."

Regarding TSPAI Agreement 2.06, the NRC staff has determined that the Enhanced FEP Plan does not provide the information or detail necessary to allow a detailed review of DOE's initial (or pre-screening) list of FEPs. Based on the information contained in the Enhanced FEP Plan, additional information is needed before the intent of TSPAI Agreement 2.06 is satisfied. This information is needed to enable the staff to conduct a detailed review of the potential license application and does not need to be conveyed in conjunction with future NRC/DOE interactions. The agreement may be satisfied without the need for additional meetings. Therefore, TSPAI Agreement 2.06 is listed as open - "need additional information."

J. Ziegler

-2-

If you have any questions regarding this letter, please contact Mr. James Andersen of my staff. He can be reached at (301) 415-5717.

Sincerely,  
/RA/

Janet Schlueter, Chief  
High-Level Waste Branch  
Division of Waste Management  
Office of Nuclear Material Safety  
and Safeguards

Enclosure: As stated  
cc: See attached distribution list

J. Ziegler

-2-

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Letter to J. Ziegler from J. Schlueter dated August 2, 2002

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H. Jackson, Public Citizen

## **NRC Review of DOE Documents Pertaining to Key Technical Issue Agreements**

The U.S. Nuclear Regulatory Commission (NRC) goal of issue resolution during the pre-licensing period is to assure that the U.S. Department of Energy (DOE) has assembled enough information on a given issue for NRC to accept a license application for review. Resolution by the NRC staff during pre-licensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. Also, and just as importantly, resolution by the NRC staff during pre-licensing does not prejudge what the NRC staff evaluation of that issue will be after its licensing review. Issues are resolved by the NRC staff during pre-licensing when the staff has no further questions or comments about how DOE is addressing an issue. Pertinent new information could raise new questions or comments on a previously resolved issue.

This enclosure addresses two NRC/DOE agreements made during the August 6-10, 2001, Total System Performance Assessment and Integration (TSPAI) Technical Exchange and Management Meeting (see NRC letter dated August 23, 2001, which summarized the meeting). By letter dated April 5, 2002, DOE submitted information to address TSPAI Agreement 2.05. Subsequently, during a Technical Exchange and Management Meeting held on April 15-16, 2002, DOE requested that NRC review the information provided on April 5, 2002, as it also pertains to TSPAI Agreement 2.06. The information submitted for these agreements is discussed below:

### **1) Total System Performance Assessment and Integration Agreement 2.05**

#### **Wording of the Agreement:**

It is not clear to the NRC that the current list of FEPs [Features, Events, and Processes] (i.e., the list of FEPs documented in TDR-WIS-MD-000003, 00/01) is sufficiently comprehensive or exhibits the necessary attribute of being auditable (e.g., transparent and traceable). As discussed in the two TSPAI technical exchanges, there are unclear aspects of the approach that DOE plans to use to develop the necessary documentation of those features, events, and processes that they have considered. Accordingly, to provide additional confidence that the DOE will provide NRC with: (1) auditable documentation of what has been considered by the DOE, (2) the technical basis for excluding FEPs, and (3) an indication of the way in which included FEPs have been incorporated in the performance assessment; DOE will provide NRC with a detailed plan (the Enhanced FEP Plan) for comment. In the Enhanced FEP Plan, DOE will address the following items: (1) the approach used to develop a pre-screening set of FEPs (i.e., the documentation of those things that DOE considered and which the DOE would use to provide support for a potential license application), (2) the guidance on the level-of-detail that DOE will use for redefining FEPs during the enhanced FEP process, (3) the form that the pre-screening list of FEPs will take (e.g., list, database, other descriptions), (4) the approach DOE would use for the ongoing evaluation of FEPs (e.g., how to address potentially new FEPs), (5) the approach that DOE would use to evaluate and update the existing scope and description of FEPs, (6) the approach that DOE would use to improve the consistency in the level of detail among FEPs, (7) how the DOE would evaluate the results of its efforts to update the existing scope and definition of FEPs, (8) how the Enhanced FEP process would support assertions that the resulting set of FEPs will be sufficiently comprehensive (e.g., represents a wide range of both beneficial and potential adverse effects on performance) to reflect clearly what DOE has considered, (9) how DOE would indicate their disposition of included FEPs in the performance assessment, (10) the role and definition of the different hierarchical levels used to document the information (e.g., "components of FEPs" and "modeling issues"), (11) how the hierarchical

Enclosure

levels used to document the information would be used within DOE's enhanced FEP process, (12) how the Enhanced FEP Plan would result in documentation that facilitates auditing (i.e., lead to a process that is transparent and traceable), (13) DOE's plans for using configuration management controls to identify FEP dependencies on ongoing work and design changes. DOE will provide the Enhanced Plan to NRC by March 2002.

NRC Review:

While conducting its review of DOE's approach to features, events, and processes in the documentation supporting the Total System Performance Assessment for Site Recommendation (TSPA-SR), the NRC staff identified a number of concerns, including that DOE's scenario analysis does not, but needs to at the time of a potential license application, provide NRC with: (1) auditable documentation of what has been considered by the DOE, (2) the technical basis for excluding FEPs, and (3) an indication of the way in which included FEPs have been incorporated in the performance assessment. These concerns were discussed during two NRC/DOE technical exchanges on the TSPAI Key Technical Issue (KTI) in 2001. During these technical exchanges, aspects of the DOE approach remained unclear to the NRC staff. Seven agreements were reached in the second of these technical exchanges. TSPAI Agreement 2.05 is one of three agreements that address DOE's scenario analysis approach globally. From the perspective of the NRC staff, this thirteen-part agreement was reached with DOE to give the NRC staff confidence that DOE had an appropriate plan for developing the information necessary to enable the NRC staff to conduct a detailed review of the potential license application.

TSPAI Agreement 2.05 addresses a plan that the DOE would develop to clarify its approach and to provide confidence that, at the conclusion of the process of conducting and documenting the scenario analysis, DOE would be able to provide the NRC with the information necessary to conduct a detailed review of this part of the potential license application. The NRC staff recognizes that DOE has some flexibility in how FEPs are addressed. Consequently, the agreement asks for DOE to provide their plan for the Enhanced FEP Process to the NRC staff for comment. The NRC staff also recognizes that implementation may result in changes to aspects of the plan. However, the approach outlined in the DOE Plan will determine or influence the information that will be available for the NRC review of a potential license application.

To evaluate whether the plan submitted by DOE fulfills the intent of TSPAI Agreement 2.05, the NRC staff evaluated whether the plan: (1) clarified sufficiently the aspects of DOE's approach, (2) provided information and detail that would give the NRC staff confidence that the process would result in the information necessary to enable a detailed review of this part of a potential license application, and (3) addressed the thirteen items listed in the agreement. Using these criteria, the NRC staff has determined that The Enhanced Plan for Features, Events, and Processes (FEPs) at Yucca Mountain (TDR-WIS-PA-000005 REV 00) (the Enhanced FEP Plan) does not fully satisfy the intent of TSPAI Agreement 2.05. The plan does address, at some level, each of the thirteen items listed in the agreement. However, the plan does not clarify a number of aspects of DOE's approach nor does it provide, in some areas, the information and detail that would give the NRC staff confidence that DOE's approach would result in the information necessary to enable a detailed review of this part of a potential license application. The information needed for DOE to fully satisfy this agreement is provided below.

## Results of the Review:

### General Observations

In the Enhanced FEP Plan, DOE has described an approach that uses “hierarchical classification levels” (Section 3.2.1). The Enhanced FEP Plan indicates that changes to the previous classification structure are being made to improve the consistency with other Yucca Mountain Project literature. Four different “hierarchical classification levels” are discussed. Hierarchical Level 1 would represent the coarsest division of the repository issues, by repository system and subsystem (e.g., engineered subsystem, natural subsystem (geosphere), biosphere, and repository system-level issues). Hierarchical Level 2 would represent the subsystem components and, as indicated in the Enhanced FEP Plan, is likely to include the list of potential engineered and natural barriers (e.g., drip shield, backfill, waste package, waste form, buffer/invert, unsaturated zone, and saturated zone). Hierarchical Level 3 would represent the characteristics, functions, processes and events that are associated with one or more subsystem components. Hierarchical Level 3 would include nominal processes, coupled processes, and disruptive events (e.g., characteristics/performance/degradation of the component, flow of water on the component, and transport of the radionuclides in the component, thermal-hydrology effects on the component, thermal-hydro-chemical effects on the component, and thermal-hydro-mechanical effects on the component, and human intrusion). DOE indicated that processes and events in Hierarchical Level 3 may be subdivided. Hierarchical Level 4 would be used to represent this subdivision.

Use of Hierarchical Level 4 for some categories and not others appears to be appropriate for the purpose of navigation in the FEP database. To the extent that Hierarchical Level 4 might be used to provide part of the technical basis for the completeness of the initial list of FEPs, DOE should address the effect of this decision. This is not to imply that DOE would need to implement Hierarchical Level 4 uniformly in order to make an appropriate case that the initial list of FEPs is complete.

Section 3.2.1.1 indicates the DOE intention to include potential barriers (e.g., backfill) on the list, even though backfill is not included in the current design (p. 21). It is acceptable for DOE to include in their initial list of FEPs, those FEPs that apply to a subsystem under consideration for the design. The NRC staff does not expect formal screening to be conducted for these FEPs. DOE could address these FEPs by stating that they are not applicable to the design (i.e., the probability is zero, because the component will not be present in the repository).

If, as described in Appendix A (A-1), DOE uses intermediate performance measures as a basis for stating that FEPs do not have a significant effect, then DOE should provide justification that the intermediate output is appropriate, including the appropriateness of the model for this demonstration and model uncertainty.

Two errors were identified in the Enhanced FEP Plan. First, the quality assurance audit in May 2001 was conducted by the DOE Office of Quality Assurance and not by NRC. NRC staff observed the audit. Second, in the excerpts of the draft Yucca Mountain Review Plan, Revision 2, portions of the review methods that NRC staff would use to evaluate the DOE information were improperly identified as acceptance criteria.

### Support for Additional Information Requests

A number of significant decisions pertaining to the approach that DOE will take have been deferred until implementation. In order for the NRC staff to have confidence that DOE’s proposed approach will result in the information necessary to enable it to conduct a detailed

review, the NRC staff needs to better understand the schedule that DOE will use to make these decisions (see additional information needed for TSPA 2.05, Item 1, below).

The approach that DOE outlines in the Enhanced FEP Plan is general and abstract. Additional detail is needed in several areas to enable the NRC staff to better understand the DOE's approach so as to have confidence that the DOE approach could result in the information necessary to enable a detailed review of a potential license application. One way to make the process more concrete and to illustrate how the process outlined in the Enhanced FEP Plan would be used by DOE, would be for DOE to provide a representative example (for a selected set of FEPs). The example would illustrate the process and shows the logic that DOE would use to make certain decisions. While this example may be useful for illustration, the intent of the agreement could be satisfied without such an example being provided.

It is not clear that using key words, alone, to describe FEP components would provide enough information to clearly indicate those things that DOE has considered (see additional information needed for TSPA 2.05, Item 2, below). The approach that DOE would use to apply its criteria for establishing an appropriate level of detail (or coarseness) for FEPs is unclear. The coarseness used to define a FEP is influenced by the decision to either include or exclude the FEP. In addition, the Enhanced FEP Plan indicates that the level of detail in the FEPs used to support the TSPA-SR is already considered, by DOE, to be appropriate to demonstrate the safety case. However, based on the NRC staff reviews of the documentation of this scenario analysis, the staff has questions about the appropriateness of the level of detail (or coarseness) of FEPs used in this earlier analysis; hence the agreements on scenario analysis were reached (see additional information needed for TSPA 2.05, Item 3 and TSPA 2.06, Item 1, below). The complexity of a site or the design of the engineered parts of the repository could influence the number of FEPs that need to be considered. The technical basis provided in the Enhanced FEP Plan is insufficient for limiting the number (e.g., several hundred) of FEPs (see additional information needed for TSPA 2.05, Item 4, below). Further, it is not clear that using the criteria, as the approach is described in Sections 3.2.1.2 and 3.2.1.3 in the Enhanced FEP Plan, would result in DOE arriving at an appropriate level of detail nor is it apparent that Hierarchical Level 3 provides an appropriate upper bound for coarseness for defining FEPs (see additional information needed for TSPA 2.05, Item 3, below).

In Section 3.2.1.2, DOE indicates that they have "a goal" of having a single, independent screening decision (i.e., include or exclude) for each FEP (pp. 25 -26). This indicates that DOE envisions that there may be some that will not have a single, independent screening decision. The NRC is unconvinced that it is appropriate to have include and exclude combined as a screening decision (see additional information needed for TSPA 2.05, Item 5, below).

The NRC has questions regarding how DOE distinguishes between FEPs and FEP components. Additional information is needed to clarify DOE's approach and to provide confidence that FEPs (e.g., if they were to be designated as FEP components rather than as FEPs, for whatever reason) are not inappropriately excluded from the performance assessment (i.e., being excluded without the appropriate basis being provided). It is not clear how DOE will ensure that the identified FEP components are sufficiently complete to indicate what had been considered. Every aspect or attribute of a FEP included in the performance assessment need not be modeled. However, it is not clear that the DOE's approach would result in the appropriate level of screening for "FEP components" that have the potential to influence repository performance (see additional information needed for TSPA 2.05, Item 2, 7, and 8, below).

The Enhanced FEP Plan included a FEP matrix, for illustration. The NRC recognizes that decisions pertaining to this approach still need to be made (e.g., final organization). The NRC

staff has several observations and questions pertaining to the FEP matrix described in the Enhanced FEP Plan, such as the following.

- 1) Hierarchical Level 2 and Hierarchical Level 3 do not appear to be sufficiently comprehensive to support assertions that the FEP matrix will lead to a complete pre-screening list of FEPs.
  - Neither Hierarchical Level 1 nor Hierarchical Level 2 includes radionuclides as a component or subcomponent.
  - Hierarchical Level 3B does not provide a complete list of the combinations of coupled processes (e.g., thermal-hydrological-mechanical-chemical, thermal-mechanical) and it is not clear why some would be listed and others not.
  - It is not clear where large scale geologic processes, such as plate tectonics, would be included, because they apply to the geosphere, but they may not be identified as being applicable to either the unsaturated zone or the saturated zone.
- 2) Hierarchical Level 4 may not be complete, if the current divisions are to be used.
  - Hierarchical Level 4A does not include a geological category (e.g., where would geophysical processes, or potential exhumation of the repository be addressed?).
  - It is not clear where tectonic transport would be addressed (e.g., transport of waste packages by vertical fault displacement).
  - There are known links between the rows and columns that have not been identified, e.g., waste form inventory effects are related to thermal-hydrological-chemical coupling (decay heat from spent nuclear fuel) and the effects of waste form on release (and, consequently, transport). Also, why is climate and igneous activity linked, but not waste form and igneous activity or waste form and human intrusion?

The approach outlined in the Enhanced FEP Plan misses the important point of auditability that was made in technical exchanges where scenario analysis was discussed. In conducting its review, it was impossible or very difficult for the NRC staff to determine where, or if, particular FEPs were considered. Auditability is affected by both the level of detail used to define FEPs and the overlapping of FEPs; neither of these considerations were addressed in the Enhanced FEP Plan (see additional information needed for TSPA I 2.05, Item 9 and TSPA I 2.06, Item 5, below).

Below, the specific information needs are identified. Although the information may be related to more than one topic, it has only been listed once, and the topics may be interrelated.

Additional Information Needed: The following information is needed from DOE. Note that each item below also includes a reference to the part of TSPA I Agreement 2.05 that is not addressed in sufficient detail, as appropriate.

- 1) The schedule for making the significant decisions identified in the Enhanced FEP Plan; including those identified in Section 3.3 (e.g., configuration control, when AMR authors will have the list of FEPs that they will need to address, FEP AMR updates, organization of the FEP matrix).

- 2) Information supporting the assertion that the approach of using key words to describe FEP components will provide sufficient information on what has been considered or a description of the approach that DOE will use to document what has been considered. As previously discussed, a general example may help to illustrate the proposed approach. [TSPAI Agreement 2.05 (1)]
- 3) Additional detail describing how DOE will apply its criteria on level of detail for redefining FEPs, so that it is clear how DOE will balance the competing goals of coarseness and specificity when defining FEPs. As previously discussed, a general example may help to illustrate the proposed approach. [TSPAI Agreement 2.05 (2)]
- 4) Adequate Justification for DOE's approach to limit *a priori* the number of FEPs to several hundred. [TSPAI Agreement 2.05 (2)]
- 5) DOE should clarify whether their Enhanced FEP Process will, or will not, lead to instances where FEPs are considered both included and excluded. DOE should clarify where it believes this may be appropriate, why it believes that this result is appropriate, and should provide examples illustrating this. [TSPAI Agreement 2.05 (6)]
- 6) Additional detail regarding the methods that DOE will use to evaluate their approach against the Yucca Mountain Review Plan criteria (as excerpted) and the principles that will be used to guide the subjective evaluation that DOE plans to conduct. For example, it is unclear whether audits of the pre-screening list of FEPs will be conducted to support the "subjective" decision. [TSPAI Agreement 2.05 (7)]
- 7) Clarify how DOE will address the completeness of the "FEP components" considered in the screening of FEPs or the modeling of FEPs and clarify how FEP components will be addressed in the screening arguments for their associated FEPs. [TSPAI Agreement 2.05 (8)]
- 8) Clarify how the approach outlined in the Enhanced FEP Plan will not result in FEPs being designated FEP components issues nor will it lead to sufficient ambiguity as to make the FEP list incapable of being audited. [TSPAI Agreement 2.05 (10)]
- 9) Additional information clarifying how the Enhanced FEP Process will address questions of auditability, such as: (1) mutual exclusivity of FEPs (e.g., overlapping of FEPs) and (2) how auditability will be preserved with the proposed approach (i.e., the varying level of detail in defining FEPs and use of Hierarchical Level 4). [TSPAI Agreement 2.05 (12)]

Status of Agreement: TSPAI Agreement 2.05 is listed as "need additional information."

## **2) Total System Performance Assessment and Integration Agreement 2.06**

Wording of the Agreement:

DOE proposes to meet with NRC periodically to provide assessments of the DOE's progress, once it has initiated the enhanced FEP process, and on changes to the approach documented in the Enhanced FEP Plan. During these progress meetings DOE agrees to provide a justification for their approach to: (1) the level of detail used to define FEPs; (2) the degree of consistency among FEPs; and (3) comprehensiveness of the set of FEPs initially considered.

NRC Review:

At the April 15-16, 2002, Technical Exchange and Management Meeting, concerning DOE's KTI Agreement Item Planning Strategy and Discussion of Fiscal Year 2002 Agreements, DOE requested the NRC staff to evaluate whether this agreement could be closed based on the response to TSPAI Agreement 2.05. The information requested in TSPAI Agreement 2.06 is necessary to enable the NRC staff to conduct a detailed review of the scenario analysis portion of the potential license application. The Enhanced FEP plan does not provide the information or detail necessary to enable a detailed review of DOE's initial (or pre-screening) list of FEPs. Based on the information contained in the Enhanced FEP Plan, additional information is needed, before the intent of TSPAI Agreement 2.06 is satisfied (see additional information needed for TSPAI 2.06, Items 1, 2, 3, 4, and 5, below).

It is necessary that DOE provide the justification for their approach to: (1) the level of detail used to define FEPs; (2) the degree of consistency among FEPs; and (3) comprehensiveness of the set of FEPs initially considered (i.e., that a complete pre-screening list of FEPs has been identified). However, it is not necessary to have meetings to relay the required information.

DOE's approach to define FEPs will require decisions about whether, or not, closely related or coupled processes are aggregated into one FEP. As described by DOE, the initial list of FEPs will include FEPs that represent different degrees of aggregation (or level of detail). In order for the staff to evaluate the adequacy of the resulting initial list of FEPs, the list will need to be auditable. Auditability of the initial FEP list would be reduced, if FEPs are not mutually exclusive or FEPs overlap. In order for the list to be auditable, particularly when the degree of aggregation (or level of detail) within the list is quite variable, the underlying approach needs to be described so as allow conclusions on whether a hypothesized FEP was, or was not, included in the initial list of FEPs to be supported (see additional information needed for TSPAI 2.06, Item 1, below).

Additional Information Needed: The following information is needed from DOE. Note that each item below also includes a reference to the part of TSPAI Agreement 2.06 that is not addressed in sufficient detail, as appropriate.

- 1) A description of the approach used to determine the degree of aggregation used to define those FEPs appearing within the initial list of FEPs should be provided. This description should include a discussion of the important decisions made during its implementation and it should address instances where FEPs are not mutually exclusive, if they were to occur. The information provided should have sufficient detail so as to allow the NRC to evaluate whether hypothesized FEPs were, or were not, included in the initial list of FEPs and to support its conclusions. Justification for the level of detail used to define FEPs that reflects the FEPs that comprise the pre-screening list of FEPs, where the justification includes an appropriate discussion of the mutual exclusivity or overlapping of FEPs. If the number of FEPs in the pre-screening list of FEPs is limited because of a criterion used by DOE, justification for the use of this criterion needs to be provided. Justification for considering FEPs as both included and excluded needs to be provided, if this approach is used by DOE. [TSPAI Agreement 2.06 (1)]
- 2) Justification for the degree of consistency among FEPs reflecting the FEPs that comprise the pre-screening list of FEPs needs to be provided. The basis for why the FEP components identified by the DOE should not be considered FEPs also needs to be provided. [TSPAI Agreement 2.06 (2)]

- 3) If DOE uses the criteria of multiple reviews by subject matter experts and external reviewers as a basis for the completeness of the FEP list (pp. 37, 40), DOE should provide the documentation about the organization and nature of the reviews and how the review applies to the list of FEPs initially considered (i.e., the pre-screening list of FEPs arising from the Enhanced FEP Process), describe the process used to conduct the review, and the results of each review. [TSPAI Agreement 2.06 (3)]
- 4) Also, DOE should provide a rationale for why reviews of different FEP lists would apply to the completeness of the actual list, because there may be changes in level of detail, etc. DOE should clarify how previous reviews of different FEP lists will support assertions that the FEP list arising from the Enhanced FEP Process is sufficiently complete. This should include a discussion of the role of FEP components and how they pertain to completeness of DOE's consideration of features, events, and processes. [TSPAI Agreement 2.06 (3)]
- 5) If DOE uses the FEP matrix to support an assertion that its list of FEPs initially considered is complete, DOE needs to provide additional information that supports the appropriateness of the FEP matrix for this purpose. This additional information should describe how the organization and content of the, as described in Appendix A (A-1), FEP matrix, and its use, supports the assertion of completeness as an attribute of the pre-screening list of FEPs. If Hierarchical Level 4 is to be used to provide part of the technical basis for the completeness of the initial list of FEPs and it is not implemented uniformly, then additional information justifying the appropriateness of DOE's approach towards Hierarchical Level 4 should be provided. TSPAI Agreement 2.06 (3)]

Status of Agreement: TSPAI Agreement 2.06 is listed as "need additional information."