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**To:** CSPE_Group; Tae Ahn; Aladar Csontos; Dennis Galvin; Roland Benke
**Subject:** DOE NRC Teleconference on TBD 6 Appendix Q, T, S, U
**Attachments:** Summary of NRC telecon TBD 6 appendix Q T S U.wpd

Attached is the teleconference summary. Sorry to be tardy with this but computer problems prevented me from sending this out sooner. Please let me know if there are any questions.

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**Summary of NRC/DOE Teleconference on CLST 2.03/2.04/2.05 & PRE 7.03/7.05**

The NRC/DOE Teleconference on Technical Clarifications Addressing the Key Technical Issue Agreements CLST 2.03/2.04/2.05 and PRE 7.03/7.05 was held September 30, 2004, 1-3pm (EDT). The purpose of the telecon was to obtain additional clarification on the information provided in the Technical Basis Document No. 6 Appendices Q, T, S, and U. An agenda was provided to the DOE prior to the telecon, however, DOE did not have staff present to discuss the information provided in Appendix S.

The following sections provide a brief summary of the telecon discussion and are arranged by agreement to be consistent with the final agenda for the telecon.

## 1 CLST 2.04 and 2.05

The issues raised by the NRC staff were focused on:

- Dissolution of topologically close-packed (TCP) phases during solution annealing
- Determination of the maximum allowable volume fraction of TCP precipitates.
- Relationship between the results of aging and phase stability experiments and thermodynamic and kinetic modeling to assess the mechanical properties of Alloy 22
- Validity of the databases used to model phase transformations in Alloy 22
- Differences in the volume fractions of precipitates in welded Alloy-22 in Appendix Q the value reported in the Supplementary Science and Performance Analyses Report

### 1.1 Summary of the discussion for CLST 2.04 and 2.05

The dissolution of TCP phases during solution annealing is important because the presence of TCP phases can affect both the mechanical properties and corrosion resistance of Alloy 22. Information provided in response to these agreements suggests that solution annealing will be used to mitigate the detrimental effects of fabrication processes. DOE did not provide additional support for these statements and acknowledged that the FY00 mockup had TCP phases in the fabrication welds following solution annealing at 1,150 °C. However DOE indicated that the phase stability issues can be screened out because oft he limited effect on mechanical properties and corrosion resistance.

The maximum allowable volume fraction of TCP phases was raised by NRC staff because of the results of previous DOE and NRC investigations have shown that the mechanical properties of Alloy 22 are influenced by the amount of TCP phases. The DOE indicated that the revision to the Aging and Phase Stability Analysis and Model Report may contain information on the volume fraction of precipitates. However, the DOE indicated that the results documented in the Aging and Phase Stability Analysis and Model Report will not be used in the total system performance assessment analysis. This analysis and model report has not been released. The DOE will use the minimum values of the mechanical properties in the ASME code. This will be extended to include the mechanical properties of welds. The ASME code contains minimum values for yield and tensile strength, elongation, and hardness. How DOE will assure that the mechanical properties of the as fabricated waste packages actually meet or exceed the ASME minimum values has not been determined.

The relationship between the results of aging and phase stability tests and the modeling of mechanical properties was not discussed because the DOE indicated that the as fabricated waste packages will meet or exceed the minimum values of the mechanical properties in the

ASME code.

The validity of the databases used to model phase transformations in Alloy 22 was not discussed and was preempted by the statement that the DOE will use the minimum values of the mechanical properties in the ASME code for the as fabricated waste packages. The validity of the data bases may be discussed in the Aging and Phase Stability Analysis and Model Report.

The DOE indicated that the differences in the volume fractions of precipitates in welded Alloy-22 in Appendix Q the value reported in the Supplementary Science and Performance Analyses Report was a result of the improved sample preparation and analysis methods. The same material was used in both analyses. The initially reported value in the Supplementary Science and Performance Analyses Report is considered invalid because of an improper sample preparation method.

### 1.2 Assessment of the DOE Response

The issues raised were focused on the effect of fabrication processes on the mechanical properties of the waste package outer containers. DOE was not able to provide additional information to support the specific statements in the original response to the agreements. The approach to screening out the effects of fabrication processes by using the mechanical properties for Alloy 22 identified in the ASME code is acceptable, however, the manner in which this approach will be implemented needs to be determined.

## 2. CLST 2.03

The issues raised by the NRC staff were focused on

- Performance metric for the maximum acceptable flaw size for Alloy 22, Ti-G 2/7, and Ti-G 5/24
- Effects of fabrication processes on the fracture toughness of Ti-G 2/7 and Ti-G 5/24
- Use of the Charpy V-Notch (CVN) to fracture toughness ($K_{IC}$) empirical relationship for Alloy 22, Ti-G 2/7, and Ti-G 5/24
- Performance metric for acceptable materials property specifications limiting the failure mode to plastic collapse of Alloy 22, Ti-G 2/7, and Ti-G 5/24 (related to Appendices T and U)

### 2.1 Summary of the discussion for CLST 2.03

The DOE response to CLST 2.03 was not discussed in detail because the DOE did not have staff present to support the response documented in Technical Basis Document No. 6 Appendix S.

### 2.2 Assessment of the DOE Response

Not Applicable

## 3. PRE 7.03

The issues raised by the NRC staff were focused on

- Performance metric for acceptable material compositions
- Performance metric for acceptable tensile mechanical properties for welded material
- Cooling rates for heat treated weldments as compared with the required cooling rates for the Alloy 22 waste package outer containers.
- Availability of actual data on TCP phase volume fractions in the welds

### 3.1 Summary of the discussion for PRE 7.03

The performance metric for material compositions and for the acceptable tensile mechanical properties of the weld were raised because information provided by DOE indicated that certain combinations of base alloy compositions and filler metal compositions could result in welds with either low yield strength or low impact strength. DOE did not provide a methodology for determining a performance metric but indicated that the minimum values of the mechanical properties in the ASME code for the as fabricated waste packages will be used.

The question on the cooling rates for heat treated weldments compared with the required cooling rates for the Alloy 22 waste package outer containers was raised because the time of exposure at temperatures where TCP phases can be formed will depend in part on the cooling rates during quenching from the solution annealing temperature. Small test specimens can be quenched quickly and the cooling rates for the laboratory test specimens may be much greater than the specified minimum cooling rate. Therefore, it is possible that the test specimens may not be representative of the actual as fabricated waste packages. The DOE staff could not provide additional information on the cooling rates for the test specimens or how these rates compared to the proposed fabrication specifications.

Availability of actual data on TCP phase volume fractions in the welds was discussed with the DOE response to CLST 2.04 and 2.05

### 3.2 Assessment of the DOE Response

The questions on performance metric for material compositions, acceptable tensile mechanical properties of the weld, cooling rates, and volume fraction of TCP phases may be moot if an acceptable approach to screening out the effects of fabrication processes by using the mechanical properties for Alloy 22 identified in the ASME code is presented.

## 4. PRE 7.05

The issues raised by the NRC staff were focused on

- Use of test results and mechanical properties distributions in models used to evaluate mechanical performance of waste packages
- Performance metric for acceptable postweld solution annealed properties considering all allowable base metal and filler metal compositions
- Availability of mechanical property data for laser peened or controlled plasticity burnished materials
- Data availability concerning postweld repairs and criteria for acceptable performance

### 4.1 Summary of the discussion for PRE 7.05

The DOE response to the questions on use of mechanical property distributions to evaluate performance, the performance metric for material compositions, and acceptable post weld solution annealed properties are included in the summary for PRE 7.03. DOE did not provide an additional information beyond that included in Technical Basis Document No. 6 Appendix U but did indicate that the minimum values of the mechanical properties in the ASME code for the as fabricated waste packages will be used.

No additional information was provided to address the lack of data for the mechanical properties of laser peened or burnished materials. DOE emphasized that the thickness of this layer was thin and would not likely alter the performance of the entire thickness of the waste package outer container.

DOE did not have staff present to address questions on the properties welds after repairs.

### 4.2 Assessment of the DOE Response

The questions on mechanical property distributions to evaluate performance and the performance metric for material compositions and for the acceptable post weld solution annealed properties may be moot if an acceptable approach to screening out the effects of fabrication processes by using the mechanical properties for Alloy 22 identified in the ASME code is presented.

The DOE assessment of the mechanical properties of laser peened or burnished materials is acceptable because the depth of the peened or burnished layer is a small fraction of the waste package outer container thickness.