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# Meeting Summary of the First Accident Tolerant Fuel Severe Accident PIRT Panel

## Background and Objectives

ATF has seen many concepts recently, including such designs as Cr coated claddings, Cr-doped UO<sub>2</sub> pellets, FeCrAl cladding, SiC cladding, UN pellets, and metallic fuels. The NRC is also looking at fuel beyond currently approved burnup limits and fuel with enrichment above 5 weight percent U-235 along with ATF. These concepts may change the insights gained from decades of experience with UO<sub>2</sub>/Zr systems and, as a result, impact guidance (e.g. RG 1.183). The focus of this work, then, is to understand these changes and anticipate their significance. The NRC is currently organizing a panel of experts that will collaborate to create a Phenomena Identification Ranking Table (PIRT) to address the significant phenomenological issues impacting core degradation and radiological releases under severe accident (SA) conditions for various ATF designs that are being considered (including the impact of burnup/enrichment). The PIRT, once complete, will help the NRC identify how ATF concepts impact severe accident progression and will provide information to improve the severe accident computer code MELCOR, used by NRC for source term analysis.

## Meeting Summary

The first meeting of this panel of experts was scheduled and held remotely on September 9 through September 11, 2020, via the Microsoft Teams application. The purpose of this first meeting was to share information, discuss severe accident issues for ATF (including the impact of burnup/enrichment), and establish common definitions for developing the PIRT. The meeting format consisted largely of a series of prepared presentations by individual panelists, with free discussion, comments, and questions during and after the presentations. On the last day of the meeting, there was additional discussion, led by ERI, aimed at reaching a consensus on scope, definitions, and the path forward for the PIRT process.

Key observations from the meeting discussions:

- Despite there being a large body of research concerning ATFs, very little of it is integral in nature or is applicable to severe accident conditions.
- Accident progression and fission product release are often as dependent on scenario boundary conditions as on the parameters of the underlying models.
- It was suggested that the PIRT should be organized chronologically (e.g., early in-vessel, late in-vessel, ex-vessel), rather than by broad phenomenological category (e.g., oxidation phenomena, relocation phenomena, etc.).
- NRC participants reiterated that the purpose of the present effort is not to revise NUREG-1465 or regulatory guidance, but to produce a PIRT which may eventually lead to MELCOR modeling improvements that could be used in any such revisions.
- GE contributed that there are no anticipated large design changes to BWR design for ATFs relative to existing BWR designs as far as the design of channel boxes, accident scenarios to consider, etc. for FeCrAl fuels; however, nothing at this point is certain as the ATF designs are evolving.

## PIRT Process

On the final day, PIRT panelists and NRC staff discussed the format and scope of this PIRT. The agreed upon process is outlined below.

- PWR/BWR: The PIRT will be formulated for PWRs with phenomena that are specifically applicable to BWRs considered as well.
- Accident Scenarios: A high-pressure scenario (e.g., Station Blackout [SBO] without intentional or unintentional depressurization) and a low-pressure scenario (either a variant of SBO or large LOCA) will be considered.
- Phenomena: Will consider both In-Vessel (early & late in-vessel) and Ex-Vessel Phenomena to the exclusion of containment-specific phenomena.

- Importance & Ranking
  - Figures-of-Merit (FOM) for the PIRT will be Source Term (Radiological Releases to Containment) and the Generation Rate and Quantity of Combustible Gases
  - Importance Ranking:
    - High (H): Phenomenon has a significant impact of FOM.
    - Medium (M): Phenomenon has a moderate impact on FOM.
    - Low (L): Phenomenon has a minimal impact on FOM.
  - State-of-Knowledge Ranks
    - High (H): Experimental data or validated simulations either available or can be generated.
    - Medium (M): Extrapolations of closely related experimental data are possible, or approximate models either are available or can be generated.
    - Low (L): Applicable experimental data and/or approximate models not available.

## Schedule

The following schedule going forward was agreed upon by NRC staff and panelists. Note that the panelists will be performing their own rankings individually with a consolidated table being constructed in December 2020. The second PIRT panel meeting will take place in January 2021 at which time the need for an additional meeting will be assessed.

|                     |  |
|---------------------|--|
| October 9, 2020     | Panel members send feedback to ERI on the strawman PIRT.                                 |
| October 10, 2020    | ERI to send PIRT table to the panel for ranking and documentation of rationale.          |
| November 20, 2020   | Panelists will provide their PIRT rankings and associated rationale.                     |
| December 31, 2020   | ERI will send a consolidated table (including ranks by each panel & rationale).          |
| January 11-15, 2021 | The second panel meeting will be held virtually to discuss and consolidate the rankings. |
| April 2021          | ERI to submit a report summarizing the PIRT process and results.                         |

## Meeting Attendees

### Panelists:

Mohsen Khatib-Rahbar (coordinator)  
 Dana Powers  
 Didier Jacquemain  
 Jeff Gabor  
 John Metcalf  
 Luis Herranz Puebla  
 Marc Barrachin  
 Randy Gauntt  
 Richard Denning  
 Richard Hobbins  
 Yu Maruyama

### NRC Staff:

Alice Chung  
 Don Algama  
 Elijah Dickson  
 Hossein Esmaili  
 James Corson  
 Kristy Bucholtz  
 Lucas Kyriazidis  
 Mark Blumberg  
 Michelle Bales  
 Michael Salay  
 Richard Lee  
 Shawn Campbell

### Observers:

Al Csontos (EPRI)  
 Fran Bolger (EPRI)  
 Fred Smith (EPRI)  
 Matt Nudi (EPRI)  
 Rob Daum (EPRI)  
 Erick Ball (ERI)  
 Alfred Krall (ERI)  
 Zhe Yuan (ERI)  
 Michael Zavisca (ERI)  
 Bret Boman (Framatome)  
 Gary Peters (Framatome)  
 Jeff Reed (Framatome)  
 Paul Whitman (Framatome)  
 Kent Halac (GNF)  
 Ricardo Davis-Zapata (GNF)  
 Myles Connor (GNF)  
 Russ Fawcett (GNF)  
 Colby Jenson (INL)  
 Ben Holtzman (NEI)  
 Dave Luxat (SNL)  
 Jesse Phillips (SNL)  
 John Reynolds (SNL)  
 Dave Mitchell (Westinghouse)  
 James Scobel (Westinghouse)  
 Ray Schneider (Westinghouse)  
 Zeses Karoutas (Westinghouse)