NuScale DC Application Design Basis Failed Fuel Fraction Issue

September 2017

Purpose of this meeting

- Recap staff actions/interactions on this subject
- Discuss NuScale's technical and regulatory approach in the development of the design basis failed fuel fraction
- Discuss the staff's evaluation of this approach
- NuScale input
- Path forward

Staff Actions to Date

- This issue was formally identified early in the pre-application phase when NuScale submitted a proposed Topical Report on Effluent Release (GALE Replacement) Methodology (but then the report was withdrawn)
- Identified during the Readiness Assessment in September 2016 as a potential docketing issue
- Documented as a critical issue in the schedule letter dated 5/22/2017
- Discussed with NuScale in public meeting on 4/18/2017 and during audit status meetings
- Issued RAI on 4/25/2017. Evaluated response dated 6/19/2017. Evaluated as closed/unresolved.
- Communicating with NuScale in the meeting today

NuScale Approach

- NuScale is proposing to use a 0.028% failed fuel fraction as the design basis for the facility while using higher source term values in design basis accident (DBA) analyses and in the TSs
  - This is an order of magnitude less than the source term used in the Chapter 15 DBA analysis
- NuScale's proposal for a lower failed fuel fraction is based on
  - Claimed realistic failed fuel fraction of 0.0028%
    - Based on operating experience from large light water reactors and assumed fuel performance during operation of the NuScale design
  - Multiplication by a factor of 10 for "conservatism"
    - NuScale's proposed consistency with licensing practice for large light water reactors

NuScale Approach

- NuScale's proposed TS 3.4.8 establishes the acceptable initial conditions for the design basis accident (DBA) source term for dose equivalent Iodine (DEI) and Xenon (DEX)
- NuScale's proposed TS permits operation above the design basis failed fuel fraction but below the DBA initial conditions
- NuScale asserts that a TS restricting operation above the design basis failed fuel fraction assumption is not warranted because it doesn't meet the criteria of 10 CFR 50.36

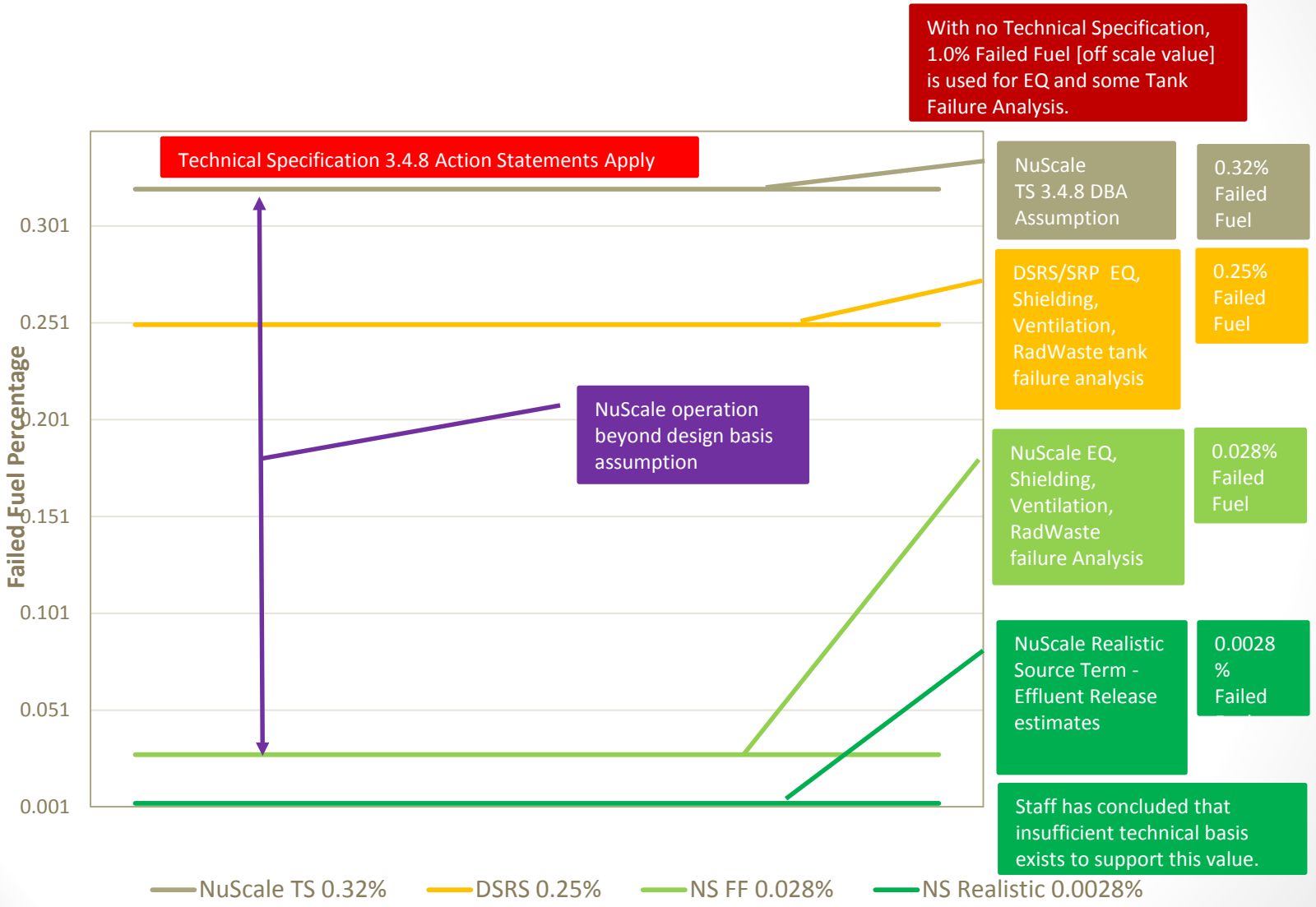
Staff Evaluation - Overview

- For an unproven and untested fuel design, a reasonably conservative approach for establishing the technical basis for the design basis failed fuel fraction is necessary
  - Operating experience has shown that fuel failures continue to occur in light water reactors
  - NuScale has not provided sufficient technical basis for its proposed design basis failed fuel fraction
  - NuScale has not proposed regulatory controls to preclude operation above design basis failed fuel fraction

Staff Evaluation

- NuScale's approach deviates from that approved for all operating reactors and previous design certifications which include a TS that encompasses the design basis failed fuel fraction
  - All operating reactors and design certification applications have assumed 0.25% failed fuel as an assumption in the design of radiation protection design features (higher values for EQ analyses)
- The staff's regulatory approach on this issue has been consistent and is documented in DSRS Chapters 11 and 12
  - The DSRS provides a possible path forward if an applicant wants to use a lower design basis failed fuel fraction that involves adoption of an appropriate TS
- The lower design basis failed fuel fraction is credited in the NuScale design for ensuring that regulatory requirements are met, including 10 CFR Part 20 requirements
- NuScale has not proposed regulatory controls to ensure the plant will be operated in accordance with the design basis radiation protection features
  - Operational programs should not be unduly credited to ensure design basis limits are met

Comparison of Failed Fuel Percentages



Staff Evaluation (con't)

- NuScale has not provided sufficient information to justify the proposed design basis failed fuel fraction
  - The derivation, including method and data used, of the design basis failed fuel fraction is not technically sufficient
  - Factor of 10 provides less absolute margin when compared to the higher failed fuel fraction assumed for currently licensed plants
- NuScale has not provided sufficient justification to support the direct applicability of operating reactor failed fuel experience to the NuScale design
  - Fuel and core design is different (first of a kind)
  - No operational experience or fuel performance testing with this design
  - Unique manufacturing and operational challenges may occur due to first of a kind fuel design

Staff evaluation (con't)

- NuScale's approach would permit operation above the assumed design basis failed fuel fraction resulting in
  - A potential unanalyzed condition requiring reliance on operational programs to minimize worker and public exposure instead of design features
  - Potentially exceeding regulatory requirements for on-site and off-site doses and does not provide reasonable assurance that the requirements of 10 CFR Part 20 (ALARA, and minimizing contamination) are met
- In addition, the EQ evaluation of safety-related SSCs has consistently been conducted at the TS limit in implementing the requirements of 10 CFR 50.49 and GDC 4. This evaluation should be conducted at the TS limit.

Staff Position

- For an unproven and untested fuel design, a reasonably conservative approach for establishing the technical basis for the design basis failed fuel fraction is necessary
- NuScale's approach would permit operation above the assumed design basis failed fuel fraction used in the design of shielding and ventilation systems and is inconsistent with EQ precedence
- As such, appropriate regulatory controls for the design basis failed fuel fraction must be established to provide reasonable assurance the reactor will be operated in accordance with the proposed design basis.
- Once sufficient operational experience and technical information are gathered with its design, NuScale may propose to relax or remove these regulatory controls.

- NuScale Input (as desired)
- Path Forward
- Opportunity for Public Comment
- Closing of Meeting