## Background

In a letter dated November 7, 2013, the NRC informed the Technical Specifications Task Force (TSTF) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13246A358) of Nuclear Regulatory Commission (NRC) staff concerns recently identified during a review of plant-specific license amendments requesting adoption of three Travelers:

- Traveler TSTF-51, Revision 2, "Revise Containment Requirements during Handling Irradiated Fuel and Core Alterations," which was approved on November 1, 1999 (ADAMS Accession No. ML993190284). TSTF-51 removed the Technical Specifications (TS) requirements for certain systems to be Operable from the Pressurized Water Reactor (PWR) and Boiling Water Reactor (BWR) Standard Technical Specifications (STS) after sufficient radioactive decay has occurred to ensure the projected offsite dose from a fuel handling accident will be less than a small fraction of the 10 CFR 100 limit. To support this change in requirements during the handling of irradiated fuel, the Operability requirements during Core Alterations were deleted. The accidents postulated to occur during Core Alterations, in addition to fuel handling accidents, are: inadvertent criticality (due to a control rod removal error or continuous control rod withdrawal error during refueling or boron dilution), and the inadvertent loading of, and subsequent operation with, a fuel assembly in an improper location. These events are not postulated to result in fuel cladding integrity damage. TSTF-51 eliminated all uses of the defined term Core Alterations from Applicability statements in the PWR NUREGs and most uses of Core Alterations in Required Actions.

- TSTF-286, Revision 2, "Operations Involving Positive Reactivity Additions," which was approved on July 6, 2000 (ADAMS Accession No. ML003730788). TSTF-286 revised Actions and Notes in the PWR STS that required suspension of operations involving positive reactivity additions or precluded reduction in boron concentration by instead limiting positive reactivity addition to within the TS-required Shutdown Margin; and

- TSTF-471, Revision 1, "Eliminate Use of Term Core Alterations in Actions and Notes," which was approved on December 7, 2006 (ADAMS Accession No. ML062860320). Following approval of TSTF-51, the defined term Core Alterations appeared in the Required Actions and Surveillance Notes of less than ten PWR STS specifications. Suspending Core Alterations or exempting testing except during Core Alterations had no effect on the initial conditions or mitigation of any Design Basis Accident (DBA) or transient, and the requirements applied an operational burden with no corresponding safety benefit. Therefore, TSTF-471 eliminated the defined term "Core Alterations," and removed the remaining references to Core Alterations from the PWR STS.

The table in Attachment 1 indicates the Technical Specifications affected by TSTF-51 (removal of Core Alterations only), TSTF-286, and TSTF-471.

The BWR STS make extensive use of the term Core Alterations in Applicability statements, Actions, and Surveillances, and in the Special Operations Specifications. TSTF-51 did not change the Technical Specifications related to source range monitors (LCO 3.3.1.2) in the BWR

ISTS. TSTF-471 and TSTF-296 did not modify the BWR ISTS. Therefore, the TSTF believes that the NRC staff concerns related to source range detectors are only applicable to PWR plants. At the January 9, 2014 TSTF/NRC public meeting, the NRC agreed to consider the TSTF position and reply. So far, no NRC response has been received.

For reference, Core Alterations is defined as, "CORE ALTERATION shall be the movement of any fuel, sources, or reactivity control components, within the reactor vessel with the vessel head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position."

**Industry/NRC Interaction**

The NRC staff questions on TSTF-51, TSTF-286, and TSTF-471 were identified during the review of two license amendment requests:

- On March 8, 2012, Arizona Public Service (APS) submitted a license amendment request for Palo Verde Units 1, 2, and 3, to adopt TSTF-471. On February 13, 2014, Arizona Public Service withdrew the Palo Verde license amendment request to adopt TSTF-471 from NRC review.

- Entergy submitted a license amendment request for Arkansas Nuclear One, Unit 2, on April 4, 2012 to adopt TSTF-51, TSTF-286, TSTF-471, and TSTF-272, "Refueling Boron Concentration Clarification," (ML12096A022).

Wolf Creek Nuclear Operating Company (WCNOC) submitted a license amendment request to adopt TSTF-51 on August 13, 2013 related to adoption of alternative source term (AST). The NRC provided the following Request for Additional Information:

> Please provide a fuel handling accident analysis that evaluates the dropping of loads allowed over irradiated fuel assemblies (i.e. new fuel assembly, sources or reactivity control components) onto irradiated fuel assemblies prior to and after the proposed 76-hour decay time. The analysis should only credit those safety systems required to be operable as required by technical specification. This will provide the staff with reasonable assurance that the fuel handling accident analysis doses remain within regulatory limits when references to Core Alterations are removed from TSs and Engineered Safety Features are no longer required during movement of loads such as new fuel assemblies, sources or reactivity control components.

The NRC and the TSTF discussed the staff concerns at the November 21, 2014 and January 9, 2014 TSTF/NRC public meetings, and during a teleconference held on November 26, 2013. The following additional information was discussed:

- In response to Question a, the NRC agreed that while in a TS action, redundant Source Range Detectors (SRDs) are not required. The NRC is concerned that while one SRD is inoperable, that removing an assembly or other core component (as insertion of positive reactivity is prohibited by the TS), that an accident, such as dropping a fresh fuel

assembly into an improper location, could lead to an accidental criticality which would not be detected by the Operable SRD. The TSTF agreed to investigate this concern.

- In response to Question b, the NRC is concerned that a partially loaded core, with no fuel close to an Operable SRD, could go critical in case of a boron dilution with no warning to the operator. The TSTF agreed to investigate this concern.

- The NRC is concerned that a postulated accident (fuel drop) or operator error with one SRM inoperable could result in an accidental criticality.

- In response to Question c, the NRC is concerned that removing the Applicability of "During Core Alterations," from mitigating systems could result in accidents with higher dose consequences than a fuel handling accident during movement of recently irradiated fuel. The TSTF agreed to investigate this concern.

- In response to Question d, the NRC agreed to consider the TSTF's position.

**NRC Staff Concerns and Industry Response**

The staff's concerns are given below in italics, followed by the industry response.

a. *NUREG-0800, The Standard Review Plan for the Review of Safety Analysis Reports [SAR] for Nuclear Power Plants: LWR [Light Water Reactor] Edition – Transient and Accident Analysis (SRP Chapter 15) Section 15.4.6, "Inadvertent Decrease In Boron Concentration in the Reactor Coolant System (PWR)," (ADAMS Accession No. ML070380222) Item 4 on page 15.4.6-8, states:*

> *When necessary, the reviewer evaluates the effects of single active failures of systems and components that may affect the course of the transient. This phase of the review uses SRP system review procedures for SAR Chapters 5, 6, 7, 8, and 9. In particular, redundant alarms that alert the operator to the unplanned dilution are confirmed.*

*It is the NRC staff's understanding that the operator relies upon a neutron flux alarm to identify and terminate a design basis boron dilution event or to detect a misloaded assembly. Additionally, licensees use the neutron flux alarm to alert personnel working in the vicinity of the reactor of the high neutron flux condition (via local alarm and/or announcement) and to prevent possible offsite releases of radioactive material.*

Industry Response

The historical NRC staff position is that the single failure criterion is a design criteria met by an appropriate system design and the TS provide a temporary relaxation of the single failure design criteria while in an Action statement. This position is recorded in several NRC documents:

- Generic Letter 80-30 states, "The NRC's Standard Technical Specifications (STS) were formulated to preserve the single failure criterion for systems that are relied upon in the safety analysis report. By and large, the single failure criterion is preserved by

specifying Limiting Conditions for Operation (LCOs) that require all redundant components of safety related systems to be OPERABLE. When the required redundancy is not maintained, either due to equipment failure or maintenance outage, action is required, within a specified time, to change the operating mode of the plant to place it in a safe condition. The specified time to take action, usually called the equipment out of service time, is a temporary relaxation of the single failure criterion, which, consistent with overall system reliability considerations, provides a limited time to fix equipment or otherwise make it OPERABLE. If equipment can be returned to OPERABLE status within the specified time, plant shutdown is not required."

- More recently, NRC Inspection Manual, Part 9900, "Operability Determinations & Functionality Assessments for Conditions Adverse to Quality or Safety," Appendix C.1, "Relationship Between the GDC and the Technical Specifications," stated, "Required actions and completion times of the TSs illustrate the relationship between the GDC and the TSs. The GDC require redundancy of function for safety systems. This is normally accomplished by incorporating at least two redundant trains into the design of each safety system. The TSs typically allow a facility to continue to operate for a specified time with only one train of a two-train safety system operable. In that case, the GDC are met because the system design provides the necessary redundancy. The TSs permit the operation of the system with only a single train based on an evaluation of the protection provided by the unique system lineup for the specified period."

Therefore, the lack of single failure protection while in the TS Action for one inoperable source range detector is consistent with the NRC position and the plant's licensing basis.

Source range detectors are not used to detect a misloaded fuel assembly. A source range detector can only detect neutrons originating from a limited area around the detector and a change in local reactivity resulting from a misloaded fuel assembly would not be detected in the majority of the core. Standard Review Plan Section 15.4, "Inadvertent Loading and Operation of a Fuel Assembly in an Improper Position," discusses identification of a misloaded assembly using incore power distribution monitoring during startup tests, as well as provisions to search for loading errors during core loading. The Standard Technical Specifications Bases incorrectly state that the source range detectors are used to detect a misloaded fuel assembly. The TSTF is preparing a TSTF Traveler to eliminate this incorrect Bases statement.

Local radiation alarms in containment may be used by licensees to alert workers in the containment of the need to evacuate. The source range detectors are not credited for this purpose.

The use of the source range detectors to detect a boron dilution accident is discussed in response to Question b.

b. *During core alterations (i.e., movement of fuel), there is the potential for operable neutron detectors to become effectively decoupled from the fuel assemblies being monitored. For example, some plants have only two source range monitors (one for each half of the core). If one source range monitor becomes inoperable, and certain, strategically located fuel*

*assemblies are removed; then the other, operable neutron source monitor may no longer be capable of monitoring some fuel assemblies that are located in the far half of the core. Therefore, the NRC staff is concerned that the removal of the words CORE ALTERATIONS from the TS LCO for source range monitors may create a situation where a boron dilution accident, misloaded fuel assembly, or an increase in neutron flux might go undetected. The NRC staff's preliminary review of this issue indicates that the removal of the words CORE ALTERATIONS may create a situation not consistent with the SRP guidance related to "redundant alarms," described in SRP Section 15.4.6.*

Industry Response

Two clarifications: The term "core alterations" has never appeared in the source range detector LCO or Applicability, only in the Required Actions. The question states, "During core alterations (i.e., movement of fuel),..." The subject Travelers did not affect requirements during the movement of irradiated fuel.

The removal of suspension of core alterations from the Required Actions of the source range detector Technical Specification (i.e., adoption TSTF-471) has no effect on the initiation or detection of a boron dilution event, as core alterations have no effect on RCS boron concentration or the ability to detect changes in reactivity.

See "Recommended Actions" for a discussion of prevention of positive reactivity additions with an inoperable source range detector for plants adopting TSTF-286 and TSTF-471.

c. *The NRC staff is concerned that a dropped source, fuel assembly, or component (or any other item allowed to be moved by CORE ALTERATIONS) could damage a fuel assembly or break creating a radioactive source term. Additionally, a dropped source, component, or fuel assembly could add reactivity if it is dropped over or in the vicinity of other fuel. If so, the NRC staff may require an analysis to show that the dose consequences of these scenarios are less limiting than the current fuel handling accident.*

Industry Response

See "Recommended Actions" for actions for plants adopting TSTF-51 or TSTF-471.

d. *The NRC staff is also concerned that if there is no definition of core alterations in the TS there may be some confusion as to the circumstances or operations under which the requirement of Title 10 of the Code of Federal Regulations Section (10 CFR) 50.54 applies. The regulation at 10 CFR 50.54 specifies the assignment of a senior operator dedicated to fuel handling tasks during core alterations.*

Industry Response

Paragraph 10 CFR 50.54(m)(2)(iv) states, "Each licensee shall have present, *during alteration of the core of a nuclear power unit (including fuel loading or transfer),* a person holding a senior operator license or a senior operator license limited to fuel handling to directly supervise the activity and, during this time, the licensee shall not assign other duties

to this person" (emphasis added). The regulation does not use or reference the TS defined term, "core alterations."

When a TS definition is intended to be used in the regulation, it is referenced. For example, 10 CFR 54(m)(2)(i), table footnote 2, states, "For the purpose of this table, a nuclear power unit is considered to be operating when it is in a mode other than cold shutdown or refueling as defined by the unit's technical specifications." If the intent was to use the TS definition of Core Alterations, the TS would have been similarly referenced in Paragraph 50.54(m)(2)(iv).

Since 10 CFR 50.54(m)(2)(iv) does not reference the TS, the phrase "alteration of the core of a nuclear power unit (including fuel loading or transfer)" must be taken as a "plain language" statement which is independent from any similar phrase in the TS. Licensees will continue, as required, to meet this regulation whether the TS "core alterations" term is present or not. Removal of the TS definition will no effect on application of the regulation.

**Proposed Actions**

1. Plants proposing to adopt TSTF-51 should confirm in the license amendment request:

   - The licensee evaluated the dropping of loads allowed over irradiated fuel assemblies (i.e. a new fuel assembly, sources, or reactivity control components) onto irradiated fuel assemblies in the reactor vessel or fuel storage pool and confirmed that the resulting onsite and offsite dose results are bounded by the fuel handling accident of record, when crediting only those safety systems required to be operable by the proposed Technical Specifications.

   - Prior to the decay time assumed in the accident analysis, new or irradiated fuel assemblies, sources, or reactivity control components are not moved over the fuel seated in the reactor vessel.

2. Plants proposing to adopt TSTF-286 should confirm in the license amendment request:

   - The proposed Technical Specifications include only the Required Actions in the ISTS Section 3.9 Nuclear Instrumentation condition for an inoperable source range detector to suspend positive reactivity additions, and do not include the Required Action to suspend operations that would cause introduction of coolant into the RCS with boron concentration less than required to meet the boron concentration of LCO 3.9.1.

   - The proposed Technical Specifications will include a Required Action to suspend movement of fuel assemblies, sources, and reactivity control components in the reactor vessel, modified by a Note that allows fuel assemblies to be moved if needed to facilitate repair of the inoperable source range detector. [This position to be discussed with the NRC, as some allowance is needed to facilitate repair of the inoperable source range.]

     - The TSTF will consider a Traveler to revise the ISTS to eliminate the Required Action which allows boron dilution.

3. Plants proposing to adopt TSTF-471 should confirm in the license amendment request:

   - The licensee evaluated the dropping of loads allowed over irradiated fuel assemblies (i.e. a new fuel assembly, sources, or reactivity control components) onto irradiated fuel assemblies in the reactor vessel or fuel storage pool and confirmed that the resulting onsite and offsite dose results are bounded by the fuel handling accident of record, when crediting only those safety systems required to be operable by the proposed Technical Specifications.

## Attachment 1

## Changes Related to TSTF-51, TSTF-286, and TSTF-471

The following tables only include TSTF-51 changes related to removal of the term "Core Alterations" from the Applicability or Actions.

### NUREG-1430, B&W

| LCO | TSTF-51 | TSTF-286 | TSTF-471 |
|---|---|---|---|
| 3.3.9, "Source Range Neutron Flux" | | X | |
| 3.3.10, "Intermediate Range Neutron Flux" | | X | |
| 3.3.15, "Reactor Building Purge Isolation" | X | | |
| 3.3.16, "control Room Isolation - High Radiation" | X | | |
| 3.4.5, "RCS Loops - Mode 3" | | X | |
| 3.4.6, "RCS Loops - Mode 4" | | X | |
| 3.4.7, "RCS Loops - Mode 5, Loops Filled" | | X | |
| 3.4.8, "RCS Loops - Mode 5, Loops Not Filled" | | X | |
| 3.7.10, "Control Room Emergency Ventilation System (CREVS)" | X | | |
| 3.7.11, "Control Room Emergency Air Temperature Control System (CREATCS)" | X | | |
| 3.8.2, "AC Sources - Shutdown" | | X | X |
| 3.8.5, "DC Sources - Shutdown" | | X | X |
| 3.8.8, "Inverters - Shutdown" | | X | X |
| 3.8.10, "Distribution Systems - Shutdown" | | X | X |
| 3.9.1, "Boron Concentration" | | | X |
| 3.9.2, "Nuclear Instrumentation" | | X | X |
| 3.9.3, "Containment Penetrations" | X | | |
| 3.9.4, "Decay Heat Removal (DHR) and Coolant | | X | |

| | | | |
|---|---|---|---|
| Circulation - High Water Level" | | | |
| 3.9.5, "Decay Heat Removal (DHR) and Coolant Circulation - Low Water Level" | | X | |
| 3.9.6, "Refueling Canal Water Level" | X | | |

**NUREG-1431, Westinghouse**

| LCO | TSTF-51 | TSTF-286 | TSTF-471 |
|---|---|---|---|
| 3.3.1, "RTS Instrumentation" | | X | |
| 3.3.9, "Boron Dilution Protection System (BDPS)" | | X | |
| 3.3.6, "Containment Purge and Exhaust Isolation Instrumentation" | X | | |
| 3.3.7, "Control Room Emergency Filtration System (CREFS) Actuation Instrumentation" | X | | |
| 3.4.5, "RCS Loops - Mode 3" | | X | |
| 3.4.6, "RCS Loops - Mode 4" | | X | |
| 3.4.7, "RCS Loops - Mode 5, Loops Filled" | | X | |
| 3.4.8, "RCS Loops - Mode 5, Loops Not Filled" | | X | |
| 3.4.18, "RCS Isolated Loop Startup" | | X | |
| 3.7.10, "Control Room Emergency Filtration System (CREFS)" | X | | |
| 3.7.11, "Control Room Emergency Air Temperature Control System (CREATCS)" | X | | |
| 3.8.2, "AC Sources - Shutdown" | | X | X |
| 3.8.5, "DC Sources - Shutdown" | | X | X |
| 3.8.8, "Inverters - Shutdown" | | X | X |
| 3.8.10, "Distribution Systems - Shutdown" | | X | X |
| 3.9.1, "Boron Concentration" | | | X |

| | | | |
|---|---|---|---|
| 3.9.2, "Unborated Water Source Isolation Valves" | | | X |
| 3.9.3, "Nuclear Instrumentation" | | X | X |
| 3.9.4, "Containment Penetrations" | X | | |
| 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation - High Water Level" | | X | |
| 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level" | | X | |
| 3.9.7, "Refueling Canal Water Level" | X | | |

**NUREG-1432, Combustion Engineering**

| LCO | TSTF-51 | TSTF-286 | TSTF-471 |
|---|---|---|---|
| 3.3.7, "Containment Purge Isolation Signal (CPIS)" (Analog) | X | | |
| 3.3.8, "Control Room Isolation Signal (CRIS)" (Analog) | X | X | |
| 3.3.8, "Containment Purge Isolation Signal (CPIS)" (Digital) | X | | X |
| 3.3.9, "Control Room Isolation Signal (CRIS)" (Digital) | X | X | |
| 3.3.13, "Logarithmic Power Monitoring Channels" (Analog) | | X | |
| 3.3.13, "Logarithmic Power Monitoring Channels" (Digital) | | X | |
| 3.4.5, "RCS Loops - Mode 3" | | X | |
| 3.4.6, "RCS Loops - Mode 4" | | X | |
| 3.4.7, "RCS Loops - Mode 5, Loops Filled" | | X | |
| 3.4.8, "RCS Loops - Mode 5, Loops Not Filled" | | X | |
| 3.7.11, "Control Room Emergency Air Cleanup System (CREACS)" | X | | |

| | | | |
|---|---|---|---|
| 3.7.12, "Control Room Emergency Air Temperature Control System (CREATCS)" | X | | |
| 3.8.2, "AC Sources - Shutdown" | | X | X |
| 3.8.5, "DC Sources - Shutdown" | | X | X |
| 3.8.8, "Inverters - Shutdown" | | X | X |
| 3.8.10, "Distribution Systems - Shutdown" | | X | X |
| 3.9.1, "Boron Concentration" | | | X |
| 3.9.2, "Nuclear Instrumentation" | | X | X |
| 3.9.3, "Containment Penetrations" | X | | |
| 3.9.4, "Shutdown Cooling (SDC) and Coolant Circulation - High Water Level" | | X | |
| 3.9.5, " Shutdown Cooling (SDC) and Coolant Circulation - Low Water Level" | | X | |
| 3.9.6, "Refueling Water Level" | X | | |

**NUREG-1433, BWR/4**

| LCO | TSTF-51 | TSTF-286 | TSTF-471 |
|---|---|---|---|
| 3.3.6.2, "Secondary Containment Isolation Instrumentation" | X | | |
| 3.3.7.1, "Main Control Room Environmental Control (MCREC) System Instrumentation" | X | | |
| 3.6.1.3, "Primary Containment Isolation Valves" | X | | |
| 3.6.4.1, "[Secondary] Containment" | X | | |
| 3.6.4.2, "Secondary Containment Isolation Valves" | X | | |
| 3.6.4.3, "Standby Gas Treatment (SGT) System" | X | | |
| 3.7.4, "Main Control Room Environmental Control (MCREC) System" | X | | |

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|---|---|---|---|
| 3.7.5, "Control Room AC System" | X | | |

**NUREG-1436, BWR/6**

| LCO | TSTF-51 | TSTF-286 | TSTF-471 |
|---|---|---|---|
| 3.3.6.1, "Primary Containment Isolation Instrumentation" | X | | |
| 3.3.6.2, "Secondary Containment Isolation Instrumentation" | X | | |
| 3.3.7.1, "Control Room Fresh Air (CRFA) System Instrumentation" | X | | |
| 3.6.1.3, "Primary Containment Isolation Valves" | X | | |
| 3.6.4.1, "[Secondary] Containment" | X | | |
| 3.6.4.2, "Secondary Containment Isolation Valves" | X | | |
| 3.6.4.3, "Standby Gas Treatment (SGT) System" | X | | |
| 3.7.3, "Control Room Fresh Air (CRFA) System" | X | | |
| 3.7.4, "Control Room AC System" | X | | |