



TSTF-576 Example Scenarios



TSTF-576, Rev. 1 - Methodology

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- 1 Under the proposed SR, the results of the Inservice Testing Program individual valve testing will be reviewed to verify that the collective performance of the S/RVs will ensure Safety Limit 2.1.2 is protected. If all of the required S/RVs actuate within the assumed tolerance, the SR is met.

- 2 If the as-found individual S/RV performance is not within the inputs and assumptions of the previous cycle RLA, the previous cycle overpressure RLA is reevaluated using revised inputs based on the as-found test results and the NRC-approved methodology for the licensee. The purpose of the evaluation is to determine if the RLA of the previous cycle bounded the actual plant performance and the SR was met. This reevaluation may be performed by the licensee or a vendor. The evaluation is performed using the measured S/RV lift settings for tested S/RVs and the upper limits of the ASME Code testing allowance for any S/RVs that were not tested. Any S/RV that was required to be tested but that could not be tested, or if the results cannot be determined, is assumed to be out-of-service.

Note: The red paragraph numbers will be referenced in the following slides.

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- 3 The previous cycle RLA reevaluation may result in one of the following outcomes:
 - 3.i If the previous cycle RLA reevaluation demonstrates that the calculated overpressure is less than or equal to the RLA calculated peak overpressure for the limiting event (i.e., the RLA results were bounding), then the SR was met and the OPS was operable during the previous cycle. It can be assumed that the current cycle RLA inputs and assumptions contain adequate conservatism to account for the as-found S/RV performance. No further action is required.
 - 3.ii If the previous cycle RLA reevaluation does not demonstrates that the calculated overpressure is less than or equal to the RLA calculated peak overpressure for the limiting event (i.e., the RLA results are not bounding), the previous cycle overpressure analysis was not consistent with actual plant performance and the issue will be entered into the Corrective Action Program (as required by 10 CFR 50, Appendix B, Criterion XVII, "Corrective Actions,"). The previous cycle performance will be evaluated for reportability under 10 CFR 50.72 and 10 CFR 50.73.
- 4 If the previous cycle RLA reevaluation determines the RLA overpressure analysis did not bound actual plant performance, the current cycle overpressure RLA must be reevaluated to determine if the overpressure RLA bounds the actual plant performance.
- 5 The current cycle reevaluation will use the licensee's NRC-approved methodology but with inputs revised to consider the results of the as-found S/RV testing. The nature of the changes to the inputs will depend on the cause of the as-found failures and the similarities or differences between the previous cycle and the current cycle. An evaluation of the cause of the as-found failures may result in changes to the S/RV tolerances or other assumptions in the reevaluation. If it is determined that the OPS is not operable, the TS Actions require a plant shutdown.



Example Plant Configuration

- Dome Pressure Safety Limit (SL): <1325psig
- 11 S/RVs, all with same nominal lift setpoints
- Standard set of assumed S/RV lift setpoints used as input to each cycle's RLA:
 - 10 valves open at +4 psi higher than nominal setpoint
 - 1 valve fails to open (1 SRVOOS)

Legend for scenario slides:

- Blue boxes describe the analyses/evaluations that exist prior to performing SR

- Orange boxes describe the available testing to support the SR

- Yellow boxes describe necessary explicit re-analyses, likely performed by the vendor

- Green boxes describe evaluations that can be performed by utility w/o need for explicit vendor re-analysis.

Acronym	Definition
Cycle N	Currently operating plant cycle of operation
Cycle N-1	Previously operated plant cycle of operation
OP	Reactor Vessel Over-Pressure
RLA	Reload Licensing Analysis (effectively the Overpressure Analysis of Record, re-performed every reload)
SL	Safety Limit
S/RV	Safety / Relief Valve
SR	Surveillance Requirement
SRVOOS	S/RV Out of Service (i.e., the S/RV is assumed to not open)



Scenario 1 (SR Met, RLA Valid)

Cycle N-1

(operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N

(currently operating)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1290 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results

10 S/RV test at +2

1 S/RV tests at +6 (accounted for by RLA 1SRVOOS)

Cycle N Current S/RV Setpoints

(not measurable during cycle operation;
all as-left setpoints were within tolerance)

Cycle N SR Evaluation

- The assumed S/RV lift setpoints input to the RLA are already more conservative than test results
 - Thus, the existing Cycle N-1 RLA SL confirmation analysis is bounding
- Satisfies SR for Cycle N-1**

Cycle N SR "Between Performance" Evaluation

Explicit Evaluation Not Needed

(The standard set of assumed S/RV lift setpoints which support the Cycle N RLA have been validated as conservative based directly on the Cycle N-1 test results)

SR Completion Steps:

Paragraph 1 – Satisfied (for N & N-1)

(Cycle N-1 test results are all less limiting than the standard set of assumed S/RV lift setpoints which support the Cycle N-1 and Cycle N RLAs, thus both RLAs remains bounding)

**SR MET for Cycle N-1,
Cycle N RLA is Valid**



Scenario 2 (SR Met, RLA Valid)

Cycle N-1

(operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N

(currently operating)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1290 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results

9 S/RVs test at +2
2 S/RVs test at +6



Cycle N-1 SR Evaluation

Explicit re-analysis performed

- Assumes: Cycle N-1 As-Found
- Yields: 1250 psig
< 1270 psig RLA
< Safety Limit → **SR MET**

Cycle N Current S/RV Setpoints

(not measurable during cycle operation;
all as-left setpoints were within tolerance)

Cycle N SR "Between Performance" Evaluation

Explicit Evaluation Not Needed

(The standard set of assumed S/RV lift setpoints which support the Cycle N RLA have effectively been validated to yield conservative OP results by the Cycle N-1 re-analysis)

SR Completion Steps:

Paragraph 1 – Not Satisfied

(Cycle N-1 test results are NOT all less limiting than the standard set of assumed S/RV lift setpoints which support the Cycle N-1 RLA, thus the Cycle N-1 RLA is not known to be bounding/conservative)

Paragraph 2 – Performed

(explicit re-analysis of Cycle N-1)

Paragraph 3.i – Satisfied (for Cycle N & N-1)

(re-analysis demonstrates that Cycle N-1 RLA inputs yield conservative OP results. Thus, the "standard" set of assumed S/RV lift setpoints are confirmed conservative, and both Cycle N-1 and N RLAs are validated)

**SR MET for Cycle N-1,
Cycle N RLA is Valid**



Scenario 3 (SR Met, RLA Valid)

Cycle N-1
(operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N
(currently operating)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1290 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results

5 S/RVs test at +2
6 S/RVs test at +6

Cycle N Current S/RV Setpoints

(not measurable during cycle operation; all as-left setpoints were within tolerance)

Cycle N-1 SR Evaluation

Explicit Re-analysis performed

- Assumes: Cycle N-1 As-Found
- Yields: 1290 psig
> 1270 psig RLA
< Safety Limit → SR MET

Cycle N SR "Between Performance" Evaluation

Qualitative Evaluation:

- 2 stage were installed in Cycle N-1, 3 stage are installed in Cycle N
- Thus Cycle N-1 as-found measurements do not invalidate Cycle N RLA input assumptions

Existing RLA continues to satisfies SR for Cycle N

SR Completion Steps:

Paragraph 1 – Not Satisfied

Paragraph 2 – Performed

Paragraph 3.i – Not Satisfied (for N)

(re-analysis did not demonstrates that the standard set of assumed S/RV lift setpoints yield bounding RLA results)

Paragraph 3.ii – Satisfied (for N-1)

(Cycle N-1 re-analysis shows OP with as-found setpoints is < SL)

Paragraph 4 – Performed

(re-evaluation of Cycle N overpressure RLA performed)

Paragraph 5 – Satisfied (for N)

(explicit Cycle N RLA re-analysis is not necessary because consideration of the Cycle N-1 as-found 2-stage S/RV test results does not directly indicate a concern with the 3-stage S/RVs installed in Cycle N. After qualitative evaluation, the utility demonstrates that the existing technical basis for their existing Cycle N RLA S/RV setpoint assumptions has not been invalidated)

SR MET for Cycle N-1, Cycle N RLA is Valid



Scenario 4 (SR Met, RLA Valid)

Cycle N-1
(operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N
(currently operating)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1290 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results

5 S/RVs test at +2
6 S/RVs test at +6

Cycle N Current S/RV Setpoints
(not measurable during cycle operation; all as-left setpoints were within tolerance)

Cycle N-1 SR Evaluation

Explicit Re-analysis performed

- Assumes: Cycle N-1 As-Found
- Yields: 1290 psig

> 1270 psig RLA
< Safety Limit → **SR MET**

Cycle N SR "Between Performance" Evaluation

Requires RLA Update

Explicit RLA Update Re-analysis

- Assumes: 10 S/RVs set at +5 psi and 1 SRVOOS (updated assumed S/RV setpoints)
- Yields: 1310 psig, <1325 psig SL

SR Completion Steps:

- Paragraph 1 – Not Satisfied
- Paragraph 2 – Performed
- Paragraph 3.i – Not Satisfied (for N)
- Paragraph 3.ii – Satisfied (for N-1)
- Paragraph 4 – Performed
- Paragraph 5 – Satisfied (for N)

- Update the standard set of assumed S/RV lift setpoints to consider the results of as-found Cycle N-1 S/RV testing
- Use the updated set of "standard" S/RV setpoints as input to an updated Cycle N RLA
- The updated Cycle N RLA confirms the SL is met for Cycle N

**SR MET for Cycle N-1,
Valid Updated Cycle N RLA Obtained**

Update Standard Set of Assumed S/RV Lift Setpoints used in RLAs *

Explicit Cycle N-1 Re-analysis of:

10 S/RVs set at +5 psi and 1 SRVOOS
(considers Cycle N-1 as-found setpoints)

- Yields: 1310 psig
- Thus: Conservative for Generic Use

* This describes a possible technique for updating the standard set of S/RV setpoints to consider the Cycle N-1 test results. Specific approaches to satisfying Paragraph 5 may vary between utilities.



Scenario 5 (SR Met, RLA Not Valid)

Cycle N-1
(operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N
(currently operating)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1290 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results

- 2 S/RVs test at +2
- 9 S/RVs test at +6

Cycle N Current S/RV Setpoints
(not measurable during cycle operation; all as-left setpoints were within tolerance)

Cycle N-1 SR Evaluation

Explicit Re-analysis performed

- Assumes: Cycle N-1 As-Found
- Yields: 1318 psig > 1270 psig RLA < Safety Limit → SR MET

Cycle N SR "Between Performance" Evaluation

Requires RLA Update

Explicit RLA Update Re-analysis

- Assumes: 11 S/RVs set at +6 psi (updated standard set of S/RV setpoints)
- Yields: 1340 psig, >1325 psig SL

SR Completion Steps:

- Paragraph 1 – Not Satisfied
- Paragraph 2 – Performed
- Paragraph 3.i – Not Satisfied (for N)
- Paragraph 3.ii – Satisfied (for N-1)
- Paragraph 4 – Performed
- Paragraph 5 – SR Not Met (for N)

- Update the standard set of assumed S/RV lift setpoints to consider the results of as-found Cycle N-1 S/RV testing
- Use the updated set of "standard" S/RV setpoints as input to an updated Cycle N RLA
- The updated Cycle N RLA can not confirm that the SR will be met at end of Cycle N

**SR MET for Cycle N-1,
Valid Cycle N RLA NOT Obtained**

Update Standard Set of Assumed S/RV Lift Setpoints used in RLAs

Explicit Cycle N-1 Re-analysis of:

- 11 S/RVs set at +6 psi (considers Cycle N-1 as-found results)
- Yields: 1320 psig, >1318 psig
- Thus: Conservative for Generic Use



Scenario 6 (SR NOT Met, RLA Valid)

Cycle N-1
(operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1280 psig < 1325 psig SL

Cycle N
(currently operating)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results

2 S/RVs test at +2
9 S/RVs test at +6

Cycle N Current S/RV Setpoints

(not measurable during cycle operation; all as-left setpoints were within tolerance)

Cycle N-1 SR Evaluation

Explicit Re-analysis performed

- Assumes: Cycle N-1 As-Found
- Yields: 1328 psig > 1280 psig RLA > Safety Limit → **SR NOT MET**

Cycle N SR "Between Performance" Evaluation

Requires RLA Update

Explicit RLA Update Re-analysis

- Assumes: 11 S/RVs set at +6 psi (updated standard set of S/RV setpoints)
- Yields: 1320 psig, <1325 psig SL

SR Completion Steps:

Paragraph 1 – Not Satisfied

Paragraph 2 – Performed

Paragraph 3.i – Not Satisfied (for N)

Paragraph 3.ii – **SR Not Met (for N-1)**

(Cycle N-1 re-analysis shows that Cycle N-1 overpressure analysis performed with S/RV setpoints at as-found values is > SL)

Paragraph 4 – Performed

Paragraph 5 – **Satisfied (for N)**

(standard setpoint input assumptions revised to consider Cycle N-1 testing, used to produce updated Cycle N RLA, and confirms the SL is satisfied for Cycle N due to a less severe Cycle N core design)

SR NOT Met* for Cycle N-1, Valid Updated Cycle N RLA Obtained

Update Standard Set of Assumed S/RV Lift Setpoints used in RLAs

Explicit Cycle N-1 Re-analysis of:

- 11 S/RVs set at +6 psi (considers Cycle N-1 as-found results)
- Yields: 1330 psig, >1328 psig
- Thus: **Conservative for Generic Use**

* More detailed operability assessments for Cycle N-1 may be able to show SR was met. The approach shown here assumes only NRC approved methodologies for cycle OP RLA analyses are utilized.



Scenario 7 (SR Met, RLA Valid)

Cycle N-1 (operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N (currently operating)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1290 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results

- 8 S/RV test at +2
- 2 S/RVs test at -6 (below +/-3 ASME tolerance)

Cycle N Current S/RV Setpoints (not measurable during cycle operation; all as-left setpoints were within tolerance)

Cycle N SR Evaluation

- The standard set of RLA input assumptions are already more conservative than test results for the purpose of the overpressure analysis, so RLA results are bounding
- **Satisfies SR for Cycle N-1**

Cycle N SR “Between Performance” Evaluation

- Explicit Evaluation Not Needed**
(there’s no concern with Cycle N standard set of RLA inputs for the purpose of the overpressure analysis, as they’ve been validated as conservative for Cycle N-1)

SR Completion Steps:

Paragraph 1 – Satisfied (for N & N-1)

(Cycle N-1 test results are all less limiting than the standard set of assumed S/RV lift setpoints which support the Cycle N-1 and Cycle N RLAs for the purposes of the overpressure analysis,* thus both RLAs remains bounding)

**SR MET for Cycle N-1,
Cycle N RLA is Valid**

* However, due to valves opening below allowable set pressure, overall potential impacts to other analyses due to the valves which opened below the ASME testing tolerance would be evaluated through the utility’s corrective action program



Scenario 8 (SR Met, RLA Valid)

Cycle N-1 (operation complete)

RLA:

- Assumes: 10 S/RVs set at +4 psi and 1 SRVOOS
- Yields: 1270 psig < 1325 psig SL

Cycle N-1 S/RV As-Found Test Results (limited-scope valve testing)

5 of 11 total S/RVs tested:

- 4 S/RV test at +2 (within ASME tolerance)
- 1 S/RVs test at +6 (above ASME tolerance)

ASME code does not require further explicit testing of valves against +/-3 tolerance

- remaining 6 S/RVs assumed "test" result at +3 (top end of ASME tolerance)

Cycle N SR Evaluation

4 S/RV test at +2 and
6 S/RV assumed "test" result at +3
are bounded by
RLA assumed 10 S/RV at +4 psi

1 S/RV test at +6
is bounded by
RLA assumed 1 SRVOOS

- Conclusion: the assumed S/RV lift setpoints input to the RLA are already more conservative than "test" results
- Thus, the existing Cycle N-1 RLA SL confirmation analysis is bounding

Satisfies SR for N-1

Cycle N SR "Between Performance" Evaluation

Explicit Evaluation Not Needed

SR Completion Steps:

Paragraph 1 – Satisfied (for N & N-1)

(The combination of the Cycle N-1 measured test results and "assumed" test results allowed per ASME code are all less limiting than the standard set of assumed S/RV lift setpoints which support the Cycle N-1 and Cycle N RLAs, thus both RLAs remains bounding)

**SR MET for Cycle N-1,
Cycle N RLA is Valid**