Proposal to Establish Alternate Requirements for Components Commensurate with Safety and Risk – Code Case N-940 Conditions

NRC Public Meeting
Rockville, MD
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Purpose

Discuss industry's response to two of the NRC's conditions on Code Case N-940 in RG 1.87 Rev. 3.

The industry's position is that these conditions are not appropriate and unnecessarily restrict use of the Code Case.

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Section III Alternate Requirements

- Supporting SI-2027-01 Increasing Value of Section III
  - Section III must take advantage of emerging technology, sound lifecycle management, and utilization of risk-informed categorization & treatment of structures, systems, and components for nuclear power reactors to improve commercial viability
  - To remain viable, Section III must also address unique aspects of Advanced Reactors

- Provide new ***options*** for construction of Section III, Div 5 items commensurate with their contribution to safety or risk (i.e., in the "intermediate" graded safety category) via alternative requirements that:
  - Use design rules developed specifically for nuclear applications
  - Align Section III construction requirements with typical industrial codes

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Section III Alternate Requirements – Technical Basis

1. Use of industrial codes is generally permitted for the "intermediate" graded safety category within the regulatory framework
   - Regulatory Guide 1.87, Revision 2 links safety classifications from categorization standards like 10CFR50.69 and NEI 18-04 to applicable minimum requirements for construction
   - Items that are NSRST or RISC-2 and RISC-3 could be constructed to industrial codes with appropriate justification and special treatments
2. Nuclear design rules are already used in nuclear applications
   - Section III design rules appropriately account for the unique requirements of nuclear applications via design allowables and Service Limits
3. Section III design rules (design allowables and Service Limits) were established independent of NDE and testing requirements

Reference: PVP2025-155535

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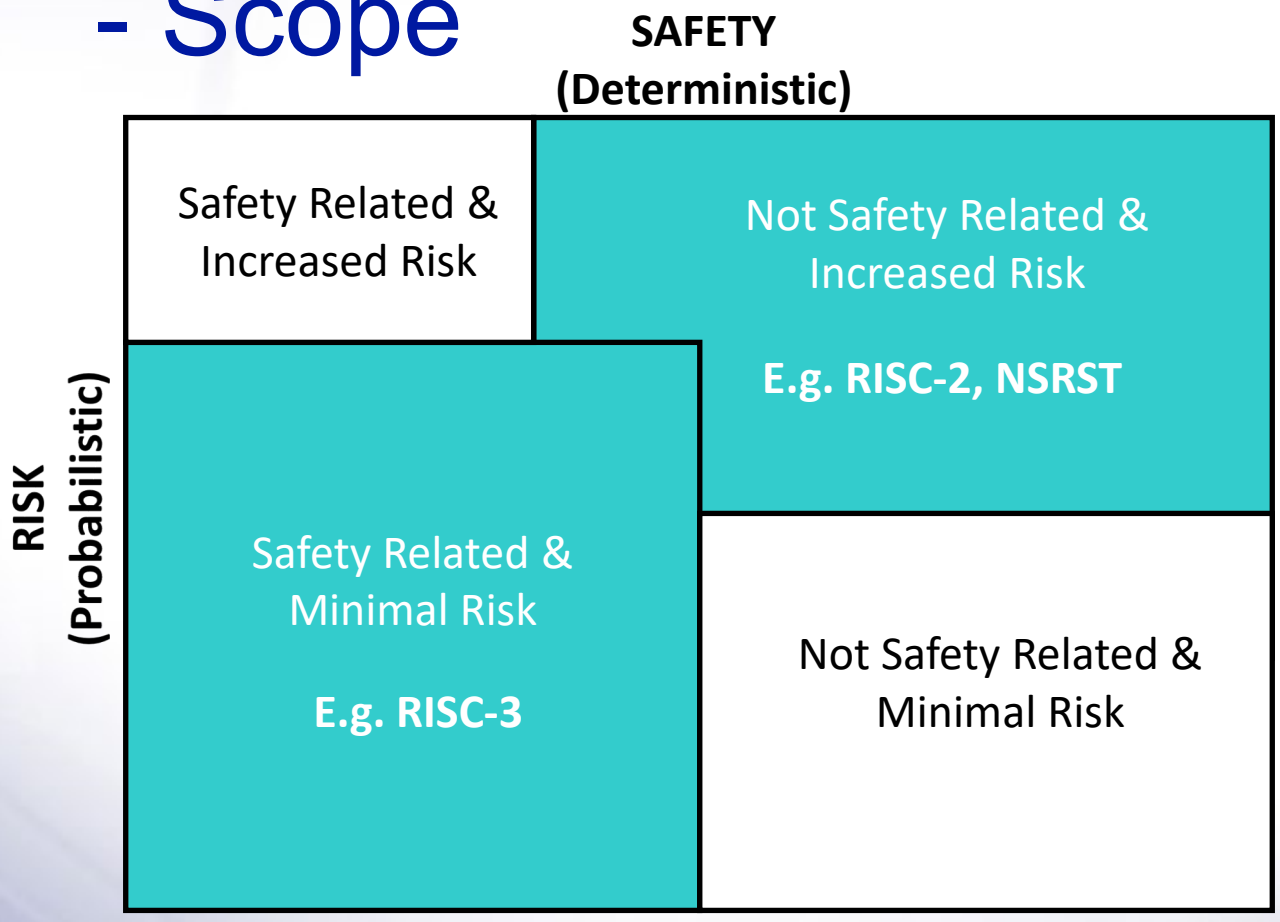
Section III Alternate Requirements - Scope



Relative size of boxes for illustration, based on engagement with AR developers

Scope of interest: Metallic items with **moderate** contribution to safety or risk, or the "intermediate" graded safety category

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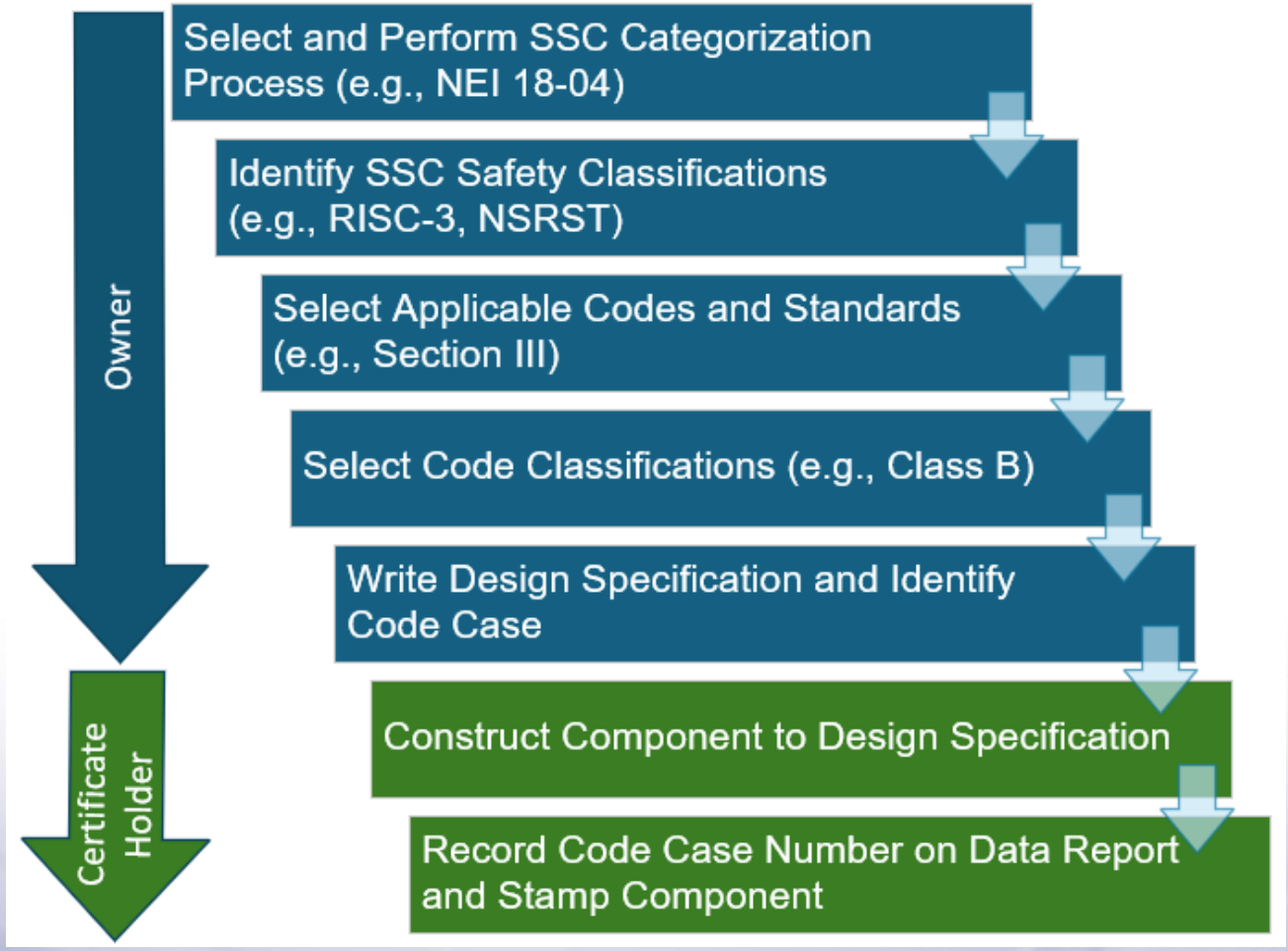
Section III Alternate Requirements - Roadmap



Reference: PVP2025-155535

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Implementation Approach

- Materials, Fabrication, and Examination Requirements
  - Code revisions for alternate material procurement
  - Code Case to permit alternate methods for NDE and testing
- Quality Assurance Requirements
  - Code Case for alternate quality assurance requirements for Subsection NCA

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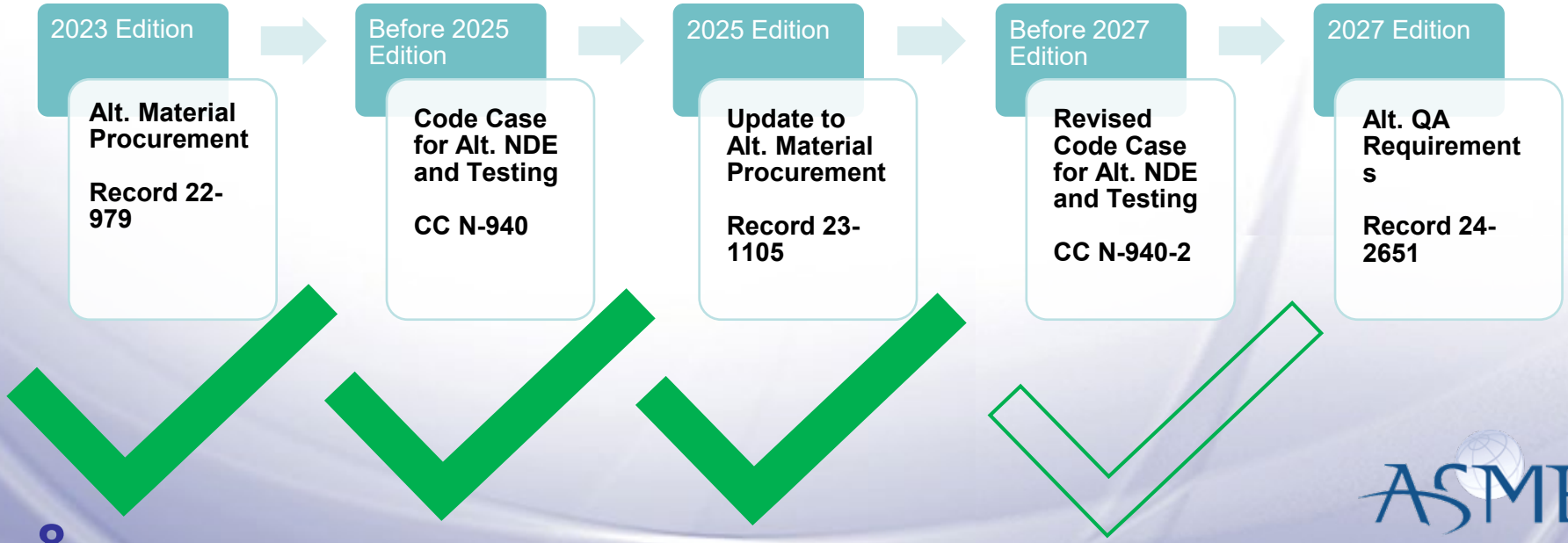

Section III Alternate Requirements - Code Case N-940

Code Case to permit additional NDE and Testing Approaches:

- Allow ultrasonic inspection for piping as an alternative to radiography
- Allow random and progressive sampling for NDE of moderate energy piping
- Allow system leak test as an alternative to hydrostatic leak test for moderate energy piping
- Allow shorter hold times for valve pressure testing

Related Records: 23-15, 25-1531

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Section III Alternate Requirements - Code Case N-940 (Organization)

Nonmandatory Appendix		A	B	D	C
Main Body Paragraph		**UT as Alternative to RT**	**Alt. Extent of Piping Examination**	**System Leak Testing as Alt. to Pressure Test**	**Alt. Valve Test Hold Times**
-2000	Class A, Low Temperature	Permitted for piping systems			X
-3000	Class A, Elevated Temperature				X
-4000, -5000	Class B, Low and Elevated Temperature	Permitted for piping systems	Permitted for moderate energy piping systems	Permitted for moderate energy piping systems	X
-6000	Supports	X			

Reference: PVP2025-155535

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Section III Alternate Requirements - Code Case N-940 (Organization)

-7000 Definitions

(b) *Moderate Energy Piping*. For the purposes of this Case, moderate energy piping systems are defined as

(1) fluid systems with water as the service fluid that operate at or below 200°F (95°C) and at or below 275 psig (1 900 kPa) during normal plant conditions

(2) fluid systems with a service fluid other than water where the Owner has specified that the piping system is moderate energy and the service fluid is not a lethal substance or other hazardous substance

Industrial codes leveraged:

- ASME B31.1 (power piping)
- ASME B31.3 (process piping)

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Code Case N-940 Conditions

- Committee has approved updates to N-940 in response to NRC conditions in DG-1436 (draft predecessor to RG 1.87, Rev. 3):
  - Add requirement for use of encoded ultrasonic testing in Nonmandatory Appendix A
  - Clarify that progressive sampling is not applied to elevated temperature operation.

- There are two conditions the industry wishes to discuss with the NRC published in RG 1.87, Revision 3:
  - System Leak Test Limitations (Condition 6 to Code Case N-940)
  - Initial Sample Size Limitations for Progressive Random Sampling (Condition 4 to Code Case N-940)

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Condition 6 to Code Case N-940

NONMANDATORY APPENDIX D
MODERATE ENERGY PIPING SYSTEM LEAK TEST REQUIREMENTS

D-1000 TEST FLUID

The test fluid is the service fluid.

D-2000 PROCEDURE

(a) During or prior to initial operation, the pressure shall be gradually increased in steps until the operating pressure is reached, holding the pressure at each step long enough to equalize piping strains.

(b) If the service fluid is a gas or vapor, the pressure shall be gradually increased until a gage pressure that is less than one-half the test pressure or 25 psi (170 kPa) is attained, at which time a preliminary visual check of the system shall be made. Thereafter, the pressure shall be gradually increased in steps until the operating pressure is reached, holding the pressure at each step long enough to equalize piping strains.

D-3000 EXAMINATION FOR LEAKS

The operating pressure shall be maintained for at least 10 min and then joints and connections of the uninsulated system shall be examined for leaks. The examination shall be conducted while the system is at operating pressure.

Basis: B31.3, Category D Fluid Service

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Condition 6 to Code Case N-940

Code Case: Allow system leak test as an alternative to hydrostatic leak test for moderate energy piping

Basis: Aligned with the requirements of B31.3-22 for Category D Fluid Service

NRC Condition: …In particular, an initial service leak test shall be used only "when other types of tests are not practical or when leak tightness is demonstrable due to the nature of the service."

NRC Revised Basis in RG 1.87: The condition in 6-CC-N-940 is consistent with industrial code ASME B31.1, which only allows initial service leak tests instead of pressure test "when other types of tests are not practical or when leak tightness is demonstrable due to the nature of the service."

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Condition 6 to Code Case N-940

Industry Comment: The premise of the Section III alternate requirements is that the **special treatment is applying the nuclear design rules with other construction requirements consistent with industrial codes**.

Therefore, the base technical requirement consistent with industrial requirement in ASME B31.3 for Category D systems (B31.3 paragraph 345.1(a)) is sufficient for this scope of components and additional conditions are not required.

NRC Response: The NRC staff disagree with this comment. The staff has considered the entirety of the construction Code in developing this position as well as considering the range of NSRST SSCs to which it could be applied under this endorsement.

Regarding leak testing, both B31.1 and B31.3 require hydrostatic testing. B31.3 allows the owner to specify initial service leak testing as an alternative to hydrostatic testing **only for Category D fluid systems. Other fluid categories including normal process fluid still require hydrostatic testing.**

Consistent with the stated objective of CC N-940 to apply Section III for design with industrial codes for construction, the staff position is that incorporating this provision from B31.1 is appropriate to provide reasonable confidence of NSRST SSC performance on a generic basis.

Question: Does the NRC's limitation unnecessarily restrict the use cases and negate the savings?

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Condition 6 to Code Case N-940

B31.3 Process Piping (N-940 Basis)

- Piping typically found in **petroleum refineries; onshore and offshore petroleum and natural gas production facilities**; chemical, pharmaceutical, textile, paper, ore processing, semiconductor, and cryogenic plants…
- Service Conditions:
  - Normal Fluid Service – generically covers piping addressed by the Code
  - Category D Fluid Service **(N-940 Basis)** – specific restrictions to fluid that is: 1) **nonflammable, nontoxic, and not damaging to human tissues**; 2) design **gage pressure does not exceed 150 psi (1035 kPa)**; 3) design **temperature does not exceed 366°F (186°C)**, and 4) fluid temp caused by anything other than atmospheric conditions is not less than -20°F (-29°C).

B31.1 Power Piping

- Piping typically found in electric power generating stations, industrial and institutional plants, geothermal heating systems, and central and district heating and cooling systems
- General philosophy is parallel to Section I Power Boilers, and is more conservative than other piping codes
- Some differences in requirements based on temperature and pressure conditions

Code Case Definition:
(1) fluid systems with **water** as the service fluid that operate **at or below 200°F (95°C)** and **at or below 275 psig (1 900 kPa)** during normal plant conditions, and
(2) fluid systems with a service fluid other than water where the Owner has specified that the piping system is moderate energy and the **service fluid is not a lethal substance or other hazardous substance**

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Condition 6 to Code Case N-940

Hold for Discussion

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Condition 4 to Code Case N-940

Code Case: Allow random and progressive sampling for NDE of moderate energy piping

Basis: Aligned with the requirements of B31.3-22 for Normal Fluid Service

B-1000 DEFINITION

When random examination of designated lots is required, the Certificate Holder shall establish the basis for designated lots unless otherwise specified by the Owner.

B-2000 SURFACE EXAMINATION

100% of all completed welds shall be surface examined by either the magnetic particle or liquid penetrant method.

Note: 100% surface examination aligns with and exceeds the B31.3 100% visual examination requirement for normal fluid service.

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Condition 4 to Code Case N-940

Code Case: Allow random and progressive sampling for NDE of moderate energy piping

Basis: Aligned with the requirements of B31.3-22 for Normal Fluid Service

B-3000 INITIAL SAMPLE SIZE

(a) **Not less than 5% of circumferential butt and miter groove welds shall be examined fully** by random radiography or by random ultrasonic examination.

(b) The welds to be examined **in each designated lot** shall include the work product of each welder or welding operator whose welds are part of the lot.

…

B-4000 EXPANSION

When the examination reveals a defect, the following shall apply:

(a) Two additional samples of the same kind (if welded or bonded joints, by the same welder, bonder, or weld operator) from the original designated lot **shall be given the same type of examination**.

(b) If the items examined as required by (a) are acceptable, the defective item shall be repaired or replaced and reexamined using the same methods and acceptance criteria employed for the original examination, and all items represented by these two additional samples shall be accepted.

(c) **If any of the items examined as required by (a) reveals a defect, two further samples of the same kind shall be examined** for each defective item found by that sampling.

(d) If all items examined as required by (c) are acceptable, the defective item(s) shall be repaired or replaced and reexamined using the same methods and acceptance criteria employed for the original examination, and all items represented by the additional sampling shall be accepted.

(e) If any of the items examined as required by (c) reveals a defect, items represented by the progressive sampling shall be either

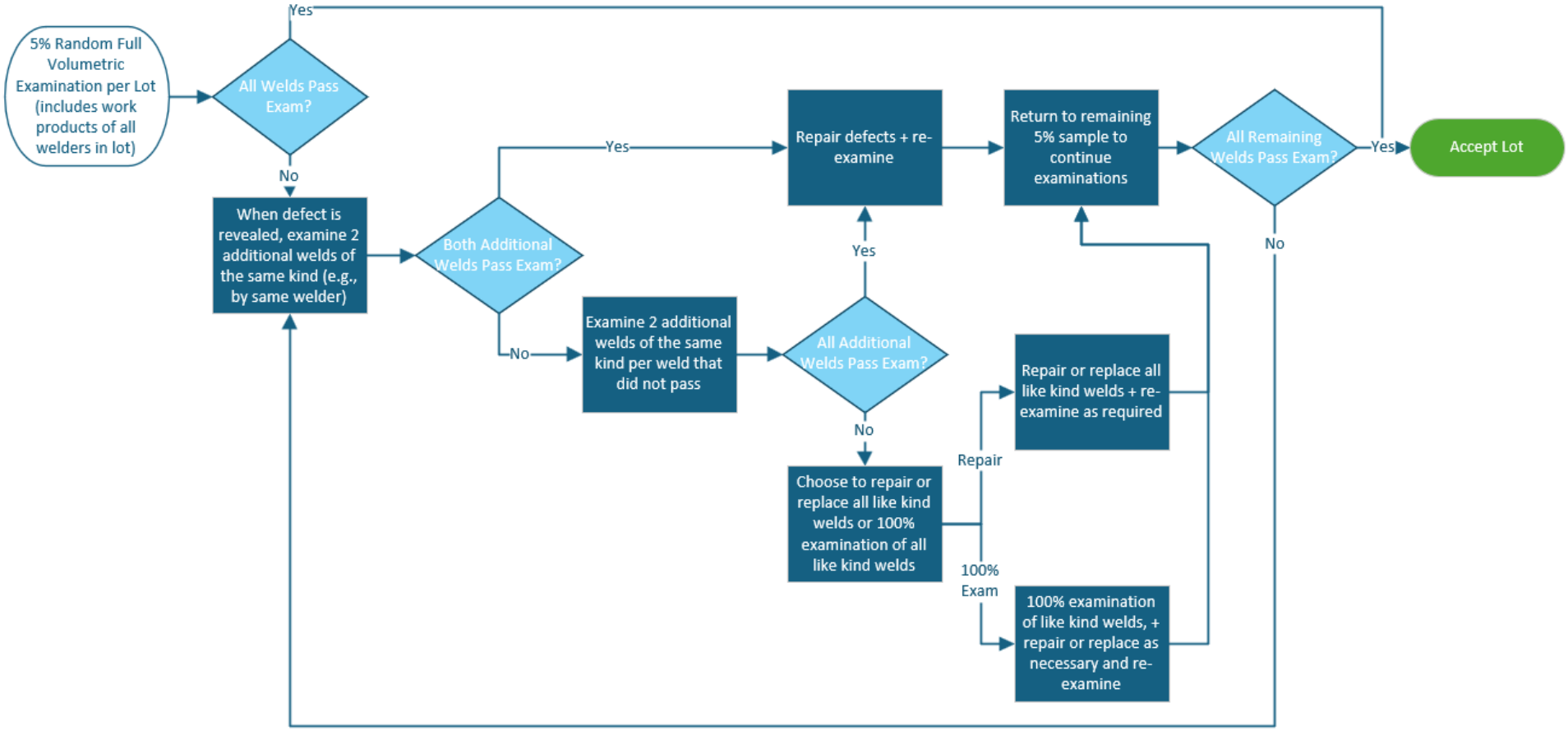
(1) repaired or replaced and reexamined as required, or

(2) fully examined and repaired or replaced as necessary, and reexamined as necessary to meet the requirements of this Case

(f) If any of the defective items are repaired or replaced, reexamined, and a defect is again detected in the repaired or replaced item, continued progressive sampling in accordance with (a), (c), and (e) is not required based on the new defects found. The defective item(s) shall be repaired or replaced and reexamined until acceptance using the same methods and acceptance criteria employed for the original examination. Spot or random examination (whichever is applicable) is then performed on the remaining unexamined joints.

Condition 4 to Code Case N-940

B31.3 progressive sampling philosophy: Our current understanding from discussions at the Task Group is this is based in workmanship standards and industry experience



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Condition 4 to Code Case N-940

Code Case: Allow random and progressive sampling for NDE of moderate energy piping (5% initial sample size of designated lot; expanded if defects revealed)

Basis: Aligned with the requirements of B31.3-22 for Normal Fluid Service

NRC Condition: For applications of progressive sampling under Nonmandatory Appendix B, the initial sample size should be one of the following:

(1) a population justified statistically to provide 95% confidence that 5% or fewer of the welds contain defects, or

(2) a lesser initial sample justified as an alternative approach as described in footnote 6 below, or

(3) for instances where a designer does not prefer to use the statistical justification in (1) or develop an alternative approach in (2), 50% random sampling is acceptable.

Footnote 6: Alternative approaches to those specified in conditions 1-CC-N-940 through 6-CC-N-940 may be proposed with justification subject to NRC review and approval. Justification should be based on the ability to meet the reliability and capability targets for the SSC...

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Condition 4 to Code Case N-940

Industry Comment: The premise of the Section III alternate requirements is that **the special treatment is applying the nuclear design rules with other construction requirements consistent with industrial codes**. Therefore, the base technical requirement consistent with industrial requirement in ASME B31.3 for Normal Fluid Service systems (B31.3 paragraph 341.4.1(b)) is sufficient for this scope of components and additional conditions are not required.

NRC Comment Response: The NRC staff disagree with this comment. The staff has considered the entirety of the construction Code in developing this position as well as considering the range of NSRST SSCs to which it could be applied under this endorsement**. Based on the scope of this endorsement being for safety-significant NSRST SSCs that should provide "increased assurance beyond normal industrial practices," the staff believe it is necessary to approve the user's sampling plans to assess the adequacy of special treatments**. The text and basis for 4-CC-N-940 have been revised to clarify the purpose of the condition and positions (1), (2), and (3) within the condition.

ASME SETTING THE STANDARD

Condition 4 to Code Case N-940

Industry Comment: The premise of the Section III alternate requirements is that **the special treatment is applying the nuclear design rules with other construction requirements consistent with industrial codes**. Therefore, the base technical requirement consistent with industrial requirement in ASME B31.3 for Normal Fluid Service systems (B31.3 paragraph 341.4.1(b)) is sufficient for this scope of components and additional conditions are not required.

NRC Revised Basis: Industrial codes, such as ASME B31.3 (Ref. 18), generally require 5% or more inspection sampling. **Given that NSRST SSCs should provide "increased assurance beyond normal industrial practices," the sampling size of 5% in N-940 does not provide reasonable confidence of performance.**

Positions (1) and (2) in condition 4-CC-N-940 in Table 5, are intended to provide a baseline on inspection sampling to provide reasonable confidence of performance, while meaningfully lowering from the 100% inspection required for SR SSCs under regular ASME BPVC Section III rules. (1) would more likely be limiting in cases where there are fewer welds to inspect, while (2) could be applied in cases with a larger population of welds that could statistically justify less than 50% sampling

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Condition 4 to Code Case N-940

Hold for Discussion

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