



A N T A R E S

NQA-1 in High Volume Reactor Manufacturing Supplier Qualification and On-boarding

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NRIC-NEI-EPRI Nuclear Quality Assurance Challenges Workshop



Company and NQA-1 Constraints

Who we are: Antares designs and builds factory mass-producible heat pipe cooled nuclear microreactors to power the DOD's most critical infrastructure.

What we're building: Baseline Reactor Design

- **1 Megawatt thermal** - Capable of scaling down to 240 kWt or up to 3 MWt depending on desired SWaP.
- **200-300 kilowatts electric** - sized for critical infrastructure resilience.
- **3 - 5 effective full-power years** of clean energy at 1 MW. Lower power operation can be used to extend generation for longer term mission needs.
- **AGR-2 TRISO** fuel enables fastest path to market

Scale of production: Grow to produce 100+ reactors a year

NQA-1 Constraint: Relying exclusively on the NQA-1 supply base can pose challenges to expanding technology and production capacity, underscoring the need to balance rigorous quality standards with strategies to foster innovation and scalability.

NQA-1 Manufacturing and Supplier Requirements

NQA-1-2022 Requirement Highlights

- **Requirement 4** – QAP requirements shall be specified in the procurement documents.
- **Requirement 7** – Supplier capability shall be evaluated to provide items or services in accordance with the requirements of procurement documents.
 - Section 200 (b) – may include current third-party certificates that recognize the Supplier’s QAP or other technical certifications.
- **CGI Definition** – Intent focused around understanding critical characteristics (design ownership) and verification

***Assumption:** Internally designed items will have key characteristics and acceptance criteria included in the design at release.*

NQA-1-2022; PART I, Requirement 4 Procurement Document Control

203 Quality Assurance Program Requirements

Quality assurance program requirements shall be specified in the procurement documents. These requirements shall be consistent with importance and/or complexity of the item or service being procured. The procurement documents shall require the Supplier to incorporate appropriate quality assurance program requirements in subtier procurement documents.

NQA-1-2022; PART I, Requirement 7 Control of Purchased Items

200 SUPPLIER EVALUATION AND SELECTION

Prior to award of a contract, the Purchaser shall evaluate the Supplier’s capability to provide items or services in accordance with the requirements of the procurement documents. Supplier evaluation and selection and the results therefrom shall be documented and shall include one or more of the following:

- (a) Supplier’s history of providing an identical or similar product that performs satisfactorily in actual use. The Supplier’s history shall reflect current capability.
- (b) Supplier’s current quality records supported by documented qualitative and quantitative information that can be objectively evaluated and may include current third-party certificates that recognize the Supplier’s quality assurance program (QAP) or other technical certifications.
- (c) Supplier’s technical and quality capability as determined by a direct evaluation of the facilities, personnel, and the implementation of the Supplier’s QAP.

NQA-1-2022; PART II, Subpart 2.14 Quality Assurance Requirements for Commercial Grade Items and Services

- **10 CFR Part 50: commercial grade item²:** a structure, system, component, or part thereof that affects its safety function, **that was not designed and manufactured (i.e., controlled) as a basic component.** Commercial grade items do not include items where the design and manufacturing process require in-process inspections and verifications to ensure that defects or failures to comply are identified and corrected (i.e., one or more critical characteristics of the item cannot be verified).
- **10 CFR Part 830: commercial grade item⁴:** a structure, system, or component, or part thereof, that affects its safety function, that **was not designed and manufactured (i.e., controlled) in accordance with the requirements of this Standard.**

Supplier Qualification and Procurement Plan Proposal

1. Develop Supplier Manual to align with NQA-1 manufacturing requirements:
 - a) Develop and Flow down manufacturing related requirements such as personnel qualifications, document control, inspection and test control, measurement equipment control, nonconforming material, correction actions and records.
2. Establish Quality Clauses that cover specific requirements for detailed flow-down on purchase order
3. Conduct supplier on-boarding audit:
 - a) Evaluate compliance with Supplier quality manual and supplier's documented QAP.
 - b) Evaluate supplier internal auditing results and third party audit certificate for QAP certification.
4. Receiving controls and inspections
 - a) Establish appropriate levels of incoming material validation appropriate with part complexity and safety requirements.
 - b) Evaluate appropriate downstream inspection and tests that provide additional verification of the item.
5. Monitor Supplier performance and scale inspections and audits based on performance.



Proposed Final Result

1. Designed under NQA-1 program
2. Manufactured in accordance with NQA-1 requirements and supplemented with additional verifications as required.
3. Procurement as a basic item