Blurry Photos to Fuzzy Confidence - NADCAP Criteria in the Context of NDE Process Reliability

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Abstract. Since 1990, NADCAP has attempted to standardize special process oversight among suppliers to primes. While generally positive results towards audit rationalization have been achieved, there still remain numerous costly requirements which are often overlapping or redundant, and have questionable added value to NDT process reliability. The effect of this state is to drive up the cost of NADCAP certification for suppliers, and perhaps also to effectively destabilize the consistency of results. Recently for the FPI method, Penetrant System performance panels and their adjudication in audits has been examined to try and define the relationship of the requirement to process reliability. This paper will further the investigation for FPI control parameters. Additionally we will examine present and proposed process audit controls for Ultrasound, conventional and Digital Radiography methods. Our objective is to map these audit controls to the Reproducibility, Repeatability and Capability components of Reliability. Finally we will propose a concept for valuation of audit requirements to drive further rationalization/standardization in process oversight, which is aligned with NDE reliability assurance.
NADCAP accreditation for Special Processes

- Special processes are defined as those material processes for which the outcome can not be determined without destructive analysis (Heat treat, chemical processes...)
- NDE processes are included in this definition
- PRI is the organization running from the 1990s which has as its charter for NADCAP:
  - “...manage a cost-effective consensus approach to special processes & products“
- The goal is consistent with establishing consistent targets & reducing variation in AP – with a challenge to achieve consensus
- While generally successful in driving to common practice, concerns exist for NADCAP originated “common spec plus” approach – which is used to define the NADCAP brand
- In an AP effectiveness assessment of the present form of NDE audits, it come into question whether certain A/C (audit checklist) parameters are valid & influential AP controls
NADCAP (AP) controls examined

In Focus: FPI

- Hopman reported a high incidence of major findings in system calibration of the FPI process resulting from the inability to reproduce sequential TAM panel photographs.
- The A/C (audit checklist) rationale holds that the process stability is known through sequential photographing of TAM (or related) artifact panels processed through the FPI process.

Observation: Panels consistent, while PODs are not

- System performance checks identical, but POD varies within method by 100% due to HF (Human Factors) et al influence.
- Robust design already accounts for variation by taking lower bound of capability.

Sys. Perf. Checks have not been validated by multiparameter POD decomposition.
Less stable process (form d)

- System performance checks generally equivalent

- 300% variation in POD

Is this TAM panel accepted process stable?

The “photo finish” A/C success criteria is influenced by:

- Magnification
- Lighting
- Filtering
- Focus
- Exposure

- But does not tell us much about subsequent FPI detection probability

- If we successfully, and expensively, (via A/C findings and additional controls on photography) control these elements....
  - We still do not understand anything regards our POD... the purpose of testing
SPC/TAM, KDS are $n$th order *indirect* measurements and fail to correctly indicate FPI performance

Assure POD instead through:

- **Direct control of the underlying parameters preferred:**
  - Cleaning ([FAA Engineering studies – CASR](#))
  - Drying ([FAA Engineering studies – CASR](#))
  - Existing Oil/dye controls (ASTM, AMS controlled)
  - Existing common spec process controls
- **Monitoring of HF (human factors) performance with regular inspector assessments of POD**
- **Benchmark within COP to determine stability**
  - (Delta; “comparative assessments of POD…”)

Adjusting/adding NDT controls takes us where?

- Concern regards common spec Prime add ons

  - The further the process is driven from the underlying POD body of knowledge, the greater the impact to our probability of detection and confidence
  - Example: A new FPI process improves the signal to noise relationship to eliminate false calls

- While this is an obvious and strong influence, many are more subtle
  - Job shops / tier 2, 3... especially impacted
  - Applicable to not only to FPI, but all methods where there has been a constant year over year growth and evolution of the A/Cs beyond the POD benchmark
  - Eg. Slightly different, but unexplained parametric shift in UT, MT, RT, ET process controls

POD capability handbook assumptions endangered by variation to common spec
Conclusions & Recommendations

- There is observed poor and in fact often no linkage between many NADCAP A/C requirements which vary from Global/common specification Reqs, and resultant POD
- Special risk of adverse POD influence from Common spec PLUS requirements being introduced by NADCAP
- These one off adjustments to specs underlying POD databases are adversely impacted, and are often not assessed
- NADCAP does make regular efforts to rationalize their A/Cs, however:
  - Primes should introduce a gap assessment process for A/C requirements against COP documented POD and impact
  - Primes should make much stronger efforts to drive to common/industry specs and critically vet A/C Plus requirements
  - Suppliers need to push back to keep process requirements aligned with POD demonstration parameters
  - The addl. TAM panel photograph requirement adds NO value, but does substantially drive up cost of maintaining the FPI process

- The “cottage industry” in equipment and resources to produce TAM panel photographs needs to be reviewed and eliminated by NADCAP