

## PROJECT CALL Q&A:

### DEMONSTRATION OF NOVEL METHODS FOR EFFECTIVE AM PROCESS QUALIFICATION/ RE-QUALIFICATION - DELTA QUALIFICATION (DELTA QUAL)

The following questions were asked during the Project Call Kick-off on April 19, 2023.

**Q: Can you better define the baseline? Will a scan strategy be provided? Vector by vector scan info?**

**A:** The baseline dataset is established as defined in the JMADD qualification program. All draft specification documents are uploaded and available on the NCAMP portal. Definitions within JMADD include the use of a stock (EOS-provided) parameter set, definitions of hardware and software configurations, post-processing (stress relief and HIP), machining as defined in NPCD 81064, and testing as defined in the test plan NTP-AM-1064. JMADD specimens are being fabricated using multiple runs of three build designs containing mixed specimen types across multiple build plate locations and orientations. Any scan strategy options chosen are defined within the Process Control Documents (PCD). Build designs used within JMADD can be provided but may not align perfectly with a proposed Delta Qual test and fabrication matrix. AMS7028 will be used to begin execution by Boeing.

**Q: Is information available on the current pre and post-processing conditions for the baseline effort, if any? This will be needed to determine the cost requirements for re-qual effort.**

**A:** The full process chain for fabrication, post-processing (cleaning, stress relief, wire EDM, and HIP), and machining is included in NPCD 81064. All powder feedstock was acquired in virgin form with certificates from material suppliers and stored within sealed argon containers until use. Feedstock specs that were acquired from each vendor are defined within NFS 064. Allowable feedstock spec limits will be generated at the end of the program once all test data is acquired. Machining follows requirements as outlined per each ASTM test standard and as may be further defined on specimen drawings, which are included in Appendix A of NTP-AM-1064. Proposers should consult JMADD process control documents at <https://ncamp.niar.wichita.edu/>. Free registration is required for access.

**Q: Which machine(s) is used in the baseline?**

**A:** JMADD is using EOS M290 with grid nozzle, hardware version V15 HCS 2.14.941.0 and EOS print version 2.10.1719, as defined within NPCD 81064.

**Q: Did JMADD develop allowables for each of the following orientations, tensile, modulus, compression, fatigue, fatigue crack growth, and fracture toughness? Also, if there are multiple orientations, is the Delta Qual program expected to demonstrate the novel approach on all of these?**

**A:** All test types, specimen orientations, test standards, properties, and test temperatures are denoted within JMADD test plan NTP-AM-1064. Fatigue crack growth is not included.

**Q: Was all testing done at room temperature?**

**A:** Room temp and elevated temp at distributed temperatures from 300-900°F. Review process control documents for more detail.

**Q: Was fatigue testing performed by the JMADD team LCF or HCF?**

**A:** Both, as defined within NTP-AM-1064.

**Q: Was modulus performed by the JMADD team from ASTM E8 or ASTM E11?**

**A:** ASTM E8 was used.

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**Q:** Did JMADD develop a fatigue allowable or just a fatigue curve? If it is required to match JMADD, then will they provide that information, (e.g. strain fixed or stress fixed, R-ratio and stress levels)?

**A:** LCF and HCF are defined within NTP-AM-1064. E606 tested for the first 50,000 cycles of LCF, followed by change to E466 (load control) for remaining cycles. E466 performed entirely for HCF. R ratios of -1 and 0.5. JMADD will be developing a fatigue curve. Fatigue allowable statistical process is not yet fully defined but will be explored.

**Q:** Did JMADD develop a fatigue crack growth allowable or just a curve? If it is required to match JMADD, then will they provide that information (e.g. which phases?)

**A:** JMADD is not testing fatigue crack growth.

**Q:** To validate the allowables from the novel approach, are we to follow MMPDS guidelines for equivalency?

**A:** From RFP: Validation of qualified AM processes and materials should demonstrate equivalence using a statistically-based approach similar to MMPDS (90% exceedance, 95% confidence interval) with a secondary goal of attaining validation through less testing, less time, and/or at a lower cost.

**Q:** Will the Delta Qual awardees receive support from the JMADD team to understand the baseline and to gain access to and ask questions about the data? Does JMADD already have funding to support us or would we be expected to include that out of the Delta Qual project funding?

**A:** The assigned America Makes Project Manager can coordinate support meetings, but JMADD does not include funding to support Delta Qual efforts. Proposers are encouraged to consider this in their approach.

**Q:** Can we use radiography instead of X-ray CT?

**A:** Yes, inspection technologies will be at the proposer's discretion. Please explain why the inspection technology you are choosing is appropriate for the effort.

**Q:** Can someone be on the Red Team AND on the project team?

**A:** There is no limitation described in the RFP that limits eligibility. Proposers are encouraged to identify any conflicts of interest to promote a fair and balanced Red Team. The Red Team should not review a Delta Qual effort that they have executed.

**Q:** Can the Delta Qual contract be FPP or is it CPFF?

**A:** No fee allowed.

**Q:** The RFP states, "baseline qualification will be supplied by Joint Metals AM Database Definition (JMADD) project," but the webinar mentioned that Boeing and NG will define requirements for the re-qualification. Is JMADD separate from the Boeing/NGC efforts, and if so, how will these two work in concert as it pertains to the RFP?

**A:** Boeing, Northrop Grumman (NG), and NIAR (JMADD) are separate. Boeing and NG are serving as industry leads to set requirements for the baseline and review executed Delta Qual efforts. Once a minor or major change has been made, NG and Boeing will review the executed Delta Qual and decide whether it was a valid change, if it has been done in an industrially relevant manner, and would be readily adoptable. JMADD is the baseline build qualification. Boeing/NG will develop its delta qualification plan with a reduced test matrix that will be compared to the JMADD's baseline qualification to assess if the delta plan will result in statistical equivalency in performance.

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**Q: For topics 1 & 2, are Boeing and NG defining the previously qualified AM component?**

**A:** *No component will be identified as a part of the Delta Qual effort. Delta Qual is primarily a process and material-centric effort focused on rapidly and affordably updating a qualified AM process to allow for changes in key AM processes, post-processes, and/or material feedstock variables. Material and process validation may feature application-relevant material performance metrics, but this is not the focus of the project call.*

**Q: What standards and measures will be used to judge success in demonstrating equivalency? Awardees will be developing and demonstrating a novel methodology. How can equivalence be demonstrated without conducting a full A/B basis allowable testing program? Also, if statistical sampling is used to demonstrate equivalence what are the required probability and confidence levels?**

**A:** *This is an excellent question and is exactly the intent of the RFP. We look forward to receiving your responses.*

**Q: If Non-Destructive Evaluation (NDE) is insisted upon, can we ask for accept/reject criteria for each NDE method to be employed? This should include details of the specific technique to be used and the specimen, part, and location to be inspected.**

**A:** *The RFP scope is focused on material and process delta qualification, not product qualification.*

**Q: Once a major single change has been made to the baseline process, can we then make subsequent changes to other process parameters to bring the re-qualified process back into alignment with the baseline?**

**A:** *Equivalency to the baseline is the most important aspect of any process change. The number of changes pursued is up to the proposer.*

**Q: What will be the total number of Red and government teams?**

**A:** *We anticipate one award in Topic 3 - Red Team. In addition, there will be a team of government representatives to help with the requirements.*

**Q: Is there any exception to the Selective Laser Sintering (SLS)?**

**A:** *Responses to this call are limited to Powder Bed Fusion Ti6AL4V grade 5 material.*

**Q: May we use our existing T64 B-Basis design allowables as the baseline?**

**A:** *Proposers may use data sets that are validated, and publicly accessible to supplement data provided by JMADD to establish the baseline. This baseline must meet the requirements defined by Boeing and NG.*

**Q: Is cost share expected for Topic 3 - Red Team?**

**A:** *All topics have a cost share requirement of 50%.*

**Q: Are heated plates in Laser Powder Based Fusion (LPBF) considered major change?**

**A:** *Heated plates alone may not be considered a major change unless a substantially different microstructure results or statistically significant mechanical performance is anticipated.*

**Q: Is there a proposal format we should follow?**

**A:** *The proposal format can be found on page 19 of the Delta Qual RFP and downloaded at [https://www.americamakes.us/project\\_calls/delta-qual-project-call-april-2023/](https://www.americamakes.us/project_calls/delta-qual-project-call-april-2023/).*

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**Q: Can cost share be applied toward new equipment procured to satisfy the project, labor, materials, and subcontracting?**

**A:** *Yes, cost share can be applied to new equipment, labor, materials, and subcontracting procured for the project. The equipment is considered government property. All required documentation must be completed by the awardee to formalize the transition plan for the equipment at the time of project completion.*

**Q: Will the baseline material dataset provided include measurements from each sample tested or only the property specification value resulting from statistical reduction of that dataset?**

**A:** *Once JMADD is complete, the reports that include reduced data as well as raw data tables in the appendix, will be published.*

**Q: Will the baseline material dataset provided include measurements of the material's microstructure? If not, could material remnants (e.g., grip sections) from the study be provided?**

**A:** *Material microstructure is being captured by microscope on etched specimens within the JMADD program. Additionally, grain size measurements are being taken.*

**Q: Will the LPBF process parameters (e.g. laser power, scan speed, etc.) used to build the baseline material be provided?**

**A:** *Yes, these as well as all post-processing are defined within JMADD NPCD 81064.*

**Q: Is there a requested number of machines/powder lots or is the minimum one with potential funding for more?**

**A:** *The number of machine, powder lots, etc., used to establish equivalency to the baseline would be at the proposer's discretion.*

**Q: If there are multiple machines/powder lots, can these either be combined or separated to meet sample sizes?**

**A:** *See answer above.*

**Q: Is Grade 23 powder acceptable? It meets all specifications of Grade 5.**

**A:** *Material substitution of that nature is likely acceptable, but proposers should consider if this would be a minor change.*

**Q: Does the powder need to be virgin to start?**

**A:** *All powder feedstock was acquired in virgin form with certificates from material suppliers and stored within sealed argon containers until use. Feedstock specs that were acquired to from each vendor are defined within NFS 064. Allowable feedstock spec limits will be generated at the end of the program once all test data is acquired.*

**Q: Is powder chemistry, PSD, hall flow, etc., desired to be tested for every powder re-use?**

**A:** *Proposers should consult JMADD process control documents at <https://ncamp.niar.wichita.edu/>. Free registration is required. Proposers should use best engineering judgement regarding what would be required to show equivalency.*