Next Generation Fire Test Burner for Powerplant Fire Testing Applications

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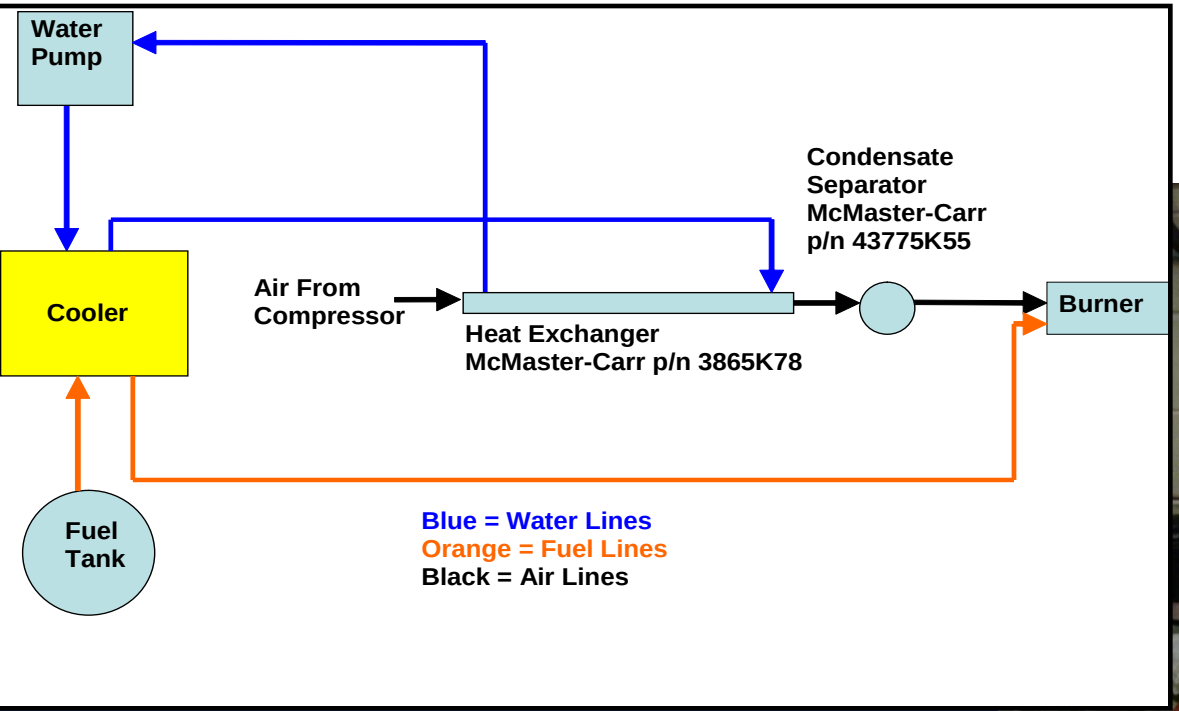
Background

- All of the specified oil burners are no longer commercially available
- Industry is left with the propane burner, which can be obtained and is typically preferred due to it's consistency and ease of use
  - Propane and jet fuel flames, despite having similar measured temperatures and heat flux, are fundamentally different
  - Propane will provide a less severe flame than a jet fuel flame, due to the transparency of the propane flame vs. the opacity of the jet fuel flame
    - As test components approach the flame temperature, they begin to re-radiate due to the high surface temperature
    - Heat is lost readily from the hot surface through the transparent propane flame
    - Heat is not lost through the opaque jet fuel flame
  - Intent of regulations is to provide protection against an *engine* fire, which is a jet fuel flame, not a propane flame
- FAA Tech Center Fire Safety Branch has been tasked by Transport Airplane Directorate to develop burner performance standards for the next-generation fire test burner for powerplant fire testing

Update on Burner Configuration

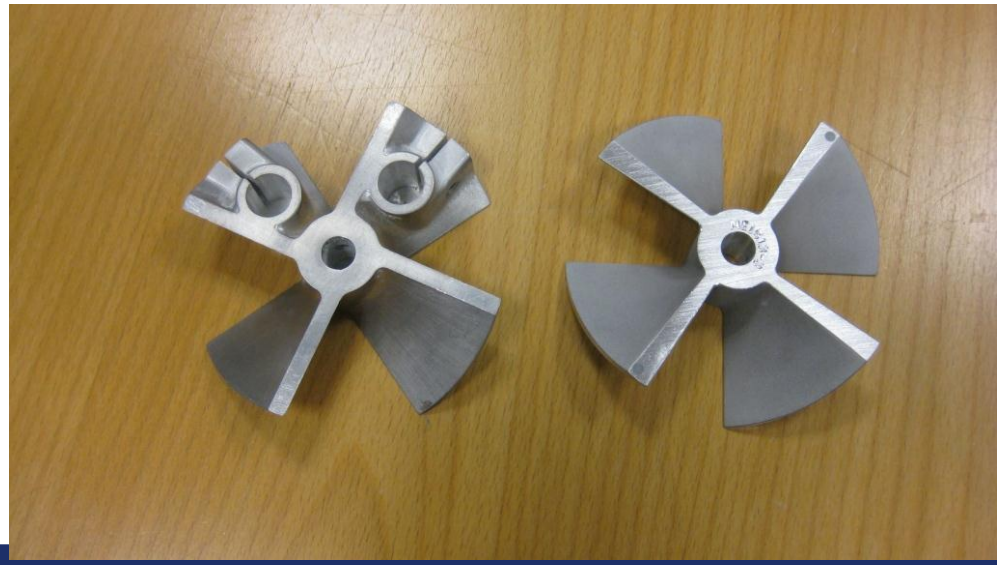
- Cooler/ice water bath has been replaced with a small (5.1 cu. ft.) freezer filled with a 50/50 mixture of antifreeze and distilled water.
  - This eliminates the need for ice/water replenishment and provides consistent cooling for both the fuel/air lines.



Update on Burner Configuration

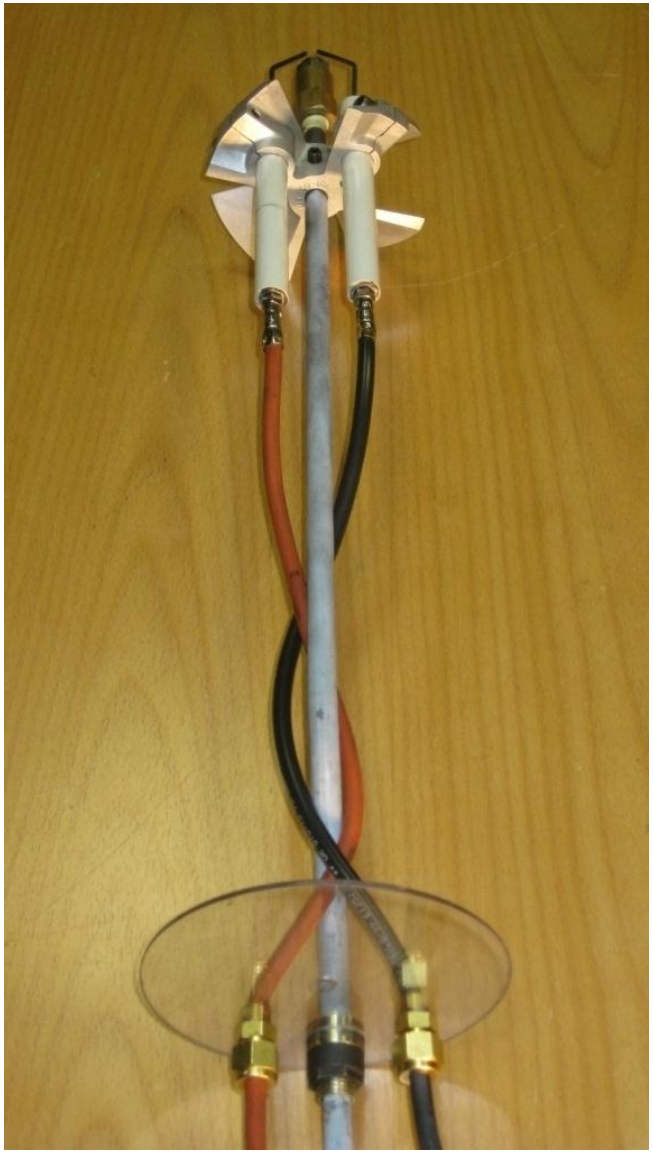
- Attempts to utilize a new stator that would eliminate ignitors/wires within burner tube were abandoned after Seat Cushion testing results showed poor correlation.

- Utilizing standardized igniter positions and wire length/positioning determined by seat cushion testing as shown on following slides

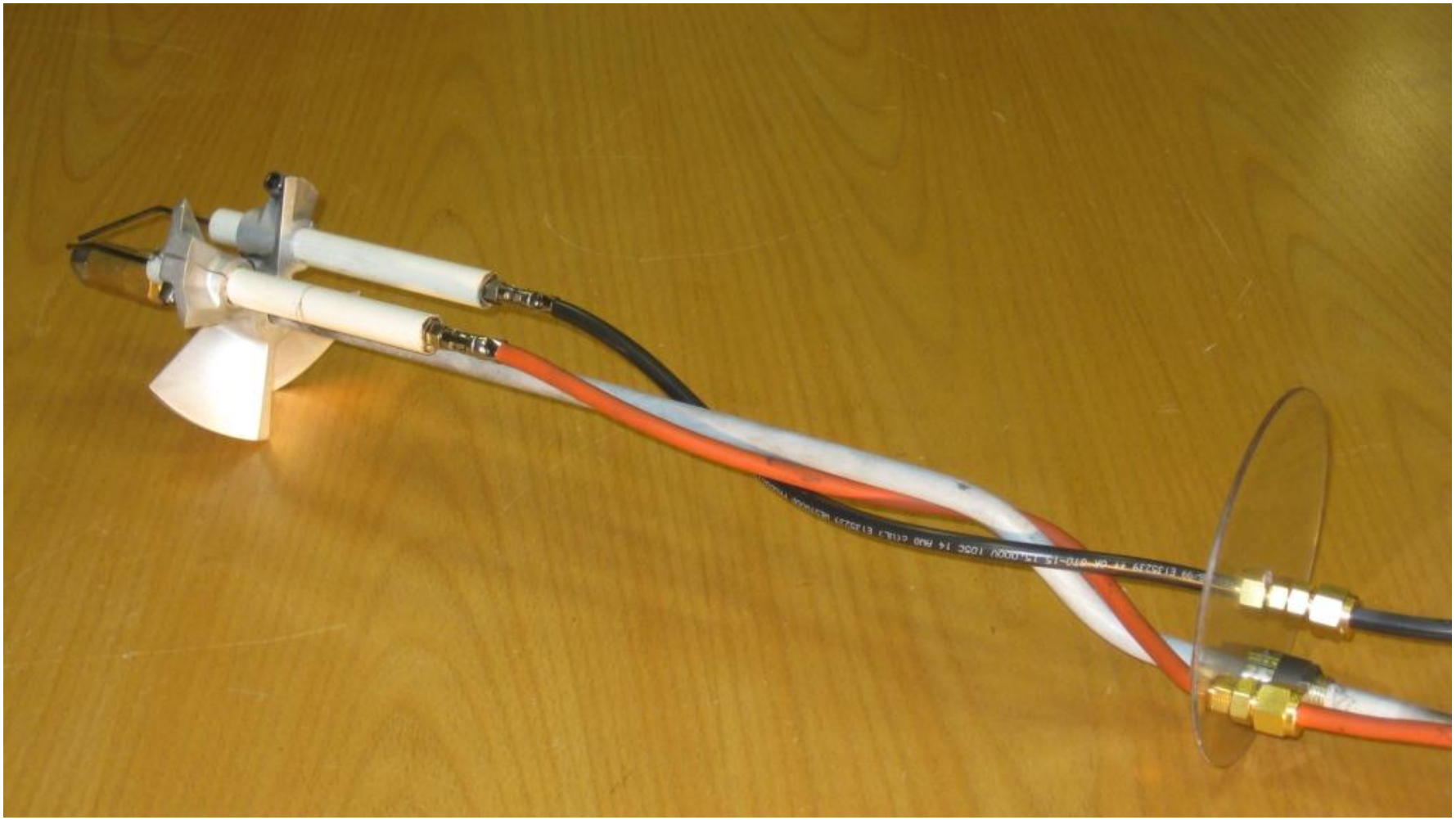


Update on Burner Configuration – Ignition Wires

- New wire length and positions minimize airflow disturbance
- Standardized wire positions to minimize variability in burner performance and data results
- Improved repeatability



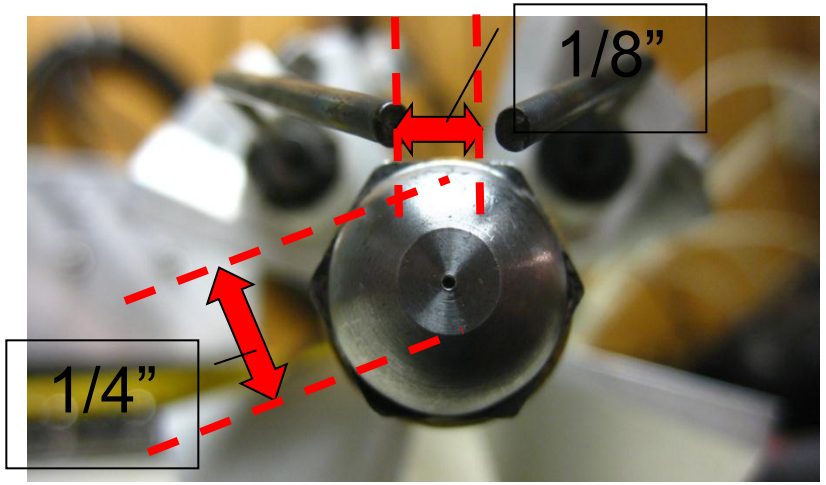
Ignition Wire Positions

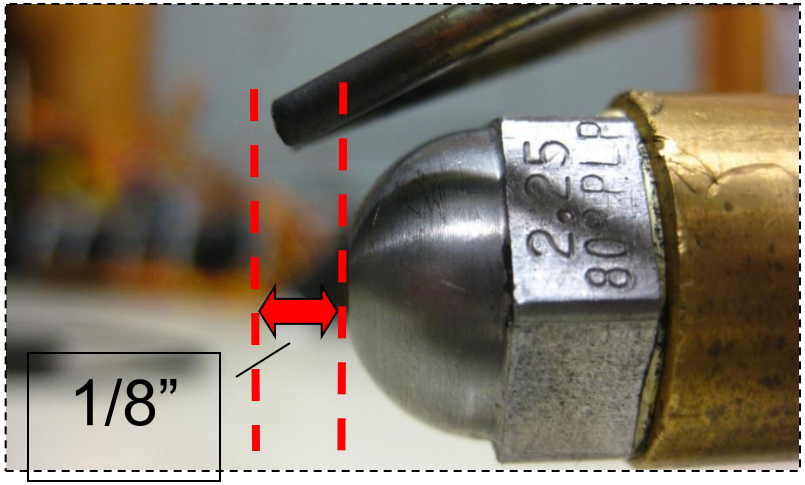


Igniter Positions

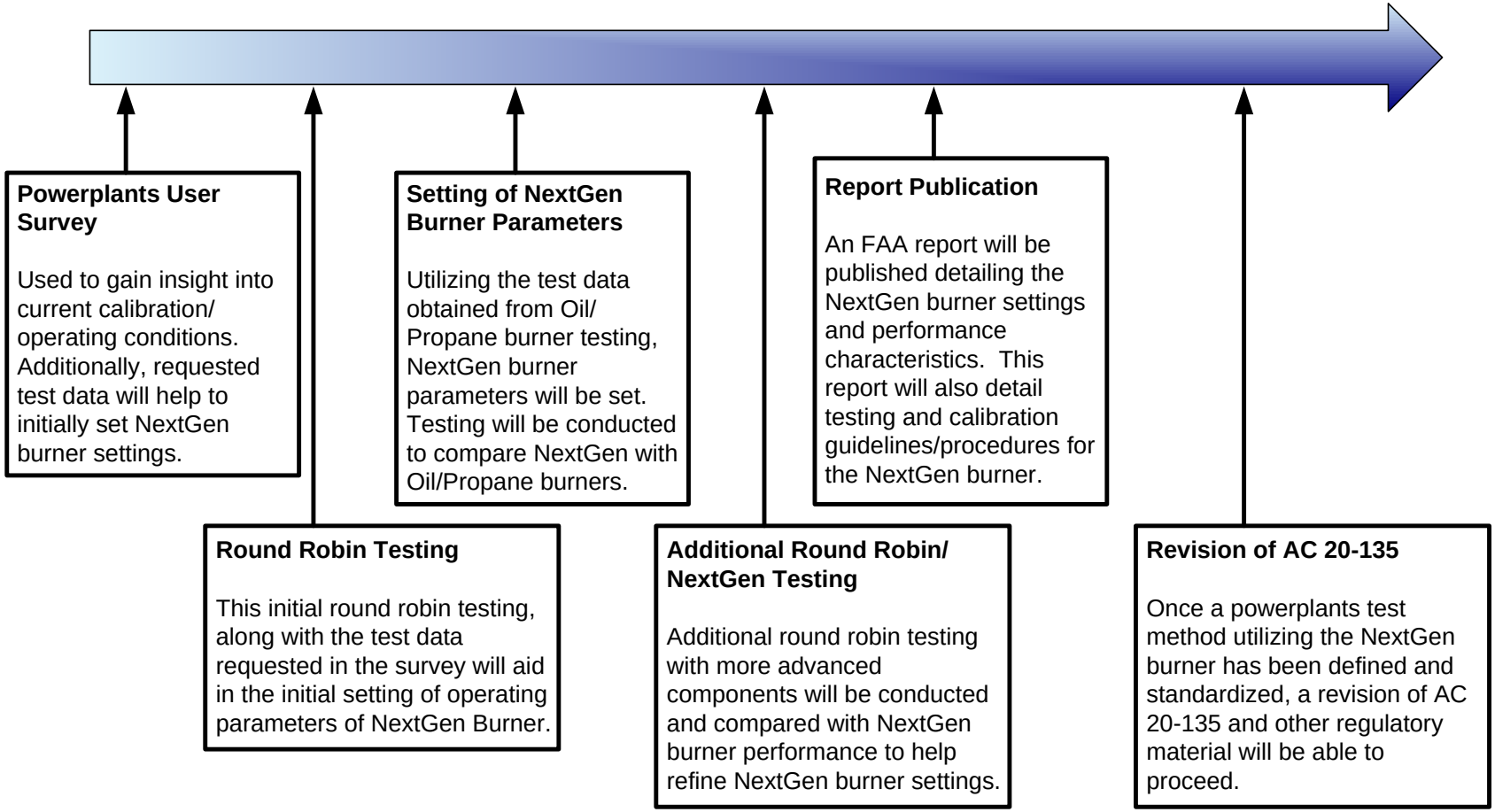
- Standardized igniter positions
- Gap between igniters
  - 1/8”
- Nozzle center to igniter
  - ¼”
- Nozzle face to igniter
  - 1/8”

*Diagrams shown only for igniter tip spacing

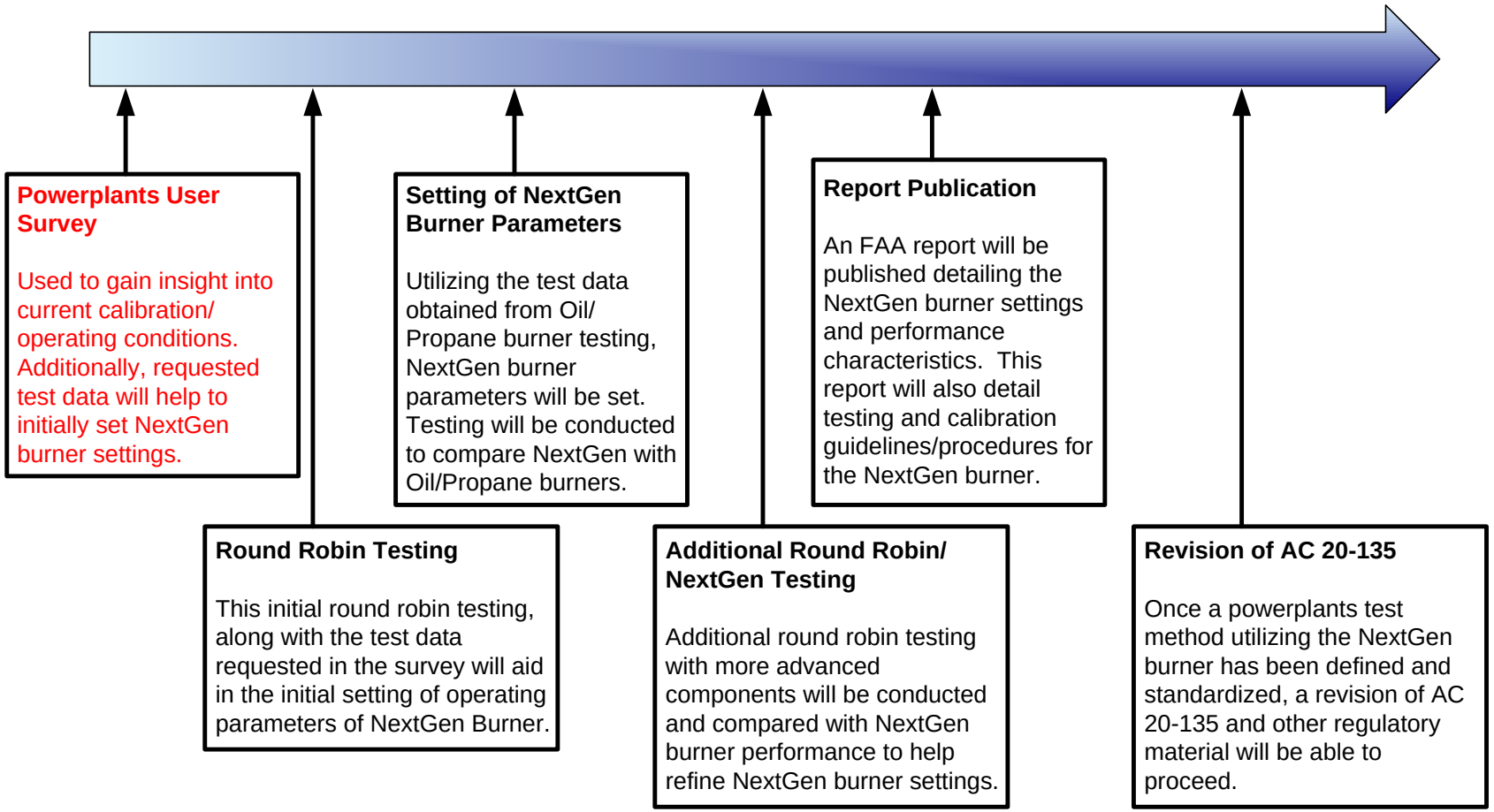




A Roadmap to NextGen Burner Implementation for Powerplant Testing



Current Status



Current Status – Powerplants User Survey

- In conjunction with DGA and EASA, a detailed user survey was created and released on the Powerplants KSN website.
- This survey was aimed at providing authorities better insight as to how the various labs are operating/calibrating their burners and what parts of the test standards need clarification and/or modification.
- As part of the survey, users were asked to conduct a sample test on a 24”x24” sheet of 2024 aluminum with a nut/bolt installation.
- A total of 10 responses to the survey were received.
- 5 labs submitted a total of 12 oil burner test results.
- 5 labs submitted a total of 12 propane burner test results.
- Survey and tests results have been analyzed and results have been presented.

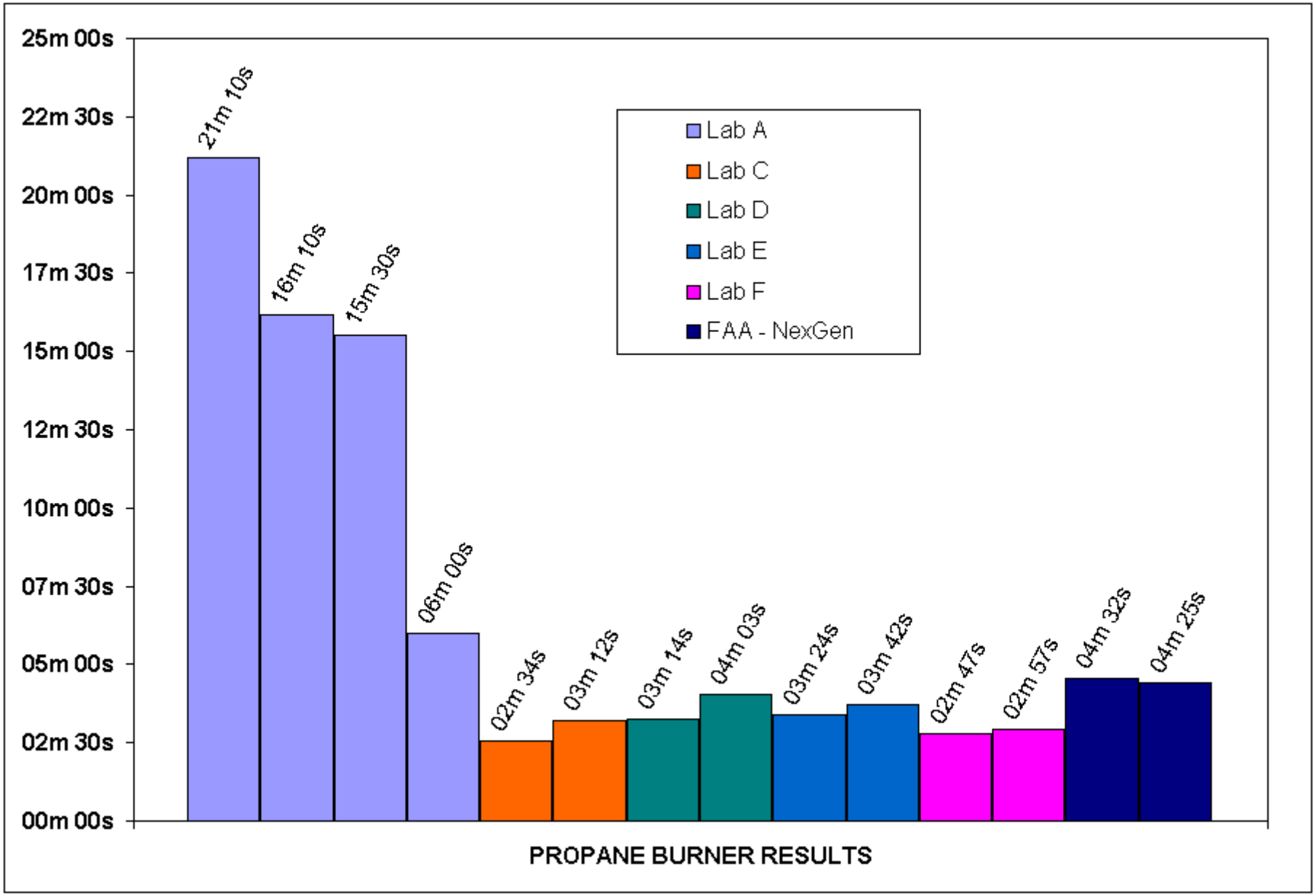
Powerplants User Survey – FAA Results

- NexGen burner testing conducted with two different nozzles
  - 2.0 gph Delavan, Solid-Cone
  - 2.25 gph Delavan, Solid-Cone

- Test specimen and calibration stands positioned 4 inches out from the burner cone and 1 inch up from centerline

- Results indicate that 2.25 gph nozzle at 100-110 psi with an air pressure of 40 psi produces results consistent with those obtained from survey participants.

- This will serve as our initial burner settings for all tests going further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20m 00s
17m 30s
15m 00s
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10m 00s
07m 30s
05m 00s
02m 30s
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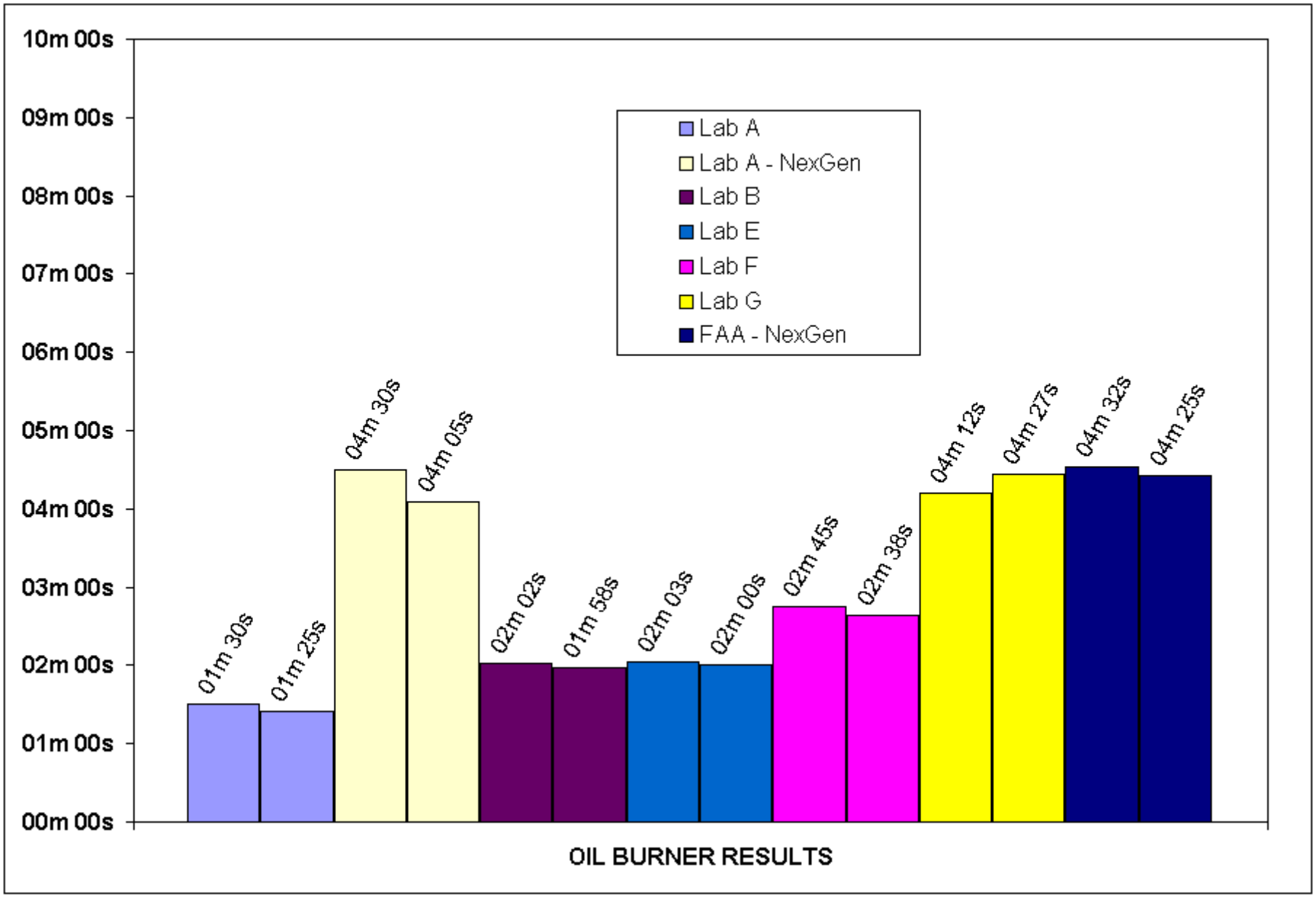
21m 10s
16m 10s
15m 30s
06m 00s
02m 34s
03m 12s
03m 14s
04m 03s
03m 24s
03m 42s
02m 47s
02m 57s
04m 32s
04m 25s
Lab A
Lab C
Lab D
Lab E
Lab F
FAA - NexGen
PROPANE BURNER RESULTS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Lab A
Lab A - NexGen
Lab B
Lab E
Lab F
Lab G
FAA - NexGen
01m 30s
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04m 30s
04m 05s
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01m 58s
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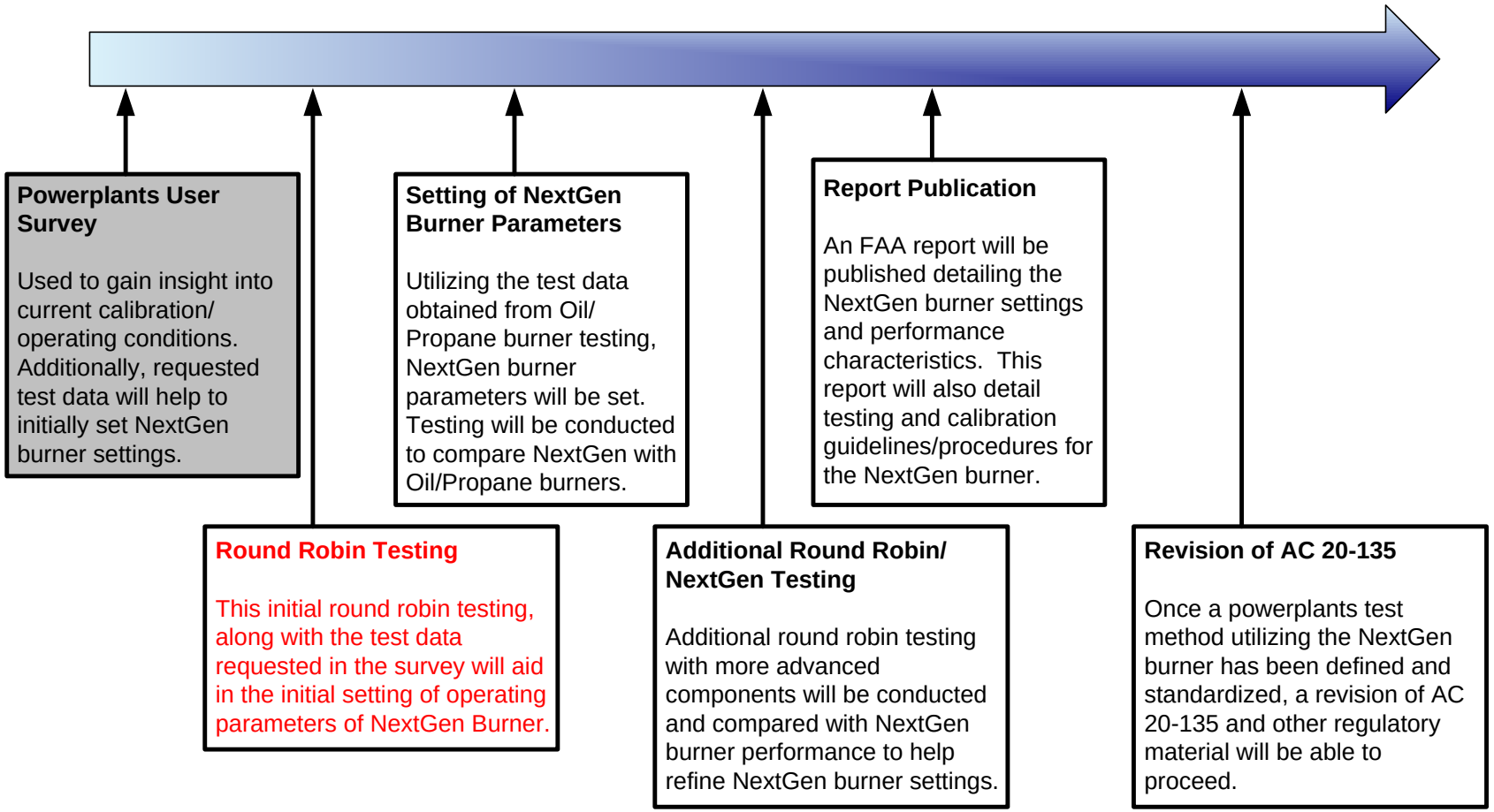
OIL BURNER RESULTS

Current Status



Current Status – Round Robin Testing

- Round Robin testing to be initiated with various labs and burners (Park DPL 3400, NexGen, and Propane). Materials to be tested include:
  - Slug Calorimeter
    - Sheet of copper with thermal absorptive coating, and thermocouple(s) on back face to determine heat flux
  - 2024 Aluminum Sheet
  - Metallic Firewall (steel)
  - Polyacrylonitrile (PAN)

- Initial testing to be conducted with FAA NexGen burner under initial burner settings to ensure consistency in results prior to initiating round robin.

Current Status – Round Robin Testing

- This testing has been delayed due to a severe roof leak in the test lab which has forced us to halt testing until repairs are made (~2-3 months).

- Information will be posted on the Powerplants KSN site as soon as available to request participants.

- Additionally, at that time we will likely be holding a Task Group meeting via conference call to discuss testing in further detail.