

INL/EXP-26-90194

(Microreactor Applications Research, Validation & EvaLuation),

Power Generation System Testing

Feb 2026

B. Baker, J. Johnson, A. Abou-Jaoude, A. Peterson (Qnergy), J. Marteny (CEI), many others (CEI)

NaK Compatibility Tests

- Report from CEI 095-15-011 NaK Compatibility Report
- Relative differences with NaK in relation to HITEC solar salt, propylene glycol, LBE, mineral oil
- Test with a control sample of each type and heated to 470°C
- Mix to test differences
- Mixed up Solar Salt types and redid it with the correct one
- Results
 - Solar Salt with NaK was similar to NaK and air but happened about 70°C sooner.



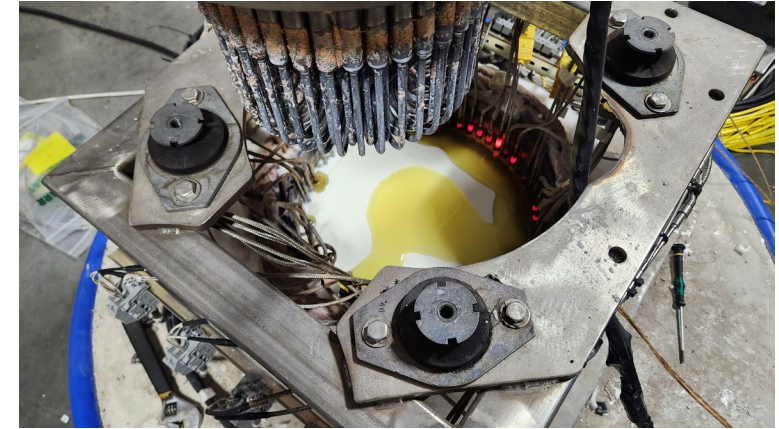
Figure 1 NaK control before heating (left) and after heating (right)

Table 1 Summary of Results

Materials in Test	Test Location	T (°C) for possible reaction indicators	Max T (°C)	Smoke Color(s)
NaK (control)	Glove box	270	475	Blue → Red
NaK + SS	Glove box	270	395	Blue → Red
SS (control)	Glove box	NA	372	NA
NaK + LBE	Glove box	250	475	Blue → Red
NaK + MO	Glove box	138/380	475	White → Blue → Red
MO (control)	Glove box	171	220	White
NaK + PG	Glove box	270	475	Blue → Red
NaK control without stirring	Fume Hood	178	650	White
NaK + SS with stirring	Fume Hood	108	620	White
NaK control with Stirring	Fume Hood	180	620	White

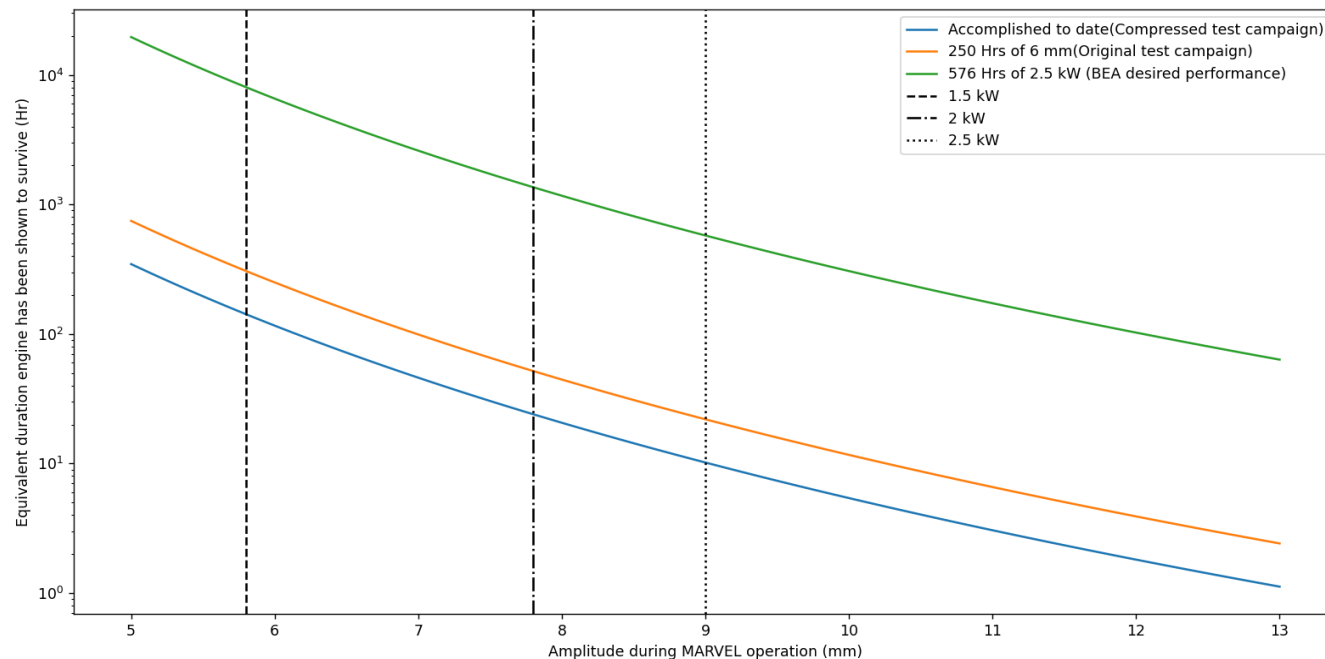
Initial Stirling Engine Tests

- Tank with Solar Salt & Support Structure
- Cartridge heaters & Band heaters
 - Several burned up and caught fire
- TC's
- Learned the wiring for the Hall Sensor was wrong (Thanks to Allen)
- Stair-Step Approach
 - Test Engine in Liquid Solar Salt (See if it breaks - Endurance)
 - Test solidification by stopping the engine first
 - Test solidification by letting the engine stop itself
 - Qnergy support with new stopping methods

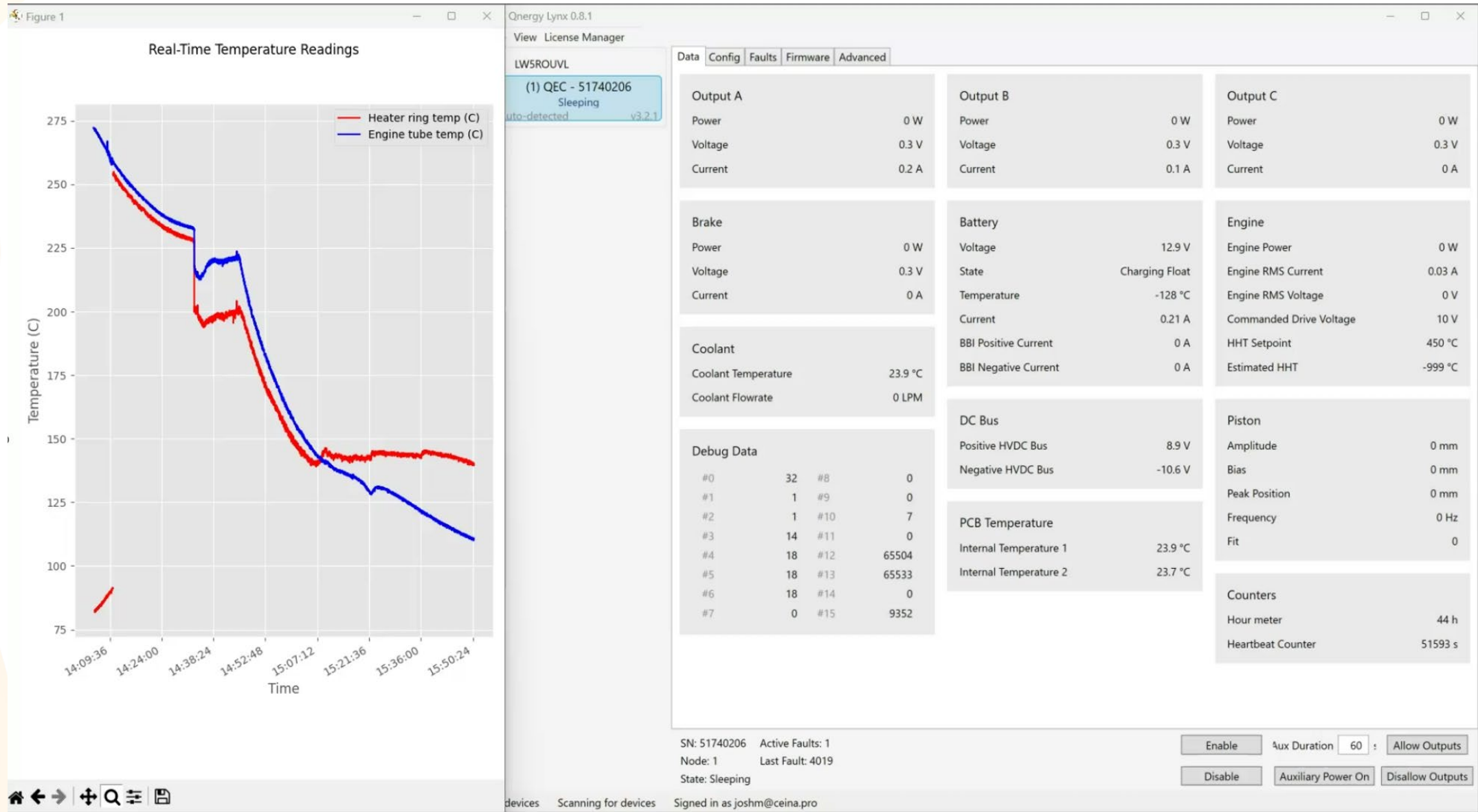


Endurance Tests

- Run the engine in liquid solar salt with as high of an amplitude as possible and see if it breaks
 - Got the amplitude higher with a trick, but it produces less power (HHT offset)
- We ran several (mm-hours) then moved on and will gain more with each test.
 - Recorded mm in logs

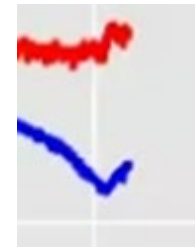
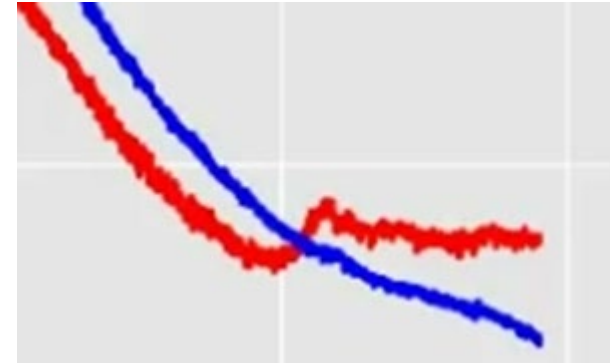


Melt/Freeze Tests



Melt/Freeze Tests

- Freezing
 - Liquid stays the same temperature
 - Engine removes more heat and cools the solid
- When Engine Disables
 - About 130C
 - TC by the tubes starts to go back up because the liquid is still hotter
- Popsicle Concept
 - A popsicle inside of a fluid is the same as the engine in the fluid
 - Distance to the rigid surfaces could matter
 - About ½ the salt between the tubes and the pot walls on the top surface was solidified – distance was about 2 inches between tubes and walls



Melt/Freeze Tests

- Freezing
 - Performed 9 times to date (probably more when we get here)
 - No problems

Qnergy support

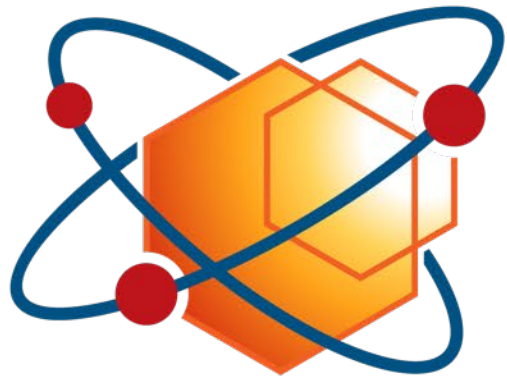
- Very nice to have someone who knows a system on your team
- Helped identify and correct initial problems with the engines
 - Saved us lots of time to have someone with experience and intuition
- Supplied us with an engine stop firmware update
 - 2 methods. Warned the software approach will not be supported in the future.
 - Tested both methods at low and high temperatures and both work.



PGS Skid Design

- Located after the process heat loop
- (Vision)Trailer with Stirling Engine (PowerGen Units on it) connected to the Process Heat Loop
- Modify
 - The bucket the engine head sits in for Solar Salt
 - The controls interface
 - The connecting lines
 - Other minor adjustments

Questions?



MRP Microreactor
Program