Supplementary Materials

Graphs and descriptions of additional cycles are presented to further verify how the method of summing the fundamental frequency and harmonics results in an acoustic signature that more closely matches the reactor power ground truth. In some cases, most especially for phone 40, the method provides a means of determining the reactor power when it is otherwise obscured by noise.

Cycle 488-B Start-up

The reactor power for HFIR Cycle 488-B started in discrete steps as described in the main section of this manuscript. The summed RMS acoustic power more closely matches the reactor power than the raw RMS acoustic power for all three phones. This was especially true for Phone 40, shown in Figure S1(c). Given the contrasting behavior between the acoustic and reactor powers, as measured by Phone 40, the summed acoustic RMS power was generated following a determination of dominant frequencies through construction of the PDR. The dominant frequencies observed in the PDR vary by approximately 1% from those present in Cycle 487. This slight variation in frequencies in the fundamental frequency and related harmonics exemplifies the need for calculating the PDR prior to generating the summed RMS acoustic power, due to the narrow 0.05-Hz band surrounding the summed frequencies.

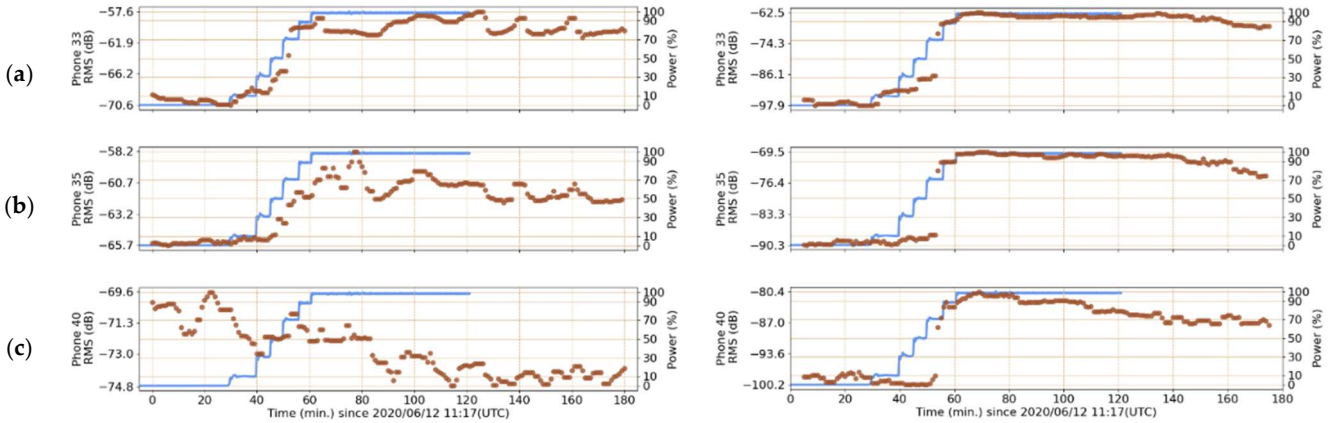

Figure S1. Acoustic RMS power (●) for HFIR Cycle 488-B start-up calculated from the raw waveform (left) and isolating and summing the characteristic harmonics (right) for Phones 33, 35, and 40 are shown in (a), (b), and (c), respectively. The estimated reactor power (—) is overlaid for comparison.

Cycle 489 Start-up

During HFIR Cycle 489, the summed RMS acoustic power for Phone 35, shown in Figure 13(b), increased to a maximum acoustic power relative to the reactor power in contrast to what was observed in the raw RMS acoustic power. In addition, the raw RMS acoustic power for Phone 40, presented in Figure S2(c) generally declined, while the summed RMS acoustic power increased relative to the reactor power. The deviations between acoustic power and reactor power may be due to wind.

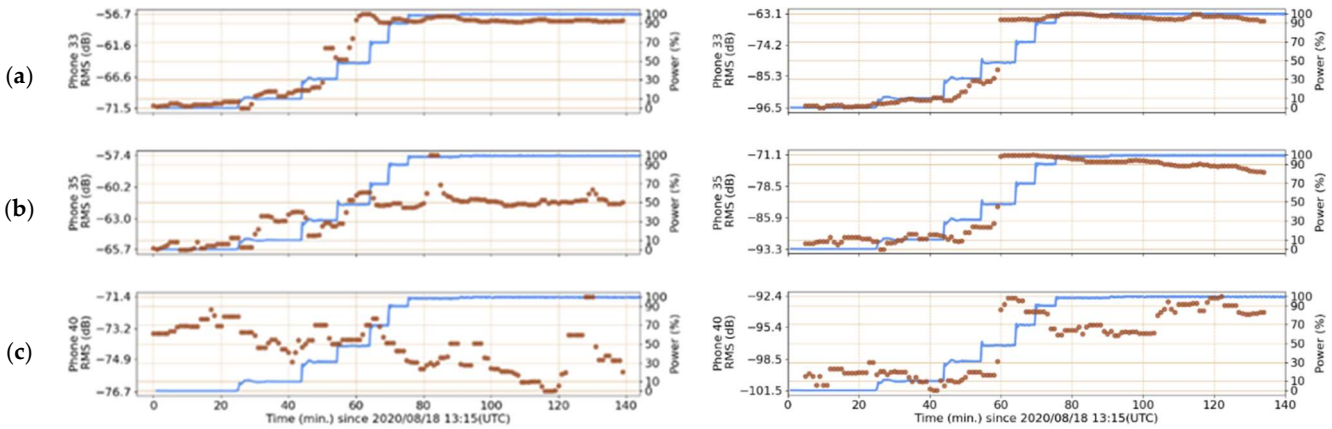

Figure S2. Acoustic RMS power (●) for HFIR Cycle 489 start-up operations calculated from the raw waveform (left) and isolating and summing the characteristic harmonics (right) for Phones 33, 35, and 40 are shown in (a), (b), and (c), respectively. The estimated reactor power (—) is overlaid for comparison.

Cycle 490 Start-up

Similarly to previous HFIR cycles presented, the implementation of isolating and summing key features determined in the PDR revealed acoustic behavior that more closely followed reactor power generation. A comparison between the raw and summed RMS acoustic powers is presented in Figure S3.

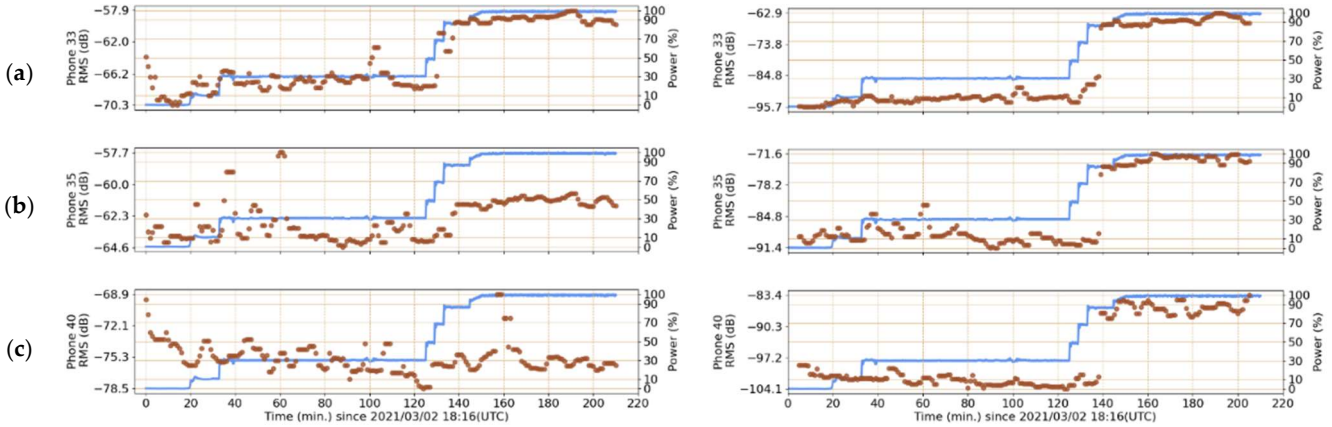

Figure S3. Acoustic RMS power (●) for HFIR Cycle 490 start-up calculated from the raw waveform (left) and isolating and summing the characteristic harmonics (right) for Phones 33, 35, and 40 are shown in (a), (b), and (c), respectively. The estimated reactor power (—) is overlaid for comparison.