Optimizing Army Tactical Power Generator Performance
Part 1—Using Motion Amplification® to Analyze Rotor-Hub Separation

RDI TECHNOLOGIES

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Industry:
Defense Depot, US Army

THE CHALLENGE

The PATRIOT Missile Defense System (MDS) relies on a stable and consistent source of electrical power. During initial testing of the 15 kW/400 Hz Advanced Medium Mobile Power Sources (AMMPS), vibration analysts identified a structural resonance issue causing stator weld fractures and catastrophic failure of the generator set. To address this, the Integrated Fires Mission Command (IFMC) developed a stiffening and damping kit designed to mitigate the effects of structural resonance. However, IFMC required a reliable method to verify the consistency and repeatability of the kit installation process, as well as to validate its effectiveness during post-production operations.

THE SOLUTION

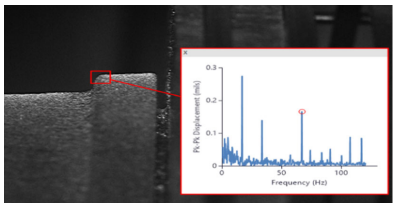
Cintel Inc., a trusted service provider for RDI Technologies, dispatched David Aebischer to conduct a Motion Amplification® (MA) service visit aimed at establishing a standard operating baseline to compare performance between unmodified and modified AMMPS generators and to set up a repeatable testing procedure for all production assets.

During this visit, David employed the Iris M™ System and MA software to capture video recordings at a critical location on the AMMPS generator. This point was chosen near the antinode between the forward engine mounts and the rear stator mounts—an optimal spot for capturing vibration data. The analysis of these video recordings, spanning spectrum, waveform, and orbit data, revealed that the vibration kit successfully shifted the natural frequency (Fn) out of the +/- 10% range around 3x the turning speed (approximately 99.7 Hz). This adjustment was consistent across most generator sets, except for two that deviated from the baseline due to a distinct failure mechanism.

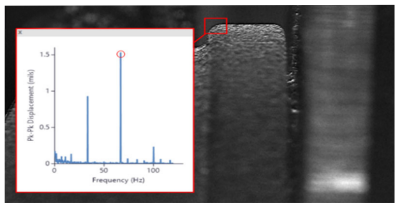
For these two sets, MA data showed abnormal readings, particularly along the X-axis at the turning speed (TS) and its multiples, with the most significant irregularities observed at 2x TS. Additionally, the orbit plot presented abnormal patterns. Upon visual inspection, it became evident that the rotor was beginning to rotate out of alignment with the flex plate hub, indicating a potential failure point.

THE RESULTS

- **Motion Amplification® established a baseline to determine the effectiveness of the stiffening and damping kit and consistency of the installation process.**
- **Baseline enabled Cintel to detect, qualify, and quantify a rotor-hub separation problem, which caused ground fault and catastrophic failure of the 15 kW/400 Hz main generator.**
- **Cintel's analysis with MA data:**
  - **improved the production process for rotor-hub installation**
  - **created new inspection procedures to increase the probability of early detection**
  - **added new safety components to ensure PATRIOT mission availability.**



RDI Motion Amplification® Plot of normal baseline on 15 kW/400 HZ generator (with vibration kit) shows normal values for spectrum on X axis. Note values for 2x Turning Speed (.14 Mils) .



RDI Motion Amplification® Plot of off-baseline during incipient stage of rotor-hub separation on 15 kW/400 HZ generator (with vibration kit) shows abnormal values for spectrum on X axis. Note values for 2x Turning Speed (1.53 Mils): a ten-fold increase!

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