WPR13FA294 Revised Brief

A company that designed and manufactured airborne radar units, primarily for military applications, was using the accident airplane (as well as one other airplane) for some of the airborne development and testing of the externally mounted radar equipment. The pilot was in the left seat and a test engineer, who was not a pilot, was in the right seat. The airplane was equipped with a supplemental electrical power supply system that the company had designed and manufactured to provide electrical power for the radar systems and support equipment on the test flights. Most of the supplemental power supply system was located in the combined baggage area and the area vacated by the removal of the rear seats. In its installed position, the supplemental power supply system was not intended or able to be reached by the pilot or engineer during flight.

About 2 hours into the radar test flight, the test engineer smelled smoke in the airplane. The pilot attempted to locate the source of the smoke and observed an open flame on the supplemental power supply. Because the fire was out of the pilot's or engineer's reach and the airplane was not equipped with a fire extinguisher, the pilot decided to land as soon as possible. During the attempted emergency landing on a road, the airplane struck power lines suspended above the road and then impacted the ground. Detailed examination of airplane and power system components revealed that the fire involved several wires that connected directly to the power system battery and that the fire had spread to the airplane floor carpet.

The supplemental electrical power supply system components included, in part, an automobile-type 12-volt direct current battery, which was encased in a covered, plastic box, and a company-designed and -manufactured hard-plastic power distribution box. The power distribution box was stacked on top of the battery box, and they were secured in place by a ratcheting cargo strap system. In that configuration, two 12- to 14-gauge plastic-insulated wires, one red and one black, were situated and pressed between the top cover of the battery box and the bottom of the power distribution box, and then routed into the distribution box via a single grommeted hole in the bottom of that box. The installation had no provisions for separating or protecting the two wires, and the evidence was consistent with the wires abutting or crossing one another while pressed between the two boxes.

The high-vibration environment of the test airplane caused relative motion between the two boxes and/or the boxes and the wires. That relative motion, combined with the pressure exerted by the boxes on the wires, abraded the insulation of those wires, which then allowed their conductors to contact one another. Because the black wire was connected directly to the negative battery terminal and the red wire was electrically connected to the positive battery terminal, contact of those conductors yielded a direct electrical short. The wires were rated to carry a maximum current of about 45 amperes, and the battery-rated output was 750 amperes. The short circuit resulted in a significant overcurrent in the wires, which caused excessive heating, additional insulation failure, smoke, and fire. Although the pilot did not recall all of the details of the event, the evidence indicated that the fire produced a significant amount of soot and heavy particulate matter, and possibly other physiological irritants.

Deleted: visually det successfully

The wire installation was not in accordance with Federal Aviation Administration (FAA) maintenance guidance, which advised that wire insulation be protected against chafing or abrasion because damage can result in a short circuit. The appearance of the supplemental electrical power supply, particularly its intercomponent wiring, was consistent with that of test-bench equipment, designed to be operated in a stationary environment with minimal or no vibration. No guidance or other documentation regarding the physical installation of the system components in the airplane or the security and protection of the associated wiring was located. A company technician, who was not an FAA-certified aircraft mechanic, reported that he accomplished the original installation of the supplemental power supply a few weeks before the accident; the power supply had accumulated about 13 hours of operation since its installation. The investigation was unable to determine if, how many times, or by whom, the power supply or its components might have been adjusted, moved, removed, and/or reinstalled. It could also not be determined whether the company-contracted aircraft mechanic had provided any installation guidance or whether he had examined, changed, or otherwise contacted or disturbed the original installation, because that mechanic did not respond to requests for information. The installation and arrangement of the affected wires were not in compliance with acceptable practices for aircraft, and the installation presented a serious hazard to flight safety due to the high potential for insulation abrasion and failure, with the resultant unintended electrical path(s).

WPR13FA294 Revised Probable Cause

The operator's improper installation of a supplemental electrical power supply, which caused a short circuit due to inadequate vibration and abrasion protection, which resulted in chafing of the wires, which contacted one another, short-circuited, and caused an onboard fire. Contributing to the accident were the installation of the supplemental electrical power supply system without the supervision of an FAA-certified mechanic, the lack of an onboard means for fire suppression, and the pilot's inability to see the low-conspicuity power lines across the landing approach path until it was too late to take evasive action.

Deleted: fire