

STATEMENT OF
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BEFORE THE
READINESS AND TACTICAL AIR & LAND FORCES SUBCOMMITTEES
OF THE
HOUSE ARMED SERVICES COMMITTEE
ON
F-35 PROGRAM UPDATE: ACCOMPLISHMENTS, ISSUES, AND RISKS

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Chairman Garamendi, Chairman Norcross, Ranking Member Lamborn, Ranking Member Hartzler, and distinguished members of the House Armed Services Committee, I appreciate the opportunity to testify on behalf of the 36,000 men and women of Pratt & Whitney (P&W) to provide an update on the production, sustainment, and modernization of the F135 engine. I would also like to thank you for your continued support of the F135 program, which contributes to more than 37,000 high-tech jobs across 35 states and provides our service men and women with a critical technological advantage over our adversaries.

The F135, the world's most advanced fighter engine, powers all three variants of the F-35 Lightning II fighter. The engine has achieved numerous engineering feats including increased thrust and thermal management capacity, adaptive controls, advanced materials, and design-for-sustainment modular architecture. Its 84 percent tri-variant commonality allows for significant economies of scale across the program. Since my testimony in November of 2019, P&W and the F135 have had many accomplishments. Notably, despite the COVID-19 pandemic, P&W successfully delivered 159 engines last year, with the global engine fleet now supporting over 625 F-35s in operation with three U.S. Services and nine international countries. Additionally, in March, P&W fully qualified 75 percent of the F135 parts previously sourced from Turkey. From a sustainment perspective, the global fleet continued to maintain an average mission capability rate of approximately 95 percent. Finally, P&W completed a six-month F135 modernization study and operational assessment – on time and on cost – to develop multiple potential growth configurations for propulsion support of Block 4 aircraft.

At the same time, there have been several challenges. While we are producing engines at an aggregate rate that meets annual production requirements, we are behind contract dates due to quality issues and COVID-19 disruptions. With respect to affordability, P&W has successfully

reduced costs to date; however, we experienced significant cost headwinds in 2020 due to limitations in resourcing parts from Turkey and the adverse impacts of COVID-19 on the commercial market. Finally, while we maintained the average mission capability rate at or above contract requirements, engine availability degraded due to the delayed stand up of depot capacity. For all these challenges, we identified improvement plans and are committed to successful execution in 2021 and beyond.

As the only 5th Generation engine in production, the F135 provides unrivaled performance for the warfighter. With a strong production foundation, P&W is resolute in pursuing production improvements in cost and quality. With a strong reliability foundation, we will address current availability challenges with urgency. Finally, leveraging the robust core of the F135, P&W will provide a series of low-risk, rapid technology upgrades to ensure the F135 remains the most capable engine for the warfighter, and the most cost-effective program for the taxpayer.

Availability: Engine Production

Delivering the F135 to the warfighter on time, 100 percent of the time, and with perfect quality remain critical goals. Over the past five years, P&W and our suppliers have invested over \$500 million in capital, process improvements, and cost reduction initiatives to enable both the required increase in production rate and also the reduction in unit cost. In 2020, we launched a \$60 million program to improve production quality. These investments will enable a stable, cost effective, and high quality production system for the program of record.

Leveraging these investments, we met or exceeded our annual production targets in 2019 and 2020. However, monthly deliveries were inconsistent. In 2020, P&W delivered 100 percent of its full-year engine quota. Eighty-three percent of the engines were late to the contract date,

but on average, only by 15 days. The principal drivers of these delays were quality findings and COVID-19 disruptions. Despite these delays, P&W continues to have sufficient capacity to support the air vehicle final assembly and sustainment needs, and Lockheed Martin has several months' worth of engines at their Fort Worth, Texas facility awaiting incorporation into aircraft.

Moreover, P&W was able to sustain the health and productivity of P&W's manufacturing and supply chain through prudent use of COVID relief progress payments and an aggressive deployment of P&W's supply chain professionals to help identify and address emerging issues. In fact, P&W was able to accelerate over \$300 million of spend into the supply base through a variety of such initiatives. These efforts were critical to enabling overall delivery at the annual target level during the pandemic.

P&W's core values are safety and quality, which serve as the foundation of the design, manufacturing, delivery, and service of all *Dependable Engines*. Our quality management system (QMS) is designed with tiers of protective measures beginning with the engine design process and following the components through manufacturing, inspection, assembly, and test processes. The F135 quality findings rate has remained flat over the past three years; however, the first quarter of 2021 witnessed a slight uptick. Although F135 quality findings drove production delays, they did not impact engine safety or reliability because they are corrected prior to engine delivery. P&W instituted continuous improvement efforts that have reduced the severity of escapes by more than 60 percent since 2016. And, we have committed to a further 40 percent reduction in quality findings through a Quality Improvement Plan (QIP) launched in 2020. This \$60 million self-funded, five-year plan will update F135 manufacturing processes with Industry 4.0 machines, measures, and methods.

P&W's goals are simple: 100 percent on-time delivery to contract, with perfect quality. We have capacity in place to support current and anticipated production needs. We have a safe and reliable engine, with a QIP that will drive stability in our production system and engine deliveries. We are not only committed to these goals, but we are also funding their implementation.

Availability: Sustainment

While the F135 currently meets mission capability objectives, engine availability declined in 2020 due to power module shortages. There are multiple causes of the power module shortage, but the primary driver is the delayed stand up of depot capacity. In early 2019, P&W began implementing the necessary corrective actions in partnership with the Joint Program Office (JPO) and the Oklahoma City Air Logistics Complex (OC-ALC) to maintain near-term mission capability targets. However, more work is needed to ensure that we maintain operational readiness as the fleet grows.

Engine availability for the F135 program is contracted and measured by a Non-Mission Capable (NMC) rate. Three critical factors most influence NMC: engine reliability; spare engine ratios; and sustainment network production. P&W is funded to design and support a sustainment network that maintains an NMC rate at no more than six percent. In 2020, NMC averaged five percent for the year, but degraded to seven percent by January of 2021. Over the past three years, the program averaged approximately five percent NMC.

The F135 is reliable, and the engine removal forecast is accurate. Reliability is measured in terms of Mean Flight Hours Between Removal (MFHBR). The current F135 production engine MFHBR is more than two times the program objective. By using these reliability measures and fleet utilization rates, P&W forecasts module removals. Between 2018 and 2020,

P&W predicted 145 power module removals; actual removals were 143. One of the major power module removal drivers over the past three years has been High Pressure Turbine (HPT) blade coating degradation. Although this is not a flight safety issue, P&W approached the problem with urgency, and developed and released a new coating in the spring of 2020. While more testing is required, P&W is confident this will reduce, if not eliminate, the issue.

Forecasted removals are further broken down into workscope estimates. A workscope is the activity required to return a module to a serviceable condition, and dictates the necessary tools, materials, and maintenance hours for repair. There are different levels of workscope based on the type of maintenance at issue. Between 2018-2019, P&W forecasted the correct quantity of power module heavy worksopes; however, the higher-level worksopes requiring heavier effort arrived sooner than anticipated. This occurrence of heavier worksopes earlier than anticipated, combined with an immature sustainment network, created a bottleneck effect that resulted in 47 percent less refurbished power modules, degrading mission capability rates.

In 2020, power module production enablers saw improvement. P&W has made progress in improving the workforce team, tools, and technical data required to maintain modules. We reduced the average turnaround time of engineering dispositions by 58 percent, increased Joint Technical Data (JTD) production by 92 percent, and delivered additional Support Equipment (SE) for module production. P&W and the F135 Heavy Maintenance Center (HMC) at OC-ALC have also focused on maintainer proficiency through a joint training program. The enterprise is on track to more than double depot power module production in 2021, and to nearly double again by 2023.

As the enterprise addresses power module availability recovery, we should also assess engine availability and mission capability. First, while the F135 exceeds reliability targets,

continued investment in the Component Improvement Program is critical. Second, the global F135 fleet is spared at less than half of other P&W engine programs. More spare engines and modules would ensure higher availability as the program matures. Third, sustainment investment has been lower than required, and we need to urgently fund additional depot activations and sufficient spare parts to ensure that depots are ready to support operational readiness. P&W continues to work with the JPO to accelerate additional depot capacity through the activation of international Maintenance, Repair, Overhaul and Upgrade (MRO&U) facilities and the expansion of existing Engine Repair Facilities (ERF), such as P&W's West Palm Beach depot, Naval Air Station Patuxent River (PAX), and Edwards Air Force Base.

Execution of the aforementioned actions will improve engine availability in 2021 and beyond. The challenges of 2020 provide a strong impetus to ensure we fund the necessary sustainment actions to account for fleet growth and uncertainty in the future. By doing so, we will ensure availability for the warfighter.

Affordability: A Cornerstone of the F135

P&W is committed to reducing F135 production and sustainment costs to meet program affordability targets. Since low-rate initial production (LRIP) 1, P&W and the JPO have jointly funded cost reduction through an approximately \$200 million War on Cost initiative. These efforts included component redesign, supplier transitions, and manufacturing process improvements. The combined JPO and P&W War on Cost efforts resulted in more than a 50 percent reduction in engine costs and contributed to approximately \$8 billion in lifecycle cost savings.

While P&W remains committed to further cost reductions, we will face considerable headwinds that could impact the next Lot buy. First, as the fleet grows and becomes fully

operational, P&W will need to balance cost reduction opportunities with investments in production quality and configuration reliability. Second, we will be challenged by near and intermediate term impacts of the commercial market downturn due to COVID-19 and the resultant disruption of the aerospace supply chain. Third, casting supplier price increases continue to challenge the program. P&W is making strategic investments for the program such as our new turbine airfoil facility in Asheville, North Carolina which will provide a cost-effective alternative to independent casting houses when fully operational. And finally, Turkey's directed removal from the F135 program, and the transition of 188 F135 specific parts, will result in an increase in engine unit recurring flyaway (URF) costs of approximately three percent in the next production contract (Lot 15).

As the program pivots to sustainment, P&W is equally committed to continuous cost reduction. Propulsion makes up about 10 percent of the operating costs of the F-35. Propulsion sustainment costs include the startup cost of establishing the depots, maintenance tools, supplies, and technical data. Propulsion operating costs also include depot maintenance, and materials. Almost 40 percent of today's sustainment spending is related to startup costs. As the fleet grows, these costs will diminish and will be replaced by recurring expenses associated with depot maintenance.

Sustainment cost reduction is driven by investment in engine reliability, repair development, and depot maintenance productivity. The primary source of reliability improvements is the Component Improvement Program (CIP). The F135 CIP is currently under contract to work proposed tasks that are expected to yield \$13 billion in lifecycle cost savings for the program. Depot productivity will be advanced through initiatives targeted at improving depot throughput and reducing module repair material costs. For example, P&W has developed and

industrialized more than 200 repairs that enable savings through new spare parts cost avoidance. By the end of 2021, P&W expects to have 400 repairs available. In addition, P&W is partnering with the JPO's Affordability War Room (AWR) to build a pipeline of affordability ideas. To date, there are over 150 new sustainment cost reduction initiatives, with 500 underlying tasks that are ready. The first phase of initiatives, if funded, are anticipated to yield close to \$1 billion in sustainment cost avoidance.

Sustainment readiness and cost reduction require funding. However, the return on this investment is improved availability and a reduction in lifecycle costs. We look forward to partnering with the Government to further develop and execute innovative sustainment cost reduction strategies.

Capability: F135 Enhancement Ready

The F135 is the most capable fighter engine in production today. It produces more thrust, features the best low-observable technologies, and supports more thermal capacity than any other fighter engine in operation. Yet, the existing air vehicle is placing new demands on the engine that are resulting in increased maintenance and higher sustainment expenditures. And to P&W's knowledge, the budget for Continuous Capability Development and Delivery (C2D2) does not address propulsion, creating risk that new C2D2 projects could exceed the F135's current capabilities.

Fortunately, the F135 has room to grow. Anticipating the need for propulsion modernization, P&W has self-funded a multi-year conceptual design with the objective of developing a low-risk spiral upgrade path for the F135 that will provide enhanced capabilities. P&W set firm requirements to provide a low-cost Engineering & Manufacturing Development (EMD) program that maintained or reduced URF and improved lifecycle cost,

while ensuring variant commonality and partner acceptance. Leveraging this design, P&W partnered with the JPO to execute a propulsion modernization study. Study results were delivered on March 31, 2021 and are currently under evaluation. This study provides options for agile propulsion upgrades – known as Enhanced Engine Packages (EEP) – that offer increased capabilities to meet immediate warfighter requirements at an affordable cost. EEP can provide double digit improvements in range, thrust, and thermal capacity. A defined propulsion requirement is needed with funding commensurate to support air vehicle capability growth. P&W stands ready to support any propulsion modernization needs.

F135: Aligned with the Warfighter, Maintainer and Taxpayer

The F135 delivers a step change in capability over 4th generation engines. This includes a substantial increase in thermal management capacity enabling the full spectrum of F-35 weapons and sensor capabilities; a precise and responsive integrated engine control system allowing the pilot to focus squarely on the mission; and an unmatched low observable signature enabling the F-35 to conduct operations in modern Anti-Access/Area Denial (A2AD) environments – a core element of the National Defense Strategy. F135 engine reliability exceeds program targets and surpasses prior generation benchmarks. P&W understands the current delivery, quality, and sustainment challenges and will correct them. Finally, the core of the F135 has ample design margin for rapid, low-cost upgrades. P&W remains committed to keeping the F135 available and capable for the warfighter and affordable for the taxpayer.