

Navair's Decision To Not Provide Updated Power Charts For The Ch-46e's ERIP Is Prematurely Aging The Assault Support Fleet

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NAVAIR'S DECISION TO NOT PROVIDE UPDATED POWER CHARTS FOR THE  
CH-46E'S ERIP IS PREMATURELY AGING THE ASSAULT SUPPORT FLEET

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To  
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The CH-46E's engine power charts must be revised to incorporate the aircraft's newly modified engine's recovered power. Every flight by the CH-46E with the modified engines in high or hot environments without new power charts wastes flight hours. Both CH-46E and CH-53E helicopters must fly additional hours in order to regain the CH-46E's lack of lift capability. The additional hours reduce the time until each aircraft reaches its service life. Naval Air Systems Command's (NAVAIR's) reluctance to provide new power charts for the CH-46E wastes money and prematurely ages the Marine Corps' assault support fleet.

#### **AGING AIRCRAFT**

The CH-46E Sea Knight is a Vietnam-era helicopter, the oldest helicopter in combat use in the military. The Naval Air Training and Operating Procedures Standardization (NATOPS) manual states:

The primary mission of the CH-46E is to rapidly disperse combat troops, support equipment and supplies from amphibious assault landing ships and established airfields to advanced bases in underdeveloped areas having limited

maintenance and logistic support under all-weather conditions (instrument flight) in day or night.<sup>1</sup>

The Sea Knight's engines are old and deteriorating, reducing the combat effectiveness of the CH-46E.

### **POWER CHARTS**

Power charts help determine how much a helicopter can lift. Power charts guarantee minimum engine power available, given predicted in-flight temperature and air pressure. Once the weight of crew, fuel, and weapons and ammunition are subtracted from the computed lift capability, the remaining weight becomes available for payload.

### **POWER DEGRADATION**

The original GE-T58-16 (-16) engine power charts guarantee 100% military power, 1870 shaft horsepower, on a standard day<sup>2</sup> at sea level. Engines experience power degradation as they age when internal components deteriorate due to heat and particulate erosion, reducing the power available and payload. The squadron maintenance department removes engines that fail to produce 100% military power during functional check flights. The Marine Aviation Logistics Squadron receives, inspects, repairs, and

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<sup>1</sup> Department of the Navy, *CH-46E NATOPS Manual*, 2005, page 1-1.

<sup>2</sup> 15°C, 59°F, and 29.92mm Hg at sea level.

returns all engines with minor and moderate damage. Repairing an engine requires many maintenance man-hours. A repaired engine does not produce the power of a new engine, nor will it perform as long before its power falls below acceptable standards, again.

### **REDUCED ENGINE STANDARDS**

In the late 1980s, the proliferation of underpowered engines forced the aviation community to reevaluate acceptable power output. The amount of time -16s operated (under-wing) before failing to produce 100% military power significantly decreased. The engines required the same amount of maintenance man-hours to repair, which caused a backlog of engines ready for issue. NAVAIR contracted with GE to produce the 95% military power chart (95% chart). The 95% chart increased the engines under-wing time but decreased the performance standard and the effectiveness of the CH-46E weapon system.

### **NEWLY MODIFIED ENGINES**

Through the Engine Reliability Improvement Program (ERIP), NAVAIR contracted with General Electric (GE) to recapture lost performance from the GE-T58-16 (-16) engines. As engines age, internal components such as compressor and turbine blades deteriorate due to heat and particulate erosion. The most

notable changes to the -16 engines are new compressor and turbine blades, changing the engine model to GE-T58-16A (-16A). The first -16A engines entered the fleet in fiscal year 2003. The contract did not require GE to guarantee original engine performance nor did it require GE to produce new power charts. Although the -16A engines produce power near or above original -16 specifications, the lack of new power charts prevents any recuperation of lift capabilities for the Marine Corps' most prolific and heavily flown helicopter.

#### **ENVIRONMENT PAYLOAD REDUCTION**

For combat missions, the CH-46E's payload is inversely related to the amount of fuel it carries. Under optimal environmental conditions, the fuel and payload must weigh less than six thousand pounds. While operating at FOB Ripley, Afghanistan, a typical flight profile consists of a sixty nautical mile (nm) combat radius, 2,600 pounds of fuel, and up to one-and-a-half hours of flight. When the aircraft operates at higher altitudes<sup>3</sup> and temperatures<sup>4</sup>, as experienced in Afghanistan, lift capability decreases beginning around 4,000' and 25°C. The aircraft still requires 2600 pounds of fuel, so the maximum payload of 3400 pounds is reduced.

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<sup>3</sup> Due to rotor blade performance reduction.

<sup>4</sup> Due to engine performance reduction.

## **MANDATED PAYLOAD REDUCTION**

Incorporated in the NATOPS manual in 2001, the 95% chart reduces the payload of the CH-46E compared to the 100% military power chart (100% chart). The fuel requirements remain constant when using either power chart. Maintaining a constant fuel load while decreasing lift capability results in a decrease in payload.

With 2600 pounds of fuel at 5000', an air temperature of 24°C, and 29.92 mm Hg, as commonly experienced early in the morning in Southern Afghanistan, the 95% chart allows a 1400-pound payload. Using the 100% chart allows a 2400-pound payload, a difference of 1000 pounds.<sup>5</sup> The reduction of lift capability results in 50 minutes less flight time and 20 NM reduction in combat radius, three less combat loaded Marines<sup>6</sup>, or a combination of the two. The payload reduction requires more helicopters to fly in a specific mission or the same helicopters to fly more sorties; either case requires more total flight hours.

## **INCREASED FLIGHT HOURS**

When a CH-46E tasked with assault support leaves Marines or equipment behind, additional assets must be allocated in order

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<sup>5</sup> NATOPS, 17-4 - 17-10.

<sup>6</sup> For planning purposes, a combat loaded Marine weighs 300 pounds.

to complete the mission. From the example in the previous paragraph, a CH-46E could carry four Marines using the 95% chart or eight Marines using the 100% chart. A factor of two is significant because twice as many CH-46Es would fly in the mission or each aircraft would fly twice as many hours. Due to the outdated pre-flight planning power charts, the amount of flight hours double, causing the airframe to reach its service life quicker.

#### **BURDENING THE CH-53E**

A CH-53E must complete any required tasking the CH-46E cannot fulfill. An aircraft requires maintenance at regular flight-hour intervals. The more hours flown on an aircraft in a given period, the less often it will be available. An HMM<sup>7</sup> has a fixed number of CH-46Es; therefore, the CH-53Es must fly additional aircraft hours in order to augment the CH-46E.

#### **SERVICE LIFE**

Increasing flight hours on the CH-46E and CH-53E is aging the fleet of assault support helicopters more rapidly than planned. The first CH-46E reached the original service life of 10,000 flight hours in 1995. As of 2005, the mean airframe flight hours is more than 9,000 hours, with some aircraft

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<sup>7</sup> Marine Medium Helicopter squadron.



exceeding 12,000 hours.<sup>8</sup> The CH-53E's original service life of 10,000 flight hours is planned to expire in 2015.<sup>9</sup> Planned and actual utilization rates (flight hours per month) for the CH-46E are 19.4 and 30.5, respectively, and the CH-53E rates are 15.6 and 25.4, respectively.<sup>10</sup> The increase in actual utilization rates over the planned utilization rates is due to the missions flown in support of the Global War on Terrorism in Iraq and Afghanistan. A portion of the utilization increase is due to the lack of accurate CH-46E pre-flight planning power charts. The CH-46E's restrained pre-flight planning power computation needlessly increases the utilization rates of both the CH-46E and the CH-53E.

#### **BUT THE GOAL OF THE ERIP IS TO INCREASE UNDER-WING TIME**

Military aircraft engines are designed to remain under-wing for 1,000 hours before performance degradation necessitates its removal. Since 1990, the -16 mean engine flight hours between repairs (MEFHBR) has been 360±65 (295-425) hours. Through the third quarter of 2005, the -16A MEFHBR is 1,019 hours.<sup>11</sup> The ERIP aimed to increase the mean engine under-wing time up to 900

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<sup>8</sup> Major Daniel Seibel, "CH-46E information," 12 December 2005. Personal email (12 December 2005).

<sup>9</sup> LtCol Smith, "CH-53E data," 15 December 2005. Personal email (15 December 2005).

<sup>10</sup> Major Seibel and LtCol Smith.

<sup>11</sup> Joe Sparks, "T58 MEFHBR\_MTSR summary 95-05," 15 November 2005. Personal email (15 November 2005).

hours, which would decrease the maintenance man-hours and money required to remove, replace, and rework engines. The ERIP cannot be classified a success yet because less than 25% of the ERIP engines have been fielded and are included in the mean under-wing time. A significant increase in mean under-wing time has been noticed and the trend appears to support the program goal.

Regardless of what mean under-wing time the -16A engines achieve, a portion of the flight hours are wasted. For every percent of lift capability regained in a new power chart, the CH-46E currently flies that percent in excess hours. The previous example using the 100% and 95% chart demonstrated a 71% increase (2400 vice 1400 pounds) in payload. If that mission requires one hundred flight hours to complete using the 100% chart, it requires 171 flight hours to complete using the 95% chart.

Deployed squadrons in Afghanistan and Iraq account for at least 40% of the annual flight hours.<sup>12</sup> If the ERIP reaches its goal of 900 hours under-wing, assuming a modest 10% payload increase, the engines must fly an additional 4% of the goal, or thirty-six hours, to make up for the non-recovered lift capabilities.

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<sup>12</sup> Major Daniel Seibel, discussion with the author, 15 December 2005.

### **WILL THE -16As EVENTUALLY DEGRADE AS THE -16s DID?**

The -16 engines had accumulated approximately 2000 mean engine flight hours<sup>13</sup> (EFHs) when GE produced the 95% military charts in the late 1980s. Through the third quarter of 2005, the -16A mean EFHs settled at 239.<sup>14</sup> Maintaining current utilization rates and continuing to add -16A engines, the -16A engines will not reach the 2000 hour mark until after 2015, which is the goal date for the V-22 Osprey to have totally replaced the CH-46E. As the V-22 squadrons replace CH-46E squadrons, less total flight hours will be flown on the same number of -16A engines, reducing the mean EFH rate. This will further extend the time until the -16As reach 2000 EFHs. The 100% chart will still be valid through the replacement of the Sea Knight.

### **THE COST OF NEW POWER CHARTS WOULD BE PROHIBITIVELY EXPENSIVE**

The cost of producing new power charts is insignificant as compared to the money spent for the ERIP upgrade. The Marine Corps spends \$450,000 per ERIP module and \$150,000 for each installation. Funding has been approved for 449 engine modifications, which will refit 100% of the CH-46Es.<sup>15</sup> The total cost for the ERIP modifications would be just less than

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<sup>13</sup> The average flight hours of all -16 engines.

<sup>14</sup> Sparks.

<sup>15</sup> Gordon Gissel, "More," 9 Novemeber 2005. Personal email (9 November 2005).

\$270,000,000. For GE to validate the old or produce new power charts would cost less than five million dollars, less than 2% of the total ERIP modification costs, the cost of eight engine modifications.

Deployed HMM Squadrons in Iraq with -16A engines have flown over 900 hours in a month.<sup>16</sup> The CH-46E costs more than \$6,000 to operate per flight hour.<sup>17</sup> Assuming a modest 10% increase in lift capabilities for one squadron, a deployed squadron would save more than 6.5 million dollars per year. In only one year, one squadron could recuperate the cost of producing new power charts, after that, the Marine Corps saves money. The dollar savings to the Marine Corps does not take into account the operating cost for the more expensive CH-53E.

#### **WHAT IF THE -16A ENGINES ENCOUNTER POWER DEGRADATION?**

The -16A engines will fail power tests sooner using revised power charts vice the 95% charts. When the ERIP engines mean under-wing time decreases below a predetermined number, NAVAIR can reinstate the 95% charts. Another option is to note degraded engine performance for specific aircraft for planning purposes and continue to use the engine as long as it exceeds the 95% charts.

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<sup>16</sup> LtCol Joeseeph George, "Update," 4 December 2005. Personal email (4 December 2005).

<sup>17</sup> Major Seibel.

### **THE CHOICE IS SIMPLE**

The -16A engines outperform the -16 engines but the preflight planning power charts do not reflect this capability. The power degradation the -16 engines have encountered should not affect the -16A engines prior to their discontinuation. NAVAIR's reluctance to provide new power charts for the Sea Knight has detrimental effects to the Marine Corps' assault support community.

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