Director, Operational Test and Evaluation

RQ-4B Global Hawk Block 30

Operational Test and Evaluation Report

May 2011

This report on the RQ-4B Global Hawk Block 30 fulfills the provisions of Title 10, United States Code, Section 2399. It assesses the adequacy of testing and the operational effectiveness and suitability of the RQ-4B Global Hawk Block 30 system.

J. Michael Gilmore
Director

The marginal cost of producing this report is estimated to be approximately $59,101. The estimated acquisition cost of the program with which this report deals is $8.6B.

The RQ-4B Global Hawk Block 30

Executive Summary

The RQ-4B Global Hawk Block 30 demonstrated the capability to provide about 40 percent of requested intelligence, surveillance, and reconnaissance (ISR) coverage when used at low operational tempos (two to three sorties per week using three air vehicles). However, the system is not operationally effective for conducting near-continuous, persistent ISR as specified in the Air Force Concept of Employment.[1] The Enhanced Imagery Sensor Suite (EISS) provides imagery that meets or exceeds most operational requirements and provides actionable imagery intelligence (IMINT) products to operational users. The Airborne Signals Intelligence Payload (ASIP) provides a limited operational utility to detect, identify, and locate some threat radars and to detect some communication signals, but does not consistently deliver actionable signal intelligence (SIGINT) products to operational users due to technical performance deficiencies and immature training, tactics, techniques, and procedures. The RQ-4B Global Hawk Block 30 is not operationally suitable. Global Hawk long endurance flights do not routinely provide persistent ISR coverage due to low air vehicle reliability. Assessments are based on operational testing conducted from October 2010 through December 2010. Additional data from developmental test and field observations supplemented operational test data.

The RQ-4B Global Hawk Block 30 system can conduct launch and recovery operations from both deployed and main operating base airfields. Operators currently conduct worldwide operations by employing time-consuming, interim operating procedures to mitigate airspace compliance and mission planning deficiencies. Ground station communication and situational awareness deficiencies hinder mission management and coordination.

When on station, the RQ-4B Global Hawk Block 30 IMINT suite of sensors produce high-resolution electro-optical (EO), infrared (IR), and synthetic aperture radar (SAR) spot mode imagery that provides valuable intelligence at short and medium ranges. The SAR sensor mode produces high-resolution imagery at longer ranges, although intelligence value degrades as range increases. The system does not provide required Wide Area Search (WAS) imaging or ground moving target indicator (GMTI) capabilities. When integrated with supporting IMINT processing, exploitation, and dissemination systems, the RQ-4B Global Hawk Block 30 system provides imagery to support pre-planned and standard ad hoc target requests, but IMINT transmission and processing times limit capabilities to respond to some short-notice, time-sensitive target imaging requests.

The RQ-4B Global Hawk Block 30 SIGINT payload collects large volumes of information across the designated frequency spectrum and provides a limited capability to detect, identify, and locate specific signals of interest. Technical deficiencies, inadequate training, and immature tactics currently limit SIGINT operational utility. SIGINT sensor instability also reduces on-station operational effectiveness. When integrated with supporting intelligence

---

[1] The Air Force Concept of Employment for a Global Hawk Combat Air Patrol consisting of three air vehicles and supporting ground stations is defined in the *Capabilities Development Document (CDD) for the Global Hawk Remotely Piloted Aircraft (RPA) System*, July 2006 and the *Air Force Air Combat Command Enabling Concept for RQ-4 Global Hawk*, June 2007.

processing and dissemination systems, the Global Hawk Block 30 system does not consistently deliver actionable SIGINT reports to operational users.

The Global Hawk Block 30 is survivable in low to medium, ground-based threat environments. IMINT sensor performance allows collection of high-resolution imagery outside the maximum engagement ranges of most short and medium range ground-based threat systems using multiple sensor modes.[2] The SAR sensor mode provides imagery at longer ranges that meets minimum image resolution requirements, which provides a limited long-range standoff IMINT collection capability. The SIGINT sensor is also capable of signal reception beyond the engagement ranges of short and medium range ground-based threats. The classified Annex A to this report provides additional information on intelligence collection capabilities at standoff ranges.

A RQ-4B Global Hawk Block 30 Combat Air Patrol (CAP) of three air vehicles and supporting ground stations cannot consistently generate or sustain long endurance missions to support persistent ISR operations. When operating at near-continuous operational tempos, the system provides less than half the required 55 percent Effective-Time-On-Station (ETOS) coverage over a 30-day period. Frequent failures of mission critical air vehicle components reduce takeoff reliability and increase mission abort rates, which reduces ETOS performance. Rapid depletion of available spare parts reduces air vehicle availability to support additional missions at near-continuous operational tempos. A Global Hawk CAP can consistently generate sorties at a lower operational tempo of up to three sorties per week, when sufficient spare parts are available. However, these individual sorties collectively produce only 42 percent of the "tasked" ISR coverage time due to poor takeoff reliability, maintenance ground aborts, and high air abort rates. Current and planned Air Force reliability improvement activities will improve system reliability. In the interim, operational commanders should anticipate low air vehicle mission capable rates, spare part shortages, and a heavy reliance on system contractor support to sustain operations when attempting to conduct operations at near-continuous operational tempos

The RQ-4B Global Hawk Block 30 Initial Operational Test and Evaluation (IOT&E) was adequate to support these conclusions. Testing was conducted in accordance with the Director, Operational Test and Evaluation (DOT&E)-approved test plan.

System Description and Mission

The Northrop Grumman RQ-4B Global Hawk Block 30 is a remotely piloted, high-altitude, long-endurance airborne ISR system. The Global Hawk Block 30 mission is to provide persistent, high-altitude, intelligence collection capabilities to support joint combatant forces or national authorities during worldwide peacetime, crisis, and wartime operations. A Global Hawk CAP consists of three air vehicles with integrated IMINT and SIGINT sensor payloads and supporting ground control stations. An integrated command, control, and communications architecture supports air vehicle operations, payload operations, and intelligence data transmission. The system is intended to provide near real-time, broad-spectrum intelligence

---

[2] The Global Hawk System Threat Assessment (STAR), NASIC-1574-2139-2009, August 2009 defines short range surface to air missiles as having an effective range of less than 15 km and medium range as 15 to 50 km.

collection capabilities in all-weather and day/night conditions to support operations in low to medium threat environments. When coupled with existing intelligence processing, exploitation, and dissemination systems, the RQ-4B Global Hawk Block 30 is intended to deliver near-real time intelligence data to operational commanders.

Test Adequacy

The operational testing of the RQ-4B Global Hawk Block 30 system was adequate to support an evaluation of operational effectiveness and operational suitability. The Air Force Operational Test and Evaluation Center (AFOTEC) conducted the RQ-4B Global Hawk Block 30 IOT&E from October 4 through December 14, 2010. During IOT&E, the Air Force 9th Reconnaissance Wing operated four production-representative RQ-4B Global Hawk Block 30 air vehicles delivered as low-rate initial production systems. One air vehicle was equipped with both the EISS and ASIP and the three remaining air vehicles carried only the EISS payload. Production Launch and Recovery Element (LRE) and Mission Control Element (MCE) ground stations supported all IOT&E missions. Operators launched and recovered missions using LREs located at Beale Air Force Base (AFB), California and Edwards AFB, California. A Beale AFB MCE controlled all IOT&E missions.

Operational intelligence tasking, processing, exploitation, and dissemination facilities supported IOT&E missions. The Air Force Combined Air Operations Center-Nellis (CAOC-N) at Nellis Air Force Base (AFB), Nevada, tasked and directed IOT&E missions. CAOC-N personnel provided operationally realistic, real-time interaction with mission crews to include coordination of dynamic mission and target changes. Intelligence analysts from the Air Force 480th Intelligence, Surveillance, and Reconnaissance Wing exploited IMINT data at the Distributed Ground Station (DGS)-2 site. Army intelligence analysts exploited imagery at a tactical intelligence site at China Lake Naval Air Warfare Center, California. Signals intelligence analysts exploited SIGINT data at the Beale AFB DGS-2 site and other distributed communications intelligence exploitation sites.

The test team evaluated RQ-4B Global Hawk Block 30 operational unit capabilities to employ the system and execute missions derived from Major Combat Operation planning scenarios, current overseas contingency operations, and homeland defense operations. Scenarios included ISR operations to detect, locate, identify, and monitor targets and operations of intelligence interest. The test team developed 19 mission scenario variations to provide an operationally realistic mission context for planning IMINT and SIGINT collection operations.

Operational Effectiveness

The RQ-4B Global Hawk Block 30 demonstrated the capability to provide about 40 percent of requested ISR coverage when used at planned peacetime or non-crisis operational tempos. However, the system is not operationally effective for conducting near-continuous, persistent ISR as specified in the Air Force Concept of Employment. The EISS provides imagery that meets or exceeds most operational requirements and provides actionable IMINT products to operational users. The ASIP provides a limited operational utility to detect, identify, and locate some threat radars and to detect some communication signals, but does not consistently deliver actionable SIGINT products to operational users due to technical performance deficiencies and immature training, tactics, techniques, and procedures.

The RQ-4B Global Hawk Block 30 system can conduct launch and recovery operations from both deployed and main operating base airfields. A lack of air vehicle anti-ice or de-ice systems limits all-weather operations and may restrict takeoff and landing operations at cold weather operating locations. Redundant air vehicle command and control systems effectively support mission operations. Operators currently conduct worldwide operations by employing time-consuming, interim operating procedures to mitigate existing airspace compliance and mission planning deficiencies. Ground mission management and coordination capabilities are adequate for most operations, but communication system deficiencies and a lack of real-time crew situational awareness tools for weather and air traffic information reduce mission effectiveness.

When operating on-station, the RQ-4B Global Hawk Block 30 provides an operational capability to collect, transmit, and process IMINT information. During daytime, clear weather conditions, the EISS EO sensor produces high-resolution spot mode imagery that provides valuable intelligence information at ranges up to 80 km. During night, clear weather operations, or in environments with high thermal gradients, the IR sensor produces high-resolution spot mode imagery at short, near-nadir (overhead) ranges. The SAR sensor provides around-the-clock, all-weather IMINT collection capabilities, producing high-resolution spot mode imagery at ranges up to 200 km, although intelligence value decreases as range increase. The EISS does not meet operational requirements for providing Wide Area Search imagery, GMTI capabilities, or target-quality coordinates from imagery. When integrated with supporting IMINT processing, exploitation, and dissemination systems, the RQ-4B Global Hawk Block 30 system provides imagery to support pre-planned and standard ad hoc target requests. IMINT transmission and processing times limit capabilities to respond to some short-notice, time-sensitive target imaging requests.

The RQ-4B Global Hawk Block 30 ASIP payload meets the Battlespace KPP requirement to collect SIGINT data across a designated frequency range. The sensor provides a limited operational capability to detect, identify, and locate radar threat emitters and to detect communications signals of interest. ASIP technical performance for electronic intelligence (ELINT) collection varies widely by threat radar signal type and operating mode. ASIP detected 62 percent of all threat radar signals. Detection rates were 70 percent or greater for 15 of the 32 specific threat radar types and modes presented during IOT&E. The system automatically identified 79 percent of the all detected signals and displayed accurate geo-containment ellipses for 66 percent of these signal sources. Although these overall threat radar signal detection, identification, and geo-location rates do not meet ASIP technical specifications, the system generates very accurate information for approximately half the tested threat radar signal types and modes, which provides a limited operational capability against these specific threats systems. ASIP technical performance supports a very limited communications intelligence (COMINT) operational capability. The system demonstrated a capability to receive large volumes of COMINT emissions at rates approaching 27,000 receptions per minute. Despite the large number of receptions, emission detection and geo-location rates for known communication signals present in the operating environment were very low. ASIP detected only 34 percent (3,601 of 10,719) of the scripted communication emissions transmitted during schedule range periods. From those detections, ASIP generated only 14 geo-containment ellipses and only seven actually contained the signal source geographic location. ASIP sensor instability also reduces operational effectiveness. Frequent sensor or application resets are required to clear system faults. Full SIGINT collection capabilities are available only 48 percent of the time during mission operations. The Global Hawk Block 30 system does not provide required SIGINT data recording capabilities necessary to allow autonomous intelligence collection operations when satellite or tactical data link systems are not available.

When integrated with supporting intelligence processing, exploitation, and dissemination systems, the Global Hawk Block 30 system did not consistently deliver SIGINT products or reports to operational users due to the combination of technical performance deficiencies and immature training, tactics, techniques, and procedures. SIGINT end-to-end mission scenario success rates are very low. Only 26 percent (40 of 152) of ELINT mission scenarios produced the expected operational intelligence reports following data processing, exploitation, and dissemination. For COMINT mission scenarios, the success rate was only eight percent (6 of 75). Inconsistent detection of threat radar emitters and communication signals reduces mission success rates. The lack of ASIP technical data and incomplete operator training often prevent full utilization of system capabilities. For most ASIP operators and supporting SIGINT exploitation sites, the IOT&E missions were the first attempt to execute operationally realistic, end-to-end missions with the Global Hawk ASIP sensor. As a result, tactics, techniques, and operating procedures were immature. The cumulative effects of these shortfalls prevent consistent delivery of SIGINT reports to operational users. Classified Annexes A and B provide detailed ASIP evaluation results.

The Global Hawk Block 30 is survivable in low to medium, ground-based threat environments. IMINT sensor performance allows collection of high-resolution imagery outside the maximum engagement ranges of most short and medium range ground-based threat systems using multiple sensor modes.[3] The SAR sensor mode provides imagery at longer ranges that meets minimum image resolution requirements, which provides a limited long-range standoff IMINT collection capability. The SIGINT sensor is also capable of signal reception beyond the engagement ranges of short and medium range ground-based threats. The lack of a near-real time tactical operating picture display reduces pilot threat situational awareness. The classified Annex A to this report provides additional information on intelligence collection capabilities at standoff ranges.

The RQ-4B Global Hawk Block 30 system does not currently meet Net Ready Key Performance Parameter (KPP) requirements for interoperability or information assurance. The Joint Interoperability Test Command (JITC) did not recommend joint interoperability certification due to critical deficiencies in communication and situational awareness systems. Implementation of required DoD information assurance controls is not complete. The Global

---

[3] The Global Hawk System Threat Assessment (STAR), NASIC-1574-2139-2009, August 2009 defines short range surface to air missiles as having an effective range of less than 15 km and medium range as 15 to 50 km.

Hawk Block 30 system is currently conducting operations under an interim authority to operate pending implementation and verification of required system security controls. See classified Annex A to this report for a summary of information assurance evaluation results.

Operational Suitability

The RQ-4B Global Hawk Block 30 is not operationally suitable. The system cannot consistently generate or sustain long endurance missions necessary to support a near-continuous, persistent ISR operational tempo. A Global Hawk CAP of three air vehicles provides less than half the required 55 percent ETOS coverage during a 30-day period. Aircraft Readiness Model (ARM) simulation results, based on system performance data collected for IOT&E, show that a single RQ-4B Global Hawk Block 30 CAP provides 27 percent ETOS during a 30-day period of near-continuous operations while relying only on pre-planned deployment spare part kits. During a shorter, seven-day "mission surge" demonstration, three air vehicles provided 39 percent ETOS while operating at near-continuous operational tempos from a main operating base with normal base supply support.

Frequent failures of mission-critical air vehicle components reduce takeoff reliability and increase mission abort rates, which reduces ETOS performance. These failures also create a high demand for mission-critical spare parts. Rapid depletion of available spare parts reduces air vehicle availability to support additional missions at near-continuous operational tempos. The high demand for air vehicle maintenance often exceeds Air Force maintenance repair capabilities. Extensive, unplanned use of system contractors is required to generate missions and sustain operations. Incomplete maintenance technical data, inadequate training, and an ineffective integrated diagnostic system also degrade system maintainability. MCE and LRE ground stations are reliable and do not contribute to low ETOS performance.

A single Global Hawk CAP can consistently generate sorties to support ISR operations at lower operational tempos. During IOT&E "non-surge" operating periods, the operational unit consistently generated up to three sorties per week, when sufficient spare parts were available. However, these individual sorties collectively produced only 42 percent of the "tasked" ISR coverage time due to poor takeoff reliability, maintenance ground aborts, and high air abort rates.

The RQ-4B Global Hawk Block 30's inability to support near-continuous, persistent ISR operations can be mitigated if the Air Force implements strong corrective actions for identified system reliability problems. Current and planned Air Force reliability improvement activities will improve system availability rates, and increase sortie generation and mission sustainment capabilities. For example, the expected 2011 delivery and retrofit of an improved 25 KVA generator will increase ETOS performance by three to five percent. Resolving maintenance technical data, training programs, and integrated diagnostic system deficiencies will improve system maintainability. In the interim, when attempting to conduct operations at near-continuous operational tempos, operational commanders should anticipate low air vehicle mission capability rates, high air abort rates, critical spare part shortages, high air vehicle cannibalization rates, and a heavy reliance on system contractor support to sustain operations.

Recommendations

The Air Force should consider the following recommendations and should verify the corrections to deficiencies during follow-on test and evaluation.

Operational Effectiveness

- Develop mission planning tools that reduce the current four-week planning process for new missions to improve rapid employment capabilities
- Develop a capability to upload new mission plans after takeoff to enable autonomous execution of new or revised missions and reduce operational risk
- Upgrade communication systems to provide real-time Global Hawk Virtual Crew voice capabilities, integrated SIPRNET access, and a redundant air traffic control voice communication capability to improve crew situational awareness and mission coordination capabilities
- Integrate real-time weather, air traffic, and tactical common operating picture information into the MCE to improve pilot situational awareness
- Develop an air vehicle anti-ice and de-ice capability to improve all-weather operational capabilities
- Continue to develop air traffic sense and avoid capabilities to ensure future access to worldwide airspace
- Complete development of EISS wide area search, GMTI, and ground target geo-location capabilities required to meet IMINT operational requirements
- Resolve ASIP signal detection, identification, and geo-location technical deficiencies to improve SIGINT capabilities
- Develop an IMINT and SIGINT data recording capability that meets the operational requirement to conduct autonomous “off-tether” missions without reliance on line-of-sight (LOS) or beyond-line-of-sight (BLOS) data link systems for intelligence data transmission
- Resolve joint interoperability and information assurance deficiencies

Operational Suitability

- Develop, fund, and implement a comprehensive reliability growth plan to correct system reliability deficiencies and increase effective-time-on-station performance
- Review spare part acquisition plans and consider increasing mission critical spare part availability until reliability deficiencies are corrected
- Resolve ASIP sensor stability deficiencies to improve on-station SIGINT collection capabilities

- Complete development and delivery of all required system maintenance and sensor payload documentation and technical data
- Improve maintenance and ASIP operator training programs
- Resolve deficiencies in air vehicle and ASIP integrated diagnostic and health monitoring systems

J. Michael Gilmore
Director

Contents

Section One
System Overview

This report covers the Initial Operational Test and Evaluation (IOT&E) of the RQ-4B Global Hawk Block 30 intelligence, surveillance, and reconnaissance (ISR) Unmanned Aerial System. The RQ-4B Global Hawk Block 30 is one of several Air Force Global Hawk variants. The Global Hawk program began as an Advanced Concept Technology Demonstration (ACTD) to provide an unmanned, high-altitude, imagery intelligence (IMINT) collection capability. The RQ-4A Global Hawk Block 10 was a production version of the initial ACTD system. The larger RQ-4B Global Hawk Block 20 system increased payload capacity and incorporated an improved imagery sensor payload. The RQ-4B Global Hawk Block 30 system, evaluated in this report, is similar to the RQ-4B Global Hawk Block 20 variant, but adds the Airborne Signals Intelligence Payload (ASIP). An additional planned Air Force variant, the RQ-4B Global Hawk Block 40, will incorporate the Multi-platform Radar-Technology Insertion Program (MP-RTIP) sensor payload. The Navy is also developing the Broad-Area Maritime Surveillance unmanned system based on the Air Force RQ-4B Global Hawk platform.

Since fiscal year (FY) 2005, the Air Force has procured 10 RQ-4B Global Hawk Block 30 air vehicles and 10 ground segments through a series of low-rate initial production decisions. The Air Force plans to procure up to 26 additional Block 30 air vehicles. Initial operational fielding and employment of the RQ-4B Global Hawk Block 30 system occurred in FY 2011 at operating bases within the continental United States and at overseas operating locations.

While not specifically designed as a one-for-one replacement for existing airborne ISR platforms, the Air Force plans to reduce existing U-2 force structure following the fielding of the RQ-4B Global Hawk Block 30 system. The current Air Force projection for U-2 operational aircraft retirement is FY 2016.

Mission

The RQ-4B Global Hawk Block 30's mission is to provide persistent, high-altitude, intelligence collection capabilities to support joint combatant forces or national authorities during worldwide peace, crisis, and wartime operations. The system uses a suite of IMINT and signals intelligence (SIGINT) sensors to provide near real-time, broad-spectrum intelligence collection capabilities. The system is intended to operate in all-weather and day/night conditions to support operations in low to medium threat environments. When coupled with existing intelligence processing, exploitation, and dissemination systems, the RQ-4B Global Hawk Block 30 provides near-real-time intelligence data to operational commanders.

System Description

The RQ-4B Global Hawk Block 30 is a remotely piloted, high-altitude, long-endurance airborne ISR system. The system consists of an unmanned air vehicle, a ground support segment, and both imagery and signals intelligence payloads. An integrated command, control, and communications architecture supports air vehicle operations, payload operations, and intelligence data transmission.

Air Vehicle

The RQ-4B Global Hawk Block 30 air vehicle has a wingspan of 116 feet and operates at altitudes up to 65,000 feet. It has a maximum takeoff weight of 26,750 pounds and is powered by an Allison Rolls Royce AE 3007H turbofan engine.

Figure 1-1. RQ-4B Block 30 Air Vehicle

On-board avionics incorporate a highly accurate, three-dimensional navigation system to support automated taxi, takeoff, landing, and mission operations. Mission computer contingency modes provide predictable operation and recovery to primary or alternate bases in the event of lost communications or other system malfunctions. The Global Hawk air vehicle does not incorporate any self-contained threat system awareness or threat protection systems.

Ground Segment

The ground segment is composed of two major elements: the RD-2A Mission Control Element (MCE) used to control the air vehicle and payloads; and the RD-2B Launch and Recovery Element (LRE) that serves as the control station during takeoff, approach, and landing.

The RD-2A MCE serves as the remote Global Hawk “cockpit” for the pilot and imagery sensor operator during en route and mission execution phases of flight. The MCE crew stations provide control of the air vehicle, Enhanced Integrated Sensor Suite (EISS) payload, and communication systems via line-of-sight (LOS) and beyond-line-of-sight (BLOS) data links. The MCE pilot station displays flight instrumentation, system status, mission plans, and navigation data. When necessary, the MCE pilot can independently conduct takeoff and landing operations from remote operating locations. The EISS sensor operator station provides the capability to command sensor operations, upload new imagery targets, monitor sensor status, initiate calibration, and distribute/store imagery data.

Figure 1-2. RD-2A Mission Control Element

The RD-2B LRE serves as the control station for takeoff, approach, and landing phases of flight. The LRE pilot station displays only flight instrumentation, system status, and data links necessary to support takeoff and landing operations. The LRE does not provide payload operations or monitoring capability. After executing takeoff operations, the LRE pilot transfers command and control (C2) of the air vehicle to the MCE before the air vehicle travels outside the range of LOS data link systems. During recovery and landing phase, the MCE transfers air vehicle control to the LRE pilot after a reliable LOS data link is established. The LRE normally deploys with the air vehicle to support operations at forward operating locations.

Figure 1-3. RD-2B Launch and Recovery Element

Sensor Payloads

The RQ-4B Global Hawk Block 30 is a multi-intelligence collection system equipped with both IMINT and SIGINT collection payloads. Both payloads operate simultaneously to provide broad area intelligence collection and sensor cross-cueing capabilities. The Air and

Ground Sensor Management Units installed in the air vehicle and MCE act as the control interface between sensor payloads and the ground segment. This system provides sensor control capabilities for sensor operators. The system uses both LOS and BLOS data links to transmit collected data to intelligence exploitation sites.

IMINT Payload

The EISS payload, developed by Raytheon, contains an independent electro-optical (EO) sensor, an infrared (IR) sensor, and synthetic aperture radar (SAR) to provide high-resolution imagery necessary to identify intelligence Essential Elements of Information (EEIs). The EO sensor is a digital camera that collects reflected solar energy to support daytime image collection. The IR sensor is a thermal imaging device used to support both day and night image collection. The SAR sensor is a radar ground mapping radar used to support day, night, and all-weather imagery collection. It also collects and processes Ground Moving Target Indication (GMTI) data. The SAR sensor can function simultaneously with either the EO or the IR sensor. An EISS sensor operator controls the payload from the MCE.

SIGINT Payload

The AN/ASQ-230 Airborne Signals Intelligence Payload (ASIP), developed by Northrop Grumman Mission Systems Electromagnetic Systems Laboratory, collects and processes radio frequency (RF) signals to support intelligence operations and analysis. The system provides automatic signal detection, identification, direction finding, and geo-location. The ASIP sensor operator controls the payload from the supporting Distributed Common Ground System (DCGS) facility.

ASIP also supports network-centric, collaborative geo-location of high-priority signals by providing emitter data in support of Airborne Overhead Cooperative Operations (AOCO). The classified appendices to this report include additional information on ASIP frequency collection ranges and AOCO capabilities.

C2 and Data Transmission Architecture

The RQ-4B Global Hawk Block 30 Airborne Integrated Communication System (AICS) provides redundant radio and satellite communications for aircraft C2, voice communications, and payload data transmission. The AICS system includes a wideband Ku-band Satellite Communications (SATCOM) data link, ultra high frequency (UHF) LOS or SATCOM C2 data link, and wideband air-to-ground Common Data Link (CDL) LOS system. Voice communication between mission crews and external agencies use the Ku-band SATCOM data link or CDL. An integrated International Maritime Satellite (INMARSAT) system provides a backup C2 capability. The Communications Airborne Modem Assembly (CAMA) controls all air vehicle communication systems. Figure 1-4 depicts the current C2 and data transmission architecture.

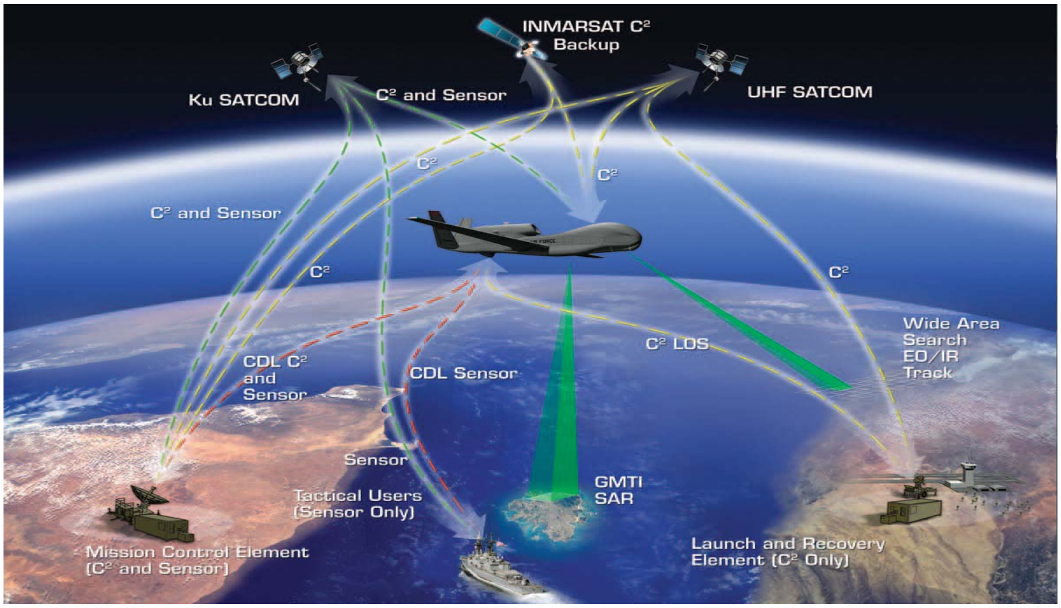


Figure 1-4. RQ-4B Global Hawk Block 30 C2 and Intelligence Data Transmission Architecture

Key Supporting Systems

Supporting systems that are not part of the core RQ-4B Global Hawk Block 30 system, but are integral to Global Hawk operations, include the Global Hawk Operations Center (GHOC) and the Air Force DCGS. The Global Hawk "Virtual Crew" concept integrates the activities of the Global Hawk mission crew with supporting systems and personnel.

Global Hawk "Virtual Crew"

The Global Hawk "Virtual Crew" includes all primary mission participants operating from geographically separated locations. Virtual crew core members are the LRE pilot, MCE pilot, EISS sensor operator, ASIP sensor operator, DCGS ISR mission commander, GHOC personnel, and the Combined Air Operations Center (CAOC) Global Hawk liaison officer (LNO). Mission requirements may expand this crew to include the CAOC Time-Sensitive Targeting (TST) cell, and other ISR system operators. Members communicate and coordinate mission activities in real time using a variety of voice and networked computer systems.

Global Hawk Operations Center (GHOC)

The GHOC is the focal point of Global Hawk operations for missions using the main operating base (MOB) MCE facility. The GHOC is manned by a Global Hawk pilot, EISS sensor operator, and intelligence officer that function as a mission coordination cell. The GHOC pilot and sensor operator support the MCE mission crew by coordinating directly with tasking authorities, operational users, and supporting agencies to maintain overall mission situational awareness. GHOC personnel monitor collection plan progress and update collection strategies to support dynamic target operations. They also provide direct support to the MCE mission crew by providing weather updates, monitoring alternate airfield status, assisting with emergencies, and providing threat awareness updates. In general, the GHOC assumes responsibility for many mission coordination activities, allowing the MCE mission crew to focus on mission tasks.

Air Force Distributed Common Ground System

The Air Force AN/GSQ-272 SENTINEL DCGS tasks, receives, processes, exploits, correlates, and disseminates intelligence data from national, theater, tactical, and commercial ISR sensors in a distributed environment. The RQ-4B Global Hawk Block 30 system routes IMINT and SIGINT data through the MCE to DCGS facilities using the Global Hawk communications architecture. Intelligence analysts (IAs) analyze, exploit, and disseminate processed intelligence information to end users through the DCGS dissemination network. Currently, the Air Force DCGS is comprised of five Distributed Ground Station (DGS) core sites. A distributed communications network allows each site to assist with data exploitation at another site, when required. Mission support capacity varies between core sites, but typical operations include simultaneous support for MQ-1 Predator, MQ-9 Reaper, RQ-4 Global Hawk, and U-2 missions.

Concept of Employment

Under the current Global Hawk concept of operations and employment, the RQ-4B Global Hawk Block 30 MOB is located at Beale Air Force Base (AFB), California.[4] Three forward operating locations (FOLs) are located in U.S. Central Command (USCENTCOM), U.S. Pacific Command (USPACOM), and U.S. European Command (USEUCOM) areas of responsibility. There are two primary employment architectures for Global Hawk operations: co-located and reach-back.

The co-located employment architecture bases all components of the Global Hawk system at the same site. Advantages of this concept include easier coordination between MCE and LRE operations, simplified communications requirements, and reduced support equipment requirements. Disadvantages include increased in-theater personnel and support requirements. The MOB at Beale AFB, California, uses this concept of employment to support training and operational missions.

The reach-back employment architecture places the LRE and air vehicle at a deployed forward operating area while the supporting MCE remains at the MOB. This allows the MCE better access to communications, backup facilities, logistics, and other support functions. Disadvantages include more complex communications architectures and increased personnel and support requirements to maintain two separate operating sites. All planned RQ-4B Global Hawk Block 30 FOLs use this employment architecture.

A deployed Global Hawk Combat Air Patrol (CAP) or “orbit” is comprised of three primary air vehicles, one backup air vehicle, an assigned MCE, an LRE, and support equipment. Approximately 66 operations and maintenance personnel are required to support MCE operations and 100 additional personnel are required to support a separate air vehicle and LRE operating location. During initial deployment, the air vehicles self-deploy by flying to the new operating location and other system components deploy by air or land transport. Upon arrival, a

---

[4] June 2007 Air Force Air Combat Command Enabling Concept for RQ-4 Global Hawk; July 2006 Capabilities Development Document (CDD) for the Global Hawk Remotely Piloted Aircraft (RPA) System

single Global Hawk CAP is intended to provide near-continuous on-station coverage for 30 days using only the spare parts contained in the pre-planned Mission Readiness Spares Package (MRSP). After 30 days of deployed operations, theater supply systems provide additional supply support to sustain near continuous operations.

The Global Hawk Capabilities Development Document (CDD) defines "near-continuous" operations and Effective-Time-On-Station (ETOS) requirements based on a specific operational scenario depicted in Figure 1-5. The CDD-defined Global Hawk operational requirement is for a single Global Hawk CAP to provide 55 percent ETOS during a 30-day period of near-continuous operations. This equates to 396 effective on-station hours during a 720-hour period of operations. While actual ETOS coverage requirements for a Global Hawk CAP vary significantly for specific operational scenarios, the capability to perform "near-continuous" operations for 30 days, as depicted below, enables the system to meet combatant commander expectations for persistent ISR support.

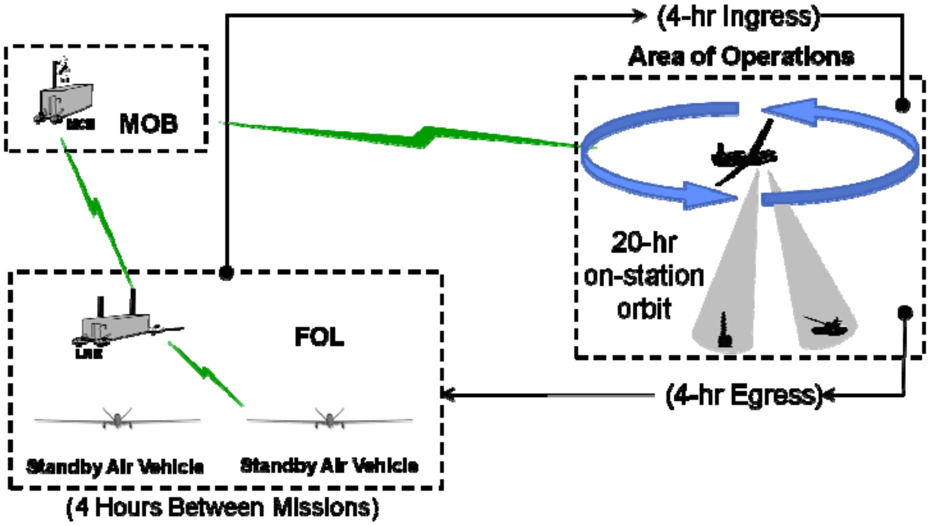


Figure 1-5. RQ-4B Global Hawk Block 30 Near-Continuous Operations (CDD Definition)

Existing theater processes provide RQ-4B Global Hawk Block 30 mission tasking. A Global Hawk LNO, assigned to the Joint Force Air Component Commander staff, provides Global Hawk expertise to the theater CAOC ISR collection manager, and aids in developing specific Global Hawk missions.

Peacetime operational mission scenarios include Homeland Defense, Humanitarian Aid, Sensitive Reconnaissance, and other combatant command tasks. Most peacetime missions execute pre-planned routes to collect intelligence data on pre-planned targets. Peacetime mission generation and time-on-station requirements for a Global Hawk CAP vary by scenario and may not require near-continuous operations. Initial Air Force plans for peacetime operations project a sustained Global Hawk CAP mission generation rate of three 24-hour missions per week. Some peacetime operational scenarios may require intermittent "surge" periods beyond this level to support specific combatant commander ISR coverage requests.

Pre-conflict or wartime operational mission scenarios include Blockade and Quarantine Enforcement, Enemy Order of Battle Information, Combat Assessment, Targeting and Precision Strike Support, Personnel Recovery, Sensitive Reconnaissance Operations, and Special Operations support. Wartime operations require a Global Hawk CAP to initiate near-continuous operations to provide theater commanders with persistent ISR coverage. Wartime missions are more fluid and include a greater proportion of ad hoc targets that emerge during mission execution. The Air Force RQ-4 Tactical Employment Manual describes three types of Global Hawk ad hoc target requests: standard, dynamic, and non-interference. Standard ad hoc targets are generally not time-sensitive and have a Latest Time Information of Value (LTIOV) greater than three hours. The mission crew adds standard ad hoc targets to the mission collection plan at an opportune time. Dynamic ad hoc target requests are time-sensitive with an LTIOV of less than three hours. The CAOC may prioritize collection of dynamic ad hoc targets ahead of all pre-planned targets. Non-interference ad hoc targets are the lowest priority and are collected without interference to any other mission priority or operation.

Key Operational Requirements

The 2006 Global Hawk CDD identifies five Key Performance Parameters (KPPs) for the Global Hawk Block 30 system shown in Table 1-1. The CDD requirements identified for delivery in FY 2009 or earlier define the system performance thresholds applicable to this IOT&E and initial RQ-4B Global Hawk Block 30 fielding. The FY 2009 CDD thresholds define the current FY 2011 program performance baseline since there was a two-year program schedule delay resulting from system development problems.

Table 1-1. RQ-4B Global Hawk Block 30 Key Performance Parameters (KPPs)

KPP	Threshold Performance
Battlespace Persistence	
Endurance	Must have, in a mission capable (MC) configuration, a minimum total endurance of 28 hours and appropriate fuel reserves in accordance with Air Force instructions.
Worldwide Operations Capable	Must be sufficiently robust to allow worldwide system employment in all classes of airspace.
Dynamic Control	Must allow operators to perform near-real-time mission control, mission monitoring, and mission updates or modifications to include dynamic platform and payload control and re-tasking.
Net-Ready	Must comply with 100% of interfaces, services, policy-enforcement controls, and data correctness, availability and processing requirements designated as enterprise-level or critical in the joint integrated architecture.
Battlespace Awareness	
Battlespace Awareness	Must meet 100% of sensor collection performance parameters designated as critical: - EO image resolution NIIRS[5] 5 at 80 km - IR image resolution NIIRS 5 at 50 km - SAR image resolution NIIRS 5 at 120 km - SIGINT collection at specified frequencies

---

[5] Global Hawk image resolution requirements are defined using the 10-point National Imagery Interpretability Rating Scale (NIIRS) that grades increasing resolution on a scale from zero to nine. This scale quantifies image resolution by applying criteria that describe typical Essential Elements of Information (EEIs) that analysts should be able to identify in a target image. For the purposes of this report, "high resolution imagery" is considered to be imagery rated at or above the Global Hawk minimum operational requirement of NIIRS 5.

The 2006 Global Hawk CDD also identifies seven Key System Attributes (KSAs) necessary to ensure mission effectiveness shown in Table 1-2.

Table 1-2. RQ-4B Global Hawk Block 30 Key System Attributes (KSAs)

KSA	Threshold
Ground Operations	Must be able to operate on airfields with other aircraft and from paved runways 8,000 feet long by 148 feet wide.
Data Recorder	Must have a IMINT and SIGINT data recording capability that permits mission accomplishment without reliance on LOS or BLOS data transfer systems (i.e., “off-tether” operations)
Mission Planning	Must accomplish mission planning in 16 hours. If external mission plan validation by six degree-of-freedom (DOF) modeling is required, planning time may take up to 6 weeks
Mission Launch and Recovery	Must be able to land at alternate/divert bases and subsequently re-launch.
Effective-Time-On-Station (ETOS)	Must provide effective, on-station ISR coverage for 55% of a 30 day period following initial deployment using only spare parts provided in the MSRP
Electromagnetic Compatibility/Interference	The aircraft, avionics, payloads, and communications equipment must operate simultaneously without causing physical damage or unacceptable mission degradation.
Payload Performance	Must detect, locate, and allow for identification of tactical sized targets, day and night. The EO and IR sensors must meet minimum image resolution requirements at specified ranges.
Locate	Must identify target location for precision air-to-ground weapons.

Maintenance and Training Concepts

Per the June 2007 Air Force Air Combat Command Enabling Concept for RQ-4 Global Hawk, Air Force military personnel provide RQ-4 Global Hawk maintenance support using a two-level maintenance concept. MOB and FOL military personnel perform organizational-level maintenance to maximize weapon system availability, unit flexibility, and self-sufficiency. Air Force Engineering and Technical Services and contractor field services representatives provide additional technical support to military maintenance personnel. Contractor personnel will perform all maintenance on the ASIP sensor payload through FY 2011. Military personnel will assume two-level maintenance responsibilities as ASIP maintenance training and technical data become available.

Contractor field services representatives provide on-site depot-level maintenance for components requiring maintenance activities beyond the scope of approved organizational-level maintenance technical orders. In the long-term, depot-level maintenance will be conducted at the three Air Force air logistics centers as directed by future Source of Repair Assignment Process decisions.

During wartime operations, contractor support personnel continue to provide maintenance support. During periods of near-continuous operations, additional Active Duty, Reserve, and National Guard personnel may augment maintenance units. For operating locations in high threat environments, unit commanders may decide to replace contractor personnel with military personnel.

The Air Force provides formal training for Global Hawk pilots and EISS sensor operators through the RQ-4 Global Hawk formal training unit located at Beale AFB, California. AF DCGS ASIP sensor operators receive formal training from the Air Force ISR Agency. Global Hawk maintenance personnel receive training that incorporates both Air Force formal training courses and on-the-job training.

Section Two
Test Adequacy

The operational testing of the RQ-4B Global Hawk Block 30 system was adequate to support an evaluation of operational effectiveness and operational suitability. The Air Force Operational Test and Evaluation Center (AFOTEC) conducted the RQ-4B Global Hawk Block 30 Initial Operational Test and Evaluation (IOT&E) from October 4 through December 14, 2010, in accordance with the DOT&E-approved test plan. During IOT&E, the Air Force 9th Reconnaissance Wing operated four production-representative RQ-4B Global Hawk Block 30 air vehicles delivered by Northrop Grumman as low-rate initial production systems. One air vehicle was equipped with both the Enhanced Integrated Sensor Suite (EISS) and Airborne Signals Intelligence Payload (ASIP) payloads. The three remaining air vehicles carried only the EISS payload, since production ASIP sensors were not yet available. Production Launch and Recovery Element (LRE) and Mission Control Element (MCE) ground stations supported all IOT&E missions.

Developmental Testing

AFOTEC collected operational test data during selected Air Force Flight Test Center integrated developmental and operational test events conducted prior to IOT&E. Table 2-1 shows integrated test events that provided operational test data for air vehicle, ground segment, and mission payload performance.

Table 2-1. Integrated Developmental/Operational Test Events

Event	Flight Test Missions
Electromagnetic Interference/Compatibility Evaluation	Ground Test Only
GPS Jamming Evaluation	1
MCE Remote Launch and Recovery Demonstration	1
Interoperability Demonstration	3
Final Integrated Systems Evaluation	3
ASIP Phase 4 System Level Evaluation	4

The Joint Interoperability Test Command (JITC) and the Defense Information Systems Agency (DISA) Field Security Operations Penetration Test Team also conducted interoperability and information assurance testing to provide data for this report.

Operational Testing

AFOTEC planned 17 IOT&E missions and added four additional missions to replace test events lost due to weather and maintenance cancellations or mission aborts. The 9th

Reconnaissance Wing flew 18 of the 21 scheduled missions for a total of 285.1 flight hours. Two missions cancelled due to maintenance problems and one cancelled due to weather.

Table 2-2. IOT&E Missions and Flight Hours by Air Vehicle

Air Vehicle	Missions	Flight Hours
Tail Number 2021	4	77.8
Tail Number 2023	2	10.6
Tail Number 2026	7	143.5
Tail Number 2028	5	53.2
Totals	**18**	**285.1**

The initial operational tempo during IOT&E replicated a peacetime mission generation rate of two to three missions per week. After four weeks of sustained peacetime operations, the operational tempo accelerated to a wartime mission "surge" to provide near continuous intelligence, surveillance, and reconnaissance (ISR) coverage per the Global Hawk Concept of Employment. During the wartime surge period, the 9th Reconnaissance Wing attempted to generate and fly five consecutive 28-hour missions in accordance with the Global Hawk Concept of Employment.

Mission Conduct

The combined AFOTEC and 9th Reconnaissance Wing test team planned and flew IOT&E missions across the western and southeastern United States and Alaska to collect imagery in desert, high foliage, littoral, and arctic environments. Missions included long endurance flights greater than 20 hours while using the following DoD test ranges and facilities:

- Utah Test and Training Range (UTTR)
- Nevada Test and Training Range (NTTR)
- Naval Strike and Air Warfare Center (NSAWC) Fallon Training Range
- Naval Air Warfare Center (NAWC) China Lake Electronic Combat Range
- Pacific Alaska Range Complex (PARC)
- Eglin Air Force Base (AFB) Test Ranges
- Fort Huachuca Electronic Proving Ground
- Yuma Proving Ground
- Fort Stewart Multi-Purpose Range Complex
- Mountain Home AFB Range Complex

Air Force 9th Reconnaissance Wing flight crews and maintenance personnel conducted IOT&E takeoff and landing operations missions at Beale AFB, California. The Air Force 412th

Test Wing provided takeoff, landing, and maintenance support for a limited number of additional missions flown from Edwards AFB, California. Air Force pilots and EISS sensor operators controlled IOT&E missions from the Global Hawk Operations Center (GHOC) and MCE at Beale AFB. ASIP sensor operators controlled the ASIP payload from the Air Force Distributed Ground Station (DGS)-2 facility at Beale AFB.

AFOTEC used operational intelligence processing, exploitation, and dissemination facilities to support IOT&E missions. Intelligence analysts from the Air Force 480th Intelligence, Surveillance, and Reconnaissance Wing exploited imagery intelligence (IMINT) data at the DGS-2 site. Army intelligence analysts exploited imagery at a tactical intelligence site at China Lake Naval Air Warfare Center, California. Signals intelligence (SIGINT) analysts exploited SIGINT data at the DGS-2 site and other distributed communications intelligence exploitation sites.

The Air Force Combined Air Operations Center-Nellis (CAOC-N) at Nellis AFB, Nevada, tasked and directed IOT&E missions. The CAOC-N Global Hawk LNO provided operationally realistic, real-time interaction with mission crews to include coordination of dynamic mission plan and target changes.

Mission Types

The test team evaluated RQ-4B Global Hawk Block 30 mission effectiveness by evaluating system performance while executing mission scenario types derived from Major Combat Operation planning scenarios, current overseas contingency operations, and homeland defense operations. Scenarios included ISR operations to detect, locate, identify, and monitor targets and operations of intelligence interest. The test team developed 19 mission scenario variations to provide an operationally realistic mission context for planning IMINT and SIGINT data collection operations.

Data Collection

During IOT&E, Global Hawk crews collected IMINT and SIGINT information while executing operationally realistic mission scenarios and interfacing with operational intelligence processing, exploitation, and dissemination facilities and processes. Air Force intelligence analysts evaluated the image resolution and operational intelligence value of 1,138 target images containing pre-identified Essential Elements of Information (EEIs). Analysts rated images for intelligence value using the AFOTEC Four-Point EEI Rating Scale.[6] EEIs are specific items of information regarding an adversary or the environment needed by commanders to support operational planning, execution, or assessment activities. They typically provide information regarding adversary capabilities, activities, status, or intentions. For IOT&E targets, EEIs included specific characteristics for personnel, missile facilities, vehicles, aircraft, buildings,

---

[6] The AFOTEC Four-Point EEI Rating Scale includes numerical Figure of Merit (FOM) ratings from 0 to 3 based on intelligence analyst ability to exploit an image and identify specific EEIs. A FOM rating of 0 indicates that no EEI content was identified by intelligence analysts. FOM 1 ratings indicate that up to 50 percent of EEIs were identified. FOM 2 ratings indicate that 51 to 99 percent of EEIs were identified. A FOM 3 rating indicates that all EEI content was identified.

railroad facilities, roads, antennas, radar sites, and decoy targets to include numbers, types, and operating status. The test team evaluated imagery collected in desert, high foliage, and arctic ground environments.

Intelligence analysts from the National Geo-Spatial Intelligence Agency evaluated 182 additional target images to determine image resolution performance for the electro-optical (EO), infrared (IR), and synthetic aperture radar (SAR) sensors. Analysts evaluated image resolution using the National Imagery Interpretability Rating Scale (NIIRS).

AFOTEC used data collected from automated systems, operator logs, and test ranges to evaluate communications, data link, and sensor payload technical performance. The test team also observed mission planning and logistics demonstrations to collect additional data in these areas. Air Force pilots, sensor operators, intelligence analysts, and maintenance personnel completed surveys to provide additional information and observations on all aspects of system performance. Survey responses included ratings based on a six-point acceptability rating scale and written comments.

AFOTEC collected system reliability, availability, and maintainability data during IOT&E and developmental test events conducted between May 1, 2010 and December 14, 2010. A Joint Reliability and Maintainability Evaluation Team (JRMET) adjudicated suitability data in accordance with established procedures and approved test plans. DOT&E representatives participated in all JRMET data reviews.

Modeling and Simulation

During IOT&E, AFOTEC used the accredited AFOTEC Global Hawk Aircraft Readiness Model (ARM) to evaluate system reliability, availability, and maintainability (RAM) performance during extended operating periods. The ARM simulation uses system design and JRMET-adjudicated maintenance data to simulate system and maintenance operations for a Global Hawk Combat Air Patrol (CAP) of three air vehicles, one MCE, and one LRE during 30 days of near-continuous operations. The model provided mission capability rates, sortie generation rates, Effective-Time-On-Station (ETOS), break rates, air abort rates, cannibalization rates, and spare parts requirements. The Global Hawk program manager also accredited this model to track and report on system RAM performance and reliability growth.

The AFOTEC test team used the Air Force Automated Air Loading and Planning Software (AALPS) model to calculate the number of C-17 cargo pallet positions required to transport a single Global Hawk CAP consisting of three air vehicles, one MCE, one LRE, ground support equipment, and associated maintenance support packages. AALPS data provided the basis for computing the number of C-17 aircraft needed to deploy a Global Hawk CAP to a deployed operating location.

Maintenance and Logistics Support

For operations at Beale AFB, 9th Reconnaissance Wing military personnel provided maintenance support during IOT&E using a two-level maintenance concept. Air Force Engineering and Technical Services and contractor field services representatives provided additional technical support. Contractor personnel provided maintenance support for the ASIP sensor payload per the current Air Force support concept. Air Force 412th Test Wing maintenance personnel provided limited maintenance support for three IOT&E missions launched and recovered at Edwards AFB, California.

Test Limitations

Operational and test resources were not available during IOT&E to demonstrate 30 consecutive days of near-continuous flight operations to evaluate wartime ETOS operational requirements. The accredited ARM simulation provided additional data necessary to complete the evaluation.

The AFOTEC test team did not observe or evaluate ground operations in extreme cold temperatures during IOT&E or the preceding developmental test program. Although operational requirements identify an operational need to operate in extreme temperature environments, initial RQ-4B Global Hawk Block 30 operating bases are not located in extreme cold weather climates.

Available test ranges were not equipped to replicate maximum SIGINT emitter density and simultaneity environments described by operational requirements documents. Observed signals environments did include high density, urban signal environments to provide a more stressing operational test scenario.

This page intentionally left blank.

Section Three
Operational Effectiveness

The RQ-4B Global Hawk Block 30 demonstrated the capability to provide about 40 percent of requested intelligence, surveillance, and reconnaissance (ISR) coverage when used at planned peacetime or non-crisis operational tempos. However, the system is not operationally effective for conducting near-continuous, persistent ISR as specified in the Air Force Concept of Employment. The Enhanced Imagery Sensor Suite (EISS) provides imagery that meets or exceeds most operational requirements and provides actionable imagery intelligence (IMINT) products to operational users. The Airborne Signals Intelligence Payload (ASIP) provides a limited operational utility to detect, identify, and locate some threat radars and to detect some communication signals, but does not consistently deliver actionable signal intelligence (SIGINT) end-products to operational users due to technical performance deficiencies and immature training, tactics, techniques, and procedures.

The RQ-4B Global Hawk Block 30 system can conduct launch and recovery operations from both deployed and main operating base airfields. A lack of air vehicle anti-ice or de-ice systems limits all-weather operations and may restrict takeoff and landing operations at cold weather operating locations. Redundant air vehicle command and control systems effectively support mission operations. Operators currently conduct worldwide operations by employing time-consuming, interim operating procedures to mitigate airspace compliance and mission planning deficiencies. Ground mission management and coordination capabilities are adequate for most operations, but communication system deficiencies and a lack of crew situational awareness tools reduce mission effectiveness.

When operating on-station, the RQ-4B Global Hawk Block 30 provides an operational capability to collect, transmit, and process IMINT information. During daytime, clear weather conditions, the EISS electro-optical (EO) sensor produces high-resolution spot mode imagery that provides valuable intelligence information at ranges up to 80 km. During night, clear weather operations, or in environments with high thermal gradients, the infrared (IR) sensor produces high-resolution spot mode imagery at short, near-nadir (overhead) ranges. The synthetic aperture radar (SAR) sensor provides around-the-clock, all-weather IMINT collection capabilities, producing high-resolution spot mode imagery at ranges up to 200 km, although intelligence value decreases as range increase. The EISS does not meet operational requirements for providing Wide Area Search (WAS) imagery, GMTI capabilities, or target-quality coordinates from imagery. When integrated with supporting IMINT processing, exploitation, and dissemination systems, the RQ-4B Global Hawk Block 30 system provides imagery to support pre-planned and standard ad hoc target requests. IMINT transmission and processing times limit capabilities to respond to some short-notice, time-sensitive target imaging requests.

The RQ-4B Global Hawk Block 30 SIGINT payload collects large volumes of information across the designated frequency spectrum and provides a limited capability to detect, identify, and locate specific signals of interest. However, when integrated with supporting intelligence processing and dissemination systems, the Global Hawk Block 30 system does not consistently deliver actionable SIGINT reports to operational users. Technical deficiencies, inadequate training, and immature tactics currently limit SIGINT operational utility. ASIP sensor instability also reduces operational effectiveness when operating on station, requiring frequent sensor or application resets are required to clear system faults.

The RQ-4B Global Hawk Block 30 system does not meet Net Ready Key Performance Parameter (KPP) requirements for interoperability or information assurance. The system is not certified for joint interoperability and implementation of required DoD information assurance controls is incomplete.

Operational effectiveness was evaluated during 21 IOT&E missions attempted between October 4 and December 14, 2010. The test team evaluated mission effectiveness while executing mission scenarios derived from major combat operation planning scenarios, current overseas contingency operations, and homeland defense operations. The test team developed 19 mission scenario variations to provide an operationally realistic mission context for IMINT and SIGINT data collection operations.

Key Performance Parameters (KPPs)

Table 3-1 shows evaluation results for the five RQ-4B Global Hawk Block 30 KPPs specified the Global Hawk Capabilities Development Document (CDD). These KPP operational requirements define essential system attributes that are pre-requisites for the delivery of desired end-to-end operational mission capabilities. The Global Hawk Block 30 system met the Endurance KPP and Battlespace Awareness KPP and partially met two additional KPPs related to ground station, and air vehicle capabilities. The system does not meet Net Ready KPP requirements. Although the Global Block 30 system largely complies with four of five KPP requirements, IOT&E results show that KPP compliance alone is not sufficient to assure operational success in all mission areas.

Table 3-1. RQ-4B Global Hawk Block 30 Key Performance Parameters (KPPs)

KPP	Threshold Requirement	KPP Assessment
Battlespace Persistence		
Endurance	Total flight endurance of 28 hours	**Met**. Flight endurance exceeds 28 hours
Worldwide Operations Capable	Capable of worldwide employment in all classes of airspace	**Partially Met**. The Global Hawk Block 30 does not comply with civil air traffic control and traffic avoidance standards. The system can operate worldwide with extensive advance airspace coordination, pre-approvals, and special procedures, which may limit mission operations.
Dynamic Control	Capable of near-real-time mission control, mission monitoring, and mission updates or modifications to include dynamic platform and payload control and re-tasking	**Partially Met**. Operators cannot upload revised mission plans during flight to enable autonomous execution of new missions or tasks. Operators can manually control the air vehicle and sensors to collect intelligence for emerging targets by assuming increased operational risk.
Net Ready	Compliance with 100% of interfaces, services, policy-enforcement controls, and data correctness, availability and processing requirements designated as enterprise-level or critical in the joint integrated architecture	**Not Met**. Interoperability certification requirements and implementation of required information assurance controls are not complete.
Battlespace Awareness		
Battlespace Awareness	Spot EO Image Resolution NIIRS 5 at 80 km Spot IR Image Resolution: NIIRS 5 at 50 km Spot SAR Image Resolution: NIIRS 5 at 120 km SIGINT collection at specified frequencies	**Met**. Spot EO and SAR images meet or exceed image resolution requirements. Spot IR image resolution does not meet threshold requirement due to a previously accepted sensor technical limitation. The SIGINT payload meets frequency operating range requirements, but technical performance deficiencies reduce operational utility.

Battlespace Persistence

The RQ-4B Global Hawk Block 30 system is capable of long endurance missions exceeding 28 hours. However, air vehicle long endurance capabilities will not routinely yield persistent ISR coverage until existing system reliability problems are resolved. The RQ-4B Global Hawk Block 30 meets, with limitations, other operational requirements necessary to provide persistent worldwide operations.

Long Endurance Flight

The RQ-4B Global Hawk Block 30 air vehicle is capable of long endurance flight in excess of 28 hours at operating altitudes up to 60,000 feet. The system demonstrated this capability during numerous developmental and operational missions. As shown in Table 3-2, IOT&E long endurance mission durations ranged from 20.3 to 28.2 hours. Each of these missions landed with sufficient fuel reserves to extend flight durations beyond 31 hours, if required.

Table 3-2: IOT&E Long Endurance Flight Missions

IOT&E Sortie Number	Actual Duration (hours)	Fuel Quantity Remaining (pounds)	Mission Fuel Burn Rate (pounds/hour)	*Projected Maximum Endurance (hours)
11	28.2	2907	372	33.3
12	26.7	2842	376	31.6
14	27.7	2954	366	33.0
16	20.3	5693	436	31.1
18	27.7	2632	366	32.2
19	25.8	3333	414	31.4
20	24.9	3552	392	31.4

* Projected maximum endurance with 1,000-pound fuel reserve.

Airfield Operations

The RQ-4B Global Hawk Block 30 meets the operational requirement to operate from standard runways at airfields conducting mixed aircraft operations. Air vehicle performance is adequate for operations from paved surface runways at least 8000 feet long and 148 feet wide. The system demonstrated the capability to safely operate from airfields conducting diverse air traffic operations with mixed aircraft types during developmental test, operational test, and real-world operations.

All Weather Operations

RQ-4B Global Hawk Block 30 all-weather operational capabilities are limited. The air vehicle does not have anti-ice or de-ice systems and does not meet the operational requirement to operate in light icing conditions. Current flight restrictions that require avoidance of visible moisture and precipitation at or above the freezing level restricts flight operations and will diminish sortie rates at some operating locations. This limitation primarily affects climb and descent flight operations near Global Hawk air vehicle operating bases.

Air vehicle and sensor payload operating limitations restrict ground and flight operations in extreme environmental conditions. Due to air vehicle and sensor payload sensitivity to hot and cold temperatures, maintenance personnel accomplish nearly all aircraft preflight and maintenance activities in environmentally controlled hangars. During high-altitude flight, operations are limited to air temperatures warmer than minus 65 degrees Celsius. This restriction may limit maximum operational altitudes for some missions.

Worldwide Airspace Operations

The RQ-4B Global Hawk Block 30 system is capable of worldwide employment in all classes of airspace, but only with extensive advance airspace coordination, pre-approvals, and special procedures. The RQ-4B Global Hawk Block 30 meets basic air traffic communication, navigation, and surveillance equipment requirements. However, the system does not currently meet all Federal Aviation Administration or International Civil Aviation Organization standards for response to dynamic air traffic control instructions or traffic awareness and avoidance. All unmanned aerial systems that operate in civil airspace currently share this deficiency and associated operating limitations. The Department of Defense is pursuing new technologies to address these shortfalls, but they are not yet available for integration with the Global Hawk system. In the interim, Global Hawk operations that transit or utilize civil airspace will require pre-coordinated special procedures and approvals. The days or weeks required to develop and implement these procedures may delay employment in new operating areas. In some cases, civil airspace operating agreements may restrict the frequency and volume of flight operations, which could reduce RQ-4B Global Hawk Block 30 operational capabilities.

Mission Planning

The current RQ-4B Global Hawk Block 30 mission planning process requires more than four weeks to produce and validate new mission plans necessary to deploy and operate in new operating areas. This meets the operational requirement threshold of less than six weeks for new missions. Creation of new Global Hawk mission plans, using the Air Force Mission Planning Support System (AFMSS), is a time and data-intensive process. Since the Global Hawk air vehicle operates autonomously during flight, all information needed to execute normal, contingency, and potential emergency flight operations is programmed using AFMSS and pre-loaded into the air vehicle mission computers for each mission. Mission planners must validate new AFMSS mission plans using a six degree of freedom (6-DOF) computer simulation to verify flight plan accuracy and preclude programming errors that could result in loss of the air vehicle. During the IOT&E mission planning event, programming an operationally realistic mission plan required 46 hours with an additional 58 hours required to create the pilot mission plan book. The required 6-DOF computer simulation and validation process required an additional four weeks. Although the Global Hawk mission planning process meets the current operational requirement of less than six weeks for new mission plans, it limits rapid system deployment or employment in new operating areas. However, operators can choose to employ the system for high-priority contingency operations, on an assumed-risk basis, without accomplishing the 6-DOF mission plan validation.

However, once planners create mission plans for an established theater operating area, they can use previously validated waypoints and mission information to support subsequent flight operations in that area. While this approach limits operations to areas already covered by previous mission plans, it is adequate to support most recurring theater Air Tasking Order (ATO) missions for current Overseas Contingency Operations (OCO).

Launch and Recovery

The Launch and Recovery Element (LRE) effectively supports air vehicle takeoff, approach, and landing operations at forward operating locations using line-of-sight (LOS) communication links. The Mission Control Element (MCE) also demonstrated the required operational capability to remotely launch and recover air vehicles from alternate or divert airfields using beyond-line-of-sight (BLOS) communication links. MCE pilots identified poorly integrated communication systems as a significant design deficiency that makes coordination of launch and recovery operations more difficult. The Hawkeye voice radio system and the classified Secret Internet Protocol Router Network (SIPRNET) computer system are the primary means of communication between the LRE pilot, MCE pilot, ground personnel, and other Global Hawk Virtual Crew members involved in launch and recovery operations. Current ground station architectures do not integrate these communications systems within the MCE or LRE and temporary installation locations are outside the normal pilot field of view. Lack of direct and visible access frequently results in delayed or missed communications between pilots and supporting personnel. Operators also cite a lack of workspace in both the LRE and MCE shelters as a major contributor to high mission workloads during preflight operations and some critical phases of flight.

Mission Management and Coordination

The RQ-4B Global Hawk Block 30 MCE provides adequate mission management and coordination capabilities for IMINT data collection, with significant operational limitations. Situational awareness and communication system shortfalls require extensive use of alternative, workaround procedures that reduce mission efficiency. Procedures for coordination of SIGINT data collection and multi-intelligence cross-cueing operations between the MCE and Distributed Common Ground System (DCGS) mission managers are immature.

The new Global Hawk Block 30 MCE Pilot Functional Display (PFD) significantly improves pilot situational awareness during basic flight operations, when compared to the RQ-4A Global Hawk Block 10 pilot displays. LRE to MCE communications support effective coordination between LRE and MCE pilots. However, the lack of a redundant Air Traffic Control (ATC) voice communication capability frequently slows coordination of mission activities. The primary Ku-band Satellite Communications (SATCOM) voice communication system is effective for ATC communications, but is not always available. Backup telephone coordination with ATC authorities is often required, which slows pilot response to ATC instructions and ATC responses to pilot requests. Delayed ATC coordination increases operational risk and may result in missed mission opportunities.

Situational awareness tools for MCE crewmembers are minimal, requiring use of multiple workarounds to assure mission situational awareness. The MCE does not provide real-time, integrated flight weather and or threat awareness information. Global Hawk Operations Center (GHOC) personnel assist by providing weather information and a standalone SIPRNET laptop computer provides access to additional flight weather updates. The Global Hawk Block 30 MCE does not incorporate the TacView tactical situational awareness messaging and display system used in the RQ-4A Global Hawk Block 10 MCE. Pilots depend on indirect, external sources for threat awareness information relayed by voice or text message systems. Lack of a similar automated situational awareness display represents a step backwards in operational capability versus the RQ-4A Global Hawk Block 10 system.

The lack of voice communication capabilities between the MCE and other mission facilities reduces Global Hawk Virtual Crew mission coordination and management capabilities. The RQ-4B Global Hawk Block 30 Voice over Internet (VoIP) communications architecture is obsolete and incompatible with modern variants used by supporting facilities such as DCGS. This severely limits rapid communication between the MCE operators, ASIP operators, DCGS mission managers, and GHOC personnel. Both MCE and DCGS operators identified the lack of network voice communications as a significant impediment to efficient, real-time mission coordination. Lacking voice communications, Global Hawk Virtual Crew personnel must rely on less efficient communication methods, such as classified network chat or text messages, for mission coordination. The lack of an integrated classified computer station in the MCE also reduces the effectiveness of this alternate procedure. MCE pilots and sensor operators could only access network chat applications from a classified laptop computer that was not easily accessible from their workstations. As a result, communications between MCE and DCGS personnel were often delayed or incomplete. A new WebPortal application, introduced during IOT&E, provided an alternate means to coordinate Global Hawk Virtual Crew mission activities. However, operating procedures for this new computer-based communications capability were not mature during IOT&E.

DCGS mission managers have acceptable tools to manage SIGINT collection operations. However, procedures for coordination of SIGINT data collection and multi-intelligence cross-cueing operations between the Global Hawk Block 30 MCE crew and DCGS mission managers are immature. During IOT&E, MCE and DCGS mission managers continued to devise and refine new tactics and techniques to improve mission coordination during multi-intelligence collection operations, but with only limited success. The lack of real-time voice communications between the MCE crew, DCGS ASIP sensor operators, and DCGS SIGINT mission managers are a significant obstacle to the development of effective multi-intelligence collection and sensor cross-cueing tactics, techniques, and procedures.

Air Vehicle and Sensor Dynamic Control

Current system capabilities partially meet the Dynamic Control KPP operational requirements. Near-real time air vehicle control capabilities are limited. Pilots are required to use manual control procedures to maneuver the air vehicle when requested to support dynamic intelligence collection requests for emerging or "ad hoc" targets. Prior to takeoff, operators upload mission plans to the air vehicle mission computers that enable autonomous execution of flight routes and mission operations. However, after takeoff, operators are unable to modify the mission plan or upload new mission plans to reprogram the system for autonomous execution of new flight profiles or alternate intelligence collection routes. This deficiency reduces mission flexibility. Pilots can manually direct the air vehicle to depart pre-planned, autonomous flight routes, however this method of dynamic control increases operational risk. If air vehicle command and control data links are lost while deviating from the original mission plan, the air vehicle will attempt to autonomously execute emergency recovery and landing instructions associated with the original flight plan route. In some situations, the air vehicle may not be able to successfully execute these instructions.

Global Hawk Block 30 EISS payload dynamic control capabilities are adequate to support standard, non-time sensitive emerging target requests, but are not always responsive enough to support the most stressing Time-Sensitive Targeting (TST) scenarios. During flight, EISS sensor operators and GHOC personnel dynamically control IMINT collection operations by modifying the pre-planned target list to include emerging or "ad hoc" targets using the Data Analysis Workstation (DAWS). The Global Hawk tactics manual defines three types of "ad hoc" targets: standard, non-interference, and dynamic. Standard ad hoc targets are generally not time-sensitive and have a Latest Time Information of Value (LTIOV) greater than three hours. The sensor operator can upload "standard ad hoc targets" for collection at the next opportune time. "Non-interference ad hoc targets" are the lowest priority and are prioritized below all other mission priority. "Dynamic ad hoc target" requests are time-sensitive with an LTIOV of less than three hours.

During IOT&E, operators uploaded 675 standard and non-interference ad hoc targets, in groups of 10 or more, using Microsoft Excel formats to speed the upload process. The average target upload time was 1.8 minutes per target, which is adequate to support all standard and non-interference ad hoc target requests. Manual upload of individual ad hoc targets, received across multiple communication systems and in various formats, is more challenging. While executing operational mission scenarios, operators manually uploaded 71 individual time-sensitive, dynamic ad hoc targets. As shown in Figure 3-1, dynamic ad hoc target upload times varied widely, but operators uploaded 75 percent of dynamic ad hoc targets in 10 minutes or less. The median upload time was five minutes.

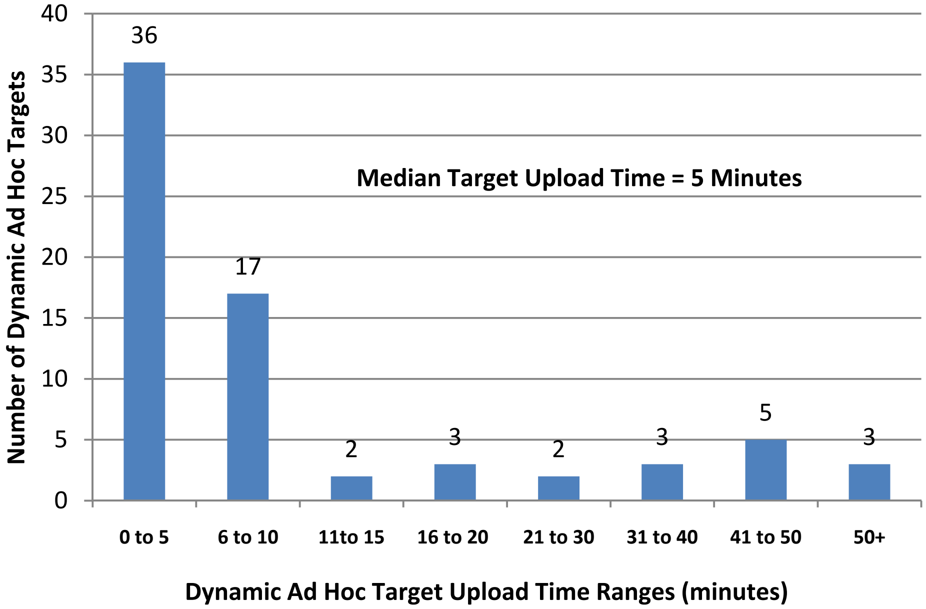


Figure 3-1: Time to Upload Dynamic Ad Hoc Targets to EISS

The lack of real-time voice communication capabilities between the MCE crew and other Global Hawk Virtual Crew members can delay ad hoc target coordination, which contributed to the wide variance in dynamic ad hoc target upload times. While these upload times are adequate to support most dynamic ad hoc targets with LTIOVs of less than three hours, they may not consistently support the most stressing TST scenarios that require delivery of imagery intelligence in just minutes.

The ASIP payload can be dynamically re-tasked to support emerging SIGINT collection opportunities. ASIP sensor operators conduct SIGINT data collection operations in near-real time and are capable of re-prioritizing payload collection operations to support emerging intelligence collection opportunities.

Battlespace Awareness

RQ-4B Global Hawk Block 30 EISS and ASIP sensor payloads provide multi-intelligence operational capabilities that meet Battlespace Awareness KPP requirements. Both sensor payloads provide operational capabilities, but with significant limitations.

IMINT Mission Performance

When operating on-station, the RQ-4B Global Hawk Block 30 EISS payload provides an operational capability to collect and transmit IMINT information high-resolution imagery that provides valuable intelligence for target areas at short and medium ranges. EISS EO and SAR imagery meets Battlespace Awareness KPP resolution requirements. EISS technical limitations prevent compliance with IR resolution requirements, but DoD accepted this known technical performance shortfall in 2008 following a review of early developmental test results. The EISS does not provide required capabilities for WAS imaging, ground moving target detection, or derivation of target-quality coordinates from imagery. When integrated with supporting IMINT processing, exploitation, and dissemination systems the system provides imagery to support pre-planned and standard ad hoc target requests, IMINT transmission and processing times limit capabilities to respond to some short-notice, time-sensitive target imaging requests.

Global Hawk image resolution requirements are defined using the 10 level (increasing resolution ratings from 0 to 9) National Imagery Interpretability Rating Scale (NIIRS).[7] This scale quantifies image resolution by applying criteria that describe typical Essential Elements of Information (EEIs) that analysts should be able to identify in an image. For example, the NIIRS 2 resolution criteria include identification of large structures such as airfield hangars, while the NIIRS 6 criteria require identification of specific aircraft types. The NIIRS standards provide separate rating criteria for EO, IR, and SAR imagery that reflect the type of EEIs typically discernable using each sensor mode. The Global Hawk CDD establishes a NIIRS 5 rating as the minimum operational requirement for “high resolution” imagery produced by EISS EO, IR, and SAR spot image modes. During IOT&E, National Geo-Spatial Intelligence Agency analysts evaluated EISS image resolution using 182 EO, IR, and SAR images collected during IOT&E missions. The test team selected imagery for NIIRS evaluation using a design-of-experiments approach based on operational factors such as sensor mode, range to target, target type, and ground environment.

While image resolution NIIRS ratings indicate what type of EEIs a sensor should be capable of identifying under optimum conditions, actual operational intelligence value depends on the ability to identify actual target EEIs while operating in operationally realistic conditions. During IOT&E, Air Force intelligence analysts determined “single pass” operational intelligence value by evaluating individual EISS EO, IR, and SAR images for 1,138 operationally realistic targets. Based on the ability to identify pre-selected EEIs, analysts quantified “operational intelligence value” by assigning an EEI Figure of Merit (FOM) rating to each target image using the four-point scale in Table 3.3.

Table 3-3: EEI Figure of Merit (FOM) Rating Scale

FOM Score	FOM Definitions	Operational Intelligence Value
0	No mission EEI content could be resolved	No Intelligence Value
1	Minimal (≤ 50%) mission EEI content could be resolved	Minimal Intelligence Value
2	Most (51-99%) mission EEI content could be resolved	High Intelligence Value
3	All (100%) mission EEI content could be resolved	

---

[7] The military NIIRS criteria used to evaluate Global Hawk Block 30 EISS EO, IR, and SAR imagery is documented in North Atlantic Treaty Organization (NATO) Standardization Agreement, STANAG 7194, Edition 2, 2010.

Figure of Merit ratings indicate EEI identification success achieved from a single attempt or "single pass" to collect imagery for a specific target. Actual operational intelligence collection missions will likely plan for multiple passes using multiple sensor modes to maximize intelligence collection opportunities. Figures 3-2 through Figure 3-7 show NIIRS image resolution and operational intelligence value test results for each sensor mode.

Electro-Optical (EO) Spot Mode Imagery

During daytime, clear weather conditions, the EISS EO sensor provides high-resolution spot mode imagery at ranges up to 80 km. As shown in Figure 3-2 and Figure 3-3, nearly all evaluated EO spot mode imagery exceeds the NIIRS 5 operational requirement at ranges up to 50 km with an average EO NIIRS rating of 6.3. Between 50 km and 80 km, the average EO NIIRS rating declines to 5.2, but remains above the NIIRS 5 minimum operational requirement. At 80 km, the Battlespace Awareness KPP minimum operational requirement of NIIRS 5 is within the statistical confidence interval for EO imagery data evaluated during IOT&E. Image resolution declines significantly at ranges beyond 80 km.

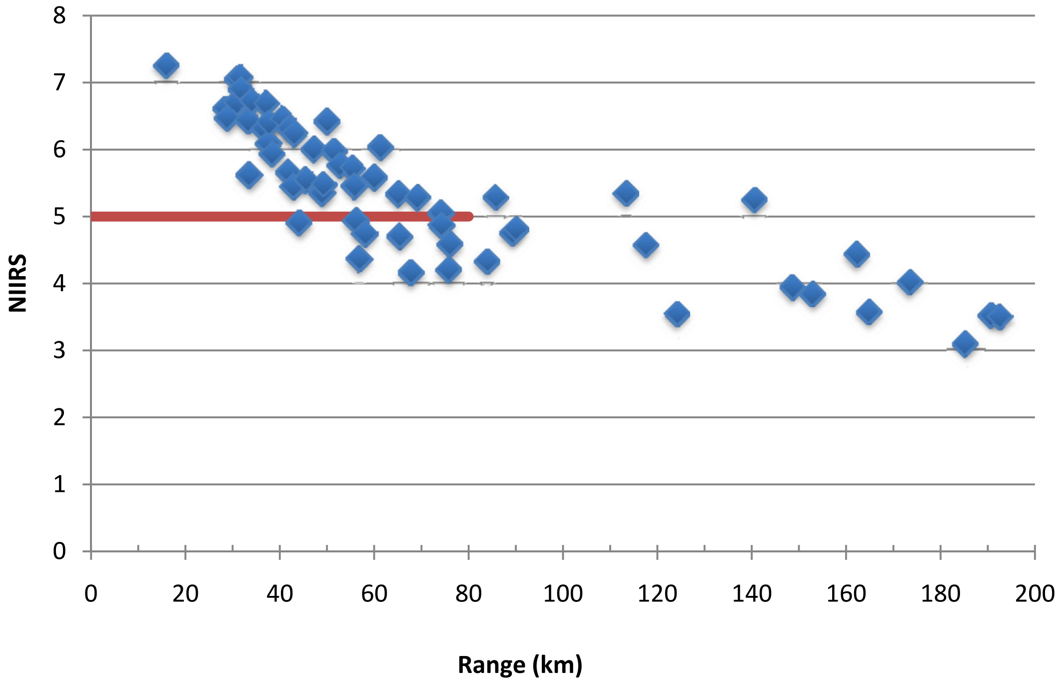
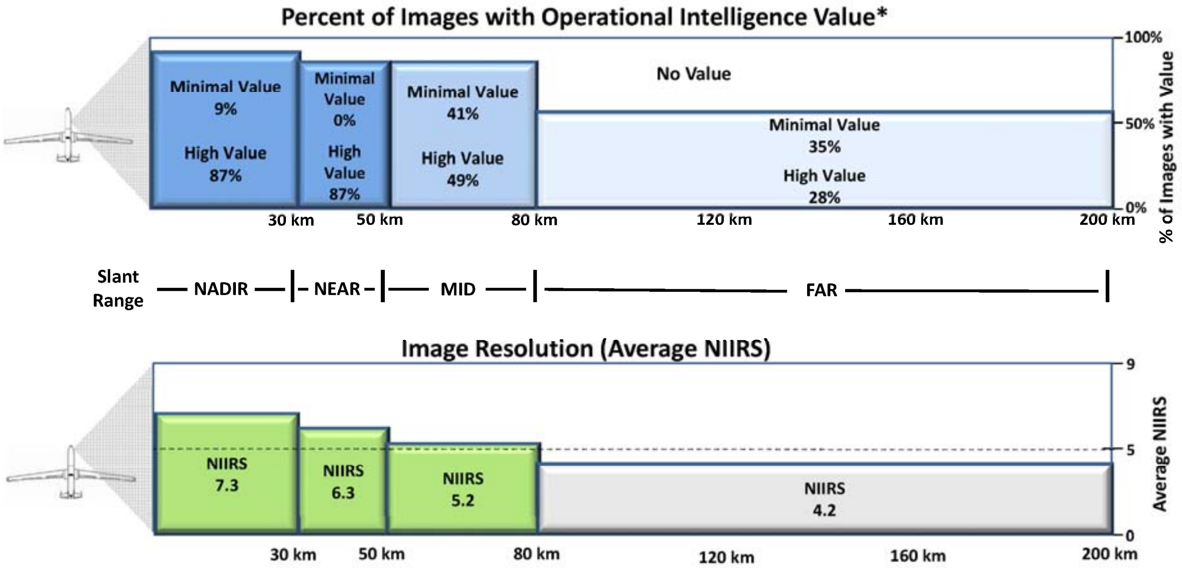


Figure 3-2: EO Spot Mode Image Resolution Ratings

During IOT&E, intelligence analysts exploited 147 EO target images to identify pre-defined EEIs and assess the intelligence value gained from a single imagery collection pass. Figure 3-3 shows the relationship between image resolution (NIIRS ratings on lower bar) and the corresponding imagery intelligence value (EEI FOM ratings on upper bar) as range to target increases. At near ranges up to 50 km, average EO NIIRS ratings exceed NIIRS 6 and 87 percent of corresponding imagery provides high intelligence value (EEI FOM 2 or 3 ratings) while up to 96 percent of images provide at least minimal intelligence value (EEI FOM 1, 2, or 3 ratings). Average EO NIIRS ratings decline to 5.2 between 50 km and 80 km, but remain above the NIIRS 5 minimum operational requirement. Corresponding imagery intelligence value at these ranges also declines, but 49 percent of images continue to provide high intelligence value and 90 percent provide at least minimal intelligence value. Beyond 80 km, both image resolution and intelligence values decline further, but over 60 percent of collected imagery provides at least minimal intelligence value.



***"Minimal Value" imagery received a Figure of Merit (FOM) 1 rating from intelligence analysts, indicating that between 1 and 50% of target area EEIs present were identified**

***"High Value" imagery received FOM 2 or 3 ratings from intelligence analysts, indicating that > 50% of target area EEIs present were identified**

Figure 3-3: EO Spot Mode Operational Performance

Infrared (IR) Spot Mode Imagery

During night, clear weather operations, or in environments with high thermal gradients, the IR sensor provides high-resolution spot mode imagery at short, near-nadir (overhead) ranges up to 30 km. As shown in Figure 3-4 and Figure 3-5, most IR spot mode images evaluated at near-nadir ranges of up to 30 km meet or exceed the minimum NIIRS 5 operational requirement, with an average IR NIIRS rating of 5.6. Between 30 km and 50 km, image resolution declines below the minimum NIIRS 5 operational requirement to an average IR NIIRS rating of 4.7 and continues to decline rapidly beyond 50 km. The IR sensor is unlikely to provide a minimum NIIRS 5 resolution rating at 50 km as required by the Battlespace Awareness KPP. The Global Hawk program office previously identified this IR sensor technical deficiency during developmental testing in 2008. Following review by the Joint Requirements Oversight Council, the Under Secretary of Defense (USD) Acquisition, Technology, and Logistics (AT&L) accepted this technical limitation and directed the Air Force to continue EISS development without further investment to improve IR image resolution.[8]

---

[8] USD AT&L Global Hawk Acquisition Decision Memorandum, October 31, 2008

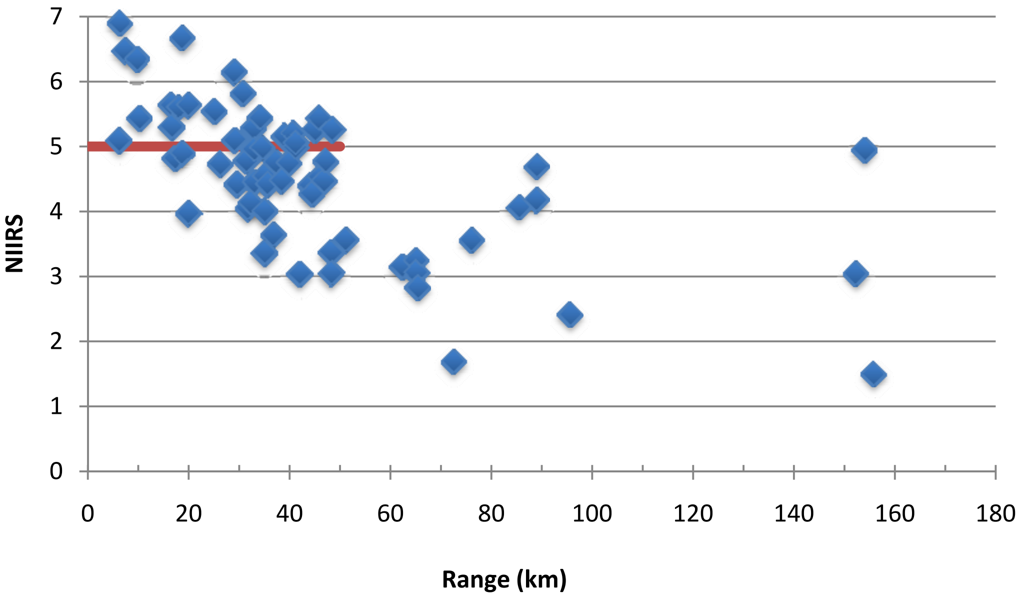
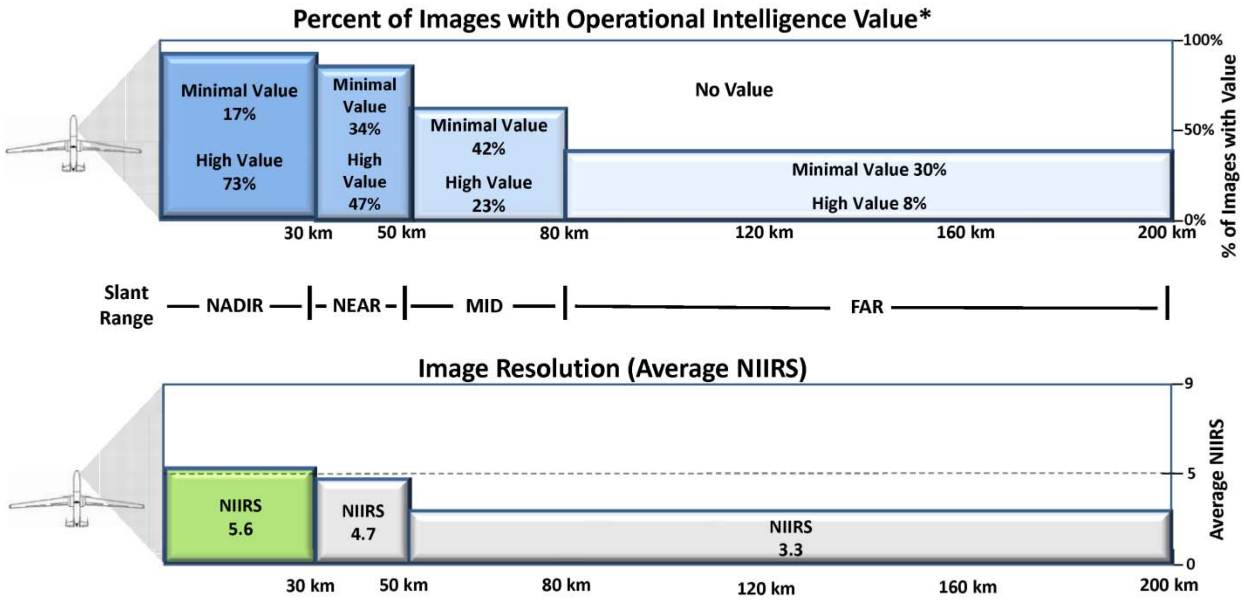


Figure 3-4: IR Image Spot Mode Resolution Ratings

Intelligence analysts exploited 418 IR target images to identify pre-defined EEIs and assess operational intelligence value gained from a single imagery collection pass. Figure 3-5 shows the relationship between image resolution and the corresponding imagery intelligence value as range to target increases. At near-nadir ranges up to 30 km, the average IR NIIRS rating is 5.6 and 73 percent of collected imagery provides high intelligence value (EEI FOM 2 or 3 ratings) while up to 90 percent of images provide at least minimal intelligence value (EEI FOM 1, 2, or 3 ratings). Between 30 km and 50 km, average IR NIIRS ratings decline to 4.7, which is below the NIIRS 5 minimum operational requirement. Corresponding imagery intelligence value at these ranges also declines, but 47 percent of images continue to provide high intelligence value and 81 percent provides at least minimal operational value. Between 50 km and 80 km, image resolution declines significantly, but over 60 percent of imagery provides at least minimal intelligence value. IR sensor performance and intelligence values decline rapidly beyond 80 km.



***"Minimal Value" imagery received a Figure of Merit (FOM) 1 rating from intelligence analysts, indicating that between 1 and 50% of target area EEIs present were identified**

***"High Value" imagery received FOM 2 or 3 ratings from intelligence analysts, indicating that > 50% of target area EEIs present were identified**

Figure 3-5: IR Spot Mode Operational Performance

Synthetic Aperture Radar (SAR) Spot Mode Imagery

The SAR sensor provides around-the-clock, all-weather IMINT collection capabilities, producing high-resolution imagery at ranges up to 170 km. As shown in Figure 3-6 and Figure 3-7, nearly all evaluated SAR spot mode imagery exceeds the NIIRS 5 operational requirement at ranges up to 170 km. Average EO NIIRS ratings vary from 5.4 to 5.7 across this range. At 120 km, the Battlespace Awareness KPP minimum operational requirement of NIIRS 5 is within the statistical confidence interval for evaluated SAR imagery data.

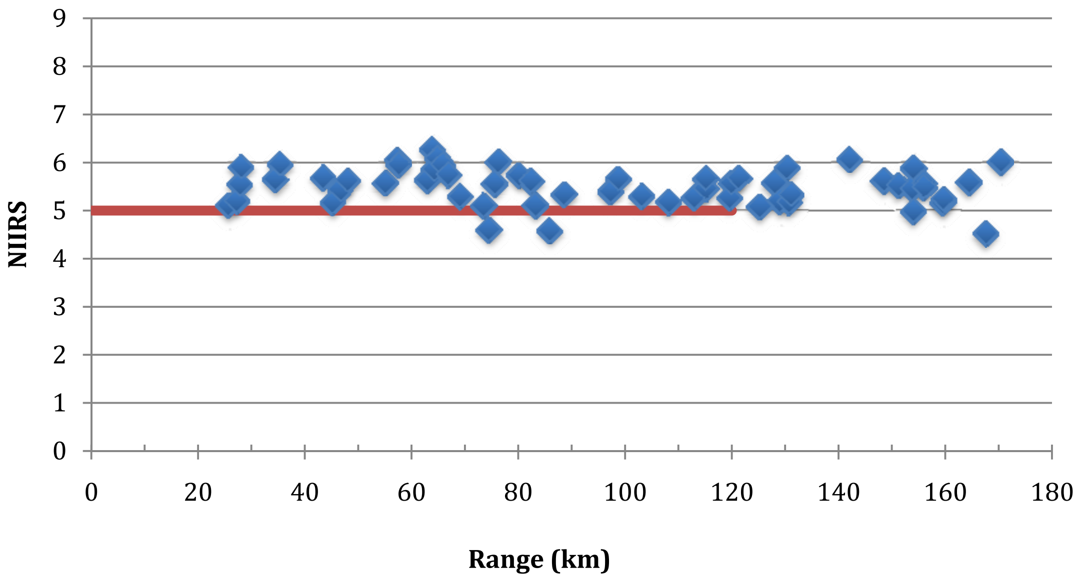
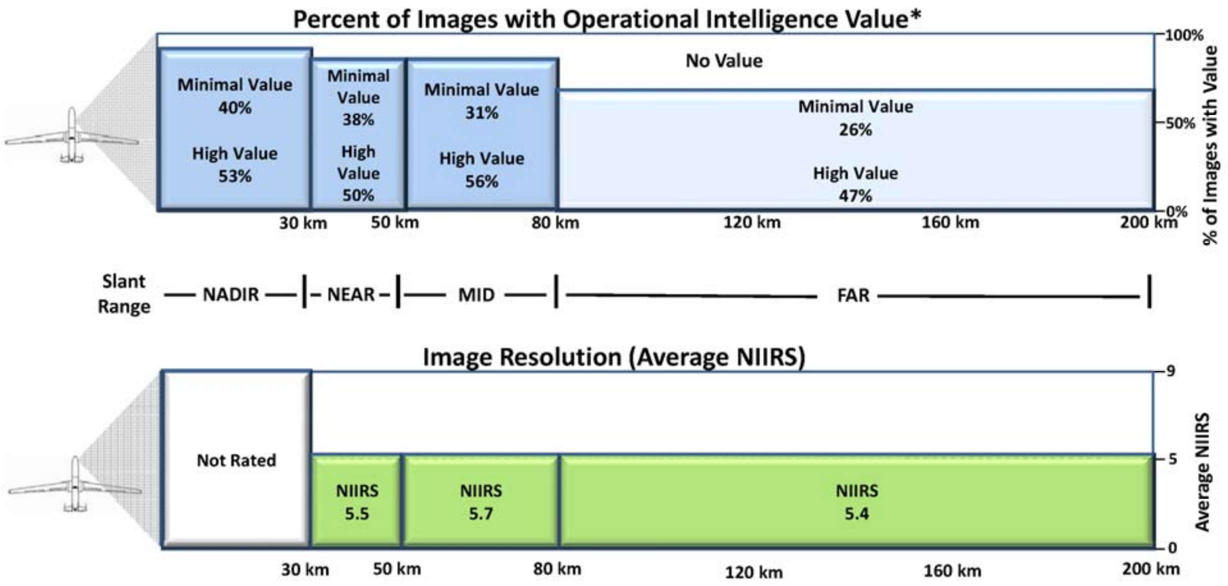


Figure 3-6: SAR Spot Mode Image Resolution Ratings

Intelligence analysts exploited 573 SAR target images to identify pre-defined EEIs and assess the intelligence value gained from a single imagery collection pass. Figure 3-7 shows the relationship between image resolution and the corresponding imagery intelligence value as range to target increases. Average SAR NIIRS ratings exceed the NIIRS 5 operational requirement at all ranges up to 170 km. At ranges up to 80 km, at least 50 percent of images provide high intelligence value (EEI FOM 2 or 3 ratings) and at least 87 percent provide at least minimal intelligence value (EEI FOM 1, 2, or 3 ratings). Beyond 80 km, intelligence value declines slightly with 47 percent providing high intelligence value and up to 73 percent providing at least minimal value.



*"Minimal Value" imagery received a Figure of Merit (FOM) 1 rating from intelligence analysts, indicating that between 1 and 50% of target area EEIs present were identified

*"High Value" imagery received FOM 2 or 3 ratings from intelligence analysts, indicating that > 50% of target area EEIs present were identified

Figure 3-7: SAR Spot Mode Operational Performance

SAR Ground Moving Target Indicator (GMTI)

The RQ-4B Global Hawk Block 30 does not provide the required SAR GMTI operational capability. Developmental and operational test results indicate low probabilities of detection for individual ground moving targets with high false target rates. The Classified Annex A to this report provides additional evaluation results for SAR GMTI mode performance.

SAR Wide Area Search (WAS)

The RQ-4B Global Hawk Block 30 does not provide a SAR WAS imaging capability. Attempts to utilize "swath SAR" operating modes during developmental and operational tests were unsuccessful. Wide area search imaging produces large amounts of data, which frequently exceeds EISS memory buffer capacity. This halts sensor operation and requires a 30-minute sensor reset procedure to restore IMINT collection capabilities.

IMINT Transmission

The RQ-4B Global Hawk Block 30 effectively transmits IMINT data to ground-based intelligence processing, exploitation, and dissemination sites using both LOS and BLOS data link systems. During IOT&E, the RQ-4B Global Hawk Block 30 successfully transmitted 3,949 of 4,400 (89 percent) EO, IR, and SAR images to the MCE via the Ku SATCOM BLOS data link, then on to the Distributed Ground Station (DGS)-2 intelligence exploitation site via the DGS wide area network. The average transmission time from the air vehicle to DGS-2 intelligence analyst station was 12 minutes. Nearly all IMINT data losses (451 scenes) occurred during transmission across the BLOS satellite data link. Less than one percent of lost data (36 scenes) occurred during ground transmission from the MCE to DGS-2 over the DGS wide area network. The 89 percent BLOS transmission success rate represents a significant improvement over previous Global Hawk operational test results. If made aware of IMINT data losses by other members of the Global Hawk Virtual Crew or by previewing collected scenes, operators can re-image lost targets.

Transmission of IMINT data to forward-based intelligence exploitation sites using the LOS Common Data Link (CDL) system is effective. During IOT&E, the system successfully transmitted 51 of 51 (100 percent) images to an intelligence exploitation site at the Naval Air Weapons Station, China Lake, California. Transmission times varied based on image type. The ground station received all 31 IR images in less than one minute, with 29 of them arriving in less than 15 seconds. The system transmitted all SAR images in 3 minutes or less. Since all CDL test events occurred at night, the test team did not evaluate EO imagery transmission. However, EO and IR image transmission times should be similar since these data files are similar in size and format.

MCE pilots and EISS sensor operators, co-located in the MCE shelter, work cooperatively to execute IMINT collection plans. GHOC personnel effectively support IMINT collection operations by assisting with mission coordination and collection plan changes. However, the MCE does not provide sensor operators with an integrated imagery preview capability to rapidly detect image defects and cue a re-imaging request before departing the target area. Current MCE systems only provide previews of small image fragments or “tiles,” which are not sufficient to assess overall image quality. As an interim measure, operators preview EISS imagery independently processed and displayed by the Joint Targeting and Attack Assessment Capability (JTAAC) cell. JTACC provides an independent capability, outside the Global Hawk system architecture, to rapidly process EISS image tiles and post complete images to a classified website for operator review. Operators access this alternative preview capability using a standalone, classified laptop computer in the MCE.

IMINT Processing, Exploitation, and Dissemination (PED) Process

When integrated with supporting IMINT processing, exploitation[9], and dissemination systems the RQ-4B Global Hawk Block 30 system provides imagery to support pre-planned and standard ad hoc target requests, but capabilities to support time sensitive, emerging IMINT collection requests are limited. The current Global Hawk IMINT processing and exploitation process does not provide a capability to derive precise, target-quality coordinates from imagery.

For most missions, the RQ-4B Global Hawk Block 30 EISS payload transmits IMINT data via BLOS satellite data links to the MCE, which relays that data across a wide area network to a DCGS ground station for processing, exploitation, and dissemination. Analysts relay exploited imagery products to the Combined Air Operations Center (CAOC) or other end-users to support intelligence requests. For imagery transmitted directly to tactical exploitation sites via the LOS CDL system, on-site intelligence analysts exploit imagery.

---

[9] Intelligence analysts “exploit” imagery to identify specific essential elements of information or support a wide range of other intelligence tasks such as scene change detection or site activity analysis. DCGS analysts use advanced software applications to manipulate and analyze imagery in order to maximize intelligence value.

During IOT&E mission scenarios, DCGS intelligence analysts conducted full exploitation, analysis, and reporting on 881 target images collected during operationally realistic mission scenarios. The quality of final IMINT products relayed to CAOC-Nellis was high, with 94 percent providing the intelligence necessary to meet defined mission success requirements. The time required to complete the IMINT PED process consists of transmission time from the air vehicle to the DCGS site plus time required for analysts to exploit the image and post final IMINT products. IMINT processing and exploitation timelines vary slightly by sensor mode and between pre-planned and ad hoc targets. Table 3-4 shows image transmission and exploitation process times.

Table 3-4: IMINT Processing, Exploitation, and Dissemination Times

EISS Sensor Mode	Average Transmission Times (minutes)	Average Intelligence Exploitation Times (minutes)	Average PED Times (minutes)
Pre-Planned Targets			
EO	Satellite Data Link: 9 Tactical CDL: <1	14	23 <15
IR	Satellite Data Link: 11 Tactical CDL: <1	13	24 <14
SAR	Satellite Data Link: 13 Tactical CDL: <3	14	27 <17
Ad Hoc Targets*			
EO	Satellite Data Link: 9 Tactical CDL: <1	16	25 <17
IR	Satellite Data Link: 12 Tactical CDL: <1	16	28 <17
SAR	Satellite Data Link: 15 Tactical CDL: <3	12	27 <15
Average Times			
All	Satellite Data Link: 12 Tactical CDL: <3	14	26 <17

*The median time required to upload ad hoc targets and dynamically re-task the EISS payload is 5 minutes, which may further increase overall response times for ad hoc targets.

On average, the time between imagery collection and presentation to the DCGS analyst is 12 minutes and less than 3 minutes when transmitted directly to tactical intelligence sites using the CDL data link. Average DCGS analyst exploitation time is 14 minutes, which is within the DCGS exploitation performance standard of 15 minutes. Intelligence analysts can exploit less complex scenes, such as rural areas, in as little as 11 minutes, while complex urban scenes can take up to 22 minutes. The average time required to complete the entire PED process and deliver intelligence products through the DCGS is 26 minutes. The average time to deliver and exploit imagery delivered directly to tactical exploitation sites is less than 17 minutes. These times support exploitation of pre-planned targets and standard, non-time-sensitive ad hoc targets. These times also support exploitation of many dynamic ad hoc targets with Latest Time Information of Values of less than three hours. However, they may not be adequate to support the most stressing TST scenarios that require imagery intelligence delivery in just minutes.

The current Global Hawk IMINT processing and exploitation process does not provide the required operational capability to derive precise target locations from EISS imagery. Software tools necessary to derive joint weapon target-quality coordinates have not been developed. The Classified Annex A to this report provides additional information on target geo-location test results.

IMINT Data Recording

When operating in areas without access to IMINT data links or in the event of data link failures, the Global Hawk Block 30 is required to conduct autonomous, "off tether" operations by storing collected IMINT data for post-flight processing and exploitation. The Air Force has not developed and delivered this capability. The RQ-4B Global Hawk Block 30 does not meet the operational requirement for conducting IMINT collection operations without reliance on either LOS or BLOS data links.

SIGINT Mission Performance

The RQ-4B Global Hawk Block 30 ASIP payload meets the Battlespace KPP requirement to collect SIGINT data across a designated frequency range. The Global Hawk ASIP sensor provides a limited operational capability to detect, identify, and locate radar threat emitters and to detect communications signals of interest.

ASIP technical performance for ELINT collection varies widely by threat radar signal type and operating mode. ASIP detected 62 percent (203 of 330) of all threat radar signals presented during IOT&E. Detection rates were 70 percent or greater for 15 of the 32 specific threat radar types and modes presented during IOT&E. The system automatically identified 79 percent (161 of 203) of all detected signals and displayed accurate geo-containment ellipses for 66 percent (134 of 203) of detected signal sources. Although ELINT signal detection, identification, and geo-location rates do not meet ASIP technical specifications, the system provides accurate information for approximately half the tested threat radar signal types and modes, which provides a limited operational capability against these specific threat systems.

ASIP technical performance supports limited COMINT operational capabilities. ASIP demonstrated the capability to receive large volumes of COMINT emissions at rates approaching 27,000 receptions per minute. Despite the large number of receptions, ASIP detection and geo-location rates for scripted signals known to be present in the operating environment were very low. ASIP detected only 34 percent (3,601 of 10,719) of the scripted communication emissions transmitted during schedule range periods. From those detections, ASIP generated only 14 geo-containment ellipses and only seven actually contained the signal source geographic location.

When integrated with supporting intelligence processing, exploitation, and dissemination systems, the ASIP sensor did not consistently deliver actionable SIGINT products or reports to operational users due to technical performance deficiencies and immature training, tactics, techniques, and procedures. SIGINT end-to-end mission scenario success rates are very low. Only 26 percent (40 of 152) of ELINT mission scenarios produced the expected operational intelligence reports following data processing, exploitation, and dissemination. For COMINT mission scenarios, the success rate was only eight percent (6 of 75). Inconsistent detection of threat radar emitters and communication signals reduces mission success rates. The lack of ASIP technical data and incomplete operator training often prevent full utilization of system capabilities, which further reduces mission effectiveness. For most ASIP operators and supporting SIGINT exploitation sites, the IOT&E missions were the first attempt to execute operationally realistic, end-to-end missions with the Global Hawk ASIP sensor. As a result, tactics, techniques, and operating procedures were immature. The cumulative effects of these shortfalls prevent consistent delivery of SIGINT reports to operational users. Classified Annexes A and B provide detailed ASIP evaluation results.

Net-Ready KPP

The RQ-4B Global Hawk Block 30 does not comply with the requirements of the Net Ready KPP (NR-KPP). During the Joint Interoperability Test Command (JITC) interoperability evaluation, conducted in conjunction with IOT&E operations at Beale AFB, California, from October 19, 2010 through December 18, 2010, the system did not comply with all joint critical information exchange requirements. JITC test results identified significant deficiencies in crew communication and situational awareness systems that degrade operational effectiveness. Information assurance evaluations conducted by AFOTEC and the Defense Information Systems Agency (DISA) Field Security Operations Penetration Test Team indicate that implementation of required information assurance controls is not complete. The system is currently conducting operations under an interim authority to operate pending implementation and verification of required system security controls.

Interoperability

The RQ-4B Global Hawk Block 30 does not meet joint interoperability certification requirements. Based on evaluation interoperability testing conducted in conjunction with IOT&E, JITC did not recommend the RQ-4B Global Hawk Block 30 for Joint Staff interoperability certification.

The system meets all information exchange criteria for interfaces with the Global Positioning System (GPS), Identification Friend or Foe (IFF) systems, non-secure LOS and BLOS voice communication systems, and network chat and text messaging systems. Encrypted secure voice communication systems were not available for testing. However, VoIP and common operating picture systems did not meet applicable joint integrated architecture criteria. The VoIP system integrated in the RQ-4B Global Hawk Block 30 system is obsolete and incompatible with modern variants used by supporting intelligence systems such as DCGS. This severely limits real-time Global Hawk Virtual Crew communications between the MCE operators, ASIP operators, DCGS mission managers, and GHOC personnel. Both MCE and DCGS operators identified the lack of network voice communications as a significant impediment to efficient, real-time mission coordination. Lacking voice communications, Global Hawk Virtual Crew personnel must rely on less efficient communication methods, such as classified network chat or text messages, for mission coordination. However, the lack of an integrated classified computer station in the MCE reduces the effectiveness of this alternate procedure. MCE pilots and sensor operators could only access network chat applications from a classified laptop computer that was not easily accessible from their workstations. As a result, communications between MCE and DCGS personnel were often delayed or incomplete. This deficiency prevents effective coordination between the MCE crew and DCGS ASIP sensor operators during multi-intelligence collection missions.

Tactical situational awareness messaging between the MCE and DCGS partially met interoperability criteria. The MCE successfully transmitted situational awareness messages to the DCGS. However, the MCE is unable to receive or display automated tactical situational awareness information provided by other platforms or sources.

IMINT data is compliant with National Imagery Transmission Format (NITF 2.1) standards. However, the system does not meet the requirement to transmit IMINT data from the MCE to DGS intelligence exploitation site in less than 10 seconds. Despite this shortfall, operational users assessed that they received 92 percent of transmitted imagery in time to meet operational mission requirements.

Information Assurance

Information assurance evaluations conducted by AFOTEC and DISA Field Security Operations Penetration Test Team show that implementation of required information assurance controls is not complete. The RQ-4B Global Hawk Block 30 system is currently conducting operations under an interim authority to operate pending implementation and verification of required system security controls. See classified Annex A to this report for information assurance evaluation results.

Survivability

RQ-4B Global Hawk Block 30 can survive and operate in the presence of information attack and physical threats, with limitations. The air vehicle is vulnerable to air-to-air weapons and must avoid airborne threats unless other assets provide protection. IMINT and SIGINT sensor capabilities support intelligence collection operations at standoff ranges outside the maximum engagement ranges of many short and medium range ground-based threat systems. Ground stations do not provide crew protection features and must operate from secure locations.

The RQ-4B Global Hawk Block 30 system is not equipped with threat warning or defensive countermeasure systems. Threat avoidance, primarily through mission planning, is the primary Global Hawk defensive tactic. The air vehicle is vulnerable to air-to-air weapons and must avoid airborne threats unless other assets provide protection. While operating at altitudes over 50,000 feet, the system is out of range for many ground-to-air threat systems such as small arms fire, man portable missiles, and most anti-aircraft artillery. The system is vulnerable to these threats during takeoff and landing operations. Ground-to-air missiles pose a more significant threat and may require the system to collect intelligence from standoff ranges, unless supported by active threat suppression operations. The Classified Annex A to this report provides additional information on sensor performance at relevant threat standoff ranges. In some unique operational scenarios, the Global Hawk unmanned system may provide commanders with an option to operate inside threat system engagement ranges on an "assumed risk" basis, without jeopardizing military personnel.

The RQ-4B Global Hawk Block 30 MCE does not provide an automated threat situational awareness display. Pilots depend on indirect, external sources for threat awareness information relayed by voice or text message systems. The ASIP sensor does have the capability to detect electronic warfare threats and provide threat warning information. However, several minutes are required to detect a threat, process and analyze information, and relay threat reports to the MCE pilot for appropriate action. In most cases, ASIP will not provide timely threat warning. The RQ-4B Global Hawk Block 30 MCE does not incorporate the TacView situational awareness messaging and display system used in the RQ-4A Global Hawk Block 10 MCE. Lack of a similar automated situational awareness display in the RQ-4B Global Hawk Block 30 MCE represents a step backward in operational capability versus the RQ-4A Global Hawk Block 10 system.

Ground stations do not provide crew protection features and must operate from secure locations. They are vulnerable to most physical threats including conventional weapons, and nuclear, chemical, and biological threats. The test team did not conduct specific ground shelter survivability testing.

Section Four

Operational Suitability

The RQ-4B Global Hawk Block 30 is not operationally suitable. The system cannot consistently generate or sustain long endurance missions necessary to support a near-continuous, persistent intelligence, surveillance, and reconnaissance (ISR) operational tempo. A Global Hawk Combat Air Patrol (CAP) of three air vehicles provides less than half the required 55 percent Effective-Time-On-Station (ETOS) coverage during a 30-day period. Aircraft Readiness Model (ARM) results, based on system performance data collected for IOT&E, show that a single RQ-4B Global Hawk Block 30 CAP provides 27 percent ETOS during a 30-day period of near-continuous operations while relying only on pre-planned deployment spare part kits. During a shorter, seven-day “mission surge” demonstration, a Global CAP of three air vehicles provided 39 percent ETOS while operating at near-continuous operational tempos from a main operating base with normal base supply support. A single Global Hawk CAP can consistently generate sorties to support ISR operations at lower operational tempos. During IOT&E “non-surge” operating periods, the operational unit consistently generated up to three sorties per week, when sufficient spare parts were available. However, these individual sorties collectively produced only 42 percent of the “tasked” ISR coverage time due to poor takeoff reliability, maintenance ground aborts, and high air abort rates.

System reliability is not adequate to support generation and sustainment of long endurance sorties necessary for near-continuous operational tempos. Frequent failures of critical air vehicle components reduce takeoff reliability and increase mission air abort rates. These failures also create a high demand for air vehicle maintenance and mission-critical spare parts. Sensor payload stability and reliability problems result in frequent, time-consuming system resets or power recycles that also reduce on-station mission effectiveness. Mission Control Element (MCE) and Launch and Recovery Element (LRE) ground stations are highly reliable and do not contribute to low ETOS performance.

System availability rates do not support sortie generation requirements for near-continuous operational tempos. Air vehicle mission capable rates within a Global Hawk CAP decline quickly during near-continuous operations due to frequent air vehicle critical component failures. Cannibalization of critical spare parts from other fleet air vehicles can temporarily improve system availability for short-term “mission surge” operations, but is not sufficient to support longer-term operations. MCE and LRE availability rates meet threshold operational requirements and support mission generation requirements at all operational tempos.

System maintainability does not fully support mission requirements. Although average repair times associated with individual repair tasks meet program goals, the high demand for air vehicle maintenance often exceeds Air Force maintenance unit capabilities. Extensive, unplanned use of system contractors is required to generate missions and sustain operations. Incomplete maintenance technical data, inadequate training, and an ineffective integrated diagnostic system also degrade system maintainability.

The current inability of the RQ-4B Global Hawk Block 30 to conduct near-continuous, persistent ISR operations is not a permanent condition. Current and planned Air Force corrective actions to improve the reliability of high-failure air vehicle components will improve system availability rates, and increase sortie generation and mission sustainment capabilities. Resolving maintenance technical data, training programs, and integrated diagnostic system deficiencies will improve system maintainability. In the interim, operational units should anticipate low air vehicle mission capability rates, high air abort rates, critical spare part shortages, high air vehicle cannibalization rates, and a heavy reliance on system contractor support to sustain operations.

This operational suitability evaluation is based on data generated from 1,424 developmental test and operational flight hours, collected from May 1 through December 15, 2010. During this period, RQ-4B Global Hawk Block 30 air vehicles accumulated 3,233 maintenance hours and 995 maintenance events. LRE maintenance activity included 57 maintenance events and 140 maintenance hours. MCE maintenance activity included 122 maintenance events and 174 maintenance hours.

Effective-Time-On-Station: Near-Continuous Operations

The RQ-4B Global Hawk Block 30 system does not meet ETOS operational requirements while conducting operations at a near-continuous operational tempo. Due to poor air vehicle reliability, operational units are not able to consistently generate or maintain long endurance sorties to provide persistent ISR support.

The Global Hawk Capabilities Development Document (CDD) defines ETOS as the primary reliability, maintainability, and availability metric for Global Hawk system. This metric incorporates key reliability, availability, and maintainability performance factors to establish the minimum time-on-station requirements for a three-aircraft Global Hawk CAP conducting near-continuous operations as outlined in Figure 4-1. To meet the operational requirement, a single Global Hawk CAP is required to maintain a mission effective air vehicle on-station 55 percent of the time during a 30-day operating period. This requires execution of at least 20 long-endurance missions, each providing approximately 20 hours of ETOS, to produce the 396 required hours of effective on-station coverage during a 720-hour (30-day) operating period. Per the Global Hawk Concept of Employment, the Global Hawk CAP operates independently using only the materials and spare parts contained in the Mission Readiness Spares Package (MRSP) deployment kit for the first 30 days of deployed operations. After 30 days, the normal supply system is available to support operations.

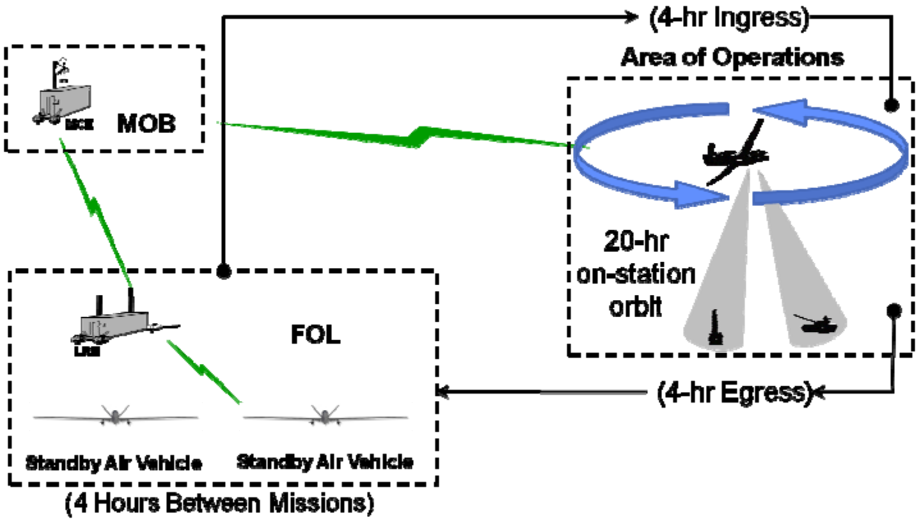
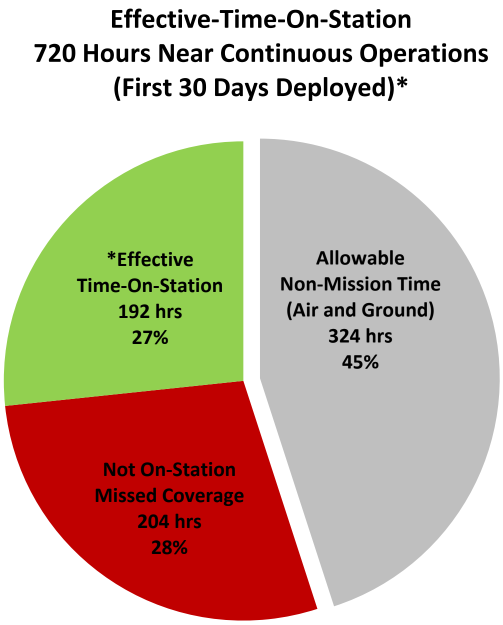


Figure 4-1. RQ-4B Global Hawk Block 30 Near-Continuous Operations (CDD Definition)

Initial Deployment (First 30 Days)

During IOT&E, the test team evaluated RQ-4B Global Hawk Block 30 ETOS for the first 30 days of deployed, near-continuous operations using the Aircraft Readiness Model (ARM). This model integrates actual component failure rates and repair times, measured during system development and IOT&E, into a near-continuous operations simulation repeated many times to project expected performance. The AFOTEC-accredited ARM evaluates Global Hawk mission generation and sustainment performance while conducting near-continuous operations.

Figure 4-2 and Table 4-1 show the ARM simulation results for the first 30 days of deployed operations. An RQ-4B Global Hawk Block 30 CAP, relying only on spare parts contained in the MRSP deployment kit, will provide 26.7 (± 14.8) percent ETOS, which does not meet the minimum 55 percent operational requirement. This equates to 192 hours of effective ISR coverage over the course of a 720-hour month, providing less than half of the minimum coverage required for persistent ISR operations.



***Operational requirement: 55% (396 hours) Effective-Time-On-Station**

Figure 4-2. RQ-4B Global Hawk Block 30 ETOS: Near-Continuous Operations (ARM Results)

The inability to meet the ETOS operational requirement is primarily due to poor air vehicle reliability. Frequent failures of mission critical air vehicle components create a high demand for spare parts and maintenance actions. During deployed operations, these high failure rates deplete MRSP deployment kit spare parts in 12 days preventing generation of additional operational sorties. Due to the rapid depletion of critical spare parts, the ARM simulation projects that a Global Hawk CAP will generate only 11.5 sorties during a 30-day period of near-continuous operations and up to 80 percent of these sorties will rely on critical spare parts cannibalized from other CAP air vehicles. This is far short of the 20 long endurance sorties necessary to meet the minimum ETOS operational requirement.

Poor air vehicle reliability also reduces the ISR coverage provided by launched sorties. The ARM simulation projects up to four of the 12 generated missions will air abort due to mission critical component failures resulting in an earlier than planned return to base.

Table 4-1. ARM Simulation Results: 30 Days Near-Continuous Deployed Operations

Suitability Metric	ARM 30 Day Simulation Results	Operational Requirement
ETOS	26.7% (±14.8)	≥ 55 %
Air Vehicle Mission Capable Rate	29.4%	≥ 85%
Air Vehicle Break Rate*	57%	-
Not Mission Capable for Supply**	64%	-
Missions Launched	11.5	≥ 20
Mission Air Aborts Air Abort Rate	3.8 33%	- -
Total Mission Flight Time	242.2 hrs	≥ 456 hrs
Spare Part Cannibalization Rate	80%	-
MRSP Deployment Kit Critical Parts Depletion	12 days	30 days
*Percent of CAP air vehicles returning with grounding maintenance discrepancies **Not mission capable for supply is the percent of CAP air vehicles grounded awaiting spare parts		

Sustained Operations (Beyond Initial Deployment)

During IOT&E, the test team also evaluated the ability to sustain a near-continuous operational tempo beyond the initial 30-day deployment period, using the main operating base supply system to provide spare parts. For a one-week period, the 9th Reconnaissance Wing accelerated operational tempo to the wartime, near-continuous operations pace defined in Figure 4-3. Operators attempted to generate and fly five consecutive 28-hour missions during a 156-hour mission surge period.

Results from this near-continuous operations period were consistent with ARM simulation results. The three-aircraft RQ-4B Global Hawk Block 30 CAP provided 60.1 hours of effective ISR coverage over the course of the 156-hour surge period resulting in an ETOS of 38.9 percent, which did not meet the 55 percent minimum ETOS requirement. Due to poor air vehicle reliability, the operational unit did not generate or sustain long endurance sorties while conducting near-continuous operations. One of the five scheduled missions cancelled due to a mission critical communications system failure. Two additional missions were unable to meet scheduled takeoff and on-station times due to pre-flight maintenance delays. One of the four launched missions air aborted and returned to base early due to a mission-critical communications system failure. An additional 7.3 hours of effective mission time was lost due to Enhanced Integrated Sensor Suite (EISS) system failures and resets.

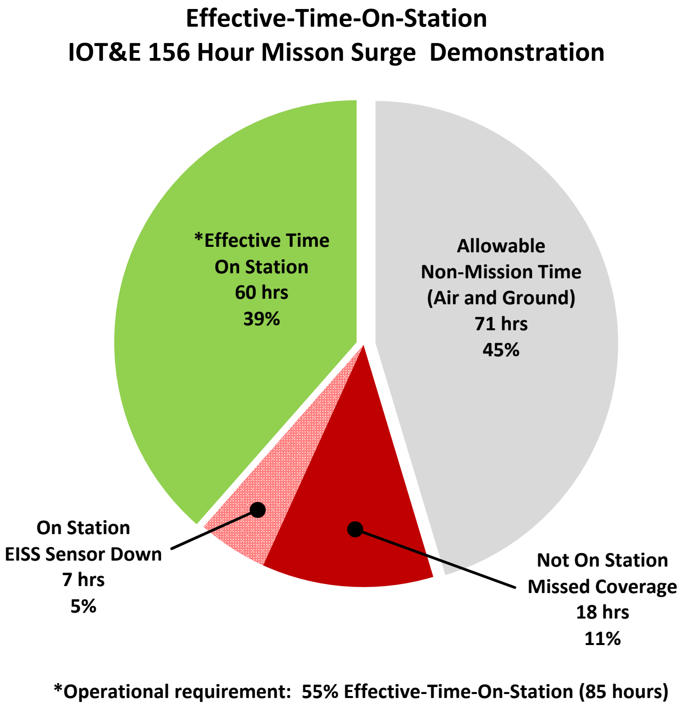


Figure 4-3. RQ-4B Effective-Time-On-Station: Near-Continuous Operations (IOT&E Demo)

As predicted by the ARM simulation, the demand for mission-critical spare parts quickly exceeded supply availability when conducting actual near-continuous operations. At the end of the seven-day mission surge period, all three air vehicles were “not mission-capable” and unavailable to support additional missions. Continuation of near-continuous surge operations for a longer period would have resulted in even lower ETOS performance due to decreasing air vehicle availability driven by a lack of mission critical spare parts.

Effective-Time-On-Station: Non-Continuous Operations

The operational unit demonstrated a capability to generate two to three sorties per week while operating at a lower, non-continuous operational tempo. During IOT&E, the 9th Reconnaissance Wing generated and launched 14 of 16 tasked sorties during six weeks of non-continuous operations.[10] This sortie generation rate is adequate to support the planned Air Force normal, peacetime operating tempo of three sorties per week at Global Hawk CAP forward operating locations.[11]

However, the 14 individual sorties launched during this period provided only 137 of 325 (42 percent) scheduled, “tasked” on-station hours as shown in Figure 4-4. Poor air vehicle reliability, inadequate maintenance technical data, and incomplete maintenance training degraded ETOS performance even at this reduced pace of operations. Ten of the fourteen

---

[10] Does not include the missions generated during the one-week mission surge.

[11] Projected normal, peacetime operating tempo based on Air Force Global Hawk flying hour program plans for three, 24-hour sorties per week at USPACOM and USEUCOM forward operating locations.

launched sorties (71 percent) failed to arrive on-station at the tasked mission time due to late takeoffs ranging from 30 minutes to 12 hours. One of the 16 planned sorties was cancelled due to maintenance and one additional sortie was cancelled due to adverse weather. Six of the fourteen launched sorties (43 percent) air aborted prior to the planned landing time due to failure of mission critical systems.

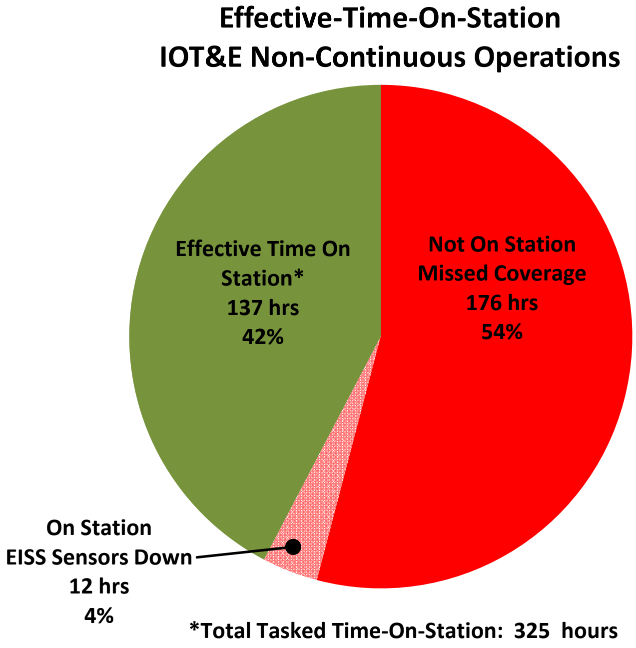


Figure 4-4. RQ-4B Effective-Time-On-Station: IOT&E Non-Continuous Operations

Reliability

The RQ-4B Global Hawk Block 30 system is not reliable. High failure rates for several air vehicle mission critical components are the primary cause for poor ETOS performance. Frequent air vehicle critical component failures reduce takeoff reliability, increase air abort rates, and create a high demand for spare parts that quickly depletes available supplies. Low air vehicle reliability also creates a higher-than-expected demand for maintenance. MCE and LRE ground station are highly reliable and fully support mission requirements at all operational tempos.

Mission Critical Failures

RQ-4B Global Hawk Block 30 mission-critical air vehicle components fail at high rates resulting in poor takeoff reliability, high air abort rates, low mission capable rates, an excessive demand for critical spare parts, and a high demand for maintenance support. Critical component failures that occur during pre-flight preparations result in delayed takeoffs or mission cancellations. Failures that occur during flight result in mission air aborts or degraded mission effectiveness. Additional failures discovered after landing require spare parts for replacement prior to the next scheduled mission. Mean Time Between Critical Failure (MTBCF) is a measure of how frequently these mission essential components fail. During the period from May 1, 2010, to December 15, 2010, the program office and test team identified 176 air vehicle critical component failures that occurred during 1,424 flight hours. The resulting air vehicle MTBCF of 8.1 (±0.8, 80 percent confidence interval) hours equates to an average of three mission essential component failures for every 28-hour mission. MCE and LRE ground stations were highly reliable with an MTBCF of 59.3 (±9.9, 80 percent confidence interval) hours, which fully supports mission requirements.

Figure 4-5 shows the nine air vehicle critical components that failed most frequently. These components are responsible for 147 (82 percent) of all observed air vehicle critical component failures. Composite aircraft structural failures comprise 41 percent of all observed critical failures. Adhesives used to secure nut plates and other structural components to composite aircraft surfaces frequently disband and require repair before returning the air vehicle to service. Disbond failures occur most frequently in areas accessed often by maintenance personnel such as the under wing fairing, nose fairing, SAR panels, or common data link radome. Repair and cure times for these failures can be up to 24 hours, which significantly reduces air vehicle availability. The remaining high failure rate components span a cross-section of electrical, navigation, sensor, engine, landing gear, and communication systems. The Air Force has initiated reliability improvement or redesign activities for most of these components. Corrective actions to improve reliability of these critical components are required to improve ETOS performance.

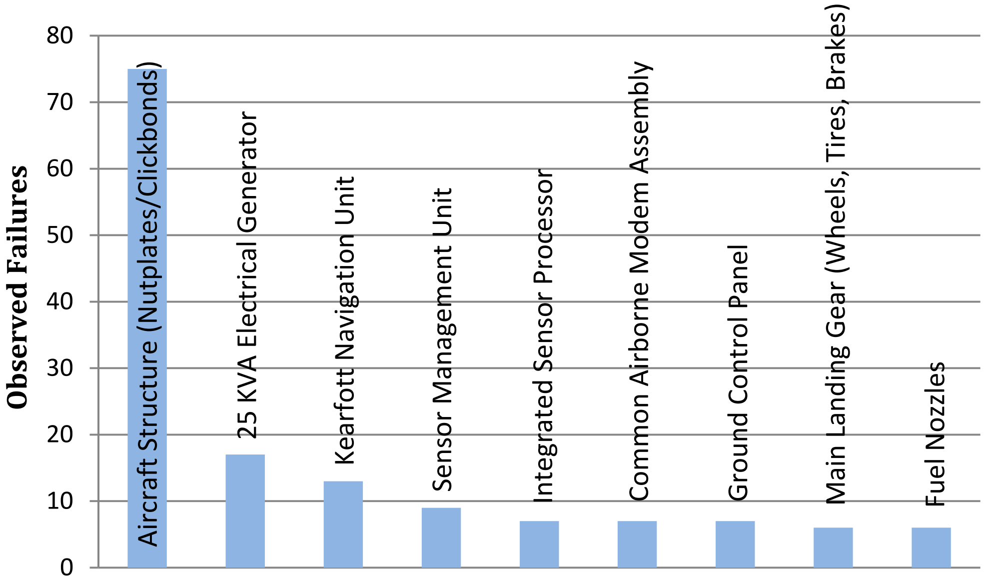
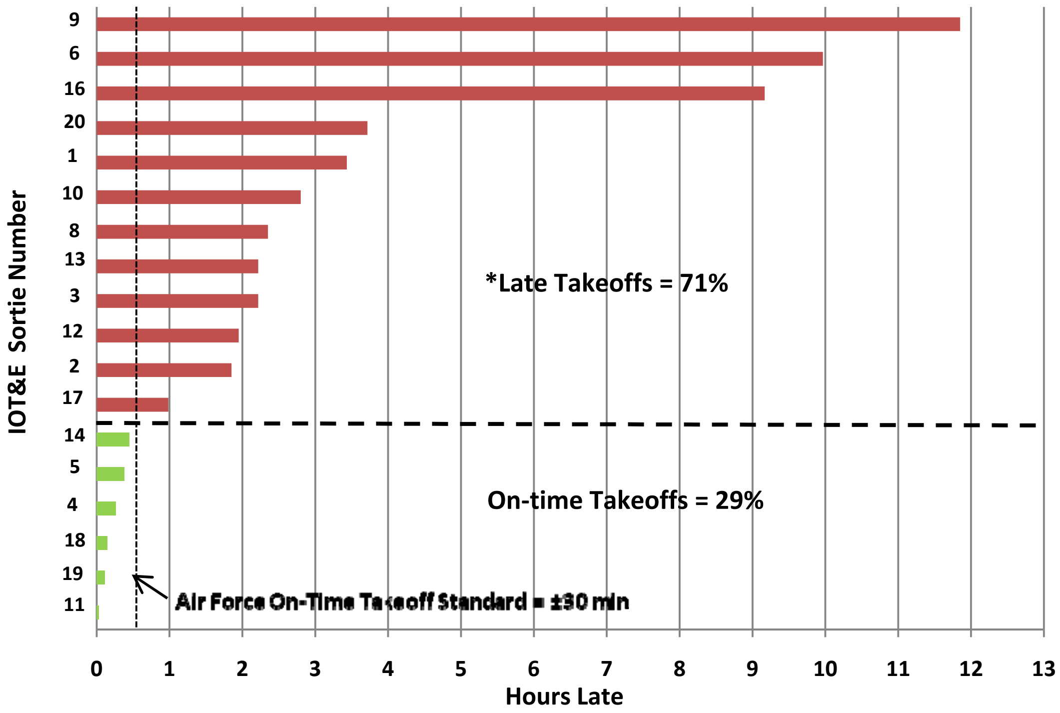


Figure 4-5. Air Vehicle High Failure Critical Components

Since IOT&E, the Air Force has continued existing or initiated reliability improvement activities for high failure rate components. For example, a re-designed 25 KVA electrical generator recently passed a 1,000-hour endurance test and shows promise as a more reliable replacement unit. Fleet-wide generator retrofits are in progress and will be complete in late 2011. Improved 25 KVA generator reliability should increase ETOS performance by three to five percent. The program office is revising repair methods for aircraft structural components to reduce adhesive disbond frequency and longer-term component design changes are under review. Improved Kearfott inertial navigation units will replace existing units by attrition. In the interim, mission essential equipment rules have been relaxed to allow mission operations to continue using redundant navigation systems when Kearfott navigation unit failures occur. Sensor management unit deficiencies are being addressed in a 2011 operating software update and by improving pre-flight procedures to preclude system configuration errors. A redesigned fuel nozzle was recently qualified for the Global Hawk engine, with retrofits planned for late 2011. The program recently completed a fleet-wide brake system control unit upgrade to address the most serious failure modes. Corrective actions for other high failure rate components and previously identified sensor reliability issues are also being evaluated.

Takeoff Reliability

Poor air vehicle reliability directly contributed to the very low takeoff reliability observed during IOT&E. As shown in Figure 4-6, only six of the 21 attempted IOT&E sorties (29 percent) met the Air Force scheduled takeoff time standard of ± 30 minutes, with missions launching up to 12 hours late.



*Note: Includes IOT&E sorties 15 and 21 cancelled for maintenance and sortie 7 cancelled for weather

Figure 4-6. IOT&E Takeoff Reliability

Frequent pre-flight delays to resolve system failures were the primary cause of poor takeoff reliability. Inadequate technical data and maintenance training also contributed to poor takeoff reliability when maintenance personnel were not able to quickly analyze and resolve problems during pre-launch preparations. Failure to arrive on-station at the designated mission time directly reduces ETOS performance. During IOT&E, late takeoffs resulted in a loss of 108 hours of planned time-on-station.

Mission Air Aborts

Frequent RQ-4B Global Hawk Block 30 mission air aborts also reduced the amount ISR coverage provided during IOT&E. Mission air aborts occur when an air vehicle returns to base prior to completing the planned time on-station due to a critical system failure. During IOT&E, eight of the 21 attempted sorties (38 percent) returned to base early due failure of flight essential or mission essential components such as electrical generators, communication systems, navigation systems, or sensor-related components. This observed air abort rate was similar to the 33 percent air abort rate projected by the ARM simulation.

Time Between Maintenance

High air vehicle critical component failure rates produce a high demand for system maintenance. Mean Time Between Maintenance (MTBM) reliability metric indicates how frequently maintenance and repair actions are required for system components. The system calculated MTBM of 1.2 (±0.1, 80 percent confidence interval) hours equates to an average of 23 maintenance actions for preparation and recovery for every 28-hour mission. Air vehicle MTBM is 1.4 (±0.1, 80 percent confidence interval) hours, which equates to 20 air vehicle maintenance actions for every 28-hour mission. MCE and LRE ground stations were highly reliable with an MTBM of 7.9 (±0.8, 80 percent confidence interval) hours. These results indicate a high demand for air vehicle maintenance for every mission, which may exceed operational unit capabilities and require increased reliance on system contractor support.

Table 4-2 shows the top five critical air vehicle components that require the most frequent maintenance. Aircraft structural components require the most frequent maintenance action. On average, a Global Hawk air vehicle requires one or more structural repair actions after every long endurance flight. These repairs vary in complexity and repair time, but the composite structure adhesives used for repair often require up to 24 hours cure time before returning the air vehicle to service. Since Global Hawk maintenance standards do not allow flight with structural deficiencies, these delays directly affect air vehicle availability to support subsequent missions. All subsystems that appear as MTBM drivers in Table 4-2 also appear in Table 4-1 as high failure rate mission critical systems.

Table 4-2. Air Vehicle Subsystem Mean Time Between Maintenance Drivers

Component	Subsystem MTBM (hours)
Aircraft Structure (Nut plates and click bonds)	16.3
Fuel Nozzles	32.6
25 KVA Electrical Generator	38.6
Kearfott Navigation Unit	54.3
Sensor Management Unit	77.2

Sensor Payload Stability

Both the EISS payload and the Airborne Signals Intelligence Payload (ASIP) experienced a significant amount of system on-station downtime that reduced intelligence collection capabilities and mission effectiveness. ASIP stability was especially poor with full SIGINT collection capabilities available only 48 percent of the time due to intermittent system faults. ASIP component resets or full system power recycles were frequently required to restore signal collection capabilities. ASIP sensor or application instability, rather than hardware failures, typically caused these sensor interruptions. As a result, ETOS results or other reliability metrics do not capture mission effectiveness losses caused by sensor instability. These losses are in addition to the time-on-station losses attributed to other system reliability shortfalls.

The test team measured EISS payload downtime during the eight long-endurance IOT&E missions of 20 hours or more. During these long endurance sorties, the EISS sensor accumulated 13.8 hours of downtime for an average of 1.7 hours per sortie. Across all 18 IOT&E missions flown, EISS instability contributed to a four to five percent ETOS loss, as shown in Figures 4-3 and 4-4.

The test team measured overall ASIP payload and individual SIGINT software application downtime during three long-endurance missions that produced 63.0 hours of ASIP operating time. The ASIP payload contains six individual components called “chassis” that contain the various SIGINT applications. Chassis one and two support electronic intelligence (ELINT) applications and chassis three, four, and five support communications intelligence (COMINT) applications. Chassis six controls signal distribution. The test team recorded the number of required chassis resets and the associated downtimes for each affected application. Resets included both individual chassis resets and full system power recycles performed to restore intelligence collection capabilities. Table 4-3 shows the number of chassis resets and power cycles, and the associated downtime for COMINT and ELINT applications. During the 63.0 hours of ASIP operation, there were 40 individual chassis resets and 10 complete power recycles required. As a result, full COMINT collection capabilities were available only 71.3 percent of the time and full ELINT collection capabilities were available only 67.3 percent of the time. Full (simultaneous) SIGINT collection capabilities were available for only 47.8 percent (30.1 of 63.0 hours) of IOT&E airborne operating time.

Table 4-3. ASIP Payload Stability

	COMINT Applications	ELINT Applications	All ASIP Applications Available
ASIP Collection Capabilities			
Collection Opportunity Rates	71.3%	67.3%	47.8%
Collection Opportunity Times	44.9 hrs	42.4 hrs	30.1 hrs
Total ASIP Operating Time*	63.0 hrs		
Sensor Downtime			
Individual Chassis Resets	Chassis 3: 1 Chassis 4: 6 Chassis 5: 12	Chassis 1: 11 Chassis 2: 9 Chassis 3: 1	Chassis 1 through 5: 40 total resets
Downtime Due to Chassis Resets	12.9 hrs	15.4 hrs	27.7**
Full ASIP Power Recycles	10		
Downtime Due to Full ASIP Power Recycles	5.2 hrs		
Overall Downtime	18.1 hrs	20.6 hrs	32.9 hrs**

* Total ASIP operating time during the three IOT&E multi-intelligence collection missions

**Total less than sum of COMINT and ELINT application downtimes since some chassis resets were simultaneous

Availability

RQ-4B Global Hawk Block 30 system availability is not sufficient to generate the sorties required to provide persistent ISR coverage. For this system, operational requirements documents define availability thresholds in terms of mission capable status. A fully mission capable system can perform all assigned missions. Partially mission capable systems can perform at least one, but not all, assigned missions.

Air Vehicle Availability

The RQ-4B Global Hawk Block 30 air vehicle mission capable rate does not support current operational requirements for persistent ISR coverage. During the period from May 1 to December 15, 2010, the RQ-4B Global Hawk Block 30 system demonstrated an air vehicle fully mission capable rate of 52 percent and a partially mission capable rate of one percent. The combined air vehicle mission capable rate of 53 percent falls well short of the Global Hawk CDD mission capable rate requirement of 85 percent. This shortfall reflects the impact of unreliable air vehicle critical components, and the resulting high demand for unavailable spare parts and increased demand for air vehicle maintenance. Low air vehicle mission capable rates reduce overall Global Hawk Block 30 system availability and are the primary factor behind ETOS performance deficiencies.

Both the ARM simulation and IOT&E mission results confirmed poor air vehicle availability. The ARM simulation projected an air vehicle mission capable rate of only 29.4 (± 10.9, 80 percent confidence interval) percent for the first 30-days of deployed operations due to exhaustion of MRSP deployment kit spare parts after 12 days of near-continuous operations. ARM simulation results projected that 57 percent of returning air vehicles require mission essential equipment maintenance action before returning to service. The seven-day IOT&E mission surge period produced similar results. After attempting to generate and fly five consecutive long-endurance missions, all three participating air vehicles were in not mission capable status awaiting maintenance or spare parts.

Ground Station Availability

RQ-4B Global Hawk Block 30 ground station availability exceeded operational requirements. Ground stations were available to support mission operations at all operational tempos. The combined mission capable rate for the LRE and MCE was 96 percent during the period from May 1, 2010, to December 15, 2010. The LRE mission capable rate during this period was 95 percent. The MCE fully mission capable rate was 88 percent and the partially mission capable rate was 7 percent. Frequent failure of redundant MCE communication and data links reduced fully mission capable rates slightly, but did not prevent system operation. These rates meet or exceed operational requirements.

Maintainability

Operational units are not able to maintain the RQ-4B Global Hawk Block 30 system in accordance with current Air Force support concepts. Average repair times for required maintenance actions are meeting program goals, but the number of required maintenance actions is very high. The high demand for maintenance often exceeds Air Force maintenance unit capabilities, requiring unplanned reliance on system contractor personnel to sustain operations.

Mean Repair Time (MRT)

Average RQ-4B Global Hawk Block 30 repair times are acceptable to support operations. MRT measures the duration of an average maintenance event including all organizational level actions such as preparation, troubleshooting, verification, operational checks, repairs, removal, and replacement of components. Table 4-4 shows maintenance events and average repair times, recorded from May 1, 2010, to December 15, 2010. The overall system MRT was 3.0, which is very close to the current Air Force mean repair time goal.

Table 4-4. RQ-4B Mean Repair Times

	Maintenance Hours	Maintenance Events	Mean Repair Time* (Hours)	Percent of Maintenance Events < 3.0 hours
Block 30 System	3548.1	1174	3.0	74.2% [70.2 – 77.8]**
Air Vehicle	3233.7	995	3.3	69.1% [64.6 – 73.3]**
Launch and Recovery Element	140.1	57	2.5	85.7% [67.7 – 94.5]**
Mission Control Element	174.4	122	1.4	88.4% [77.4 – 94.4]**

*Current Air Force maintainability MRT goal is MRT ≤ 3.0 hours per 2011 Global Hawk System Engineering Plan
** 80 percent confidence bound estimate

Maintainers identified accessibility to some air vehicle equipment bays as a significant maintainability problem. Tight access clearances made removal and installation of components difficult and frequently resulted in broken aircraft structural components such as equipment standoff brackets and access panel nut plates. Repairs to these composite aircraft structural components often require extensive adhesive cure times, which reduce air vehicle availability to support operations.

Integrated Diagnostics

The RQ-4B Global Hawk Block 30 air vehicle fault detection and indication system provides a useful capability to monitor system status and faults during flight operations. However, the system is not effective for post-flight maintenance fault isolation. Air Force maintenance personnel are unable to evaluate the large number of presented fault codes to identify specific system failures. On average, post-mission system fault logs contain over 3,000 individual fault codes and require over 20 hours with system contractor support to reduce them to useful maintenance troubleshooting information. Supporting integrated diagnostic system technical data is insufficient.

The ASIP Maintenance System Evaluation Module (MSEM), located in the Distributed Common Ground System (DCGS) facility, monitors ASIP sensor payload status and provides real-time status for all ASIP chassis and SIGINT applications. However, the MSEM does not accurately reflect SIGINT application status. The system did not always display frequent ASIP sensor or SIGINT application failures, leading to continued mission operations without warning of degraded system capabilities. In addition, training and technical data for Air Force MSEM technicians are incomplete. As a result, extensive system contractor support is required to use MSEM troubleshooting and corrective action capabilities.

Supply Support System

The RQ-4B Global Hawk Block 30 MRSP is not adequate to support a Global Hawk CAP during the first 30 days of deployed operations without additional resupply. Poor air vehicle reliability, particularly high failure rates for critical components and components not included in the kit, quickly deplete MRSP spare parts. The ARM simulation projects that the current MRSP deployment kit will sustain operations for only 12 of the first 30 days of deployed operations. Without resupply, the system is unable to generate sufficient sorties to meet ETOS operational requirements. As currently planned, the MRSP does not contain spares for known high failure rate parts such as main landing gear components and fuel nozzles.

During IOT&E, the main operating base supply system effectively provided available spare parts and other supply support functions necessary to sustain operations. However, based on ARM simulation and demonstrated mission surge results, supply levels for mission critical parts are not sufficient to sustain operations at high operational tempos. ARM simulation results project Not Mission Capable for Supply (NMCS) rates of up to 64 percent during sustained Global Hawk CAP operations at high operational tempos. Spare part shortages also hampered more recent real-world operational missions. During February and March 2011, some RQ-4B

Global Hawk Block 30 operating locations experienced NMCS rates over 50 percent and spare part cannibalization rates in excess of 100 percent.

Deployability

The RQ-4B Global Hawk Block 30 system meets the operational deployment requirement to transport all system components and support materials using four or less C-17 cargo aircraft equivalents. The test team used the Automated Air Loading Planning tool to calculate that 3.3 C-17 equivalents are necessary to transport the Global Hawk ground stations, personnel, and support materials necessary to sustain near-continuous operations for the first 30 days of deployed, near-continuous operations. Estimated total equipment weight is 280,000 pounds plus accompanying operational and maintenance personnel. Although the Air Force has not finalized all deployment equipment requirements or configurations, these estimates are consistent with planning factors and allowances provided for the recent deployment of 9th Reconnaissance Wing systems to forward operating locations in the U.S. Pacific Command and U.S. European Command theaters. Air vehicles have demonstrated the capability to self-deploy during recent real-world operations.

Technical Data and Documentation

RQ-4B Global Hawk Block 30 documentation and technical orders are not adequate. Lack of complete and accurate technical data for system operators and maintenance personnel contributed to poor takeoff reliability, increased repair times, and low mission capable rates during IOT&E. Due to a lack of appropriate technical data, Air Force personnel are unable to operate or maintain the RQ-4B Global Hawk Block 30 system in accordance with the Air Force support concept. Successful operations are only possible with extensive system contractor support.

Pilot and Sensor Operator Technical Data

Pilot and EISS Sensor Operator documentation and technical orders are adequate to support routine flight operations. Crew surveys reflected a “largely acceptable” rating or better for computer-based, electronic pilot flight manual. However, updates to electronic flight manuals often required several weeks. As a result, the program office publishes interim, written supplements for urgent operational or safety-related procedural changes. Crewmembers reported that is it difficult to identify and reconcile written technical data with the often conflicting electronic technical orders available at their MCE workstations, especially during emergency situations.

Due to known program delays, ASIP sensor operator documentation, operating procedures, checklists, and troubleshooting procedures were not available for IOT&E. ASIP operators rely on informal operating procedures and checklists to operate the system. Extensive contractor support is required to execute system operations. Lack of technical data and procedures degrade SIGINT collection operations.

Maintenance Technical Data

Global Hawk maintenance documentation and technical orders are not adequate. Incomplete and inaccurate technical orders directly contributed to low mission capable rates, high late takeoff rates, and increased system repair times. Although the 9th Reconnaissance Wing at Beale AFB assumed responsibility for RQ-4B Global Hawk Block 30 maintenance operations in June 2010, quality assurance inspectors verified only 15 percent of the 180 maintenance technical orders by December 2010. Air vehicle and sensor payload maintenance documentation and technical orders are available for routine maintenance operations. However, technical data for the full range of aircraft maintenance actions is incomplete. For example, the program did not provide verified technical data for over 500 structural repair tasks.

The program deferred delivery of ASIP sensor payload maintenance technical orders until FY 12, requiring continued reliance on contractor personnel for routine system maintenance support. Technical data for the ASIP MSEM system, located in the DCGS facility to support in-flight system status monitoring, was not available. ASIP system monitoring relied upon informal procedures developed by DCGS personnel or system contractor support.

Ground station maintenance technical orders are not adequate. Unplanned, additional system contractor support is required to perform critical system maintenance activities. Air Force maintenance personnel repeatedly noted that technical order deviations were required to make the ground stations work. For example, during IOT&E mission two, maintainers were unable to configure the MCE sensor management unit during pre-flight preparations using available technical data. The proper system configuration was eventually established using a trial and error process, but mission takeoff was delayed for over 40 minutes. Later in the same mission, the MCE crew was unable to establish air vehicle command and control via the INMARSAT data link system. Maintenance personnel were unable to resolve this discrepancy, and system contractor personnel subsequently fixed the problem using procedures not documented in system technical data.

Training

Training programs for RQ-4B Global Hawk Block 30 pilots and EISS sensor operators is adequate. ASIP sensor operator training is not available and operations currently rely on extensive system contractor support. Training for maintenance personnel is not adequate and directly contributed to poor takeoff reliability, increased repair times, and low mission capable rates during IOT&E. Due to a lack of effective maintenance training, Air Force personnel are unable to maintain the RQ-4B Global Hawk Block 30 system in accordance with Air Force support concepts. Successful maintenance operations are only possible with extensive system contractor support.

Pilot and Sensor Operator Training

The 1st Reconnaissance Squadron at Beale AFB, California, conducts formal Air Force training for both MCE pilots and EISS sensor operators. For operators transitioning from the RQ-4A Global Hawk Block 10 system, only ground-based difference is required. Pilot and EISS sensor operator training is adequate to support traditional IMINT collection operations.

However, the lack of additional training for integrated IMINT and SIGINT operations contributed to poor mission coordination between the MCE crew and DCGS ASIP sensor operators during IOT&E.

Training for the ASIP sensor operators, including technical reporters, ELINT operators, COMINT operators, special signals analysts, and ASIP MSEM technicians is not adequate. No formal training is provided for any ASIP-related crew position. System operators rely on previous on-the-job experience gained during U-2 ASIP operations or previous Global Hawk ASIP developmental test events. Previous AFOTEC recommendations to develop formal ASIP training programs, provided in the July 2008 ASIP Operational Assessment Report, have not been implemented. Crew surveys and IOT&E results indicate a pressing need for formal ASIP operator training. The lack of training affected the overall effectiveness of SIGINT collection operations during IOT&E, particularly when using automated ASIP functions. For example, on legacy Air Force COMINT systems, operators can set individual signal threshold strengths for frequency monitoring. However, the ASIP system sets those thresholds automatically to pre-determined default settings. ASIP operators can adjust these default thresholds to optimize signal collection opportunities when needed, but ASIP operators have not been trained to adjust system settings.

Maintenance Training

Training for RQ-4B maintenance personnel is not adequate. Formal Air Force training was not provided for air vehicle and ground station systems. Contractor-provided training consisted of slide presentations describing the differences between the RQ-4A Global Hawk Block 10 and RA-4B Global Hawk Block 30 systems. A cadre of experienced Air Force maintainers received this training and provided similar presentations to other maintenance personnel. This approach did not produce qualified, task-certified maintenance personnel. Surveys indicate that informal, on-the-job training was the primary source of effective training for specific maintenance tasks. Training devices and simulators are not available and on-aircraft training opportunities are limited by operational priorities. As a result, much of the informal on-aircraft training occurred during actual aircraft maintenance activities, including IOT&E operations. Incomplete and missing technical orders reduced the effectiveness of all training efforts.

This page intentionally left blank.

Section Five
Recommendations

The Air Force should consider the following recommendations and should verify the corrections to deficiencies during follow-on test and evaluation.

Operational Effectiveness

- Develop mission planning tools that reduce the current four-week planning process for new missions to improve rapid employment capabilities
- Develop a capability to upload new mission plans after takeoff to enable autonomous execution of new or revised missions and reduce operational risk
- Upgrade communication systems to provide real-time Global Hawk Virtual Crew voice capabilities, integrated SIPRNET access, and a redundant air traffic control voice communication capability to improve crew situational awareness and mission coordination capabilities
- Integrate real-time weather, air traffic, and tactical common operating picture information into the MCE to improve pilot situational awareness
- Develop an air vehicle anti-ice and de-ice capability to improve all-weather operational capabilities
- Continue to develop air traffic sense and avoid capabilities to ensure future access to worldwide airspace
- Complete development of EISS wide area search, GMTI, and ground target geo-location capabilities required to meet IMINT operational requirements
- Resolve ASIP signal detection, identification, and geo-location technical deficiencies to improve SIGINT capabilities
- Develop an IMINT and SIGINT data recording capability that meets the operational requirement to conduct autonomous “off-tether” missions without reliance on line-of-sight (LOS) or beyond-line-of-sight (BLOS) data link systems for intelligence data transmission
- Resolve joint interoperability and information assurance deficiencies

Operational Suitability

- Develop, fund, and implement a comprehensive reliability growth plan to correct system reliability deficiencies and increase effective-time-on-station performance
- Review spare part acquisition plans and consider increasing mission critical spare part availability until reliability deficiencies are corrected
- Resolve ASIP sensor stability deficiencies to improve on-station SIGINT collection capabilities

- Complete development and delivery of all required system maintenance and sensor payload documentation and technical data
- Improve maintenance and ASIP operator training programs
- Resolve deficiencies in air vehicle and ASIP integrated diagnostic and health monitoring systems