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The Problematic Nexus: Where Unmanned Combat Air Vehicles and the Law of Armed Conflict Meet

by

John J. Klein, LCDR USN

Abstract

Unmanned combat air vehicles (UCAVs) have taken on a greater role in the U.S. Armed Forces, as evidenced by the Predator vehicle's lethality during operations in Iraq, Afghanistan, and Yemen. Despite the combat power UCAVs promise to deliver, factors exist which limit their operational effectiveness. These factors are due to the problematic interaction of UCAV implementation and the law of armed conflict. Nevertheless, by understanding these factors and relevant issues, recommendations can be developed that maximize the unmanned aircraft's combat effectiveness.

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Now it is clear the military does not have enough unmanned vehicles. We're entering an era in which unmanned vehicles of all kinds will take on greater importance – in space, on land, in the air, and at sea.

—President George W. Bush

My JAG [Judge Advocate General] doesn't like this, so we're not going to fire.

—CENTCOM Commander, General Tommy R. Franks

Overview

With advancements in technology and concerns for friendly force fatalities, Unmanned Combat Air Vehicles (UCAVs) promise to dramatically revolutionize combat operations. Although the only UCAV currently in the U.S. inventory is the specially modified Predator unmanned aircraft—jointly used by the U.S. Air Force and Central Intelligence Agency—it is clear from President Bush's comment that UCAVs will play a vital role in the U.S. Armed Forces' future.[1] Indeed, the Predator UCAV has demonstrated both its combat effectiveness and lethality during operations in Iraq, Afghanistan, and Yemen.[2] Despite the anticipated combat power UCAVs promise to deliver, conditions exist which currently limit their operational effectiveness.

This point is illustrated by GEN Franks' statement above, which was given when asked why the Predator UCAV did not launch a Hellfire missile at a vehicle convoy carrying Taliban leader Mullah

Omar.[3] GEN Franks' concern was said to be whether the Predator's attack was lawful under the law of armed conflict.[4] Franks decided not to attack the Taliban leader, but directed the Predator to destroy empty vehicles around Omar's position. In the end, however, Mullah Omar eluded U.S. forces and escaped.[5]

As demonstrated by the example above, the methods and procedures to effectively use UCAVs have not been fully refined. This is due, in part, to the fact UCAV operations differ significantly from that of manned aircraft, and these differences result in problematic implications when observing the law of armed conflict. Consequently, the pertinent issues related to the law of armed conflict and UCAVs will be addressed, in an effort to identify recommendations for Combatant Commanders and their staffs to maximize the unmanned aircraft's combat effectiveness.

The Law of Armed Conflict

The law of armed conflict has been defined as "that part of international law that regulates the conduct of armed hostilities."[6] It generally encompasses international treaty law and customary international law regulating the methods of warfare and defines who is an appropriate target. Its intent is to ensure hostile action is directed against enemy forces, while minimizing unnecessary human misery or physical destruction. The law of armed conflict reveals relevant considerations for UCAV operations, especially regarding who should control the vehicle and how combat power is applied.

Combatants vs. Noncombatants

The law of armed conflict makes a distinction between those who are combatants and noncombatants.[7] The term combatant applies to those persons who have the right under international law to participate in armed conflict. These persons include members of the regular armed forces (except medical personnel, chaplains, civil defense personnel, and members of the armed forces who have acquired civil defense status) and irregular forces under responsible command, who carry their arms openly and distinguish themselves from the civilian population.[8] The term noncombatant applies to those people not part of the armed forces who refrain from directly supporting of hostile acts. In general, civilians are considered non-combatants.[9] The term noncombatant includes medical officers, corpsmen, chaplains, civilian war correspondents, and technical representatives. Since only combatants may lawfully participate directly in armed conflict, noncombatants that do so are acting unlawfully and are considered illegal combatants. More importantly, civilian personnel who are illegal combatants constitute a legitimate military target, can be legally prosecuted for their wartime actions, and do not enjoy the same prisoner of war protections as lawful combatants under the Geneva Conventions.

Lawful Targeting

Also of relevance is the principle of lawful targeting, which is based upon three underpinnings.[10] First, a belligerent's right of injuring the enemy is not unlimited. Second, launching attacks against civilian populations is prohibited. Third, distinctions between combatants and noncombatant must be made, to spare noncombatants as much as possible. Consequently, under lawful targeting, all "reasonable precautions" must be taken to ensure only military objectives[11] are targeted, so damage to civilian objects (collateral damage) or death and injury to civilians (incidental injury) is avoided as much as possible.[12]

Military Necessity

The law of armed conflict calls for using only that degree and kind of force required for the partial or complete submission of the enemy, while considering the minimum expenditure of time, life, and physical resources.[13] Often referred to as military necessity, this principle is designed to limit the application of force to that required to carry out lawful military purposes. Often, this principle is misunderstood and misapplied to support the excessive and unlawful application of military force, since military necessity is frequently used to justify any mission accomplishment. While military necessity recognizes some collateral damage and incidental injury to civilians may occur when a legitimate military target is attacked, it does not excuse the wanton destruction of lives and property disproportionate to the military advantage to be gained.[14]

Rules of Engagement

In the end, mission accomplishment must be "balanced" against military necessity, along with the possibility of incidental injury and collateral damage.[15] Military planners apply this "balancing test" when deciding when and where to employ UCAVs against the enemy. Acting as the "fulcrum" in this "balancing" are Rules of Engagement, since they serve to guide the military's applications of force, while still observing applicable law of armed conflict provisions.

A fundamental idea permeating Rules of Engagement is the inherent right of self-defense. This right applies during peace or war, and stems from customary international law dating back at least three hundred years. Furthermore, it is delineated in Article 51 of the United Nations Charter, which states, "Nothing … shall impair the inherent right of individual or collective self-defense if an armed attack occurs…."[16]

For the U.S. military, there are two categories of Rules of Engagement: Standing Rules of Engagement and Supplemental Rules of Engagement. Standing Rules of Engagement provide overarching guidance for the application of force during peace and war.[17] In contrast, Supplemental Rules of Engagement are specifically issued for the accomplishment of mission objectives during specified hostilities or other military operations.

Standing Rules of Engagement

The Chairman of the Joint Chiefs of Staff promulgates the U.S. Standing Rules of Engagement, reflecting the inherent right of self-defense. Furthermore, it divides self-defense into three categories. The first category, national self-defense, applies to the United States, its forces, and in specific circumstances, U.S. nationals and their property. The second category, collective self-defense, applies to designated non-U.S. forces, foreign nationals, and their property. The third major category is unit self-defense and applies to a particular U.S. force element, including individual personnel, and other U.S. forces in the vicinity.[18]

Supplemental Rules of Engagement

Supplemental Rules of Engagement are issued to provide specific guidance for the accomplishment of mission objectives. Moreover, Supplemental Rules of Engagement usually delineate what is considered mission essential equipment. This term applies to equipment or property considered vital for the accomplishment of mission objectives, and because of its importance, mission essential equipment is deemed necessary to protect by force.

Considerations

The nexus of UCAV implementation and the law of armed conflict reveals pertinent operational considerations resulting from the particular level and method of human involvement. Specifically, this is influenced by whether remotely piloted, autonomous, or semi-autonomous systems are used.[19] By addressing the various concerns, recommendations can subsequently be formulated, thereby optimizing the unmanned vehicle's effectiveness.

UCAV Operators: Lawful or Unlawful Combatants?

While UCAVs do not have a traditional aircrew like manned aircraft, remotely piloted and semi-autonomous systems require personnel to control the vehicle. There have been significant discussions regarding the use of civilians as unmanned aircraft control operators; specifically, Department of Defense comptrollers have argued for civilian operators vice military personnel. Civilians are said to be more cost effective to train, since military personnel rotate assignments every few years, requiring the training of follow-on personnel.[20]

Notwithstanding the cost advantages, the idea of using civilians during UCAV operations has made some senior military officers "nervous."[21] While uniformed members of the armed forces fall under the definition of a lawful combatant, a civilian UCAV operator could arguably be considered an illegal combatant under the law of armed conflict. Consequently, civilian operators could be prosecuted for their actions and would not have the same prisoner of wartime protections as members of the Armed Forces. Furthermore, the pervasive use of illegal combatants may have serious unintended consequences—such as our adversary conducting reprisals against civilian personnel, suspecting that others may also be combatants.

Applying the "Balancing Test"

UCAVs have employment considerations differing from those of manned aircraft, and this is apparent when balancing mission accomplishment and protection of forces against incidental injury and collateral damage. Usually, manned aircraft frequently have a minimum operating altitude restriction, due to concerns of being shot down by enemy fire.

This was the case in Kosovo, when the Rules of Engagement restricted aircraft to remain at least 15,000 ft above ground level to avoid hostile fire.[22] Complaints arose that this minimum altitude restriction frequently precluded fulfilling a significant tenet of lawful targeting—positively identifying enemy targets. This often resulted in the aircrew not releasing their bombs.[23] Unfortunately in one instance, aircrew attacked what was believed to be an enemy troop column. Tragically, however, the column contained refugees, and many civilian deaths resulted. It was speculated that if aircraft had been allowed to fly at a lower altitude, the column might have been correctly identified, avoiding the death of innocents.[24]

Weapon Release Authority and Accountability

Once technology becomes sufficiently mature to allow for purely autonomous UCAVs, the problem of determining accountability and responsibility will arise. During optimal autonomous UCAV operations, the aircraft can detect, identify, and engage enemy targets using its onboard weapons system, without the direct intervention of personnel. The absence of human intervention during the weapons release process proves problematic when determining who is to be held accountable

following violations of the law of armed conflict.

In a conventional military chain-of-command, responsibility and accountability are clear within the traditional hierarchy structure. With manned aircraft, individual aircrew are normally held accountable for correctly targeting and engaging enemy forces. Therefore, if it is determined aircrew inappropriately released their weapons, resulting in the unlawful injury of friendly or non-combatant forces, they are held accountable for their actions. An April 2002 incident illustrates this point, when Air National Guard F-16 pilots allegedly bombed friendly Canadian forces in Afghanistan.[25]

If these same Canadian forces had been attacked by an autonomous UCAV, determining who is accountable proves difficult.[26] Would accountability lie with the civilian software programmers who wrote the faulty target identification software, the UCAV squadron's Commanding Officer, or the Combatant Commander who authorized the operational use of the UCAV?[27] Or are they collectively held responsible and accountable? Because of this ambiguity, the methods of UCAVs employment should ensure accountability can be readily determined.

No Inherent Right to Self-Defense

Though subject to debate, it is argued here that the "self" in unit self-defense applies solely to an individual person or persons and not physical assets or property. It is then presumed that UCAVs do not enjoy the inherent right of self-defense prescribed under international law, since they are unmanned. This results in significant differences as to how UCAVs can respond when fired upon, compared to manned aircraft.

For instance, manned aircraft enjoy wide discretion in how they respond against hostile intent or hostile action.[28] If a manned aircraft is illuminated and tracked by an unknown surface-to-air missile radar system during peacetime operations, the aircrew can preemptively attack the missile site under individual self-defense provisions, since hostile intent is displayed. Furthermore, if an aircrew's first indication of a nearby surface-to-air battery is a missile flying up towards the aircraft, the aircrew can engage the battery since an identifiable hostile act has occurred.

On the other hand, the two above scenarios would not hold true for UCAVs. Self-defense under international law would not be justified, since neither an individual nor individuals are physically threatened.[29] Exceptions would be if the unmanned aircraft is considered national property, due to its strategic capability, or if the vehicle is considered essential for mission accomplishment.

Recommendations

By fully appreciating UCAV limitations and the associated need to comply with international law provisions, recommendations for employment can be inferred. By following these recommendations, Combatant Commander's and their staffs can effectively plan for unmanned operations.

Keep the Man-in-the-Loop, For Now

Considering the limitations of existing technology, UCAVs should employ either remotely piloted or semi-autonomous command and control systems, thus keeping humans in the identification and targeting decision cycle. This reduces the probability of incidental deaths and collateral damage during combat operations, and this command and control method ensures traditional accountability measures. Nevertheless, once autonomous command and control systems are proven accurate and

reliable, autonomous operations should be reconsidered, albeit with specific employment restrictions.

Only Military "Trigger Pullers"

Even though civilian controllers might be more cost effective or deemed advantageous over military personnel, civilians who launch weapons would likely be considered illegal combatants under the law of armed conflict. Such a scenario would have legal, political, and military consequences. Therefore, during remotely piloted and semi-autonomous operations, only uniformed, military personnel should have UCAV weapon release authority and perform the physical action that launches weapons.

Restrict Lethal Autonomous Operations

Once technology advances to enable reliable autonomous operations, maintaining accountability proves problematic. Because of this, "kill box" operations should be considered during lethal, autonomous missions to mitigate accountability concerns. During these operations, a geographic area—defined by specific three-dimensional coordinates—is designated, within which enemy targets can be engaged once properly identified and after weapon release authority is given.[30] By inserting humans into the autonomous operations, thereby verifying and overseeing target identification and weapon release processes, autonomous UCAVs can still employ lethal force, while incorporating appropriate accountability measures.[31]

In one possible approach, a Forward Air Controller locates and identifies enemy positions prior to the UCAV arriving on the scene, while ensuring sufficient target separation between friendly and enemy forces. Once the UCAV arrives on scene, targeting data and "clear to fire" authorization is relayed to the unmanned aircraft, thus maintaining authority and accountability in a manner commensurate with manned aircraft systems. This "kill box" approach would be appropriate when friendly and enemy forces are located in close proximity to one another.

In a second approach, military personnel monitor and oversee the UCAV's automated identification and targeting solutions from the control station, ensuring correctness and accuracy. Therefore, if it appears the UCAV is about to engage the wrong target, personnel insert themselves into the process, overriding the aircraft's automated weapon systems.[32] This would effectively be a "command by negation" arrangement, and would be appropriate when enemy and friendly forces are not in close proximity to each other.

Use Non-Lethal Weapons

Non-lethal weapons are a natural fit for autonomous UCAVs. These weapons use non-lethal force, such as high-power microwave energy, to degrade equipment or impair troop mobility without causing permanent, irreparable injury. Non-lethal weapons attempt to mitigate incidents of collateral damage and incidental injury in accordance with the principle of lawful targeting; therefore, the most significant drawback of autonomous UCAV operations—determining accountability and assigning blame following an unlawful act—is lessened by non-lethal weapons. Moreover, by employing non-lethal weapons, the Combatant Commander will gain more war fighting options, since a level of force can still be applied when military necessity does not warrant lethal force.

Give UCAVs Special Designations

Since UCAVs are unmanned, they do not enjoy the same flexibility under the inherent right of self-defense when fired upon. If in the future, however, our national and military leaders determine an

particular unmanned aircraft provides strategic-level capabilities, it is recommended such UCAVs be designated "national assets," since this designation would allow execution of self-defense under the national self-defense criteria. While this might seem implausible considering current employment and technology, if UCAVs develop, for example, a persistent, all-weather attack and signals collection ability, they might eventually reach this status.

Regardless of their future strategic value, UCAVs should be designated "mission essential equipment" in Supplemental Rules of Engagement to enable their self-protection and defense by friendly forces, until the aircraft can be mass-produced in a significant numbers.

Fly Lower than Manned Aircraft

Since unmanned aircraft do not put aircrew at risk, they possess different force protection considerations. For example, if unmanned aircraft are designed with an identification and targeting capability commensurate with that of manned aircraft, then they should in general operate at lower altitudes than manned aircraft, to fulfill the principle of lawful targeting. This lower altitude increases the probability of correct target identification and consequently minimizes the potential for collateral damage and incidental injury.

Albeit aircrew are not placed at risk, and it might appear UCAVs should fly at the lowest altitude possible, military planners need to consider several factors when determining UCAVs' minimum operating altitude. For example, the vehicle's vulnerability to enemy fire and weapon systems subsequently falling into enemy hands must be a planning consideration. Another concern is whether the vehicle is in fact "mission essential" equipment, and consequently too valuable to risk destruction.

Conclusion

Unmanned Combat Air Vehicles have proven their lethality during recent combat operations, and because of these successes, the Armed Forces are moving toward a greater reliance on unmanned aircraft. Despite the Armed Forces' enthusiasm, the level of effort spent to understand the inherent advantages and limitations of UCAVs has been inadequate. Specifically, scant attention has been given to how the law of armed conflict impacts UCAV combat operations.

Because of this prior oversight, it is paramount that more detailed consideration and planning be conducted regarding the integration of unmanned aircraft into future combat operations. In particular, Combatant Commanders and their staffs should heed the stated recommendations, so the UCAV's combat power can be maximized while still observing international law.

Failure to understand and plan in appropriate detail for UCAV employment will lead to indecision on the battlefield when the aircraft's firepower is needed most, enabling the enemy to evade our military might. However, by considering pertinent employment issues beforehand, the Unmanned Combat Air Vehicle will realize its full potential, empowering the US to meet the national security challenges of the future.

Notes

1. ***George W. Bush, Citadel speech, 11 December 2001. The Predator's original design was modified to carry the Hellfire laser-guided, air-to-ground missile. The Navy does not currently have an operational UCAV, but it has established a UCAV program office which is working toward fielding a dedicated UCAV in about 8 years, as stated in Unmanned Aerial Vehicles Roadmap 2000-2025 (Washington, DC: Office of the Secretary of Defense) 06 April 2001, 18. Additionally, the Army and Marine Corps have no official UCAV programs, but are expected to consider joint-use with either the Air Force or Navy. For more information, see reference, Christopher J. Castelli, "Navy Delays Armed Drone Effort, Mulls Teaming With Air Force," InsideDefense.com, 09 September 2002; downloaded from www.insidedefense.com on 18 December 2002.***

2. ***Eric Schmidt, "U.S. Would Use Drones to Attack Iraqi Target," The New York Times, 06 November 2002, 1. The article reports the total number of Hellfire missiles launched by Predator UCAVs in both Iraq and Afghanistan is over 70. In the reference, Esther Schrader and Henry Weinstein, "U.S. Enters a Legal Gray Zone," Los Angeles Times, 05 November 2002, 1, it is reported a Predator UCAV controlled by the CIA launched a Hellfire, killing several Al Qaeda operatives in Yemen.***

3. ***Seymour M. Hersh, "King's Ransom: How Vulnerable are the Saudi Royals?" The New Yorker, 22 October 2001, 36.***

4. ***Judith Miller and Eric Schmitt, "A Nation Challenged: The Battle; Ugly Duckling Turns Out to be Formidable in the Air," The New York Times, 23 November 2001, p. B-1. It is reported GEN Franks asked for approval from senior officials in Washington before engaging the enemy, since civilian fatalities were likely.***

5. ***Hersh, 35.***

6. ***Joint Chiefs of Staff, Department of Defense Dictionary of Military and Associated Terms, Joint Publication 1-02 (Washington, DC: 23 March 1994), 215.***

7. The Commander's Handbook on the Law of Naval Operations, NWP-14M (Washington DC: Department of the Navy, 1995), 5-1.

8. Ibid., 5-2.

9. Ibid. Also, see paragraph 12.7.1 for amplifying information.

10. Ibid., 8-1. The three underpinning coming from paragraph 8.1.

11. Ibid. From paragraph 8.1.1, "Military objectives are combatants and those objects which, by their nature, location, purpose, or use, effectively contribute to the enemy's war-fighting or war-sustaining capability and whose total or partial destruction, capture, or neutralization would constitute a definite military advantage to the attacker under the circumstance at the time of the attack."

12. Ibid., 8-1. Paragraph 8.1.2 states, "Civilian objects consist of all civilian property and activities other than those used to support or sustain the enemy's war-fighting capabilities. Attacks on installations such as dikes and dams are prohibited if their breach or destruction would result in the loss of civilian lives disproportionate to the military advantage to be gained. Similarly, the intentional destruction of food, crops, livestock, drinking water, and other objects indispensable to the survival of the civilian population, for the specific purpose of denying the civilian population of their use, is prohibited."

13. Ibid, 6-5.

14. Ibid.

15. Ibid., 8-1 and 8-2.

16. James C. Duncan, "The Commander's Role in Developing Rules of Engagement," Naval War College Review (Summer 1999), 81. Article 51 states, "Nothing in this present Charter shall impair the inherent right of individual or collective self-defense if an armed attack occurs against a Member of the United Nations, until the Security Council has taken measures necessary to maintain international peace and security."

17. Chairman of the Joint Chief of Staff, Standing Rules of Engagement for US Forces, CJCSI 3121.01A Instruction (Washington, DC: 15 January 2000), 1.

18. Standing Rules of Engagement for US Forces, Enclosure A (Unclassified Appendix), A-4.

19. The Predator UCAVs that engaged targets in Iraq, Afghanistan, and Yemen were remotely piloted. See Hersh, 35. In this type of command and control system, the aircraft uses a communications link with a manned control station, dictating the vehicle's flight path and operation. Additionally, imagery from the UCAV's sensors is transmitted to the control station, enabling the human operator to locate, identify, and engage enemy targets.

On the other end of the technological spectrum is the autonomous command and control system, which uses the unmanned aircraft's onboard computer to locate, identify, track, and expeditiously attack targets. This system does not use man-in-the-loop control, and a receiving station is only used to monitor the aircraft's onboard sensor and flight profile information.

With semi-autonomous systems, specific phases of the mission are remotely piloted, while other phases are performed independently by the vehicle, thus attempting to blend the advantages of both man-in-the-loop and autonomous operations. Therefore, mundane and time consuming tasks, such as aircraft station keeping and searching for the enemy, are accomplished autonomously using the vehicle's onboard sensors and computer. Once a potential target is identified, human decision-makers intervene, verifying target identification and suitable conditions for weapon release.

20. Amy Butler, "USAF Vice Chief Cites LOAC Concerns over Civilian UAV Pilots," Inside the Air Force, 08 November 2002, 5.

21. Ibid. According to the November 7, 2002 interview, General Robert Foglesong said, "One of the things that makes us a little nervous is the law of war. You have to be a little careful here about having non-uniformed, non-combatant members actually pulling the trigger on something and killing something or somebody."

22. Philip Meilinger, "Precision Aerospace Power, Discrimination, and Future War," Aerospace Power Journal, Fall 2001, 3.

23. Ibid.

24. Ibid.

25. Rowan Scarborough, "Canadians Fired into the Air Before Fatal Friendly Fire," The Washington Times, 26 November 2002, 3. This article reports two Illinois Air National Guard F-16 pilots were charged with manslaughter by the Air Force for supposedly bombing and killing four Canadian soldiers.

26. Anthony J. Lazarski, "Legal Implications of the Uninhabited Combat Air Vehicle," Aerospace Power Journal, Summer 2002, 81. This article states accountability may potentially lie with the entire UCAV control team.

27. The theory of "command responsibility" stipulates that political and military leaders are legally culpable if they fail to do "everything possible" to prevent isolated acts committed by individual soldiers in battle. See reference, Loredana Vuoto, "Gen. Franks is Not a War Criminal," Washington Times, 08 May 2003 for a recent discussion.

28. Standing Rules of Engagement for US Forces, GL-13 and GL-14. Hostile act is defined as "an attack or other use of force by a civilian, paramilitary, or military force or terrorist(s) with or without national designation against the United States, U.S. forces, and in certain circumstances, U.S. nationals, their property, U.S. commercial assets, and other designated non-U.S. forces, foreign nationals and their property." Hostile intent is defined as "the threat of [the] imminent use of force against the United States, U.S. forces, and in certain circumstances, U.S. nationals, their property, U.S. commercial assets, and/or other designated non-U.S. forces, foreign nationals and their property."

29. This is the author's view.

30. Deputy Chief of Staff, Plans and Operations, JFACC Primer, (Washington, DC: U.S. Air Force, 1994), 12.

31. Some would argue that this scheme would not, in fact, be considered autonomous operations, since humans are inserted into the process.

32. Since this arrangement would necessitate a datalink with a control station—thus reducing one of the greatest advantages of autonomous systems—it might be susceptible to enemy jamming.

Bibliography

Chairman of the Joint Chief of Staff. Standing Rules of Engagement for US Forces. CJCSI 3121.01A Instruction. Washington, DC: Joint Chiefs of Staff, 15 January 2000.

Deputy Chief of Staff, Plans and Operations. JFACC Primer. Washington, DC: Department of the U.S. Air Force, 1994.

Duncan, James C. "The Commander's Role in Developing Rules of Engagement." Naval War College Review. Newport, RI: Naval War College Press, Summer 1999: 76-89.

Hersh, Seymour M. "King's Ransom: How Vulnerable are the Saudi Royals?" The New Yorker, 22 October 2001: 35-40.

Joint Chiefs of Staff. Department of Defense Dictionary of Military and Associated Terms. Joint Publication 1-02.Washington, DC: Department of Defense, 23 March 1994.

Lazarski, Anthony J. "Legal Implications of the Uninhabited Combat Air Vehicle." Aerospace Power Journal. Maxwell AFB, AL: Department of the Air Force, Summer 2002: 74-83.

Meilinger, Philip. "Precision Aerospace Power, Discrimination, and Future War." Aerospace Power Journal. Maxwell AFB, AL: Department of the Air Force, Fall 2001: 12-20.

Office of the Secretary of Defense. Unmanned Aerial Vehicles Roadmap 2000-2025. Washington, DC: Department of Defense, 2001.

Walling, Eileen M. High Power Microwaves: Strategic and Operational Implications for Warfare. Occasional Paper No. 11. Maxwell Air Force Base, AL: Center for Strategy and Technology, Air War College, February 2000.

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