Department of Defense
DIRECTIVE

NUMBER 3000.09
November 21, 2012
Incorporating Change 1, May 8, 2017

USD(P)

SUBJECT: Autonomy in Weapon Systems

References: See Enclosure 1

1. PURPOSE. This Directive:

a. Establishes DoD policy and assigns responsibilities for the development and use of autonomous and semi-autonomous functions in weapon systems, including manned and unmanned platforms.

b. Establishes guidelines designed to minimize the probability and consequences of failures in autonomous and semi-autonomous weapon systems that could lead to unintended engagements.

2. APPLICABILITY. This Directive:

a. Applies to:

(1) OSD, the Military Departments, the Office of the Chairman of the Joint Chiefs of Staff and the Joint Staff (CJCS), the Combatant Commands, the Office of the Inspector General of the Department of Defense, the Defense Agencies, the DoD Field Activities, and all other organizational entities within the DoD (hereinafter referred to collectively as the "DoD Components").

(2) The design, development, acquisition, testing, fielding, and employment of autonomous and semi-autonomous weapon systems, including guided munitions that can independently select and discriminate targets.

(3) The application of lethal or non-lethal, kinetic or non-kinetic, force by autonomous or semi-autonomous weapon systems.

b. Does not apply to autonomous or semi-autonomous cyberspace systems for cyberspace operations; unarmed, unmanned platforms; unguided munitions; munitions manually guided by the operator (e.g., laser- or wire-guided munitions); mines; or unexploded explosive ordnance.

3. DEFINITIONS. See Glossary.

4. POLICY. It is DoD policy that:

a. Autonomous and semi-autonomous weapon systems shall be designed to allow commanders and operators to exercise appropriate levels of human judgment over the use of force.

(1) Systems will go through rigorous hardware and software verification and validation (V&V) and realistic system developmental and operational test and evaluation (T&E) in accordance with the guidelines in Enclosure 2. Training, doctrine, and tactics, techniques, and procedures (TTPs) will be established. These measures will ensure that autonomous and semi-autonomous weapon systems:

(a) Function as anticipated in realistic operational environments against adaptive adversaries.

(b) Complete engagements in a timeframe consistent with commander and operator intentions and, if unable to do so, terminate engagements or seek additional human operator input before continuing the engagement.

(c) Are sufficiently robust to minimize failures that could lead to unintended engagements or to loss of control of the system to unauthorized parties.

(2) Consistent with the potential consequences of an unintended engagement or loss of control of the system to unauthorized parties, physical hardware and software will be designed with appropriate:

(a) Safeties, anti-tamper mechanisms, and information assurance in accordance with DoD ~~Directive~~ *Instruction* 8500.01~~E~~ (Reference (a)).

(b) Human-machine interfaces and controls.

(3) In order for operators to make informed and appropriate decisions in engaging targets, the interface between people and machines for autonomous and semi-autonomous weapon systems shall:

(a) Be readily understandable to trained operators.

(b) Provide traceable feedback on system status.

(c) Provide clear procedures for trained operators to activate and deactivate system functions.

b. Persons who authorize the use of, direct the use of, or operate autonomous and semi-autonomous weapon systems must do so with appropriate care and in accordance with the law of war, applicable treaties, weapon system safety rules, and applicable rules of engagement (ROE).

c. Autonomous and semi-autonomous weapon systems intended to be used in a manner that falls within the policies in subparagraphs 4.c.(1) through 4.c.(3) will be considered for approval in accordance with the approval procedures in DoD Directive 5000.01 (Reference (b)), DoD Instruction 5000.02 (Reference (c)), and other applicable policies and issuances.

(1) Semi-autonomous weapon systems (including manned or unmanned platforms, munitions, or sub-munitions that function as semi-autonomous weapon systems or as subcomponents of semi-autonomous weapon systems) may be used to apply lethal or non-lethal, kinetic or non-kinetic force. Semi-autonomous weapon systems that are onboard or integrated with unmanned platforms must be designed such that, in the event of degraded or lost communications, the system does not autonomously select and engage individual targets or specific target groups that have not been previously selected by an authorized human operator.

(2) Human-supervised autonomous weapon systems may be used to select and engage targets, with the exception of selecting humans as targets, for local defense to intercept attempted time-critical or saturation attacks for:

(a) Static defense of manned installations.

(b) Onboard defense of manned platforms.

(3) Autonomous weapon systems may be used to apply non-lethal, non-kinetic force, such as some forms of electronic attack, against materiel targets in accordance with DoD Directive 3000.*0*3*E* (Reference (d)).

d. Autonomous or semi-autonomous weapon systems intended to be used in a manner that falls outside the policies in subparagraphs 4.c.(1) through 4.c.(3) must be approved by the Under Secretary of Defense for Policy (USD(P)); the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)); and the CJCS before formal development and again before fielding in accordance with the guidelines in Enclosure 3, References (b) and (c), and other applicable policies and issuances.

e. International sales or transfers of autonomous and semi-autonomous weapon systems will be approved in accordance with existing technology security and foreign disclosure requirements and processes, in accordance with ~~Directive-Type Memorandum 11-053~~ *DoD Directive 5111.21* (Reference (e)).

5. RESPONSIBILITIES. See Enclosure 4.

6. RELEASABILITY. ~~UNLIMITED~~ ***Cleared for public release***. This Directive is ~~approved for public release and is~~ available on the ~~Internet from the~~ DoD Issuances Website at http://www.dtic.mil/whs/directives.

7. EFFECTIVE DATE. This Directive~~:~~ *is effective November 21, 2012.*

~~a. Is effective November 21, 2012.~~

~~b. Must be reissued, cancelled, or certified current within 5 years of its publication in accordance with DoD Instruction 5025.01 (Reference (f)). If not, it will expire effective November 21, 2022 and be removed from the DoD Issuances Website.~~

Ashton B. Carter
Deputy Secretary of Defense

Enclosures
1. References
2. V&V and T&E of Autonomous and Semi-Autonomous Weapon Systems
3. Guidelines for Review of Certain Autonomous or Semi-Autonomous Weapon Systems
4. Responsibilities

Glossary

ENCLOSURE 1

REFERENCES

~~(a) DoD Directive 8500.01E, "Information Assurance (IA)," October 24, 2002~~
(a) DoD Instruction 8500.01, "Cybersecurity," March 14, 2014
(b) DoD Directive 5000.01, "The Defense Acquisition System," May 12, 2003
(c) DoD Instruction 5000.02, "Operation of the Defense Acquisition System," ~~December 8, 2008~~ *January 7, 2015, as amended*
~~(d) DoD Directive 3000.3, "Policy for Non-Lethal Weapons," July 9, 1996~~
(d) DoD Directive 3000.03E, "DoD Executive Agent for Non-Lethal Weapons (NLW), and NLW Policy," April 25, 2013
(e) ~~Directive Type Memorandum (DTM) 11-053, "Technology Security and Foreign Disclosure (TS&FD) Processes," January 9, 2012~~ *DoD Directive 5111.21, "Arms Transfer and Technology Release Senior Steering Group and Technology Security and Foreign Disclosure Office," October 14, 2014*
~~(f) DoD Instruction 5025.01, "DoD Directives Program," September 26, 2012~~
(~~g~~*f*) DoD Directive 2311.01E, "DoD Law of War Program," May 9, 2006*, as amended*
(~~h~~*g*) DoD Directive 1322.18, "Military Training," January 13, 2009*, as amended*

ENCLOSURE 2

V&V AND T&E OF AUTONOMOUS AND SEMI-AUTONOMOUS WEAPON SYSTEMS

To ensure autonomous and semi-autonomous weapon systems function as anticipated in realistic operational environments against adaptive adversaries and are sufficiently robust to minimize failures that could lead to unintended engagements or to loss of control of the system, in accordance with subparagraph 4.a.(1) above the signature of this Directive:

a. Systems will go through rigorous hardware and software V&V and realistic system developmental and operational T&E, including analysis of unanticipated emergent behavior resulting from the effects of complex operational environments on autonomous or semi-autonomous systems.

b. After initial operational test and evaluation (IOT&E), any further changes to the system will undergo V&V and T&E in order to ensure that critical safety features have not been degraded.

(1) A regression test of the software shall be applied to validate critical safety features have not been degraded. Automated regression testing tools will be used whenever feasible. The regression testing shall identify any new operating states and changes in the state transition matrix of the autonomous or semi-autonomous weapon system.

(2) Each new or revised operating state shall undergo integrated T&E to characterize the system behavior in that new operating state. Changes to the state transition matrix may require whole system follow-on operational T&E, as directed by the Director of Operational Test and Evaluation (DOT&E).

ENCLOSURE 3

GUIDELINES FOR REVIEW OF CERTAIN AUTONOMOUS OR SEMI-AUTONOMOUS WEAPON SYSTEMS

1. Autonomous or semi-autonomous weapon systems intended to be used in a manner that falls outside the policies in subparagraphs 4.c.(1) through 4.c.(3) above the signature of this Directive must be approved by the USD(P), USD(AT&L), and CJCS before formal development and again before fielding.

a. Before a decision to enter into formal development, the USD(P), USD(AT&L), and CJCS shall ensure:

(1) The system design incorporates the necessary capabilities to allow commanders and operators to exercise appropriate levels of human judgment in the use of force.

(2) The system is designed to complete engagements in a timeframe consistent with commander and operator intentions and, if unable to do so, to terminate engagements or seek additional human operator input before continuing the engagement.

(3) The system design, including safeties, anti-tamper mechanisms, and information assurance in accordance with Reference (a), addresses and minimizes the probability or consequences of failures that could lead to unintended engagements or to loss of control of the system.

(4) Plans are in place for V&V and T&E to establish system reliability, effectiveness, and suitability under realistic conditions, including possible adversary actions, to a sufficient standard consistent with the potential consequences of an unintended engagement or loss of control of the system.

(5) A preliminary legal review of the weapon system has been completed, in coordination with the General Counsel of the Department of Defense (GC, DoD) and in accordance with References (b) and (c), DoD Directive 2311.01E (Reference (~~g~~*f*)), and, where applicable, Reference (d).

b. Before fielding, the USD(P), USD(AT&L), and CJCS shall ensure:

(1) System capabilities, human-machine interfaces, doctrine, TTPs, and training have demonstrated the capability to allow commanders and operators to exercise appropriate levels of human judgment in the use of force and to employ systems with appropriate care and in accordance with the law of war, applicable treaties, weapon system safety rules, and applicable ROE.

(2) Sufficient safeties, anti-tamper mechanisms, and information assurance in accordance with Reference (a) have been implemented to minimize the probability or consequences of failures that could lead to unintended engagements or to loss of control of the system.

(3) V&V and T&E assess system performance, capability, reliability, effectiveness, and suitability under realistic conditions, including possible adversary actions, consistent with the potential consequences of an unintended engagement or loss of control of the system.

(4) Adequate training, TTPs, and doctrine are available, periodically reviewed, and used by system operators and commanders to understand the functioning, capabilities, and limitations of the system's autonomy in realistic operational conditions.

(5) System design and human-machine interfaces are readily understandable to trained operators, provide traceable feedback on system status, and provide clear procedures for trained operators to activate and deactivate system functions.

(6) A legal review of the weapon system has been completed, in coordination with the GC, DoD, and in accordance with References (b), (c), (~~g~~*f*), and, where applicable, Reference (d).

2. The USD(P), USD(AT&L), and CJCS may request a Deputy Secretary of Defense waiver for the requirements outlined in section 1 of this enclosure, with the exception of the requirement for a legal review, in cases of urgent military operational need.

ENCLOSURE 4

RESPONSIBILITIES

1. USD(P). The USD(P) shall:

a. Provide policy oversight for the development and employment of autonomous and semi-autonomous weapon systems.

b. In coordination with the USD(AT&L) and CJCS, review and consider for approval weapon systems submitted in accordance with paragraph 4.d. above the signature of this Directive.

c. Review, as necessary, the appropriateness of guidance established in accordance with this Directive given the continual advancement of new technologies and changing warfighter needs.

d. Approve the DoD position on international sales or transfers of autonomous and semi-autonomous weapon systems in accordance with existing technology security and foreign disclosure requirements and processes.

2. USD(AT&L). The USD(AT&L) shall:

a. Provide principal oversight responsibility for the establishment and enforcement of standards for testing, safety and reliability, hardware and software V&V, anti-tamper mechanisms, and information assurance in accordance with Reference (a), for autonomous and semi-autonomous weapon systems in order to minimize the probability and consequences of failures that could lead to unintended engagements or to loss of control of the system.

b. Provide principal oversight responsibility for the establishment of science and technology and research and development priorities for autonomy in weapon systems, including the development of new methods of V&V and T&E.

c. Oversee adequate developmental testing of autonomous and semi-autonomous weapon systems to assess the risk of failures that could lead to unintended engagements or to loss of control of the system.

d. In coordination with the USD(P) and CJCS, review and consider for approval weapon systems submitted in accordance with paragraph 4.d. above the signature of this Directive.

3. UNDER SECRETARY OF DEFENSE FOR PERSONNEL AND READINESS (USD(P&R)). The USD(P&R) shall, consistent with DoD Directive 1322.18 (Reference (~~h~~*g*)), oversee and provide policy for:

a. Individual military training programs for the Total Force relating to autonomous and semi-autonomous weapon systems.

b. Individual and functional training programs for military personnel and the collective training programs of military units and staffs relating to autonomous and semi-autonomous weapon systems.

4. DOT&E. The DOT&E shall:

a. Provide principal oversight responsibility for the development of realistic operational T&E standards for semi-autonomous and autonomous weapon systems, including standards for T&E of any changes to the system following IOT&E, in accordance with subparagraph 4.a.(1) above the signature of this Directive and Enclosure 2.

b. Evaluate whether semi-autonomous and autonomous weapon systems under DOT&E oversight have met sufficient V&V and T&E in realistic operational conditions, including potential adversary action, in order to minimize the probability and consequences of failures that could lead to unintended engagements or to loss of control of the system to unauthorized parties.

5. GC, DoD. The GC, DoD, shall, in accordance with References (b), (c), (~~g~~*f*), and, where applicable, Reference (d), provide for guidance in and coordination of legal reviews of weapon systems submitted in accordance with paragraph 4.d. above the signature of this Directive.

6. DEPARTMENT OF DEFENSE CHIEF INFORMATION OFFICER (DoD CIO). The DoD CIO, shall monitor, evaluate, and provide advice to the Secretary of Defense regarding information assurance for autonomous and semi-autonomous weapon systems, in accordance with subparagraph 4.a.(2)(a) above the signature of this Directive and Reference (a).

7. ASSISTANT TO THE SECRETARY OF DEFENSE FOR PUBLIC AFFAIRS (ATSD(PA)). The ATSD(PA) shall coordinate and approve guidance on public affairs matters concerning autonomous and semi-autonomous weapon systems and their use.

8. SECRETARIES OF THE MILITARY DEPARTMENTS; COMMANDER, U.S. SPECIAL OPERATIONS COMMAND (USSOCOM); AND THE HEADS OF THE DEFENSE AGENCIES AND DoD FIELD ACTIVITIES. The Secretaries of the Military Departments; the Commander, USSOCOM; and the Heads of the Defense Agencies and DoD Field Activities shall:

a. Develop and implement employment concepts, doctrine, experimentation strategies, TTPs, training, logistics support, V&V, anti-tamper mechanisms, physical hardware and software-level safeties, information assurance in accordance with Reference (a), and

developmental and operational T&E appropriate for autonomous and semi-autonomous weapon systems.

(1) Design autonomous and semi-autonomous weapon systems in such a manner as to minimize the probability and consequences of failures that could lead to unintended engagements or to loss of control of the system.

(2) Perform rigorous and realistic developmental and operational T&E and V&V, including T&E of any changes to the system following IOT&E, in accordance with subparagraph 4.a.(1) above the signature of this Directive and Enclosure 2.

(3) Design autonomous and semi-autonomous weapon systems with sufficient safeties, anti-tamper mechanisms, and information assurance in accordance with subparagraph 4.a.(2) above the signature of this Directive and Reference (a).

(4) Design human-machine interfaces for autonomous and semi-autonomous weapon systems to be readily understandable to trained operators, provide traceable feedback on system status, and provide clear procedures for trained operators to activate and deactivate system functions, in accordance with subparagraph 4.a.(3) above the signature of this Directive.

(5) Certify that operators of autonomous and semi-autonomous weapon systems have been trained in system capabilities, doctrine, and TTPs in order to exercise appropriate levels of human judgment in the use of force and employ systems with appropriate care and in accordance with the law of war, applicable treaties, weapon system safety rules, and applicable ROE.

(6) Establish and periodically review training, TTPs, and doctrine for autonomous and semi-autonomous weapon systems to ensure operators and commanders understand the functioning, capabilities, and limitations of a system's autonomy in realistic operational conditions, including as a result of possible adversary actions.

b. Ensure that legal reviews of autonomous and semi-autonomous weapon systems are conducted in accordance with References (b), (c), (~~g~~f) and, where applicable, Reference (d). Legal reviews should ensure consistency with all applicable domestic and international law and, in particular, the law of war.

c. Consider for support only those autonomous and semi-autonomous weapon systems that are technically feasible and that conform to this Directive. Submit to the USD(P), USD(AT&L), and CJCS for review, in accordance with paragraph 4.d. above the signature of this Directive, any autonomous or semi-autonomous weapon system intended to be used in a manner that falls outside the policies in subparagraphs 4.c.(1) through 4.c.(3) above the signature of this Directive before a decision to enter into formal development and again before fielding of any such system.

9. CJCS. The CJCS shall:

a. Advise the Secretary of Defense on the capability needs and employment of autonomous and semi-autonomous weapon systems.

b. Assess military requirements for autonomous and semi-autonomous weapon systems, including applicable key performance parameters and key system attributes.

c. Develop and publish joint doctrine, as appropriate, to incorporate emerging capabilities of autonomous and semi-autonomous weapon systems.

d. In coordination with the USD(P) and USD(AT&L), review and consider for approval autonomous weapon systems submitted in accordance with paragraph 4.d. above the signature of this Directive.

10. COMMANDERS OF THE COMBATANT COMMANDS. The Commanders of the Combatant Commands shall:

a. Use autonomous and semi-autonomous weapon systems in accordance with this Directive and in a manner consistent with their design, testing, certification, operator training, doctrine, TTPs, and approval as autonomous or semi-autonomous systems.

b. Employ autonomous and semi-autonomous weapon systems with appropriate care and in accordance with the law of war, applicable treaties, weapon system safety rules, and applicable ROE, in accordance with paragraph 4.b. above the signature of this Directive.

c. Ensure that weapon systems are not employed or modified to operate in a manner that falls outside the policies in subparagraphs 4.c.(1) through 4.c.(3) above the signature of this Directive without specific approval in accordance with paragraph 4.d. above the signature of this Directive.

d. Integrate autonomous and semi-autonomous weapon systems into operational mission planning.

e. Through the CJCS, identify warfighter priorities and operational needs that may be met by autonomous and semi-autonomous weapon systems.

GLOSSARY

PART I. ABBREVIATIONS AND ACRONYMS

ATSD(PA)	Assistant to the Secretary of Defense for Public Affairs
CJCS	Chairman of the Joint Chiefs of Staff
DoD CIO	Department of Defense Chief Information Officer
DOT&E	Director of Operational Test and Evaluation
GC, DoD	General Counsel of the Department of Defense
IOT&E	initial operational test and evaluation
ROE	rules of engagement
T&E	test and evaluation
TTP	tactics, techniques, and procedures
USD(AT&L)	Under Secretary of Defense for Acquisition, Technology, and Logistics
USD(P)	Under Secretary of Defense for Policy
USD(P&R)	Under Secretary of Defense for Personnel and Readiness
USSOCOM	U.S. Special Operations Command
V&V	verification and validation

PART II. DEFINITIONS

These terms and their definitions are for the purpose of this Directive.

automated regression testing. A type of regression testing that uses testing tools and repeatable test scripts.

autonomous weapon system. A weapon system that, once activated, can select and engage targets without further intervention by a human operator. This includes human-supervised autonomous weapon systems that are designed to allow human operators to override operation of

the weapon system, but can select and engage targets without further human input after activation.

electronic attack. Division of electronic warfare involving the use of electromagnetic energy, directed energy, or antiradiation weapons to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability and is considered a form of fires.

failures. An actual or perceived degradation or loss of intended functionality or inability of the system to perform as intended or designed. Failures can result from a number of causes, including, but not limited to, human error, human-machine interaction failures, malfunctions, communications degradation, software coding errors, enemy cyber attacks or infiltration into the industrial supply chain, jamming, spoofing, decoys, other enemy countermeasures or actions, or unanticipated situations on the battlefield.

human-supervised autonomous weapon system. An autonomous weapon system that is designed to provide human operators with the ability to intervene and terminate engagements, including in the event of a weapon system failure, before unacceptable levels of damage occur.

operating state. A variable or vector reflecting the status of the system.

operator. A person who operates a weapon system.

regression testing. A type of software testing that seeks to uncover new deficiencies (i.e., regressions) in the existing functional and non-functional areas of a system created by changes to the software, including enhancements, patches, emergency transports, or configuration changes.

semi-autonomous weapon system. A weapon system that, once activated, is intended to only engage individual targets or specific target groups that have been selected by a human operator. This includes:

Semi-autonomous weapon systems that employ autonomy for engagement-related functions including, but not limited to, acquiring, tracking, and identifying potential targets; cueing potential targets to human operators; prioritizing selected targets; timing of when to fire; or providing terminal guidance to home in on selected targets, provided that human control is retained over the decision to select individual targets and specific target groups for engagement.

"Fire and forget" or lock-on-after-launch homing munitions that rely on TTPs to maximize the probability that the only targets within the seeker's acquisition basket when the seeker activates are those individual targets or specific target groups that have been selected by a human operator.

state transition matrix. A matrix that characterizes the ability of a system to transition from one operating state to another.

target selection. The determination that an individual target or a specific group of targets is to be engaged.

unintended engagement. The use of force resulting in damage to persons or objects that human operators did not intend to be the targets of U.S. military operations, including unacceptable levels of collateral damage beyond those consistent with the law of war, ROE, and commander's intent.

unmanned platform. An air, land, surface, subsurface, or space platform that does not have the human operator physically onboard the platform.