

**AC 20-136B (Field Coordination)
Comment and Disposition Matrix**

Paragraph Number	Commenter/ Organization	Comment Summary & Proposed Recommendation	Disposition
6.h	John Lee Atlanta ACO	Please change firmware to airborne electronic hardware (AEH).	Not accepted. Airborne electronic hardware (AEH) is not the same as firmware. Firmware is permanently loaded into a memory device. No change made.
7.d	John Lee	Please change firmware to airborne electronic hardware (AEH).	Not accepted. Airborne electronic hardware (AEH) is not the same as firmware. Firmware is permanently loaded into a memory device. No change made.
App 1	John Lee	Is Part 23 1306 or 1316, like Parts 25, 27 and 29? If 23.1306, then try to change to 23.1316.	It's 14 CFR 23.1306. We can't assign 23.1316 due to the restriction of the numbering of the governing section of Part 23 (i.e., the Instruments: Installation of Subpart F starts with § 23.1311). For the same reason, the HIRF rule for Part 23 is 14 CFR 23.1308 instead of 23.1317.
App 1	John Lee	Part 25 is titled "System lightning protection". Parts 23, 27 and 29 are titled "Electrical and electronic system lightning protection". Please make the titles the same across all four Parts.	Accepted. Action: Change to § 25.1316 Electrical and electronic system lightning protection

App 1	John Lee	Does this AC not also apply to Part 33?	<p>No. This AC provides acceptable means of compliance for 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316.</p> <p>AC 33.28-1() (Compliance Criteria for 14 CFR 33.28, Aircraft Engines, Electrical and electronic engine control systems) provides acceptable means of compliance for lightning protection of part 33 aircraft engines, electrical and electronic engine control systems.</p>
4.c.2	John Lee	Does Figure 1 need to also address Failure Condition = D (i.e. Minor)?	<p>No. 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 address lightning protection for electrical and electronic systems with catastrophic, hazardous, or major failure conditions. This is consistent with the Aviation Rulemaking Advisory Committee (ARAC) recommendations. (The HIRF rules, 14 CFR 23.1308, 25.1317, 27.1317, and 29.1317, also do not address systems with minor failure conditions.)</p>
6, f (2)	Schwab/ASW112	First sentence grammar, the word “is” should be deleted.	<p>Accepted.</p> <p>Action: Delete the word “is”.</p>
Appendix 2, Definitions table	Schwab/ASW112	Draft watermark is displayed on both pages of this Appendix.	<p>Accepted.</p> <p>Action: Delete the Draft watermark.</p>

2.a & b	David Walen – CSTA Lightning	<p>Reword these two paragraphs to delete the words ‘direct’ and ‘indirect’ when referring to lightning effects. These words are imprecise, and have resulted in confusion among applicants. Applicants have interpreted the rule to apply only to ‘indirect’ lightning effects, based on this usage in the AC.</p> <p>Reword to read:</p> <p>a. This AC provides guidance for complying with 14 CFR §§ [23.1306], 25.1316, [27.1316], and [29.1316] for the effects on electrical and electronic systems due to lightning transients induced or conducted onto equipment and wiring.</p> <p>b. Applicants must also comply with 14 CFR §§ [23.1306], 25.1316, [27.1316], and [29.1316] for the effects on electrical and electronic systems when lightning directly attaches to equipment, components, or wiring. This AC does not address these lightning effects, such as burning, eroding, and blasting of aircraft equipment, components, or wiring. For showing compliance for these effects, we recommend using SAE ARP 5577, <i>Aircraft Lightning Direct Effects Certification</i>.</p>	<p>Accepted. Adopt the suggested changes. Delete ‘these’ before ‘lightning effects’ in second sentence of 2.b.</p> <p>a. This AC provides guidance for complying with 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 for the effects on electrical and electronic systems due to lightning transients induced or conducted onto equipment and wiring.</p> <p>b. Applicants must also comply with 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 for the effects on electrical and electronic systems when lightning directly attaches to equipment, components, or wiring. This AC does not address lightning effects, such as burning, eroding, and blasting of aircraft equipment, components, or wiring. For showing compliance for these effects, we recommend using SAE ARP 5577, <i>Aircraft Lightning Direct Effects Certification</i>.</p>
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2.c	David Walen – CSTA Lightning	<p>Reword so that the text in the sentences is appropriate for the references cited. For example, the reference to DO-160 should include both sections 22 and 23.</p> <p>Reword to read:</p> <ol style="list-style-type: none"> a. For information on fuel ignition hazards, see AC 20-53, <i>Protection of Aircraft Fuel Systems Against Fuel Vapor Ignition Caused By Lightning</i>. This AC does not address lightning zoning methods, lightning environment definition, or lightning test methods. For information on lightning zoning methods and lightning environment definition, see AC 20-155, <i>SAE Documents To Support Aircraft Lightning Protection Certification</i>. For information on lightning test methods, see SAE ARP 5416, <i>Aircraft Lightning Test Methods</i>, or RTCA/DO-160, Section 22, <i>Lightning Induced Transient Susceptibility</i>, and Section 23, <i>Lightning Direct Effects</i>. <p>Note: The RTCA/DO-160 referenced in this AC refers to the current revisions or FAA-accepted revisions. Use of RTCA/DO-160C or earlier versions is not acceptable.</p>	Accepted. Adopt the suggested changes.
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<p>3.b.1 & 2</p>	<p>David Walen – CSTA Lightning</p>	<p>Reword for clarity. Also, the example of the function needs to describe an action. The regulations do not address any effects of lightning, only adverse effects.</p> <p>Reword to read:</p> <p>b. Regulatory Requirements. The regulations of 14 CFR §§ [23.1306], 25.1316, [27.1316], and [29.1316] are intended to address protection against the effects of lightning for aircraft electrical and electronic systems, regardless of whether these are ‘indirect’ or ‘direct’ effects of lightning. The terms ‘indirect’ and ‘direct’ are often used to classify the effects of lightning. However, the regulations do not, and are not intended to, differentiate between the effects of lightning. The focus is on protection of aircraft electrical and electronic systems against effects of lightning. The regulations listed in this paragraph introduce several terms which are further explained below, including:</p> <p>(1) System. Piece of equipment connected via electrical conductors to another piece of equipment, both of which are required to make a system function. A system can include equipment, components, parts, wire bundles, and software.</p> <p>(2) Function. The lowest defined level of a specific action of a system, equipment, and flight crew performance aboard the aircraft that, by itself, provides a completely recognizable operational capability. For example, ‘display aircraft heading to the pilots’ is a function. One or more systems may perform a specific function or one system may perform multiple functions.</p>	<p>Accepted. Adopt the suggested changes.</p> <p>b. Regulatory Requirements. The regulations of 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 are intended to address protection against the effects of lightning for aircraft electrical and electronic systems, regardless of whether these are ‘indirect’ or ‘direct’ effects of lightning. The terms ‘indirect’ and ‘direct’ are often used to classify the effects of lightning. However, the regulations do not, and are not intended to, differentiate between the effects of lightning. The focus is on protection of aircraft electrical and electronic systems against effects of lightning. The regulations listed in this paragraph introduce several terms which are further explained below, including:</p> <p>(1) System. Piece of equipment connected via electrical conductors to another piece of equipment, both of which are required to make a system function. A system can include equipment, components, parts, wire bundles, and software.</p> <p>(2) Function. The lowest defined level of a specific action of a system, equipment, and flight crew performance aboard the aircraft that, by itself, provides a completely recognizable operational capability. For example, ‘display aircraft heading to the pilots’ is a function. One or more systems may perform a specific function or one system may perform multiple functions.</p>
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4.b	David Walen – CSTA Lightning	<p>Add the words ‘equipment and’. Externally mounted devices may include items other than sensors, such as actuators.</p> <p>Reword to read:</p> <ul style="list-style-type: none">a. The steps above should be performed to address lightning transients induced in electrical and electronic system wiring and equipment, and lightning damage to aircraft external equipment and sensors that are connected to electrical and electronic systems, such as radio antennas and air data probes. Additional guidance on lightning protection against lightning damage for external equipment and sensor installations can be found in SAE ARP 5577, <i>Aircraft Lightning Direct Effects Certification</i>.	Accepted. Adopt the suggested changes.
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4.f.(1) & (2)	David Walen – CSTA Lightning	<p>Insert missing comma. Use the word ‘amplitudes’ instead of ‘ATLs’ because the concept of ATLs is not described until 4.g. These paragraphs are more oriented to the general concept of waveforms and amplitudes, not ATLs.</p> <p>Reword to read:</p> <p>(1) The lightning environment, as seen by electrical and electronic systems, consists of voltages and currents produced by lightning current flowing through the aircraft. The voltages and currents that appear at system wiring interfaces result from aperture coupling, structural IR voltages, or conducted currents resulting from direct attachments to sensors.</p> <p>(2) Determine the lightning voltage and current transient waveforms and the amplitudes that can appear at the electrical and electronic equipment interface circuits for each system identified in paragraph 4.c. You may determine the lightning transients in terms of the wire bundle current, or the open circuit voltage and the short circuit current appearing at system wiring and equipment interface circuits. The voltage and current transient waveforms and amplitudes are dependent upon the loop impedances of the system and its interconnecting wiring.</p>	<p>Accepted. Adopt the suggested changes.</p> <p>Lee Nguyen’s Note: To be consistent with Dave Walen’s comment on paragraph 4.b (see above), add ‘equipment and’ to last sentence of 4.f.(1). Also delete ‘the’ before ‘amplitudes’ in first sentence of 4.f.(2).</p> <p>(1) The lightning environment, as seen by electrical and electronic systems, consists of voltages and currents produced by lightning current flowing through the aircraft. The voltages and currents that appear at system wiring interfaces result from aperture coupling, structural IR voltages, or conducted currents resulting from direct attachments to equipment and sensors.</p> <p>(2) Determine the lightning voltage and current transient waveforms and amplitudes that can appear at the electrical and electronic equipment interface circuits for each system identified in paragraph 4.c. You may determine the lightning transients in terms of the wire bundle current, or the open circuit voltage and the short circuit current appearing at system wiring and equipment interface circuits. The voltage and current transient waveforms and amplitudes are dependent upon the loop impedances of the system and its interconnecting wiring.</p>
1.0	ACE-117C SS	Rule 14 CFR 25.1316 calls it “System lightning protection” but AC-136B references it as “Electrical and Electronic System lightning protection”.	<p>The revised 14 CFR 25.1316(, and new 23.1306, 27.1316, and 29.1316) are titled ‘Electrical and electronic system lightning protection’.</p> <p>No change made.</p>

1.c.	ACE-117C mep	This paragraph states that this AC cancels AC 20-136A, which includes indirect effects in the title of the canceled AC. This new AC does not identify indirect effects explicitly in the title, yet paragraph 2.a. states that this AC is for indirect effects of lightning. Why was indirect effects removed from the title, then?	<p>In the proposed AC 20-136B, we delete the words ‘direct’ and ‘indirect’ when referring to lightning effects. These words are imprecise, and have resulted in confusion among applicants. Applicants have interpreted the System lightning protection rule to apply only to ‘indirect’ lightning effects, based on this usage in the AC.</p> <p>Action: Change paragraph 2.a. as:</p> <p style="padding-left: 40px;">c. This AC provides guidance for complying with 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 for the effects on electrical and electronic systems due to lightning transients induced or conducted onto equipment and wiring.</p>
2.c.	ACE-117C mep	This paragraph identifies section 23 in DO-160 for information regarding direct effects of lightning. It should include a reference to section 22 for additional information regarding induced transient susceptibility due to lightning, as well here.	<p>Accepted.</p> <p>Action: Change the last sentence of paragraph 2.c as: For information on lightning test methods, see SAE ARP 5416, <i>Aircraft Lightning Test Methods</i>, or RTCA/DO-160, Section 22, <i>Lightning Induced Transient Susceptibility</i>, and Section 23, <i>Lightning Direct Effects</i>.</p>
3.b.	ACE-117C mep	States that the regulations do not differentiate direct or indirect effects of lightning. Why should this AC differentiate?	<p>The electrical and electronic system lightning protection regulations do not differentiate direct or indirect effects of lightning.</p> <p>In the proposed AC 20-136B, we delete the words ‘direct’ and ‘indirect’ in paragraph 1.c. when referring to lightning effects. These words are imprecise, and have resulted in confusion among applicants. Applicants have interpreted the System lightning protection rule to apply only to ‘indirect’ lightning effects, based on this usage in the AC 20-136A.</p>
3.b.	ACE-117C mep	States that the regulations do not differentiate direct or indirect effects of lightning. Why should this AC differentiate?	<p>The electrical and electronic system lightning protection regulations do not differentiate direct or indirect effects of lightning.</p> <p>In the proposed AC 20-136B, we delete the words ‘direct’ and ‘indirect’ in paragraph 1.c. when referring to lightning effects. These words are imprecise, and have resulted in confusion among applicants. Applicants have interpreted the System lightning protection rule to apply only to ‘indirect’ lightning effects, based on this usage in the AC 20-136A.</p>

7 (d)	ACE-117C SS	Recommend to add last bullet: You cannot use similarity for a new aircraft design with new systems.	<p>Not accepted.</p> <p>The intent of the recommended added sentence is correct. However, paragraphs 7d(1) and (3) cover this intent. (See below)</p> <p>Paragraph 7d(1) states: (1) You may verify ETDs by similarity to previously certified systems without performing more tests. You may do this when:</p> <ul style="list-style-type: none"> • There are only minor differences between the previously certified system and installation, and the system and installation to be certified; • There are no unresolved in-service system problems related to lightning strikes on the previously certified system; and • The previously certified system ETDs were verified by qualification tests. <p>In addition, paragraph 7d(3) states: (3) If significant differences are found that will affect the systems and installations, you must perform more tests and analyses to resolve the open issues.</p>
3.a.	Ervin Dvorak ACE-111	Add 14CFR before part 25.	<p>Accepted.</p> <p>Action: Add suggested changes to para. 3.a.</p>

3.b.	Ervin Dvorak	<p>The definition for “Continued Safe Flight and Landing” has been deleted of Appendix 2 from the previous version. Appendix 2 seems to be reserved for lightning terms so I can understand this deletion from Appendix 2. However “Continued Safe Flight and Landing” is a regulatory term that needs to be explained for clarification like the other terms in this paragraph. There is often confusion with this term. It is suggested that this term be added as shown below.</p> <p>Continued Safe Flight and Landing The aircraft can safely abort or continue a takeoff, or continue controlled flight and landing, possibly using emergency procedures. The aircraft must do this without requiring exceptional pilot skill or strength. Some aircraft damage may occur because of the failure condition or on landing. For transport airplanes, the pilot must be able to land safely at a suitable airport. For Part 23 airplanes, it is not necessary to land at an airport. For rotorcraft, the rotorcraft must continue to cope with adverse operating conditions, and the pilot must be able to land safely at a suitable site.</p>	<p>Accepted.</p> <p>Action: Add suggested changes to Appendix 2. Definitions</p>
Appendix 1	Ervin Dvorak	<p>Appendix 1 would be more complete if other related regulations were added. Complete the other related regulations by adding § 23.867 and § 23.954 to part 23; adding § 25. 581 and§ 25.954 to part 25; adding § 27.610 and§ 27.954 to part 27; and adding § 29.610 and§ 29.954 to part 29.</p>	<p>Accepted.</p> <p>Action: Add suggested changes (sections and their titles) to Appendix 1.</p>

4.a	Loran Haworth/ ANM-111	Add a step as part of showing compliance for identifying “Timely Manner” for the design	<p>Partially Accepted.</p> <p>Paragraph 3.b(4) provides guidance on “timely manner” that FAA would determine what constitutes ‘timely’ automatic recovery for recovery of functions with catastrophic, hazardous, and major failure conditions on a case-by-case evaluation for failure of any specific function and its failure effect on the aircraft, pilot workload, and safety margins. The determination should be included in the certification plan for review and approval by the certification authorities.</p> <p>Showing compliance for identifying “Timely Manner” for the design is included in paragraph 4.a(6) (Verify compliance to the requirements). Verify compliance to the requirements (as discussed in paragraph 4.h) includes: “Submit your certification plan early in the program to the cognizant aircraft certification office (ACO) for review. Experience shows, particularly with aircraft using new technology or those that have complex systems, that early agreement on the certification plan benefits both the applicant and the cognizant ACO.”</p> <p>Showing compliance to system lightning protection requirements also includes other pass/fail criteria such as each Level A system function is not adversely affected during and after the time... , automatic recovery of the affected function, and the lightning environment for the aircraft and installed systems, etc.</p> <p>Section 25.1316(c) (prior amendment) covers the same compliance steps as described in paragraphs 4(a)(1) to (a)(7) of AC 20-136A/B and includes compliance verification for identifying “Timely Manner” for the design in the “Verify compliance to the requirements” step. The same compliance steps are described in AC 20-136A (as in paragraphs 4(a)(1) to (a)(7) of AC 20-136B) and have been accepted and used successfully since 2006.</p> <p>Action: However to clarify, add the following as new paragraph 4.h(1): Show that the systems comply with the applicable requirements of 14 CFR 23.1306, 25.1316, 27.1316, or 29.1316.</p> <p>Also, renumber current paragraphs 4.h accordingly.</p>
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<p>Page 2, Sec 3, b. (2)</p>	<p>Will Struck/ ANM-111</p>	<p>Not sure what is intended by "lowest defined level", especially related to "flight crew performance". Needs clarification.</p>	<p>Accepted.</p> <p>The following definition of “function” in paragraph 3.b(2) is copied from the definition of “function” in AC 23.1309-1D/():</p> <p>(2) Function. The lowest defined level of a specific action of a system, equipment, and flight crew performance aboard the aircraft that, by itself, provides a completely recognizable operational capability (for example, an aircraft heading is a function). One or more systems may contain a specific function or one system may contain multiple functions.</p> <p>Delete "lowest defined level" in the definition of function.</p> <p>Action: Revise the definition of function as:</p> <p>(2) Function. The specific action of a system, equipment, and flight crew performance aboard the aircraft that, by itself, provides a completely recognizable operational capability (for example, an aircraft heading is a function). One or more systems may contain a specific function or one system may contain multiple functions.</p>
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<p>Page 4, Figure 1</p>	<p>Will Struck/ ANM-111</p>	<p>The failure condition categories are not consistent with those of AC 25.1309-1A, but are consistent with the unofficial proposed new release of the AC (the “Arsenal” version).</p>	<p>The left column of Table 1 of the draft revised AC 20-138B is the actual text from the regulations 23.1306, 25.1316, 27.1316 and 29.1316. It is also similar to the regulatory text in 25.1316 (prior amendment).</p> <p>The mapping between the regulatory text and the terms Catastrophic, Hazardous, and Major is generally consistent with the definitions within AC 25.1309-1A (and AC 23.1309-1C), although the .1309 ACs go into a more detailed discussion of the terms.</p> <p>The AC 20-136A (definition of the failure conditions) should not modify the text of the regulation.</p> <p>In Part 25 we have 3 sets of definitions for the failure condition classifications:</p> <ol style="list-style-type: none"> 1) The definitions in the current (old) 25.1309/AC; 2) the definitions in 25.1316 and 25.1317 (HIRF rule) which were "molded" from the definitions in 1) above; 3) The ARAC recommended changes to 25.1309/AC (the “Arsenal” version) which FAA has been very slow to adopt, but they have been widely used because they are in the current CS 25.1309. <p>Although each set is slightly different, the intents are the same. The differences you raised, while notable, are really in the weeds and there is little risk of misunderstanding or incorrect classifications. Again, the intent is consistent across these definitions.</p> <p>No change to AC 20-136B.</p>
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Figure 1	Will Struck/ ANM-111	"Lightning Certification Level" or LCL - Sec 4 c. (2) (a), (b), and throughout the remainder of the document. Suggest that LCL be used instead of just "Level" to distinguish the "Lightning Certification Level" from other commonly uses of the term "Level", such as System Development Assurance Level, Electronic Hardware Design Assurance Level, DO-160F EQT levels, and Software Level.	<p>Not accepted.</p> <p>The System Lightning Certification Levels (A, B, and C) are shorthand notations that relate to catastrophic, hazardous, and major failure conditions. The System Lightning Certification Levels are different from other uses of the term "Level", such as System Development Assurance Level, Electronic Hardware Design Assurance Level, Software Level, etc. Use of the terms System Lightning Certification Levels is clear and has been accepted since 2006. (For HIRF certification, AC 20-158 uses the term System HIRF Certification Level without acronym and its use has been accepted since 2007.)</p> <p>The Lightning Certification Level and HIRF Certification Level are only used in HIRF and Lightning certification plans. There is no need to use the acronym LCL for "Lightning Certification Level".</p> <p>No change to AC 20-136B.</p>
Page 11, Sec 6, b. last sentence	Will Struck/ ANM-111	Unclear what an "acceptable margin" might be. If that is defined somewhere in the AC, then it may be okay.	<p>Paragraph 6.i provides guidance on "acceptable margin":</p> <p>An ETDL that exceeds the ATL by a factor of two is an acceptable margin for Level A systems, if this margin is verified by aircraft test or by analysis supported by aircraft tests.</p> <p>No change to AC 20-136B.</p>
Page 14, Sec 6, g. (1) last sentence	Will Struck/ ANM-111	Change "must" to "should" - the AC should not levy requirements on the ACO. Same for bullet (3).	<p>Partially accepted.</p> <p>Action: Revise the sentence:</p> <p>“The cognizant ACO must approve your system configuration for ETDL verification tests.” as:</p> <p>“You must obtain the cognizant ACO approval of your system configuration for ETDL verification tests.”</p> <p>Revise the sentence of para. 6g(3):</p> <p>“The cognizant ACO must approve your evaluation.” as:</p> <p>“You must obtain the cognizant ACO approval of your evaluation.”</p>

<p>Page 17, Sec 7, c. (2) 2nd sentence</p>	<p>Will Struck/ ANM-111</p>	<p>Change "must" to "should" - the AC should not levy requirements on the ACO.</p>	<p>Partially accepted. Revise the sentence: “The cognizant ACO must approve your evaluation.” as: “You must obtain the cognizant ACO approval of your evaluation.”</p>
<p>Page A3-1</p>	<p>Will Struck/ ANM-111</p>	<p>Add "LCL Lightning Certification Level" to Acronyms list.</p>	<p>Not accepted. The System Lightning Certification Levels (A, B, and C) are shorthand notations that relate to catastrophic, hazardous, and major failure conditions. The System Lightning Certification Levels are different from other uses of the term "Level", such as System Development Assurance Level, Electronic Hardware Design Assurance Level, Software Level, etc. Use of the terms System Lightning Certification Levels is clear and has been accepted since 2006. (For HIRF certification, AC 20-158 uses the term System HIRF Certification Level without acronym and its use has been accepted since 2007.) The Lightning Certification Level and HIRF Certification Level are only used in HIRF and Lightning certification plans. There is no need to use the acronym LCL for "Lightning Certification Level". No change to AC 20-136B.</p>

Page 2	Mike Dostert/ ANM-112	<p>This AC is focused on systems and I could not find any fuel system related guidance other than the reference to AC20-53 that is shown as follows:</p> <p>a. For information on fuel ignition hazards, see AC 20-53, <i>Protection of Aircraft Fuel Systems Against Fuel Vapor Ignition Caused By Lightning</i>. This AC does not address lightning zoning methods, lightning environment definition or lightning test methods, nor methods and techniques for coverings (for example, fairing, skin, and cowl). For information on lightning zoning methods and lightning environment definition, see AC 20-155, <i>SAE Documents To Support Aircraft Lightning Protection Certification</i>. For information on lightning test methods, see SAE ARP 5416, <i>Aircraft Lightning Test Methods</i>, or RTCA/DO-160, Section 23, <i>Lightning Direct Effects</i>.</p> <p>Based upon all the work done for lightning protection, including the public policy, IPs, SAE etc. it seems like this reference should be updated. If an applicant goes to AC20-53 they will not get a complete story.</p>	<p>Not accepted.</p> <p>The AC 20-136A/B does not address lightning protection of fuel systems. It refers to AC 20-53(), <i>Protection of Aircraft Fuel Systems Against Fuel Vapor Ignition Caused By Lightning</i>.</p> <p>The SAE AE4L Lightning Subcommittee provided recommended guidance for the AC 20-53() and the DOT/FAA/CT-83/3 (User's Manual for AC 20-53A, <i>Protection of Aircraft Fuel Systems Against Fuel Vapor Ignition Caused By Lightning</i>).</p> <p>AC 25.981-1(), <i>Fuel Tank Ignition Source Prevention Guidelines</i>, provides guidance for demonstrating compliance with the certification requirements for prevention of ignition sources (due to lightning) within the fuel tanks of transport category airplanes.</p> <p>There are current activities sponsored by the Transport Airplane Directorate that will produce recommended revision of 25.981 and guidance for the recommended amendment of 25.981 concerning with fuel systems lightning protection.</p> <p>Since the AC 20-136B does not address lightning protection of fuel systems, we don't refer to public policy, IPs for lightning protection of fuel systems in AC 20-136B. No change to AC 20-136B.</p> <p>No change to AC 20-136B.</p>
Page 7, Figure 2	Massoud Sadeghi/ ANM-111	Figure 2 should be located in the body of the document after the reference to the figure is made.	<p>Accepted.</p> <p>Action: Move Figure 2 to after paragraph 4.g(2) (i.e. after the reference to the figure is made).</p>
Page 3, 4.b.	ANM100D R. Derby	Once an SAE ARP is referenced in full, there's no need to repeat the title in subsequent reference. Remove the SAE document title from the last sentence in ¶ 4.b.	<p>Accepted.</p> <p>Action: Make the change.</p>

Page 4, 4.c.(2)	ANM100D R. Derby	This paragraph contains the first reference to ARP 4754 & 4761, so the title of the documents should be included: <ul style="list-style-type: none"> • SAE ARP 4754a, <i>Guidelines for Development of Civil Aircraft and Systems</i> • SAE ARP 4761, <i>Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment</i> 	Accepted. Action: Make the change.
Page 4, Figure 1	ANM100D R. Derby	ARP 4754a defines the following failure classification: Catastrophic, Hazardous/Severe-Major, Major, Minor. The “Hazardous” failure condition in Figure 1, should be changed to “Hazardous/Severe-Major” to be consistent with ARP 4754a.	Not accepted. Hazardous/Severe-Major is used by EASA. The preamble of the electrical and electronic system lightning rules (14 CFR 23.1306, 25.1316, 27.1316, and 29.1316) uses ‘hazardous’. The HIRF AC 20-158 also uses ‘hazardous’. The intents are the same whether ‘hazardous/severe-major’ or ‘hazardous’ is used. The difference between ‘hazardous/severe-major’ and ‘hazardous’ is really in the weeds and there is little risk of misunderstanding or incorrect classifications. No change made.
Page 6, 4.f.(1)	ANM100D R. Derby	The acronym abbreviation IR should be defined in this paragraph since it is the first instance of the abbreviation.	Not accepted. Delete the term ‘IR’. The structural voltage may also be due to diffusion effects, not just resistive effects. Action: Delete the term ‘IR’ in paragraph 4.f.(1). Also, delete ‘IR’ in Appendix 2 Acronym.
Page 6, 4.f.(2)	ANM100D R. Derby	The acronym ATL should be defined in this paragraph since it is the first instance of the acronym.	Not accepted. The acronym ATL is first used and defined in paragraph 4.a.(5) “Establish equipment transient design levels (ETDLs) and aircraft actual transient levels (ATLs)”. No change made.

Global Change	AIR-500	<p>Incorrect formatting for citing reference and using section symbol (§).</p> <p>Do not use the section (§) symbol or the word “section” when the reference follows “XX CFR”. Only use the section symbol (§) when referring to different paragraphs/subparagraphs within the same section. For example: Correct way to cite: 14 CFR 23.1306 Incorrect: 14 CFR § 23.1306</p>	<p>Not Accepted.</p> <p>Since the first time ‘Title 14 of the Code of Federal Regulations (14 CFR) §§ 23.1306, 25.1316, 27.1316, and 29.1316’ is used, the subsequent reference should be ‘14 CFR §§ 23.1306, 25.1316, 27.1316, and 29.1316’.</p> <p>No change made.</p>
Global Change	AIR-500	<p>Incorrect formatting.</p> <p>Since we do not print our documents anymore, format the header by placing the date in the top left-hand corner and the AC number in the top right-corner of the document of every page.</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>
Global Change	AIR-500	<p>Incorrect font size within the header.</p> <p>Use Times New Roman 11 or 12pt. within the header.</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>
Global Change	AIR-500	<p>Unnecessary bold.</p> <p>Remove bold from paragraph/section references. For examples refer to pages 4, 6, 7, 8, 9, 16, etc.</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>
Global Change	AIR-500	<p>Remove bullets.</p> <p>Replace with letters or numbers when necessary. Also, the right margins need to align with the rest of the document.</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>
Global Change	AIR-500	<p>Incorrect format.</p> <p>Remove bold and brackets from 14 CFR references.</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>

Global Change	AIR-500	<p>Incorrect format.</p> <p>Remove the bold from the title of subsections. Only the first two levels of the paragraph should be bold. For an example refer to paragraph 3b (1) – (4).</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>
Global Change	AIR-500	<p>Define SAE document at first reference, then the title is not needed for future references.</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>
Global Change within Appendices	AIR-500	<p>Incorrect font size within the footer.</p> <p>Use Times New Roman 11 or 12pt. within the header.</p>	<p>Accepted.</p> <p>Action: Make all changes.</p>
Subject Area, Page 1	AIR-500	<p>Improper capitalization.</p> <p>Remove the capitalization from all the letters within the title of the AC. Use title case instead.</p>	<p>Accepted.</p> <p>Action: Make the change.</p>
Paragraph 1c, Page 1	AIR-500	<p>Incorrect placement of paragraph.</p> <p>Subparagraph 1c should be a separate paragraph titled as “Cancellation”.</p>	<p>Accepted.</p> <p>Action: Create new paragraph 3 titled as “Cancellation”. Renumber existing paragraphs 2 to 8 (and their references in the document) accordingly.</p> <p>Note: See Item #13.</p>
Paragraph 1d, Page 1	AIR-500	<p>Incorrect placement of paragraph.</p> <p>Subparagraph 1d should not be apart of the “Purpose” paragraph at all.</p>	<p>Accepted.</p> <p>Action: Delete paragraph 1d.</p>

Paragraph 2, Page 1	AIR-500	<p>Missing “Applicability” paragraph.</p> <p>There are always two mandatory paragraphs within an AC. The “Applicability” paragraph should be paragraph #2. Re-number the paragraphs within the document accordingly.</p>	<p>Accepted. Action: Create new paragraph 2 titled as “Applicability”.</p> <p>2. Applicability. This AC applies to all applicants for a new type certificate (TC) or a change to an existing TC when the certification basis requires you to address the certification requirements of 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316.</p> <p>Revise first two sentences of current paragraph 1.a as:</p> <p>a. This advisory circular (AC) provide you with information and guidance on how you can protect aircraft electrical and electronic systems from the effects of lightning.</p> <p>Also, renumber existing paragraphs 2 to 8 (and their references in the document) accordingly.</p>
Paragraph 3, 3 rd sentence, Page 2	AIR-500	<p>Change wording.</p> <p>Rewrite to read: The requirements apply to all aircraft certificated under parts 25 and 29.</p>	<p>Accepted. Action: Make the change.</p>
Paragraph 3b(4), Page 3	AIR-500	<p>Unnecessary bold/Typo.</p> <p>Remove bold from the labeling of subparagraph (4).</p>	<p>Accepted. Action: Make the change.</p>
Paragraph 4(c)(2), 2 nd sentence, Page 4	AIR-500	<p>Change wording.</p> <p>Rewrite to read: ...appropriate lightning certification levels, as shown in Table 1.</p>	<p>Accepted. Action: Make the change.</p>
Paragraph 4(c)(2), Figure 1, Page 4	AIR-500	<p>Change wording/labeling of title of Figure 1.</p> <p>Rewrite to read: Table 1: Lightning Failure Conditions and Certification Levels.</p>	<p>Accepted. Action: Make the change.</p>

Paragraph 4(1), last sentence, Page 6	AIR-500	Define the term for the acronym “IR” first. Use the acronym “IR” after the first usage.	Not accepted. Delete the term ‘IR’. The structural voltage may also be due to diffusion effects, not just resistive effects. Action: Delete the term ‘IR’. Also, delete ‘IR’ in Appendix 2 Acronym.
Paragraph 4i(3), 2 nd and 3 rd sentences, Page 7	AIR-500	Incorrect usage of plural tense. Remove the plural possession from the acronym “TCL”.	Accepted. Action: Make the change.
Paragraph 4i(3), 4 th sentence, Page 7	AIR-500	The term “aircraft actual transient levels” has already been defined. Use the acronym “ATLs”.	Accepted. Action: Make the change.
Paragraph 4h, Page 7	AIR-500	Incorrect format. Move the title of paragraph 4h to the next page with related information.	Accepted. Action: Make the change.
Paragraph 4h(2), last sentence, Page 8	AIR-500	Unnecessary bold/Typo. Remove bold from the period at the end of sentence.	Accepted. Action: Make the change.
Paragraph 4h(3), last sentence, Page 8	AIR-500	Change wording. Rewrite to read: The plan may include the items listed in Table 3.	Accepted. Action: Make the change.
Paragraph 4i, Figure 3, Page 8	AIR-500	Change wording. Rewrite to read: Table 3 Items to Include in a Lightning Certification Plan.	Accepted. Action: Make the change.

Paragraph 6a, 3 rd sentence, Page 9	AIR-500	Change wording and clarity of passive voice. Rewrite to read: An ACO should concur on this criterion before you begin testing or analyzing your Level A system.	Accepted. Action: Make the change.
Paragraph 6c, Page 11	AIR-500	The title “SAE ARP 5415 and SAE ARP 5416” has already defined. Use the reference of the SAE ARP only not the title.	Accepted. Action: Make the change.
Paragraph 6f(3), Page 12	AIR-500	Change wording/labeling. Replace with “Table 5”.	Partially Accepted. Action: Replace with “Table 4”. Note: Also, replace “Figure 4” (on page 10, and its reference in the document) with “Figure 1”.
Paragraph 6f(3), last sentence, Page 12	AIR-500	Missing capitalization. Capitalize the term “figure” that reference figure 5. It should be a table.	Partially Accepted. Action: Replace with “Table 4”.
Figure 5, Page 13	AIR-500	Change wording of Figure 5. Rewrite to read: Table 3: Equipment Transient Design Levels – Level A Displays.	Partially Accepted. Action: Replace with “Table 4: Equipment Transient Design Levels – Level A Displays”.
Figure 5, 1 st Paragraph, last sentence, Page 13	AIR-500	Change wording. Rewrite to read: The FAA defines these areas as:	Accepted. Action: Make the change.
Paragraph 6i, 5 th sentence, Page 15	AIR-500	Missing capitalization. Capitalize the term “figure” that reference figure 5. It should be a table.	Partially Accepted. Action: Replace with “Table 4”.

Paragraph 6i, 5 th sentence, Page 15	AIR-500	Change wording. Rewrite to read: For Level A display systems where the ETDs are determined using guidance provided in Figure 5, an acceptable margin...	Partially Accepted. Action: Rewrite to read: For Level A display systems where the ETDs are determined using guidance provided in Table 4, an acceptable margin...
Paragraph 7, Page 15	AIR-500	Incorrect formatting. Move paragraph 7 to the next page with related information.	Accepted. Action: Make the change.
Appendix 1, Paragraph 1, last sentence, Page A1-1	AIR-500	Add wording. Rewrite to read: You can also access copies from the Government Printing...	Accepted. Action: Make the change.
Appendix 1, Paragraph 2, Page A1-2	AIR-500	Clarity. What about the engine CS?	Not accepted. Action: This AC does not address engine CS.
Appendix 1, Paragraph 3, 1 st sentence, Page A1-2	AIR-500	Outdated information. Since we do not print our documents anymore remove this statement.	Accepted. Action: Make the change.
Appendix 1, Paragraph 4a, Page A1-2	AIR-500	Change wording. Rewrite to read: European Organization for Civil Aviation Equipment (EUROCAE).	Accepted. Action: Make the change.
Appendix 1, Paragraph 4b, Page A1- 3	AIR-500	Change wording. Rewrite to read: RTCA.	Accepted. Action: Make the change
Appendix 1, Paragraph 4b, 1 st sentence, Page A1-3	AIR-500	Missing italic. Place the title of "RTCA/DO-160" in italic.	Accepted. Action: Make the change

Appendix 1, Paragraph 4c, Page A1-3	AIR-500	Change wording. Rewrite to read: Society of Automotive Engineers (SAE).	Accepted. Action: Make the change
Appendix 2, Page A2-1	AIR-500	Suggestion. Remove table and number definitions using standard format.	Not accepted. This format is used in current AC 20-136A and HIRF AC 20-158. Action: No change made.
6, f (2)	Schwab/ASW112	First sentence grammar, the word “is” should be deleted.	Accepted. Action: Delete the word “is”.
Appendix 2, Definitions table	Schwab/ASW112	Draft watermark is displayed on both pages of this Appendix.	Accepted. Action: Delete the Draft watermark.
3.b.1	Lee Nguyen, AIR-130	Add ‘, and firmware’ to the end of 3.b.(1) System.	Revise 3.b.(1) System as: (1) System. Piece of equipment connected via electrical conductors to another piece of equipment, both of which are required to make a system function. A system can include equipment, components, parts, wire bundles, software, and firmware.

4a.(2)(c) Failure Condition	David Walen – CSTA Lightning	Move ‘For example, redundant external sensors may mitigate direct lightning attachment damage, if there is acceptable separation between the sensors to prevent damage to multiple sensors so that the function is maintained’ to subparagraph 4a.(2)(b) (Level B or C Systems) and after ‘Simultaneous and common failures due to lightning exposure generally do not have to be assumed for Level B or C systems incorporating redundant, spatially separated installations in the aircraft. This is because aircraft transfer function tests and in-service experience have shown these redundant and spatially separated installations are not simultaneously exposed to the maximum lightning induced transients.’	Accepted. Action: Move the sentence as commented.
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<p>4a.(2) Safety Assessment</p>	<p>AGC-210</p>	<p>Change Description: Specifies that the requirements in the lightning regulations take precedence over the xx. 1309 regulations.</p> <p>Delete: The electrical and electronic system lightning protection requirements in 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 take precedence over requirements in 14 CFR 23.1309, 25.1309, 27.1309, and 29.1309.</p> <p>All cert. basis requirements are of equal importance. Any priority should only be established on an invalid cert. basis.</p>	<p>Partially accepted.</p> <p>The electrical and electronic system lightning protection requirements in 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 define the failure condition classification for the effects of system failures due to lightning. For electrical and electronic system lightning protection, the assessment of system failures due to lightning effects to comply with the lightning protection requirements in 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 takes precedence over the safety assessment process to meet requirements in 14 CFR 23.1309, 25.1309, 27.1309, and 29.1309.</p> <p>Thus, the safety assessment process of 23, 25, 27, and 29.1309 does not supersede the lightning-specific requirements. Specifically, lightning effects on electrical and electronic systems are generally assessed independently from other system failures that are unrelated to lightning, and do not need be considered in combination with unrelated latent or active failures.</p> <p>In fact, AC 23.1309-1D (SYSTEM SAFETY ANALYSIS AND ASSESSMENT FOR PART 23 AIRPLANES) states: “5. Applicability. a. This AC is generally applicable only to the original applicant seeking issuance of a type certificate (TC), amended type certificate (ATC), and supplemental type certificate (STC) for the initial approval of the new type design or a change in the type design. This document addresses general applicability, and it should not be utilized to replace any specific guidance intended for individual types of equipment, systems, and installations.” (Highlight added)</p> <p>The certification basis requires you to address the certification requirements of 14 CFR 23.1309, 25.1309, 27.1309, and 29.1309 must address these requirements. The certification basis requires you to address the certification requirements of 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 must address these requirements.</p> <p>The lightning certification plan should address the assessment of system failures due to lightning effects to comply with the lightning protection requirements in 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316. Specifically, lightning effects on electrical and electronic systems are generally assessed independently from other system failures that are unrelated to lightning, and do not need be considered in combination with unrelated latent or active failures.</p> <p>We probably need to clarify that in system evaluation</p>
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1a	AGC-210	Change Description: Changed reg. ref. to 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316.	<p>The summary description of the proposed change is correct.</p> <p>Agree with editorial comments.</p> <p>Action: Make the change.</p>
2a Scope	AGC-210	Change Description: Clarifies that Direct and Indirect Effects must be addressed for rule compliance. This AC still only covers indirect, SAE ARP 5577 covers direct.	<p>The summary description of the proposed change is partially correct. The proposed change clarifies that direct and indirect effects must be addressed for rule compliance. (However, reword the scope paragraphs to delete the words ‘direct’ and ‘indirect’ when referring to lightning effects. These words are imprecise, and have resulted in confusion among applicants. Applicants have interpreted the rule to apply only to ‘indirect’ lightning effects, based on this usage in the AC.) The proposed AC 20-136B also addresses compliance with 14 CFR 23.1306, 25.1316, 27.1316, and 29.1316 for the effects on electrical and electronic systems when lightning directly attaches to equipment, components, or wiring. The proposed AC 20-136B does not address lightning effects, such as burning, eroding, and blasting of aircraft equipment, components, or wiring. For showing compliance for these effects, the AC recommends using SAE ARP 5577, <i>Aircraft Lightning Direct Effects Certification</i>.</p> <p>Agree with editorial comments.</p> <p>Action: Make the change.</p>

2b	AGC-210	<p>Change Description: Explicitly states that RTCA DO-160C are not appropriate for lightning. AC 20-136A previously called out DO-160E, where as the new AC allows DO-160 revisions D, E, F, or G.</p>	<p>The summary description of the proposed change is partially correct. The proposed AC 20-136B explicitly states that use of RTCA/DO-160C or earlier versions is not acceptable. The RTCA/DO-160 referenced in the proposed AC refers to the current revisions or FAA-accepted revisions. AC 20-136A previously called out DO-160E, since DO-160E was the most recent version when AC 20-136A was issued.</p> <p>The proposed AC 20-136B should state that use of RTCA/DO-160D, Change Notice 3 or subsequent revisions is acceptable, since multiple stroke and multiple burst testing was first addressed in section 22 of DO-160D, Change Notice 3.</p> <p>Action: Revise the Note statement as: Note: Use of RTCA/DO-160D, Change Notice 3, or later revisions is acceptable.</p> <p>Also move the Note statement to paragraph 4b of Appendix 1 (Related Documents and How to Get Them).</p>
3 Background	AGC-210	<p>Change Description: Adds background paragraph on the rule. Explains</p> <ul style="list-style-type: none"> - Regulatory Applicability - Regulatory Requirements - Defines: System, Function, Adverse Effect, and Timely Manner 	<p>The summary description of the proposed change is correct.</p> <p>Agree with editorial comments.</p> <p>Action: Make the change.</p>
4 Compliance Steps	AGC-210	<p>Change Description: Clarifies Step 3:</p> <p>From: Set airframe current path for each zone.</p> <p>To: Establish aircraft lightning environment for each zone.</p>	<p>The summary description of the proposed change is correct.</p> <p>Clarifies Step 3:</p> <p>From: Establish the airframe lightning current paths for the zones.</p> <p>To: Establish aircraft lightning environment for each zone.</p>

4 Compliance Steps	AGC-210	<p>Change Description: Clarifies Step 4:</p> <p>From: Determine aircraft internal lightning transient environment.</p> <p>To: Determine lightning transient environment associated with systems.</p>	<p>The summary description of the proposed change is correct.</p> <p>Agree with editorial comments.</p> <p>Action: Make the change.</p>
4 Compliance Steps	AGC-210	<p>Change Description: Clarifies Step 5:</p> <p>From: Set TCL and ETDL.</p> <p>To: Establish ETDL and ATLS.</p>	<p>The summary description of the proposed change is correct.</p>
4 Compliance Steps	AGC-210	<p>Change Description: Add additional language on direct effects</p>	<p>The summary description of the proposed change is partially correct.</p> <p>The proposed change add new paragraph 4b: The (compliance) steps above should be performed to address lightning transients induced in electrical and electronic system wiring and equipment, and lightning damage to aircraft external equipment and sensors that are connected to electrical and electronic systems, such as radio antennas and air data probes.</p>
4a.(2) Safety Assessment	AGC-210	<p>Change Description: Adds clarifying text on Combined Effects on Level A Systems.</p>	<p>The summary description of the proposed change is correct.</p>
4a.(2) Safety Assessment	AGC-210	<p>Change Description: Adds clarifying text on Combined Effects on Level B and C Systems.</p>	<p>The summary description of the proposed change is correct.</p> <p>Agree with editorial comments.</p> <p>Action: Make the change.</p>

Figure 1	AGC-210	Change Description: Changes the Failure condition table to match the language in the new rule. Overall, detail is removed, but intent is unchanged.	The summary description of the proposed change is correct.
4a.(2)(c) Failure Condition	AGC-210	Change Description: Adds clarifying language consistent with the rule language” “safety assessment should consider all potential adverse effects due to system failure, malfunctions, or misleading information.”	The summary description of the proposed change is correct. Agree with editorial comments. Action: Make the change.
4a.(2)(c) Failure Condition	AGC-210	Change Description: Adds clarifying language consistent with the rule language that direct effects need to be included in the failure condition classification.	The summary description of the proposed change is partially correct. The proposed change adds clarifying language that “redundancy can provide protection against direct attachment of lightning. For example, redundant external sensors may mitigate direct lightning attachment damage, if there is acceptable separation between the sensors to prevent damage to multiple sensors so that the function is maintained.” However, the added clarifying sentences were moved out of the Failure Conditions paragraph to the subsection c on Identify the Systems to be Assessed.
4.c Establishing Lightning Environment	AGC-210	Change Description: Clarifying language on establishing the aircraft lightning environment. See also paragraph 4 (Step 3)	The summary description of the proposed change is correct. Agree with editorial comments. Action: Make the change.
4.d Determining Lightning Environment	AGC-210	Change Description: Paragraph rewritten, but intent unchanged.	The summary description of the proposed change is correct.

4.e Establish ETDL & ATL	AGC-210	Change Description: Clarifying change which details procedures for comparing TCL/ATL to ETDL.	The summary description of the proposed change is partially correct. The proposed change adds clarifying language on establishing ETDLs and ATLS Agree with editorial comments. Action: Make the change.
4.f Verify Compliance	AGC-210	Change Description: Clarifies that the appropriate margin must be established in the applicant's certification plan.	The summary description of the proposed change is not correct. Paragraph (Verify Compliance) of the current AC 20-136A also addresses that "the ETDLs should exceed the ATLS by the margin established in (the applicant's) certification plan." Agree with editorial comments. Action: Make the change.
6.b Establish ETDL	AGC-210	Change Description: Clarifying changes in text, however no change in intent. Both AC 20-136A and 20-136B guidance discusses determining the ETDL based on the expected lightning environment.	The summary description of the proposed change is partially correct. The proposed change adds clarifying language on establishing System ETDLs, and deletes the reference to TCLs. However, there is no change in intent.
6.j & 7.f Corrective Measures	AGC-210	Change Description: Clarifies that significant changes to the system require the lightning certification plan to be updated and resubmitted to the FAA.	The summary description of the proposed change is not correct. Paragraph (Corrective Measures) of the current AC 20-136A also addresses that "When significant changes are necessary, update your lightning certification plan accordingly. The updated certification plan should be resubmitted to the cognizant ACO for review." Agree with editorial comments. Action: Make the change.

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